Shaw Environmental & Infrastructure, Inc.

1430 Enclave Parkway
Houston, Texas 77077-2023
281-368-4400
Fax: 281-368-4401

Shaw™ Shaw Environmental & Infrastructure, Inc.

August 26, 2004

Mr. Subhash Pal
Project Manager
Superfund Cleanup Section
Texas Commission on Environmental Quality
12100 Park 35 Circle, Bldg. D
Austin, Texas 78753

Re: Remedial Investigation – General Groundwater (Inorganic) Quality Characterization and Comparison, March 2004 at Jones Road Superfund Site, Northwest Harris County (near Houston), Texas

Dear Mr. Pal:

Shaw Environmental, Inc. (Shaw) is pleased to present to the Texas Commission on Environmental Quality (TCEQ) this letter report which summarizes the results of the Remedial Investigation (RI) – General Groundwater Quality (Inorganic) Characterization and Comparison and the related field work conducted at the above-referenced site in March 2004. This letter report is not intended to be a final report nor does it preclude or serve in the place of the Remedial Investigation Technical Memorandum; rather, this letter report provides a summary of results and preliminary conclusions based on Shaw's interpretations of the currently available data.

The objectives of this specific phase of the RI investigation included:

- Characterize general groundwater quality (inorganic) parameters from selected monitor wells and/or existing private water wells serving residential or business property owners (herein after referred to collectively as "residential wells").

- Compare water quality between wells (of both types) to assess whether the groundwater from different wells represents the same, similar, or different WBU and, as practicable, use this information to help assess the nature and extent of migration (vertical and horizontal) of the primary Constituents of Interest (COIs; these are PCE and its degradation daughter products) at the subject site.

Summary of Field Activities

As previously stated, the objectives of this phase of the RI was to characterize and compare general groundwater quality (inorganic) parameters between the different WBUs represented in monitor wells and/or existing residential wells and to assess whether the groundwater from different wells represented the same, similar, or different WBUs. Prior to mobilization into the field, an amendment to the Field Sampling Plan was developed by Shaw at the request of the TCEQ that describes the field sampling procedures and analytical methods that were used for this General Groundwater Quality (Inorganic) Characterization and Comparison study at the Jones Road NPL site.

The evaluation of inorganic water quality parameters (cations and anions) provides the means for comparisons of the groundwater quality between a group of wells. The groundwater quality parameters selected for comparison as part of this RI activity are identified below.

Groundwater Quality Parameters

Ions	Group I	Group II
Cations	Magnesium, Manganese, Iron^{+2}, Iron^{+3}, Calcium, Sodium, Potassium	Barium, Zinc, Boron
Anions	Chloride, Alkalinity (HCO_3), Nitrate, Sulfate, Total Dissolved Solids (TDS), Total Organic Carbon (TOC)	Phosphate, Fluoride, Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD)

Group I represents the primary cations and anions of interest that were sampled to perform groundwater comparisons. Group II represents some additional cations and anions that were collected at the request of the TCEQ or by the recommendation from Shaw. In addition, field tests for ammonia (using color-metric strips) were performed at the request of the TCEQ to qualitatively assess whether any potential impacts from septic/sewage discharges were evident at any of the wells.

Selections of the specific wells targeted for sampling in this assessment were made by TCEQ technical representatives with input from Shaw personnel. Wells were selected on the basis of the following factors:

- wells exhibiting prior detections of COIs were excluded from this specific assessment
- general proximity to one another with different completion depths/screen intervals, facilitating comparisons along general transect lines (i.e., cross-sections) between different WBUs
- availability of well construction information (screen intervals) from drilling logs
- quality of available well construction information (drilling logs)

A total of 18 locations (3 monitoring wells and 15 residential wells) were selected for the collection of groundwater samples. Locations and well identification numbers of the targeted wells are shown in Figure 1. Field activities associated with this phase of the RI commenced on March 24, 2004 and were completed on March 25, 2004. Groundwater sampling from both the selected monitoring and residential wells was performed by Shaw in accordance with the procedures described in the appropriate respective section of the FSP and consistent with applicable TCEQ SOPs. All wells were

sampled in accordance with the appropriate sampling methods specified for monitoring wells and residential wells as described in the FSP.

A total of 18 groundwater samples were collected from the selected wells for analyses; additionally, 6 samples for laboratory QC and Data Review purposes were collected. Appropriate Chain-of-Custody and Request for Analyses Forms and Field Activity Daily Logs and field notes were completed as part of the sampling activities by Shaw field personnel.

As part of the sample collection from monitor wells, each well was gauged for water levels and then purged prior to sampling. Purging was accomplished using the low-flow technique with hydrogeochemical parameter monitoring. Stabilization parameters included temperature, pH, conductivity, and dissolved oxygen.

Samples collected from residential wells were purged for at least 15 minutes and readings for temperature, pH, conductivity, and dissolved oxygen were measured every 5 minutes. Once three consecutive readings stabilize or water was purged for a maximum of 30 minutes (which ever came first), samples were collected for analyses in accordance with applicable TCEQ SOPs. For any residential well with an activated carbon filtration systems installed, the sample was collected before the first carbon vessel.

All groundwater samples were placed in appropriate containers after collection as specified within the FSP. Each container was then placed into a cooler containing ice for chilling. All samples were transported to the laboratory in ice-chilled coolers maintained at a temperature of 4° degrees Celsius (+/- 2° C) on the same day as their collection. Samples remained in the custody of the sample collector throughout the collection process as documented on the Chain-of-Custody Form. Changes or transfers of the custodial care of individual samples were documented on the Chain-of-Custody Form, starting from the time of their collection through transportation and ultimately delivery to the analytical laboratory. Samples were prepared and subsequently analyzed by Accutest in accordance with the applicable test methods specified for the groundwater quality parameters by the FSP, shown below.

Analytical Test Methods for Metals and Groundwater Quality Parameters

Metals	Test Method		Groundwater Quality Parameters	Test Method
Calcium	6010B		Alkalinity (HCO_3)	310.1
Barium	6010B		Chlorides	9056
Boron	6010B		Fluoride	9056
$Iron^{+2}$	8146 (or equivalent field test method)		Nitrate (NO_3)	9056
$Iron^{+3}$	6010B - Calculation		Phosphates	9056
Magnesium	6010B		Sulfates	9056
Manganese	6010B		Biological Oxygen Demand (BOD)	405.1
Metals Digestion	3010		Chemical Oxygen Demand (COD)	410.4
Potassium	6010B		Total Dissolved Solids (TDS)	160.1
Sodium	6010B		Total Organic Carbon (TOC)	415.1 or 9060
Zinc	6020A			

Given the qualitative nature of the data quality objectives for this activity, applicable sample aliquots were not field filtered but were instead filtered by the analytical testing laboratory (Accutest) using a 0.45 micron filter media in the controlled environment of the laboratory. In addition, field testing for ferrous iron and ammonia (NH4) was performed by Shaw personnel on sample aliquots, collected from each groundwater sample, using HACH® colorimetric field test methods.

Regional Geology/Hydrogeology

The Jones Road Superfund site is located within the Texas Gulf Coastal Plain. The uppermost geologic formations are of Pliocene, Pleistocene, and Holocene age. These formations consist of fluvial, deltaic, coastal marsh, and lagoonal soil material and shallow sea deposits. The sedimentary deposits slope gently toward the Gulf of Mexico. The Beaumont Formation of Pleistocene Age underlies the area. This formation consists of river delta and over-bank flood deposits composed of clays and interbedded silts and fine sands that were deposited by rivers at various stages of flow and flood. The soils were exposed to air-drying after deposition and the resulting shrinkage caused the clay to become generally stiff and over consolidated.

Records from State of Texas Water Well Report's available for domestic wells near the site suggest that the shallow (<300 ft below ground surface [bgs]) lithology consists of interbedded clay, sand and silt. Discrete clay horizons are identified on driller's logs of private and public water supply wells in the area.

Water for Harris County is drawn from the Chicot and Evangeline Aquifers, and from Lake Houston. Groundwater comes from mixed sources including shallow (200 to 400 ft bgs) private water supply wells, and public water sources derived from deep wells (typically greater than 600 ft bgs). Four municipal water supply wells have been identified at a distance of approximately 3 miles from the former Bell Dry Cleaners location.

The Chicot Aquifer (in Holocene- and Pleistocene-age sediments) and the Evangeline Aquifer (in Pliocene- and Miocene-age sediments) are the two primary aquifers in the Houston-Galveston region and are part of the Gulf Coast aquifer system. Both hydrogeologic units are laterally discontinuous, fluvial-deltaic deposits of gravel, sand, silt, and clay that dip and thicken from northwest to southeast. Both aquifers out crop in bands inland, parallel to the coast, but progressively become more deeply buried (increase in depth from bgs) and confined toward the coast. The Chicot outcrop, which comprises the youngest sediments, is the closest of the aquifer outcrops to the coast, followed farther inland by the Evangeline outcrop. The Evangeline is one of the more productive Texas aquifers, and is expected to be located at a depth of 300 to 400 feet bgs in the Jones Road area (Texas Department of Water Resources, Report 236).

The Chicot Aquifer can be differentiated from the geologically similar Evangeline Aquifer on the basis of its contrasting relatively lower transmissivity. A weak hydraulic connection between land surface

and the Chicot Aquifer and between the Chicot and Evangeline Aquifers allows vertical movement of water into and between the aquifers; the aquifer system thus is characterized as “leaky” (Carr and others, 1985, p. 10).

The water in both the Chicot and Evangeline Aquifers is fresh (less than 1,000 milligrams per liter dissolved solids concentration) in the region, but becomes more saline in the downdip and deeply buried parts of the aquifers in the direction towards the coast. In the natural ground-water-flow system, water recharges the aquifers in the unconfined outcrop areas, moves downward and coastward, and discharges vertically as diffuse upward leakage in the confined downdip areas (United States Geological Survey, Open File Report 03-377).

Summary of Analytical Results

A summary of the analytical results for all samples analyzed is presented in Table 1. Data are sorted from shallowest to deepest screened interval. The qualitative comparisons of these inorganic data provide interpretations and insight into the hydrologic system that exists beneath the Jones Road Superfund site and may help identify the potential migration pathways of the primary (organic) contaminants of interest. More detailed discussion of these results is given in the following subsections.

Data Distribution

Box and Whisker plot diagrams provide a pictorial presentation of the statistical (simple) distribution of data. Box and Whisker plots which show the distribution of the data population for the results for 21 parameters from all 18 wells sampled are provided in Appendix A. Information presented in these plots includes the median value, limits of the distribution of results from at the 25 to the 75 percentile range (represented by the "box"), and the high/low limits of the normal distribution (represented by the "whiskers"). Values falling outside the normal distribution range are identified with separate symbols as "outliers". Additionally, in some cases outlier values are identified in the identified on the Box and Whisker plots as "extreme" values depending upon their proximity beyond the maximum and minimum values (relative to the distribution range) .

The parameters exhibiting the narrowest range in concentrations variability include Ammonia (NH4), Iron (Fe) , Boron (B) , Sodium (Na), Magnesium (Mg), Manganese (Mn), Potassium (K), Barium (Ba), Zinc (Zn), Fluoride (F), Phosphorus (P), Biological Oxygen Demand (BOD), and Total Organic Carbon (TOC). The values represented by these parameters do not vary from sample to sample, thus, with respect to these parameters, all of the samples appear similar in water quality, with some exceptions. Conversely, Calcium (Ca), Alkalinity (HCO3), Total Dissolved Solids (TDS), Nitrates (NO3), Sulfates (SO4), and Chlorides (Cl) exhibit much broader concentration value distributions.

Comparisons of Groundwater Quality Using Geochemical Graphical Plots

Comparisons of graphical plots employed for this assessment include Stiff, Radial, and Scatter Plot diagrams generated using AquaChem software; these are presented in Appendix B, Attachments 1, 2,

and 3, respectively. (In the case of Radial Plots, three different plots schemes were used in order to present various selected parameter groupings.)

In this section, comparisons of the Stiff and Radial Plot diagrams are specifically summarized. Samples have been grouped by cross-section association as devised by the TCEQ (Cross-sections A-A' through Cross-sections D-D'. Under each cross-section sample group, comparisons of samples within the group have been made followed by the comparisons of the cross-section group of samples to the 30-foot WBS, the 400-foot WBS, and then to the water quality represented in JR11414; this well is screened in the lower part of the Chicot WBU and represents the water quality within this zone nearest to the former Bell Cleaner site.

Cross-Section A-A' (FV11118, FV11127, FV11135)

A-A' Stiff Diagram Comparisons

Similar except the concentration of Ca is lower in FV11127 (whose screened interval is deeper than FV11118 and FV11135).

A-A' Radial Diagram Comparisons

Similar with the exception of FV11118; it exhibits elevated Zn and NH4 concentrations with lower concentrations of P and Mn.

Comparisons to 30-foot WBS

A-A' samples exhibit elevated Cl concentrations and lower Ca concentrations than JR11600(7) through JR 11600(9) which collectively represent the 30-foot WBS.

Comparisons to 400-foot WBS

Samples FV11118 and FV11135 exhibit elevated Cl and Ca relative to WE10814 representing the 350-foot WBU or Evangeline Aquifer. In addition, relatively lower Zn concentrations and higher NH4 were also observed except in FV11118.

Comparisons to JR11414

Similar with the exception of elevated Ca observed in FV11118 and FV11135.

Cross-Section B-B' (TT1114, TT11215, TT11227)

B-B' Stiff Diagram Comparisons

Very similar.

B-B' Radial Diagram Comparisons

Similar but with elevated NO3 and reduced P and Mn in TT11114; screen interval of TT1114 is deeper than TT11227.

Comparisons to 30-foot WBS

Similar with but with higher Cl and lower Ca concentrations in all; lower N03 except in TT11114.

Comparisons to 400-foot WBS

Similar but with higher concentrations of Cl and Ca and lower NO3 in all

Comparisons to JR11414

Similar but with higher concentrations of Cl and Ca.

Cross-Section C-C' (TC11219, TC11108)

C-C' Stiff Diagram Comparisons

Very similar.

C-C' Radial Diagram Comparisons

Similar but with higher Zn, NH4, and NO3 in TC11108; screen interval is deeper than that of TC11219.

Comparisons to 30-foot WBS

Similar but with higher Cl and slightly lower Ca.

Comparisons to 400-foot WBS

Similar but with higher Cl and Ca and lower N03.

Comparisons to JR11414

Similar but with higher Ca.

Cross-Section D-D' (TO10635, TO10830)

D-D' Stiff Diagram Comparisons

Very similar.

D-D' Radial Diagram Comparisons

Very similar but with higher Zn in TO10830.

Comparisons to 30-foot WBS

Similar but with lower Ca.

Comparisons to 400-foot WBS

Similar but with higher Ca.

Comparisons to JR11414

Similar but with elevated Ca

PH11611, PH11738, OV11635 (representing far west plume boundary)

Stiff Diagram Comparisons

Very similar.

Radial Diagram Comparisons

Very similar but higher NO3 in PH11738.

Comparisons to 30-foot WBS

Similar but with higher Cl and lower Ca.

Comparisons to 400-foot WBS

Similar.

Comparisons to JR11414

Similar.

Preliminary Conclusions

The objectives of this specific phase of the RI included the following:

- Characterize general groundwater quality (inorganic) parameters represented in selected monitor wells and/or existing residential wells.

- Compare water quality between wells (of both types) to assess whether the groundwater from different wells represents the same, similar, or different WBUs; as practicable, use this information for insights and support in the assessment of the nature and extent (vertical and horizontal) migration of the primary constituents of concern (PCE and its degradation daughter products) at the subject site.

In the following sections, preliminary conclusions based on the assessment of the data will be discussed.

<u>General Groundwater Quality Characterization – 30-foot WBU</u>

Groundwater samples were collected from three Monitoring Wells, MW-7, MW-8, and MW-9 which are in close proximity of the 11600 Jones Road address of the former Bell Dry Cleaners (Figure 1). [The samples collected from these wells are identified as JR11600(7), JR11600(8), and JR11600(9), respectively.] Based on their screening intervals, the groundwater samples from these wells represent the water quality of a water bearing unit (WBU) at an approximate 30-foot depth below ground surface (bgs).

Review of the results of the laboratory analyses performed as part of this assessment indicate that the groundwater from the 30-foot WBU can be characterized as a soft, fresh water, low in concentrations of salts (chlorides and sulfates). Relative to the other WBUs assessed as part of this phase of the RI, the 30-foot WBU generally exhibited low concentrations of Cl and K, with the highest concentrations (outliers are denoted in *italics*) represented by all of the WBUs collectively assessed for Ca, *Mg*, *Ba*, P, Mn, *NH4*, SO4, NO3, *F*, TDS, *Alkalinity*, *TOC*, and BOD.

General Groundwater Quality Characterization – Chicot WBU (185 to 310-foot interval)

Groundwater samples were collected from wells TT11215, TC11219, PH11611, PH11738, TC1108, TT11114, T010830, OV11635, FV11118, FV11135, FV11127, TO10635, and JR11414, representing screened intervals from 185 to 310 feet bgs (in respective order from shallowest to deepest). Well TT11227 has a screen interval some 65+ feet shallower than the others listed; however, its water quality does not differ greatly from this group. Review of the results of the laboratory analyses performed as part of this assessment indicate that the water from this WBU can be characterized as a very soft, very fresh water, low in concentrations of salts (chlorides and sulfates). Variability in parameter concentrations is expected within this group of samples, given a larger sample population of samples is represented by this group.

General Groundwater Quality Characterization – 400 foot WBU (Evangeline)

Groundwater samples were collected for analyses at well WE1010814 which is screened from a depth of 395 to 405 feet; these intervals represent the Evangeline Aquifer as determined from Driller's Log Information available from the area. Review of the results of the laboratory analyses performed as part of this assessment indicate that the water from the 400-foot WBU can be characterized as a very soft, very fresh water, low in concentrations of salts (chlorides and sulfates). Relative to the other WBUs assessed as part of this phase of the RI, the 400-foot WBU generally exhibited lower concentrations of Ca, Na, Mg, Cl, SO4, Alkalinity but higher concentrations of NO3 and TDS in comparison to the other WBUs assessed.

General Groundwater Quality Observations

- Groundwater quality of all of the WBU's represented are generally similar.

- Ba, SO4, TDS, TOC, Ca, and Alkalinity decrease with increasing depth.

- General similarity of groundwater quality among all of the WBUs assessed suggests vertical mixing of groundwater occurs between the units; concentration gradient observed for Ba, SO4, TDS, TOC, Ca, and Alkalinity also supports the occurrence of vertical mixing between WBUs.

- Elevated NO3 was observed in FV11118, FV11135, TT11114, but not in FV11127; all are screened in the Chicot WBU and in close spatial proximity to one another. [Presence of NO3 may indicate influence from near surface septic field discharge impacts (elevated outlier concentrations of NH4, another indicator of septic field discharges, were observed in FV11118 and TT11114)].

- Elevated COD and Cl in TT11215 and TC11219 which are screened at similar depths within the Chicot WBU and in close spatial proximity to one another; water quality very similar in nearby TT11227 which is screened some 65 feet shallower.

- Water quality in OV11635 and PH11738, which are in general proximity of one another (and furthest west of 11600 Jones Road), is very similar.

- Water quality of TO10635 and TO10830 are similar (with the exception of NO3) and in general proximity of one another; NO3 is highest in T010635 which is screened some 75 feet deeper than TO10830. [Presence of NO3 may indicate influences from near surface septic field discharges.]

- Outlier concentrations of Zn were observed in TC11108 and TO10830 at nearly an order of magnitude greater than all other samples; may represent artifacts from corrosion or wear from the well/pump construction materials and not represent the groundwater quality at this location.

Preliminary Recommendations

- Further assessment may be warranted to assess and verify the mechanism(s) of the apparent vertical mixing observed between the different WBU (apparent from the results herein).

This concludes the summary letter report of the General Groundwater (Inorganic) Quality Characterization and Comparison. If you have any questions, please either contact me at 281-396-4590 or Bill Hardmant at 281-396-4599.

Sincerely,
Shaw Environmental, Inc.

Perry Mann
Program Manager

PM/mfa
Attachments

FIGURES

OAK VALLEY DRIVE
POSSUM HOLLOW LANE
TIMBER HOLLOW LANE
ECHO SPRING LANE
WOODEDGE DRIVE
POSSUM HOLLOW DRIVE
TIMBER HOLLOW DRIVE
ECHO SPRING LANE
FOREST VALLEY DRIVE
TALL TIMBERS DRIVE
TIMBER CREST DRIVE
TOWER OAKS BOULEVARD
BARELY LANE
JONES ROAD
STEEPLETOP DRIVE
NEESHAW DRIVE
AMIRA DRIVE
10814
11635
11611
11118
11127
11135
11114
11215
11227
11108
11219
MW-8
MW-9
MW-7
11414
10830
10635
N
SCALE
0
300
600 FEET
Shaw
TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
FIGURE 1
WELL LOCATIONS
GROUDWATER QUALITY COMPARISONS
CERCLIS #TXN000605460
HOUSTON, TEXAS
DRAWING NUMBER 100249-B16
APPROVED BY
CHECKED BY
DRAWN BY J. RDZ 5/20/04
OFFICE Houston, Texas
X-REF ---
IMAGE ---
PLOT DATE: 5/20/04
FORMAT REVISION 3/25/99

TABLES

Jones Road Groundwater Plume
Inorganic Sampling Results
March 2004

Sample ID Address	TD	Screen Interval	Na	K	Mg	Ca	Mn	Fe^{total}	Fe^{+2}	Fe^{+3}	Ba	B	Zn	NH4	P	Cl	SO4	P	HCO3	F	NO3	TDS	TOC	BOD	COD
			mg/L																						
MW-7	35	20-35	16.6	0.275	9.91	108	0.0346	0.047	0.035	0.012	1.06	0.0599	0.0325	ND	0.012	20.8	18.2	0.012	317	0.33	0.41	408	10	1	7
MW-9	35	20-35	36.2	1.11	12	139	0.00115	0.047	0.035	0.012	1.01	0.0566	0.0227	0.6	0.033	42.4	16.2	0.033	409	0.5	2.4	508	17	4	7
MW-8	36	21-36	35.3	0.582	14.3	124	0.00115	0.047	0.035	0.012	1.02	0.0553	0.0291	0.12	0.033	19.5	18.1	0.033	411	0.95	3.2	480	19	2	10
TT11227	120	110-120	39.6	0.921	6.16	77.6	0.0023	0.094	0.07	0.024	0.211	0.0505	0.144	ND	0.01	78.9	13.1	0.01	198	0.21	0.15	380	6	2	13
TT11215	195	185-195	35.7	0.934	5.19	69.7	0.0023	0.094	0.07	0.024	0.189	0.0468	0.0224	ND	0.0009	64.6	12	0.0009	196	0.17	0.24	352	7	2	13
TC11219	197	192-197	40.9	0.959	5.98	77.2	0.0023	0.094	0.07	0.024	0.227	0.0496	0.0649	ND	0.0007	87.6	12.5	0.0007	202	0.2	0.13	396	5	2	13
PH11611	210	200-210	37.3	0.971	5.9	72.8	0.0023	0.094	0.07	0.024	0.242	0.0508	0.167	ND	0.01	79.3	11.6	0.01	194	0.21	0.19	370	7	2	5.1
PH11738	217	207-217	41.4	1.13	7.2	102	0.0023	0.094	0.07	0.024	0.357	0.0575	0.486	ND	0.013	73.8	14.3	0.013	268	0.15	2.2	442	10	2	10
TC11108	220	210-220	35.7	1.02	6.54	88.8	0.0078	0.094	0.07	0.024	0.286	0.0486	2.05	0.24	0.009	54	12.8	0.009	266	0.17	0.94	396	9	2	10
TO10830	238	217-223	36.3	0.997	5.73	86.7	0.00115	0.047	0.035	0.012	0.286	0.0511	0.275	ND	0.013	31	12.6	0.013	288	0.17	0.57	346	7	2	2.55
TT11114	225	215-225	42.9	0.937	7.45	102	0.0023	0.094	0.07	0.024	0.304	0.0532	0.047	0.36	0.012	73	14.2	0.012	278	0.17	1.7	446	7	2	7
FV11118	240	230-240	35.3	1.07	6.52	84.8	0.00115	0.047	0.035	0.012	0.289	0.05	0.143	0.36	0.01	61.9	12.3	0.01	241	0.17	1.9	382	9	2	5.1
OV11635	240	225-240	34.1	0.922	5.1	63.3	0.0023	0.094	0.07	0.024	0.252	0.0457	0.0535	ND	0.012	50.5	11.2	0.012	190	0.21	0.2	288	6	2	10
FV11135	268	258-268	37.4	1.17	7.37	92.3	0.0023	0.094	0.035	0.059	0.34	0.0563	0.0104	ND	0.012	72.9	12.7	0.012	235	0.17	2.3	408	9	2	10
FV11127	280	270-280	29.3	0.966	4.26	54.2	0.00115	0.047	0.035	0.012	0.242	0.0414	0.0155	ND	0.009	38.5	10.5	0.009	166	0.22	0.89	282	4	2	7
TO10635	305	295-305	31.9	1.19	4.92	64.8	0.00115	0.047	0.035	0.012	0.343	0.0441	0.0418	ND	0.012	53.7	10.8	0.012	184	0.18	1.4	298	5	2	2.55
JR11414	310	269-310	29.5	1.06	4.6	57	0.00115	0.047	0.035	0.012	0.381	0.0408	0.0751	ND	0.01	45.5	10.6	0.01	182	0.21	0.22	258	4	2	10
WE10814	407	395-405	23.3	0.782	2.81	48.2	0.00115	0.047	0.035	0.012	0.158	0.0557	0.209	ND	0.012	29.5	10	0.012	168	0.18	2.9	238	4	2	10

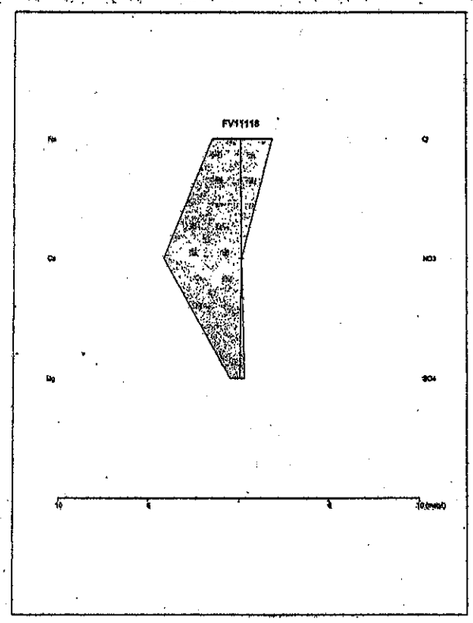
Jones Road Groundwater Plume
Inorganic Sampling Results
March 2004
General Statistics Summary

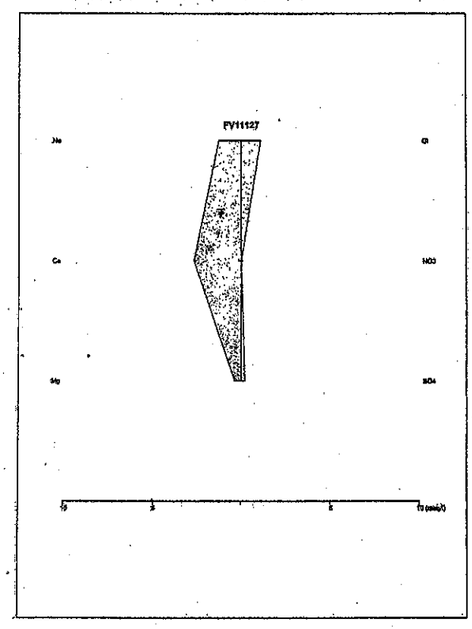
Analyte	Min	Max	Average	St. Dev.	Dev. Coeff	Variance %
B	0.041	0.06	0.051	0.006	10.934	32
Ba	0.158	1.06	0.4	0.296	74.025	85
Ca	48.2	139	84.022	24.328	28.955	65
Cl	19.5	87.6	54.3	21.079	38.82	78
Cl	19.5	87.6	54.3	21.079	38.82	78
F	0.15	0.95	0.254	0.192	75.62	84
Fe (total)	0.047	0.094	0.071	0.024	34.3	50
Mg	2.81	14.3	6.774	2.8	41.33	80
Mn	1.15	0.035	0.004	0.008	200.997	97
Na	16.6	42.9	34.372	6.491	18.884	61
NH4	<0.01	0.6	0.093	0.177	189.774	100
NO3	0.13	3.2	1.219	1.047	85.926	96
P	0.001	0.033	0.012	0.008	66.66	98
SO4	10	18.2	12.983	2.419	18.634	45
Zn	0.01	2.05	0.216	0.473	219.029	99

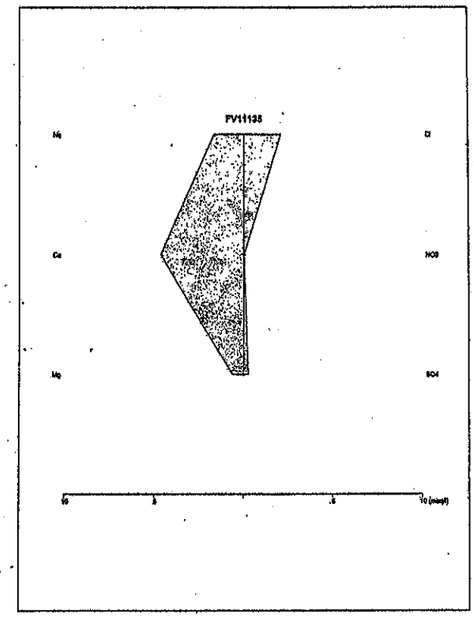
ATTACHMENT 1

Stiff Diagrams

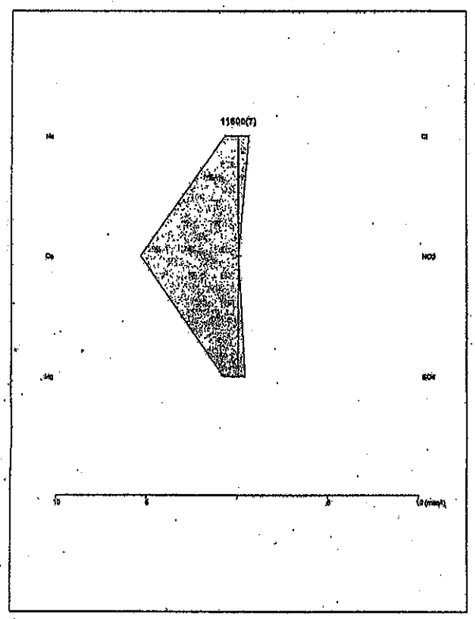
Cross-Section A-A' (FV11118, FV11127, FV11135)

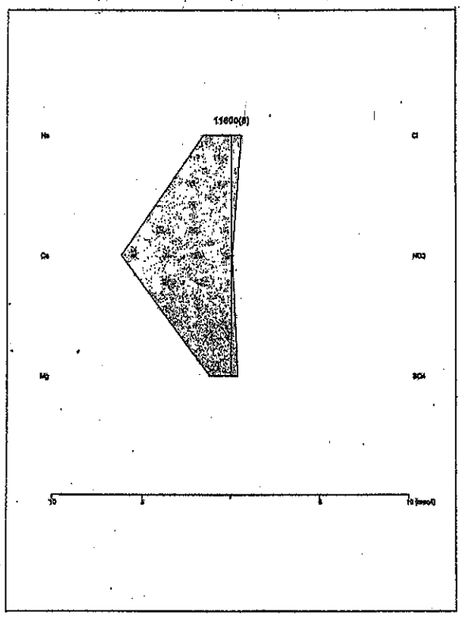


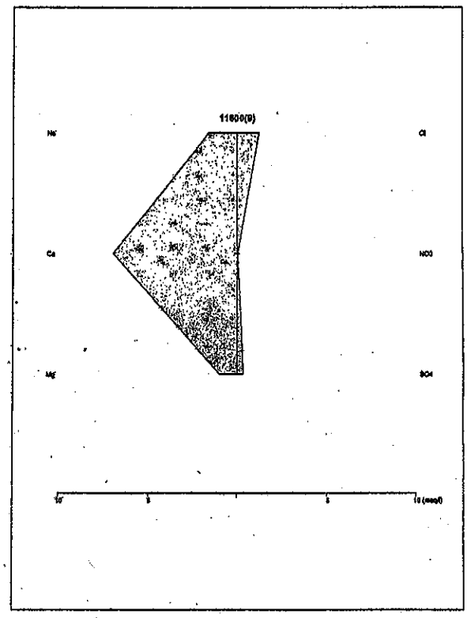




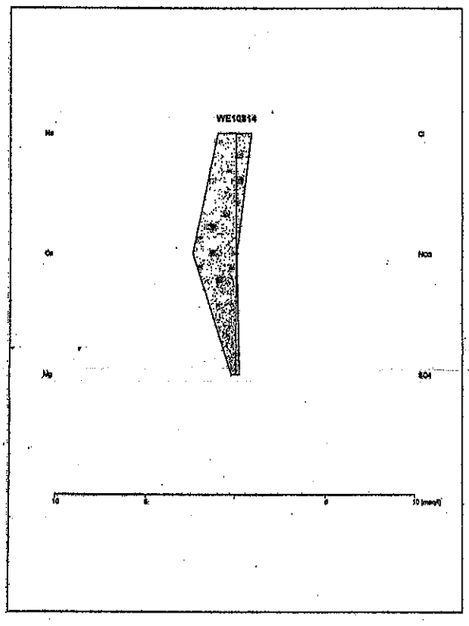
30-Foot WBS



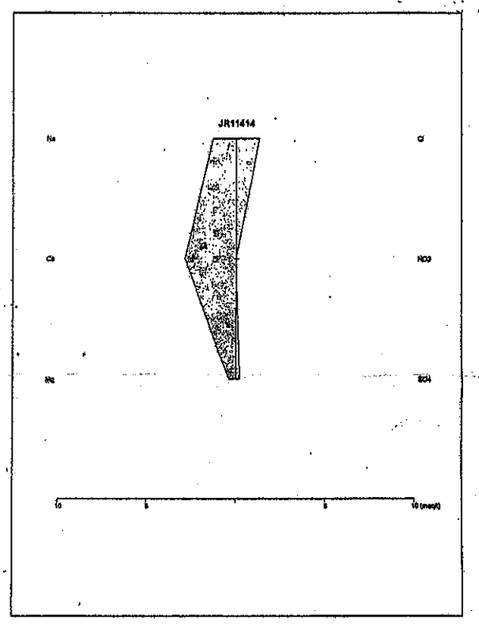




400-Foot WBS



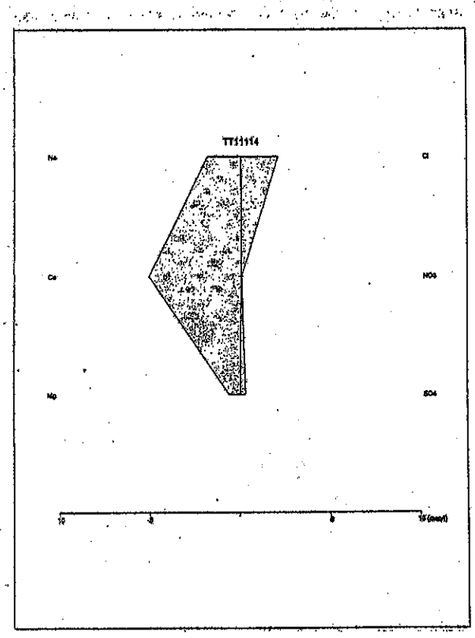
JR11414

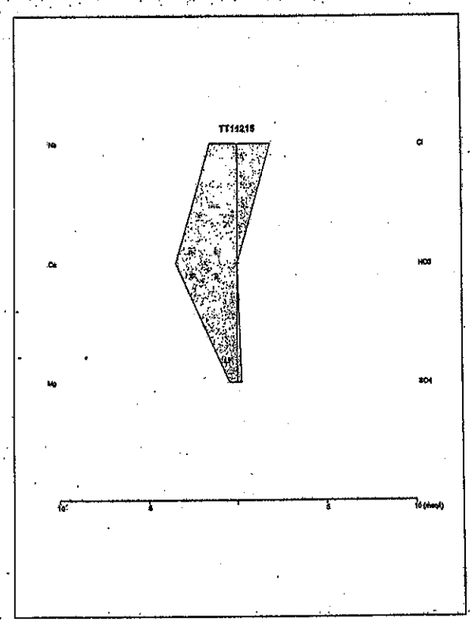


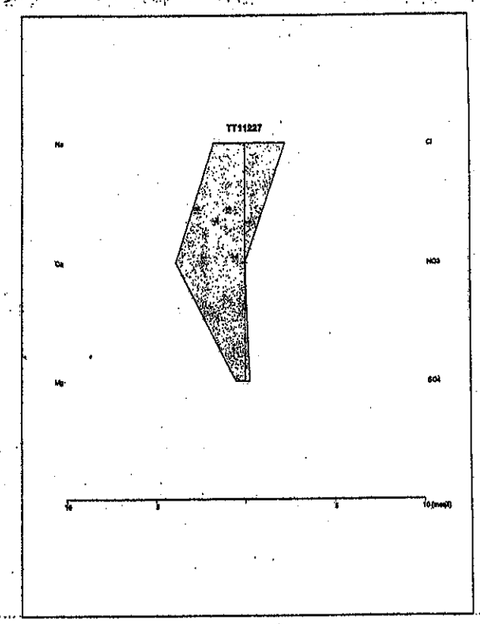
Comparisons of Stiff Diagrams

Jones Road
CERCLIS # TXN000605460
Houston, Texas

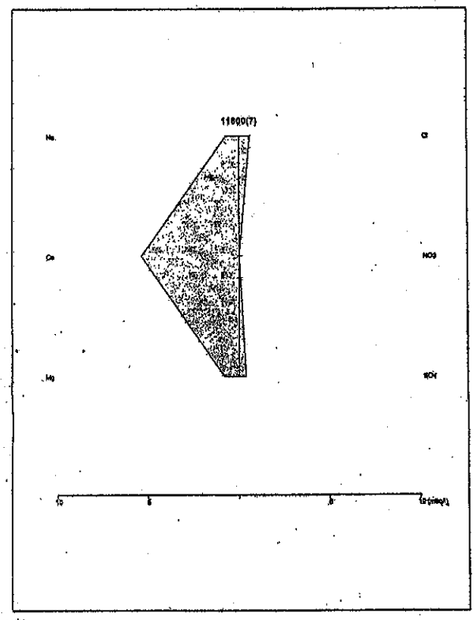
Cross-Section B-B' (TT1114, TT11215, TT11227)

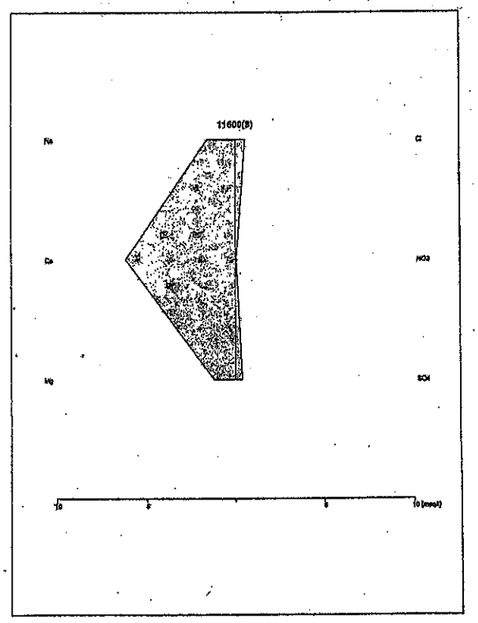


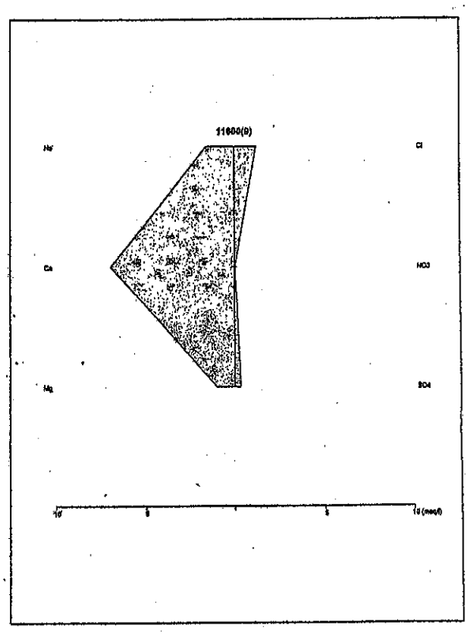




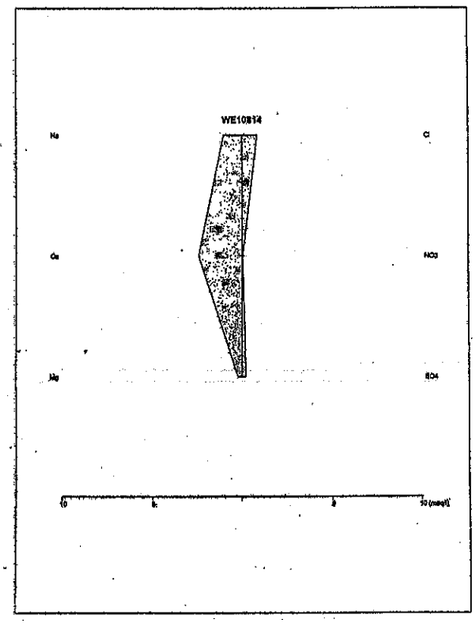
30-Foot WBS



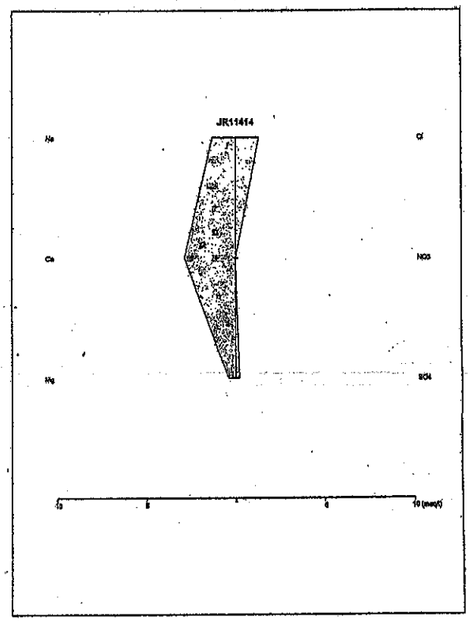




400-Foot WBS



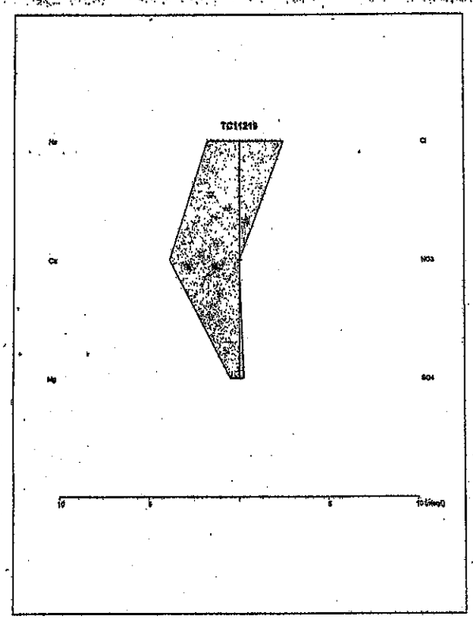
JR11414

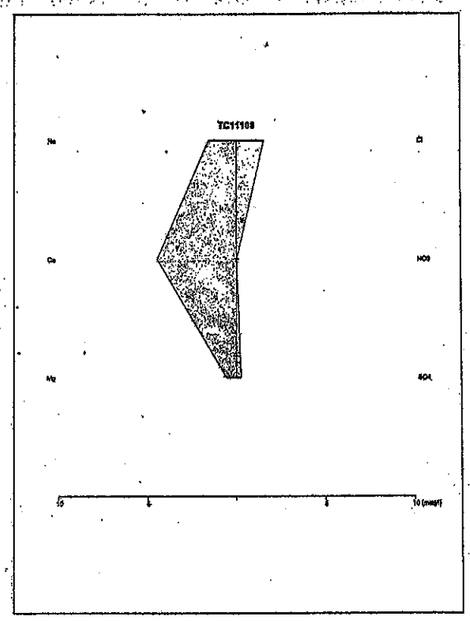


Comparisons of Stiff Diagrams

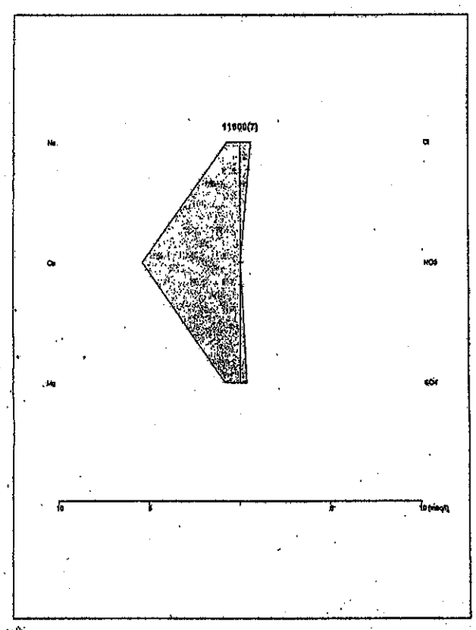
Jones Road
CERCLIS # TXN000605460
Houston, Texas

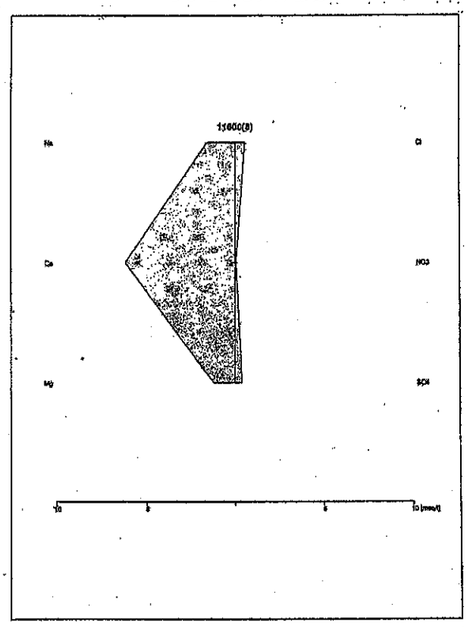
Cross-Section C-C' (TC11219. TC11108)

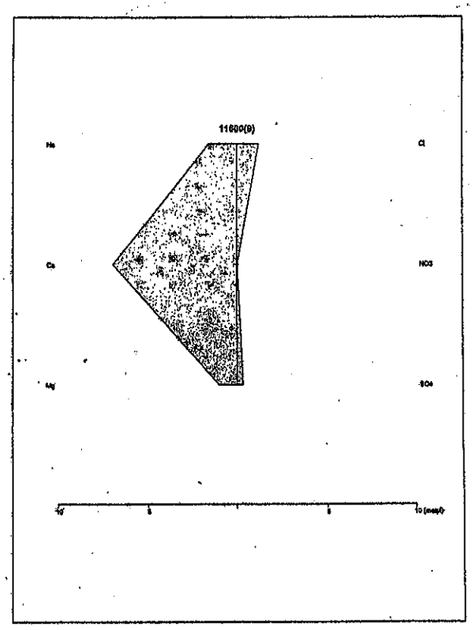




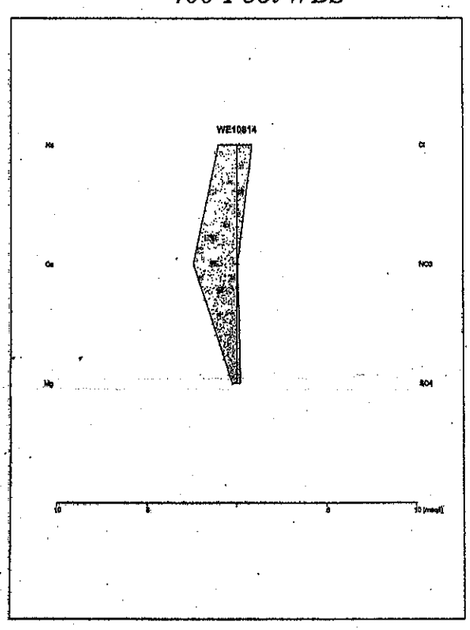
30-Foot WBS



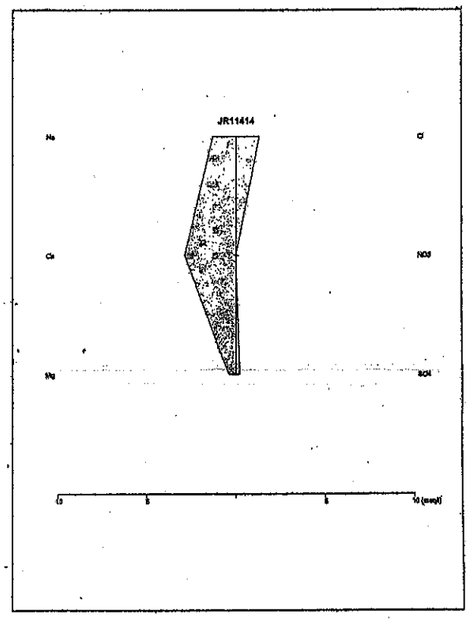




400-Foot WBS



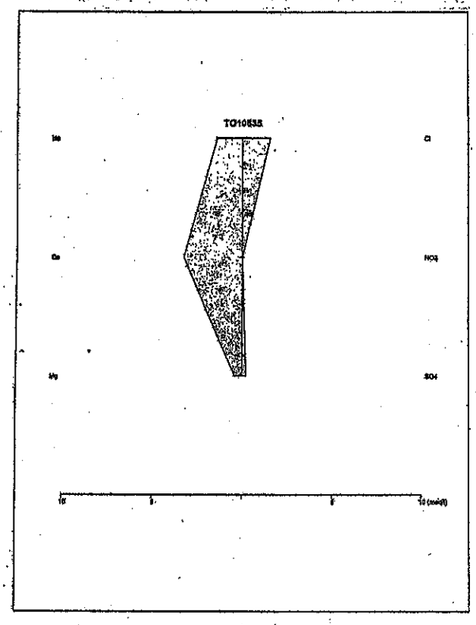
JR11414

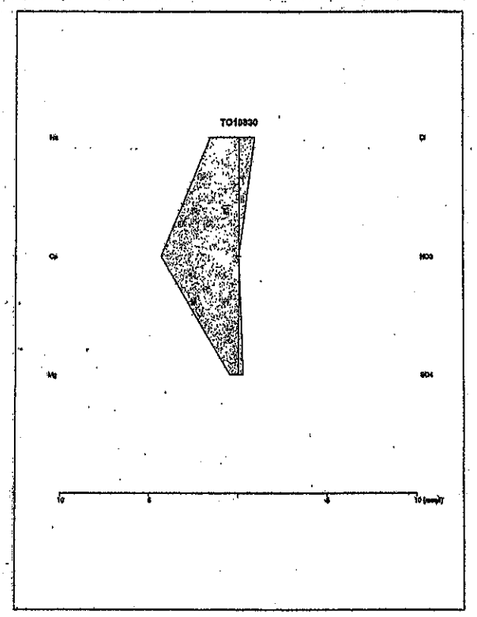


Comparisons of Stiff Diagrams

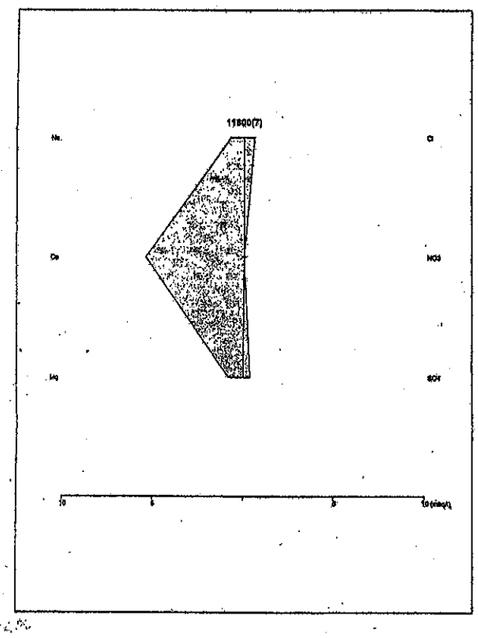
Jones Road
CERCLIS # TXN000605460
Houston, Texas

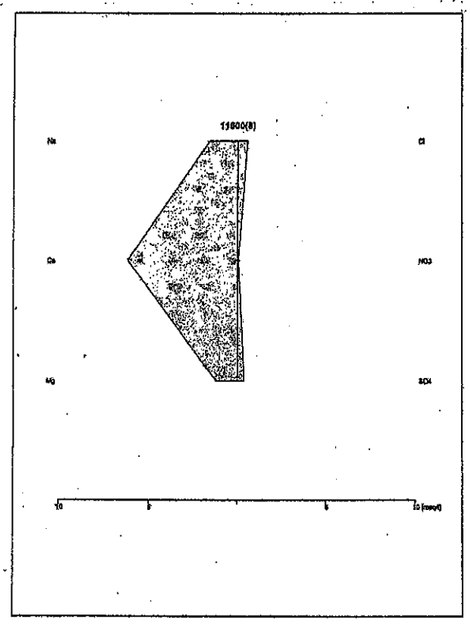
Cross-Section D-D' (TO10635, TO10830)

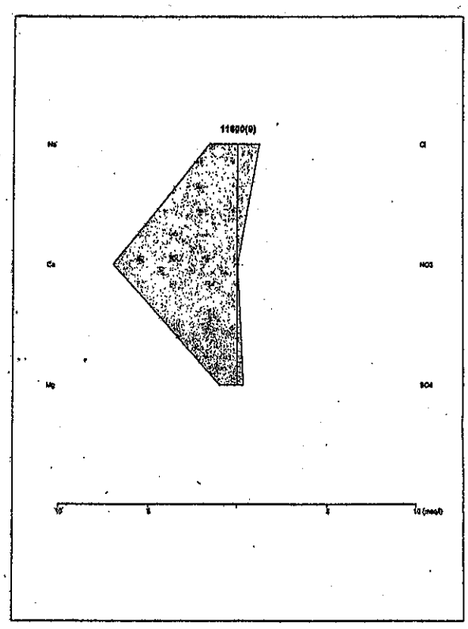




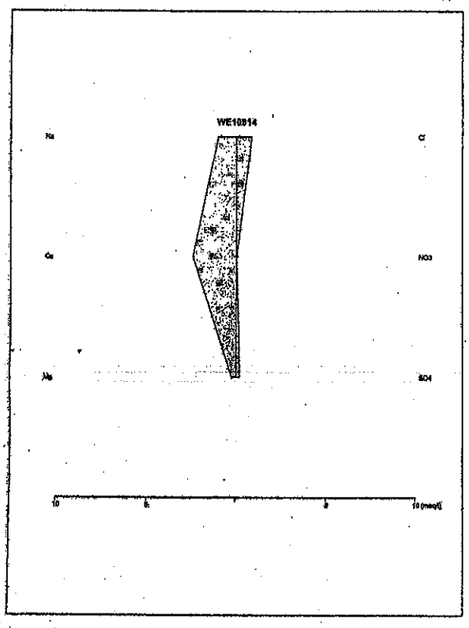
30-Foot WBS



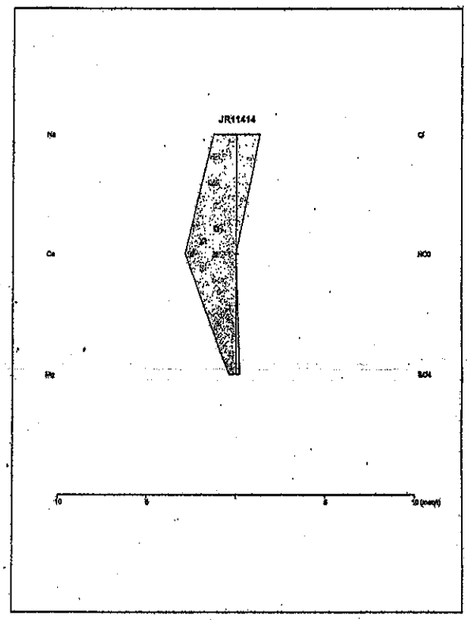




400-Foot WBS



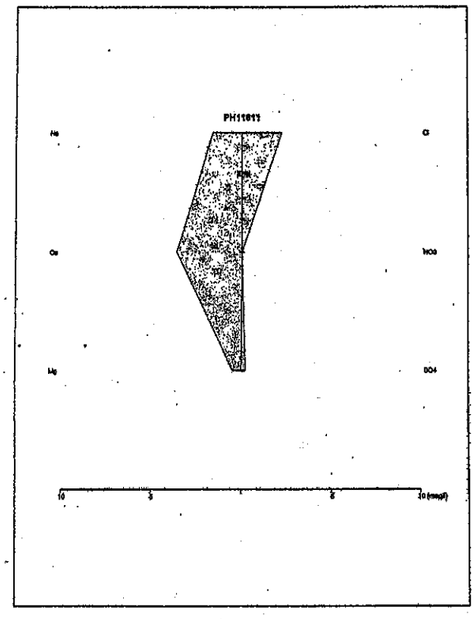
JR11414

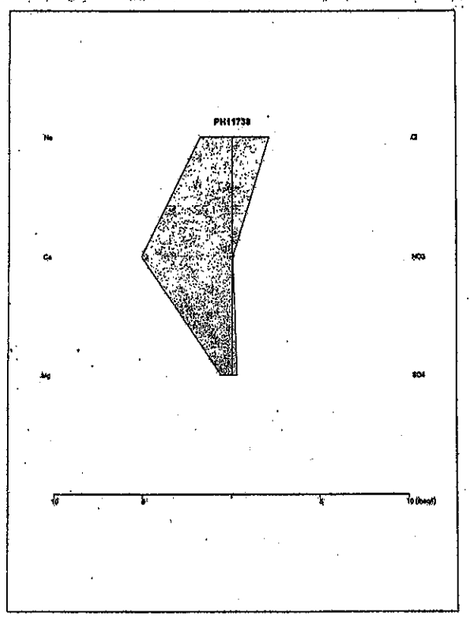


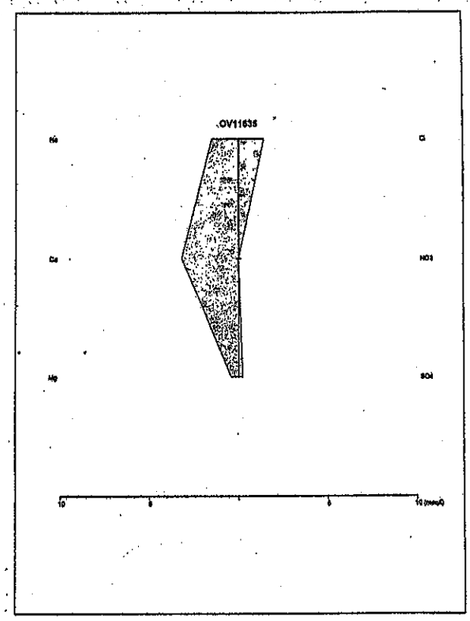
Comparisons of Stiff Diagrams

Jones Road
CERCLIS # TXN000605460
Houston, Texas

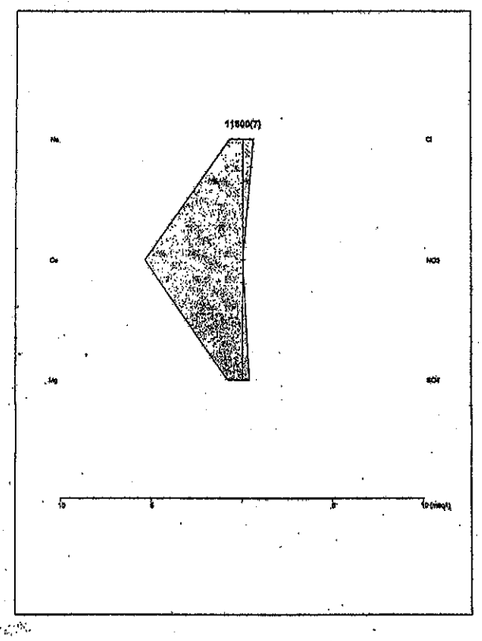
PH11611, PH11738, OV11635 (representing far west plume boundary)

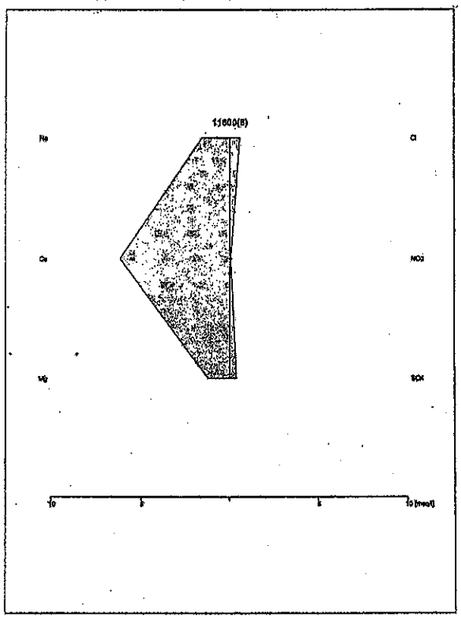


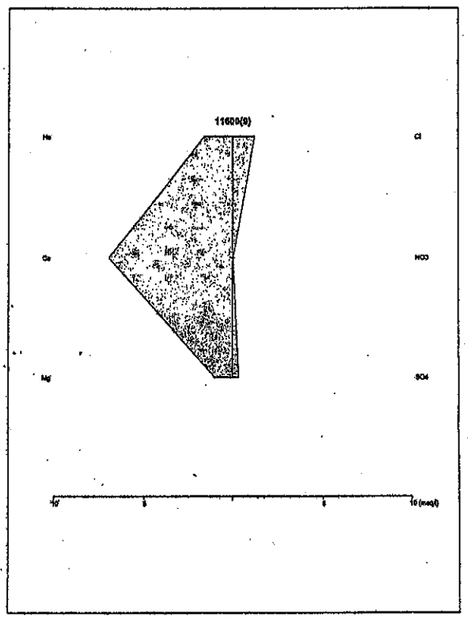




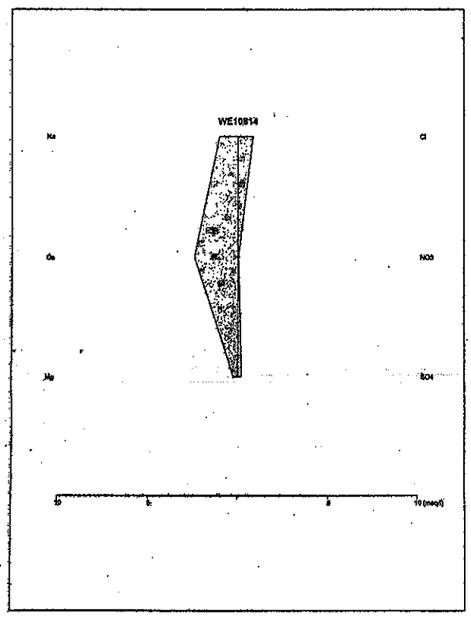
30-Foot WBS



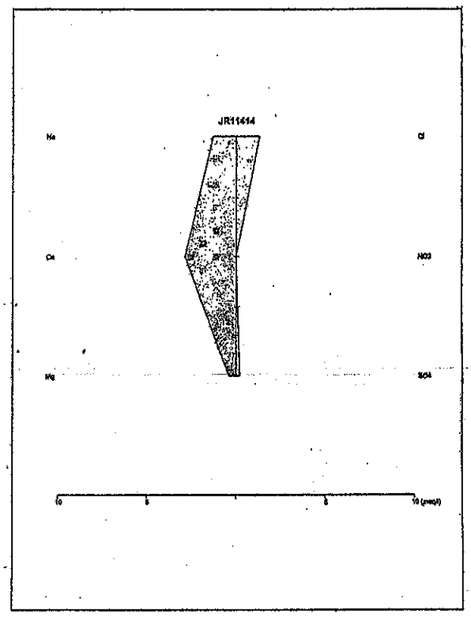




400-Foot WBS



JR11414



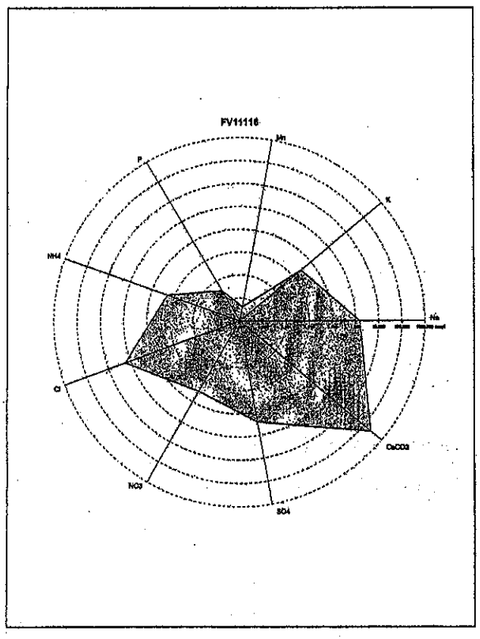
Comparisons of Stiff Diagrams

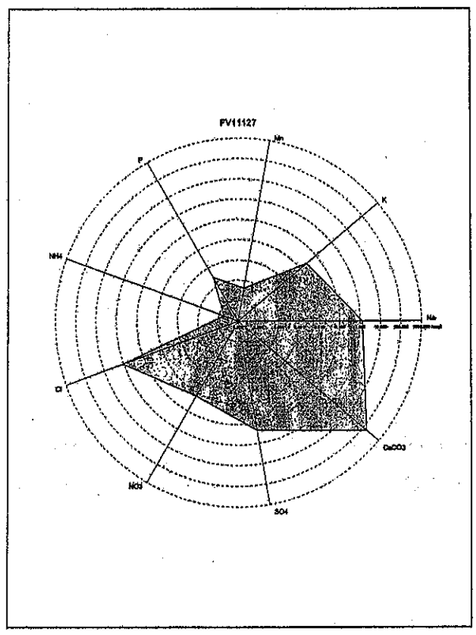
Jones Road
CERCLIS # TXN000605460
Houston, Texas

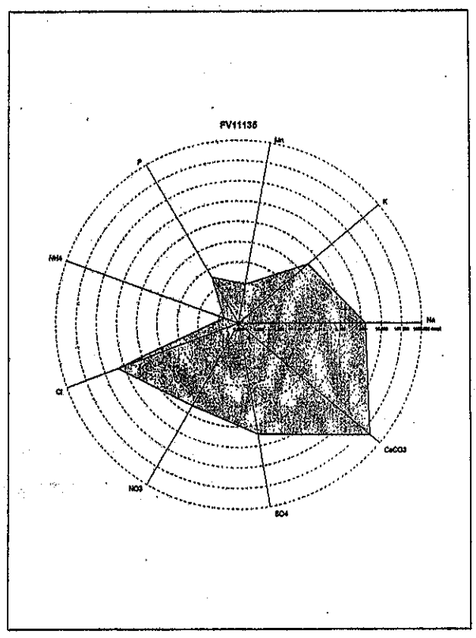
ATTACHMENT 2

Group 1 Radial Diagrams

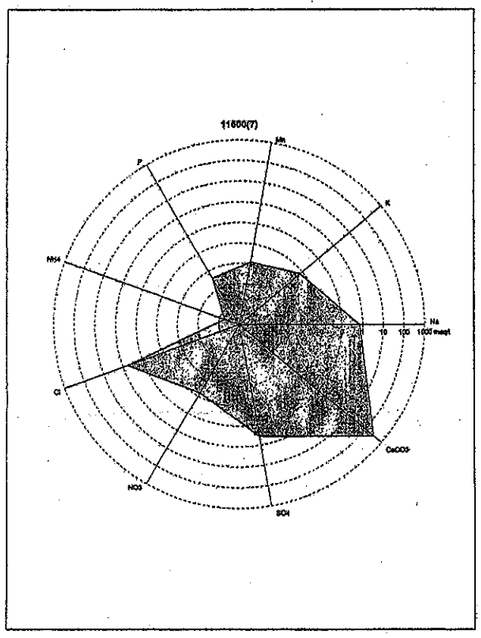
Cross-Section A-A' (FV11118, FV11127, FV11135)

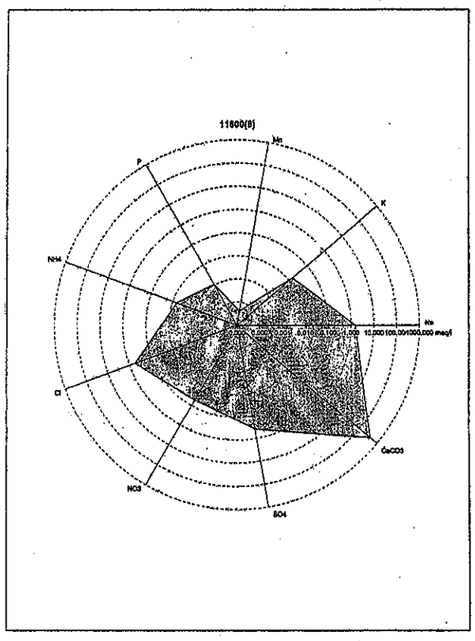


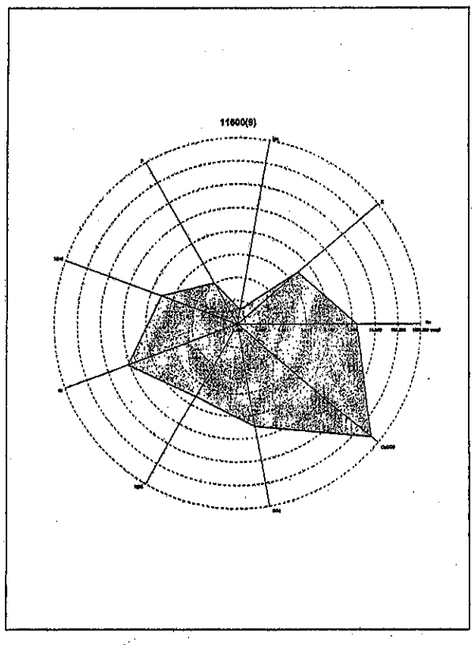




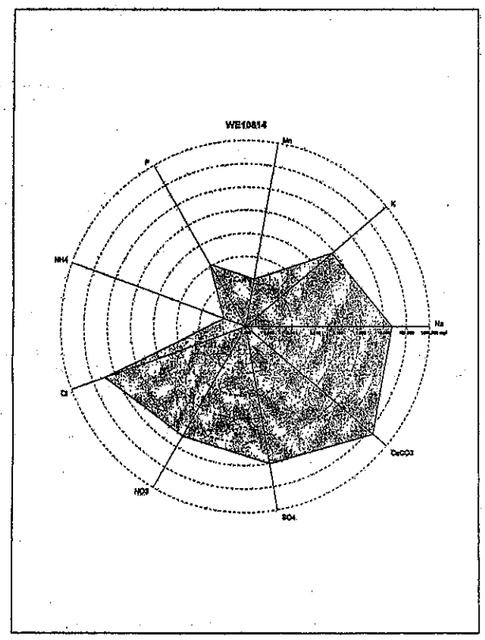
30-Foot WBS



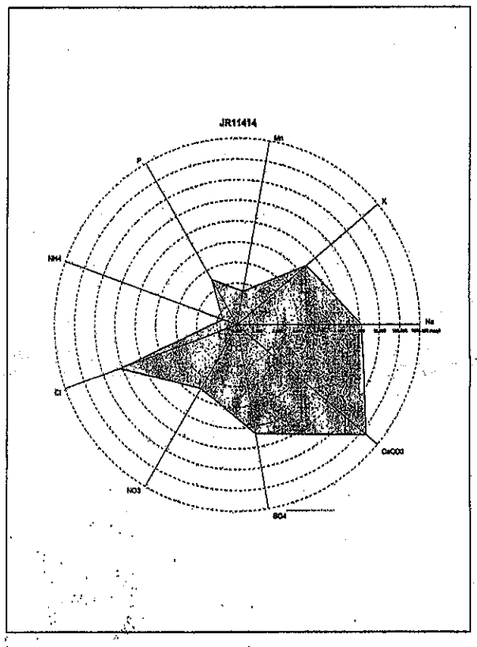




400-Foot WBS



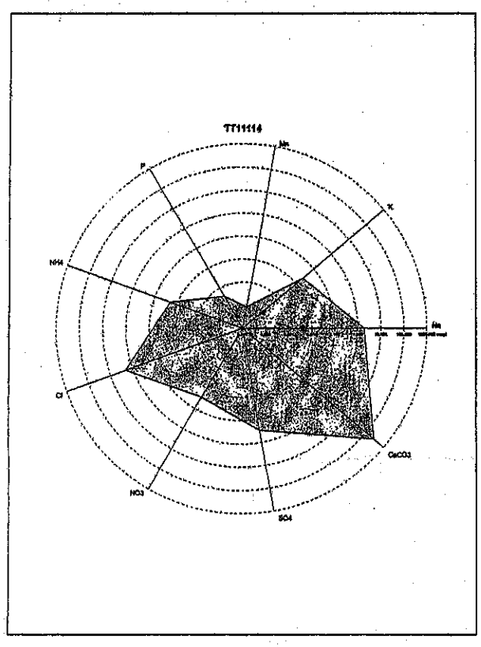
JR11414

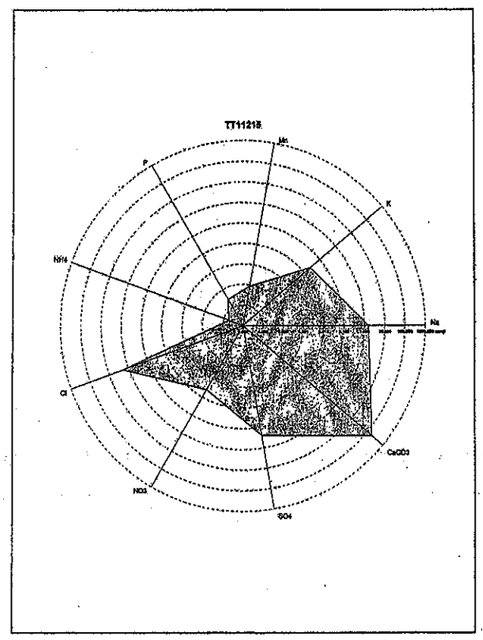


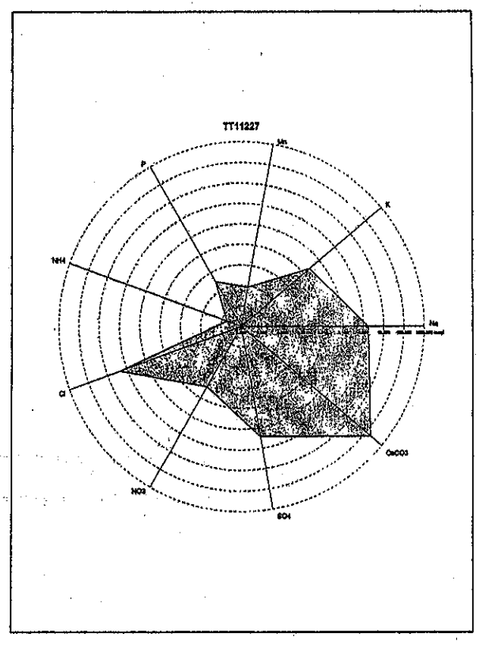
Comparisons of Radial Diagrams (1)

Jones Road
CERCLIS # TXN000605460
Houston, Texas

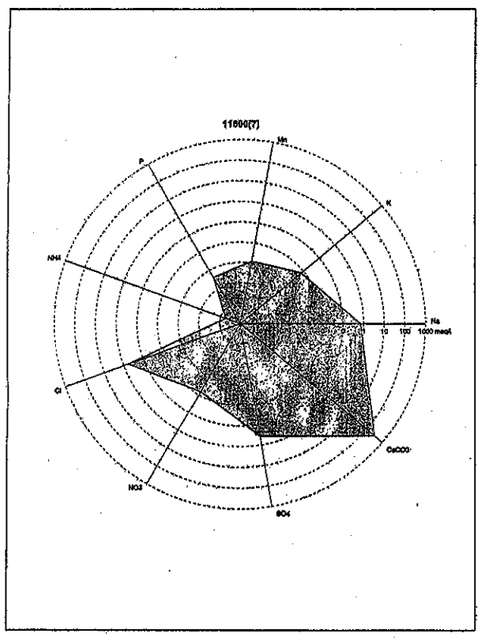
Cross-Section B-B' (TT1114, TT11215, TT11227)

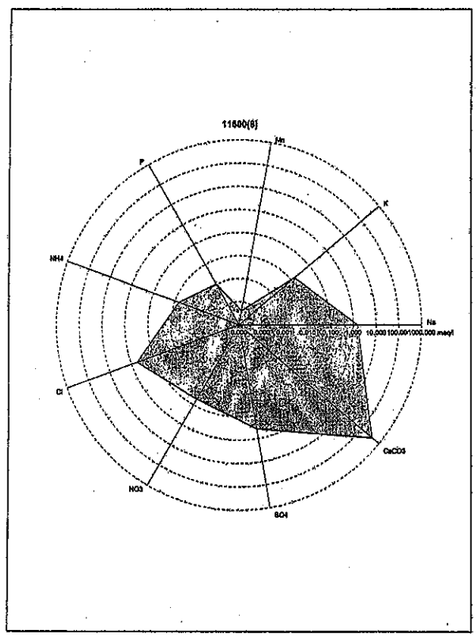


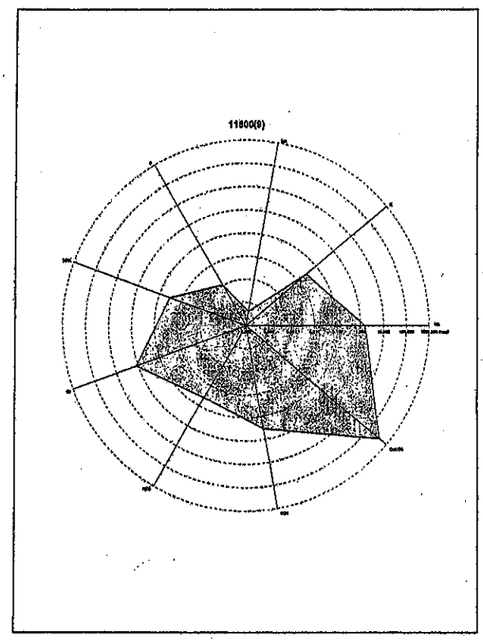




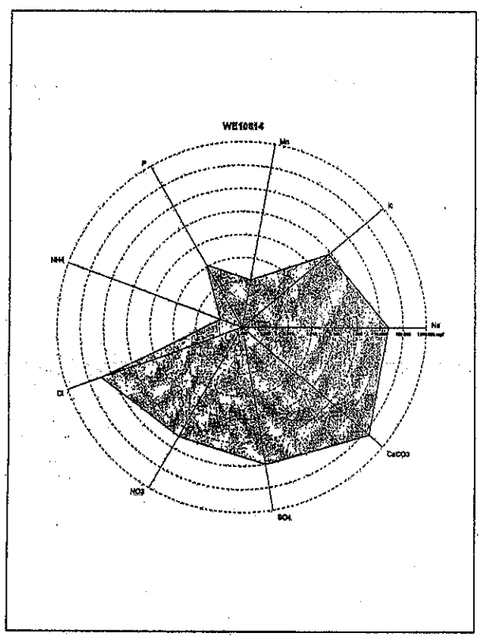
30-Foot WBS



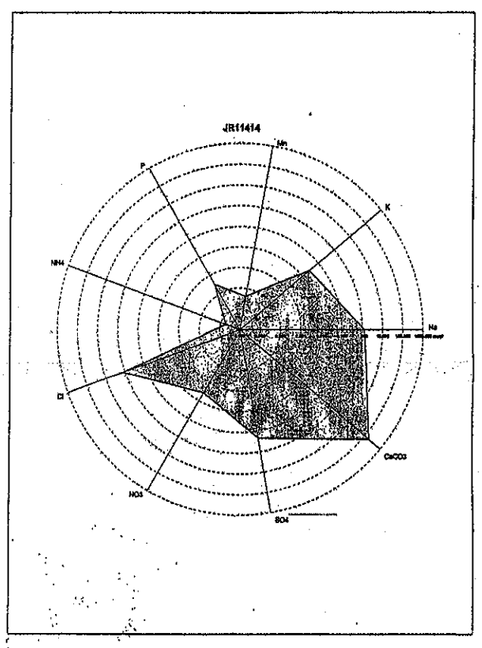




400-Foot WBS



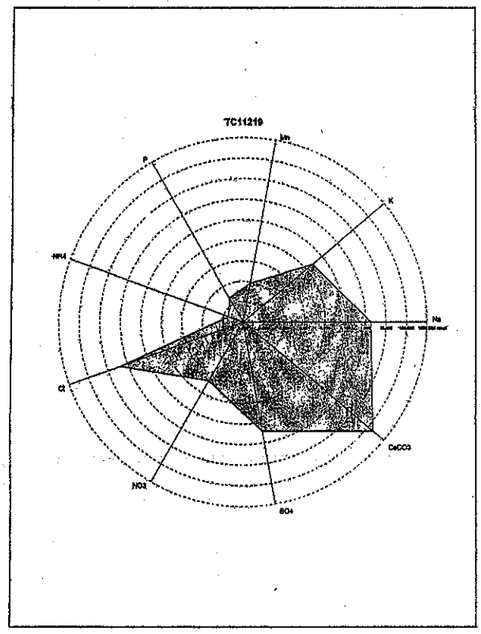
JR11414

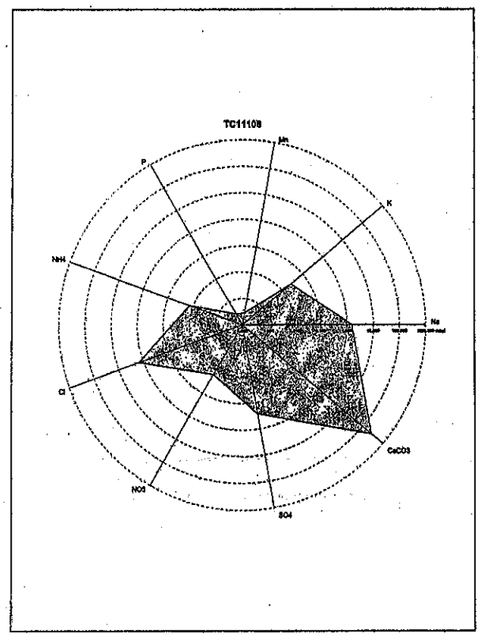


Comparisons of Radial Diagrams (1)

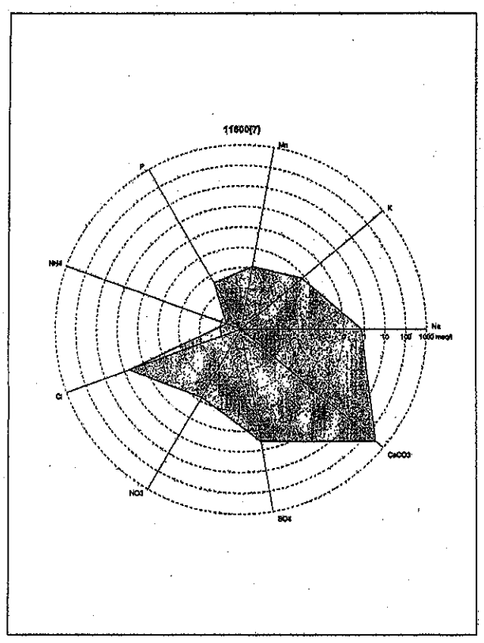
Jones Road
CERCLIS # TXN000605460
Houston, Texas

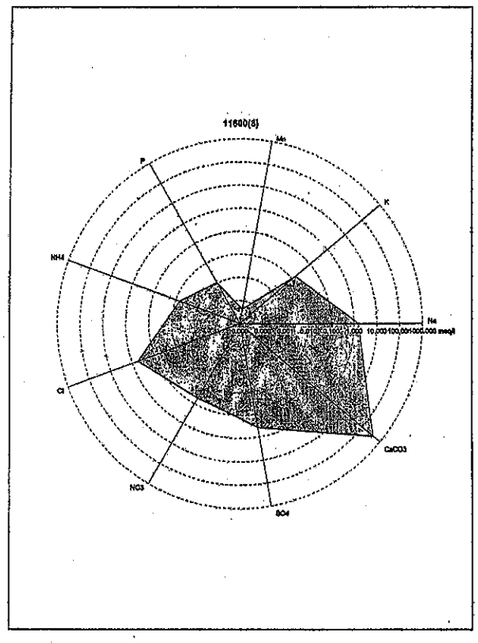
Cross-Section C-C' (TC11219, TC11108)

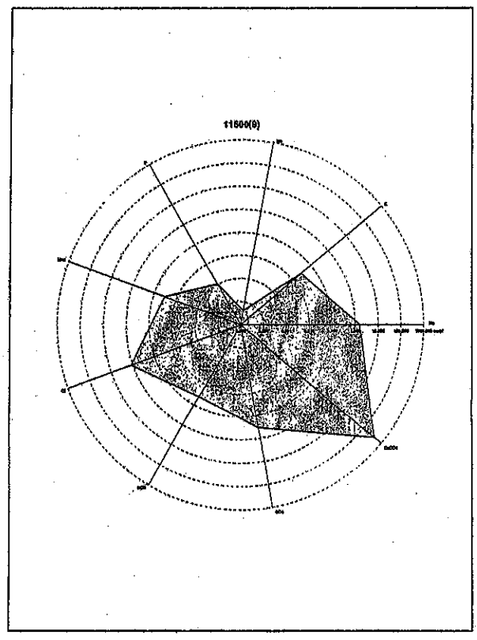




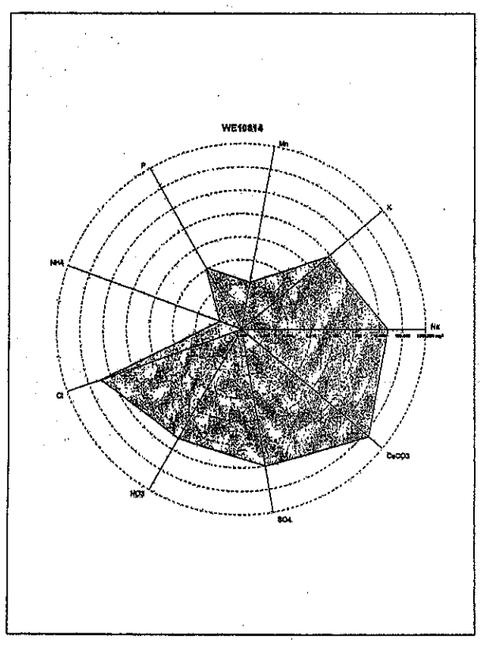
30-Foot WBS



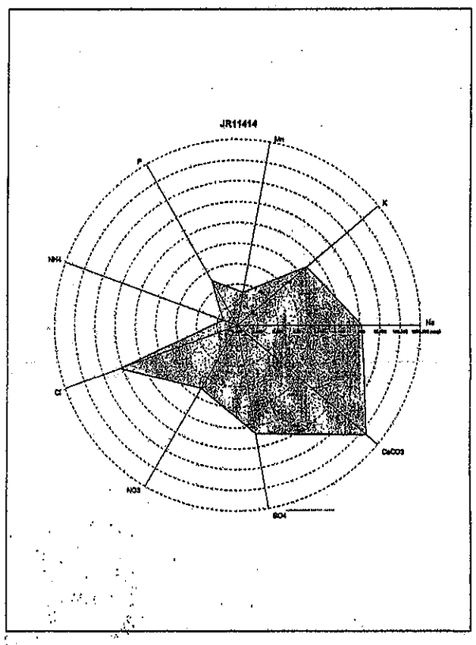




400-Foot WBS



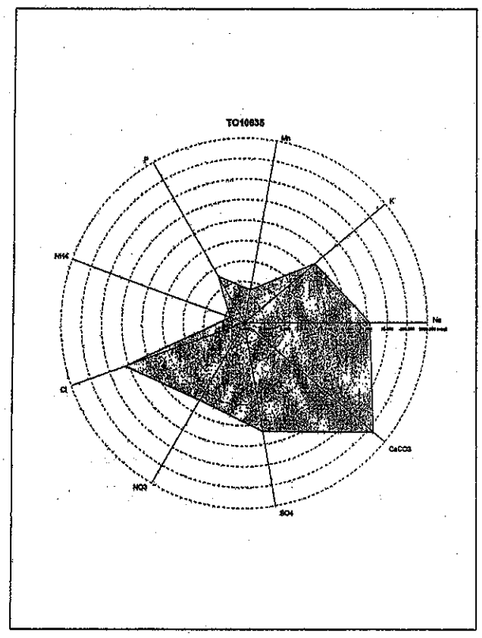
JR11414

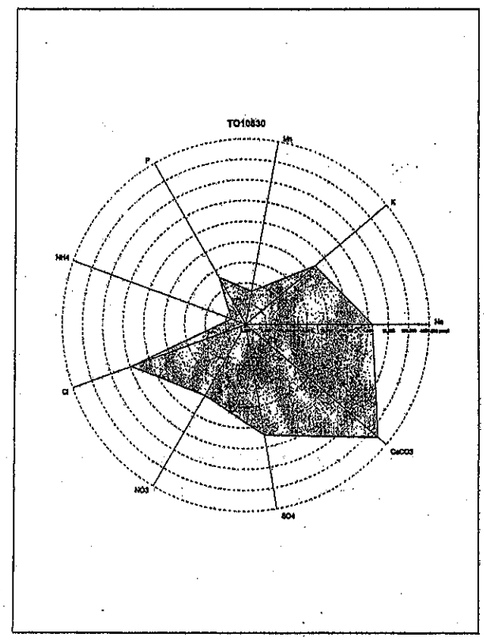


Comparisons of Radial Diagrams (1)

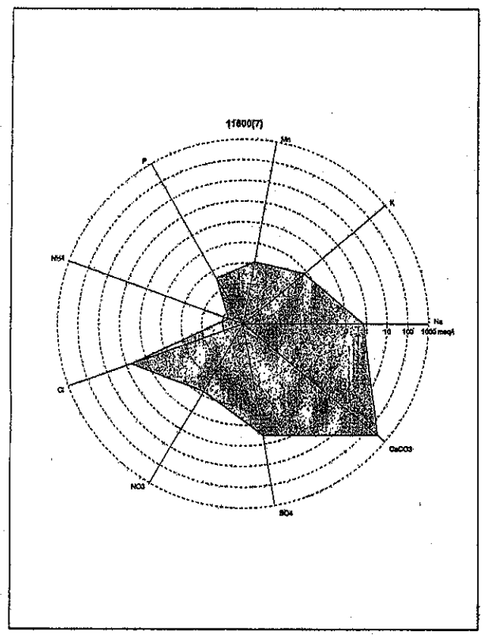
Jones Road
CERCLIS # TXN000605460
Houston, Texas

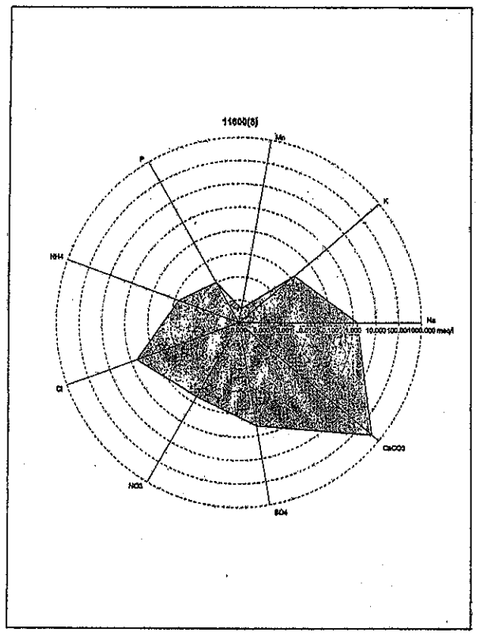
Cross-Section D-D' (TO10635, TO10830)

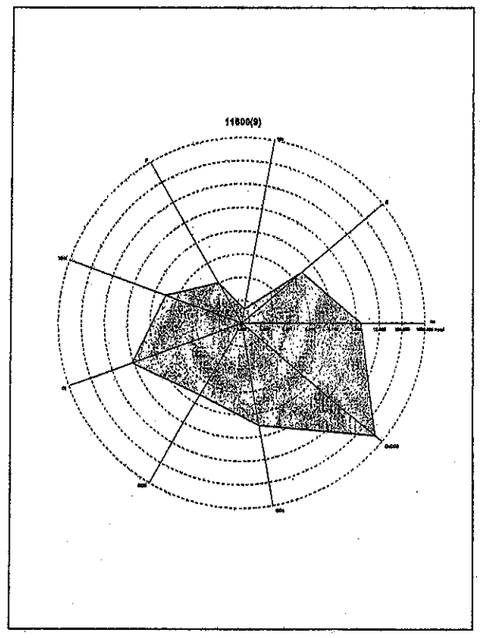




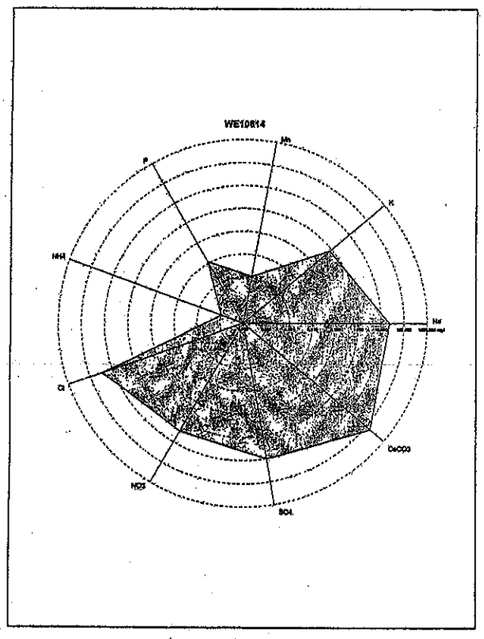
30-Foot WBS



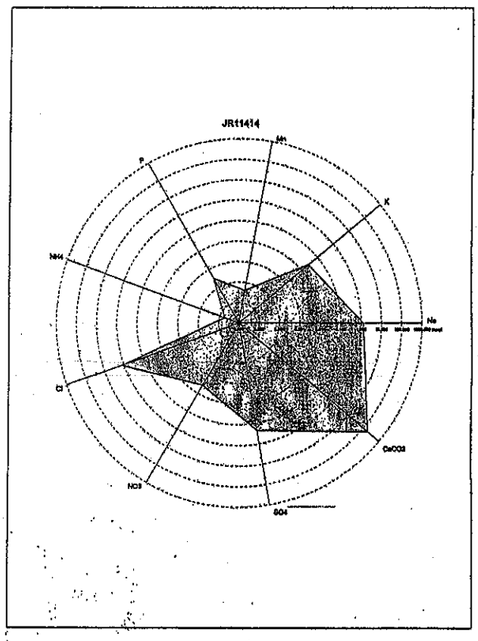




400-Foot WBS



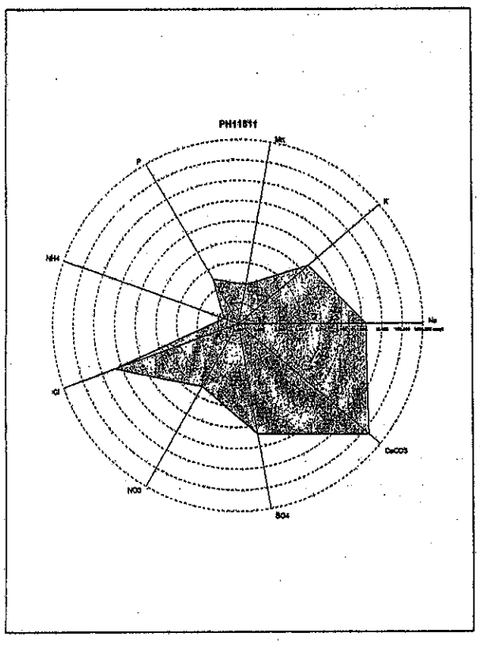
JR11414

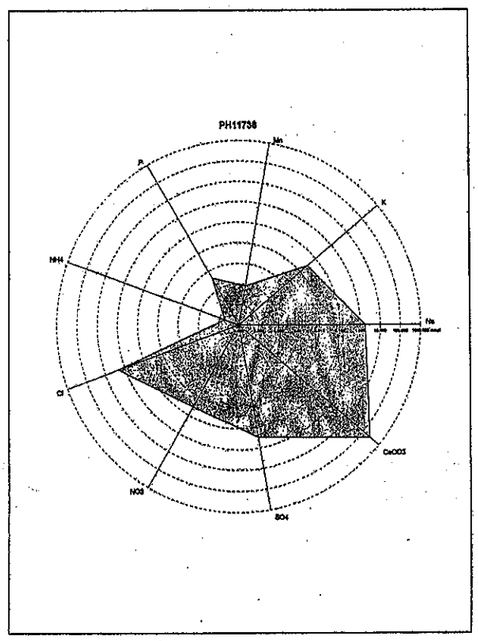


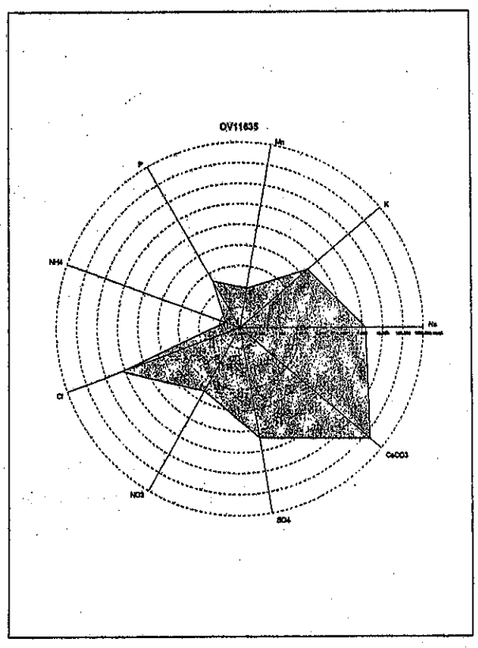
Comparisons of Radial Diagrams (1)

Jones Road
CERCLIS # TXN000605460
Houston, Texas

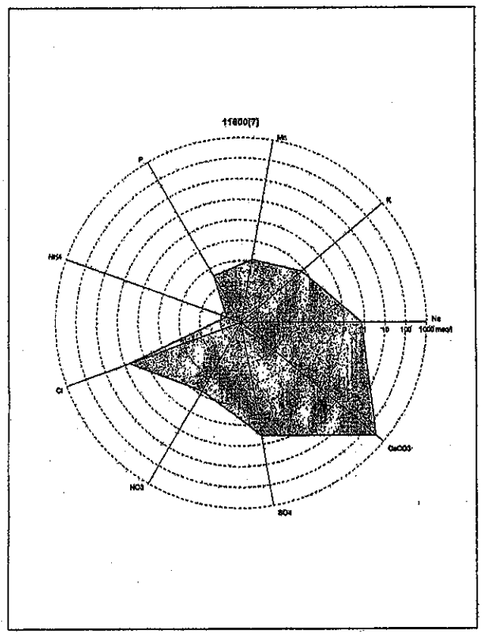
PH11611, PH11738, OV11635 (representing far west plume boundary)

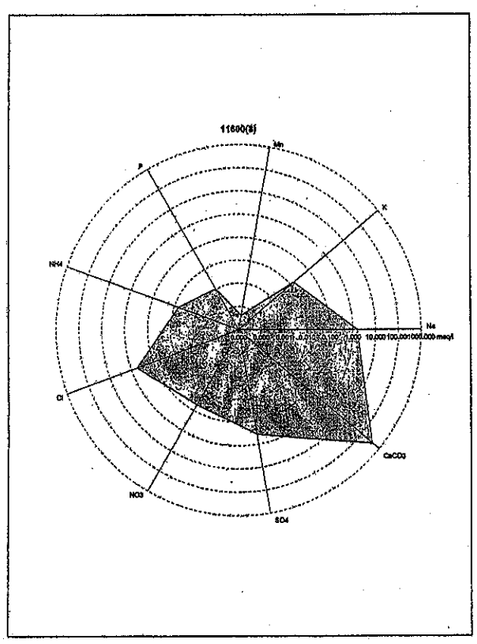


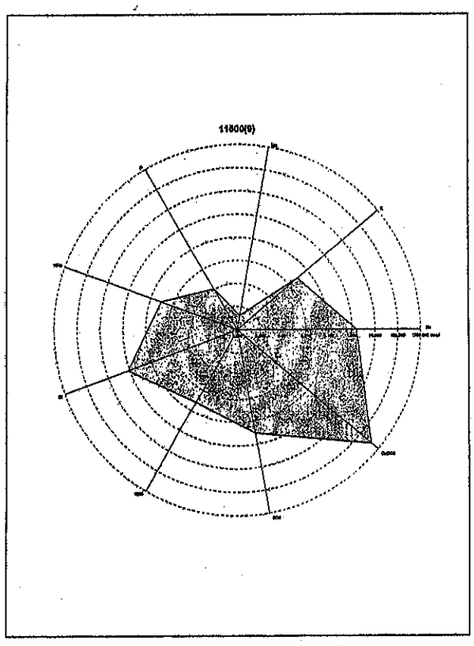




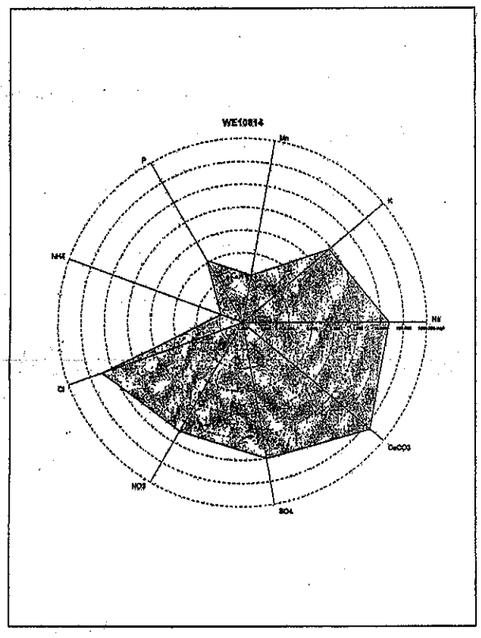
30-Foot WBS



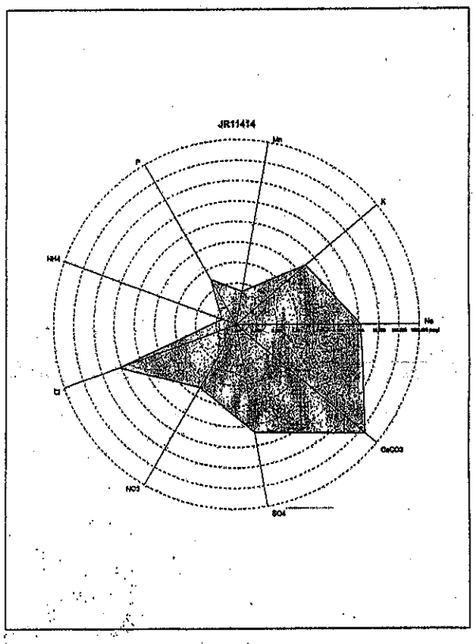




400-Foot WBS



JR11414



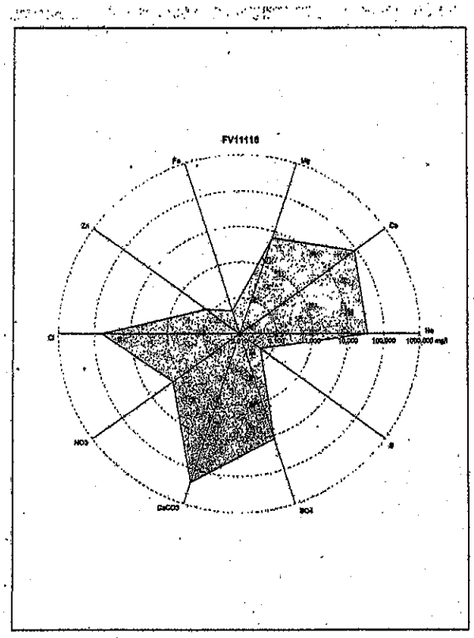
Comparisons of Radial Diagrams (1)

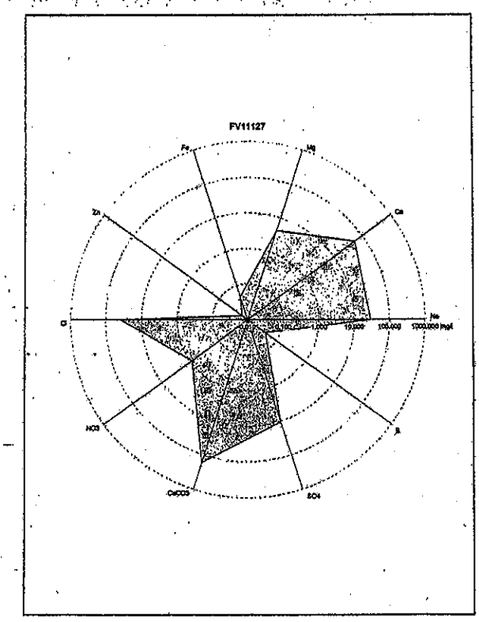
Jones Road
CERCLIS # TXN000605460
Houston, Texas

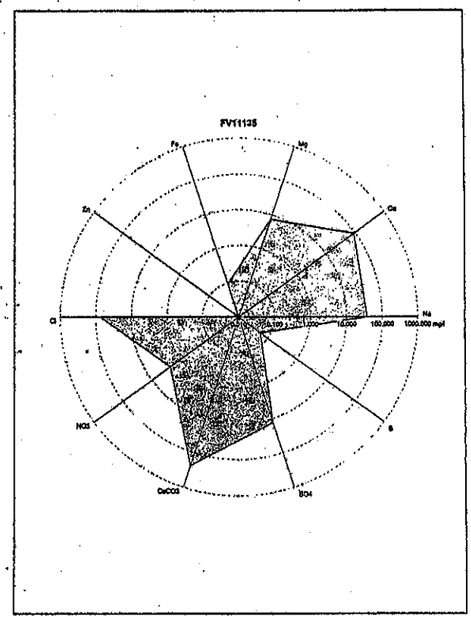
ATTACHMENT 2

Group 2 Radial Diagrams

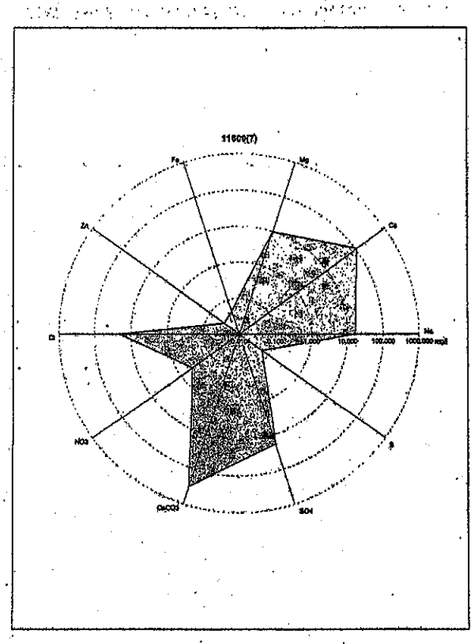
Cross-Section A-A' (FV11118, FV11127, FV11135)

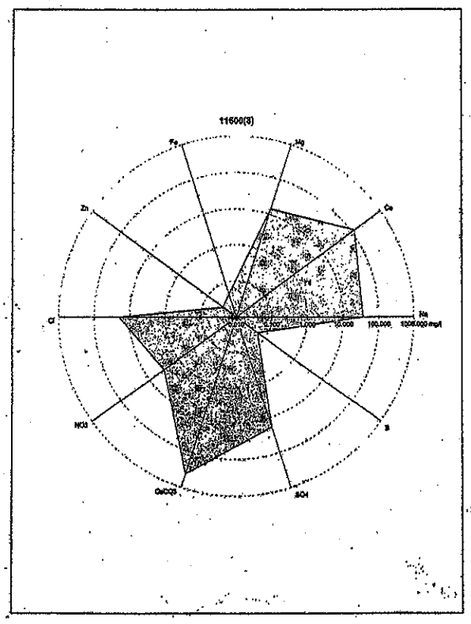


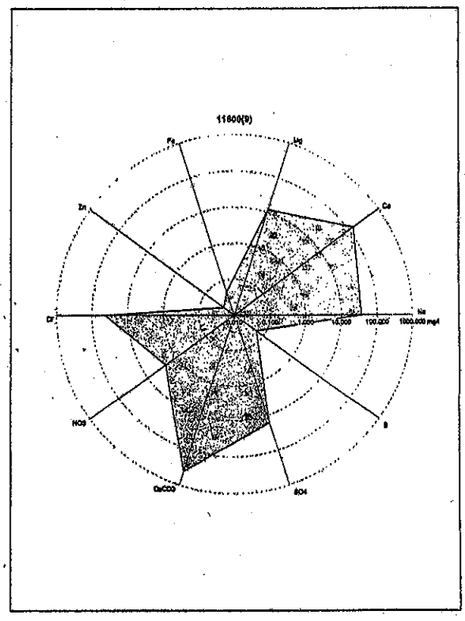




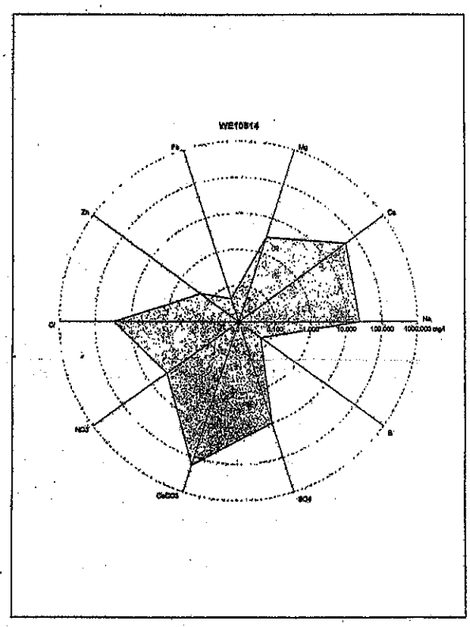
30-Foot WBS



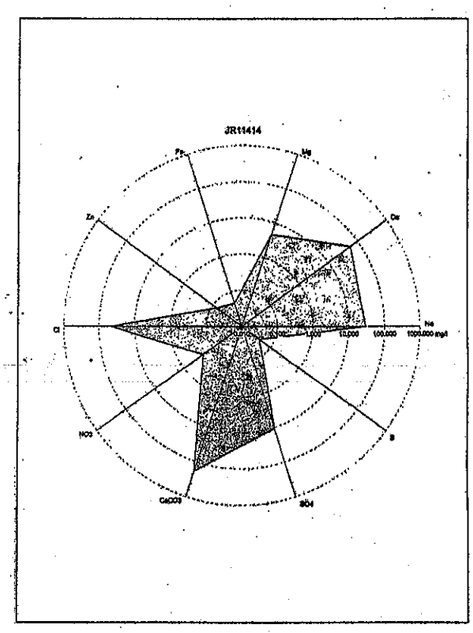




400-Foot WBS



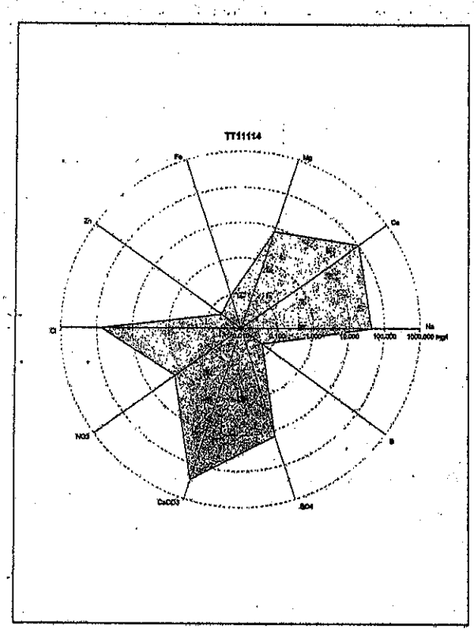
JR11414

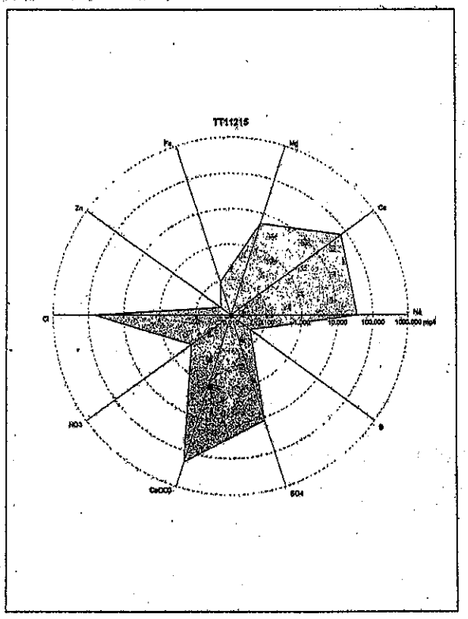


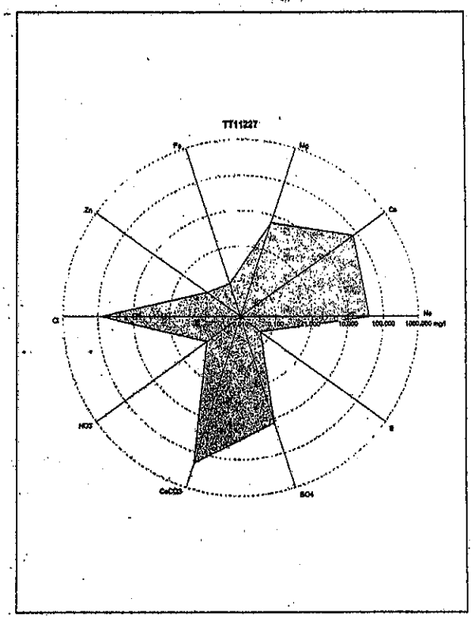
Comparisons of Radial Diagrams (2)

Jones Road
CERCLIS # TXN000605460
Houston, Texas

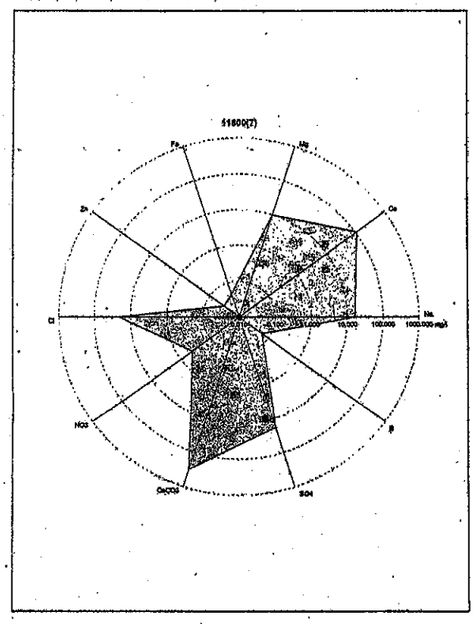
Cross-Section B-B' (TT1114, TT11215, TT11227)

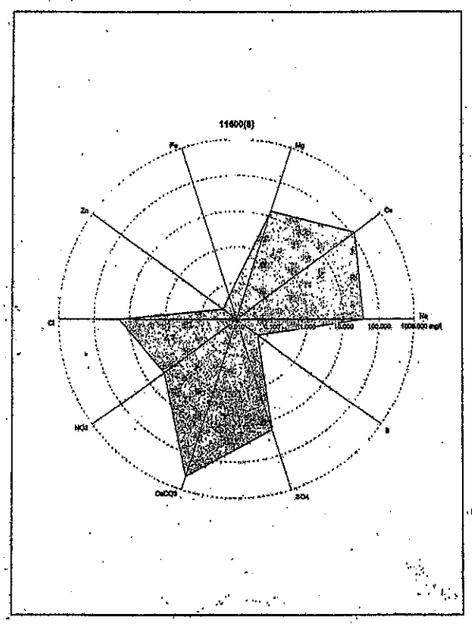


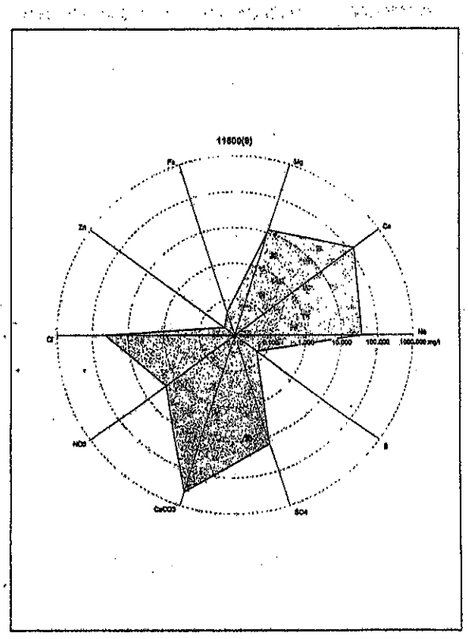




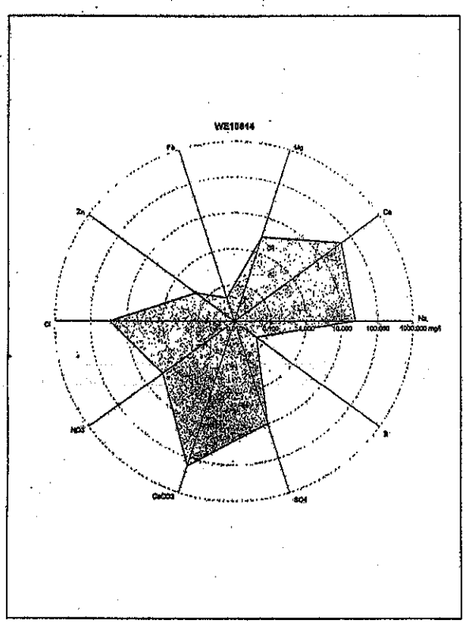
30-Foot WBS



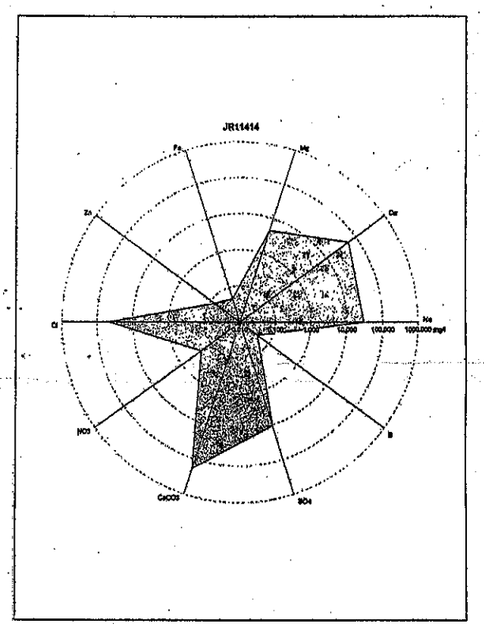




400-Foot WBS



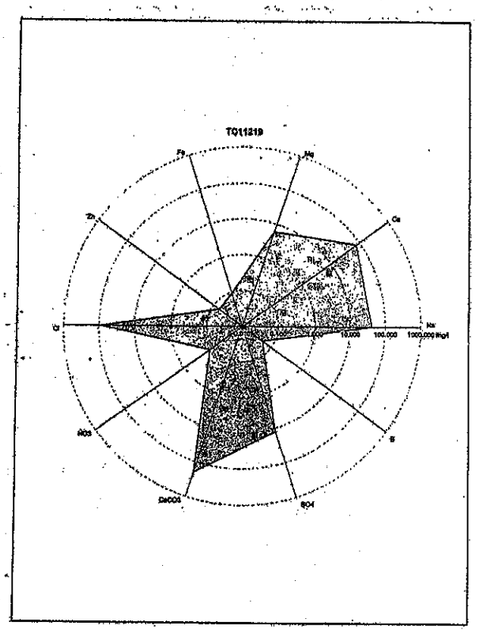
JR11414

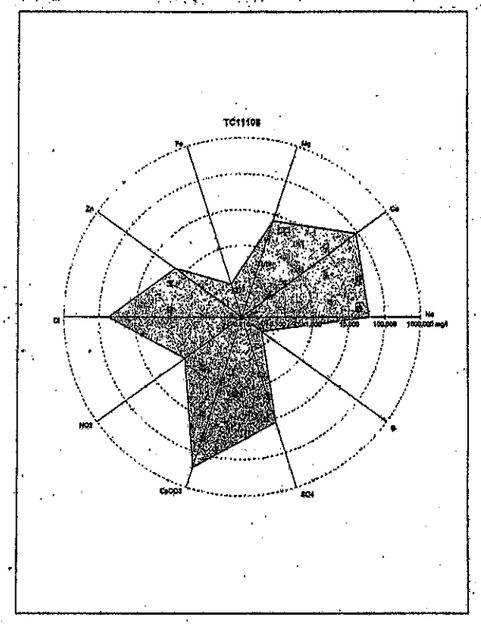


Comparisons of Radial Diagrams (2)

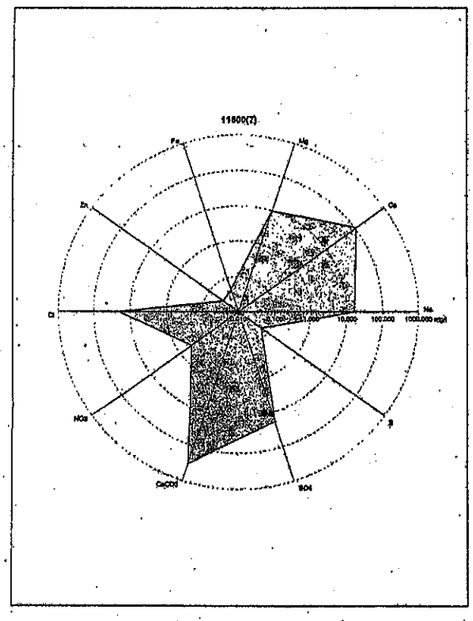
Jones Road
CERCLIS # TXN000605460
Houston, Texas

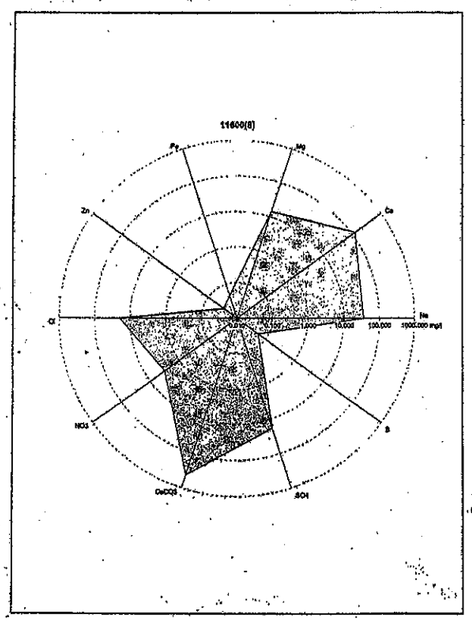
Cross-Section C-C' (TC11219, TC11108)

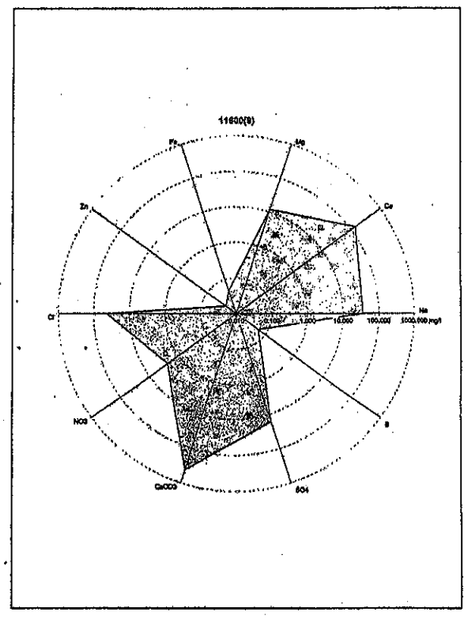




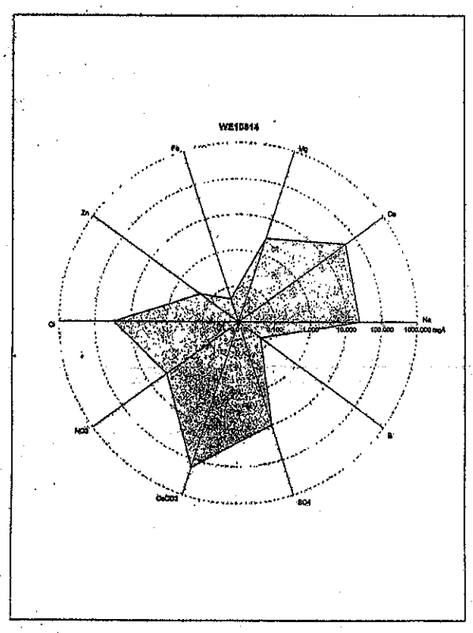
30-Foot WBS



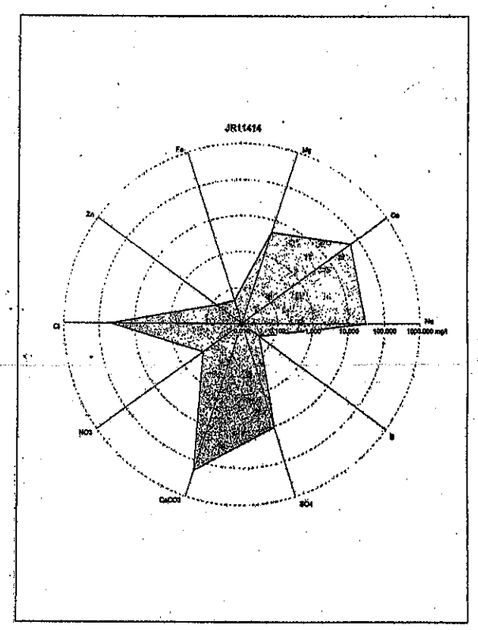




400-Foot WBS



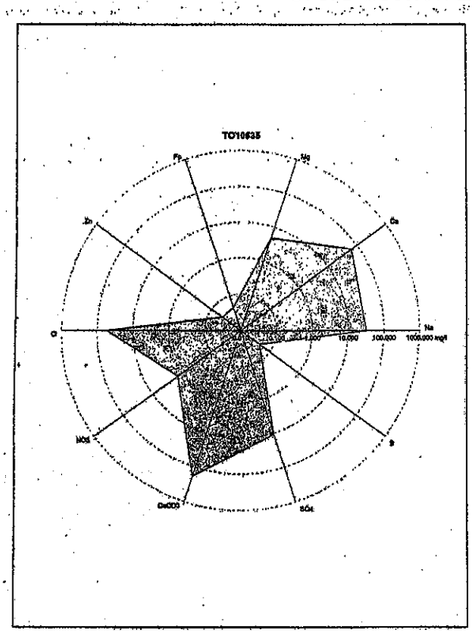
JR11414

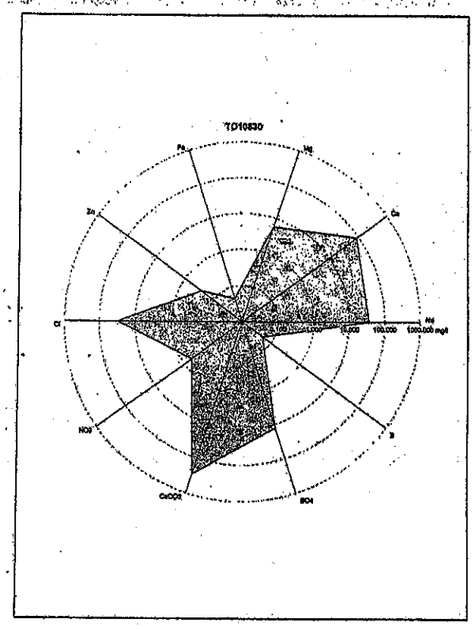


Comparisons of Radial Diagrams (2)

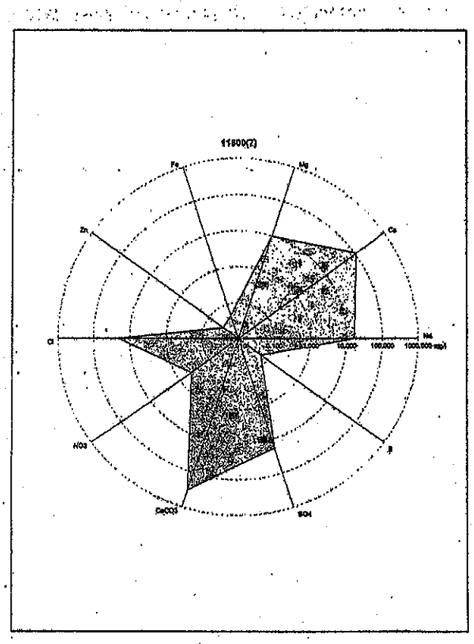
Jones Road
CERCLIS # TXN000605460
Houston, Texas

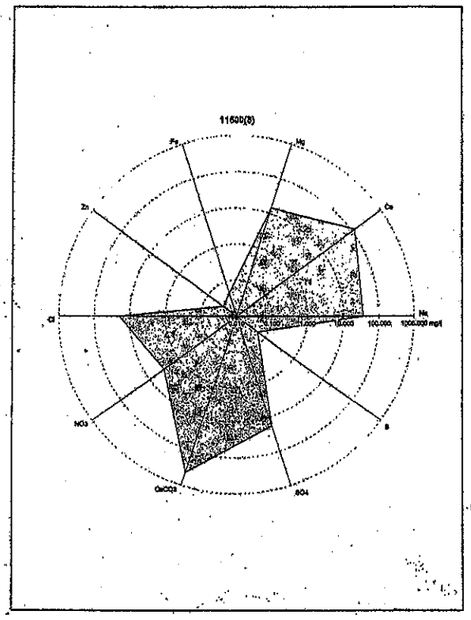
Cross-Section D-D' (TO10635, TO10830)

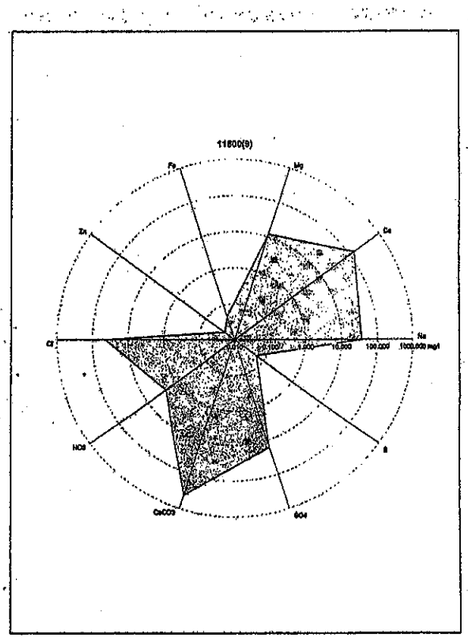




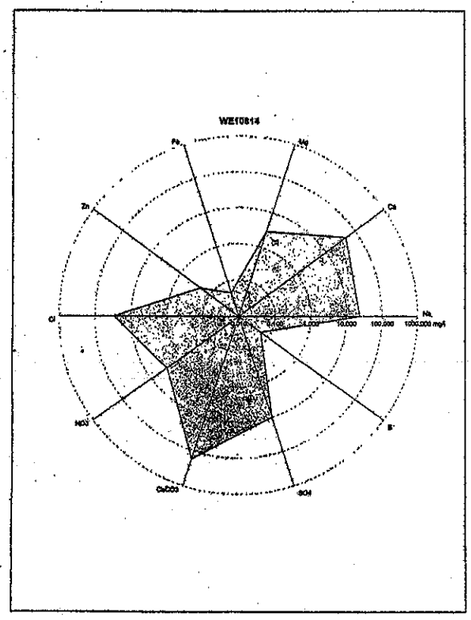
30-Foot WBS



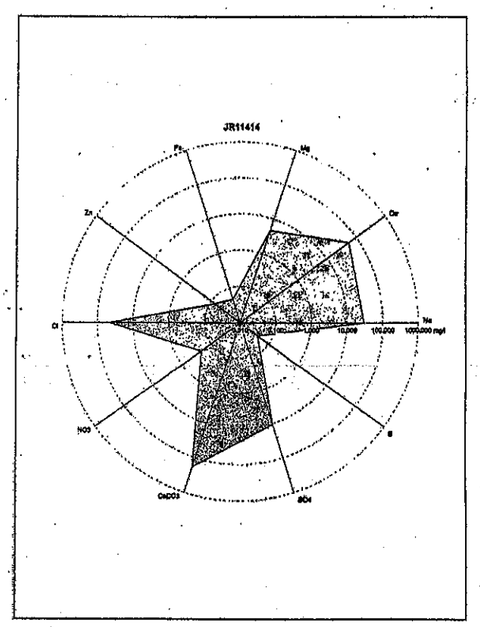




400-Foot WBS



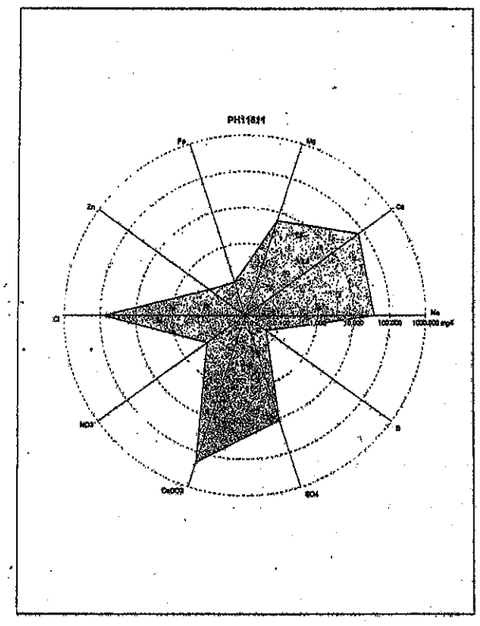
JR11414

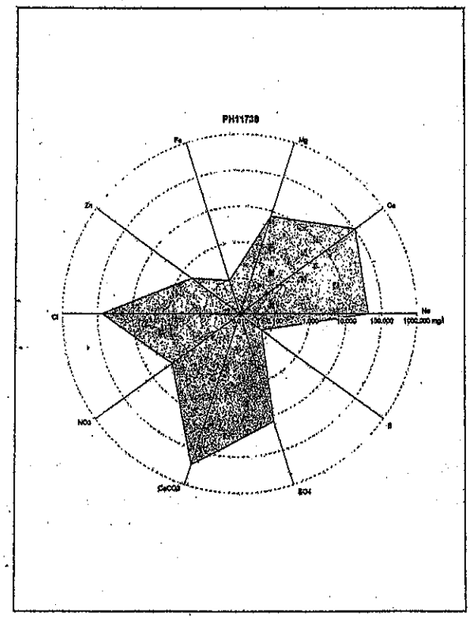


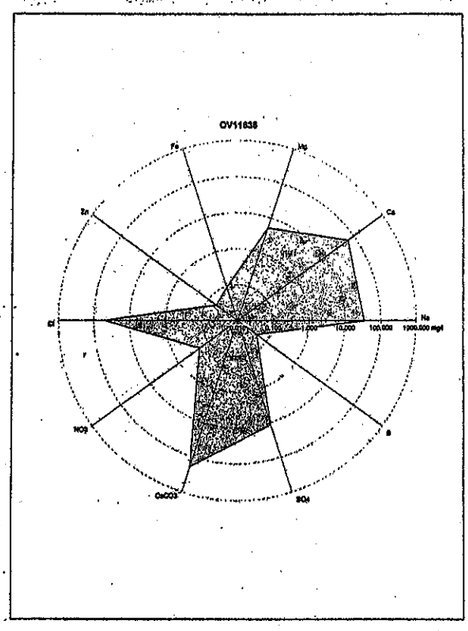
Comparisons of Radial Diagrams (2)

Jones Road
CERCLIS # TXN000605460
Houston, Texas

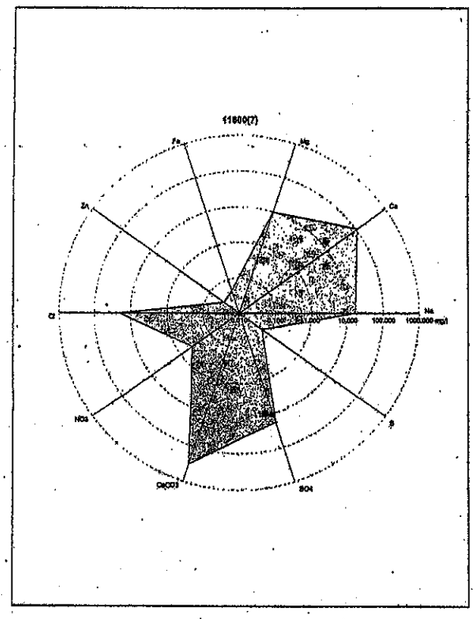
PH11611, PH11738, OV11635 (representing far west plume boundary)

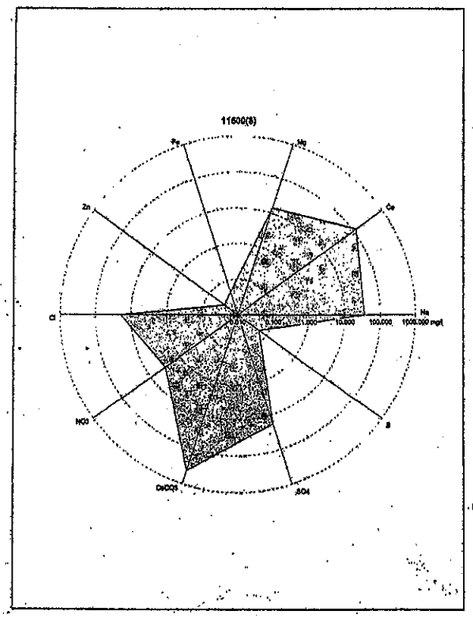


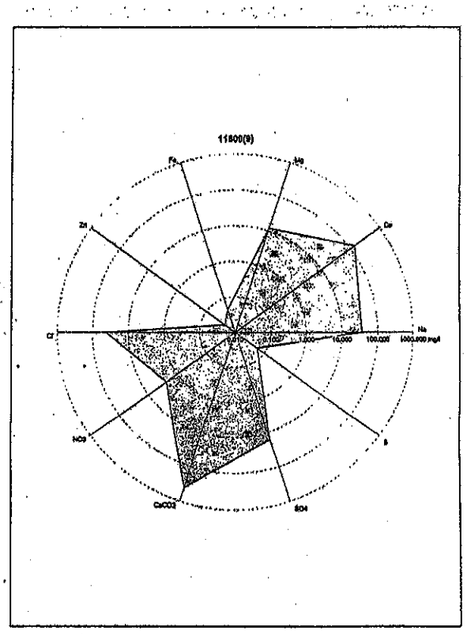




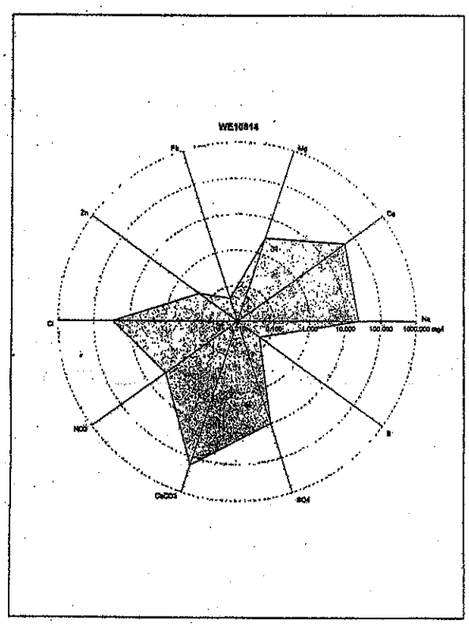
30-Foot WBS



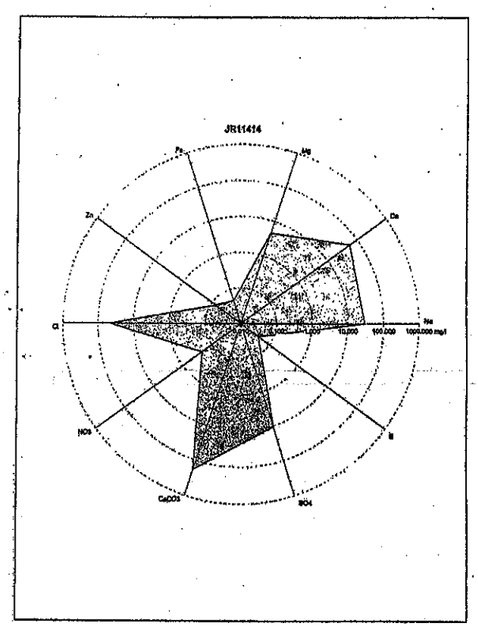




400-Foot WBS



JR11414



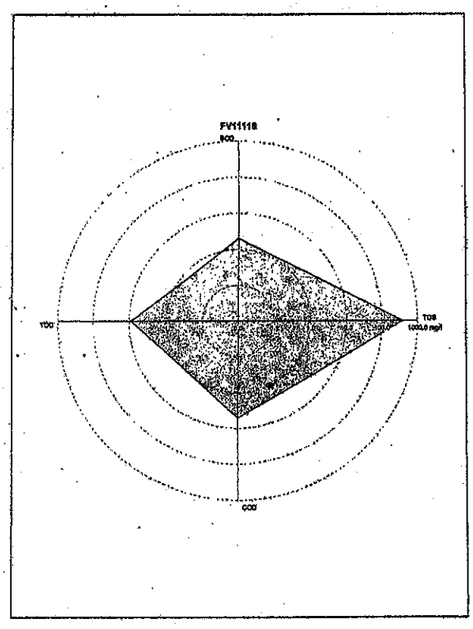
Comparisons of Radial Diagrams (2)

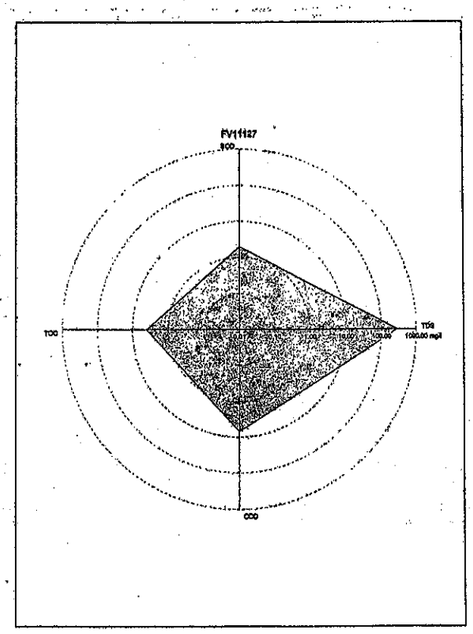
Jones Road
CERCLIS # TXN000605460
Houston, Texas

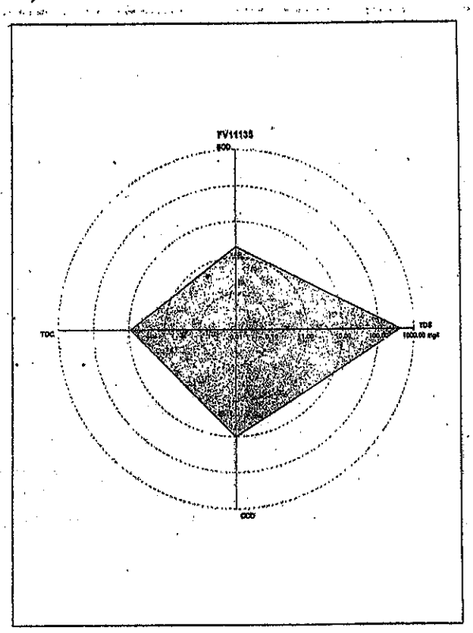
ATTACHMENT 2

Group 3 Radial Diagrams

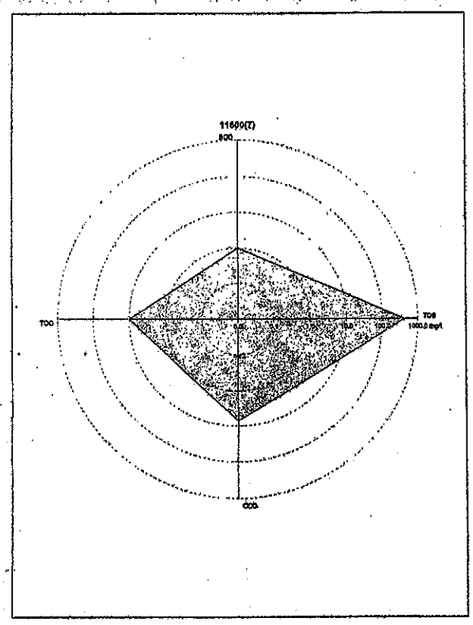
Cross-Section A-A' (FV11118, FV11127, FV11135)

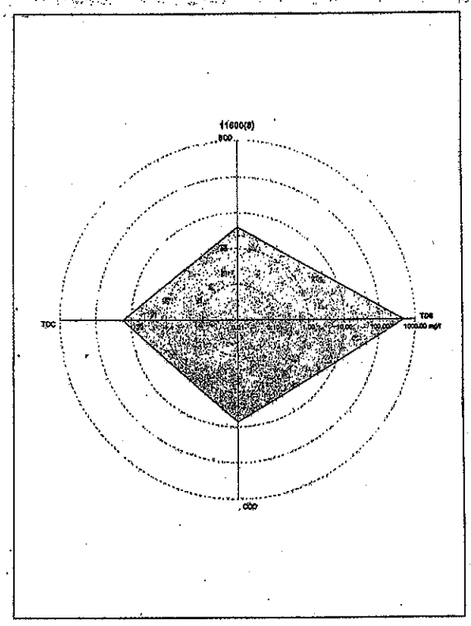


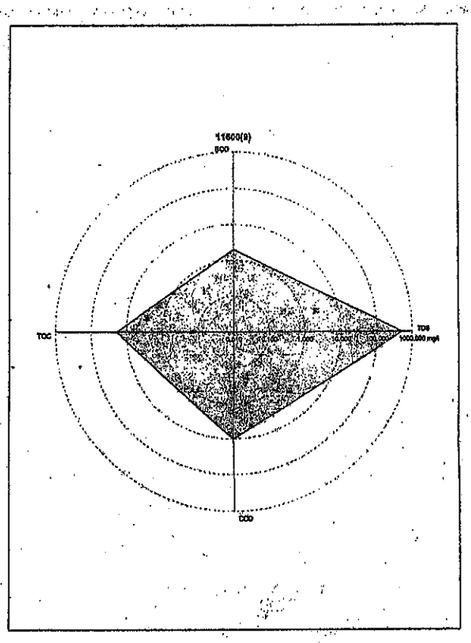




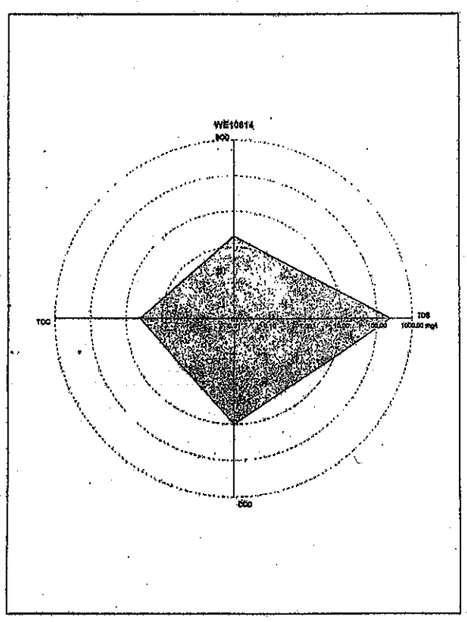
30-Foot WBS



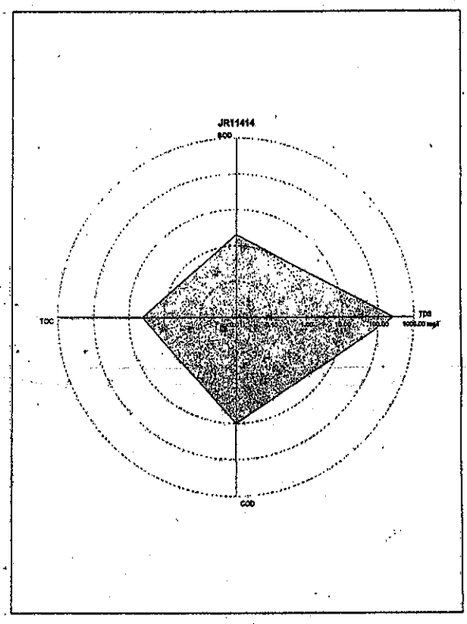




400-Foot WBS



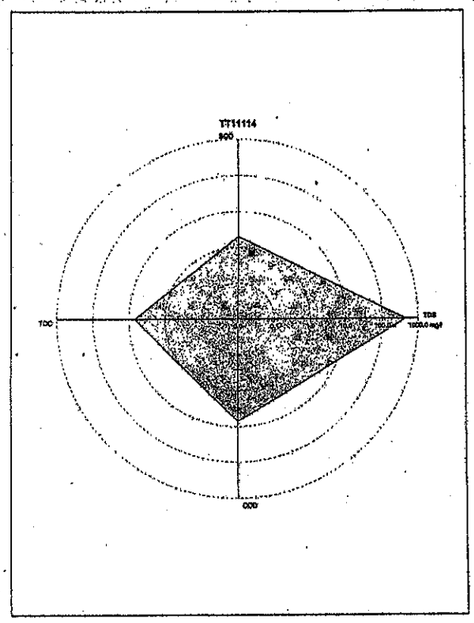
JR11414

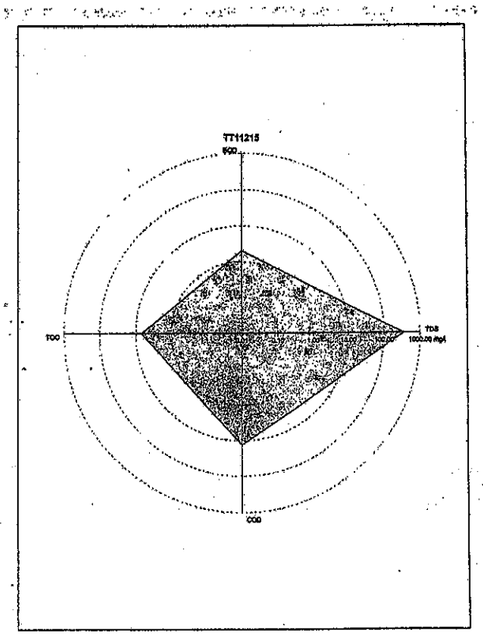


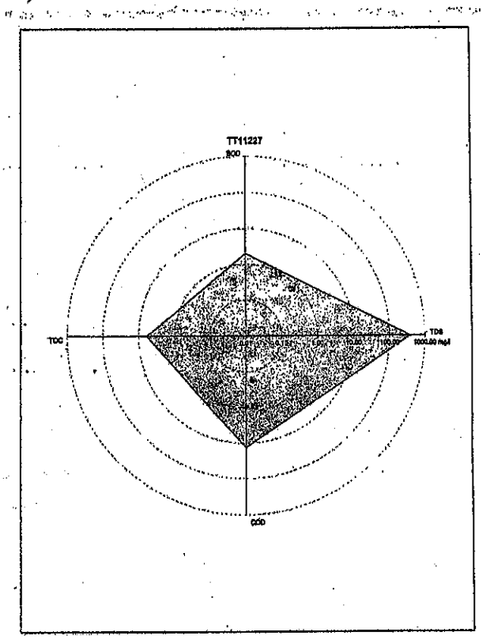
Comparisons of Radial Diagrams (3)

Jones Road
CERCLIS # TXN000605460
Houston, Texas

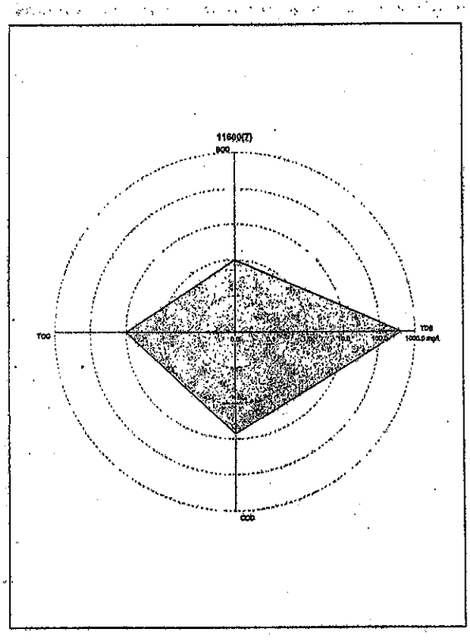
Cross-Section B-B' (TT1114, TT11215, TT11227)

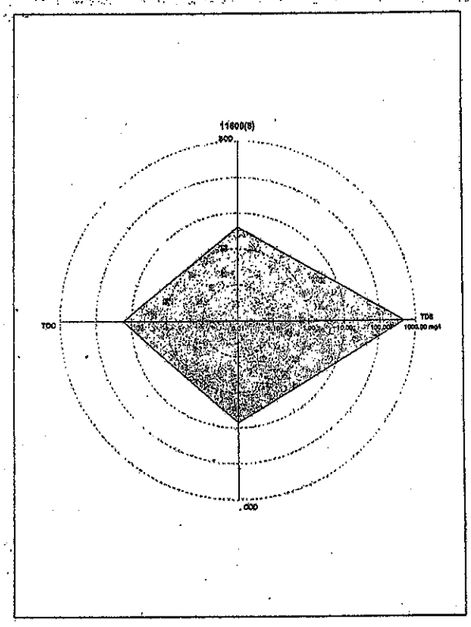


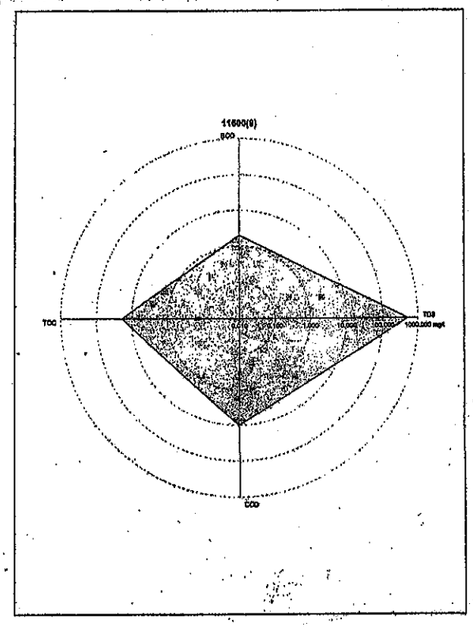




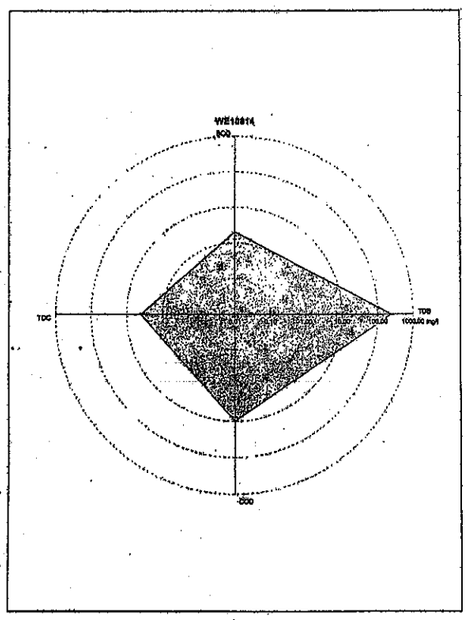
30-Foot WBS



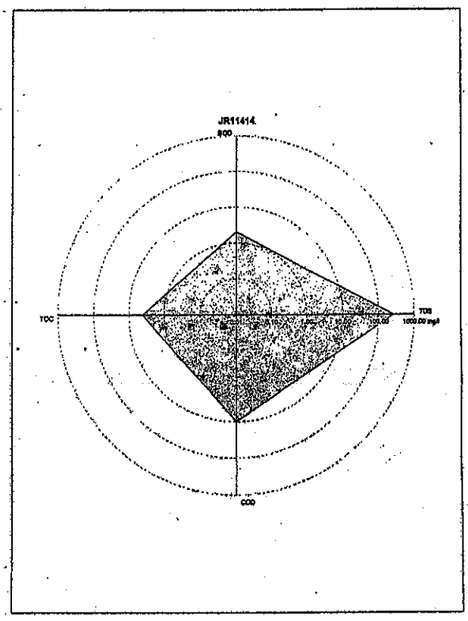




400-Foot WBS



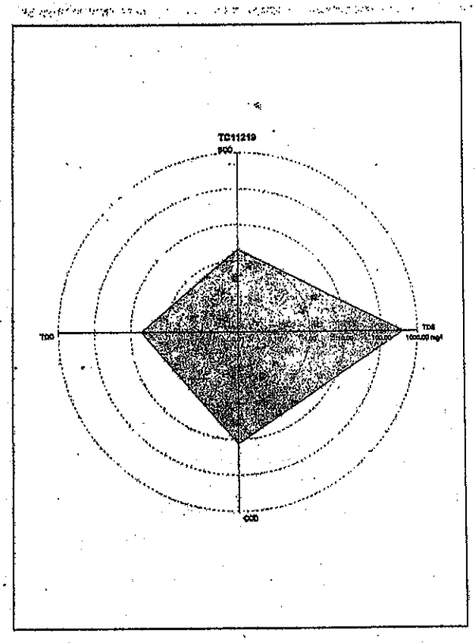
JR11414

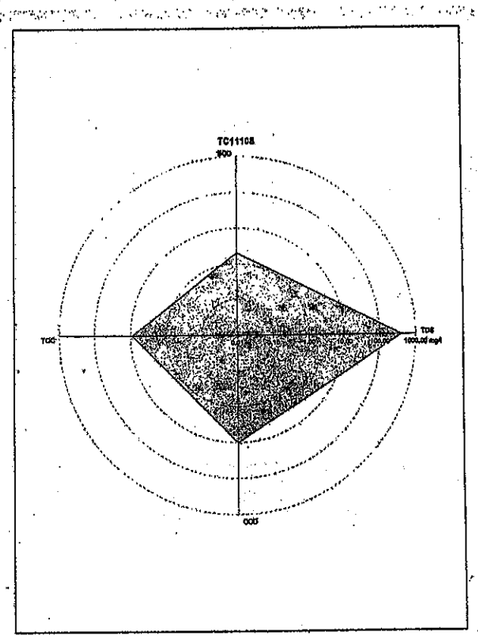


Comparisons of Radial Diagrams (3)

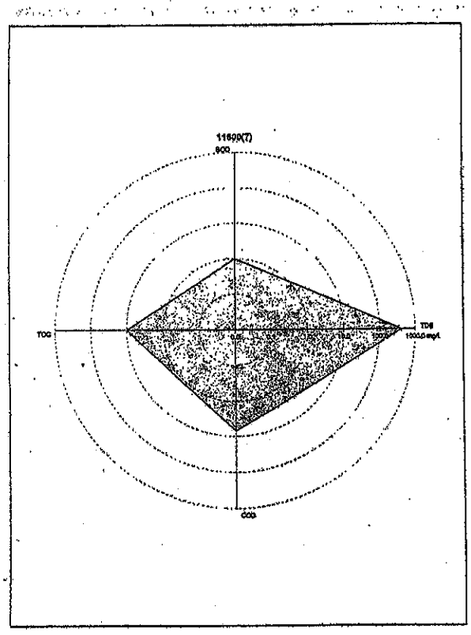
Jones Road
CERCLIS # TXN000605460
Houston, Texas

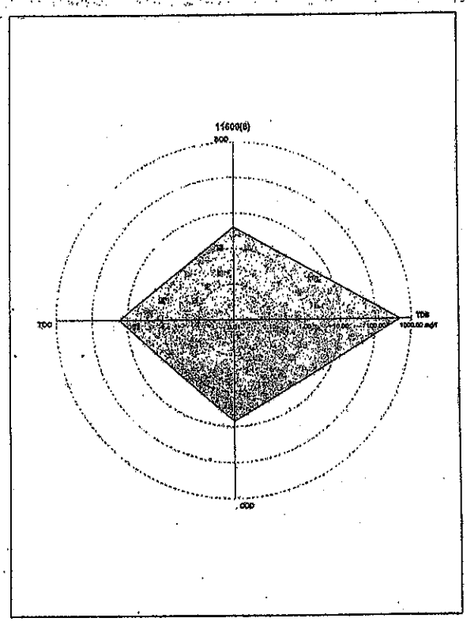
Cross-Section C-C' (TC11219, TC11108)

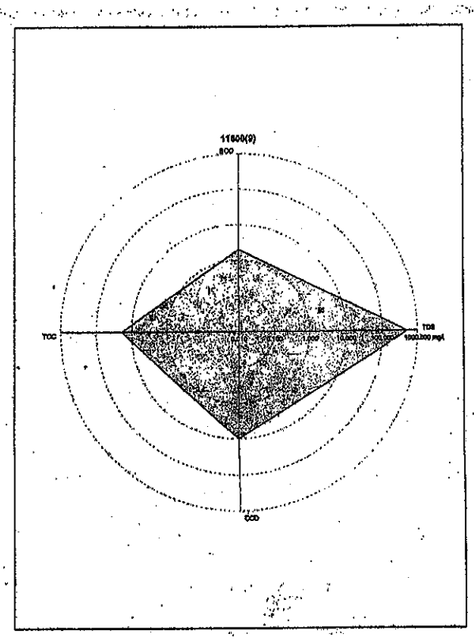




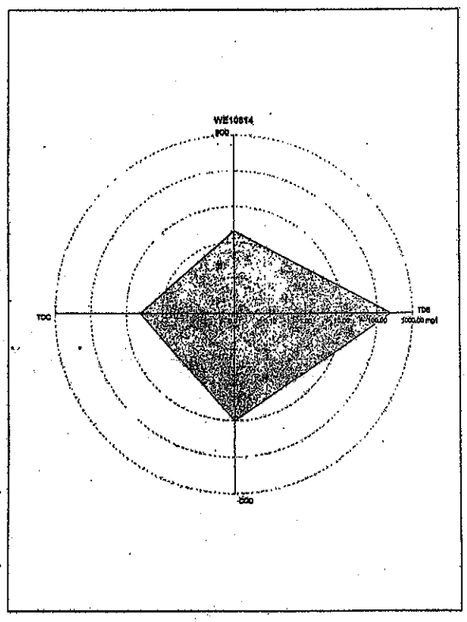
30-Foot WBS



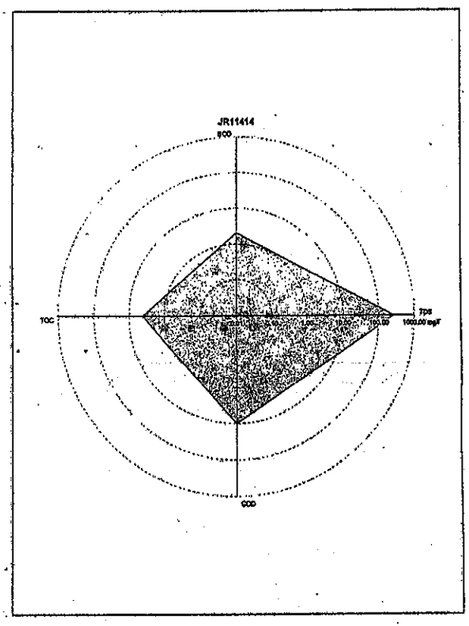




400-Foot WBS



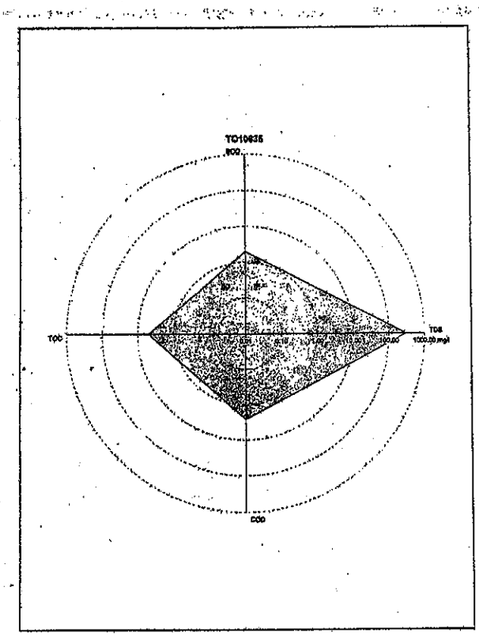
JR11414

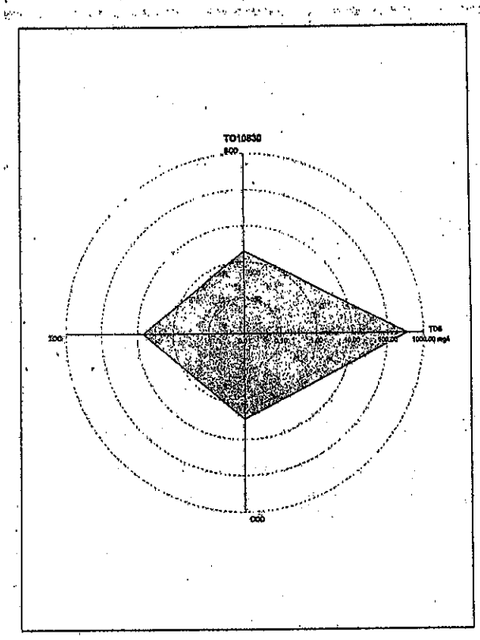


Comparisons of Radial Diagrams (3)

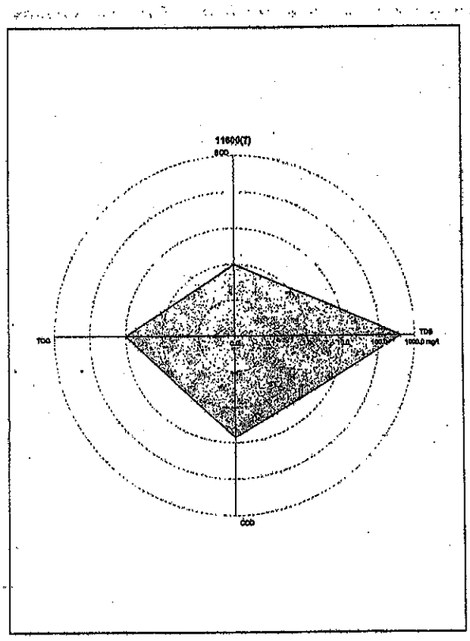
Jones Road
CERCLIS # TXN000605460
Houston, Texas

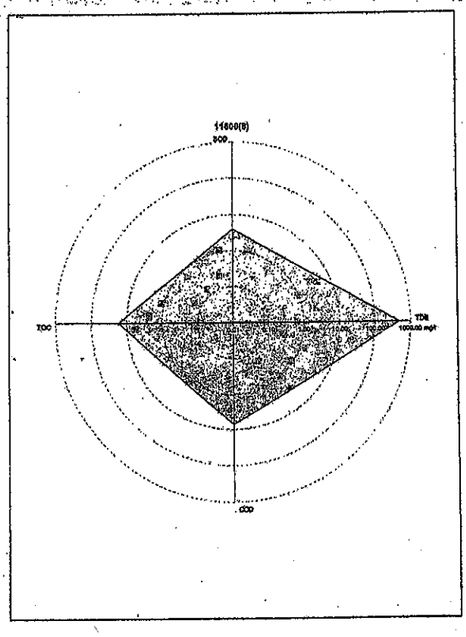
Cross-Section D-D' (TO10635, TO10830)

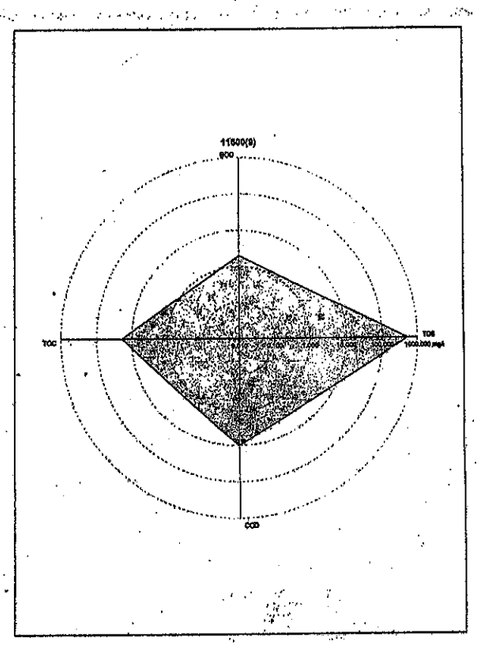




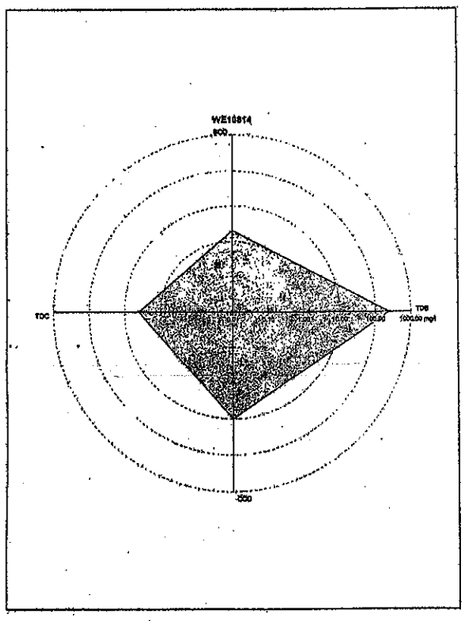
30-Foot WBS



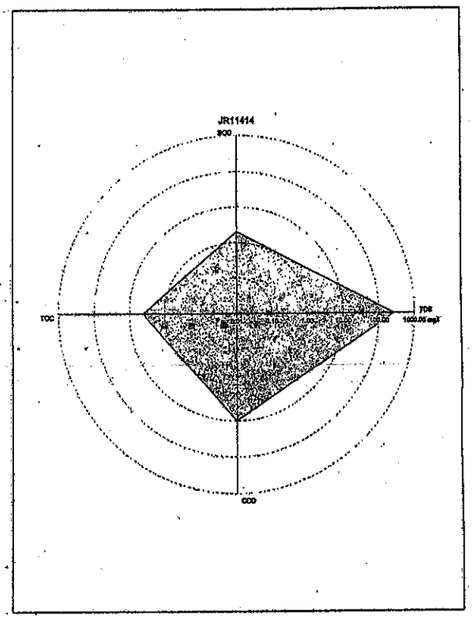




400-Foot WBS



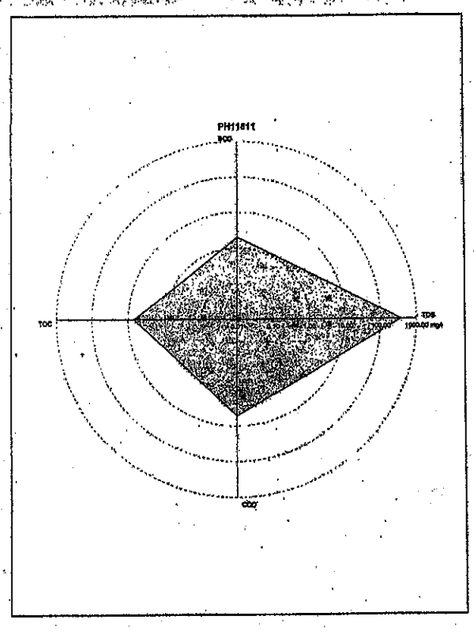
JR11414

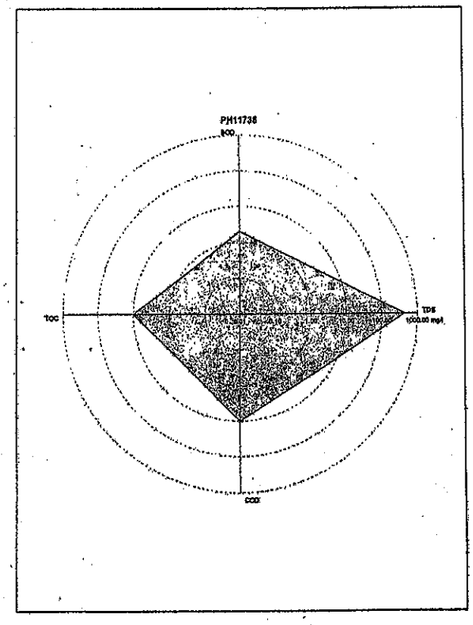


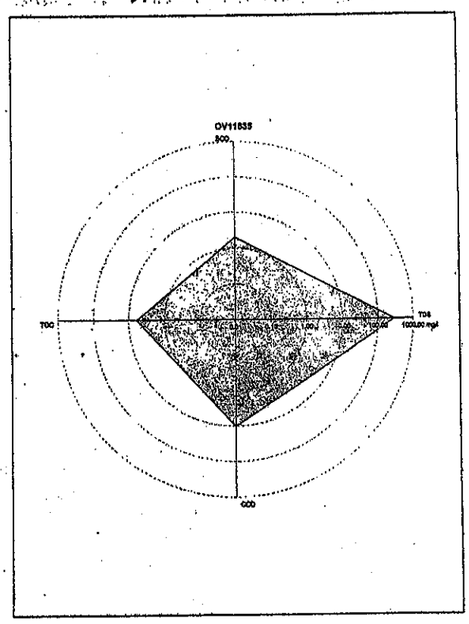
Comparisons of Radial Diagrams (3)

Jones Road
CERCLIS # TXN000605460
Houston, Texas

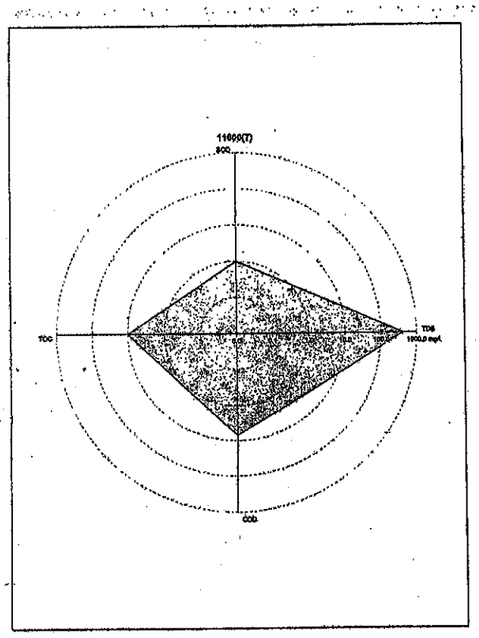
PH11611, PH11738, OV11635 (representing far west plume boundary)

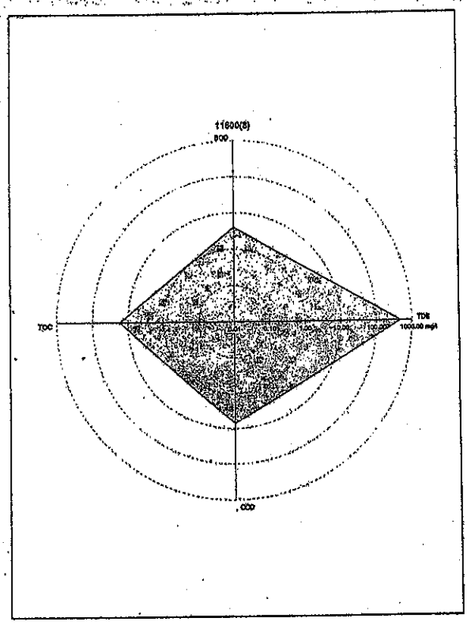


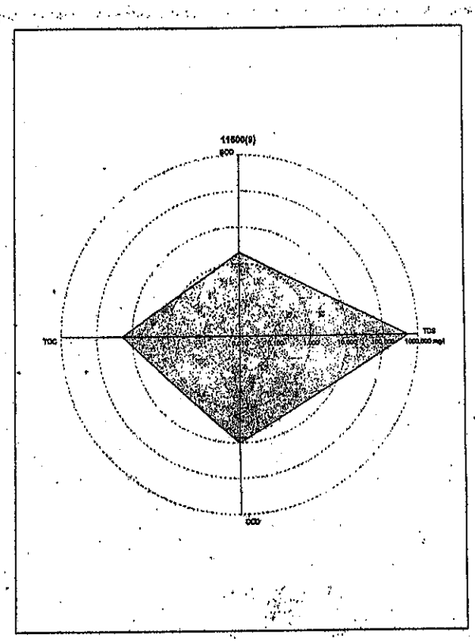




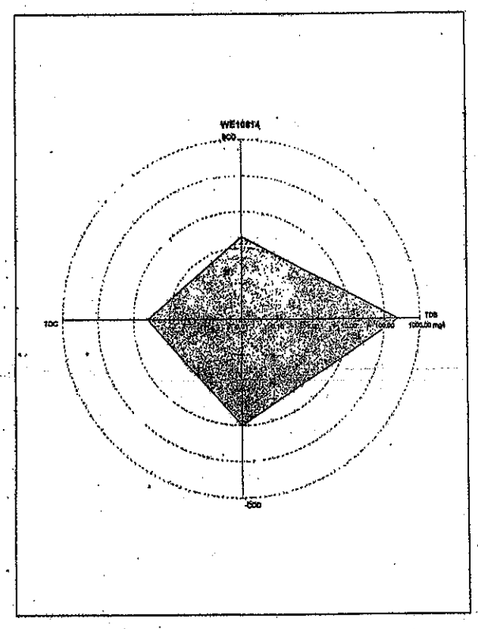
30-Foot WBS



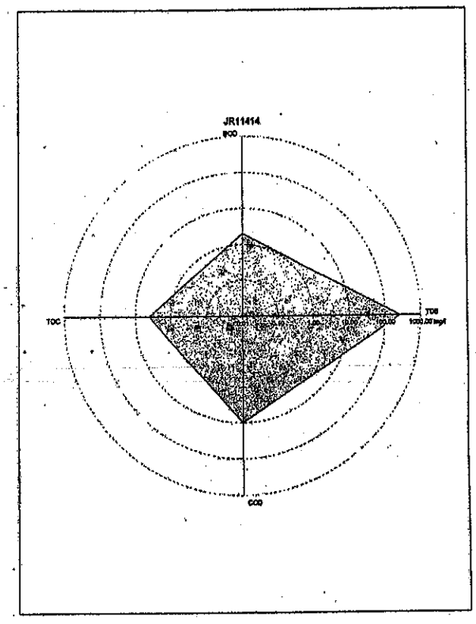




400-Foot WBS



JR11414



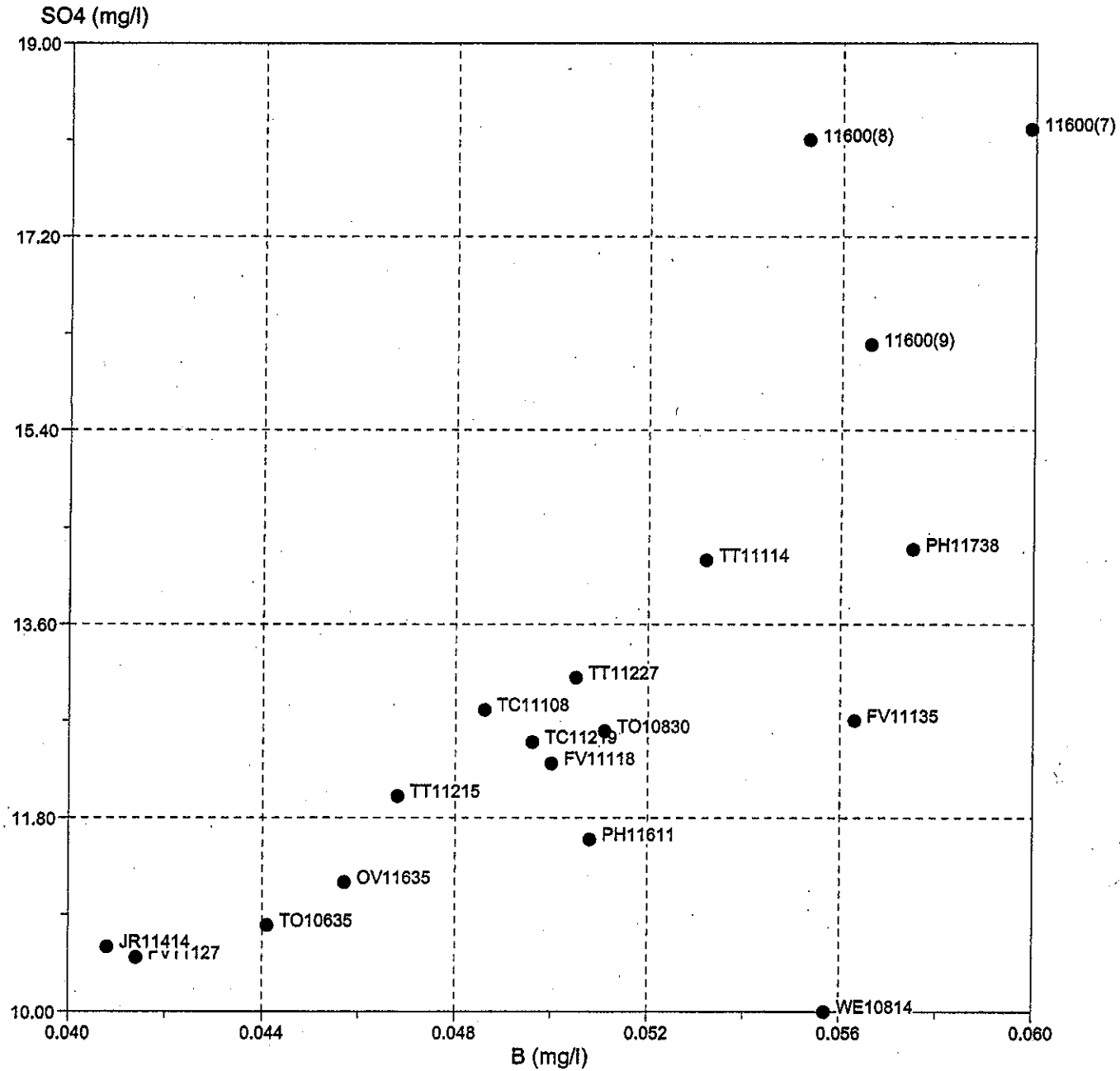
Comparisons of Radial Diagrams (3)

Jones Road
CERCLIS # TXN000605460
Houston, Texas

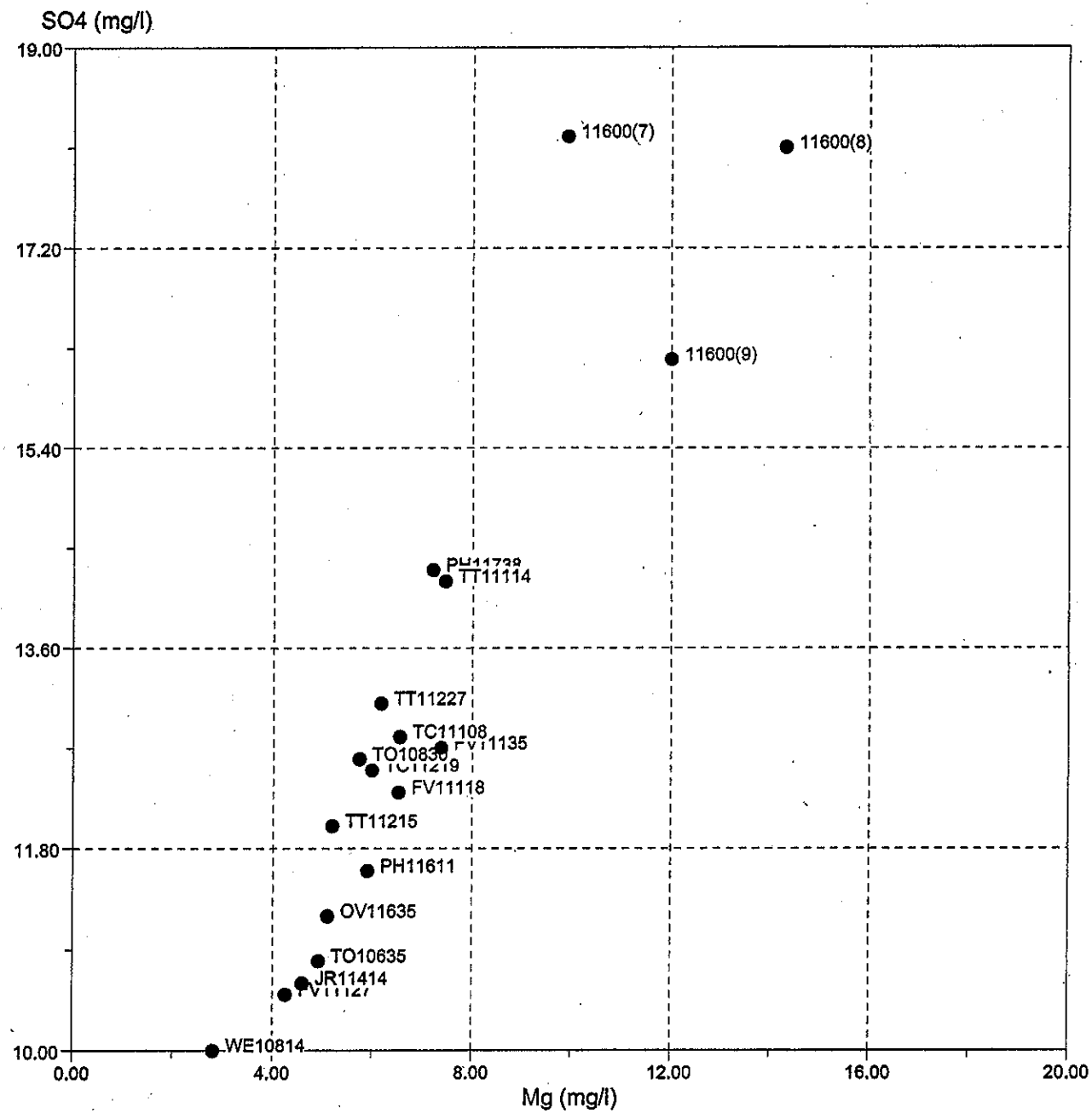
ATTACHMENT 3

Scatter Plot Diagrams

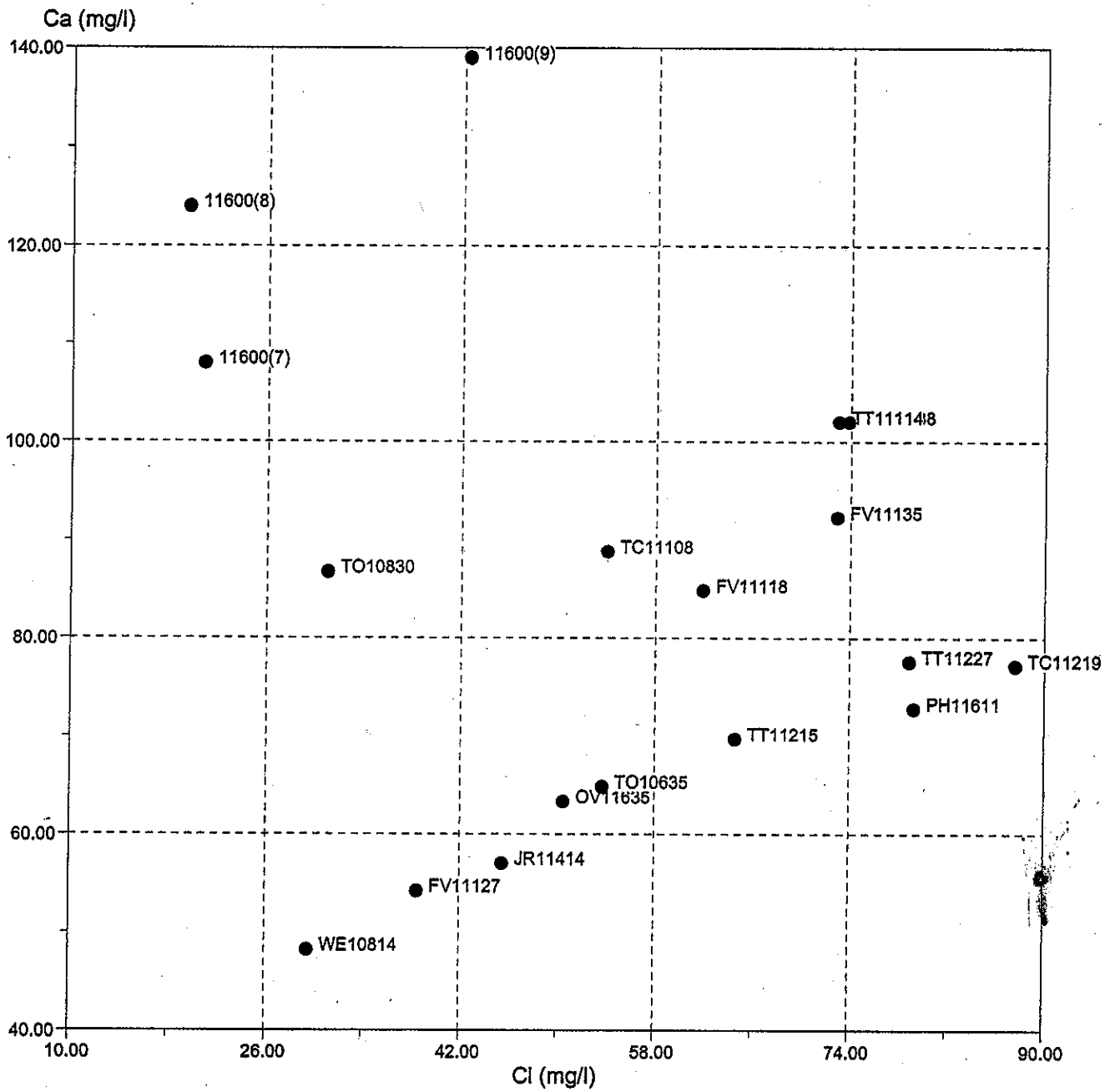
Jones Road Barium vs Sulfates



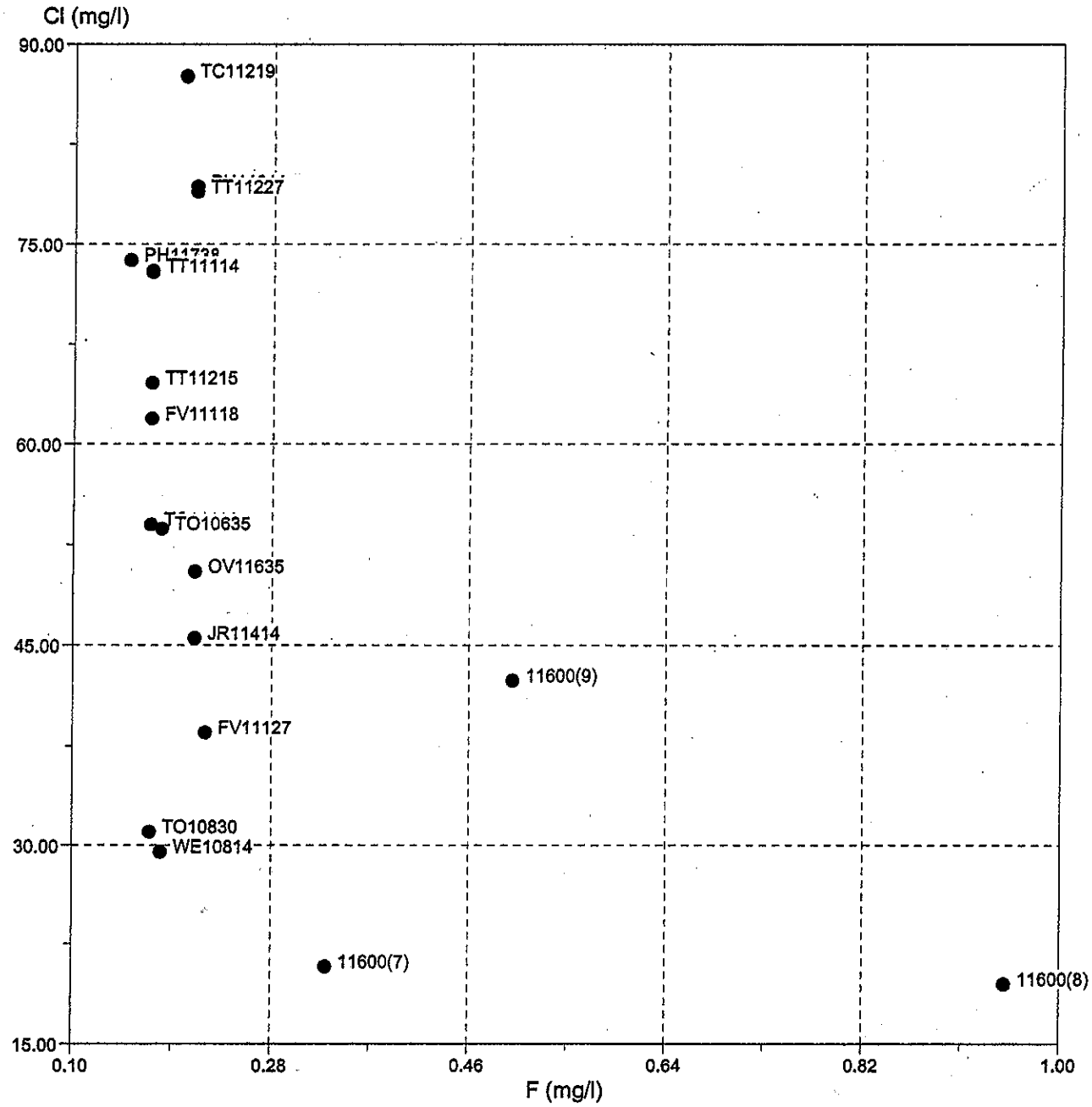
Jones Road Magnesium vs Sulfates



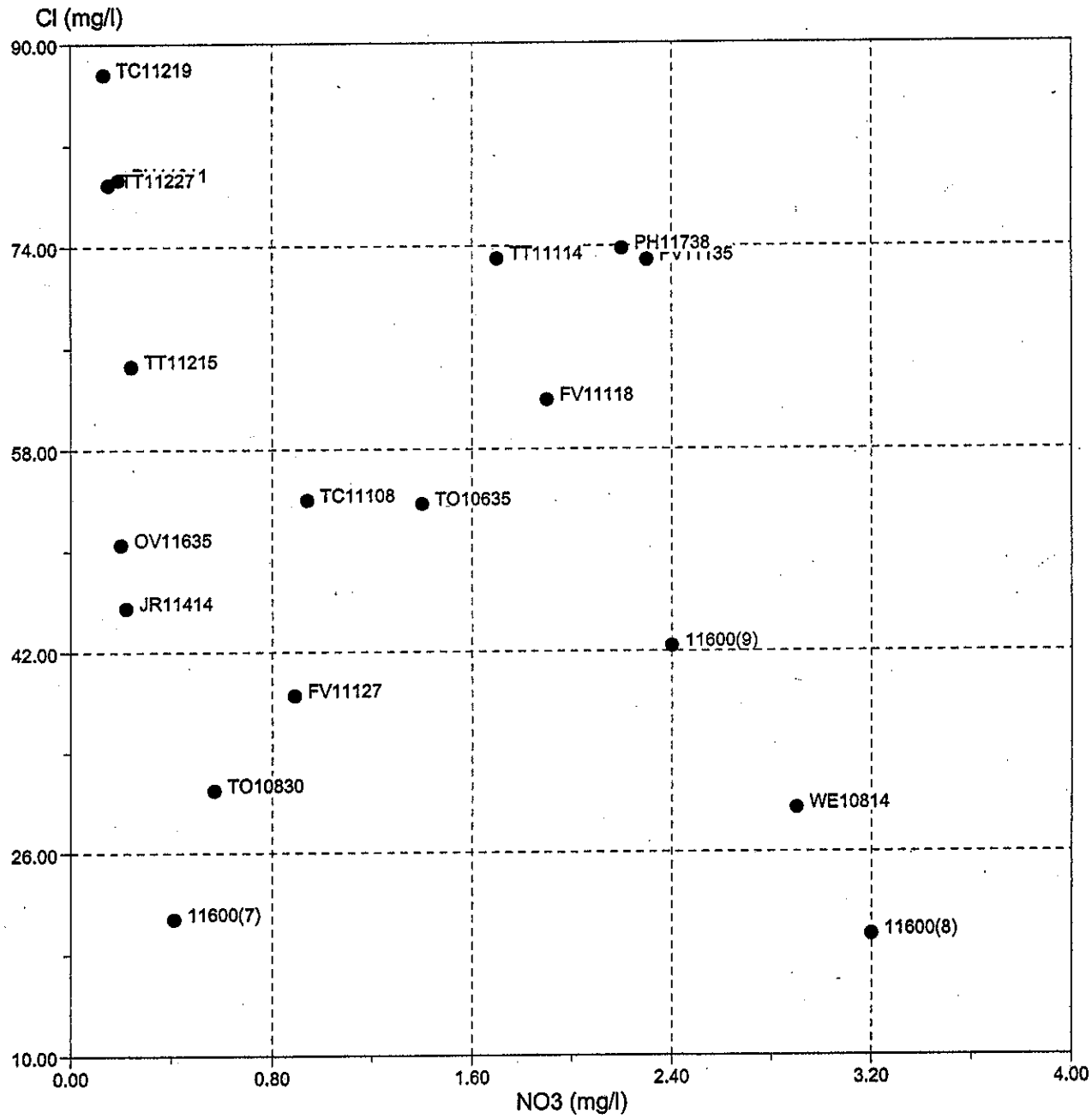
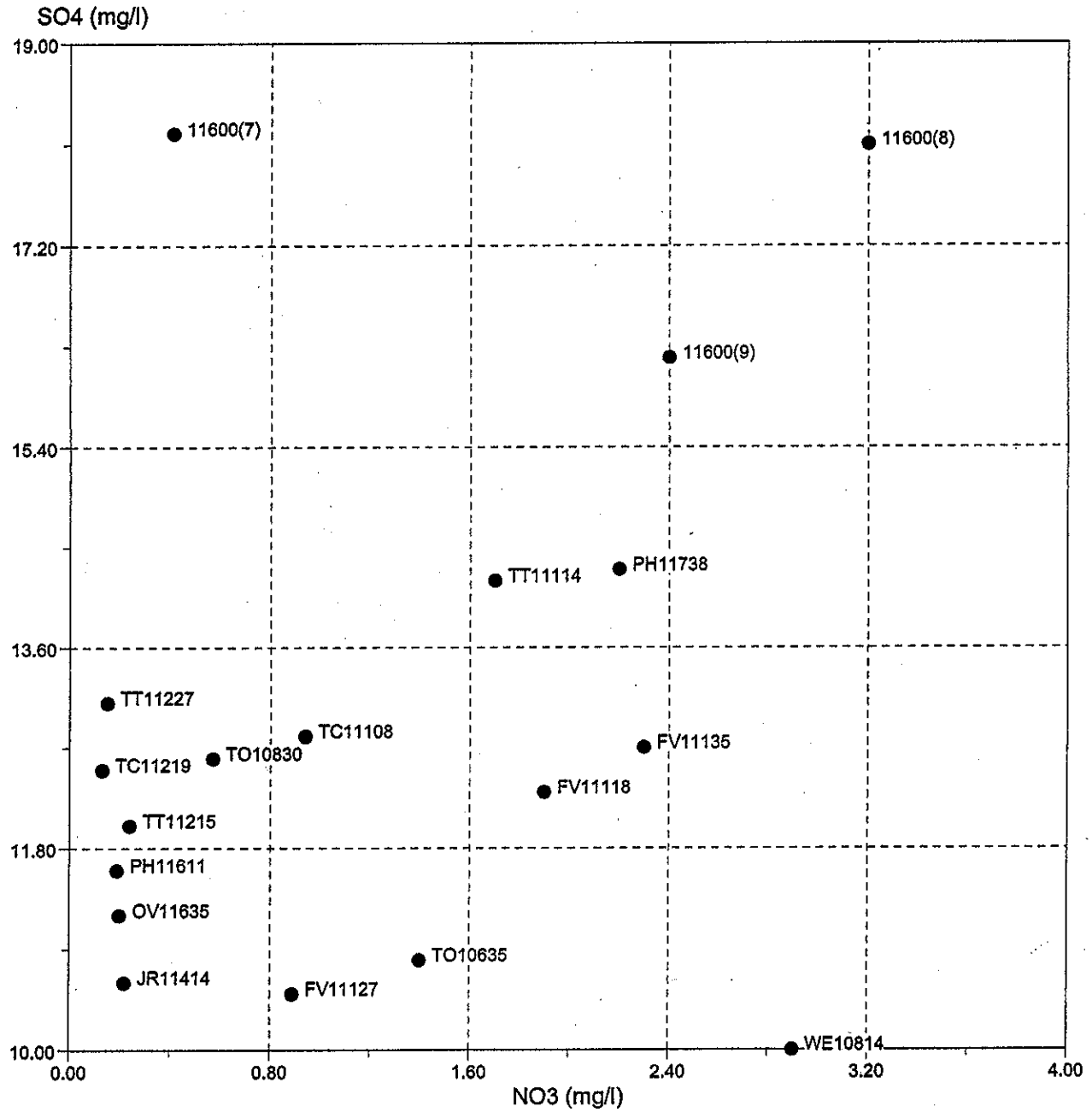
Jones Road Calcium vs Chloride



Jones Road Floride vs Chloride



Jones Road Chloride vs Nitrates



Jones Road Sulfates vs Nitrates