3207

RCRA/CERCLA BACKGROUND SOIL SAMPLING PLAN AT THE FERNALD ENVIRONMENTAL MANAGEMENT PROJECT FERNALD, OHIO REMEDIAL INVESTIGATION/FEASIBILITY STUDY APRIL

04/28/92

43
ENCLOSURE

RCRA/CERCLA Background Soil Study

3207

Sampling and Analysis Plan

Fernald Environmental Management Project

Fernald, Ohio

Remedial Investigation/Feasibility Study

April 1992

U.S. Department of Energy
Fernald Field Office

FINAL

RCRA/CERCLA Background Soil Study

3207

Sampling and Analysis Plan

Fernald Environmental Management Project

Fernald, Ohio

Remedial Investigation/Feasibility Study

April 1992

U.S. Department of Energy
Fernald Field Office

FINAL

1.0 INTRODUCTION

Remedial activities at the Fernald Environmental Management Project (FEMP) will include soil removal under both Resource Conservation and Recovery Act (RCRA) and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) programs. In order to determine the effectiveness of any soil removal program the background character of the soils must be established. This sampling plan is designed to provide a statistically valid characterization of the concentration of inorganics and radionuclides in background soil. This plan is the culmination of efforts under the FEMP RCRA and CERCLA programs and incorporates all Department of Energy (DOE), Westinghouse Environmental Management Company of Ohio (WEMCO), United States Environmental Protection Agency (U.S. EPA) and Ohio Environmental Protection Agency (OEPA) comments. Agreement on the concept of this sampling plan was reached with all parties concerned at a meeting in Chicago on January 16, 1992. The Ohio and U.S. EPAs made additional comments on this sampling plan in, respectively, March and April 1992. These latter comments have also been incorporated in this document.

The data gathered under this RI/FS Work Plan Addendum will be used for the RI/FS Site-Wide Risk Assessment to support selection of preliminary remediation goals (PRGs). It is also urgently needed to comply with the approved closure plan requirements of the Plant 6 pad and bulk storage tanks T5 and T6. Data collected under this plan will support certification of all RCRA closures at the FEMP. Further, closure certification requires that soil sampling data from closure activities be compared to background concentrations of naturally-occurring constituents. The work completed under this Sampling and Analysis Plan will be presented in a report at the conclusion of the study.

Regional data for radionuclides and inorganic compounds in surface soil from Ohio and Indiana will be used for the Operable Unit 2 Remedial Investigation Report in the absence of the results of the background sampling program. The regional data are given in Attachment 1. If data from the background sampling program are available prior to delivery of the Operable Unit 2 Remedial Investigation Report to EPA, the data will be reviewed to determine what, if any, impacts the data have on the Report.

2.0 DEFINING A BACKGROUND AREA

The development of a background sampling plan first requires a definition of a background area. A review of EPA comments on an earlier draft of a background sampling plan, the geologic data, and the various guidance documents for determining background has resulted in a definition of a background

3207

area and a sampling logic for the area. In brief, the approach is to treat the glacial overburden as a bulk material; sample the glacial overburden over a wide area, where it can be demonstrated with earlier sampling that the impact of the FEMP has been minimal or is not present; collect samples at three depths at each location to determine the impact of possible local sources of contamination; collect what is believed to be an excessive amount of samples in one sampling program, to assure that a sufficient number of samples are available in case the variability within the initial analytical results is greater than estimated from the historic sampling.

2.1 DEFINING GEOLOGIC BACKGROUND

The geologic units at the FEMP consist of three principle units. The first geologic unit is the Ordovician bedrock which consists of calcarious shales with thin interbedded limestone layers generally less than six inches thick. The Ordovician bedrock material underlies the buried valley, where the Great Miami Aquifer is located, and the adjacent uplands. The Great Miami Aquifer is the second geologic unit and is characteristically composed of a 150- to 200-foot-thick sequence of very clean, fine to coarse sands with occasional discontinuous clay lenses. Overlying the aquifer is the third geologic unit, unconsolidated glacial overburden, which is the surface material over most of the FEMP and generally the area north of the Great Miami River.

The geomorphology of the area around the FEMP clearly indicates that the ice lobe that deposited the glacial overburden moved down the present Paddys Run valley. Although there are differences in texture and grain size, the bulk chemistry of all of this material is similar since it was derived from bedrock and glacial deposits to the north. The advancing ice mixed these materials and smeared them over the bedrock and aquifer as it advanced to the south-southeast across the FEMP. A detailed description of the glacial deposits in the area is included in Brockman (1988).

It is quite possible that the glacial overburden was deposited by multiple advances of the small lobe of the continental ice sheet. There has been no identification of any time-stratigraphic feature within the glacial overburden such as a fossil soil or lake bed with distinctive fossils. These features, if they existed, would generate a concern that there might be chemical differences in the soil material above and below these time lines. The absence of distinct time lines also precludes the possibility of correlating materials at a given depth with any other material at a similar depth.

The glacial overburden varies from 20 to 50 feet in thickness within the boundaries of the FEMP. The surface deposits within the glacial overburden include clay-rich till, angular fine-grained loess, lacustrian deposits of beach sand, and settled lake clays as well as outwash lenses of sand and gravel.

3207

These surface deposits are all reworked material derived from the till that was smeared over the area by the advancing glacier. While their grain size distribution is different, these surface materials are not likely to have a wide range of chemical compositions because of their common origin.

Even the flood plain of Paddys Run consists of glacial overburden that has been reworked by the lateral meanders of the stream and the deposition of material washed down the valley from the north. Thus, even though this material has a different soil classification, it probably has a bulk composition that is similar to the more clay-rich material forming the banks of the stream valley.

The FMPC RI/FS Groundwater Report (DOE 1990) presented generalized cross sections and fence diagrams from borings in the Production Area that were produced by grouping thin, silty, sandy lenses and predominantly clay-rich zones. These sections show that there is a relatively local sandy layer greater than 10-feet thick under the southwestern quadrant of the Production Area where the glacial overburden is 35 to 40 feet thick. This sand layer is not laterally extensive and there is no similar sand under the southeast quadrant of the Production Area where the glacial overburden is only 20 feet thick. This lateral variation in composition and thickness makes it impossible to correlate a sand strata in one area with a sand strata in another area with any degree of confidence.

This lack of vertical stratigraphy and the common origin of the components of the glacial overburden suggest that a bulk characterization of the glacial overburden should be used for a background determination. Clearly, a detailed chemical characterization of the vertical sequence of individual sand, silt, and clay-rich materials under the southwest quadrant would not give a representative or comparable set of data for the vertical sequence under the southeast quadrant of the Production area. How then could a detailed vertical sequence of samples from a location outside the site be adequately compared to any sequence within the site? Such an approach simply cannot be implemented.

Under the Soil Conservation Service classification system, the surface soils in and around the FEMP have many different names. The distinctions that result in the different names are largely due to textural differences, not bulk chemical differences. The textural differences are due to mechanical erosion, chemical weathering, and local variations in grain size. Most of the soils described in the Hamilton and Butler county soil surveys have a vertical extent of 36 inches or less. Descriptions of the underlying material are quite similar regardless of the surface soil type. This further suggests that a bulk characterization of the soil could be used for a background determination.

A final argument for bulk characterization is suggested by the extensive rework of materials by man's activities at the FEMP site. Construction activities have required multiple cut and fill operations

during the forty year history of DOE's activities. These operations tend to further homogenize the various soil types.

2.2 PREVIOUS SAMPLING

The litigation study conducted by IT Corporation in 1986 for National Lead of Ohio included soil sampling within a five-mile radius from the center of the FEMP. Soil samples were analyzed for isotopic uranium to help interpret the extent to which airborne emissions from the FEMP have impacted the surrounding area. The data were evaluated on a quadrant by quadrant basis to determine the mean concentration of each uranium isotope. Data from the litigation study on radionuclides in the area northwest of the FEMP show relatively low variability with a coefficient of variation of 37 percent.

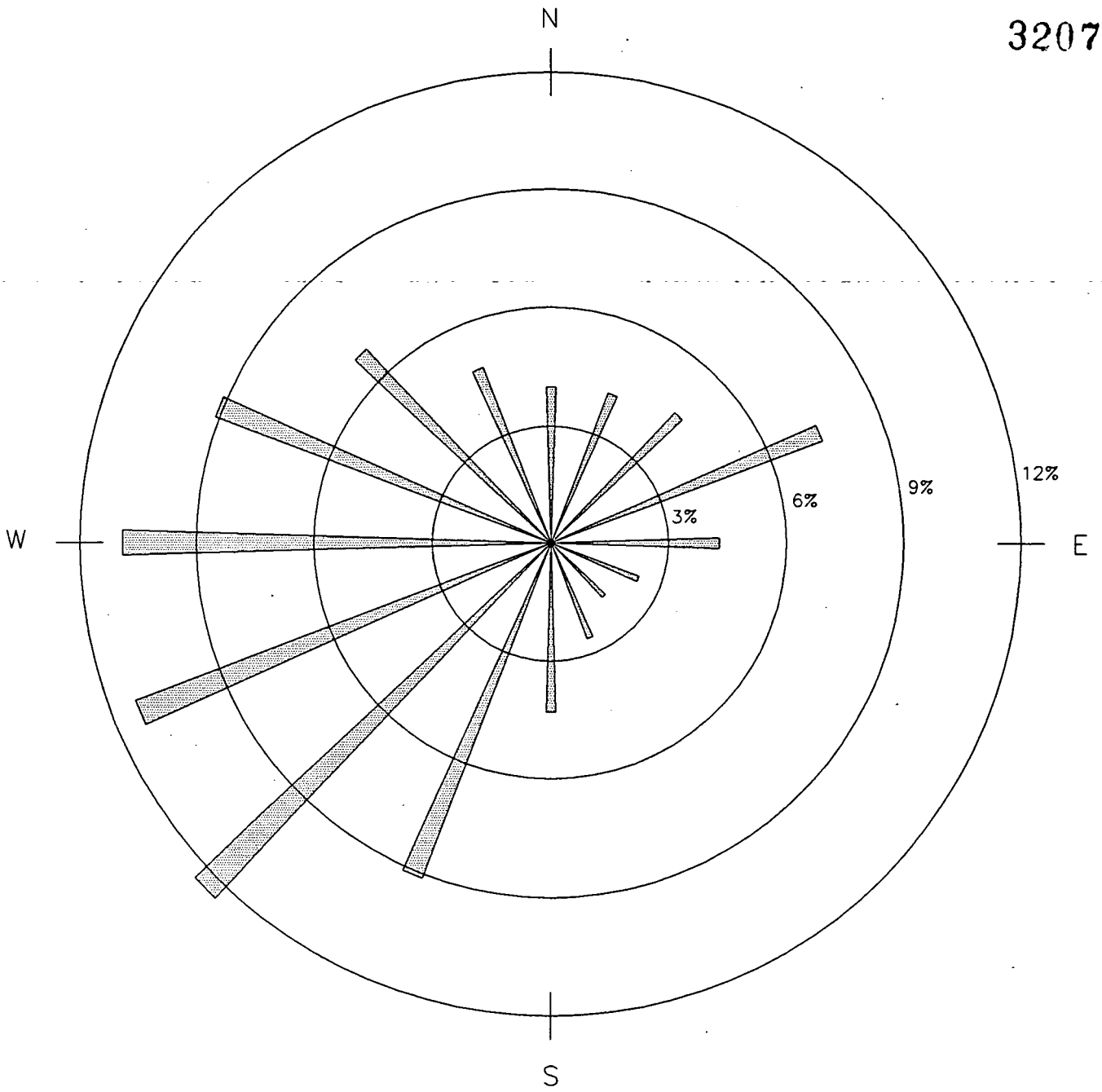
2.3 WIND DIRECTION

The litigation study finding is consistent with the records for the prevailing wind direction at the FEMP. Figure 1 is the wind rose for all data from 1987 through 1990 for the FEMP at a 10-meter height. The figure clearly shows that the prevailing winds are from the west southwest. More importantly, Figure 1 shows that the least frequent wind direction is from the southeast. Therefore, the area to the northwest of the FEMP would have experienced the least impact from airborne contamination.

2.4 BACKGROUND AREA DEFINED

Three converging lines of evidence indicate that the area to the northwest of the FEMP is an appropriate background area. Geologically, the upper portion of the Paddys Run drainage area is the source area for the glacial overburden deposited on the FEMP. Isotope-specific data for uranium have shown that the area to the northwest has the least variation between sample results. The prevailing winds indicate that the area northwest of the FEMP is the least likely area to be significantly impacted by air emissions from the FEMP.

Background sampling will be conducted within six square miles located north of the village of Shandon. The background area shown in Figure 2 is the northern end of the northern portion of the Paddys Run drainage basin.



NOTES:

DIAGRAM OF THE FREQUENCY OF OCCURENCE FOR EACH WIND DIRECTION. WIND DIRECTION IS THE DIRECTION FROM WHICH THE WIND IS BLOWING. EXAMPLE – WIND IS BLOWING FROM THE NORTH 4.0 PERCENT OF THE TIME.

1987 – 1990
10-METER LEVEL
FEMP

602.A_WROSEBOB_CIN

FIGURE 1. WIND ROSE FOR 10-METER LEVEL

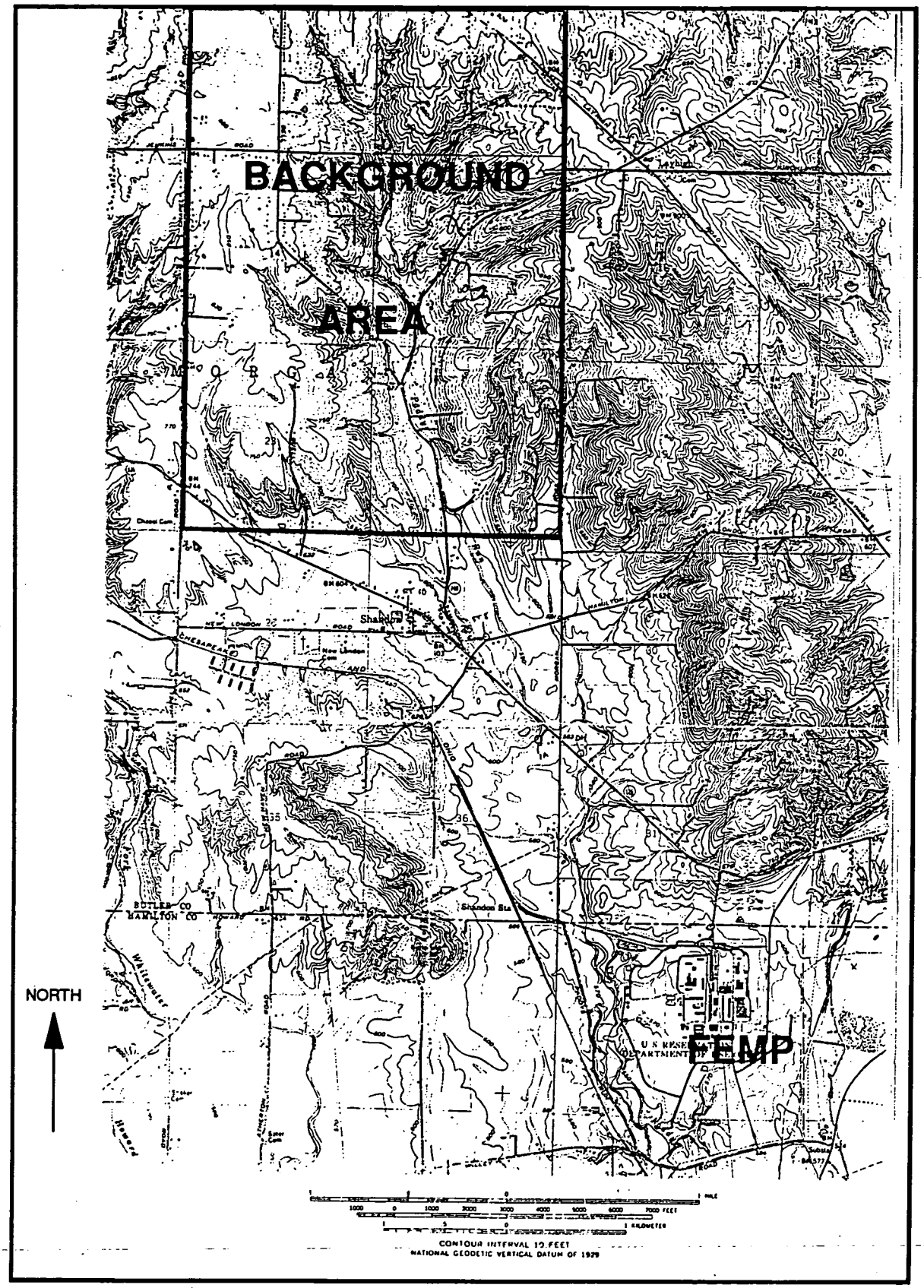


FIGURE 2 BACKGROUND AREA LOCATION

3.0 SAMPLING APPROACH

The sampling approach is designed to characterize a material that is relatively homogeneous chemically, but has a weathered surface. This weathered surface may also contain contamination from local activities such as lead from automobile exhaust or arsenic from agricultural pesticides. Therefore, it is proposed that samples be collected over a wide area to sample the variability of the glacial overburden. Samples will also be collected at three depths at each location to determine the impact of weathering and potential local contamination.

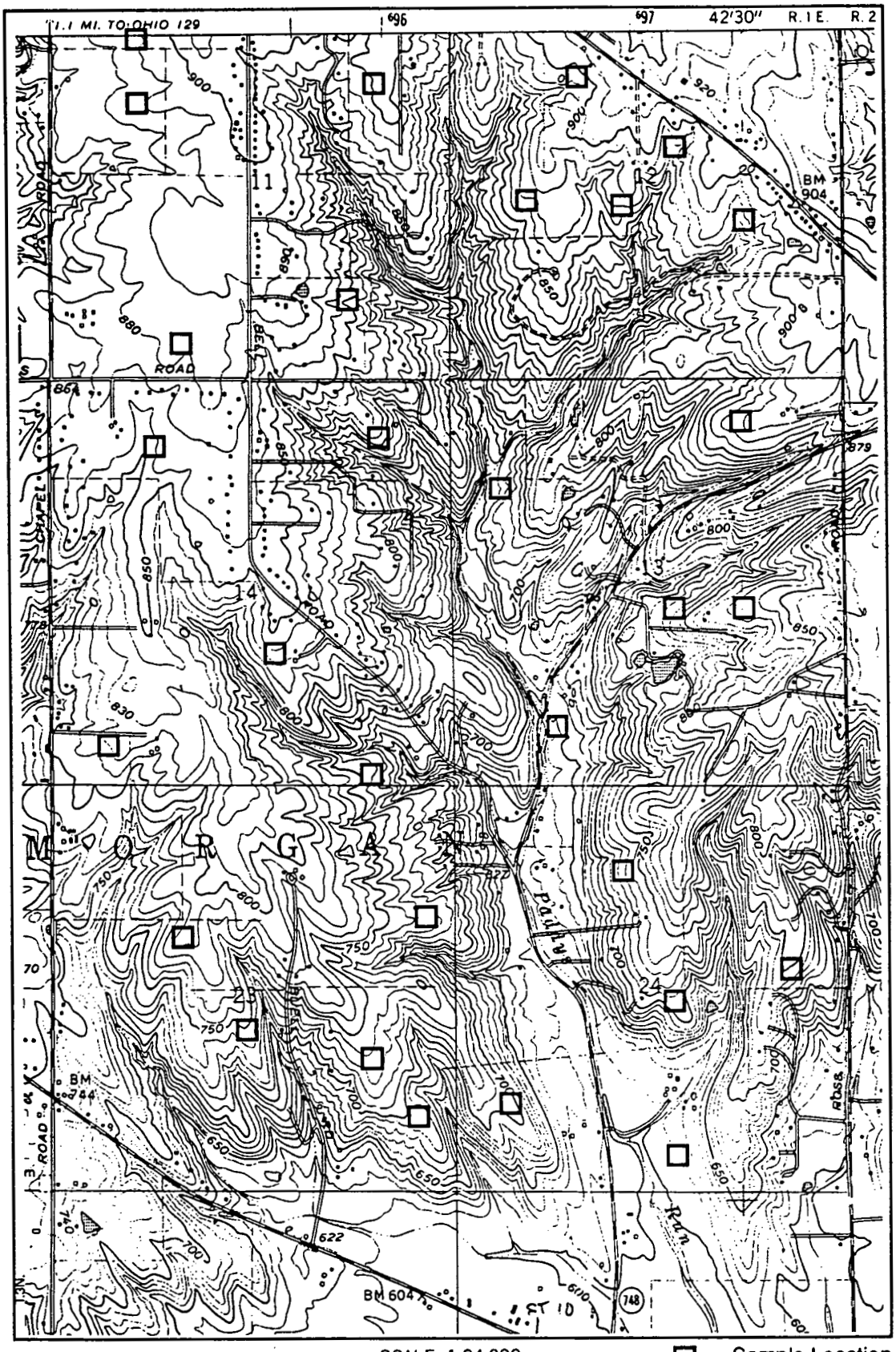
3.1 SAMPLING AREA

Figure 3 shows the background sampling locations for the six-square-mile area. Five sampling sites were selected at random in each of the six 1-square-mile sections. The locations were adjusted using the following criteria:

- Areas where solid or hazardous waste may have been stored or areas affected by their runoff
- Roads, parking lots or other paved areas
- Railroad tracks or areas affected by railway access
- Storm drains or ditches presently or historically receiving industrial, urban or agricultural runoff
- Fill areas
- Spill areas
- Areas subject to residential influence such as fertilized yards and gardens

Because the FEMP is essentially flat and it is important to get a full soil profile, locations were also moved to relatively flat areas. Some locations are in the bottom of the Paddys Run valley in order to sample floodplain deposits.

Since it may not be possible to get permission or find access to all these locations, Figure 4 was prepared with an alternate set of 30 random sampling locations. The objectives of the sampling



SCALE 1:24 000 = Sample Location

1 ½ 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

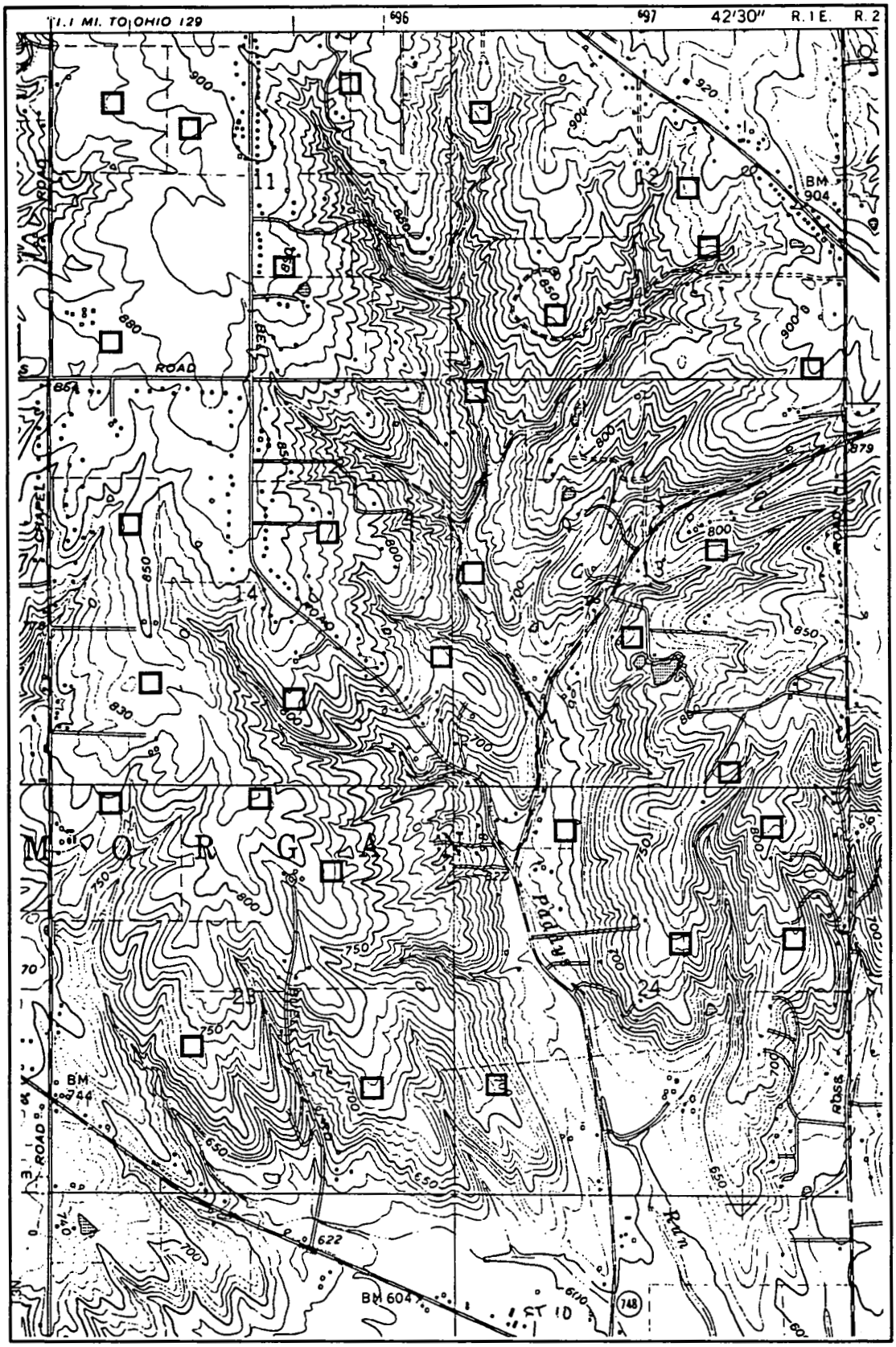
1 .5 0 1 KILOMETER

CONTOUR INTERVAL 10 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

Figure 3. BACKGROUND SOIL SAMPLE LOCATIONS

DRAWING NO.	S-313027-1-8-1/82-1
CHECKED BY	
APPROVED BY	
DRAWING BY	JS, III 1/20/82

320



SCALE 1:24 000

□ = Sample Location

1 ½ 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

CONTOUR INTERVAL 10 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

Figure 4. ALTERNATE BACKGROUND SOIL SAMPLE LOCATIONS

320

DRAWING NO. S-313327-1-8-1/92-2

DRAWING BY JIS, III 1/20/92

CHECKED BY

APPROVED BY

program can be achieved by substituting locations from Figure 4 if locations in Figure 3 are not available.

These locations have been selected using the U.S. Geological Survey, Shandon, Ohio, 7.5 minute, topographic quadrangle which was photorevised in 1981. Since the areas have not been field checked, some locations may have to be adjusted in the field in accordance with the criteria listed above if conditions have changed since the map was revised.

3.2 VERTICAL PROFILE SAMPLING

A sample from the surface to a depth of six inches will be collected to determine the nature of soil that is influenced by local activities of man and weathering. This will include the impact of lead from gasoline, metals from fertilizers, and any leaching due to weathering or plant nutrient uptake. A second sample will be collected from a depth of 36 to 42 inches, by definition the lower extent of significant weathering. A third sample will be collected from 48 to 54 inches, which is generally below the depth of soil development but above the perched water table.

The samples from each layer will be statistically tested to determine the variability of the values for the metals within each layer. Then, the variability will be compared between the layers. It is anticipated that the surface layer will probably contain more distinct differences from the other two layers because it is most directly impacted by man and weathering. The background composition of the glacial overburden will be established by statistical analyses of the chemical data in the deepest and perhaps the middle sampling zones, if the two do not have a significant difference.

This approach will allow sampling to be conducted with hand augers, minimizing the impact on the area where samples are collected. This should make it easier to obtain permission to enter private land for sampling. The relatively lower cost of hand auguring over machine auguring also means more sample locations can be used than are statistically required during the sampling program.

3.3 SAMPLING PROCEDURES

Surface samples will be collected with a stainless steel hand trowel. The samples at 36 to 42 inches and 48 to 54 inches will be collected with stainless steel hand samplers. Regardless of the sampling equipment all sampling will follow procedures specified in Section 6.4 of the RI/FS Quality Assurance Project Plan (QAPP) unless specifically altered in this plan. No radiation survey will be conducted owing to the expected low concentrations of radionuclides in these areas. Such survey could

potentially lead to the avoidance of areas having higher naturally occurring radionuclide concentrations.

3207

As outlined in the RI/FS QAPP (1988), Section 5, page 25, Visual Classification of Soils forms will be completed for each boring to provide a description of soils encountered and Field Activity Daily Logs will be completed to document sampling activities. After sampling, boreholes will be filled with excess sample material and locally available topsoil. A stake will be placed next to each boring which will have the 1000-series boring number clearly written, using an indelible marker. Each sample location will then be surveyed by a licensed surveyor so a permanent record of the location can be entered into the RI/FS database.

Quality control samples will be used to check the analytical validity of field procedures, field equipment, and laboratory analyses. The RI/FS contract lab regularly performs its own quality control procedures as outlined in the QAPP. The field program and data validation collect the following quality control samples:

- One rinsate per day of decontamination activities or one per ten samples (whichever is more frequent)
- One blind duplicate for every three borings (9 samples)
- One container deionized/water blank for each lot of sample containers or lot of deionized water used
- Decon blanks for each lot of nitric acid and methanol used for decontamination of field equipment
- Reagent blanks for each lot of nitric acid and sodium hydroxide used for preservation of rinsates

All appropriate field equipment will be decontaminated prior to use following the sequence below:

1. Alconox and deionized water wash
2. Deionized water rinse
3. Nitric acid (10%) rinse
4. Deionized water rinse
5. Methanol rinse
6. Deionized water rinse

Decontamination will be conducted at a location sufficient distanced from the site to avoid cross-contamination. Sample preparation and packaging for shipping will be performed at an off-site location.

3207

3.4 ANALYTICAL PARAMETERS

All soil samples will be analyzed for the parameters listed in Table 1. This list was compiled after a review of the potential contaminants of concern for all operable units. Potassium-40 has been added to the list as a quality check for gamma spectroscopy analysis although it is not a contaminant of concern. Nonhazardous inorganic elements are being analyzed in order to provide additional information on soil composition. Organic compounds and pesticides will not be analyzed as their presence in the environment is most frequently due to anthropogenic sources. Further, data collected to date under the RI/FS would not suggest any significant natural level of organics. Table 1 also lists the risk-based concentrations of concern for each of the analytes and the required detection limits. The risk-based concentrations of concern which will be used to determine preliminary remediation goals in turn dictate the analytical detection required in the analyses. In some cases, these detection limits are lower than those prescribed in the QAPP or QAPjP. Several radionuclides will require more sensitive analytical procedures than are required under the standard analytical protocols of the RI/FS QAPP, but are being utilized to ensure adequate knowledge of the environment.

Table 2 is a summary of the data quality objectives of this program.

3.5 SAMPLE SIZE

Representative samples will be collected at three sampling depths at 30 locations within a six-square-mile area northwest of the FEMP site. Because the determination of background is critical to the completion of two closures under RCRA and the Baseline Risk Assessment under CERCLA, all 90 soil samples will be analyzed as soon as they are collected. This will ensure that even if some samples do not pass validation there will be a sufficient number of samples, possibly 30 for each depth interval, available for the statistical analysis. Analysis of this number of samples exceeds the minimum requirements of pertinent guidance addressing RCRA closure actions.

3207

TABLE 1

LIST OF PROPOSED ANALYTES

Radionuclides	Risk-Based (10^{-6}) Cleanup Goal[a] (pCi/g)	Analytical Detection Limit (pCi/g)	Inorganics	Potential Level of Concern[b] (mg/kg)	Detection Limit (mg/kg)
Actinium-227	1.0	0.6	Aluminum	--	20
Cesium-137	0.01	0.2	Arsenic	270	1.0
Protactinium-231	0.06	0.1	Antimony	110	6.0
Lead-210	0.3	0.3	Barium	13,500	20
Radium-224	0.2	0.5	Beryllium	1400	0.5
Radium-226	0.3	0.3	Boron	11,500	10.0
Radium-228	3.8	1.0	Cadmium	270	0.5
Strontium-90	10	1.0	Calcium	--	4.0
Technetium-99	270	1.0	Chromium	1300	2.0
Thorium-228	0.8	0.6	Cobalt	330	5.0
Thorium-230	1.9	0.6	Copper	--	2.5
Thorium-232	2.3	0.6	Cyanide	2,600	0.2
Uranium-234	1.2	0.6	Iron	--	2.0
Uranium-235	0.01	0.02	Lead	190	0.5
Uranium-238	1.4	0.6	Magnesium	--	10.0
Potassium-40	--	10	Manganese	27,000	500
Ruthenium-106	39	1.0	Mercury	80	.04
			Molybdenum	1100	2.0
			Nickel	5400	4.0
			Potassium	--	20.0
			Selenium	640	0.5

Radionuclides	Risk-Based (10^{-6}) Cleanup Goal[a] (pCi/g)	Analytical Detection Limit (pCi/g)	Inorganics	Potential Level of Concern[b] (mg/kg)	Detection Limit (mg/kg)
			Silver	800	2.0
			Silicon	--	5.0
			Sodium	--	20.0
			Thallium	20	1.0
			Vanadium	1900	5.0
			Zinc	54,000	2.0

[a] Assuming a lifetime risk of cancer incidence of 1 x 10^{-6}, and utilizing the method and parameters recommended in Part B of the Risk Assessment Guidance for Superfund (12/91), except that a 70-year exposure period was deemed appropriate for the FEMP.
[b] Calculation was based on Eq. 5 of the Risk Assessment Guidance for Superfund, Part B .

3207

TABLE 2
DATA QUALITY OBJECTIVES FOR THE BACKGROUND CHARACTERISTICS OF SOILS

Activity	Conduct hand soil sampling with trowels and hand augers at 30 background locations. Samples will be collected at 0-6, 36-42 and 48-54 inch depth intervals. All samples will be analyzed for the constituents listed in Table 1.
Objectives	Define the background concentration of radionuclides and inorganics in soils.
Prioritized Data Use(s)	The priority data use is background soil characterization. Background soil characterization data is used for risk assessment, selection of remedial alternatives, and during determination of final remediation levels.
Appropriate Analytical Level	Radionuclides: Level V Inorganic Chemicals: Level IV
Constituents of Concern	See Table 1.
Level of Concern	See Table 1.
Required Detection Limits	See Table 1.
Critical Samples	No individual sample is considered critical; however, an aggregate of samples is considered critical to characterization of background. The study requires that a sufficient number of the samples pass the specified data validation to meet the criteria of Section 4.0 for each of the three sampling intervals.

3207

4.0 STATISTICAL ANALYSIS

4.1 DESCRIPTIVE STATISTICS

The statistical analysis of the sample data will begin with the calculation of descriptive statistics. These descriptive statistics will provide summary information and allow for a preliminary and subjective evaluation of the data. The descriptive statistics will include the arithmetic and geometric mean and standard deviation, sample median, minimum and maximum exposures, and sample size. Descriptive statistics will be calculated separately for each contaminant at each of the three sampling depths. Graphic data presentation will be made as appropriate.

The background data set for each contaminant at each of the sampling depths will be evaluated to determine the probability distribution (normal, lognormal, or other) that best describes the data. Two methods will be used to determine the distribution type. In the first method, a histogram will be constructed from each data set and will be visually inspected to see if the distribution appears to be normal, lognormal, or other. Although this determination is subjective, the method complements inspection of data in tabular form or data that are summarized by descriptive statistics. The second method consists of a quantitative evaluation of the linearity of probability plots of the data (or of log transformed data). A more complete description of the methodology for determining the distribution type for background data is given in the Risk Assessment Work Plan Addendum for the RI/FS.

The mean concentration will be further characterized by a 95 percent confidence interval. A 95 percent confidence interval is an interval for which there is 95 percent certainty that the interval estimate contains the true mean concentration. An interval estimate of the mean exposure is preferable to a point estimate, such as the mean, because interval estimation provides information on the precision of the estimation.

Sampling results will also be evaluated using an upper one-sided tolerance limit. The upper tolerance limit (UTL) will provide a maximum concentration below which a specified portion of all concentrations will fall, with a high degree of confidence. In essence, a UTL is an upper confidence limit for a percentile of a distribution of concentrations. For these sampling results, the UTL will be calculated such that it will provide a maximum concentration below which 95 percent of all concentrations will fall, with 95 percent confidence (EPA 1989).

It is expected that some number of samples will yield nondetectable results for certain contaminants of interest. Here, a nondetectable result is defined as any sample which is reported to be less than the sample quantification limit (SQL) as defined by the analytical method. A method for handling nondetectable values is essential in producing accurate descriptive statistics. The method to be used involves setting all nondetectable values to one-half of the SQL.

The data will also be evaluated to identify potential outlier observations. An outlier is defined as a measurement that is extremely large or small relative to the rest of the data and is suspected of misrepresenting the true background concentration. If a particular observation is suspected as being an outlier, additional data validation, field investigations, and confirmation sampling and analysis will be conducted as necessary to determine the reason for the anomalous value. A suspected outlier will not be eliminated from the data set unless there is definitive evidence that the measurement is in error.

Outliers will be evaluated to determine whether the results are a consequence of laboratory error or field sampling errors. The outlier sampling location will be examined to determine if the result is due to a localized source of contamination. UTL calculations will be made and presented with and without outliers.

4.2 COMPARISON OF SAMPLING DEPTHS

The mean contaminant concentrations at the three sampling depths will be tested statistically by using analysis of variance (ANOVA) techniques. If there is no statistically significant evidence of differences in mean concentrations among the three sampling depths, the data may be pooled to obtain an overall estimate of background contamination.

ANOVA procedures are parametric methods based on the assumptions that exposure measurements are independently and normally distributed with constant variance. These assumptions will be tested to determine the validity of the ANOVA results. If the assumptions do not appear reasonable, alternative procedures based on the random reclassification of the sample results may be used. These procedures, commonly referred to as randomization or permutation tests, are useful when the validity of the assumptions associated with common parametric statistical procedures are questionable.

The assumption of normality will be tested by using the Shapiro-Wilk procedure (Shapiro and Wilk 1965) and an omnibus test developed by D'Agostino and Pearson (1973) which is able to detect deviations from normality due to either skewness or kurtosis. If the data are not adequately described by a normal distribution, the natural logs of the data will be evaluated. This is equivalent to assuming that the data follow a lognormal distribution; that is, the natural logarithms of the data are normally distributed.

REFERENCES

Brockman, C. S., 1988 "Report of Progress on the Final Phase of Glacial Geologic Mapping in Hamilton County, Ohio," Ohio Dept. of Natural Resources, Div. of Geological Survey, Columbus, OH.

D'Agostino, R. B. and Pearson, E. S., 1973, "Testing for the Departures from Normality. I. Fuller Empirical Results for the Distribution of b_2 and $\sqrt{b_1}$," Biometrika, 60, 613-622.

International Technology Corp., 1986, "Final Interim Report - Air, Soil, Water, and Health Risk Assessment in the Vicinity of the FMPC, Fernald, Ohio," report and data package prepared for the U.S. Dept. of Energy in support of the Fernald litigation, Oak Ridge Operations Office, Oak Ridge, TN.

Shapiro, S. S. and Wilk, M. B., 1965, " An Analysis of Variance Test for Normality (Complete Samples)," Biometrika, 52, 591-611.

U.S. Department of Energy, 1990, "Groundwater Report, Feed Materials Production Center, Fernald, Ohio, Remedial Investigation and Feasibility Study," Draft, DOE, Oak Ridge Operations Office, Oak Ridge, TN.

U.S. Environmental Protection Agency, 1989, "Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities," EPA/530-SW-89-026, EPA, Office of Solid Waste, Washington, DC.

DETERMINATION OF UPPER TOLERANCE LIMITS FOR RADIONUCLIDES AND CHEMICALS FOR SURFACE SOIL AT THE FEMP

3207

March 24, 1992
John R. Frazier, Ph.D., CHP

Upper Tolerance Limits (UTLs) are selected to correspond to the upper 95% confidence limit on the 95th quantile of the background distribution. Regional data for Indiana and Ohio have been used as background data for radionuclides and chemicals in surface soil. The data for radionuclides are taken from a report by Myrick, et al. (1981) and are presented in Attachment I. Regional data for fission products (e.g., Cs-137) and activation products are not available, and UTLs for such radionuclides are assumed to be zero until site-specific background measurements are available. The data for chemicals are taken from the U.S. Department of Interior Geological Survey Report (1981) and are presented in Attachment II.

The data for radionuclides are summarized in Table I.

Table I
BACKGROUND DATA FOR RADIONUCLIDES IN SURFACE SOIL

Radionuclide	Frequency of Detection	Range of Values (pCi/g)	Arithmetic Mean (pCi/g)	Distribution Type	UTL[a] (pCi/g)
Ra-226	14/14	0.81-2.5	1.41	Lognormal	2.230
Th-232	14/14	0.71-1.5	1.05	Lognormal	1.475
U-238	14/14	0.76-2.2	1.36	Lognormal	2.109

[a]The use of four significant figures is not intended to imply a high degree of precision or accuracy, but rather to present results as calculated for future comparisons.

Determination of the distribution type was made in accordance with the methodology presented in Section 4.0 of the RI/FS Risk Assessment Work Plan Addendum, February 1992. The data for each radionuclide suggest that either a normal or lognormal distribution can be assumed, but a lognormal distribution is more appropriate for these data.

The UTL for each radionuclide given in Table I is calculated from the regional data as (Gilbert 1987):

$$UTL = e^{(\bar{y} + Zs_y)}$$

where

$$\bar{y} = \frac{1}{n} \Sigma \ln x$$

such that $e^{\bar{y}}$ is the geometric mean,

21

Z = 1.645 (95% confidence limit for one-tailed test)

(Pearson and Hartley 1966)

and

3207

$$Sy=\frac{\sqrt{\Sigma(y-\bar{y})^2}}{n-1}$$

such that e^{Sy} is the geometric standard deviation.

If a normal distribution had been assumed for each radionuclide, the UTL is calculated to be (EPA 1989):

Radionuclide	UTL (pCi/g)
Ra-226	2.613
Th-232	1.668
U-238	2.368

But, as stated previously, the lognormal distribution is more appropriate for these data.

It is assumed that the radioactive progeny of these radionuclides are in secular equilibrium whereby the UTLs are as follows:

	Radionuclide	UTL (pCi/g)
Thorium Series	Ra-228	1.475
	Ac-228	1.475
	Th-228	1.475
	Ra-224	1.475
Uranium Series	Th-234	2.109
	Pa-234	2.109
	U-234	2.109
	Th-230	2.109
Uranium Series below Rn-222	Po-218	2.230
	Pb-214	2.230
	Bi-214	2.230
	Po-214	2.230
	Pb-210	2.230
	Bi-210	2.230
	Po-210	2.230

It is also assumed that uranium-235 occurs at its natural isotopic abundance (0.72% by mass) in background soil. The UTL for uranium-235 and each selected progeny (Th-231, Pa-231, Ac-227) is equal to 0.097 pCi/g.

The data for chemicals in surface soil are summarized in Table II. UTLs are calculated according to the referenced methodology for the appropriate distribution type.

22

Table II

BACKGROUND DATA FOR CHEMICALS IN SURFACE SOIL

Chemical	Frequency of Detection[a]	Range of Values (mg/kg)	Arithmetic Mean[b] (mg/kg)	Dist Type	UTL (mg/kg)
Aluminum	24/24	15000-100000	52500	normal	108200.
Arsenic	24/24	3.6-27.00	9.98	lognormal	20.5
Barium	24/24	300.-700.	483.	normal	815.
Beryllium	8/24	<1.00-2.00	1.56	normal	2.15
Cadmium	15/15	1.00-11.00	2.67	normal	11.1
Calcium	24/24	1100-160800	15700.	lognormal	41300.
Chromium	24/24	15.0-100.	51.3	normal	103.
Cobalt	24/24	3.00-20.0	11.7	normal	21.4
Copper	24/24	7.00-70.0	27.6	lognormal	58.6
Iron	24/24	10000-50000	24600.	lognormal	46200.
Lead	23/24	<15.0-30.0	21.5	normal	37.3
Magnesium	24/24	1500-30000	6460.	lognormal	15900.
Manganese	24/24	150.-1000	535.	lognormal	1140.
Mercury	24/24	0.030-0.590	0.13	lognormal	0.292
Molybdenum	11/24	<3.00-7.00	5.55	normal	8.85
Nickel	24/24	7.00-50.0	21.8	lognormal	33.4
Potassium	24/24	11800-25100	17100.	lognormal	23800.
Selenium	21/24	<0.100-1.20	0.52	normal	1.17
Silver	6/6	0.700-5.00	2.78	normal	8.03
Sodium	23/23	5000-10000	7520.	normal	11400.
Vanadium	24/24	20.0-150.	81.3	normal	172.
Zinc	24/24	25.0-113.	62.7	lognormal	113.

[a]Regional data for Ohio and Indiana except for cadmium and silver, which are national data.
[b]Arithmetic mean of the detected values.

The UTLs presented for radionuclides and chemicals are also assumed for subsurface soil and sediment. UTLs for other constituents and/or other media are generally based on site-specific data rather than on regional data. A sampling and analysis program is currently underway to determine site-specific UTLs to replace regional values.

REFERENCES

Boerngen, J.G. and H.T. Shacklette, 1981, Chemical Analyses of Soils and Other Surficial Materials of the Conterminous United States, Open-File Report 91-197, U.S. Department of the Interior, Geological Survey, Washington, DC.

Gilbert, R.O., 1987, Statistical Methods for Environmental Pollution Monitoring, Van Nostrand Reinhold, New York, NY.

Myrick, T.E., B.A. Berven, and F.F. Haywood, November, 1981, State Background Radiation Levels: Results of Measurements Taken During 1975-1979, ORNL/TM-7343, Oak Ridge National Laboratory, Oak Ridge, TN.

Pearson, E.S. and H.O. Hartley, 1966, Biometric Tables for Statisticians, Vol. 1, 3rd ed., Cambridge University Press, London.

U.S. Environmental Protection Agency, 1989, "Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities", EPA/530-SW-89-026, EPA, Office of Solid Waste, Washington, DC.

Attachment I

BACKGROUND LEVELS FOR RADIONUCLIDES IN SURFACE SOIL[1]

Table 25. Background radiation levels and nuclide concentrations in surface soil samples in the State of Ohio

Sample designation	Description of sample location	Average external gamma exposure rate (μR/h)[a]	Nuclide concentration in surface soil (pCi/g)[b]		
			^{226}Ra	^{232}Th	^{238}U
OH-1	Rest area on S side of I-71, ~16 km S of Columbus, Ohio, at mile marker 92	9.2	2.5 ± 0.16	0.71 ± 0.02	2.2
OH-2	Approx. 51 km N of Columbus, Ohio, at rest stop on S side of I-71	7.1	1.5 ± 0.12	0.74 ± 0.60	1.3
OH-3	Approx. 21 km E of Wickliffe, Ohio, at rest stop on S side of I-90	9.2	1.1 ± 0.04	1.1 ± 0.10	1.2
OH-4	Approx. 8 km S of I-70, at intersection of Hwy 13 and 188, near Thornville, Ohio	c	2.0 ± 0.14	1.0 ± 0.16	1.7
OH-5	SE corner of intersection of I-77 and Hwy 821, at Macksburg, Ohio	11	1.3 ± 0.12	1.5 ± 0.20	1.6
OH-6	Rest area on E side of I-77, ~16 km S of I-70, near Buffalo, Ohio	8.2	1.9 ± 0.16	1.1 ± 0.24	1.6
OH-7	SW corner of intersection of I-70 and Hwy 9, S of St. Clairsville, Ohio	8.5	1.5 ± 0.16	1.5 ± 0.18	1.7
OH-8	W side of I-475, between Hwys 20 and 2, in W Toledo, Ohio	5.1	0.81 ± 0.04	0.80 ± 0.02	0.76
OH-9	Rest stop on W side of I-75, just S of Findlay, Ohio	4.9	1.3 ± 0.08	0.93 ± 0.06	1.2
OH-10	W side of I-75, just S of Hwy 67 exit, E of Wapakoneta, Ohio	4.8	1.5 ± 0.06	1.0 ± 0.06	1.4
OH-11	W side of I-75, ~0.4 km N of intersection with Hwy 571, near Tipp City, Ohio	2.8	1.2 ± 0.04	0.99 ± 0.06	0.96
OH-12	W side of I-75, just N of intersection with Hwy 122, E of Middletown, Ohio	4.8	1.0 ± 0.04	0.98 ± 0.04	0.86

[a]Exposure rate determined from 3 to 4 measurements at each location using a "Phil" tube as described in Appendix I.

[b]Standard deviation of ^{226}Ra and ^{232}Th measurements are given as the 2σ value. Error in the ^{238}U measurements are ≤5% (2σ).

[c]No data obtained.

Table 12. Background radiation levels and nuclide concentrations in surface soil samples in the State of Indiana

Sample designation	Description of sample location	Average external gamma exposure rate (μR/h)[a]	Nuclide concentration in surface soil (pCi/g)[b]		
			^{226}Ra	^{232}Th	^{238}U
IN-1	SE corner of intersection of I-64 and Hwy 161, in edge of woods	6.0	1.0 ± 0.08	1.1 ± 0.10	1.1
IN-2	SE corner of intersection of I-64 and Hwy 66, next to graveyard	7.1	1.1 ± 0.06	1.2 ± 0.08	1.4

[a]Exposure rate determined from 3 to 4 measurements at each location using a "Phil" tube as described in Appendix I.

[b]Standard deviation of ^{226}Ra and ^{232}Th measurements are given as the 2σ value. Error in the ^{238}U measurements are ≤5% (2σ).

[1] Myrick, T.E., B.A. Berven, and F.F. Haywood, November 1981, State Background Radiation Levels: Results of Measurements Taken During 1975-1979, ORNL/TM-7343, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Attachment II

BACKGROUND LEVELS FOR CHEMICALS IN SURFACE SOIL

UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

3207

CHEMICAL ANALYSES OF SOILS AND OTHER SURFICIAL MATERIALS OF THE CONTERMINOUS UNITED STATES

By

Josephine G. Boerngen and Hansford T. Shacklette

Open-File Report 81-197

1981

This report is preliminary and has not been edited or reviewed for conformity with U.S. Geological Survey standards or nomenclature.

Table 1.--Location, description, and concentrati. of elements for samples of surficial materials--co. .ued

Sample No.	State	County	Lati-tude	Long-itude	Date Colln.	Site and Soil Descriptions
GC034550	ID	JEROME	42 40	114 31	65 8	RT 79 4 MI S JEROME; GRAY-BROWN SILT ON BASALT
GC037050	ID	KOOTENAI	47 40	116 45	65 10	I-90 1 MI S COER D'ALENE; MED BROWN SILT
GC038050	ID	MADISON	43 53	111 38	65 10	RT 33 1 MI E TETON; BROWN-GRAY SILTY LOAM EDGE CULTIVATED FIELD
GC061250	ID	NEZ PERCE	46 26	116 50	70 10	US 12 10 MI E LEWISTON; ORGANIC SILT OVER BASALT
GC017050	ID	OWYHEE	42 27	115 35	63 10	CO RD 40 MI SE BRUNEAU ON INDIAN HOT SPRING RD; SOIL UNDER HOPSAGE
GC076050	ID	POWER	42 37	113 9	73 9	I-15W 1.9 E CASSIA CO LINE; LOESSIAL SILT BY SNAKE RIVER
GC037150	ID	SHOSHONE	47 29	115 58	65 10	US 10 1 MI NW WALLACE; BROWN-BLACK ORGANIC COLLUVIUM
GC038150	ID	TETON	43 39	111 7	65 10	RT 33 5 MI S DRIGGS; BROWN-GRAY SANDY LOAM
GC231150	ID	VALLEY	45 16	115 14	66 7	BIG RAMEY CR UPPER RAMEY MEADOWS; SOIL NOT DESCRIBED
GC231550	ID	VALLEY	44 16	116 5	66 7	RT 15 2 MI S SMITHS FERRY; POOR B HORIZON ON GRANITE
GC026850	ID	WASHINGTON	44 20	116 23	71 9	DIRT RD IN BROAD VALLEY 1 MI SE JCT CRANE CREEK RD; ON BASALT ALLUV
GC057550	IL	BUREAU	41 17	89 22	70 6	RT 29 2 MI NW HENNEPIN; BROWN FOREST LOAM
GC057950	IL	CLARK	39 18	87 50	70 8	US 50 9 MI E MARTAINSVILLE; LOAM FROM GLACIAL TILL
GC002250	IL	COOK	41 30	87 44	62 5	US 30 5 MI W CHICAGO HTS; DARK BROWN-BLACK SILTY CLAY LOAM
GC007650	IL	DOUGLAS	39 47	88 17	62 10	US 36 2 MI W US 45 JCT; DARK BROWN-GRAY CLAY LOAM
GC059750	IL	EFFINGHAM	39 3	88 45	70 8	US 40 .8 MI E ALTAMONT; GRAY SILT
GC002150	IL	GRUNDY	41 11	88 19	62 5	US 66 1 MI W GARDNER; DARK BROWN-BLACK SILTY CLAY LOAM
GC042950	IL	HENRY	41 25	90 0	66 10	I-80 AT ATKINSON; BROWNISH-BLACK SILTY CLAY LOAM
GC042650	IL	IROQUOIS	40 47	87 40	66 10	US 24 5 MI W IND-ILL LINE; BLACK SILTY LOAM
GC030150	IL	KANE	42 7	88 28	72 9	JCT I-90 & US 20; DARK PRAIRIE SOIL
GC042850	IL	LA SALLE	41 20	89 0	66 10	US 51 5 MI S PERU; BLACK SILTY LOAM
GC067150	IL	LAWRENCE	38 43	87 45	72 10	US 50 4 MI W LAWRENCEVILLE; YELLOW CLAY
GC001950	IL	LOGAN	40 3	89 28	62 5	US 66 1 MI N BROADWELL SW HI; BROWN CLAY LOAM
GC007750	IL	MACON	39 50	89 8	62 10	US 36 10 MI W DECATUR; DARK BROWN-GRAY CLAY LOAM
GC057750	IL	MC DONOUGH	40 26	90 48	70 6	N EDGE OF COLCHESTER; LOAM ON LOESS
GC002050	IL	MC LEAN	40 40	88 46	62 5	US 66 1 MI N LEXINGTON; DARK BROWN CLAY LOAM
GC057650	IL	OGLE	41 59	89 16	70 6	RT 64 4 MI E OREGON; SANDY SOIL OVER SANDSTONE
GC001650	IL	PIKE	39 43	91 12	62 5	US 36 AT HULL; DARK BROWN-GRAY CLAY LOAM
GC001750	IL	PIKE	39 36	90 46	62 5	US 36-54 2 MI E PITTSFIELD; OLIVE-GRAY SILTY CLAY LOAM
GC057850	IL	RANDOLPH	38 6	89 40	70 6	RT 4 4 MI S SPARTA; BROWN FOREST
GC001850	IL	SANGAMON	39 44	89 57	62 5	US 36-54 2 MI W NEW BERLIN; DARK BROWN CLAYEY LOAM
GC067050	IL	ST CLAIR	38 36	87 45	72 10	US 50 4 MI W LEBANON; CLAY LOAM
GC047451	IL	STEPHENSON	42 5	89 55	61 7	US 52 4.5 MI W LANARK; YELLOWISH-BROWN
GC042350	IN	ADAMS	40 45	84 52	66 10	RT 124 .7 MI W OHIO-IND LINE; BROWN SILTY LOAM
GC002450	IN	ELKHART	41 44	85 59	62 5	IND TPK 1 MI W JCT RT 19; ORANGE-BROWN SANDY SUBSOIL
GC067250	IN	FLOYD	38 17	85 51	72 10	I-64 2 MI W NEW ALBANY; CLAY SOIL IN FOREST
GC007450	IN	HENDRICKS	39 46	86 29	62 10	US 36 4 MI W AVON; GRAY-ORANGE SANDY CLAY SUBSOIL
GC007350	IN	HENRY	39 48	85 19	62 10	US 40 2 MI W STRAUGHN; BROWN CLAY LOAM
GC059950	IN	MONROE	39 10	86 32	70 8	AT BLOOMINGTON, STARNES RD NEAR FLATWOODS RD JCT; LOAM ON TILL
GC002350	IN	PORTER	41 36	87 4	62 5	RT 49 3 MI N BLACK HAWK BEACH; ORANGE-BROWN SILTY LOAM
GC002550	IN	STEUBEN	41 44	84 58	62 5	IND TPK AT INTERCHANGE 10; OLIVE CLAY & LEACHED CLAY
GC007550	IN	VERMILLION	39 48	87 27	62 10	US 36 2 MI E IND 71 JCT; BROWNISH-GRAY CLAY LOAM
GC042450	IN	WABASH	40 44	85 46	66 10	RT 15 4 MI NW LAFONTAINE; GRAY-BROWN SILTY LOAM
GC042550	IN	WHITE	40 50	86 45	66 10	US 24 3.5 MI W IDAVILLE; BLACK SILTY LOAM
GC155850	KS	BOURBON	37 45	94 55	63 10	US 54 10 MI W FT. SCOTT; DARK PRAIRIE SOIL OVER LIMESTONE
GC156050	KS	BUTLER	37 45	96 37	63 10	US 54 1 MI W ROSALIA; DARK PRAIRIE SOIL OVER LIMESTONE
GC058650	KS	CHEROKEE	37 9	94 48	70 10	RT 96 6 MI E COLUMBUS; PLOW ZONE
GC000450	KS	CHEYENNE	39 45	101 32	62 5	US 36 6 MI E BIRD CITY; BROWN-GRAY SILTY LOAM
GC058250	KS	COMANCHE	37 13	99 27	70 10	RT 160 4 MI E PROTECTION; SANDY SOIL
GC058450	KS	COWLEY	37 15	96 46	70 10	RT 160 5 MI S BURDEN; CHERNOZEM

3207

Table 1.--Locations, descriptions, and concentration of elements for samples of surficial materials--continued

Sample No.	Al %	As ppm	B ppm	Ba ppm	Be ppm	Br ppm	C %	Ce %	Ce ppm	Co ppm	Cr ppm	Cu ppm
GC034550	5.00	3.7	30	700	N	--	--	1.30	N	15	50.0	20.0
GC037050	>10.00	23.0	20	1,000	N	--	--	1.00	N	15	50.0	70.0
GC038050	7.00	4.5	30	700	N	--	--	1.20	N	10	70.0	20.0
GC061250	7.00	4.7	<20	1,000	N	--	--	2.54	<150	15	30.0	20.0
GC017050	>10.00	--	N	500	1.5	--	--	2.00	N	7	50.0	15.0
GC076050	5.00	4.2	50	700	2.0	<.5	1.0	1.61	N	7	50.0	20.0
GC037150	7.00	13.0	150	700	N	--	--	4.20	N	5	50.0	30.0
GC038150	5.00	11.0	30	500	N	--	--	8.10	N	5	70.0	20.0
GC231150	7.00	2.7	N	1,000	1.0	--	--	.79	150	5	15.0	7.0
GC231550	7.00	3.8	N	700	N	--	--	2.21	150	7	15.0	7.0
GC026850	10.00	3.6	N	1,000	2.0	<.5	.9	2.31	N	20	15.0	70.0
GC057550	7.00	5.8	30	700	N	--	1.3	.40	N	7	50.0	10.0
GC057950	7.00	7.0	50	700	1.0	--	--	.27	N	5	50.0	20.0
GC002250	3.00	8.4	70	500	N	--	--	.86	N	15	50.0	30.0
GC007650	7.00	8.4	N	500	N	--	--	.70	N	10	50.0	30.0
GC059750	7.00	3.3	30	500	N	--	--	.30	N	3	30.0	15.0
GC002150	3.00	10.0	70	300	N	--	--	.71	N	7	30.0	30.0
GC042950	7.00	9.2	50	700	1.0	--	--	.65	150	15	70.0	30.0
GC042650	7.00	7.4	70	700	1.5	--	--	.70	N	10	70.0	30.0
GC030150	3.00	3.3	20	300	N	1.1	5.7	1.10	N	5	50.0	30.0
GC042850	7.00	9.8	50	700	1.0	--	--	.75	150	15	70.0	20.0
GC067150	3.00	7.9	70	500	1.5	.9	2.0	.28	N	10	70.0	15.0
GC001950	3.00	11.0	70	500	1.5	--	--	1.07	N	15	30.0	50.0
GC007750	7.00	7.9	30	500	N	--	--	.50	N	10	50.0	20.0
GC057750	7.00	5.2	50	700	N	--	.8	.30	N	10	50.0	10.0
GC002050	3.00	10.0	30	500	N	--	--	.49	150	15	30.0	30.0
GC057650	.30	2.7	30	30	N	--	.5	--	N	N	15.0	7.0
GC001650	3.00	4.3	70	700	N	--	--	.61	N	7	30.0	30.0
GC001750	3.00	8.8	70	500	N	--	--	.56	150	15	30.0	30.0
GC057850	7.00	4.4	30	700	N	--	1.3	.40	N	7	50.0	10.0
GC001850	3.00	8.4	70	700	N	--	--	.71	150	15	50.0	50.0
GC067050	5.00	7.5	50	700	N	.9	3.2	.66	<150	7	70.0	30.0
GC047451	--	4.7	30	500	--	--	--	.50	--	10	70.0	10.0
GC042350	5.00	7.9	70	500	1.0	--	--	7.10	N	15	70.0	50.0
GC002450	1.50	3.6	30	300	N	--	--	.30	N	7	15.0	15.0
GC067250	10.00	10.2	70	500	2.0	1.0	3.4	.19	<150	10	70.0	20.0
GC007450	7.00	15.0	30	500	N	--	--	.70	N	15	50.0	30.0
GC007350	5.00	4.8	30	500	N	--	--	.62	N	10	50.0	20.0
GC059950	7.00	8.0	50	700	N	--	--	.25	<150	7	50.0	15.0
GC002350	3.00	5.7	70	500	N	--	--	.34	N	15	30.0	15.0
GC002550	3.00	4.4	N	300	N	--	--	16.08	N	7	30.0	15.0
GC007550	7.00	12.0	30	500	N	--	--	.40	N	15	50.0	30.0
GC042450	5.00	7.5	70	700	1.0	--	--	1.80	150	7	70.0	70.0
GC042550	1.50	3.7	30	500	N	--	--	.65	N	3	30.0	15.0
GC155850	7.00	6.3	30	500	N	--	--	.56	N	7	70.0	15.0
GC156050	7.00	9.7	30	500	1.5	--	--	.56	N	10	70.0	20.0
GC058650	7.00	8.3	30	500	<1.0	--	--	.28	<150	3	50.0	20.0
GC000450	5.00	3.7	30	700	N	--	--	1.00	150	15	30.0	30.0
GC058250	7.00	2.4	<20	1,000	N	--	--	.41	N	N	10.0	7.0
GC058450	7.00	7.2	20	300	<1.0	--	--	8.65	N	5	50.0	50.0

Table 1.--Location, description, and concentration of elements for samples of surficial materials--continued

Sample No.	F %	Fe %	Ga ppm	Ge ppm	Hg ppm	I ppm	K %	La ppm	Li ppm	Mg %	Mn ppm	Mo ppm
GC034550	.020	2.00	20	--	.06	--	2.00	30	19	1.000	700	N
GC037050	.033	7.00	20	--	.03	--	2.80	50	31	.700	700	N
GC038050	.029	2.00	15	--	.06	--	1.20	30	26	.700	500	N
GC061250	.056	7.00	15	--	.03	--	1.52	50	22	1.500	500	N
GC017050	--	2.00	20	--	--	--	2.50	30	--	1.000	200	5
GC076050	.060	2.00	10	1.42	.01	.7	1.85	50	20	1.000	500	N
GC037150	.098	2.00	15	--	.71	--	2.50	N	112	1.000	500	N
GC038150	.050	2.00	15	--	.05	--	2.10	N	20	2.000	500	N
GC231150	.038	3.00	30	--	.12	--	3.34	70	30	.500	500	N
GC231550	.027	3.00	30	--	.14	--	1.76	70	29	1.000	500	N
GC026850	--	7.00	15	1.66	.03	<.5	1.54	30	15	.500	1,000	N
GC057550	.015	1.50	10	--	.06	<.5	1.60	30	17	.200	1,000	N
GC057950	.013	1.50	10	--	.04	--	1.48	30	23	.300	200	N
GC002250	.040	3.00	30	--	.26	--	1.89	30	32	.700	300	N
GC007650	.024	1.50	20	--	.20	--	2.00	30	26	.700	500	N
GC059750	.012	1.00	7	--	.05	--	1.31	30	14	.150	700	N
GC002150	.025	2.00	30	--	.12	--	1.83	30	30	1.000	300	3
GC042950	.019	3.00	20	--	.07	--	1.10	50	19	.300	700	N
GC042650	.013	3.00	30	--	.14	--	1.70	50	33	.300	300	N
GC030150	--	2.00	10	.70	.05	1.8	1.48	<30	20	.500	700	N
GC042850	.017	3.00	30	--	.06	--	1.60	70	24	.300	1,000	N
GC067150	--	1.50	7	1.45	.07	.8	1.37	<30	15	.200	1,500	N
GC001950	.007	3.00	20	--	.37	--	1.73	30	22	.700	1,000	3
GC007750	.015	1.50	15	--	.13	--	1.80	30	25	.500	700	N
GC057750	.021	1.50	10	--	.04	<.5	1.60	30	20	.200	700	N
GC002050	.023	3.00	30	--	.11	--	1.78	70	27	.700	700	N
GC057650	.030	.15	N	--	.03	<.5	.20	N	<5	.020	15	N
GC001650	.023	1.50	15	--	.07	--	1.64	30	19	.300	700	N
GC001750	.017	1.50	15	--	.13	--	1.74	70	20	.700	1,000	N
GC057850	.013	1.50	10	--	.04	<.5	1.40	30	17	.200	300	N
GC001850	.036	3.00	20	--	.16	--	1.83	50	22	.700	700	N
GC067050	--	1.50	10	1.49	.04	1.4	1.68	50	15	.300	700	N
GC047451	.050	1.00	7	--	.20	--	1.80	--	17	.200	500	--
GC042350	.047	3.00	30	--	.07	--	2.20	30	37	1.500	500	7
GC002450	.006	1.50	7	--	.09	--	1.27	N	13	.150	700	N
GC067250	.050	5.00	20	1.63	.05	.9	2.12	70	57	.700	200	N
GC007450	.036	2.00	20	--	.26	--	1.70	N	29	.500	500	5
GC007350	.026	1.50	15	--	.21	--	1.80	30	28	.500	500	N
GC059950	.055	1.50	10	--	.04	--	1.43	30	19	.300	500	N
GC002350	.032	1.50	15	--	.11	--	1.86	30	16	.300	1,000	N
GC002550	.057	1.50	15	--	.07	--	1.20	N	22	3.000	300	7
GC007550	.026	2.00	20	--	.16	--	1.90	N	27	.500	1,000	N
GC042450	.007	3.00	30	--	.06	--	1.50	30	20	.700	300	7
GC042550	.003	1.00	15	--	.08	--	1.30	N	10	.150	200	N
GC155850	.030	1.50	15	--	.05	--	1.40	50	27	.500	500	N
GC156050	.030	3.00	30	--	.11	--	1.60	50	34	.700	500	N
GC058650	.013	1.50	7	--	.04	--	.96	50	28	.200	700	N
GC000450	.051	1.50	30	--	.04	--	2.23	70	26	.700	500	N
GC058250	.001	.70	5	--	.04	--	2.37	N	9	.150	150	N
GC058450	.020	1.50	10	--	.11	--	1.25	30	25	.500	700	N

Table 1.--Location, description, and concentration of elements for samples of surficial materials--continued

Sample No.	Na %	Nb ppm	Nd ppm	Ni ppm	P %	Pb ppm	Rb ppm	S %	Sb ppm	Sc ppm	Se ppm	Si %
GC034550	1.00	30	N	20	.030	30	--	--	--	10	.1	--
GC037050	1.50	N	N	30	.004	20	--	--	--	15	.3	--
GC038050	1.50	N	N	30	.030	N	--	--	--	7	.4	--
GC061250	1.50	10	70	15	--	10	--	--	--	20	.2	--
GC017050	1.50	10	--	20	.170	15	--	--	--	10	--	--
GC076050	.70	<10	N	15	--	15	70	<.08	<1	7	<.1	33
GC037150	1.50	N	--	15	.030	50	--	--	--	10	<.1	--
GC038150	1.00	N	--	20	.024	N	--	--	--	7	.4	--
GC231150	3.00	10	70	<5	.074	15	--	--	--	7	<.1	--
GC231550	1.50	15	70	5	.105	15	--	--	--	7	1.2	--
GC026850	1.00	10	N	10	--	15	60	<.08	<1	20	.3	28
GC057550	--	<10	<70	15	.039	15	--	--	--	7	.2	37
GC057950	.70	10	N	10	--	30	--	--	--	7	.2	--
GC002250	.70	15	N	30	.052	70	--	--	--	15	1.0	--
GC007650	1.00	10	N	20	.040	20	--	--	--	7	.5	--
GC059750	.70	10	N	7	--	20	--	--	--	7	.6	--
GC002150	.70	15	N	30	.048	30	--	--	--	10	.6	--
GC042950	.70	10	70	30	.020	30	--	--	--	15	.5	--
GC042650	1.00	15	70	30	.040	20	--	--	--	15	1.0	--
GC030150	.70	N	N	10	--	30	50	<.08	<1	7	.1	32
GC042850	.70	10	70	20	.030	30	--	--	--	15	.6	--
GC067150	.70	10	N	10	--	30	60	<.08	<1	7	.4	36
GC001950	.70	15	N	30	.092	300	--	--	--	15	.5	--
GC007750	1.00	15	N	20	.030	15	--	--	--	7	.7	--
GC057750	--	10	N	15	.031	20	--	--	--	7	.6	38
GC002050	.70	15	N	20	.162	30	--	--	--	15	1.9	--
GC057650	--	N	--	N	.052	N	--	--	--	N	.1	42
GC001650	.70	15	N	15	.052	15	--	--	--	7	.5	--
GC001750	.70	30	N	20	.031	30	--	--	--	15	.5	--
GC057850	--	<10	N	15	.044	15	--	--	--	7	.4	39
GC001850	.70	30	N	30	.131	30	--	--	--	15	.8	--
GC067050	1.00	<10	70	15	--	50	65	<.08	1	7	<.1	33
GC047451	--	--	--	15	.030	15	--	--	--	--	.6	--
GC042350	1.00	10	N	30	.040	15	--	--	--	15	.4	--
GC002450	.50	10	N	15	.035	N	--	--	--	N	<.1	--
GC067250	1.00	10	70	20	--	30	110	<.08	<1	10	<.1	28
GC007450	1.00	15	N	20	.020	20	--	--	--	10	.4	--
GC007350	1.00	10	N	20	.030	15	--	--	--	7	.3	--
GC059950	.70	10	70	10	--	15	--	--	--	7	.4	--
GC002350	.70	15	N	15	.017	15	--	--	--	7	.5	--
GC002550	.70	N	--	20	.052	15	--	--	--	15	.5	--
GC007550	1.00	15	N	20	.020	20	--	--	--	7	.4	--
GC042450	.70	15	N	20	.020	20	--	--	--	10	.5	--
GC042550	.50	10	--	7	.040	30	--	--	--	5	.3	--
GC155850	1.00	20	N	20	.016	20	--	--	--	10	.6	--
GC156050	1.00	15	N	30	.012	30	--	--	--	10	.6	--
GC058650	.50	10	70	10	--	20	--	--	--	10	.5	--
GC000450	.70	15	70	15	.044	30	--	--	--	15	.3	--
GC058250	.50	<10	N	<5	--	15	--	--	--	N	<.1	--
GC058450	.70	<10	N	15	--	15	--	--	--	7	.5	--

Table 1.--Location, description, and concentration of elements for samples of surficial materials--continued

Sample No.	Sn ppm	Sr ppm	Ti %	Th ppm	U ppm	V ppm	Y ppm	Yb ppm	Zn %	Zr ppm
GC034550	--	200	.300	--	--	70	30	3.0	30	300
GC037050	--	300	.500	--	--	150	30	3.0	90	150
GC038050	--	200	.300	--	--	70	20	2.0	50	300
GC061250	--	300	.700	--	--	150	50	5.0	88	150
GC017050	--	200	.200	--	--	70	30	3.0	25	150
GC076050	1.44	200	.300	11.73	3.07	70	20	3.0	56	500
GC037150	--	70	.300	--	--	70	30	3.0	170	150
GC038150	--	200	.150	--	--	70	30	2.0	60	150
GC231150	--	300	.200	--	--	30	20	2.0	56	300
GC231550	--	500	.200	--	--	70	15	1.5	95	150
GC026850	1.94	300	1.000	22.00	2.88	300	20	2.0	117	200
GC057550	--	150	.300	--	--	50	20	3.0	87	300
GC057950	--	150	.300	--	--	50	20	3.0	38	300
GC002250	--	70	.300	--	--	70	30	3.0	100	200
GC007650	--	150	.200	--	--	70	20	2.0	65	150
GC059750	--	100	.300	--	--	30	30	3.0	59	200
GC002150	--	70	.150	--	--	70	30	3.0	84	200
GC042950	--	200	.300	--	--	70	50	5.0	50	200
GC042650	--	200	.300	--	--	100	30	5.0	50	150
GC030150	.57	100	.150	--	2.16	70	15	1.5	80	100
GC042850	--	200	.500	--	--	70	50	5.0	70	200
GC067150	1.24	100	.300	10.04	3.41	70	30	5.0	47	300
GC001950	--	70	.200	--	--	70	30	7.0	140	300
GC007750	--	200	.300	--	--	100	30	3.0	45	200
GC057750	--	150	.500	--	--	70	20	3.0	47	300
GC002050	--	70	.300	--	--	70	30	7.0	67	300
GC057650	--	7	.050	--	--	10	N	N	--	30
GC001650	--	70	.300	--	--	30	30	7.0	63	300
GC001750	--	70	.300	--	--	70	30	7.0	56	500
GC057850	--	150	.500	--	--	50	20	2.0	34	200
GC001850	--	100	.300	--	--	70	50	7.0	110	300
GC067050	1.56	150	.300	10.55	3.38	70	30	5.0	67	300
GC042451	--	150	.200	--	--	30	20	--	50	300
GC042350	--	300	.300	--	--	100	30	3.0	50	100
GC002450	--	30	.150	--	--	20	15	1.5	32	150
GC067250	1.15	150	.500	10.94	3.23	150	30	5.0	113	200
GC007450	--	150	.200	--	--	100	20	2.0	70	150
GC007350	--	150	.300	--	--	70	20	2.0	50	150
GC059950	--	100	.500	--	--	70	30	3.0	45	500
GC002350	--	70	.300	--	--	30	30	3.0	51	300
GC002550	--	500	.150	--	--	70	15	3.0	55	70
GC007550	--	150	.200	--	--	100	30	3.0	55	200
GC042450	--	200	.300	--	--	70	30	5.0	50	300
GC042550	--	100	.150	--	--	30	15	1.5	60	150
GC155850	--	100	.500	--	--	50	30	5.0	50	300
GC156050	--	150	.300	--	--	100	30	5.0	50	300
GC058650	--	70	.700	--	--	50	30	3.0	200	300
GC000450	--	150	.150	--	--	70	30	5.0	74	300
GC058250	--	100	.150	--	--	15	15	1.5	21	300
GC058450	--	150	.300	--	--	70	30	3.0	78	300

32

3207

Table 1.--Location, description, and concentrat of elements for samples of surficial materials--co ued

Sample No.	State	County	Latitude	Longitude	Date Colln.	Site and Soil Descriptions
GC052550	NV	NYE	36 45	116 15	63 6	SITE AND SOIL DESCRIPTION NOT RECORDED
GC072250	NV	NYE	36 36	116 0	73 2	US 95 5 MI NW OF CO LINE NEAR MERCURY EXIT; GRAY DESERT ALKALI SOIL
GC262450	NV	NYE	38 40	116 15	68 7	DIRT RD IN HOT CREEK VALLEY ABOUT 45 MI NE WARM SPRINGS; LIGHT ROCKY
GC262650	NV	NYE	36 52	116 45	68 7	US 95 2 MI S BEATTY; ALLUVIUM BELOW DESERT PAVEMENT
GC262850	NV	NYE	38 45	117 7	68 7	RT 8A 3 MI S JCT RT 92 TO ROUND MOUNTAIN; HEAVY ALLUVIUM
GC241750	NV	PERSHING	40 40	118 4	66 7	I-80 AT MILL CITY; SOIL NOT DESCRIBED
GC241850	NV	PERSHING	40 21	118 19	66 7	I-80 AT RT 50 EXIT 14 MI N LOVELOCK; SOIL NOT DESCRIBED
GC060150	NV	WASHOE	39 56	119 22	70 10	RT 34 40 MI S GERLACH; GRAY DESERT OVER OLD PLAYA
GC062750	NV	WASHOE	40 39	119 23	70 10	RT 81 8 MI N GERLACH; GRAY DESERT IN PLAYA
GC242550	NV	WASHOE	39 31	119 52	66 7	US 395 5 MI E PURDY; SOIL NOT DESCRIBED
GC015450	NV	WHITE PINE	39 1	114 32	62 8	US 6 29 MI SE ELY; B IN. ON PEDIMENT SURFACE
GC065650	NV	WHITE PINE	39 24	115 28	72 9	US 50 AT LITTLE ANTELOPE SUMMIT; BROWN SOIL WITH ANDESITE FLOAT
GC065750	NV	WHITE PINE	39 10	114 40	72 9	US 50, 6, & 93 AT SCHELL CREEK TURNOFF; LGHT BRWN SOIL ON GRAVEL TILL
GC065850	NV	WHITE PINE	39 5	114 8	72 9	US 50 AT SCHELL CREEK TURNOFF; LIGHT BROWN SILT IN TERT/QUAT ALLUVIUM
GC078850	NV	WHITE PINE	39 4	114 30	73 9	RT 50 4 MI E JCT RT 93; LIGHT BROWN SILT UNDER DESERT PAVEMENT
GC263050	NV	WHITE PINE	39 40	114 15	68 7	US 93-US ALT 50,5 MI S JCT OF THESE HIGHWAYS; ALLUVIUM HIGH IN CLAY
GC003850	NY	ALBANY	42 45	73 56	62 5	I-90 AT INTERCHANGE 25; SANDY B HORIZON
GC003150	NY	CHAUTAUQUA	42 15	79 45	62 5	I-90 1 MI E NY STATE LINE; WELL DEVELOPED YELLOWISH-ORANGE SOIL
GC031050	NY	CHAUTAUQUA	42 32	79 10	72 9	I-90 2 MI S SILVER CREEK; LIGHT BROWN CLAY
GC031250	NY	CHENANGO	42 41	75 28	72 9	RT 80 2.5 MI E SHERBOURNE; LIGHT BROWN SILT
GC184350	NY	CHENANGO	42 17	75 29	76 11	RT 7 1 MI S BAINBRIDGE; SOIL NOT DESCRIBED
GC040250	NY	CLINTON	44 58	73 40	66 10	US 11 3.5 MI W MOOERS; B HORIZON IN SANDY DRIFT
GC003250	NY	ERIE	42 39	78 58	62 5	I-90 9 MI E INTERCHANGE 58; CLAYEY B HORIZON
GC040350	NY	FRANKLIN	44 45	74 35	66 10	US 11 .8 MI W MOIRA; GRAY CLAYEY SAND DEVELOPED ON OUTWASH
GC003350	NY	GENESEE	43 0	78 21	62 5	I-90 7 MI W INTERCHANGE 48; ORANGE-BROWN TO BROWN SANDY LOAM
GC040750	NY	HAMILTON	43 45	74 20	66 10	RT 28 3 MI W INDIAN LAKE; B HORIZON ON SANDY TILL
GC003750	NY	HERKIMER	43 2	74 37	62 5	I-90 AT INDIAN CASTLE SERVICE AREA; ORANGE-BROWN SANDY B HORIZON
GC040550	NY	JEFFERSON	43 58	75 50	66 10	RT 12 1 MI S RT 3 JCT NEAR WATERTOWN; BLACK SANDY LOAM
GC040650	NY	LEWIS	43 35	75 10	66 10	CO RD 3 MI NE PORTER; SANDY ORANGE-BROWN B HORIZON
GC003650	NY	ONEIDA	43 7	75 25	62 5	I-90 1 MI W INTERCHANGE 32; BROWN SAND
GC003550	NY	ONONDAGA	43 6	76 3	62 5	I-90 AT INTERCHANGE 35; SANDY LOAM
GC003450	NY	ONTARIO	43 0	77 9	62 5	I-90 3 MI E INTERCHANGE 43; B HORIZON IN PEBBLY SAND
GC031350	NY	SCHOHARIE	42 25	74 35	72 9	RT 23 2 MI E STAMFORD; LIGHT BROWN SANDY SOIL
GC040450	NY	ST LAWRENCE	44 30	75 20	66 10	US 11 2.5 MI W DEKALB JCT; POORLY DEVELOPED B HORIZON IN CLAYEY SAND
GC061550	NY	STEUBEN	42 10	77 8	70 9	RT 415 .7 MI N US 15 INTERCHANGE; SOIL NOT DESCRIBED
GC031550	NY	SULLIVAN	41 34	74 30	72 9	US 209 2 MI SW WURTSBORO; SILTY LOAM, ROCKY
GC184150	NY	TIOGA	42 0	76 30	67 11	RT 17 NEAR WAVERLY; LITHOSOL DERIVED FROM SHALE
GC184250	NY	TOMPKINS	42 25	76 30	67 11	RT 34 NEAR ITHACA; SOIL FROM DEVONIAN SHALE
GC031450	NY	ULSTER	41 55	74 11	72 9	RT 213 2 MI S OLIVEBRIDGE; LIGHT BROWN SANDY LOAM
GC040850	NY	WASHINGTON	43 25	73 37	66 10	RT 149 .3 MI E US 9-L JCT SE LAKE GEORGE; B HORIZON ON SANDY DRIFT
GC031150	NY	WAYNE	43 16	77 0	72 9	LAKE RD 1 MI W SODUS POINT; YELLOW-BROWN SANDY LOAM
GC006950	OH	ATHENS	39 17	82 8	62 10	US 50 5 MI SW ATHENS; YELLOW-ORANGE SILT SUBSOIL
GC042250	OH	AUGLAIZE	40 30	83 55	66 10	US 33 1 MI NW LAKE VIEW; BROWN SILTY LOAM CULTIVATED
GC002850	OH	CUYAHOGA	41 18	81 42	62 5	OHIO TPK 2 MI W INTERCHANGE 11; YELLOW-BROWN CLAY
GC007150	OH	FAYETTE	39 35	83 35	62 10	US 35 8 MI NW WASHINGTON C.H.; ORANGE AND GRAY CLAY LOAM
GC042150	OH	FRANKLIN	40 7	83 7	66 10	US 33 .8 MI W JCT RT 161 AT DUBLIN; OLIVE-GRAY CLAY LOAM
GC002650	OH	FULTON	41 36	83 53	62 5	OHIO TPK FALLEN TIMBERS SERV AREA; SANDY YELLOW-BROWN SUBSOIL
GC041950	OH	GUERNSEY	40 3	81 15	66 10	US 40 17 MI W ST CLAIRSVILLE; SANDY LOAM
GC057450	OH	HENRY	41 11	84 3	70 6	RT 109 3 MI S HAMLER; BLACK CLAY LOAM
GC002950	OH	LAKE	41 40	81 17	62 5	I-90 4 MI E RT 306 INTERCHANGE; YELLOW CLAYEY SOIL

Table 1.--Locations, descriptions, and concentration of elements for samples of surficial materials--continued

Sample No.	Al %	As ppm	B ppm	Ba ppm	Be ppm	Br ppm	C %	Ca %	Ce ppm	Co ppm	Cr ppm	Cu pp
GC052550	7.00	--	30	1,000	1.5	--	--	2.10	N	7	50.0	15.0
GC072250	10.00	4.2	20	500	2.0	<.5	.8	2.68	200	5	50.0	10.0
GC262450	>10.00	7.9	30	1,500	2.0	--	--	.50	200	3	7.0	7.0
GC262650	>10.00	14.0	30	700	1.5	--	--	4.10	150	10	30.0	15.0
GC262850	>10.00	8.7	30	1,000	2.0	--	--	1.20	150	7	15.0	15.0
GC241750	7.00	8.7	30	700	N	--	--	2.96	150	10	30.0	30.0
GC241850	3.00	20.0	70	500	1.0	--	--	3.50	N	10	30.0	30.0
GC060150	7.00	11.0	N	1,000	N	--	--	15.44	N	7	30.0	70.0
GC062750	7.00	6.0	30	2,000	N	--	--	15.01	N	7	50.0	30.0
GC242550	7.00	5.7	70	700	N	--	--	2.69	N	15	70.0	30.0
GC015450	7.00	--	N	300	N	--	--	9.60	--	5	50.0	30.0
GC065650	>10.00	7.7	50	1,000	2.0	<.5	1.3	1.91	<150	20	100.0	70.0
GC065750	3.00	10.2	<20	300	N	3.1	5.4	15.60	N	5	30.0	20.0
GC065850	3.00	5.1	20	500	N	3.0	2.8	9.13	N	5	50.0	30.0
GC078850	5.00	8.0	<20	500	1.5	1.5	3.4	9.82	--	5	30.0	10.0
GC263050	>10.00	7.2	20	1,000	3.0	--	--	2.70	150	7	20.0	15.0
GC003850	2.00	2.6	30	300	N	--	--	.55	N	5	15.0	7.0
GC003150	3.00	9.2	70	300	N	--	--	.38	N	7	30.0	30.0
GC031050	10.00	8.8	50	500	N	2.1	5.4	.36	<150	5	70.0	50.0
GC031250	10.00	8.4	100	500	2.0	.9	2.9	.19	<150	10	100.0	20.0
GC184350	7.00	8.2	70	200	1.0	--	--	.20	N	10	30.0	15.0
GC040250	1.50	4.9	N	300	N	--	--	.10	N	3	15.0	7.0
GC003250	3.00	13.0	70	500	N	--	--	.28	N	15	30.0	20.0
GC040350	5.00	1.6	30	500	1.5	--	--	.90	150	10	30.0	7.0
GC003350	2.00	2.0	N	300	N	--	--	.71	N	3	15.0	7.0
GC040750	5.00	3.8	30	300	1.5	--	--	2.80	N	15	30.0	7.0
GC003750	2.00	9.6	30	200	N	--	--	.30	N	7	20.0	30.0
GC040550	3.00	2.6	50	300	1.5	--	--	1.00	N	7	30.0	15.0
GC040650	5.00	1.5	N	500	1.5	--	--	.85	N	3	7.0	3.0
GC003650	3.00	13.0	70	300	N	--	--	.41	N	15	30.0	70.0
GC003550	2.00	7.6	30	200	N	--	--	.36	N	3	15.0	30.0
GC003450	3.00	2.5	70	300	N	--	--	.59	N	15	30.0	70.0
GC031350	7.00	10.9	50	300	N	1.7	5.8	.13	<150	5	70.0	20.0
GC040450	3.00	5.9	150	500	1.5	--	--	.75	N	10	30.0	10.0
GC061550	7.00	7.2	50	300	1.0	--	--	.19	N	10	30.0	20.0
GC031550	10.00	7.1	30	300	N	1.1	3.9	.10	200	7	50.0	30.0
GC184150	7.00	16.0	70	300	1.5	--	--	.15	N	15	30.0	15.0
GC184250	7.00	16.0	70	300	N	--	--	.35	N	7	30.0	15.0
GC031450	5.00	5.3	50	200	N	2.4	3.1	.08	N	5	50.0	20.0
GC040850	1.50	2.7	30	300	N	--	--	.60	N	7	30.0	15.0
GC031150	5.00	4.1	50	300	N	.7	2.1	.68	<150	5	30.0	20.0
GC006950	7.00	9.8	30	500	N	--	--	.30	N	15	50.0	20.0
GC042250	7.00	13.0	70	700	2.0	--	--	1.00	150	15	100.0	70.0
GC002850	3.00	10.0	70	300	N	--	--	.21	N	15	30.0	15.0
GC007150	7.00	22.0	50	500	N	--	--	.42	N	15	50.0	30.0
GC042150	7.00	18.0	70	700	2.0	--	--	.50	150	20	70.0	30.0
GC002650	2.00	7.5	30	300	N	--	--	.61	N	7	15.0	7.0
GC041950	3.00	7.3	30	500	1.5	--	--	.25	N	10	70.0	20.0
GC057450	10.00	5.2	50	500	1.5	--	4.4	1.10	N	7	50.0	30.0
GC002950	3.00	27.0	70	300	N	--	--	.11	N	10	30.0	20.0

Table 1.--Location, description, and concentration of elements for samples of surficial materials--continued

Sample No.	F %	Fe %	Ga ppm	Ge ppm	Hg ppm	I ppm	K %	La ppm	Li ppm	Mg %	Mn ppm	Mo ppm
GC052550	--	3.00	30	--	--	--	2.90	70	--	1.500	700	N
GC072250	--	3.00	15	1.23	.02	1.0	1.92	150	25	1.000	300	N
GC262450	.038	1.00	30	--	.02	--	4.20	200	39	.300	700	3
GC262650	.056	2.00	30	--	.05	--	3.60	150	36	1.000	700	N
GC262850	.042	1.00	20	--	.06	--	3.80	70	37	.700	300	<3
GC241750	.035	3.00	30	--	.08	--	2.34	70	42	1.500	700	N
GC241850	.049	2.00	30	--	.16	--	2.34	30	46	1.500	500	N
GC060150	.074	5.00	20	--	.02	--	1.30	30	22	1.500	700	N
GC062750	.041	2.00	15	--	.01	--	1.48	30	45	2.000	300	N
GC242550	.006	3.00	30	--	.03	--	2.19	N	18	1.500	700	N
GC015450	--	1.50	20	--	--	--	1.80	30	--	1.000	300	N
GC065650	.060	7.00	20	1.62	.04	1.0	2.09	50	30	1.500	1.000	N
GC065750	.060	1.00	10	1.13	.04	3.8	1.15	N	23	1.500	300	N
GC065850	.050	2.00	10	1.12	.08	4.6	1.62	N	30	1.500	200	N
GC078850	--	1.50	10	1.47	.02	1.9	1.36	N	20	1.000	300	N
GC263050	.071	2.00	30	--	.03	--	4.30	70	30	.700	500	3
GC003850	.006	2.00	15	--	.05	--	1.39	N	15	.300	500	N
GC003150	.015	2.00	15	--	.06	--	1.21	N	31	.500	300	3
GC031050	.060	5.00	20	1.62	.07	1.6	1.22	50	30	.500	150	10
GC031250	--	5.00	15	1.64	.13	1.7	1.73	70	55	.500	300	N
GC184350	.018	1.50	15	--	.08	--	1.00	30	44	.300	700	N
GC040250	.018	1.00	7	--	.06	--	1.80	N	7	.150	150	N
GC003250	.037	3.00	30	--	.04	--	1.66	N	37	.700	300	3
GC040350	.041	3.00	20	--	.06	--	2.00	70	22	.700	300	N
GC003350	.015	1.50	15	--	.25	--	1.18	N	18	.300	300	N
GC040750	.095	7.00	30	--	.35	--	1.90	N	24	1.500	700	N
GC003750	.028	2.00	15	--	.08	--	1.47	N	29	.700	1.500	N
GC040550	.047	3.00	30	--	.48	--	1.80	30	18	.500	700	N
GC040650	.027	3.00	30	--	.06	--	3.70	30	13	.300	300	N
GC003650	.036	3.00	20	--	.38	--	1.20	30	49	.700	2.000	N
GC003550	.006	1.50	15	--	.60	--	1.08	N	22	.300	300	N
GC003450	.055	3.00	30	--	.09	--	1.92	30	57	1.500	700	N
GC031350	.050	3.00	20	1.83	.08	1.3	1.38	50	40	.300	700	N
GC040450	.043	3.00	30	--	.08	--	2.50	30	17	.700	700	N
GC061550	.032	3.00	15	--	.03	--	1.21	30	43	.300	700	N
GC031550	.080	5.00	15	1.59	.06	2.2	.71	150	32	.300	500	N
GC184150	.039	1.50	15	--	.08	--	2.10	30	64	.700	300	N
GC184250	.031	1.50	15	--	.37	--	1.60	30	40	.300	300	N
GC031450	--	2.00	10	1.81	.07	3.1	.44	N	27	.200	70	N
GC040850	.016	2.00	10	--	.05	--	1.00	N	11	.300	700	N
GC031150	.040	2.00	10	1.47	.06	1.4	1.53	<30	20	.500	200	N
GC006950	.015	3.00	20	--	.13	--	1.60	30	32	.300	500	N
GC042250	.081	5.00	30	--	.10	--	2.50	70	46	.700	300	7
GC002850	.079	2.00	20	--	.18	--	1.42	30	28	.700	700	3
GC007150	.061	3.00	20	--	.22	--	1.90	30	45	.500	300	5
GC042150	.018	5.00	30	--	.08	--	1.60	70	32	.300	1.000	7
GC002650	.005	1.50	15	--	.08	--	1.18	N	10	.300	700	N
GC041950	.024	3.00	20	--	.03	--	1.30	50	25	.300	500	N
GC057450	.034	2.00	20	--	.59	<.5	2.00	30	39	.700	150	N
GC002950	.030	2.00	20	--	.06	--	1.62	30	44	.300	300	3

Table 1.--Locations, descriptions, and concentration of elements for samples of surficial materials--continued

Sample No.	Na %	Nb ppm	Nd ppm	Ni ppm	P %	Pb ppm	Rb ppm	S %	Sb ppm	Sc ppm	Se ppm	Si %
GC052550	2.00	10	--	15	.050	20	--	--	--	10	--	--
GC072250	.70	<10	150	10	--	10	90	<.08	<1	7	.5	31
GC262450	.70	15	100	7	.016	70	--	--	--	<5	.2	--
GC262650	3.00	20	70	20	.040	30	--	--	--	7	<.1	--
GC262850	1.00	10	70	10	.016	30	--	--	--	7	.2	--
GC241750	1.50	15	70	15	.135	30	--	--	--	15	.3	--
GC241850	1.00	15	N	15	.131	70	--	--	--	10	.8	--
GC060150	3.00	N	N	10	--	10	--	--	--	10	<.1	--
GC062750	2.00	N	N	15	--	15	--	--	--	15	.1	--
GC242550	1.50	N	N	30	.096	50	--	--	--	15	.4	--
GC015450	1.50	15	N	15	.044	15	--	--	--	7	--	--
GC065650	1.50	10	70	50	--	15	115	<.08	1	15	.5	27
GC065750	1.00	N	--	10	--	10	60	<.08	<1	5	.2	18
GC065850	1.00	N	--	15	--	15	75	.09	<1	5	<.1	24
GC078850	.70	<10	--	5	--	10	70	<.08	<1	5	.3	25
GC263050	.70	15	70	7	.050	20	--	--	--	7	.2	--
GC003850	.70	15	--	7	.057	N	--	--	--	7	.1	--
GC003150	.70	15	--	15	.035	15	--	--	--	10	.4	--
GC031050	.70	10	N	20	--	30	95	.31	<1	10	<.1	26
GC031250	.70	<10	70	20	--	20	120	<.08	<1	15	.2	29
GC184350	.70	10	70	20	.120	30	--	--	--	7	.6	--
GC040250	.30	<10	--	N	.016	10	--	--	--	N	<.1	--
GC003250	.70	15	--	15	--	30	--	--	--	15	.4	--
GC040350	1.00	10	70	15	.050	15	--	--	--	15	.4	--
GC003350	.70	15	--	7	.039	15	--	--	--	7	.4	--
GC040750	1.50	15	--	7	.090	15	--	--	--	15	<.1	--
GC003750	.70	15	--	15	.013	15	--	--	--	7	.2	--
GC040550	1.00	10	70	15	.100	30	--	--	--	7	.5	--
GC040650	1.50	15	N	N	.030	30	--	--	--	7	.4	--
GC003650	.70	15	N	20	.052	15	--	--	--	15	.5	--
GC003550	.70	15	--	7	.070	15	--	--	--	7	.6	--
GC003450	.70	15	70	15	.039	30	--	--	--	15	.5	--
GC031350	.50	10	N	15	.684	50	105	.08	1	7	<.1	27
GC040450	1.00	10	N	15	.040	15	--	--	--	7	.2	--
GC061550	.70	10	70	30	--	15	--	--	--	7	.3	--
GC031550	.50	<10	150	15	--	50	60	.09	1	5	<.1	32
GC184150	.70	15	70	30	.050	15	--	--	--	15	.4	--
GC184250	.70	15	N	20	.060	30	--	--	--	7	.5	--
GC031450	.50	10	--	5	--	20	30	<.08	1	5	<.1	36
GC040850	.50	10	--	15	.040	10	--	--	--	7	.1	--
GC031150	.70	<10	N	10	--	15	55	<.08	<1	7	.2	33
GC006950	.70	15	N	20	.020	20	--	--	--	10	1.1	--
GC042250	.70	15	70	30	.080	30	--	--	--	15	1.2	--
GC002850	.70	15	N	15	.022	30	--	--	--	10	.8	--
GC007150	.70	N	N	50	.020	20	--	--	--	10	.5	--
GC042150	.70	15	70	30	.030	30	--	--	--	15	.3	--
GC002650	.70	15	--	15	.035	15	--	--	--	7	<.1	--
GC041950	.70	15	70	20	.030	30	--	--	--	7	.1	--
GC057450	--	<10	<70	30	.109	15	--	--	--	15	1.0	29
GC002950	.50	15	N	15	.031	30	--	--	--	10	.3	--

Table 1.--Location, description, and concentration of elements for samples of surficial materials--continued

Sample No.	Sn ppm	Sr ppm	Ti %	Th ppm	U ppm	V ppm	Y ppm	Yb ppm	Zn %	Zr ppm
GC052550	--	500	.200	--	--	70	20	3.0	50	300
GC072250	.81	200	.200	12.74	2.87	70	20	3.0	58	150
GC262450	--	200	.150	--	--	30	30	3.0	45	150
GC262650	--	500	.300	--	--	50	50	5.0	45	300
GC262850	--	500	.150	--	--	30	30	3.0	45	200
GC241750	--	300	.200	--	--	70	30	5.0	90	150
GC241850	--	150	.150	--	--	70	30	3.0	110	150
GC060150	--	1,500	.300	--	--	100	20	2.0	79	70
GC062750	--	1,500	.200	--	--	100	30	3.0	73	100
GC242550	--	300	.300	--	--	150	30	3.0	90	100
GC015450	--	300	.150	--	--	50	20	2.0	45	100
GC065650	1.35	300	.500	8.51	3.25	150	20	2.0	113	300
GC065750	1.14	100	.100	8.25	1.99	30	10	2.0	60	70
GC065850	1.14	500	.200	11.49	1.87	30	10	1.0	51	100
GC078850	.72	300	.100	10.42	2.01	50	15	2.0	55	50
GC263050	--	300	.300	--	--	50	30	5.0	55	200
GC003850	--	30	.300	--	--	30	30	3.0	39	300
GC003150	--	70	.300	--	--	50	30	5.0	93	300
GC031050	1.91	150	.500	--	4.91	150	20	3.0	95	200
GC031250	1.89	150	.500	12.37	3.85	150	30	5.0	101	200
GC184350	--	70	.300	--	--	50	30	5.0	80	300
GC040250	--	70	.100	--	--	20	10	1.5	25	200
GC003250	--	70	.300	--	--	70	30	7.0	63	300
GC040350	--	200	.300	--	--	70	70	7.0	50	300
GC003350	--	70	.150	--	--	30	15	1.5	49	150
GC040750	--	200	.700	--	--	150	50	7.0	40	200
GC003750	--	30	.300	--	--	30	20	5.0	81	300
GC040550	--	150	.300	--	--	50	30	5.0	50	300
GC040650	--	150	.300	--	--	30	30	5.0	30	200
GC003650	--	30	.150	--	--	70	30	7.0	100	300
GC003550	--	50	.150	--	--	30	20	3.0	41	300
GC003450	--	70	.300	--	--	70	30	7.0	120	300
GC031350	2.71	100	.200	7.62	2.59	100	30	3.0	88	150
GC040450	--	150	.300	--	--	50	30	5.0	30	200
GC061550	--	70	.500	--	--	50	30	3.0	77	500
GC031550	1.74	70	.300	9.70	2.05	70	20	3.0	76	150
GC184150	--	100	.300	--	--	70	30	5.0	75	200
GC184250	--	100	.300	--	--	50	30	3.0	85	150
GC031450	2.16	30	.200	9.65	2.28	70	20	3.0	38	200
GC040850	--	70	.300	--	--	30	30	3.0	20	200
GC031150	1.19	150	.300	6.05	1.94	70	15	2.0	47	300
GC006950	--	70	.300	--	--	70	20	3.0	50	200
GC042250	--	300	.300	--	--	150	30	5.0	90	150
GC002850	--	70	.300	--	--	70	30	7.0	81	200
GC007150	--	100	.200	--	--	100	30	5.0	110	150
GC042150	--	200	.300	--	--	100	70	7.0	80	200
GC002650	--	70	.150	--	--	20	15	1.5	25	200
GC041950	--	150	.300	--	--	70	30	3.0	30	200
GC057450	--	200	.300	--	--	150	20	2.0	96	100
GC002950	--	30	.300	--	--	70	30	7.0	76	200

Table 1.--Location, description, and concentratic | elements for samples of surficial materials--cont ed

Sample No.	State	County	Latitude	Longitude	Date Colln.	Site and Soil Descriptions
GC007250	OH	MONTGOMERY	39 44	84 29	62 10	US 35 5 MI W NEW LEBANON; MEDIUM BROWN SILTY CLAY LOAM
GC042050	OH	MUSKINGUM	39 58	82 7	66 10	US 40 5 MI W ZANESVILLE; YELLOWISH-ORANGE SILTY LOAM
GC007050	OH	ROSS	39 17	82 51	62 10	US 50 3 MI W LONDONDERRY; MEDIUM BROWN LOAM
GC002750	OH	SANDUSKY	41 21	82 56	62 5	OHIO TPK COMM PERRY SERV AREA; OLIVE BROWNISH-GRAY CLAY
GC065350	OK	BEAVER	36 37	100 22	72 10	US 270 14 MI W SLAPOUT; CLAY LOAM
GC277450	OK	CIMARRON	36 45	102 30	69 1	US 385 1 MI N BOISE CITY; TAN PRAIRIE SOIL
GC199850	OK	CREEK	36 5	96 22	65 7	RT 51 6 MI W MANNFORD; YELLOW SANDSTONE LITHOSOL
GC200150	OK	CUSTER	35 47	98 43	65 7	RT 33 6 MI E THOMAS; LIGHT BROWN VERY SANDY LOAM
GC199650	OK	DELAWARE	36 11	94 53	65 7	RT 33 3 MI W FLINT; YELLOW LOAM LITHOSOL
GC065050	OK	GARFIELD	36 24	97 58	72 10	US 60 1 MI W ENID; BROWN SANDY SOIL
GC276650	OK	GARVIN	34 35	97 18	69 1	RT 7 11 MI S DAVIS; DARK BROWN ALLUVIUM
GC276950	OK	JACKSON	34 40	99 32	69 1	US 62 2 MI E DUKE; BLACK PRAIRIE SOIL
GC200050	OK	KINGFISHER	35 54	97 56	65 7	US 81 12 MI S HENNESEY; CHOCOLATE BROWN LOAM
GC276850	OK	KIOWA	34 37	98 43	69 1	US 62 4 MI W CACHE; BLACK PRAIRIE SOIL
GC276350	OK	LATIMER	34 55	95 15	69 1	US 270 3 MI E WILBURTON; LITHOSOL OVER SANDSTONE
GC276250	OK	LE FLORE	34 38	94 30	69 1	RT 128 2 MI W STATE LINE; RED AND GRAY MOTTLED CLAY OVER SHALE
GC065150	OK	MAJOR	36 25	98 48	72 10	RT 15 8 MI E JCT US 281; RED SANDY SOIL
GC064950	OK	NOBLE	36 18	97 10	72 10	US 64 8 MI E PERRY; BROWN SILTY LOAM
GC064850	OK	PAWNEE	36 14	96 25	72 10	US 64 8 MI SE CLEVELAND; BROWN SAND
GC199950	OK	PAYNE	36 5	97 10	65 7	RT 51 10 MI W STILLWATER; MEDIUM BROWN LOAM
GC276450	OK	PITTSBURG	34 57	96 1	69 1	US 270 4 MI W APELAR; LITHOSOL OVER SANDSTONE
GC276550	OK	PONTOTOC	34 44	96 41	69 1	RT 12 3 MI S ADA; LITHOSOL OVER SANDSTONE
GC200250	OK	ROGER MILLS	35 48	99 23	65 7	RT 47 3 MI E ANGORA; DARK BROWN SOIL OVER SANDSTONE
GC199750	OK	ROGERS	36 8	95 46	65 7	RT 33 AT CATOOSA; ORANGE, SANDY, OVER SANDSTONE
GC064750	OK	SEQUOYAH	35 30	95 0	72 10	I-40 1 MI W VIAN; BROWN SILTY LOAM
GC276750	OK	STEPHENS	34 35	98 2	69 1	RT 7 22 MI E LAWTON; DARK BROWN LOAM OVER SANDSTONE
GC065450	OK	TEXAS	36 37	101 14	72 10	RT 3 3 MI W HARDESTY; WHITE ALLUVIAL SAND
GC065550	OK	TEXAS	36 45	102 0	72 10	US 64 7 MI W RT 95 JCT; BROWN LOAM
GC065250	OK	WOODWARD	36 32	99 30	72 10	US 270 12 MI W WOODWARD; TAN SANDY SOIL
GC035050	OR	BAKER	44 53	117 55	65 8	US 30 7 MI NW BAKER; DARK GRAY CLAY LOAM
GC269650	OR	BENTON	44 36	123 32	68 9	US 20 2 MI W BLODGETT; B HORIZON SOIL
GC076550	OR	COLUMBIA	46 8	123 20	73 9	US 30 2 MI E WESTPORT; REDDISH-YELLOW LOAM
GC076850	OR	COOS	43 9	124 24	73 9	US 101 4 MI N BRANDON; SAND OF OLD BEACH DUNE
GC076950	OR	CURRY	42 30	124 24	72 9	US 101 12 MI N GOLD BEACH; DUNE SAND
GC060450	OR	DESCHUTES	43 48	120 28	70 10	US 20 AT BROTHERS; GRAY SILT DEVELOPED FROM PUMICE
GC269850	OR	DOUGLAS	43 28	123 25	68 9	RT 38 2 MI E REEDSPORT; B HORIZON SOIL
GC269950	OR	DOUGLAS	43 20	122 56	68 9	RT 138 7 MI SE KELLOGG; B HORIZON SOIL
GC270050	OR	DOUGLAS	43 15	122 10	68 9	RT 138 5 MI E IDLEYLD PARK; B HORIZON SOIL
GC035450	OR	GILLIAM	45 43	120 33	65 8	I-80N 3 MI W QUINTON; BROWN COLLUVIAL SILT AT FOOT OF BASALT WALL
GC269250	OR	GRANT	43 58	118 59	68 9	US 395 AT SENECA; B HORIZON SOIL
GC269350	OR	GRANT	44 24	119 4	68 9	US 395 AT BEACH CK. RECREATION AREA MALHEUR NAT. FOR.; B HORIZON SOIL
GC059850	OR	HARNEY	43 15	119 37	70 10	US 395 AT WAGONTIRE; SHALLOW GRAY SILT OVER PUMICE-BRECCIA
GC269150	OR	HARNEY	43 37	118 43	68 9	US 20 6 MI W BUCHANAN; B HORIZON SOIL
GC060550	OR	JEFFERSON	44 32	121 8	70 10	US 97 10 MI S MADRAS; SHALLOW GRAY SILT OVER VOLCANIC ROCK
GC270150	OR	KLAMATH	42 41	122 0	68 9	RT 138 5 MI N DIAMOND LAKE; B HORIZON SOIL
GC270250	OR	KLAMATH	42 2	121 35	68 9	RT 62 AT JCT WITH RT 232 2 MI S FT KLAMATH; B HORIZON SOIL
GC060350	OR	LAKE	42 28	120 16	70 10	US 395 2 MI S VALLEY FALLS; DARK SILT OVER BASALT
GC269750	OR	LINCOLN	44 30	124 5	68 9	US 101 AT SEAL ROCK; H HORIZON SOIL
GC034950	OR	MALHEUR	44 12	117 9	65 8	I-80N 15 MI NW ONTARIO; BROWNISH-GRAY SILT
GC060050	OR	MALHEUR	42 20	117 50	70 10	US 95 AT BLUE MT PASS; TAN SILT OVER BASALT

Table 1.--Location, description, and concentration of elements for samples of surficial materials--continued

Sample No.	Al %	As ppm	B ppm	Ba ppm	Be ppm	Br ppm	C %	Ca %	Ce ppm	Co ppm	Cr ppm	Cu ppm
GC007250	5.00	9.8	30	300	N	--	--	3.10	N	10	50.0	30.0
GC042050	7.00	9.9	70	700	1.5	--	--	.25	150	15	100.0	30.0
GC007050	5.00	8.0	30	500	N	--	--	.44	N	15	50.0	15.0
GC002750	5.00	9.1	70	300	N	--	--	.86	150	15	50.0	50.0
GC065350	5.00	5.1	20	700	1.5	.5	1.4	2.13	N	5	50.0	15.0
GC277450	5.00	3.8	<20	500	N	--	--	1.20	N	5	20.0	15.0
GC199850	2.00	3.4	50	200	N	--	--	.25	N	5	50.0	15.0
GC200150	2.00	1.9	N	500	N	--	--	.35	N	N	10.0	7.0
GC199650	1.50	12.0	N	300	N	--	--	.20	N	10	100.0	15.0
GC065050	3.00	2.4	20	500	N	<.5	.9	.31	N	3	15.0	7.0
GC276650	5.00	4.3	30	500	1.0	--	--	.65	N	5	30.0	20.0
GC276950	7.00	6.1	30	700	1.0	--	--	.65	150	7	50.0	20.0
GC200050	5.00	5.8	70	500	N	--	--	.45	N	7	70.0	15.0
GC276850	7.00	5.7	30	500	3.0	--	--	1.20	150	10	50.0	20.0
GC276350	3.00	30.0	20	300	3.0	--	--	.12	N	15	70.0	15.0
GC276250	>10.00	19.0	50	300	3.0	--	--	.06	150	15	100.0	50.0
GC065150	5.00	2.2	100	500	2.0	<.5	1.0	.86	N	7	70.0	15.0
GC064950	3.00	4.3	30	300	1.5	2.0	1.7	.42	<150	5	50.0	50.0
GC064850	2.00	2.0	20	200	N	<.5	.7	.21	<150	5	50.0	10.0
GC199950	2.00	3.3	50	150	N	--	--	.30	N	7	30.0	10.0
GC276450	2.00	27.0	N	200	2.0	--	--	.08	N	20	50.0	20.0
GC276550	3.00	7.7	20	150	N	--	--	5.30	N	3	30.0	10.0
GC200250	5.00	2.5	70	500	N	--	--	4.50	N	10	70.0	15.0
GC199750	2.00	6.4	30	150	N	--	--	.20	N	10	15.0	10.0
GC064750	3.00	7.7	50	300	N	<.5	1.3	.19	N	7	70.0	10.0
GC276750	1.50	3.4	20	300	N	--	--	.13	N	3	20.0	7.0
GC065450	2.00	2.1	<20	1,000	N	<.5	.7	1.94	N	N	20.0	3.0
GC065550	10.00	6.8	20	1,000	2.0	1.2	1.7	1.28	<150	10	50.0	20.0
GC065250	2.00	<.1	20	500	N	<.5	.4	.29	N	N	10.0	3.0
GC035050	7.00	3.9	N	500	N	--	--	10.20	--	10	50.0	30.0
GC269650	10.00	10.0	20	300	1.0	--	--	.45	N	3	100.0	70.0
GC076550	>10.00	4.5	<20	700	1.5	9.1	3.5	.45	N	7	100.0	20.0
GC076850	3.00	1.1	<20	500	N	.9	6.1	.36	N	N	150.0	10.0
GC076950	7.00	4.7	70	200	N	<.5	.3	3.03	--	10	2,000.0	7.0
GC060450	>10.00	3.5	N	1,000	1.5	--	--	1.52	N	7	20.0	20.0
GC269850	>10.00	2.8	20	1,500	N	--	--	.65	N	10	70.0	10.0
GC269950	>10.00	4.5	<20	300	1.0	--	--	4.10	N	15	3.0	7.0
GC270050	>10.00	2.6	20	700	N	--	--	2.40	N	10	20.0	70.0
GC035450	>10.00	2.3	N	700	N	--	--	3.80	N	30	50.0	30.0
GC269250	>10.00	12.0	30	70	1.0	--	--	2.40	N	15	30.0	150.0
GC269350	7.00	1.2	N	500	N	--	--	6.30	N	30	150.0	200.0
GC059850	10.00	7.8	20	700	1.5	--	--	1.16	<150	7	30.0	30.0
GC269150	>10.00	5.5	20	700	1.5	--	--	1.60	N	15	30.0	30.0
GC060550	10.00	3.2	<20	500	1.0	--	--	2.77	N	15	30.0	50.0
GC270150	>10.00	2.4	20	700	1.0	--	--	3.00	N	10	20.0	70.0
GC270250	>10.00	5.8	20	700	1.0	--	--	4.60	N	20	70.0	70.0
GC060350	>10.00	6.0	N	1,000	1.0	--	--	2.68	<150	15	30.0	50.0
GC269750	10.00	4.3	20	700	1.0	--	--	1.30	N	3	100.0	7.0
GC034950	>10.00	12.0	30	700	2.0	--	--	1.80	N	20	70.0	30.0
GC060050	10.00	8.9	N	1,500	1.5	--	--	1.58	<150	15	50.0	50.0

Table 1.--Location, description, and concentration of elements for samples of surficial materials--continued

Sample No.	F %	Fe %	Ga ppm	Ge ppm	Hg ppm	I ppm	K %	La ppm	Li ppm	Mg %	Mn ppm	Mo ppm
GC007250	.043	1.50	15	--	.08	--	1.80	30	29	1.000	500	N
GC042050	.026	3.00	30	--	.13	--	1.80	70	31	.300	700	3
GC007050	.013	1.50	15	--	.08	--	1.50	50	24	.300	1,000	N
GC002750	.018	3.00	30	--	.08	--	2.51	70	30	1.500	500	7
GC065350	--	2.00	10	1.36	.02	.7	2.05	N	15	.500	300	N
GC277450	.008	1.00	10	--	.03	--	1.90	N	13	.200	200	N
GC199850	.029	1.00	7	--	.06	--	.50	30	16	.150	150	N
GC200150	.013	.70	7	--	.02	--	1.40	N	8	.100	150	N
GC199650	.009	3.00	10	--	.05	--	.60	N	15	.100	700	N
GC065050	--	1.00	7	1.32	.03	.8	1.84	N	--	.100	100	N
GC276650	.023	1.50	10	--	.03	--	1.70	30	21	.300	700	N
GC276950	.040	2.00	15	--	.05	--	2.00	50	29	.700	500	N
GC200050	.003	1.50	10	--	.03	--	1.60	30	23	.500	300	N
GC276850	.038	3.00	15	--	.03	--	1.10	70	33	1.000	500	N
GC276350	.024	3.00	7	--	.11	--	.65	30	24	.150	2,000	N
GC276250	.007	5.00	30	--	.08	--	2.00	50	98	.700	500	N
GC065150	.050	3.00	15	.85	.03	.7	2.57	<30	38	1.500	300	N
GC064950	--	1.00	10	1.39	.02	1.3	1.10	50	16	.200	300	N
GC064850	--	.70	5	1.09	.02	<.5	.63	N	13	.100	200	N
GC199950	.005	1.00	5	--	.03	--	.40	30	16	.150	200	N
GC276450	.013	7.00	7	--	.06	--	.43	N	20	.100	2,000	N
GC276550	.004	1.00	7	--	.15	--	.55	N	16	.200	300	N
GC200250	.025	1.50	15	--	.03	--	2.20	N	46	3.000	300	N
GC199750	.017	1.50	5	--	.02	--	.37	30	10	.100	300	N
GC064750	--	2.00	7	1.55	.05	<.5	.81	50	16	.100	700	N
GC276750	.006	.50	5	--	.03	--	.60	N	11	.150	200	N
GC065450	--	.70	5	1.27	.01	1.4	2.17	N	--	.200	70	N
GC065550	.050	3.00	20	1.56	.04	1.7	1.92	70	22	.700	500	N
GC065250	--	.70	5	.96	.01	<.5	1.84	N	6	.100	150	N
GC035050	.042	1.50	15	--	.03	--	1.30	N	20	3.000	500	N
GC269650	.005	5.00	20	--	.19	--	1.00	N	29	.700	700	<3
GC076550	--	5.00	30	1.81	.09	9.6	1.56	N	25	.500	700	N
GC076850	--	1.00	15	.90	.02	.9	.77	N	15	.100	100	N
GC076950	--	3.00	10	1.51	.02	<.5	.44	N	15	1.500	500	N
GC060450	.032	3.00	20	--	.02	--	2.06	30	32	.700	500	3
GC269850	.020	3.00	15	--	.03	--	2.60	30	24	.700	700	N
GC269950	.090	7.00	30	--	.03	--	.85	N	16	2.000	700	3
GC270050	.018	5.00	20	--	.70	--	1.30	N	24	1.500	700	3
GC035450	.028	7.00	30	--	.06	--	1.40	N	15	2.000	1,000	5
GC269250	.046	5.00	15	--	.03	--	2.40	N	25	1.500	700	7
GC269350	.013	10.00	20	--	.04	--	.65	N	11	2.000	1,000	N
GC059850	.021	3.00	20	--	.03	--	2.53	50	33	.500	500	N
GC269150	<.001	5.00	30	--	.02	--	2.80	50	26	.700	700	5
GC060550	.018	5.00	20	--	.01	--	1.14	30	25	1.000	500	N
GC270150	.025	3.00	30	--	.08	--	1.40	N	23	2.000	700	3
GC270250	.015	7.00	20	--	.04	--	1.30	N	21	2.000	500	N
GC060350	.026	5.00	20	--	.06	--	1.30	50	15	.700	1,000	N
GC269750	.004	1.00	10	--	.04	--	1.70	N	19	.300	150	N
GC034950	.025	3.00	20	--	.07	--	1.90	50	30	.700	700	N
GC060050	.025	5.00	20	--	.04	--	2.63	70	27	.500	1,000	3

Table 1.--Location, description, and concentration of elements for samples of surficial materials--continued

Sample No.	Na %	Nb ppm	Nd ppm	Ni ppm	P %	Pb ppm	Rb ppm	S %	Sb ppm	Sc ppm	Se ppm	Si %
GC007250	1.00	N	N	20	.040	15	--	--	--	7	.6	--
GC042050	.70	15	70	30	.030	30	--	--	--	15	.5	--
GC007050	.70	15	N	20	.040	20	--	--	--	7	.3	--
GC002750	.70	15	70	30	.065	15	--	--	--	15	.5	--
GC065350	.70	<10	--	10	--	20	65	<.08	<1	7	.4	32
GC277450	.50	10	--	10	.016	15	--	--	--	5	.2	--
GC199850	.30	20	N	10	.008	N	--	--	--	5	<.1	--
GC200150	.70	N	N	5	.004	N	--	--	--	N	<.1	--
GC199650	.20	20	N	10	.024	30	--	--	--	N	.6	--
GC065050	.70	N	--	5	--	15	65	.09	<1	<5	<.1	36
GC276650	1.00	15	70	15	.040	20	--	--	--	7	.3	--
GC276950	.70	15	70	15	.030	20	--	--	--	10	.7	--
GC200050	.70	20	N	20	.012	15	--	--	--	7	.3	--
GC276850	.70	20	70	30	.016	15	--	--	--	10	.4	--
GC276350	.20	10	N	20	.100	15	--	--	--	7	.7	--
GC276250	.30	10	70	50	.040	30	--	--	--	15	.7	--
GC065150	.70	10	N	20	--	15	95	<.08	<1	10	<.1	34
GC064950	.70	10	N	10	--	20	50	.11	<1	7	.6	38
GC064850	.30	<10	--	7	--	N	35	<.08	<1	5	.1	41
GC199950	.15	20	N	10	.006	10	--	--	--	5	.1	--
GC276450	.15	10	--	30	.070	30	--	--	--	7	.9	--
GC276550	.20	10	--	15	.016	50	--	--	--	5	.2	--
GC200250	1.00	15	N	20	.024	20	--	--	--	10	.2	--
GC199750	.15	10	N	15	.012	10	--	--	--	5	.2	--
GC064750	.30	10	N	10	--	15	45	<.08	1	5	<.1	39
GC276750	.70	10	--	7	.008	<10	--	--	--	N	.2	--
GC065450	.70	N	--	<5	--	15	65	<.08	<1	N	<.1	33
GC065550	.70	10	70	20	--	20	100	.11	<1	10	<.1	30
GC065250	.50	<10	--	<5	--	15	55	<.08	<1	N	<.1	41
GC035050	3.00	N	N	15	.030	15	--	--	--	10	.3	--
GC269650	.30	10	--	15	.090	15	--	--	--	10	1.0	--
GC076550	1.00	<10	--	10	--	15	65	<.08	<1	10	1.1	26
GC076850	.70	<10	--	7	--	10	35	<.08	<1	N	.2	33
GC076950	.70	N	--	20	--	N	20	<.08	<1	10	<.1	33
GC060450	3.00	10	70	15	--	15	--	--	--	15	<.1	--
GC269850	1.50	15	N	15	.060	15	--	--	--	7	<.1	--
GC269950	1.50	10	--	<5	.040	10	--	--	--	30	<.1	--
GC270050	3.00	N	--	15	.060	10	--	--	--	10	.1	--
GC035450	2.00	15	N	20	.090	15	--	--	--	30	<.1	--
GC269250	1.00	10	--	30	.090	10	--	--	--	15	2.6	--
GC269350	1.50	20	--	50	.060	N	--	--	--	50	<.1	--
GC059850	3.00	<10	70	15	--	15	--	--	--	15	.3	--
GC269150	1.50	15	<70	20	.030	10	--	--	--	10	<.1	--
GC060550	2.00	<10	N	20	--	15	--	--	--	20	<.1	--
GC270150	3.00	10	--	15	.120	10	--	--	--	15	<.1	--
GC270250	1.50	10	--	50	.030	10	--	--	--	20	<.1	--
GC060350	3.00	10	70	20	--	15	--	--	--	15	<.1	--
GC269750	1.50	10	--	15	.016	10	--	--	--	7	.3	--
GC034950	1.50	30	N	30	.016	30	--	--	--	15	.2	--
GC060050	1.50	10	70	15	--	15	--	--	--	15	.1	--

Table 1.--Location, description, and concentration of elements for samples of surficial materials--continued

Sample No.	Sn ppm	Sr ppm	Ti %	Th ppm	U ppm	V ppm	Y ppm	Yb ppm	Zn %	Zr pp
GC007250	--	150	.200	--	--	70	20	2.0	70	100
GC042050	--	200	.700	--	--	70	70	7.0	50	300
GC007050	--	100	.300	--	--	50	30	5.0	45	300
GC002750	--	100	.300	--	--	150	50	7.0	91	200
GC065350	1.42	150	.300	8.15	3.04	70	20	3.0	36	500
GC277450	--	100	.200	--	--	30	10	2.0	30	150
GC199850	--	70	.300	--	--	30	20	3.0	--	300
GC200150	--	70	.100	--	--	20	10	1.0	--	200
GC199650	--	50	.300	--	--	70	30	3.0	--	200
GC065050	.94	70	.200	5.69	1.93	20	10	1.0	33	500
GC276650	--	70	.500	--	--	30	50	5.0	35	300
GC276950	--	150	.300	--	--	50	30	5.0	40	300
GC200050	--	70	.300	--	--	70	20	3.0	20	300
GC276850	--	150	.500	--	--	70	70	7.0	50	300
GC276350	--	70	.200	--	--	30	50	5.0	70	150
GC276250	--	100	.500	--	--	150	50	5.0	90	150
GC065150	.43	100	.200	7.30	2.03	70	15	3.0	60	150
GC064950	.40	100	.300	7.59	3.36	50	20	5.0	96	700
GC064850	.12	50	.300	8.69	2.56	20	15	3.0	21	700
GC199950	--	20	.300	--	--	50	20	3.0	--	300
GC276450	--	30	.150	--	--	30	20	3.0	85	100
GC276550	--	50	.150	--	--	30	20	2.0	95	150
GC200250	--	150	.200	--	--	70	20	3.0	35	150
GC199750	--	70	.200	--	--	30	15	1.5	--	100
GC064750	1.62	70	.500	9.49	3.43	50	50	5.0	65	500
GC276750	--	30	.150	--	--	20	30	3.0	15	500
GC065450	.47	100	.150	5.77	1.49	20	<10	1.0	15	150
GC065550	1.31	300	.200	10.34	3.04	150	50	7.0	97	300
GC065250	<.10	50	.150	--	1.34	20	15	2.0	20	200
GC035050	--	1,000	.200	--	--	100	15	2.0	35	70
GC269650	--	100	.300	--	--	70	15	2.0	50	150
GC076550	1.34	300	.300	11.02	2.25	150	10	2.0	93	100
GC076850	1.74	150	.100	3.09	1.07	70	<10	1.5	16	100
GC076950	.28	200	.150	--	.68	150	15	3.0	39	200
GC060450	--	500	.300	--	--	70	30	3.0	75	150
GC269850	--	300	.300	--	--	50	30	2.0	55	200
GC269950	--	500	.700	--	--	200	30	3.0	65	70
GC270050	--	500	.300	--	--	70	30	2.0	35	150
GC035450	--	700	1.000	--	--	200	30	5.0	75	150
GC269250	--	300	.300	--	--	200	30	3.0	310	150
GC269350	--	300	1.000	--	--	500	30	5.0	65	70
GC059850	--	500	.200	--	--	70	50	5.0	99	100
GC269150	--	300	1.000	--	--	70	70	7.0	50	200
GC060550	--	500	.500	--	--	150	30	3.0	88	100
GC270150	--	700	.300	--	--	70	20	3.0	40	100
GC270250	--	700	.500	--	--	150	30	2.0	50	100
GC060350	--	700	.700	--	--	150	30	3.0	97	150
GC269750	--	300	.200	--	--	30	10	1.5	20	70
GC034950	--	500	.700	--	--	150	30	5.0	45	200
GC060050	--	300	.700	--	--	100	50	3.0	116	200

SAMPLE NO.	STATE	COUNTY	LATI-TUDE	LONGI-TUDE	DATE COLLECTED	LOCATION, DESCRIPTION, AND CONCENTRATION (PPM) OF ELEMENTS	
						BISMUTH	
0C171650	AZ	PINAL	33 18	111 5	64 5	US 60-70 W EDGE OF SUPERIOR; STONY ROUGH SOIL	15
250450	CA	INYO	36 28	117 52	66 6	RT 190 OWENS LAKE 5 MI S KEELER; SAND NEAR PLAYA	15
						CADMIUM	
060250	CA	KERN	35 30	119 38	70 7	JCT RT 33 AND UNNUMBERED RD 10 MI NW BUTTONWILLOW; SOIL NOT DESCRIBED	1.0
242750	CA	NEVADA	39 14	121 2	66 7	I-40 AT CISCO; SOIL NOT DESCRIBED	1.0
243150	CA	SANTA CLARA	36 58	121 33	66 7	US 101 AT RT 152 EXIT GILROY; SOIL NOT DESCRIBED	10.0
270650	CA	SHASTA	40 31	121 30	68 9	IN LASSEN VOLCANIC N.P. 3 MI SE MANZANITA LAKE; B HORIZON SOIL	1.0
185450	CO	MOFFAT	40 15	108 40	65 6	US 40 5 MI E MASSADONA; BROWN CLAYEY SILT 8 IN. DEPTH	1.0
066950	CO	SUMMIT	39 33	106 9	72 9	US 6 .5 MI E OFFICERS GULCH CAMPGROUND; BROWN GRAVELLY SOIL ON TILL	11.0
155850	KS	BOURBON	37 45	94 55	63 10	US 54 10 MI W FT. SCOTT; DARK PRAIRIE SOIL OVER LIMESTONE	1.5
024850	KS	LOGAN	39 7	101 44	71 10	US 40 AT OAKLEY; BLACK PRAIRIE SOIL	2.0
023550	MT	CASCADE	47 32	111 10	71 5	1 MI NORTH MALSTROM AIR BASE; CULTIVATED, PLOW ZONE	2.0
191350	NM	CHAVES	33 22	104 50	65 6	US 70 18 MI SW ROSWELL; VERY DRY, TAN, MANY CHERT FRAGMENTS	1.5
042250	OH	AUGLAIZE	40 30	83 55	66 10	US 33 1 MI NW LAKEVIEW; BROWN SILTY LOAM CULTIVATED	1.0
267450	SD	BROWN	45 25	98 7	68 8	RT 37 1 MI S GROTON; GRAY MOTTLED B HORIZON LACUSTRINE CLAY, GRASSLAND	1.0
152150	TX	HARRIS	29 47	95 38	63 7	US 90 2 MI E ADDICKS; DARK ALLUVIAL CLAY	1.0
022750	VA	WYTHE	36 58	80 57	72 9	RT 121 AT MAX MEADOWS; MUCK	4.0
056050	WI	POLK	45 31	92 35	70 5	RT 35 2 MI S LUCK; YELLOW SANDY LOAM	1.0
						PRASEODYMIUM	
070350	AL	MONTGOMERY	32 17	86 12	73 1	US 231 5 MI S MONTGOMERY; SANDY LOAM	100
						SILVER	
171450	AZ	COCONINO	34 33	111 18	64 5	RT 87 AT CLINTS WELL; DARK FOREST SOIL	3.0
033150	CO	CLEAR CREEK	39 47	105 47	65 8	US 40 ON BERTHOUD PASS; BROWN, ON GRANITE AND GNEISS RUBBLE	2.0
186250	ID	BANNOCK	42 47	112 24	65 6	I-15 8 MI SE POCATELLO; BROWN SILT, 4 IN. DEPTH	3.0
023550	MT	CASCADE	47 32	111 10	71 5	1 MI NORTH MALSTROM AIR BASE; CULTIVATED, PLOW ZONE	.7
263150	UT	SUMMIT	40 52	111 15	68 7	I-80 2 MI S RT 133 EXIT NEAR STREAM BED; BLACK ORGANIC ALLUVIUM	5.0
022750	VA	WYTHE	36 58	80 57	72 9	RT 121 AT MAX MEADOWS; MUCK	3.0