MASTER

DATA REPORT: ILLINOIS, INDIANA, KENTUCKY, TENNESSEE, AND OHIO

NATIONAL URANIUM RESOURCE EVALUATION PROGRAM

HYDROGEOCHEMICAL AND STREAM SEDIMENT RECONNAISSANCE

**KENNETH A. SARGENT, JAMES R. COOK,
AND WILLIAM M. FAY**

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ABSTRACT

This report presents the results of ground water, stream water, and stream sediment reconnaissance in Illinois, Indiana, Kentucky, Tennessee, and Ohio. The following sample types were collected in each state:

	<u>Stream Sediment</u>	<u>Ground Water</u>	<u>Stream Water</u>
Illinois	716	1046	337
Indiana	126	443	111
Kentucky	4901	6408	3966
Tennessee	3309	3574	1584
Ohio	1214	2049	1205

Neutron activation analyses are given for U, Br, Cl, F, Mn, Na, Al, V, and Dy in ground water and stream water, and for U, Th, Hf, Ce, Fe, Mn, Na, Sc, Ti, V, Al, Dy, Eu, La, Sm, Yb, and Lu in sediments. Supplementary analyses by other techniques are reported for U (extractable), Ag, As, Ba, Be, Ca, Co, Cr, Cu, K, Li, Mg, Mo, Nb, Ni, P, Pb, Se, Sn, Sr, W, Y, and Zn. These analyses were made on 248 sediment samples from Tennessee. Field measurements and observations are reported for each site. Oak Ridge National Laboratory analyzed sediment samples which were not analyzed by Savannah River Laboratory neutron activation.

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DATA REPORT: ILLINOIS, INDIANA, KENTUCKY, TENNESSEE, AND OHIO

INTRODUCTION

The National Uranium Resource Evaluation (NURE) program was established to evaluate domestic uranium resources in the continental United States and to identify areas favorable for uranium exploration. The Grand Junction Office (GJO) of the U. S. Department of Energy (DOE) is responsible for administering the program. The Savannah River Laboratory (SRL) is responsible for hydrogeochemical and surface sediment reconnaissance (HSSR) of 3.9 million square kilometers (1.5 million square miles) in 37 eastern and western states.

The data presented here are reconnaissance data intended for use in identifying broad areas for further study. While care has been taken to provide reliable sampling and analysis, verification of individual analyses is beyond the scope of this report. The data should be viewed statistically because "one-point anomalies" may be misleading. Regional trends, however, should be reliable.

This report is one of a series presenting SRL reconnaissance data by state. Sampling procedures are detailed in a field manual assembled specifically for this program (Price and Jones, 1979). A summary of the SRL development program in support of the reconnaissance is available in SRL-NURE progress reports (SRL-138, see references). SRL data reports (SRL-146, see references) covering parts of Illinois, Indiana, Kentucky, Tennessee, and Ohio have previously been released. Figure 1 presents a location map showing the reported areas. The data within the present report may not be identical with those reported previously. This is due to the use of different "scrub" procedures for the preparation of the data for release. The differences should be minor. The data are presented in tabular form on microfiche at the end of this report and are also available on magnetic tape from:

Bendix Field Engineering Corp.
Technical Library
P. O. Box 1569
Grand Junction, CO 81501

FIGURE 1. Map of Quadrangles Included in SRL Data and Supplemental Data Reports (SRL Data Reports have been released for the quadrangles marked with a ruled pattern.)

DATA PRESENTATION

The data in this report are presented in tables on microfiche. Sediment samples were collected from 10,266 sites (Figure 2). Figure 3 shows the geographic distribution of the 4563 sediments which were analyzed by neutron activation techniques. Figure 4 shows the geographic distribution of the 248 sediments which were analyzed by the supplemental analytical techniques. Oak Ridge National Laboratory (ORNL) analyzed sediments by other methods. The sediments chosen were those not analyzed by SRL neutron activation.

Ground water samples were collected at 13,520 sites and analyzed by neutron activation techniques. The geographic distribution of these sites is given in Figure 5.

Stream water samples from 7203 sites were returned for neutron activation analysis. The geographic distribution of these samples is given in Figure 6.

FACTORS AFFECTING THE DATA

The data reported here represent sampling and analytical efforts that span several years. Consequently, some variations should occur in the data due to seasonal variations, sampling changes, and changing analytical parameters.

Sampling in one area may have been accomplished in summer and in an adjacent area in winter. Thus, seasonal effects may affect the data. Sampling and analysis were done either by county or $1^{\circ} \times 2^{\circ}$ NTMS quadrangle. Thus, adjacent areas may have been sampled and/or analyzed at different times. The neutron activation facility, as it was being used, was evolving in terms of analytical precision and accuracy. Consequently, later analyses can differ from those performed earlier. This can result in apparent geochemical boundaries that are coincident with county or quadrangle boundaries. The sampling date appears in the tables. The analysis date, while not appearing in the tables, is included on the magnetic tape.

Sampling density can also affect the interpretation of these data. Coastal Plain areas were sampled for ground water at a higher density than other areas and for sediment at a lower density. Adjacent areas may not be sampled at the same density since later surveys were sometimes made at higher densities. Some areas were not sampled due to urban or industrial contamination, geographic inaccessibility (swamp, lake, etc.), or lack of permission to sample. Additionally, some counties or portions of counties were inadvertently left out of the analytical schedule. Careful attention should be paid to the site location maps before interpretation of geochemical trends.

FIGURE 2. Sediment Sample Sites

FIGURE 3. Analyzed Sediment Samples

FIGURE 4. Supplemental Sediment Analyses

FIGURE 5. Ground Water Sample Sites

FIGURE 6. Stream Water Sample Sites

At least 8% of the sample sites were routinely checked by SRL personnel or by a specified subcontractor to assure that the reported field locations were accurate. Based on these quality assurance checks, more than 98% of the sampled sites were judged to be located as accurately as they could be plotted on county road maps. No evidence has been discovered of deliberate malfeasance by the sampling teams. Most sites that were mapped incorrectly were within 300 meters of their correct locations. Thus, the goals of the regional reconnaissance have not been compromised by mapping errors. Details of the quality assurance program are given in the progress reports (SRL-138, see references).

Analytical precision was assured by analyzing standard sediment samples, along with the NURE samples. Analyses of these standards (SRL 2.2, 3.1, and 4.1) provide routine checks of the analytical equipment and software. Tables 1, 2, and 3 contain some results from the standards and are representative of the analytical precision.

SAMPLE COLLECTION AND FIELD MEASUREMENTS

Sampling personnel were trained by SRL staff members according to procedures in published SRL documents (Price and Jones, 1979).

A minimum of five sediment subsamples was composited from each stream site. Approximately 400 grams of sediment passing a 420 micrometer screen (U. S. Std. 40 mesh) were collected at each surface site. Dissolved ions in individual water samples were concentrated on portions of ion exchange resin and returned for analysis. In selected areas, separate ground water samples were collected for laboratory analysis of helium and neon.

Nominal ground water and stream sampling density in rural areas varies from 13 to 25 square kilometers (5 to 10 square miles) per site, depending upon the geology of the area. In areas of crystalline rock, surface sampling is generally denser than ground water sampling. In areas of sedimentary rocks, the converse is true. Areas thought to have relatively high uranium potential are sampled more densely than those thought to have lower potential.

Sampling site locations were marked precisely on compilation maps. The maps were returned to SRL for determination of geographic coordinates. An electronic digitizer was used to measure, verify, and enter latitude and longitude data for each site into the SRL-NURE data base. These data are recorded to four decimal places but are considered reliable to only three decimal places.

TABLE 1

Statistical Summary of Analytical Results for SRL 2.2
Sediment Standard

<u>Element</u>	<u>Number</u>	<u>Mean, ppm</u>	<u>Coefficient of Variation, %</u>	<u>Probable Value, ppm</u>
U	294	21.8	5.8	22.2
Th	295	114	15.2	125
Hf	296	146	18.1	156
Al	289	7000	10.8	6500
Ce	288	534	15.5	614
Fe	273	6600	26.2	6700
Mn	266	275	15.8	300
Sc	297	3.41	26.8	3.9
Na	278	150	36.3	145
Ti	271	12,400	20.6	13,200
V	282	33.7	16.9	34.7
Dy	275	27.3	38.0	<22
Eu	175	2.74	35.4	2.5
La	276	279	17.5	301
Lu	253	2.55	13.2	2.9
Sm	280	47.7	38.2	51.3
Yb	294	15.9	21.3	18.2

TABLE 2

Statistical Summary of Analytical Results for SRL 3.1
Sediment Standard

<u>Element</u>	<u>Number</u>	<u>Mean, ppm</u>	<u>Coefficient of Variation, %</u>	<u>Probable Value, ppm</u>
U	162	42.0	5.0	41.3
Th	163	166	15.5	162
Hf	44	4.7	39.2	7.2
Al	132	37,000	16.6	30,600
Ce	149	913	17.5	903
Fe	160	16,000	19.3	15,200
Mn	156	283	16.4	289
Sc	169	4.55	36.7	4.19
Na	167	1030	30.6	901
Ti	114	5870	15.9	6100
V	147	50.6	17.0	54.4
Dy	135	71.2	20.9	50*
Eu	151	3.90	29.3	3.86
La	153	470	16.4	443
Lu	152	4.78	17.3	4.4
Sm	159	68.8	36.6	69.2
Yb	161	33.1	18.6	29.9

* Only one laboratory reported a value for dysprosium.

TABLE 3

Statistical Summary of Analytical Results for SRL 4.1
Sediment Standard

<u>Element</u>	<u>Number</u>	<u>Mean, ppm</u>	<u>Coefficient of Variation, %</u>	<u>Probable Value, ppm</u>
U	159	0.56	11.8	0.58
Th	93	2.4	42.3	2.1
Hf	122	3.2	46.4	3.3
Al	112	71,000	15.7	66,700
Ce	105	59	22.8	44
Fe	156	85,500	14.6	87,300
Mn	141	1850	16.8	1970
Sc	158	20	34.4	21
Na	153	18,800	15.6	16,100
Ti	91	26,700	14.6	25,200
V	136	259	16.1	273
Dy	16	7.3	29.2	<22
Eu	79	1.47	37.2	1.16
La	157	18.2	18.1	18.6
Lu	129	0.22	31.4	0.28
Sm	152	3.4	24.6	4.2
Yb	60	2.1	47.8	1.6

METHODS OF ANALYSIS

The analyses for U, Th, Hf, Ce, Fe, Mn, Na, Sc, Ti, V, Al, Dy, Eu, La, Sm, Yb, Lu, Br, Cl, and F were performed by automated neutron activation analysis (NAA). Sediment samples were dried at 105°C, sieved to <149 µm (100 mesh), blended, coned, and quartered. One and a half-gram aliquots of the <149 µm material were packed into ultrapure polyethylene capsules for analysis. The encapsulated samples, in batches of 25, including one standard and one blank, were loaded into the NAA pneumatic system. Transport into the irradiation assembly and counting stations and the collection and processing of data were computer-controlled.

Each ground water sample was treated with a 10-gram portion of ultrapure mixed cation-anion exchange resin that collected all dissolved ions from the water. The volumes of water ranged from 50 to 1000 mL, depending upon sample conductivity. Resin samples were dried at 105°C and packed in ultrapure polyethylene capsules for analysis. The encapsulated samples were loaded into the NAA pneumatic system in batches of 25, including one blank. Standards were included in every fourth batch.

Uranium was determined by counting neutrons emitted by induced fission products of ^{235}U in the sample. Other elements were determined by computer reduction of gamma-ray spectra collected at intervals from a few seconds to about 10 days after irradiation. Delayed counts were not made for resin samples. Details of the activation analysis system at SRL have been presented elsewhere (see References 1 and 3-J).

Stream sediments were analyzed for supplemental elements by a subcontractor. Methods of sample dissolution and analysis for each element are given in Figure 7. A summary of the analytical results for 100 test standards (unknown to the vendor) is shown in Table 4. Analytical results are well within specifications. A standard and blank were analyzed with each group of 40 samples. Extractable uranium was determined after a 30-minute leach using hot (180°C) 4:1 nitric and perchloric acids.

Oak Ridge National Laboratory analyzed sediment samples by methods shown in Table 5. The sediment samples analyzed by Oak Ridge were those not analyzed by SRL using neutron activation.

FIGURE 7. Analysis Scheme for Supplemental Elements

PHASE II:

FIGURE 7. Continued

PHASE III:

FIGURE 7. Continued

TABLE 4

Results of Certification Test for Supplemental Analyses*

Element**	Concentration, ppm		Diff.	Accuracy, [†] %	Relative Precision (3 σ), %
	Accepted	Measured			
Ag	29.4	33.6	4.2	12	5
Ba	498	508	10	2	6
Be	13.6	15.1	1.5	1	15
Co	49.6	46.4	-3.2	-7	10
Cr	149	152	3	2	22
Cu	50.1	51.1	1.0	2	24
K	5020	5170	155	3	5
Li	150	147	-3	-2	6
Mg	5000	5150	154	3	3
Mo	25	25	0	0	12
Nb	49.9	47.5	-2.4	-5	27
Ni	149	139	-10	-7	6
P	802	794	-8	-1	17
Pb	308	335	27	12	5
Sn	125	121	-4	-3	14
Sr	970	1170	199	17	10
W	150	148	-1.5	-1	16
Y	490	434	-56	-13	12
Zn	120	112	-8	-7	4

* Standards included the geochemical soil standards and rock standards currently available from U.S. Geological Survey, SRL stream sediment standards doped with varying levels of the elements, and synthetic standards.

** No statistical data have been collected for As, Se, Ca, Th, and extractable U.

[†] "Accuracy" is a measure of deviation from the accepted value.

TABLE 5

Oak Ridge National Laboratory's Elemental Determination
Methods and Detection Limits

<u>Variable</u>	<u>Method</u>	<u>Detection Limit, ppm</u>
U-FL	Fluorometry	-
U-NT	Neutron Activation-Delayed Neutron Count	0.02
Ag	Plasma Source Emission Spectrometry	2
Al	Plasma Source Emission Spectrometry	0.05*
B	Plasma Source Emission Spectrometry	10
Ba	Plasma Source Emission Spectrometry	2
Be	Plasma Source Emission Spectrometry	1
Ca	Plasma Source Emission Spectrometry	0.05*
Ce	Plasma Source Emission Spectrometry	10
Co	Plasma Source Emission Spectrometry	4
Cr	Plasma Source Emission Spectrometry	1
Cu	Plasma Source Emission Spectrometry	2
Fe	Plasma Source Emission Spectrometry	0.05*
Hf	Plasma Source Emission Spectrometry	15
K	Plasma Source Emission Spectrometry	0.05*
La	Plasma Source Emission Spectrometry	2
Li	Plasma Source Emission Spectrometry	1
Mg	Plasma Source Emission Spectrometry	0.05*
Mn	Plasma Source Emission Spectrometry	4
Mo	Plasma Source Emission Spectrometry	4
Na	Plasma Source Emission Spectrometry	0.05*
Nb	Plasma Source Emission Spectrometry	4
Ni	Plasma Source Emission Spectrometry	2
P	Plasma Source Emission Spectrometry	5
Pb	Plasma Source Emission Spectrometry	10
Sc	Plasma Source Emission Spectrometry	1
Si	Plasma Source Emission Spectrometry	-
Sr	Plasma Source Emission Spectrometry	1
Th	Plasma Source Emission Spectrometry	2
Ti	Plasma Source Emission Spectrometry	10
V	Plasma Source Emission Spectrometry	2
Y	Plasma Source Emission Spectrometry	1
Zn	Plasma Source Emission Spectrometry	2
Zr	Plasma Source Emission Spectrometry	2

* Detection limits expressed in percent.

USER'S GUIDE TO DATA TABLES ON MICROFICHE

This guide provides a detailed description of the format, abbreviations, and codes used in the data tables within this report. The data are presented in tabular form on microfiche included at the end of this report. The data are divided by state, and the microfiche are labeled accordingly.

Ground water analyses and site descriptions are given in Tables A-1 and A-2.

Table A-1 contains the following information:

SRL Identification Number	Each SRL identification site code consists of seven characters. The first two give the state using standard U.S. Postal Service abbreviations. Characters three and four designate the county. The county abbreviations used are given in Table 6. Sites are numbered sequentially within each map unit (characters five, six, and seven). Numbers 501 to 998 are used for ground water samples. An "R" in column eight means that ion exchange resin was analyzed for all elements reported except for helium.
DOE Identification Number	Each DOE identification number consists of 28 characters as follows: 1-2 State (see Table 7) 4-10 Latitude of site 12-19 Longitude of site 21 Laboratory code (4=SRL) 23-24 Sample type (see Table 8) 26-28 Not used in this report (-000)
pH	Normally, pH will be in the range of 4.0 to 9.5. Values far outside this range may suggest instrument malfunction or pollution.
COND	Conductivity, measured in micromhos/cm.

TABLE 6

County Abbreviations Used in the SRL I.D.

<u>County</u>	<u>Code</u>	<u>County</u>	<u>Code</u>
<u>Illinois</u>		<u>Indiana (Cont'd)</u>	
Alexander	AL	Gibson	GI
Franklin	FR	Grant	GR
Gallitin	GA	Greene	GE
Hamilton	HM	Hamilton	HA
Hardin	HR	Hancock	HN
Jackson	JA	Harrison	HR
Johnson	JO	Hendricks	HE
Massac	MC	Henry	HY
Perry	PR	Howard	HO
Pope	PO	Huntington	HU
Pulaski	PU	Jackson	JA
Randolph	RA	Jasper	JS
Saline	SA	Jay	JY
Union	UN	Jefferson	JE
White	WH	Jennings	JN
Williamson	WL	Johnson	JO
		Knox	KN
		Kosciusko	KO
<u>Indiana</u>		Lagrange	LA
Adams	AD	Lake	LK
Allen	AL	LaPorte	LP
Bartholomew	BA	Lawrence	LW
Benton	BE	Madison	MD
Blackford	BL	Marion	MR
Boone	BO	Marshall	MS
Brown	BR	Martin	MT
Carroll	CA	Miami	MI
Cass	CS	Monroe	MO
Clark	CL	Montgomery	MN
Clay	CY	Morgan	MG
Clinton	CI	Newton	NE
Crawford	CR	Noble	NO
Davies	DA	Ohio	OH
Dearborn	DE	Orange	OR
Decatur	DC	Owen	OW
Dekalb	DK	Parke	PA
Delaware	DL	Perry	PE
Dubois	DU	Pike	PI
Elkhart	EL	Porter	PO
Fayette	FA	Posey	PS
Floyd	FL	Pulaski	PU
Fountain	FO	Putnam	PT
Franklin	FR	Randolph	RA
Fulton	FU		

TABLE 6 (Continued)

<u>County</u>	<u>Code</u>	<u>County</u>	<u>Code</u>
<u>Indiana (Cont'd)</u>		<u>Kentucky (Cont'd)</u>	
Ripley	RI	Campbell	CM
Rush	RU	Carlisle	CR
St. Joseph	SJ	Carroll	CO
Scott	SC	Carter	CT
Shelby	SH	Casey	CS
Spencer	SP	Christian	CH
Starke	ST	Clark	CK
Steuben	SU	Clay	CY
Sullivan	SL	Clinton	CI
Switzerland	SW	Crittenden	CE
Tippecande	TI	Cumberland	CU
Tipton	TP	Daviess	DA
Union	UN	Edmonsun	ED
Vanderburgh	VA	Elliot	EL
Vermillion	VE	Estill	ES
Vigo	VI	Fayette	FA
Wabash	WA	Fleming	FL
Warren	WR	Floyd	FO
Warrick	WK	Franklin	FR
Washington	WS	Fulton	FU
Wayne	WY	Gallatin	GA
Wells	WE	Garrard	GR
White	WH	Grant	GN
Whitley	WI	Graves	GV
		Grayson	GY
		Green	GE
<u>Kentucky</u>		Greenup	GU
Adair	AD	Hancock	HA
Allen	AL	Hardin	HR
Anderson	AN	Harlan	HL
Ballard	BA	Harrison	HI
Barren	DR	Hart	HT
Bath	BT	Henderson	HE
Bell	BE	Henry	HN
Boone	BO	Hickman	HC
Bourbon	BU	Hopkins	HO
Boyd	BY	Jackson	JA
Boyle	BL	Jefferson	JE
Bracken	BC	Jessamine	JS
Breathitt	BH	Johnson	JO
Breckenridge	BK	Kenton	KE
Bullitt	BI	Knott	KN
Butler	UT	Knox	KO
Caldwell	CA	Larue	LA
Calloway	CL		

TABLE 6 (Continued)

<u>County</u>	<u>Code</u>	<u>County</u>	<u>Code</u>
<u>Kentucky (Cont'd)</u>		<u>Kentucky (Cont'd)</u>	
Laurel	LU	Simpson	SI
Lawrence	LW	Spencer	SP
Lee	LE	Taylor	TA
Leslie	LS	Todd	TO
Letcher	LT	Trigg	TR
Lewis	LI	Trimble	TI
Lincoln	LN	Union	UN
Livingston	LV	Warren	WA
Logan	LO	Washington	WS
Lyon	LY	Wayne	WY
McCracken	MC	Webster	WE
McCreary	ME	Whitley	WH
McLean	ML	Wolfe	WO
Madison	MA	Woodford	WD
Magoffin	MG		
Marion	MR	<u>Tennessee</u>	
Marshall	MS	Anderson	AN
Martin	MT	Bedford	BE
Mason	MO	Benton	BN
Meade	MD	Bledsoe	BL
Menifee	MN	Blount	BO
Mercer	ER	Bradley	BR
Metcalf	MF	Campbell	CA
Monroe	ON	Cannon	CN
Montgomery	MM	Carroll	CR
Morgan	OR	Carter	CT
Muhlenberg	MU	Cheatham	CH
Nelson	NE	Chester	CE
Nicholas	NI	Claiborne	CL
Ohio	OH	Clay	CY
Oldham	OL	Cocke	CO
Owen	OW	Coffee	CF
Owsley	OS	Crockett	CK
Pendleton	PE	Cumberland	CU
Perry	PR	Davidson	DA
Pike	PI	Decatur	DE
Powell	PO	Dekalb	DK
Pulaski	PU	Dickson	DI
Robertson	RO	Dyer	DY
Rockcastle	RC	Fayette	FA
Rowan	RW	Fentress	FE
Russell	RU	Franklin	FR
Scott	SC	Gibson	GI
Shelby	SH	Giles	GL

TABLE 6 (Continued)

<u>County</u>	<u>Code</u>		<u>County</u>	<u>Code</u>
<u>Tennessee</u> (Cont'd)				
Grainger	GR		Roane	RO
Greene	GE		Robertson	RB
Grundy	GU		Rutherford	RU
Hanblen	HA		Scott	SC
Hamilton	HM		Sequatchie	SE
Hancock	HN		Sevier	SV
Hardeman	HZ		Shelby	SH
Hardin	HD		Smith	SM
Hawkins	HW		Steward	ST
Haywood	HY		Sullivan	SL
Henderson	HE		Sumner	SU
Henry	HR		Tipton	TI
Hickman	HI		Trousdale	TR
Houston	HO		Unicoi	UC
Humphreys	HU		Union	UO
Jackson	JA		Van Buren	VB
Jefferson	JE		Warren	WA
Johnson	JO		Washington	WS
Knox	KN		Wayne	WY
Lake	LA		Weakley	WE
Lauderdale	LU		White	WH
Lawrence	LW		Williamson	WI
Lewis	LE		Wilson	WL
Lincoln	LI			
Loudon	LO	<u>Ohio</u>		
McMinn	MI		Adams	AD
McNairy	MC		Allen	AL
Macon	MA		Ashland	AS
Madison	MD		Ashtabula	AH
Marion	MR		Athens	AT
Marshall	MS		Auglaize	AU
Maurry	MU		Belmont	BE
Meigs	MG		Brown	BR
Monroe	MO		Butler	BU
Montgomery	MN		Carroll	CA
Moore	ME		Champaign	CH
Morgan	MZ		Clark	CL
Ohion	OB		Clermont	CE
Overton	OV		Clinton	CI
Perry	PE		Columbiana	CO
Pickett	PI		Coshocton	CS
Polk	PO		Crawford	CR
Putnam	PU		Cuyahoga	CU
Rhea	RH		Darke	DA

TABLE 6 (Continued)

<u>County</u>	<u>Code</u>	<u>County</u>	<u>Code</u>
<u>Ohio (Cont'd)</u>			
Defiance	DE	Perry	PE
Deleware	DL	Pickaway	PI
Erie	ER	Pike	PK
Fairfield	FA	Portage	PO
Fayette	FY	Preble	PR
Franklin	FR	Putnam	PU
Fulton	FU	Richland	RI
Gallia	GA	Ross	RO
Geauga	GE	Sandusky	SA
Green	GR	Scioto	SC
Guernsey	GU	Seneca	SE
Hamilton	HA	Shelby	SH
Hancock	HN	Stark	ST
Hardin	HR	Summit	SU
Harrison	HI	Trumbull	TR
Henry	HE	Tuscarawas	TU
Highland	HG	Union	UN
Hocking	HO	Van Wert	VA
Holmes	HL	Vinton	VI
Huron	HU	Warren	WA
Jackson	JA	Washington	WS
Jefferson	JE	Wayne	WY
Knox	KN	Williams	WI
Lake	LA	Wood	WO
Lawrence	LW	Wyandot	WN
Licking	LI		
Logan	LO		
Loraine	LR		
Lucas	LU		
Madison	MA		
Mahoning	MH		
Marion	MR		
Medina	ME		
Meigs	MI		
Mercer	MC		
Miami	MM		
Monroe	MO		
Montgomery	MN		
Morgan	MG		
Morrow	MW		
Muskingum	MU		
Noble	NO		
Ottawa	OT		
Paulding	PA		

TABLE 7

State Codes Used in DOE Identification Number.

<u>State</u>	<u>Code</u>	<u>State</u>	<u>Code</u>
Alabama	01	New Hampshire	33
Arkansas	05	New Jersey	34
Connecticut	09	New York	36
Delaware	10	North Carolina	37
Georgia	13	Ohio	39
Illinois	17	Oklahoma	40
Indiana	18	Pennsylvania	42
Kentucky	21	Rhode Island	44
Louisiana	22	South Carolina	45
Maine	23	Tennessee	47
Maryland	24	Texas	48
Massachusetts	25	Vermont	50
Mississippi	28	Virginia	51
Missouri	29	West Virginia	54

TABLE 8

Type Codes Used in DOE Sample Identification Number.

<u>Digit</u>	<u>Sample Type</u>
50	Stream sediment, sieved $\leq 149 \mu\text{m}$ and dried $\leq 110^\circ\text{C}$
51	Stream water, filtered through $\leq 0.8 \mu\text{m}$ filter at the site
52	Well water, filtered through $\leq 0.8 \mu\text{m}$ filter at the site
53	Spring water, filtered through $\leq 0.8 \mu\text{m}$ filter at the site

AKMXD

Alkalinity as milliequivalents of sulfuric acid required per liter of sample (meq/L) to titrate to a pH of approximately 4.5 (bromcresol green/methyl red endpoint).

U

Uranium concentration is determined by delayed neutron counting of uranium from ground water concentrated on ion exchange resin. U is reported in parts per billion (ppb).

Values have been rounded to appropriate significant figures. Values for uranium are reported for all samples analyzed; however, analyses less than 0.040 ppb exhibit a high coefficient of variation. Missing data are indicated by "M."

U/COND

Uranium concentration in ppb multiplied by 1000 and divided by conductivity. This value gives an approximation of the ratio of uranium to total dissolved solids.

Helium

When available, helium values are reported in standard cubic centimeters of helium per 1000 liters of air (i.e. ppm by volume).

Other Key Elemental Analyses

Other elements were determined by neutron activation analysis and are listed alphabetically.

Concentrations are reported in ppb. Values below detection limit are indicated by a minus (-). For example, -3 means that the sample contains less than 3 ppb of that element. If background is so high that an accurate estimate of the minimum detection limit is not available, a period (.) is used to indicate not only that the element was not detected, but that the detection limit is unusually high in that sample. Missing data are indicated by "M."

Table A-2 contains the following information:

SRL Identification Number	Same format as in Table A-1.
Elemental Analyses	Same format as in Table A-1.
SAMPDATE	The date of sampling (month/day/year). For example, 7/15/77 is July 15, 1977.
TEAM	This code identifies the personnel who performed the sampling and is used by SRL for quality assurance monitoring.
WATERTEM	The water temperature at the time of sampling. The water temperature is recorded in degrees Celsius (C) to the nearest whole degree.
WELSPR	A "W" in this column denotes a ground water sample taken from a well, and "S" denotes a sample taken from a flowing spring.
DEPTHCON	<p>Confidence in the values of well depths is given according to the following codes:</p> <ol style="list-style-type: none">1. Certain2. Probable3. Possible4. Educated guess5. Unknown <p>Any site with "U" listed in WELDEPTH should have "5" listed for DEPTHCON.</p>
AGE	The ages of sampled wells are recorded to the nearest whole year. When only minimum ages are known, they are recorded. A "U" means the age of the well is unknown. Wells less than one year old are not sampled.
AGECON	Confidence in the age determination is given according to the same code used for DEPTHCON.

WELLTYPE

Sampled wells are classified by method of construction:

1. Drilled (rotary drill or auger)
2. Dug (manual or mechanical scoop)
3. Driven (vertical pile driver)
4. Unknown

WELLUSE

The primary use of water from the well:

1. Human drinking
2. Animal drinking
3. Irrigation
4. All other purposes

WELLFREQ

The frequency of well use:

1. Continuous (more than once/day)
2. Once per day
3. Once per week
4. Once per month
5. Less than once per month
6. Not in use

Wells used less frequently than once per week are generally not sampled.

WELLODOR

Hydrogen sulfide and other odors in well water are reported as follows:

1. No odor
2. Weak H₂S odor
3. Strong H₂S odor
4. Others

PIPECOMP

The major materials used in well pipes are reported as follows:

1. Galvanized
2. Copper
3. Plastic
4. Steel
5. Lead
6. Unknown
7. Others

WELLOC

The relative position in the plumbing system at which the sample was taken:

1. Immediately after storage tank
2. From pipe before storage tank
3. Directly from pump
4. Direct from well or spring
5. From municipal system
6. Unknown
7. Others

WELCLASS

The classification of the well by use:

1. Private (less than 3 families)
2. Semiprivate (3 to 10 families)
3. Public (more than 10 families)
4. Industrial
5. Commercial (motel, etc.)
6. Recreational
7. Agricultural
8. Unknown
9. Others

WELDEPTH

Depth of the well in feet, if known. This information is generally provided by the householder. "U" indicates that the well depth is not known. Springs are coded as having a depth of 0 feet.

Sediment analyses, site descriptions, and accompanying water quality measurements are given in Tables B-1, B-2, and B-3.

Table B-1 contains the following information:

SRL Identification Number

Each SRL identification site code consists of seven characters. The first two characters give the state using standard U.S. Postal Service abbreviations. Characters three and four designate the county. The county abbreviations used are given in Table 5. Sites are numbered sequentially within each map unit (characters five, six, and seven). Numbers 001 to 498 are used for sediment samples. Characters eight and nine designate the sample analyzed. In most reports the S1 size fraction [finer than 149 micrometers (U. S. Std. 100 mesh)] was analyzed. S6 denotes the 40 to 100 mesh fraction, S7 the less than 100 mesh fraction (same as S1), S8 the 100 to 200 mesh fraction, and S9 the less than 200 mesh fraction. When no designator is given, the S1 fraction is assumed.

DOE Identification Number

Same format as Table A-1.

pH; COND, AKMXD

Same format as Table A-1.

Elemental Analyses

The first three elements are listed in order of importance. Other key elements are listed alphabetically.

Concentrations of each element (in ppm) are determined by neutron activation analysis. Values have been rounded to appropriate significant figures. Note that the elemental concentration (not oxide) is quoted in this table. Values below detection limit are indicated by a minus (-). For example, -3 means that the sample contains less than 3 ppm of that element. If background limit is not available, a period (.) is used to indicate not only that the element was not detected, but that the detection limit is unusually high in that sample. Missing data are indicated by "M."

Table B-2 contains the following information:

SRL Identification Number	Same format as Table B-1.
Elemental Analyses	Same format as Table B-1.

Table B-3 contains the following information:

SAMPDATE	The date of sampling, month/day/year.
TEAM	This code identifies the personnel who performed the sampling and is used by SRL for quality assurance monitoring.
SEDTYPE	<p>The dominant type of sediment comprising the stream bed:</p> <ol style="list-style-type: none">1. Boulder2. Cobble3. Pebble4. Sand5. Silt6. Clay7. Organic muck8. Others

SEDCOLOR

The color of the sediment:

1. White/buff
2. Yellow
3. Orange
4. Pink/red
5. Green
6. Brown
7. Gray
8. Black
9. Other

STMWIDTH AND STMDEPTH

The width and depth of the stream. An estimate of the average value for the stream over the 100 to 200 feet of stream length where the sample was taken:

1. <1/2 ft
2. 1/2 to 1 ft
3. 1 to 2 ft
4. 2 to 4 ft
5. 4 to 8 ft
6. 8 to 16 ft
7. 16 to 32 ft
8. More than 32 ft
9. Dry

STMFLOW

The rate of flow at the sampling site:

1. Stagnant
2. Slow
3. Moderate
4. Fast
5. Torrent
6. Dry

STMLEVEL

The level of the stream at the time of sampling:

1. Dry
2. Low
3. Normal
4. High
5. Flood

STMCOLOR

Stream color reflects the amount and type of dissolved or suspended load in water on the basis of color:

1. Clear
2. Brown-clear
3. Cloudy
4. Muddy
5. Algal
6. Other

STMCHANL

The general nature of the stream:

1. Depositing
2. Eroding
3. Unknown

VEGTYPE

The dominant type of vegetation at or near the sampling site. Conifers are broadly classed as evergreen trees and shrubs. Deciduous plants are broadly classed as trees and shrubs that seasonally lose their leaves. Brush denotes relatively low-growing plants, conifer or deciduous. Grass denotes grasses of all types including natural and/or crops:

1. Conifer
2. Deciduous
3. Brush
4. Grass/pasture
5. Marsh/swamp
6. Peat bog
7. Other

VEGDENS

The amount of plant growth in the immediate area of the sample location. This is a subjective observation made in relation to visibility and ease of access:

1. Barren
2. Sparse
3. Moderate
4. Dense
5. Very dense

RELIEF

Relief is an indicator of the local surface expression. The area included around a sample location will usually not exceed a few hundred yards in mountainous terrains, but may exceed up to 1/2 mile in flat areas:

1. Flat
2. Low, 0 to 50 ft
3. Gentle, 50 to 200 ft
4. Moderate, 200 to 1000 ft
5. High, more than 1000 ft

WEATHER

An indicator of the prevailing weather conditions at the time of sampling:

1. Sunny/clear
2. Overcast
3. Light rain
4. Heavy rain
5. Snowy
6. Other

COMPOSIT

This is the number of subsamples taken at each site that are composited to give the sieved sample at that site.

**CONTAMN1
CONTAMN2
CONTAMN3
CONTAMN4**

The major nearby activities and/or contaminants which may influence the analytical results. The major activity and/or contamination is always listed under CONTAMN4, the second under CONTAMN3, etc.

1. Chemical
2. Smelting
3. Mining
4. Sewage
5. Dumps
6. Farming
7. Power generation
8. Urban
9. Other industrial
- A. Recreational
- B. Residential

WATERTEM

The water temperature, taken at the time of sampling, is recorded in degrees Celsius to the nearest whole degree.

For areas where stream water samples were collected for analysis, the chemical analyses and water quality measurements are given in Table C-1. Where only sediments were collected, stream water quality measurements are given in Table B-1.

Table B-4 contains the following information:

SRL Identification Number Same format as Table B-1.

UX

Extractable uranium.

Elemental Analyses

The elements are listed alphabetically. Concentrations are reported in parts per million (ppm) by weight. Elemental rather than oxide concentrations are reported. Values below detection limits are indicated by a minus (-). For example, -3 means that the sample contained less than 3 ppm of that element. A period (.) is used to indicate that the element was not detected and that a detection limit is not estimated for that element. Missing data are indicated by "M" and are indicative of insufficient sample for analysis.

Table B-5 contains the following information:

SRL Identification Number Same format as Table B-1.

Elemental Analyses Same format as Table B-4.

Table C-1 contains the following information:

SRL Identification Number Each SRL identification site code consists of seven characters as described for Table B-1. An "R" in column eight indicates that ion exchange resin was analyzed for all elements reported.

DOE Identification Number Same format as Table A-1.

pH; COND, AKMXD Same format as Table A-1.

U, U/COND, Other Elemental Analyses Same format as Table A-1.

USER'S GUIDE TO OAK RIDGE DATA ON MICROFICHE

Many of the sediments not analyzed by SRL were analyzed by Oak Ridge National Laboratory. Table 5 lists the analytical techniques and detection limits of the analyses. Table 9 lists the column headings of the microfiche tables.

TABLE 9

Data on Oak Ridge Microfiche

SAMPLE	=	Oak Ridge Sample Number
ASID	=	Savannah River Sample Number
U-FL	=	Uranium by Fluorometry (PPM)
U-NT	=	Uranium by Neutron Activation (PPM)
AG	=	Silver (PPM)
AL	=	Aluminum (%)
B	=	Boron (PPM)
BA	=	Barium (PPM)
BE	=	Beryllium (PPM)
CA	=	Calcium (%)
CE	=	Cerium (PPM)
CO	=	Cobalt (PPM)
CR	=	Chromium (PPM)
CU	=	Copper (PPM)
FE	=	Iron (%)
HF	=	Hafnium 9(PPM)
K	=	Potassium (%)
LA	=	Lanthanum (PPM)
LI	=	Lithium (PPM)
MG	=	Magnesium (%)
MN	=	Manganese (PPM)
MO	=	Molybdenum (PPM)
NA	=	Sodium (%)
NB	=	Niobium (PPM)
NI	=	Nickel (PPM)
P	=	Phosphorus (PPM)
PB	=	Lead (PPM)
SC	=	Scandium (PPM)
SR	=	Strontium (PPM)
TH	=	Thorium (PPM)
TI	=	Titanium (PPM)
V	=	Vanadium (PPM)
Y	=	Yttrium (PPM)
ZN	=	Zinc (PPM)
ZR	=	Zirconium (PPM)

REFERENCES

1. Bowman, W. W., 1977, Neutron Activation Analysis for Uranium and Associated Elements. In: Proceedings ERDA-GJO Symposium on Hydrogeochemical and Stream Sediment Reconnaissance. Grand Junction, CO, March 16-17, 1977. DOE-GJ Document No. GJBX-77(77).
2. Price, V., and Jones, P. L., 1979, Training Manual for Water and Sediment Geochemical Reconnaissance: SRL Internal Doc. DPST-79-219, E. I. du Pont de Nemours & Co., Savannah River Laboratory, Aiken, SC.
3. SRL-138, Savannah River Laboratory Quarterly and Semiannual Reports. Hydrogeochemical and Stream Sediment Reconnaissance. National Uranium Resource Evaluation Program: E. I. du Pont de Nemours & Co., Savannah River Laboratory, Aiken, SC.

<u>Period</u>	<u>SRL Doc. No.</u>	<u>DOE-GJO Doc. No.*</u>
a. January-March 1975	DPST-75-138-1	GJBX-5(76)
b. April-June 1975	DPST-75-138-2	GJBX-6(76)
c. July-September 1975	DPST-75-138-3	GJBX-7(76)
d. October-December 1975	DPST-75-138-4	GJBX-8(76)
e. January-March 1976	DPST-76-138-1	GJBX-17(76)
f. April-June 1976	DPST-76-138-2	GJBX-27(76)
g. July-September 1976	DPST-76-138-3	GJBX-63(76)
h. October-December 1976	DPST-76-138-4	GJBX-6(77)
i. January-March 1977	DPST-77-138-1	GJBX-35(77)
j. April-June 1977	DPST-77-138-2	GJBX-55(77)
k. July-September 1977	DPST-77-138-3	GJBX-90(77)
l. October-December 1977	DPST-77-138-4	GJBX-37(78)
m. January-March 1978	DPST-78-138-1	GJBX-66(78)
n. April-September 1978	DPST-78-138-2	GJBX-13(79)
o. October 1978-March 1979	DPST-79-138-1	GJBX-86(79)
p. April-September 1979	DPST-79-138-2	GJBX-160(79)
q. October 1979-March 1980	DPST-80-138-1	GJBX-146(80)

4. SRL-146, SRL-NURE Data Reports, E. I. du Pont de Nemours & Co., Savannah River Laboratory, Aiken, SC.

<u>NTMS 1° x 2° Quadrangle</u>	<u>SRL Doc. No.</u>	<u>DOE-GJO Doc. No.*</u>
Bluefield	DPST-81-146-11	GJBX-234(81)
Dyersburg	DPST-79-146-5	GJBX-58(79)
Johnson City	DPST-80-146-14	GJBX-26(81)
Knoxville	DPST-78-146-5	GJBX-75(79)
Winston Salem	DPST-77-146-1	GJBX-6(77)

* These reports are available on microfiche from the Grand Junction Office, DOE. Inquiries should be addressed to:

Bendix Field Engineering Corporation, Technical Library,
P. O. Box 1569, Grand Junction, CO 81501.