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THE OAK RIDGE GEOCHEMICAL RECONNAISSANCE PROGRAM

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The U. S. Energy Research and Development Administration (ERDA) has assigned the Nuclear Division of Union Carbide Corporation (UCC-ND) the responsibility for conducting a reconnaissance geochemical survey in a 12-state area covering Texas, Oklahoma, Kansas, Nebraska, South Dakota, North Dakota, Minnesota, Wisconsin, Michigan, Iowa, Indiana, and Illinois.

PROGRAM CONCEPT

Geochemical sampling is considered to be a valuable technique by the exploration industry. The program, which is used for the entire 12-state area to be surveyed by the Uranium Resource Evaluation (URE) Project at Oak Ridge, is based on the concept that geochemical techniques can identify promising uranium-bearing areas at virtually any scale. Concentrations of uranium increase as a mineralized area is approached. Figure 1 shows an increase in the log uranium concentration versus areal extent. As will be noted, the largest area is background where uranium concentrations are relatively low. The province may be of the order of 250 km^2 (100 mi^2) to 2500 km^2 (1000 mi^2), and the uranium concentration an order of magnitude greater in the province. Similarly, the distance is 25 km^2 (10 mi^2) to 250 km^2 (100 mi^2) with a corresponding increase of uranium content. At the deposit scale, uranium content increases to ore grade. The objective of the URE Project is to define the areal extent of the levels of uranium concentration illustrated in Figure 1. The program is designed to outline uranium provinces and districts, and it is industry's job to locate the deposits within the outlined areas.

The URE Project of UCC-ND consists of pilot surveys and 2 reconnaissance sampling phases, with samples of stream sediment, stream water, and well water collected in each phase. Samples are analyzed for uranium and other trace elements which more completely describe geochemical patterns. This allows collection of fewer samples than if samples were analyzed for uranium only.

Pilot surveys are intended to provide information on the following:

1. Trace elements indicative of uranium mineralization,
2. Relationship between sample types and relative importance of each,
3. Range of geochemical concentrations from mineralized to background areas,
4. Adequacy of laboratory sensitivity,
5. Types of treatments to be given samples,
6. Area to which Pilot Survey applies, and
7. Adequacy of sample spacing.

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GEOCHEMICAL CONCENTRATION VS. PROXIMITY TO URANIUM DEPOSIT

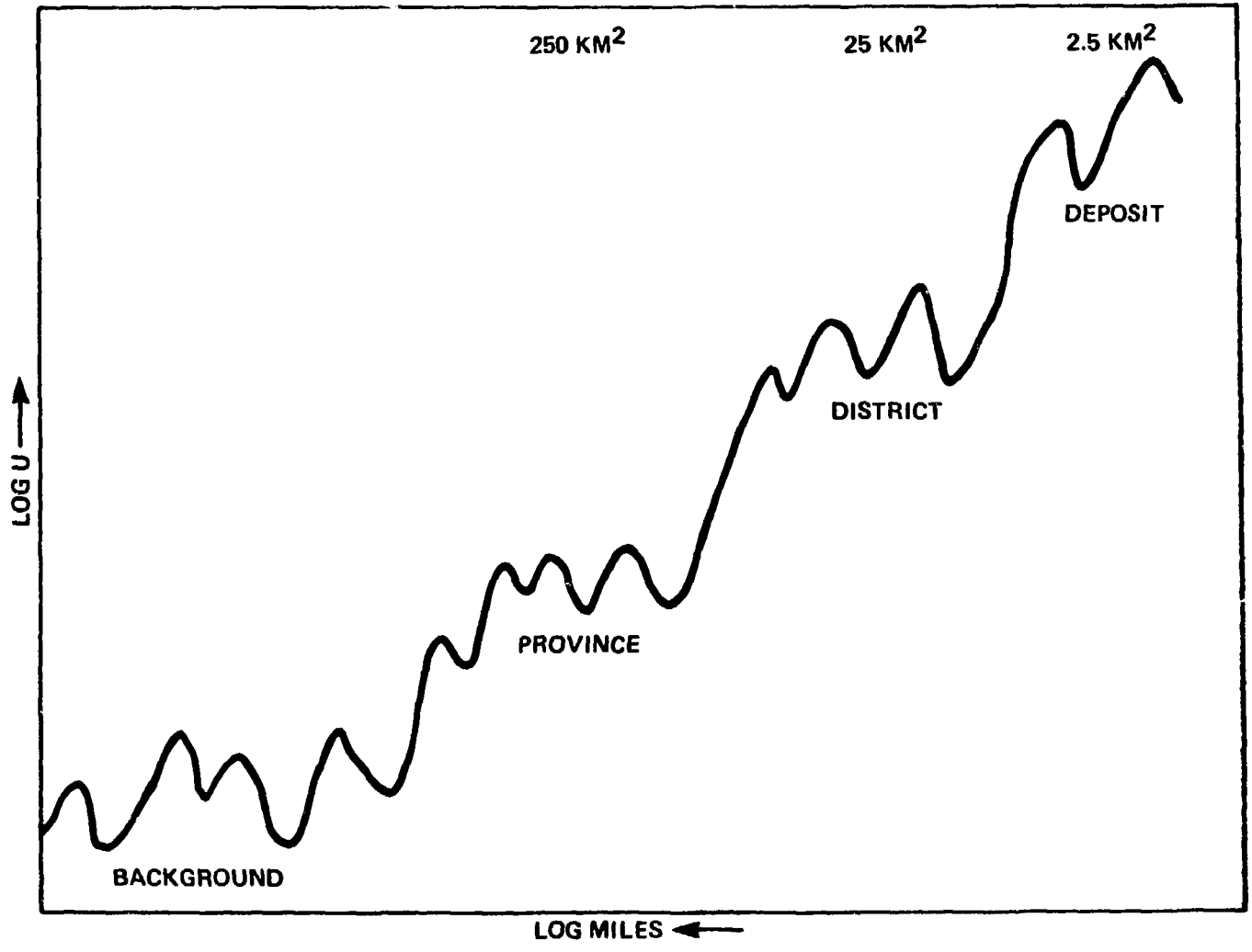


Figure 1

Phase I stream sediment and stream water samples collected from basins of approximately 250 km^2 (100 mi^2) and well water samples collected at 10-mi spacings are used to delineate the boundaries of uranium provinces. A small uranium province (or large district) of approximately 16 x 160 km (10 x 100 mi) will have approximately 10 samples of each type collected within its area at a target sample spacing of 1 per 250 km^2 (100 mi^2). These and the surrounding background samples are adequate to generally outline the uranium province. Phase II stream sediment and stream water samples collected from basins of approximately 25 km^2 (10 mi^2) and well water samples collected at a 3.3-mi spacing are used to delineate uranium districts. A small district of 16 x 16 km (10 x 10 mi) will have approximately 10 samples of each type collected within the anomalous area.

SAMPLING PROGRAM

The objectives of the field program are to:

1. Obtain necessary coverage of a geographic area,
2. Obtain the most representative samples possible, and
3. Accurately describe the environment from which the samples were taken.

The sample types collected include:

1. Stream water,
2. Stream sediment composite,
3. Botanical samples, and
4. Well water.

Stream sediments are collected as composite samples generally parallel to the axis of the stream over a 25- to 50-m interval. Samples are placed in paper envelopes and sent to the URE Laboratory at Oak Ridge, Tennessee for disaggregation, sieving to <149 microns (100 mesh), dissolution, and analysis.

Water samples are collected directly in 250-ml polyethylene bottles with no field treatment. Stream water samples are collected at the point of maximum flow rate. Groundwater samples are collected from wells at the point nearest the wellhead. Measurements for water which are routinely made in the field include: temperature, conductivity, pH, dissolved oxygen, and alkalinity. Water samples are shipped to Oak Ridge for filtration and analysis.

Some botanical samples (tree branches) are being collected in pilot surveys to determine their potential usefulness in reconnaissance surveying.

In the talk that follows, Dr. T. R. Butz will present additional information to support the URE Program concept and field program utilizing data from south Texas.

ANALYTICAL PROGRAM

Dr. Gordon W. Cagle discussed the Analytical Program of the URE Project in his paper *The Oak Ridge Analtical Program.*

DATA MANAGEMENT AND STATISTICAL ANALYSIS

Dr. V. E. Kane discussed the Data Management and Statistical Analysis Program in his papers, *Data Verification Procedures* and *Geostatistics*, which were given yesterday.

PLANNING AND ORGANIZATION

Detailed project planning is an essential element being employed to carry out an innovative and cost-effective hydrogeochemical and stream sediment survey. The URE Project office is located at the Oak Ridge Gaseous Diffusion Plant (ORGDP). The expertise and capabilities of the Y-12 Plant and the Oak Ridge National Laboratory (ORNL) are also available to provide essential services in the project. In addition, the facilities and expertise of the Paducah Gaseous Diffusion Plant (PGDP) are also available for use in the project if required. Functional support services provided within the Nuclear Division are shown in Figure 2, URE support organizations in Figure 3, and the URE Project organization in Figure 4.

Many of the time-proven production procedures being used by the Nuclear Division were directly applicable to the URE Project. An example of this activity is the Y-12 Plant production control system which was used in the design of the URE sample storage and retrieval system. Samples collected during the program are optimally scheduled, controlled, and placed in retrievable storage for additional tests if required.

Project plans include the maximum use of automated equipment to minimize costs and potential errors. Automated equipment is included in the analytical laboratories and data management activity. An automatic digitizer is also used to determine latitude and longitude of sample sites on field maps.

Major considerations in the scheduling of field activities include geologic favorability, statistical validity of the sampling design, funds available, time constraints, and weather. Sampling is scheduled during time of low runoff, but not during normal periods of freezing.

PRESENT PLANS

The Oak Ridge area of responsibility is equivalent to approximately 136 quadrangles (1,000,000 mi^2) of the 1° x 2° national topographic map series. All of these will be covered by Phase I sampling and approximately one-half of these are expected to be favorable for Phase II sampling. The scheduling of Phase I sampling is shown in Figure 5. Phase II sampling is scheduled on a year-to-year basis and some of the considerations are: (1) priorities based on coordination with other ERDA NURE Program activities, (2) uranium favorability, and (3) funding availability. Table 1 summarizes the projected number of samples to be collected and analyzed in the 3 parts of the program.

To make Phase II hydrogeochemical data available in conjunction with the aerial radiometric survey, drilling programs, and other geological investigations, the URE Project is currently considering a modified sample plan. The modified plan would eliminate Phase I sampling in some areas, and only Phase II sampling would be accomplished in areas which have been determined to have high uranium favorability.

FUNCTIONAL REQUIREMENTS OF THE URANIUM RESOURCE EVALUATION PROJECT (HYDROGEOCHEM AND STREAM SEDIMENT SURVEY)

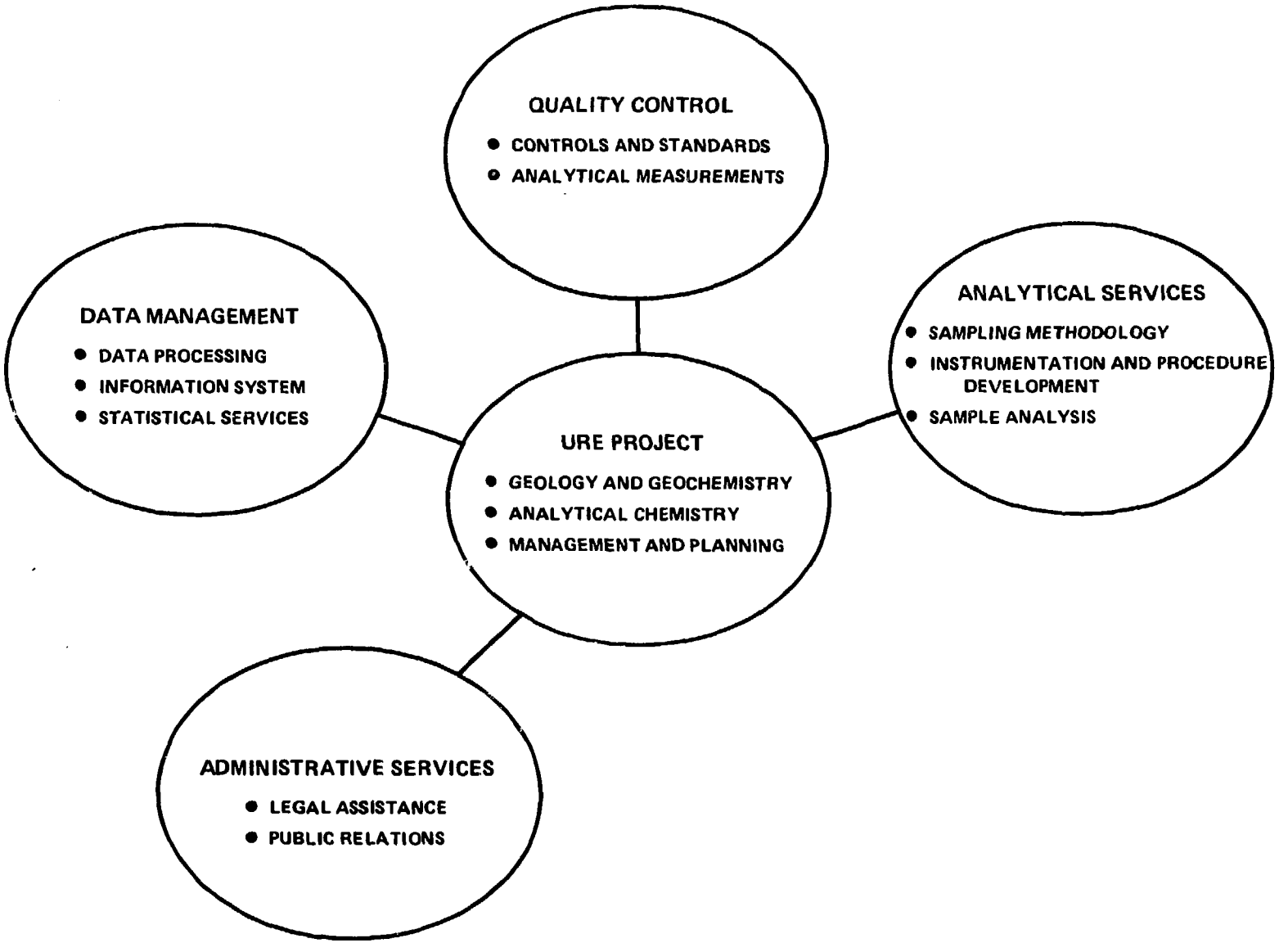
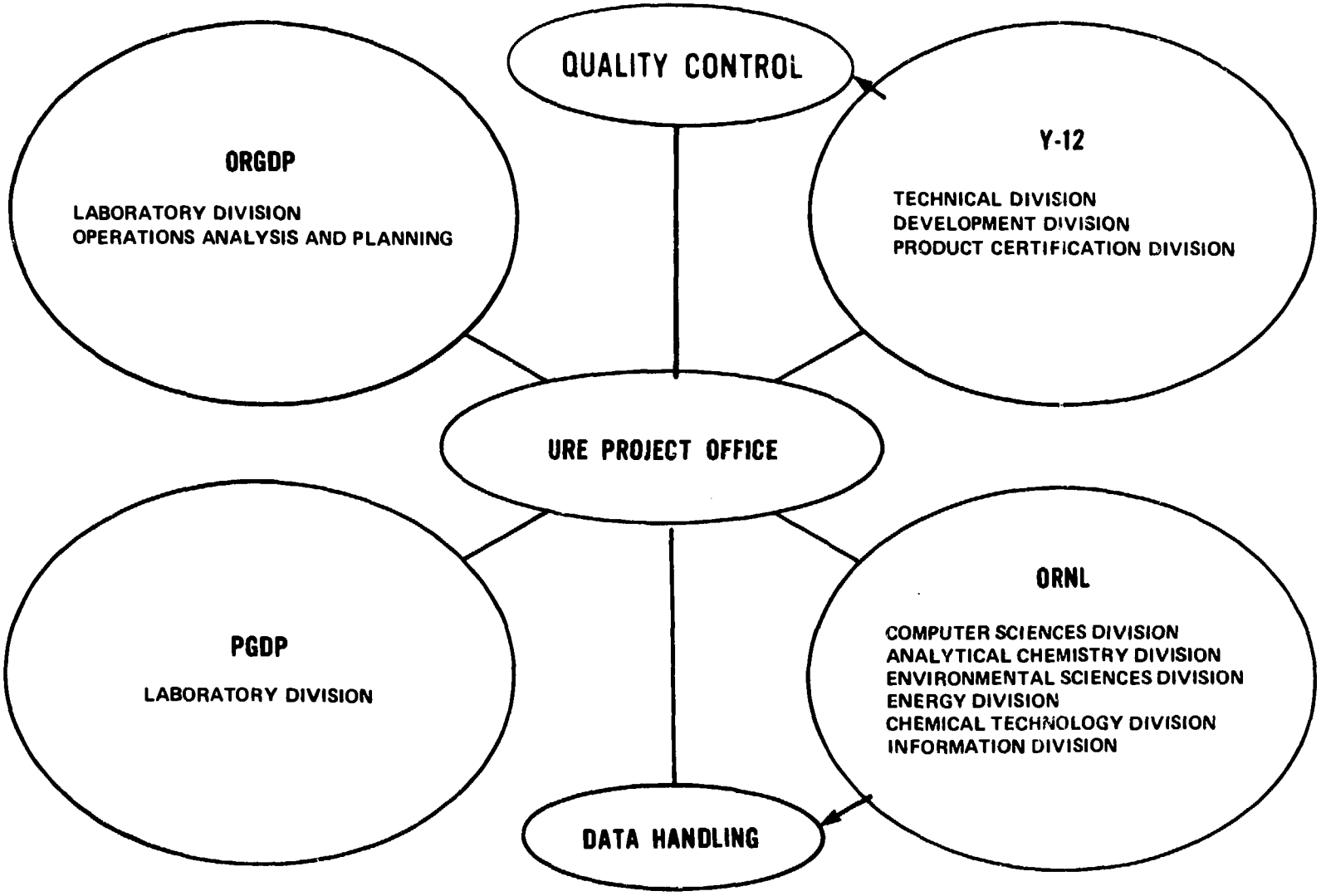


Figure 2

URE SUPPORT ORGANIZATIONS



UNION CARBIDE

ORGANIZATION CHART
URANIUM RESOURCE EVALUATION PROJECT

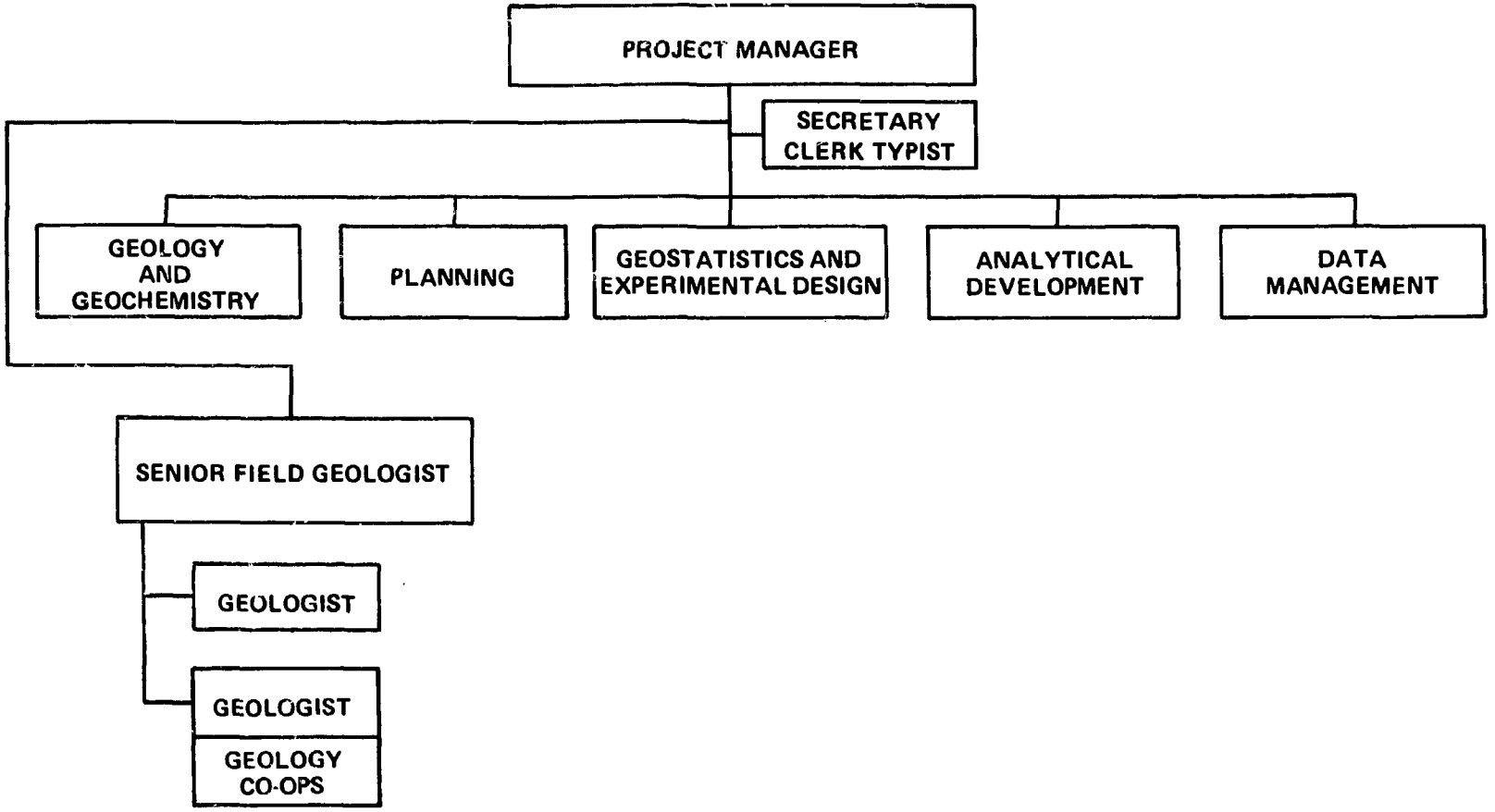


Figure 4

PHASE I SAMPLING SCHEDULE

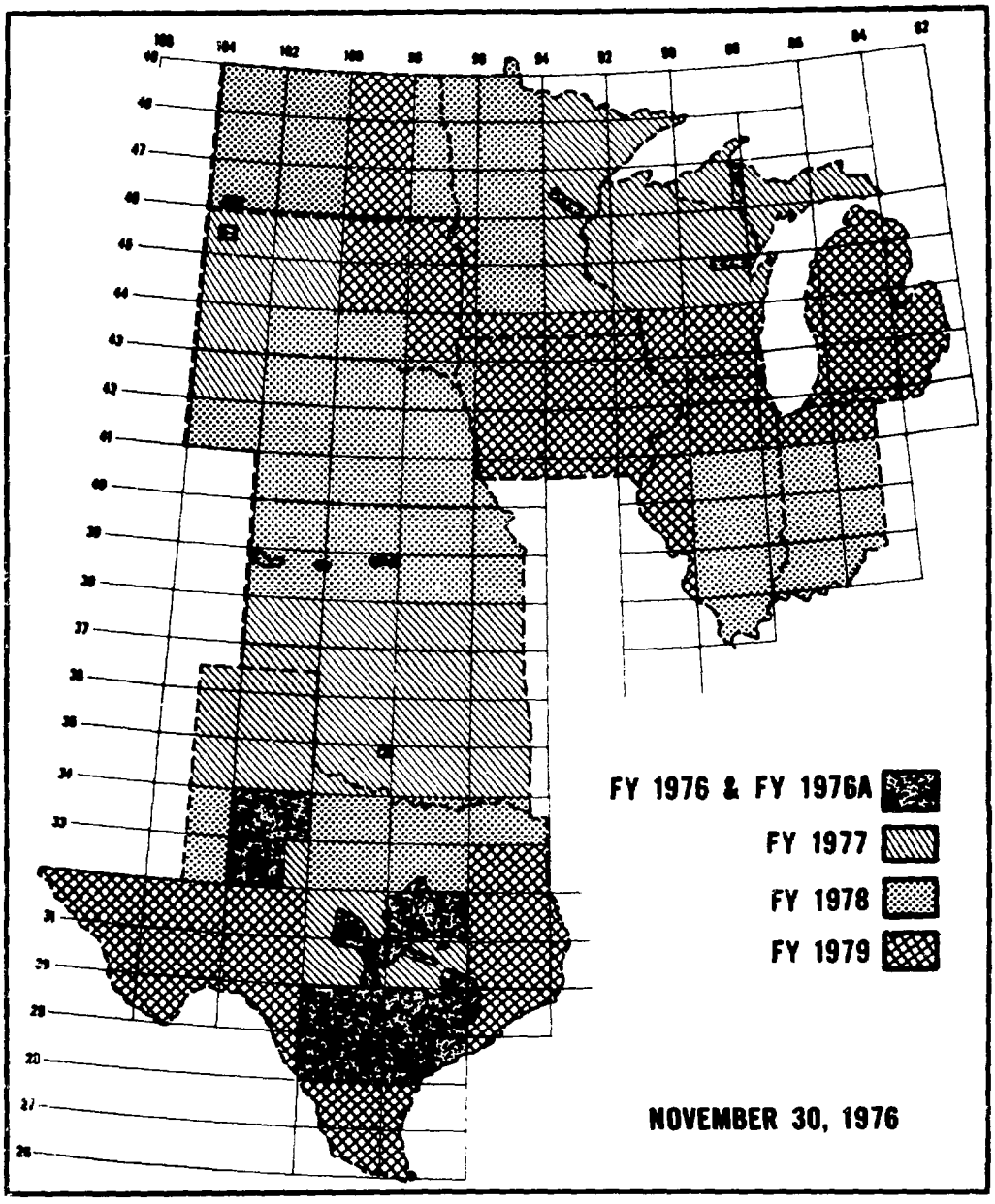


Figure 5

URANIUM RESOURCE EVALUATION PROJECT SAMPLE SCHEDULE

	FY 1976 and 1976A		FY 1977		FY 1978		FY 1979		FY 1980		FY 1981		Total[a]	
Phase	Sites	Samples	Sites	Samples	Sites	Samples	Sites	Samples	Sites	Samples	Sites	Samples	Sites	Samples
Pilot Surveys	1,216	2,919	50	150	0	0	0	0	0	0	0	0	1,266	3,066
Phase I	642	1,020	4,878	7,267	7,500	11,200	7,500	11,200	0	0	0	0	20,520	30,687
Phase II	1,828	2,868	5,886	8,779	23,500	35,300	23,500	35,300	33,000	49,000	11,500	15,000	99,214	146,247
TOTAL	3,686	6,804	10,814	16,196	31,000	46,500	31,000	46,500	33,000	49,000	11,500	15,000	121,000	180,000

(a) Does not include duplicate water samples.
Based on assumption that 50% of the area will be sampled in Phase II.
Does not include 12,200 quality control samples.

December 2, 1976

Table 1

During the period May through October 1977, the major effort will be Phase II sampling in Northern Michigan, Wisconsin, and part of Minnesota, and Phase I sampling in Kansas and Oklahoma.

PUBLICITY PROGRAM

A publicity plan was implemented for the URE Project. Newspaper releases relating to URE Project activities are prepared for state and local distribution. A 1-min color film for television, prepared for use in news programs and public service spots, is provided to all television stations in the 12-state area. Pamphlets explaining the NURE Program and the part played by the URE Project are provided to personnel collecting samples for the purpose of increasing public awareness and cooperation.

LANDOWNER'S NOTIFICATION LETTER

Landowners who request analytical results of samples collected on their property are provided the information after the data have been open filed. The landowner's name and address are recorded on the field form at the time the samples are collected and then stored in the URE data base. After the data have been open filed by the Grand Junction Office, a computerized system prints a letter containing the analytical results and an address label for mailing. An example of the landowner's notification letter is presented in Figure 6.

URANIUM RESOURCE EVALUATION PROJECT
OAK RIDGE GASEOUS DIFFUSION PLANT
P.O. BOX P MAIL STOP 246
OAK RIDGE, TENNESSEE 37830

NOVEMBER 18, 1976

Name
Address

DEAR SIR:

THESE ARE THE RESULTS OF ANALYSIS OF SAMPLES OBTAINED BY OUR GEOLOGIST FROM YOUR PROPERTY ON APRIL 19, 1976 IN CONNECTION WITH THE UNITED STATES ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION HYDROGEOCHEMICAL AND STREAM SEDIMENT SURVEY.

THANK YOU FOR YOUR COOPERATION.

J. W. ARENDT

PROJECT MANAGER

Figure 6

*

WELL WATER SAMPLE (SAMPLE NUMBER 2243)

STATION LOCATION : LATITUDE= ; LONGITUDE=

WATER MEASUREMENTS

TEMPERATURE (C)	=	17.7
PH	=	7.2
M ALKALINITY (PPM)	=	288
TOTAL ALKALINITY (PPM)	=	292
SULFATE (PPM)	=	1220

ELEMENT DETERMINATIONS(PPB)

URANIUM	=		26.67
ARSENIC	=		6.4
SELENIUM	=	<	0.2
ALUMINUM	=	<	40
GOLD	=	<	4
BORON	=		990
BARIUM	=		99
COBALT	=	<	8
CHROMIUM	=	<	4
COPPER	=	<	16
IRON	=	<	40
MANGANESE	=		13
MOLYBDENUM	=		7
NIOBIUM	=	<	4
NICKEL	=	<	16
PHOSPHORUS	=	<	400
LEAD	=		7
SCANDIUM	=	<	4
THORIUM	=	<	16
TITANIUM	=		40
VANADIUM	=		66
ZINC	=	<	240
ZIRCONIUM	=	<	8

*

THESE VALUES CAN NOT BE USED AS AN INDEX OF DRINKING WATER QUALITY

PPB MEANS PARTS PER BILLION
PPM MEANS PARTS PER MILLION
< MEANS LESS THAN

Figure 6 (cont'd)