PROCEDURES MANUAL FOR GROUNDWATER RECONNAISSANCE SAMPLING

URANIUM RESOURCE EVALUATION PROJECT

March 31, 1978

UNION CARBIDE

OAK RIDGE GASEOUS DIFFUSION PLANT
OAK RIDGE, TENNESSEE

prepared for the U.S. DEPARTMENT OF ENERGY *under*
U.S. GOVERNMENT *Contract W-7405 eng 26*

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Grand Junction Office
P.O. Box 2567, Grand Junction, CO 81501

FOR IMMEDIATE RELEASE
May 11, 1978

DOE ISSUES FOUR REPORTS AS PART OF URANIUM RESOURCE EVALUATION PROGRAM

The Grand Junction, Colorado, Office, U.S. Department of Energy (DOE), has issued four reports as part of the hydrogeochemical and stream sediment reconnaissance, National Uranium Resource Evaluation (NURE). The reports are:

1. GJBX-61(78), "Orientation Study Data Release VI: Leesville, South Carolina Area," by Van Price and P.L. Jones, Savannah River Laboratory, Aiken, South Carolina, March 1978, 39 pages (SRL No. DPST-78-141-1).

2. GJBX-62(78), "Procedures Manual for Groundwater Reconnaissance Sampling," Oak Ridge Gaseous Diffusion Plant, Oak Ridge, Tennessee, March 31, 1978, 52 pages (ORGDP No. K/UR-12).

3. GJBX-65(78), "Raw Data Report, Winnemucca Dry Lake Basin Orientation Study, Nevada," K.P. Puchlik, B.E. Holder, and C.F. Smith, Lawrence Livermore Laboratory, Livermore, California, January 1978, 36 pages, 8 oversize overlays, and 1 microfiche table (LLL No. UCID-17699).

4. GJBX-66(78), "Hydrogeochemical and Stream Sediment Reconnaissance - Eastern United States, January-March 1978," Savannah River Laboratory (SRL No. DPST-78-138-1).

The four reports resulted as part of NURE, a program of DOE's Grand Junction Office which includes the compilation and development of geologic and other information with which to assess the magnitude and distribution of uranium resources and to determine areas favorable for the occurrence of uranium in the United States.

The reports have been placed on open file at the following locations:

No. 78-48
News Media Contact: Peter Mygatt, 303/242-8621, Ext. 293
To order microfiche: Contact Library, Ext. 278

GRAND JUNCTION, CO: Technical Library, Grand Junction Office, Department of Energy.

ALSUQUERQUE, NM: Government Publications Section, Zimmerman Library, University of New Mexico, 11 a.m. MST

ANCHORAGE, AK: Division of Geological & Geophysical Surveys, 323 E. 4th Avenue.

ATLANTA, GA: Department of Energy, Suite 428, 1655 Peachtree Street, 1 p.m. EST

AUSTIN, TX: Bureau of Economic Geology, Geology Building, University of Texas.

BUTTE, MT: Montana Bureau of Mines and Geology, Montana College of Mineral Science and Technology.

CAMBRIDGE, MA: Massachusetts Institute of Technology, Lindgren Library, 14E-210.

CASPER, WY: Natrona County Public Library.

COLUMBIA, SC: Division of Geology, South Carolina State Development Board.

DENVER, CO: Colorado Geological Survey, Department of Natural Resources, State Centennial Bldg., 1313 Sherman St., Rm. 715.

GOLDEN, CO: U.S. Geological Survey Library, 1526 Cole Blvd., (West Colfax at Hawthorne),

LARAMIE, WY: Wyoming Geological Survey, P.O. Box 3008, University Station.

LAWRENCE, KS: Kansas Geological Survey, 1930 Avenue "A", Campus West, The University of Kansas.

LUBBOCK, TX: Documents Library, Texas Tech University.

MENLO PARK, CA: U.S. Geological Survey, Library, 345 Middlefield Road.

NORMAN, OK: Oklahoma Geological Survey, The University of Oklahoma, 830 Van Vleet Oval, Rm. 163.

PITTSBURGH, PA: Department of Energy, Suite 221, 9 Parkway Center, 675 Greentree Road.

PORTLAND, OR: Department of Geology and Mineral Industries, 1069 State Office Building.

RALEIGH, NC: Office of Earth Resources, Department of Natural and Economic Resources.

RENO, NV: Nevada Bureau of Mines and Geology, Mackay School of Mines, University of Nevada.

RESTON, VA: U.S. Geological Survey Library, Gifts & Exchange Unit, National Center

SALT LAKE CITY, UT: Documents Division, Marriott Library, University of Utah.

SALT LAKE CITY, UT: Utah Geological Survey, 606 Black Hawk Way.

SOCORRO, NM: New Mexico Bureau of Mines, Campus Station.

SPOKANE, WA: U.S. Geological Survey Library, U.S. Court House, Rm 678.

WASHINGTON, D.C.: Department of Energy, Library, 20 Massachusetts Avenue, NW

These reports will be available on microfiche from the Grand Junction Office DOE, at the following prices: GJBX-61(78), GJBX-62(78), GJBX66(78), $3 each; GJBX-65(78), $7. Prepaid orders should be sent to: Bendix Field Engineering Corporation, Technical Library, P.O. Box 1569, Grand Junction, Colorado 81501. Checks or money orders should be made out to Bendix Field Engineering Corporation, the operating contractor for DOE's Grand Junction Office.

Date of Issue: March 31, 1978 Report Number: K/UR-12

PROCEDURES MANUAL FOR GROUNDWATER RECONNAISSANCE SAMPLING

Uranium Resource Evaluation Project

Union Carbide Corporation, Nuclear Division
Oak Ridge Gaseous Diffusion Plant
Oak Ridge, Tennessee

Prepared for the U. S. Department of Energy
Under U. S. Government Contract W-7405 eng 26

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Gordon W. Cagle - Analytical Chemistry and Reports

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INTRODUCTION

NATIONAL URANIUM RESOURCE EVALUATION PROGRAM

The National Uranium Resource Evaluation (NURE) Program was established in 1973 by the U. S. Atomic Energy Commission (AEC) which later became the U. S. Energy Research and Development Administration (ERDA) and is now funded by the United States Department of Energy (DOE). The principal objectives of the NURE Program are:

1. To complete a comprehensive assessment of the uranium reserves of the United States as rapidly as possible,

2. To identify areas favorable for uranium resources, and

3. To develop new and improved technologies.

The DOE Grand Junction, Colorado Office (GJO) is responsible for administering and coordinating efforts to meet these objectives. Input to the NURE Program comes from DOE prime contractors, DOE-sponsored research and development, the uranium industry, U. S. Geological Survey, U. S. Bureau of Mines, and other governmental agencies and independent sources.

The NURE Program consists of five parts:

1. Hydrogeochemical and Stream Sediment Reconnaissance Survey,

2. Aerial Radiometric Survey,

3. Surface Geologic Investigations,

4. Drilling for Geologic Information, and

5. Geophysical Technology Development.

To ensure a standard reporting format, data from all five phases of the NURE Program will be combined within the 1° x 2° National Topographic Map Service (NTMS) quadrangle boundaries and will form the basis on which uranium reserve calculations will be made.

In 1975, ERDA assigned the Nuclear Division of Union Carbide Corporation (UCC-ND), Uranium Resource Evaluation Project (URE Project) located at the Oak Ridge Gaseous Diffusion Plant (ORGDP), Oak Ridge, Tennessee, the responsibility for hydrogeochemical and stream sediment reconnaissance in an area covering the states of Texas, Oklahoma, Kansas, Nebraska, South Dakota, North Dakota, Michigan, Minnesota, Wisconsin, Iowa, Indiana, Illinois, and parts of Missouri, Arkansas, and New Mexico. The objective of this portion of the program is to accomplish a systematic determination of the distribution of uranium and associated elements in

surface and underground waters and in stream sediments. The significance of the distribution of uranium in natural waters and stream sediments will be assessed as an indicator of areas favorable for the identification of uranium provinces and districts.

Because the UCC-ND URE Project is a portion of the NURE Program and is being conducted with public funds, contractors participating in the URE Project have an obligation to hold all information as *Business Confidential*. All samples, duplicates, data, field form observations, site locations, equipment, and other information obtained during the course of operation under a contract to participate in the UCC-ND/URE Project are to be provided only to the UCC-ND/URE Project. Nothing is to be retained for private use nor is any information to be communicated to others without prior written consent of the URE Project Manager and DOE. The DOE-GJO will time-release data and reports on each 1° x 2° quadrangle simultaneously in a number of predesignated sites across the country as soon as these reports are made available by the URE Project. At that time, any information presented in the report is available for public use.

Landowners, who require that the Project provide results of analyses of samples collected on their property before giving permission to sample, are provided the information after the data have been open filed. The landowners' names and addresses 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 DOE, a computerized system prints a letter containing the analytical results and an address label for mailing.

URANIUM RESOURCE EVALUATION PROJECT

Program Concept

Geochemical sampling is considered to be a valuable technique by the exploration industry. The program, which is used for the entire area to be surveyed by the UCC-ND URE Project, 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 aerial extent. As will be noted, the largest area is background where uranium concentrations are relatively low. The province may be of the order of 260 km^2 (100 mi^2) to 2600 km^2 (1000 mi^2), and the uranium concentration an order of magnitude greater in the province. Similarly, for a district, the area is 26 km^2 (10 mi^2) to 260 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 aerial extent of uranium provinces and districts using geochemical exploration techniques.

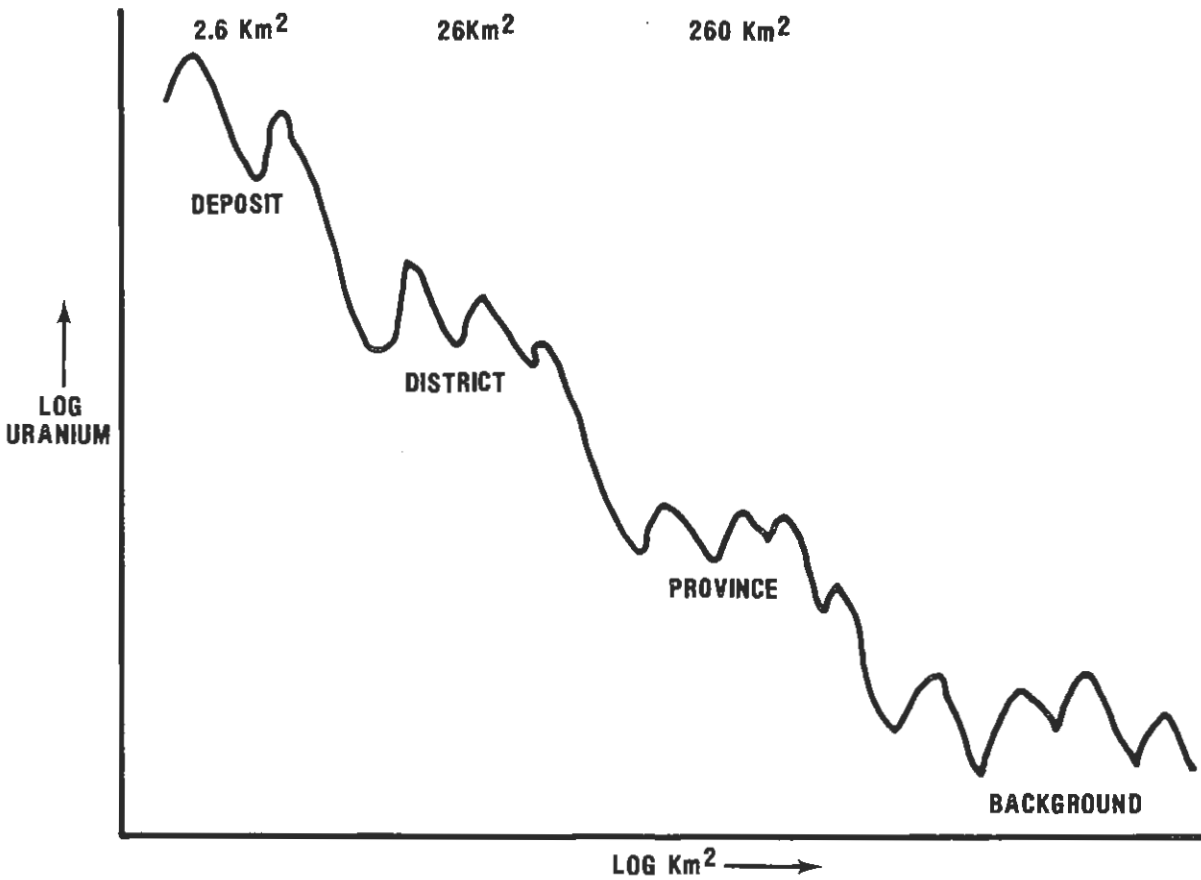

Figure 1

CONCEPT OF GEOCHEMICAL THRESHOLDS

The URE Project of UCC-ND consists of pilot surveys followed by geochemical reconnaissance with samples of stream sediment, stream water, and well water collected, depending on the results of pilot surveys. Samples are analyzed for uranium and other trace elements which more completely describe geochemical patterns. This allows collection of fewer samples than if analyses were 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.

In the reconnaissance program, samples are collected from wells at a grid spacing of 5.1 km (3.2 mi) giving an average density of one well per 26 km^2 (10 mi^2). Stream sediment or stream water samples are collected from basins that range from 5.2 to 52 km^2 with supplemental coverage in areas where basins of the specified size range are not available. The result is an average sampling density for drainage basins of one sample per 26 km^2 (10 mi^2). Samples of well water and those collected from drainage basins provide geochemical data on both surface and subsurface conditions that serve as a basis for defining areas of uranium favorability.

Field Geology Program

The objectives of the field geology program are to:

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

The sample types collected depend on the results of pilot surveys and may include:

1. Stream water,
2. Stream sediment composite, and
3. Well Water

Stream sediments are collected as composite samples generally parallel to the axis of the stream over a 25- to 50-m interval. The samples are placed in paper envelopes and sent to the URE Project Laboratory for disaggregation, sieving to <149 μ(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. Groundwater samples are collected from wells at the point nearest the well head. 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) have been collected in pilot surveys to determine their potential usefulness but are not being collected in reconnaissance surveying.

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 ORGDP. The expertise and capabilities of the Y-12 Plant and the Oak Ridge National Laboratory (ORNL) are also available to provide essential services to 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, and URE support organizations in Figure 3.

Many of the time-proven production procedures being used by UCC-ND 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. Automatic digitizers are also used to determine accurate latitudes and longitudes of sample sites on field maps.

Sampling is scheduled on a year-to-year basis and some considerations include: (1) uranium favorability, (2) funds available, (3) coordination with other DOE/NURE Program activities, and (4) weather. Basin sampling is scheduled during time of low runoff, but not during normal periods of freezing.

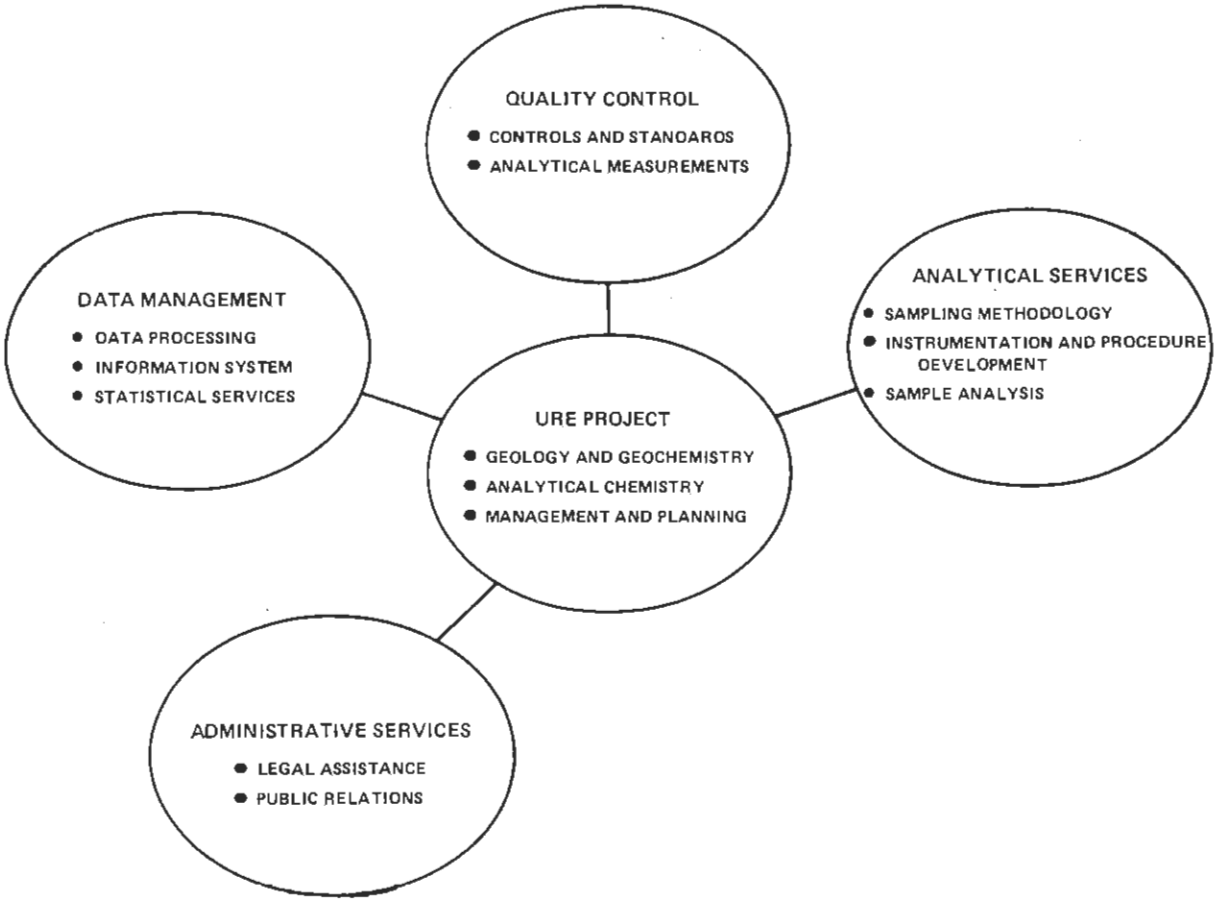

Figure 2

FUNCTIONAL REQUIREMENTS OF THE
URANIUM RESOURCE EVALUATION PROJECT

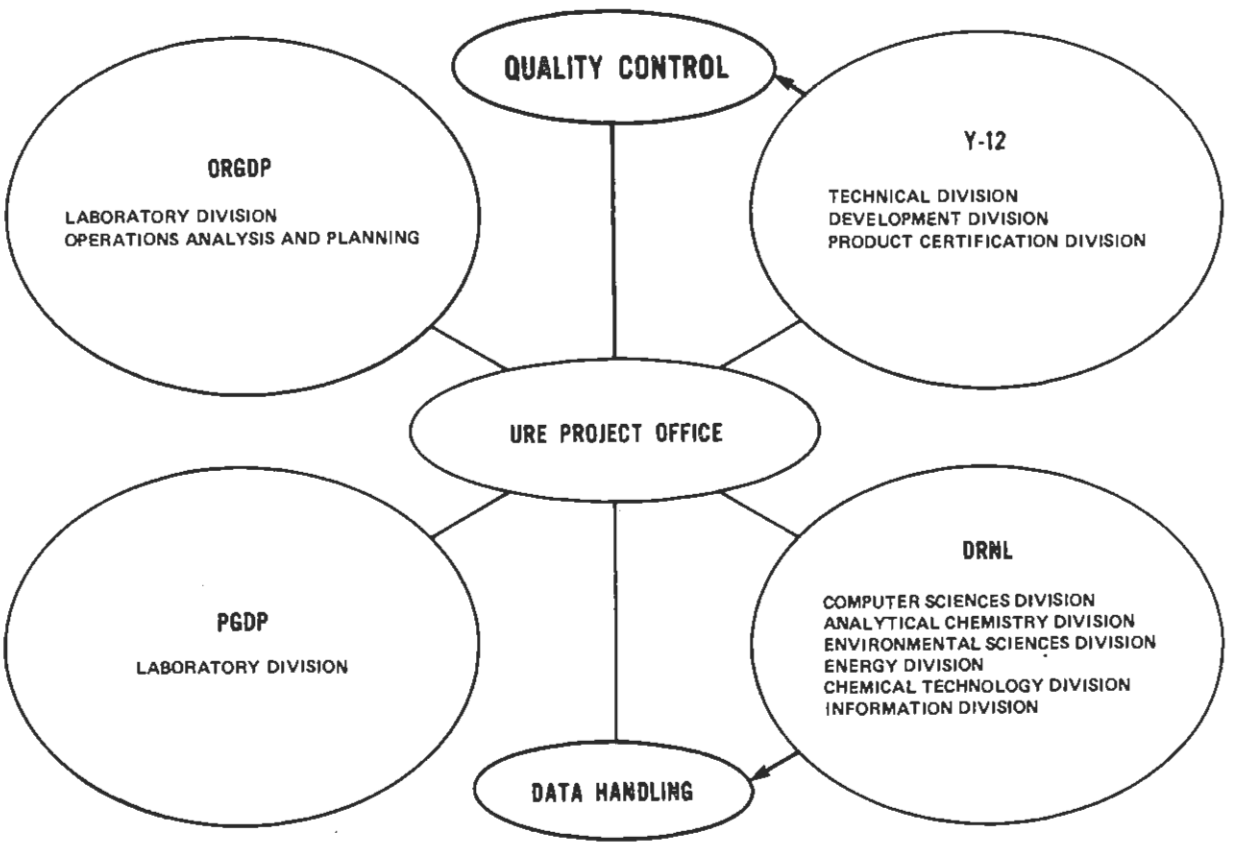

Figure 3

URANIUM RESOURCE EVALUATION PROJECT
SUPPORT ORGANIZATIONS

Present Plans

The URE Project's area of responsibility is equivalent to approximately 2,600,000 km^2 (1,000,000 mi^2) and is contained on 154 maps of the 1° x 2° national topographic map series. Initial reconnaissance will be conducted only in geologically favorable areas assigned the highest priority by DOE. The remainder of the area will be sampled after completion of the favorable quadrangles. Reports for individual 1° x 2° quadrangles will be open filed as soon as possible after sampling, analysis, and data verification have been accomplished.

FIELD OPERATIONS

LOGISTICS

Publicity Program

Pamphlets explaining the NURE Program and the responsibility of the URE Project may be provided to personnel collecting samples for the purpose of increasing public awareness and cooperation. At a contractor's request the URE Project will provide a short filmstrip to local television stations to increase public awareness of the NURE Program.

Gaining Access

Private Property. Most samples will be collected on private property. All rights of the property owner should be respected and care must be taken to avoid any damage. Most landowners will be happy to cooperate and may volunteer much useful information; however, if a landowner prohibits a sample from being taken or withdraws permission once a sample has been collected, return the sample and leave. Do not argue.

Forest Service Lands. Forest Service Lands of the U. S. Department of Agriculture constitute a significant land area in many of the quadrangles to be sampled. The NURE Program has been assured the cooperation of the Forest Service as long as the activities are not detrimental to the forest environment or resources. The URE Project will attempt to provide contractors with lists of the appropriate personnel to contact in each forest area. In general, each Forest Supervisor should be consulted in advance of field operations and must be notified at least a week in advance of actual sampling. The URE Project should receive a copy of any correspondence between a contractor and Forest Service personnel. The contractor's field supervisor must contact District Rangers when sampling teams actually arrive and before sampling is begun.

Commercial exploration on Forest Service land requires the issuance of a mineral exploration permit. The Forest Service has agreed to waive this requirement for the NURE Program so care should be taken to respect Forest Service requests.

Indian Reservations, Parks, Wildlife Refuges, etc. The contractor's field supervisor should arrange contact with the local agent, tribal representative, ranger, warden, or other official in charge several weeks prior to anticipated sampling. In general, good public relations will gain access. The URE Project should receive a copy of any correspondence between the contractor and agencies or individuals contacted

Military Bases. Government of each military base is left to the discretion of the Base Commander and access to any installation is dependent on permission given only by the Base Commander. The contractor's field supervisor must attempt to contact this individual well in advance of any planned sampling on the base. Problems in gaining access should be reported to the URE Project. The URE Project should receive copies of any correspondence between the contractor and the Base Commander or a designated representative.

Liaison with the URE Project Contract Supervisor

The contractor's field supervisor will contact the URE Project's contract supervisor at least weekly by telephone. A motel address and telephone number where this supervisor can be contacted at URE Project initiative during any 24-hr period will be provided. The supervisor will also provide monthly progress reports due on the last week of each month on 1° x 2° quadrangle maps showing the areas sampled.

The contractor's field supervisor is expected to be abreast of team activities at all times. Under normal circumstances, the URE Project will communicate with field teams only through the contractor's field supervisor.

Routine maintenance of equipment is the responsibility of the contractor's field supervisor. The URE Project will perform major repairs or replacement of equipment, but the turn-around time may be several weeks. The contractor's field supervisor should try to detect failing instruments and anticipate needed repairs. It is suggested that a daily log of instrument calibrations be kept to aid in identifying failing equipment.

The contractor's field supervisor should also anticipate the need for resupply far enough in advance to allow time for shipping. The URE Project will process requests for supplies made through the URE Project's contract supervisor once per week and turn-around time on such request can be expected to be at least two weeks.

SITE SELECTION AND SAMPLING PROCEDURES

Sampling Density

Pilot surveys have indicated the average sampling density necessary to define most geologic features. The sampling density to be used in each 1° x 2° quadrangle has been specified in the contract. It is the responsibility of the contractor to identify sites to maintain the specified density. When it is apparent that sites are not available to be sampled at the specified density, it is the responsibility of the contractor to inform the URE Project contract supervisor of the situation.

Site Selection

The procedure suggested for site selection is given in *Appendix A*.

Sample Collection

Detailed instructions for sample collection are given in *Appendix B.*

Data Recording

Detailed instructions for completing the Oak Ridge Geochemical Sampling Form and entering sites on *digitizer maps* are given in *Appendix C.*

SHIPPING PROCEDURES

Samples

Mail all samples within a week of collection, preferably on Friday or Saturday. Prior to mailing, check the total number of samples versus the total number of field forms completed and make sure that all sample labels are legible. Assemble a packing box that has been provided and tape securely. Samples should be packed snugly so that they cannot move around in the box. It may require using newspapers as a packing material to make sure that the fit is snug. When the bottom of the box is filled with bottles, put a cardboard insert on top of the first layer of bottles and fill the box with a second layer. Do not cut a shipping box for this purpose. When samples are placed in boxes, they must be kept in sequence within the boxes shipped. Attach one of the address labels provided to the inside flap of the box. Place another on the outside and also indicate the Oak Ridge address as the return address. The labels for the sample boxes are provided, and an example is shown below.

Union Carbide Corporation
Nuclear Division
Attention: Mr. L. E. White
P. O. Box Y
Building 9720-6, Dock 31
Oak Ridge, Tennessee 37830

On the outside of the box, record the sample number range included in the box. Two bottles of the same sample number should not be split between two boxes. Also, on the outside of the box, write the map code of the 1° x 2° quadrangle from which the samples have been collected (See Figure 5 for map codes); and indicate which box of how many are shipped on that day (example: box 1 of 4, box 2 of 4, box 3 of 4, box 4 of 4). At the post office, insure the box of samples for a minimum amount and mail *Parcel Post Regular.* Indicate at the post office that the contents are geologic samples.

The contractor's field supervisor shall inform the URE Project's field supervisor at the end of each month how many samples have been mailed during that month.

Field Forms

Mail the corresponding Oak Ridge Geochemical Sampling Forms to the URE Project office on the same day the samples are shipped. Field forms are to be placed in an envelope and the seams of the envelope are to be sealed with masking tape. The field forms are to be mailed *Certified Mail, No Return Receipt Requested.* The label for the field form envelopes is shown below. Note that this address is not the same as that to which samples are shipped.

J. W. Arendt
Union Carbide Corporation
Nuclear Division
P. O. Box P, Mail Stop 246
Oak Ridge, TN 37830

Maps

Maps that are to be digitized (*digitizer maps*), with sample locations identified and numbered, are to be mailed to the URE Project office no more than two weeks after sampling has been completed for the area covered by that map. These maps shall remain unfolded and rolled in protective map tubes. Map tubes are to be mailed to the same address as field forms. The address is given below.

J. W. Arendt
Union Carbide Corporation
Nuclear Division
P. O. Box P, Mail Stop 246
Oak Ridge, TN 37830

The contractor's field supervisor is responsible for reporting to the URE Project's contract supervisor at the end of each month the number of maps sent to Oak Ridge to be digitized. It is important to note that many sample locations are present on an individual base map; and without the sample information from a base map, the actual sample and field form data are worthless.

Receiving Packages from the URE Project Office

Packages will be sent to the field addressed to the contractor's field supervisor, in care of either the contractor's office or General Delivery at a particular post office. The post office will usually hold this type of package for ten days. If it is not possible to pick up the package, call the post office to have the package held for a longer period or to have it forwarded. United Parcel Service does not normally have the facilities to hold packages as does the U. S. Post Office.

When a package from the URE Project is received, this information should be reported to the URE Project's contract supervisor.

APPENDIX A

SITE SELECTION FOR WELL WATER SAMPLES

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SITE SELECTION FOR WELL WATER SAMPLES

The site selection procedure described herein was developed for areas which are being sampled at a nominal 3.2-mi spacing (one well per 10 mi^2). The spacing to be used in a particular quadrangle is specified in the contract. This procedure is meant to serve as a guideline to ensure a degree of uniformity in site selection. It should be kept in mind that the primary objective is to obtain coverage that is uniform, complete, and representative. Note that uniform coverage of a favorable producing horizon should not be sacrificed for the uniform geographic distribution of data points. For general guidelines for data control, see *Appendix E*.

1. Accurate base maps are required in the planning phase and for final sample location. When available, coverage should be planned on 7-1/2' or 15' topographic maps. County highway maps may be substituted; however, inaccurate location of coordinates often leads to improper assignment of latitude and longitude for site locations. If county highway maps are to be used, their coordinates must be carefully checked. Site selection requires two copies of each of the 7-1/2' or 15' topographic maps for a 1° x 2° quadrangle area and one copy of the 1:250,000 scale NTMS 1° x 2° topographic map. The 1° x 2° topographic map and one of the copies of the 7-1/2' or 15' topographic maps are to be used for planning. The remaining copy of the 7-1/2' or 15' topographic map is to be used for plotting the actual sample locations and sent to Oak Ridge to be digitized.

2. Initial site selection is conducted by drawing the appropriate grid (3.2-mi line spacing) on the 1° x 2°, 1:250,000 scale topographic map. The grid nodes established on the 1° x 2° master planning map should then be transferred to the appropriate 7-1/2' or 15' topographic maps (or county maps if they are used). The transfer of the grid nodes must be accomplished with great care so the grid does not become offset. It may be useful to transfer the grid nodes to the planning base maps by indicating them with an open circle drawn with a bright colored marking pen.

3. Once the grid nodes have all been established on the planning maps, actual site selection will be accomplished by searching existing well log records to find a water well producing from a known stratigraphic horizon as near to the grid node as possible. The tolerances are ±1.6 mi from the grid node for wells at 3.2-mi spacing (10 mi^2). If a well is not available within the specified radius of the grid node, it is necessary to seek out a well and

establish producing horizon information in the field. If it is not possible to identify a well site in the field within the radius of the grid node, the potential site will be voided and so indicated on the planning maps.

4. Once preliminary wells have been identified by review of well logs, the following information will be entered on the Oak Ridge Geochemical Sampling Form from existing records using URE Project codes or categories:

   Surface geologic unit,
   Identity of producing horizon,
   Confidence of producing horizon identity,
   Source of producing horizon identity,
   Type of well,
   Type of casing,
   Depth to top of producing horizon,
   Confidence of producing horizon depth,
   Source of producing horizon depth information,
   Total well depth,
   Confidence of total well depth,
   Source of total well depth information,
   Owners name and address, and
   Well log number.

   Field form information completed in the office should be entered according to procedures specified in *Appendix C, Well Water Sample Data Recording*. If certain information is not available from drillers records or other sources, it may be possible to obtain this information in the field from the well owner.

5. Sample coverage and field form information listed above is subject to the approval of the URE Project contract supervisor.

APPENDIX B

WELL WATER SAMPLE COLLECTION AND FIELD MEASUREMENT

APPENDIX B

WELL WATER SAMPLE COLLECTION AND FIELD MEASUREMENT

SAMPLING ROUTINE

1. Drive to a sample site indicated on your planning map and verify that you are at that location.
2. Secure permission to sample.
3. Ask the owner (resident) pertinent questions to establish the accuracy of the information already listed on the field form.
4. Observe the well for contaminants.
5. Run water to flush the pipes and/or pressure tank.
6. Rinse both bottles and their caps.
7. Collect the sample and seal both bottles.
8. Label both the samples and the field form with a sample number.
9. Make field measurements. (Make sure all measurements are recorded as they are taken, do not work from memory.)
10. Complete the remaining sections of the field form.
11. Enter the sample location and sample numbers on a *digitizer map*.
12. Review both field form and map data for accuracy.

GUIDELINES FOR SAMPLING

General Guidelines

1. Sampling the preselected wells is important. Do your best to gain access and obtain permission.
2. Try to find someone that knows about the well in order to verify the information.
3. Check the accuracy of the items on the field form that were completed in the office.
4. Ask the following questions about the well:

    a. How old is the well? Note very old or very new wells in the *Remarks Section*.
    b. Does the casing extend below the water table? Is the casing perforated? Is the casing corroded and allowing water seepage?
    c. If the water has been sitting in the pipes (especially windmill) or pressure tank for long periods of time and it is not possible to flush them, record, in the *Remarks Section*, how many hours the water has been standing.

d. Is the pump submersible? What is the composition of the pump? Brass, steel, etc.?
e. Inquire about possible contamination of the groundwater, such as cesspools or mining/oil-gas recovery techniques. Also, ask if the water has been treated, filtered, demineralized, or acidified (for cleaning the well). Do not collect water that has been softened or demineralized. (See *Appendix D, Evaluation of Contamination*).
f. Ask owner how the water tastes. Smell the water.
g. Inquire about the quality of water (sulphur wells, gypsum water, brine) produced from other wells in the area. Record this information in the *Remarks Section* of the field form. Also inquire about any mineral trends in the vicinity of the well being sampled.

5. If it is suspected that a well is producing from alluvium, ask the user if the water rises rapidly in the well during a flood. Alluvium wells should be avoided, if possible.

Sample Collection

1. Collect the well water sample as close to the well head as is feasible. A great majority of well samples are obtained from the pressure tank. If possible, obtain the sample before the pressure tank. In any case, get the well water as close to where it comes out of the ground as possible, but do not disassemble a well-pipe system for a sample.

2. Collect water from the holding tank only under extreme circumstances there are no other wells in the vicinity, and there is no way to obtain the water before the holding tank). If a holding tank sample is necessary, take the water from as close to the center as is possible. Note this on the field form as a contaminant in the *Remarks Section*.

3. Flush water from pipes and/or pressure tank for as long as is necessary to reduce the water temperature to that of natural groundwater (indicating the sample is fresh from the aquifer).

4. Do not operate electric well switches or holding tank electrodes. Do not stand in the puddle of water created by flushing the tank or pipes.

5. Rinse two bottles and their caps five times. Rinse by filling bottles 10-20% full and shaking vigorously. Fill sample bottles 90% full and then screw on the caps. Tap the bottles on a hard surface to dislodge all bubbles, then invert the bottle and let the large air bubble collect all the small bubbles. Reopen the bottle and fill completely. Seal the cap tightly and tape with green vinyl tape. Be sure that the cap does not become unscrewed when applying the tape.

6. Wipe the sample bottles dry and apply the sample labels. (Note: the two bottles taken from a well should have identical sample numbers).

7. Fill out the remainder of the field form as specified in *Appendix C, Well Water Sample Data Recording*.

Recommended Field Pack Contents

1. Hand towel,
2. Three sample bottles (1 extra in case of contamination inside a bottle),
3. Vinyl tape (to seal the bottles),
4. Notebook with field forms, labels, geologic map, and geologic unit code list,
5. Alkalinity kit with extra vial,
6. Horiba Model U-7 Water Analyzer in the field pack carrying case,
7. Bunge cord for Horiba case,
8. Plastic file box which includes:

    a. Two thermometers
    b. Extra pens
    c. Pencil
    d. Lo-Ion pH kits, and

9. Plastic liter bottle.

If it is necessary to hike to a location which is out of sight of the sample vehicle, carry a map for navigational purposes. Remember to keep the pack well supplied, because a trip back to the truck wastes valuable time.

FIELD TESTS

Field measurements are made of conductivity, dissolved oxygen, temperature, pH (using the Horiba U-7 Water Analyzer), and alkalinity (using a titration kit). Care must be exercised to ensure precise measurements that are useful in interpreting geochemical data. Under no circumstances should equipment be abused. It is the responsibility of the contractor's field supervisor to identify malfunctioning equipment and bring it to the attention of the URE Project's contract supervisor.

The Horiba is an expensive and delicate instrument designed to provide precise measurements and has proven to be an excellent piece of field equipment when treated with care. The instruction manual provided with each instrument *must* be thoroughly studied prior to operating the instrument. Loss of the instruction manual should be reported immediately. The Horiba must be calibrated for pH and dissolved oxygen each morning before going into the field. Each night after returning to the motel, the instrument should be recharged (refer to the appropriate section

of the instruction manual). The instrument may need occasional maintenance while in the field. This maintenance includes cleaning the sensor elements, recharging the pH reference electrode, recharging the dissolved oxygen electrode, and replacement of stirrer battery.

CAUTION: No maintenance shall be done without prior instruction from the URE Project contract supervisor. For detailed instructions on routine maintenance, refer to the appropriate section of the instruction manual.

Care of the Horiba U-7 Water Analyzer

1. Read and follow carefully the Horiba U-7 Water Analyzer Manual.
2. Do not drop the Horiba.
3. Be extremely careful when removing the pod covers.
4. Do not touch bare electrodes with any object.
5. Dry the outside of the pod after immersing in water. The electrical connections of the Horiba are very sensitive to water. Protect the Horiba from rain.
6. Tape the connection between the pod and the body to keep water out of the connection which can short out the electrode.
7. Make sure the sponge, towel, etc, in the Horiba pack case are not damp.
8. Do not overcharge the Horiba. Read the instruction book for instructions on recharging.
9. Use a neck strap attached to the Horiba if it is necessary to move it while in use.

Field Measurements with the Horiba U-7 Water Analyzer

Electrode Pod Placement. Suspend the electrode pod with the perforated cover in a liter bottle or plastic bucket filled with water from the same outlet from which the samples were collected. Let the water run gently down the side of the container so the water is not oxygenated. Turn on the *power* to the machine and leave the *display* off. The display drains the battery pack very quickly and should be used only to take readings. Allow the machine to warm up for 2 min. Turn on the display and take the pH, temperature, conductivity, and dissolved oxygen readings. Gently agitate the pod until the readings stabilize while measuring dissolved oxygen. Once all measurements have been read and recorded on the field form, turn off the *display* and *power*. Dry the pod.

Alternate Methods. If the Horiba does not operate correctly, take temperature with the mercury thermometer and pH with Lo-Ion paper. Note on the field form in the *Remarks Section* that tests have been made by alternate methods. Providing it is convenient and quick, a site may be revisited to take the Horiba measurements if the Horiba starts working again. Carry the entire Horiba kit with buffer solutions in the sampling vehicle during the day in case there is a need to recalibrate at a sampling site.

Field Alkalinity Test

Requirements:

1. *Keep the kit clean.*

2. Carry two alkalinity vials in the kit. Fill both at the site, one for Total alkalinity (T-alkalinity) and the other for P- and M-alkalinity. Rinse both vials twice before titrating.

3. If another bottle is refilled with alkalinity reagent B, label the bottle with tape and indelible ink. Rinse the bottle thoroughly with water and alkalinity reagent B before filling with reagent B.

Field Procedure for Alkalinity Test Kit Model WAT-MPH. The LaMotte Alkalinity Test Kit comes with an instruction sheet. It must be read prior to use in the field. Alkalinity measurements are always taken in the following order: T-alkalinity, P-alkalinity, and M-alkalinity.

1. T-Alkalinity

The test vial is cleaned and rinsed in the water to be tested. It must not contain any old reagents or foreign matter. Fill the bottle to the 10-ppm level. The water meniscus should appear on top of the 10-ppm level marker. Other measurement levels may be used, but 10 ppm is most applicable. An accurate volume must be measured for this test to be of value. Add three drops of the BCG-MR indicator; cap bottle, and stir. Fill the syringe with the alkalinity titration reagent B by inserting the tip of the syringe in the reagent bottle opening, invert and expel all air bubbles from the syringe, and then withdraw reagent until the plunger tip is exactly on the zero-mark on the syringe. Transfer the syringe to the titration bottle. Slowly titrate the sample drop-by-drop while shaking the bottle until the blue BCG-MR indicator starts to turn pink. Add the titration reagent a drop at a time until the sample turns pink. Carefully, read the volume used on the syringe. Calculate ppm alkalinity by multiplying the syringe reading by ten (if the 10-ppm line was used).

2. P-Alkalinity

Clean and fill the titration bottle as explained in the preceding *T-Alkalinity Section* to the 10-ppm level. Add two drops of the phenolphthalein liquid or one phenolphthalein tablet and shake gently. If no pink color appears, the P-alkalinity is zero (ppm). If it does turn pink, fill the syringe with reagent B as indicated previously in the *T-alkalinity Section.* Titrate the solution drop-by-drop, while shaking the sample, until the solution turns clear. Read the volume used on the syringe. Note that a P-alkalinity

should be zero for a pH of 8 or less. Note all exceptions in the *Remarks Section* of the field form. Calculate ppm alkalinity by multiplying the syringe reading by ten (if the 10-ppm line was used).

3. M-Alkalinity

Use the remaining alkalinity titration liquid in the syringe used for the P-alkalinity measurement whether or not the P-alkalinity was zero. If the P-alkalinity was zero, the syringe will be full at the start of the M-alkalinity titration; and, if a P-alkalinity was measured, the M-alkalinity titration will start with a syringe less than full by the amount titrated for the P-alkalinity measurement. Add three drops of BCG-MR indicator to the solution already used to measure P-alkalinity. Titrate it to a pink color as previously described in the *T-Alkalinity Section* and multiply the syringe reading by ten to get results in ppm. It should agree to within 10% of the T-alkalinity measurement. If it does not, repeat all alkalinity measurements and record the discrepancy in the *Remarks Section* of the field form (Note: T-alkalinity = M-alkalinity).

4. Alternate pH Test Using Lo-Ion Paper

a. Read the procedures outlined on the Lo-Ion Kit.

b. Rinse the test tube and the cap twice.

c. Fill the test tube with water before inserting a piece of Lo-Ion paper.

d. The Lo-Ion kit, range 6.0-8.0, should be tried first because most of the water sampled has this pH range.

e. It is difficult to distinguish pH values between 7.9 and 8.3 with the paper.

f. When reading the color chart for pH determination, shade the chart and tube from direct sunlight to get an accurate reading.

g. Begin reading the pH color chart at 50 sec. This gives 10 sec to determine color.

h. Keep the Lo-Ion paper dry. It is good to test the accuracy of the paper against the Horiba before beginning a sampling tour. The paper can become defective with age.

i. Perform the Lo-Ion paper pH test once a week for practice on judging colors.

APPENDIX C

WELL WATER SAMPLE DATA RECORDING

APPENDIX C

WELL WATER SAMPLE DATA RECORDING

THE OAK RIDGE GEOCHEMICAL SAMPLING FORM

All field data is recorded on the Oak Ridge Geochemical Sampling Form (See Figure 4) which is a form designed for all sample types collected in the URE Project. It is subdivided into four keypunch cards which approximate grouping of information. Card 1, General Site Data, identifies data needed for all samples. Card 2 is completed for plant, stream sediment, and general water data. Card 3 is completed for well water and lake water samples. Card 4, the *Remarks Section* at the end of the field form, is reserved for specific information otherwise not recorded such as well log number, well location, owner's name and address, contamination, etc. Some of the data listed will be completed before going to the field; however, because alternate sites will be chosen on some occasions, instructions are given for completing all sections pertinent to well water sampling.

General Guidelines

1. Use red ink to complete the field form. A fine point accounting pen is best. Legibility is essential to accurate data transcription. In order to maintain legibility, upper case, readable block letters must be used. No lower case letters are allowed. When all blocks are not filled, all entries must be right justified.

2. When decimal points are provided in the boxes, do not enter another decimal point in a blank box. Where decimal points are not fixed and one is required, enter a decimal point in a blank box making sure that the numbers are right justified. Be aware of significant digits. A zero to the left of a decimal point is not significant but may be used if desired. A zero to the right of a decimal point is a significant digit. Record a zero to the right of a decimal point only when the zero is an exact measurement. Never use .00 as an entry. If a measurement is lower than .01, then use a .01 and explain in the *Remarks Section* that the number is less than .01.

3. Use Ø for the letter O except when writing in the *Remarks Section* (example: PØQ for the Quartermaster Formation)

OAK RIDGE GEOCHEMICAL SAMPLING FORM

1	Card Number
1	

GENERAL SITE DATA

Attach Identical Sample Number Here

2	3	4	5	6	7

8	9	10	11

Site Number

12	13	14	15		16	17
				–		

Map Code

Sample Type

18	
M	Stream Sediment
H	Lake Sediment
S	Stream Water
W	Well Water
P	Spring Water
L	Lake Water
A	Bog Water
B	Plant
F	Soil (Use Remarks)
G	Rock
Ø	Other

19	
	Replicate Letter (A–Z)

Hour		Day		Month		Year	
20	21	22	23	24	25	26	27

28	29	30

Collector's Initials

31	
	Phase (P, 1, 2, or G)

32	Field Sheet Status
Ø	Original
C	Correction
V	Voiding

33	Control Sample
A	Sediment, High U
B	Sediment, Low U
C	Water, High U
D	Water, Low U
Ø	Other

34	35	36	37
		•	

Air Temperature (°C)

Location

Latitude						Longitude					
Deg.		Min.		Sec.		Deg.		Min.		Sec.	
38	39	40	41	42	43	44	45	46	47	48	49	50

51	52	53	54

Surface Geologic Unit Code

UCN-11992 (1 5-77)

Type of Vegetation

55	(Within 1 Km Upstream)
C	Conifer
&	Conifer & Deciduous
D	Deciduous
B	Brush
G	Grass
M	Moss
L	Lichen
Ø	Other

Density of Vegetation

56	(Within 1 Km Upstream)
B	Barren
S	Sparse
M	Moderate
D	Dense
V	Very Dense

Local Relief

57	(Within 1 Km Upstream)	
F	Flat	(<2m)
L	Low	(2–15m)
G	Gentle	(15–60m)
M	Moderate	(60–300m)
H	High	(>300m)
Ø	Other	

Weather

58		59	
C	Calm	C	Clear
P	Lt Wind	L	Pt Cldy
V	Windy	W	Overcst
R	V. Windy	V	Rainy
S	Gale	G	Snowy

Classes of Contaminants

60	
N	None
M	Mining (Use Remarks)
A	Agriculture
F	Oil Field
I	Industry
S	Sewage
P	Power Plant
U	Urban
Ø	Other

Average Stream Velocity (m/sec)

61	62	63

N = No Visible Movement
P = Stagnant Pool

64	65	66

Water Width (m)

67	68	69

Average Depth (m)

Water Level

70		70	
D	Dry	N	Normal
P	Pools	H	High
L	Low	F	Flood

Dominant Bed Material

71	
B	Boulder
C	Cobble
P	Pebble
S	Sand
T	Silt
Y	Clay
N	None (Use Remarks)

Sample Color (Except Plants)

	Adj		Noun	
72	73	74	75	76

V V Lt	PK Pink
L Light	RD Red
M Medium	GN Green
D Dark	BU Blue
CL Clear	BN Brown
WH White	GY Gray
YL Yellow	BK Black
OR Orange	OT Other

77	Odor of Sampled Material
N	None
S	H_2S
Ø	Other

78	
R	Results Request (Use Remarks)

1	Card Number
2	

PLANT SAMPLE

18	19	
		Number of Plants Sampled (Number of grabs for moss)

20	21	22	
	•		Trunk Diameter (m) (1 m above ground)

23	24	25	
	•		Plant Height (m) (Average of Plants Sampled)

Name of Tree, Deciduous

26		26	
R	Alto Verde	U	Locust
A	Ash	P	Maple
B	Beech	M	Mesquite
I	Birch	K	Oak, Other
D	Box Elder	V	Olive
F	Cherry	Y	Poplar
N	Cottonwood	S	Sycamore
E	Elm	T	Salt Cedar
H	Hackberry	G	Walnut
C	Hickory	X	Willow
W	Huisache	Ø	Other
L	Live Oak		

Name of Tree, Conifer

27		27	
A	N. Wh. Cedar	L	Larch
C	Cedar, Other	P	Pine
F	Fir	S	Spruce
H	Hemlock	Ø	Other
J	Juniper		

Name of Bush

28		28	
A	Alder	W	Witch Hazel
B	Blueberry	Y	Yew
P	Pussy Willow	Ø	Other

Name of Moss

29	
P	Peat
S	Sphagnum (live)
Ø	Other

Algae

30	
G	Blue-Green
B	Brown
Ø	Other

Figure 4

OAK RIDGE GEOCHEMICAL SAMPLING FORM

STREAM OR LAKE SEDIMENT

Sample Condition

31
D — Dry
W — wet

Sample Treatment

32
N — None ←
S — Sieved
Ø — Other

33 34 — Number of Grabs

35 36 — % Organic Material (Field Estimate)

GENERAL WATER SAMPLES

Water Sample Treatment

37
N — None
F — Filtered Only
C — Acidified Only
A — Acidified and Filtered
Ø — Other

Depth of Visibility (m)

38 39 40 — C = Clear

41 42 43 44 45 — Conductivity (μmhos/cm)

46 47 48 — Dissolved O_2 (ppm)

49 50 51 — Temperature (°C)

52 53 54 — pH

55 — P — pH by Lo-Ion Paper

56 57 58 59 — Total Alkalinity (ppm)

60 61 62 63 — P Alkalinity (ppm)

64 65 66 67 — M Alkalinity (ppm)

Appearance of Water

68
C — Clear
M — Murky
A — Algal
Ø — Other

69 70 71 72 73 — Discharge (liters/min)

REMARKS (Card 4)

74 75 76 77 — Identification of Producing Horizon (Geologic Unit Code)

Confidence of Producing Horizon Identification

78
H — High Degree
R — Probable
S — Possible

Source of Producing Horizon Identification

79
P — Publication
W — Owner
U — User
G — Geologic Inference
Ø — Other

1 3 — Card Number

WELL WATER

Type of Well

18
D — Drilled
P — Drive Point
G — Dug
U — Unknown
Ø — Other

Power Classification

19
A — Artesian Flow
E — Electric
G — Gasoline
W — Wind
H — Hand
Ø — Other

Casing

20
N — None (Below Water Table)
S — Steel
G — Galvanized
P — Plastic
U — Unknown
Ø — Other

Pipe Composition

21
F — Steel
Z — Galvanized
C — Copper
P — Plastic
U — Unknown
Ø — Other

Sample Location

22 23 24 — Meters from Well Head
H = Holding Tank (Use Remarks)

Where Sample Taken With Respect To Pressure Tank

25
B — Before
A — After
N — No Pressure Tank
F — From Pressure Tank (Use Remarks)

Use of Well

26
M — Municipal
H — Household
S — Stock
I — Irrigation
A — All of above
X — H and S
Y — H and I
Z — S and I
N — None
Ø — Other

Frequency of Pumping

27
C — Constant (hourly)
F — Frequent (daily)
I — Infrequent (weekly)
R — Rare (no recent use)

Depth to top of Producing Horizon

28 29 30 31 — (Meters)

Confidence of Producing Depth

32
H — High
R — Probable
S — Possible

Source of Producing Depth Information

33
P — Publication
W — Owner
U — User
G — Geologic Inference
Ø — Other

Total Well Depth

34 35 36 37 — (Meters)

Confidence of Total Depth

38
H — High
R — Probable
S — Possible

Source of Total Depth Information

39
P — Publications
W — Owner
U — User
G — Geologic Inference
Ø — Other

LAKE WATER

Type of Lake

56
N — Natural
M — Manmade

Lake Area

56 57 58 59 — (sq km)

Figure 4 (cont'd)

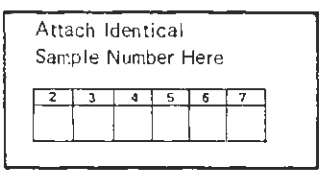
OAK RIDGE GEOCHEMICAL SAMPLING FORM

4. Anytime *Other* is marked as a choice, explain the observation in the *Remarks Section*. Entries are made in the *Remarks Section* by indicating the card and the block number to which the remarks apply and then writing out the remark (Example: 1-78 followed by a name and address for *Results Request*).

5. If it is necessary to void a figure because an error has been made, mark through the original figure and draw another box with its number next to the printed box, and place the correct entry in the sketched box.

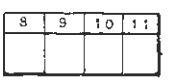
Card 1, General Site Data

Blocks 2-7



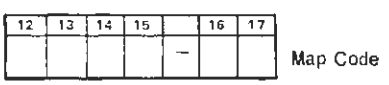
Attach the sample number label identical to that attached to the sample bottles over Blocks 2-7. If the label to be used on the field form is ruined or lost, record the numbers legibly on the field form. Note the two bottles of water collected at each site are identified by identical sample labels.

Blocks 8-11



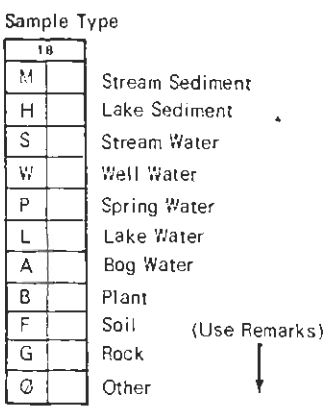
Enter the unique site number in Blocks 8-11. Each point of sample collection (well) is defined as a site. Each site will have a unique number within any 1° x 2° quadrangle (starting with 1).

Blocks 12-17



Enter the map code in Blocks 12-17. Each 1° x 2° quadrangle has a unique map code (see Figure 5 at the end of the appendix for the appropriate code).

Block 18



Indicate the sample type in Block 18 by placing an "X" in the box for *Well Water*.

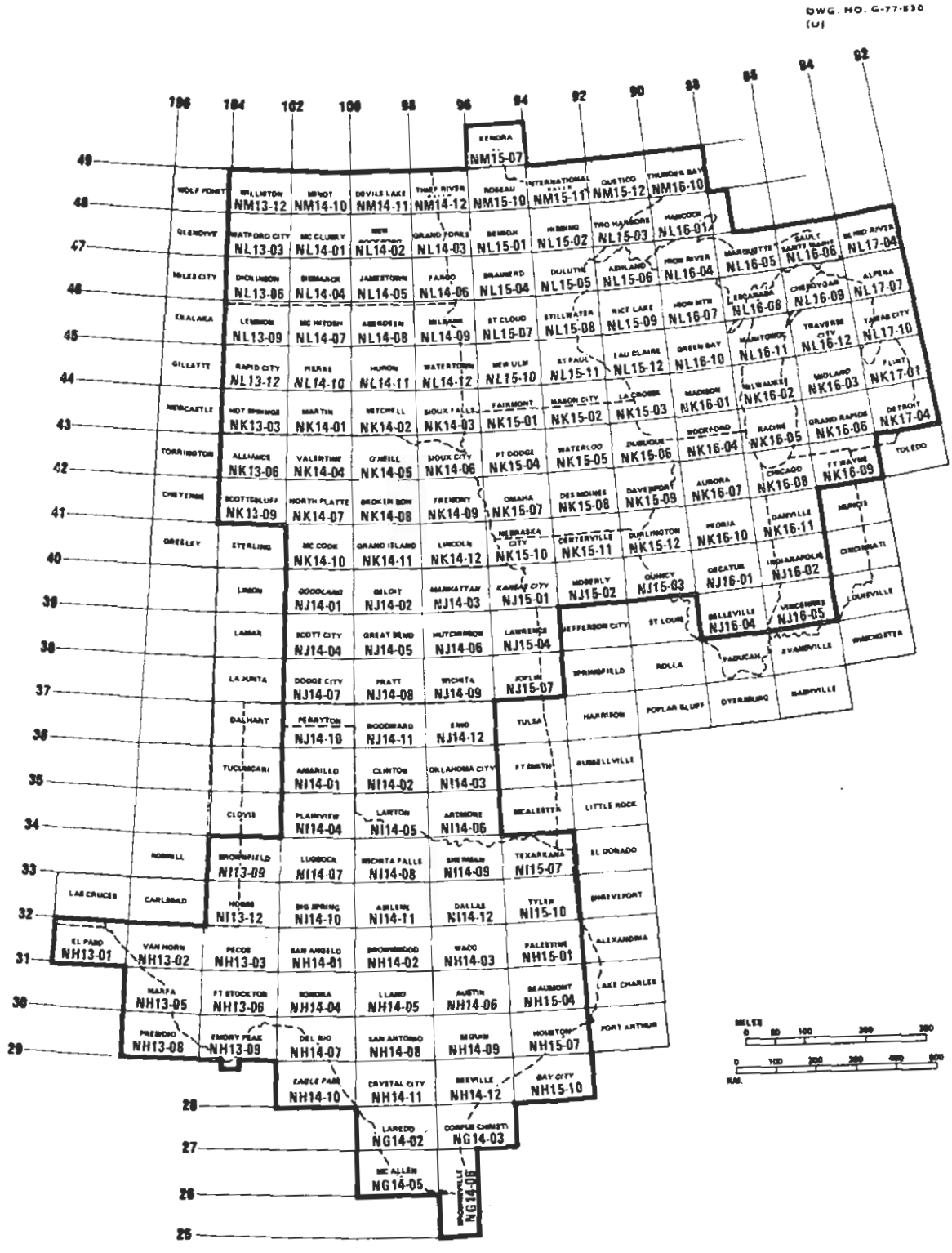
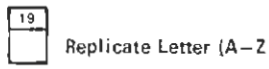


Figure 5

1° x 2° QUADRANGLE MAP CODES

Block 19



Leave Block 19 blank.

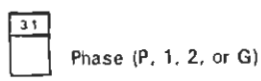
Blocks 20-27

Enter the time to the nearest hour that the sample was collected in Blocks 20-27. Use the military 24-hour system of telling time (example: 1:00 p.m. should be recorded as 13).

Blocks 28-30

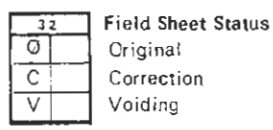
Enter the sample collector's three initials in Blocks 28-30 (or those designated for their use).

Block 31



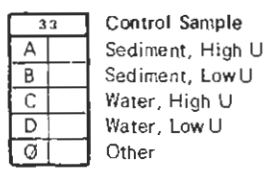
In Block 31, enter the phase. If sampling is being conducted on a 3.2-mi grid (10 mi^2), enter "2".

Block 32



Enter the *Field Sheet Status* in Block 32. All new forms are *originals* and should be so designated. Forms submitted later to correct errors on forms previously submitted should be marked *Correction*.

Block 33



Leave Block 33 blank.

Blocks 34-37

Enter the air temperature in Blocks 34-37. Measure the air temperature by hanging the mercury thermometer in the shade. Let the thermometer stabilize for several minutes before reading and record the temperature to the nearest tenth of a degree.

Blocks 38-50

Location

Latitude						Longitude						
Deg.		Min.		Sec.		Deg.			Min.		Sec.	
38	39	40	41	42	43	44	45	46	47	48	49	50

Leave Blocks 38-50 blank. The Latitude and Longitude are obtained from the electronic digitizer in Oak Ridge.

Blocks 51-54

51	52	53	54

Surface Geologic Unit Code

Enter the surface geologic unit code for the formation present at the surface where the well is located in Blocks 51-54. Prior to leaving the office, obtain a geologic code list for the region and be absolutely sure that the list is the most recent. If an alternate site must be selected, the surface geologic unit may be different than at the original site. It may be best to check with the contractor's field supervisor to determine which designator is most appropriate for an alternate site.

Block 55

Type of Vegetation

55		(Within 1 Km Upstream)
C		Conifer
&		Conifer & Deciduous
D		Deciduous
B		Brush
G		Grass
M		Moss
L		Lichen
Ø		Other

Enter the type of vegetation present within 1 km of the sample site in Block 55. If conifer and deciduous are mixed by more than 10% of the other type, then mark *Conifer* and *Deciduous*. Inspect the sampling site for vegetation type as the site is entered while driving or on foot.

Block 56

Density of Vegetation

56		(Within 1 Km Upstream)
B		Barren
S		Sparse
M		Moderate
D		Dense
V		Very Dense

Enter the density of vegetation within 1 km of the site in Block 56. *Barren* means no vegetation. *Sparse* indicates a definite lack of vegetation where grass, brush, etc. are present but the soil is uncovered between patches of grass. *Moderate* is the normal vegetative cover. *Dense* indicates a growth so thick that movement through it is difficult. *Very Dense* would be a jungle or rain forest. A pasture may appear as a sparse situation but if covered with grass, it would be classified as *Moderate*.

Block 57

Local Relief

57		(Within 1 Km Upstream)	
F		Flat	(< 2m)
L		Low	(2–15m)
G		Gentle	(15–60m)
M		Moderate	(60–300m)
H		High	(>300m)
O		Other	

Enter the local relief in Block 57. The categories of local relief are defined by the difference in elevation from the sample site to the highest point within a half kilometer radius of the sampling site. Relief is best estimated while driving or hiking to the site. These numbers are most accurately determined from a topographic map.

Blocks 58-59

Weather

58			59	
C		Calm	C	Clear
P		Lt Wind	L	Pt Cldy
V		Windy	W	Overcst
R		V. Windy	V	Rainy
S		Gale	G	Snowy

Enter the appropriate choices for weather in both Blocks 58 and 59. There is a difference between *Windy* and *Very Windy*. When the wind makes it difficult to handle papers or equipment, it is defined as *Very Windy*. If more than 10% of the sky is covered by clouds, then mark *Partly Cloudy*.

Block 60

Classes of Contaminants

60			
N		None	
M		Mining	(Use Remarks)
A		Agriculture	
F		Oil Field	
I		Industry	
S		Sewage	
P		Power Plant	
U		Urban	
O		Other	

Enter any type of contamination near the well in Block 60 (Refer to *Appendix D, Evaluation of Contamination*). For all categories except *None*, an explanation must be included in the *Remarks Section* of the field form. This includes a specific description of the situation including the position of the potential source of contamination with respect to the site. In the case of *Mining*, the description should include the size of the area disturbed in the surrounding area and the type of material mined. In the case of *Agriculture*, include the type of crop, size of cultivated field, and information that might be helpful in evaluating the type of fertilizer used. The presence of cows in a field is not of itself considered evidence of agricultural contamination. The categories of *Industry*, *Power Plants*, and *Urban* are included to give an indication of the particular trace elements which are most likely to be present.

Blocks 72-76

Sample Color (Except Plants)

	Adj		Noun	
72	73	74	75	76

V V Lt
L Light
M Medium
D Dark
CL Clear
WH White
YL Yellow
ØR Orange
PK Pink
RD Red
GN Green
BU Blue
BN Brown
GY Gray
BK Black
ØT Other

Enter the sample color of the well water sampled in Blocks 72-76. The color of water from wells is determined by placing white paper against a liter bottle full of water.

Block 77

77
N
S
Ø

Odor of Sampled Material
None
H_2S
Other

Indicate the odor of the well water in Block 77. Pay special attention to H_2S odors.

Block 78

78
R

Results Request
(Use Remarks)

If it is necessary to provide the results to obtain permission to sample, check Block 78. Enter the person's name and mailing address in the *Remarks Section*. Legibility is essential. Place "%" after the standard pauses in a person's mailing address to instruct the computer where to start a new line when addressing the results. Be sure to obtain the Zip Code (See an example in *Section E-4* of *Appendix C*).

Card 2, General Water Samples

Block 37

Water Sample Treatment

37	
N	None
F	Filtered Only
C	Acidified Only
A	Acidified and Filtered
Ø	Other

Enter the water sample treatment applied in Block 37. If raw water samples were collected, indicate *None*.

Block 38-40

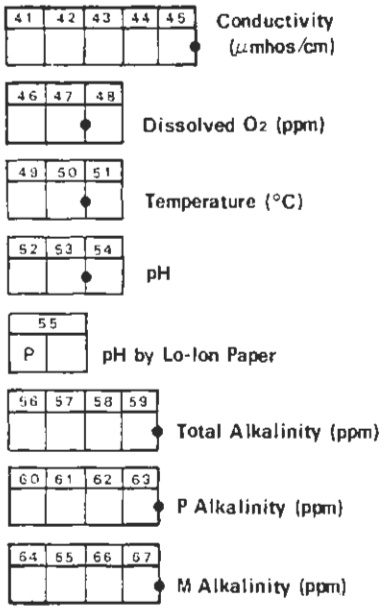
Depth of Visibility (m)

38	39	40

C = Clear

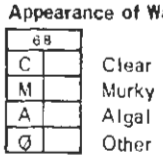
In Blocks 38-40, indicate the depth of visibility. This must be estimated from water collected in a liter bottle. Use *Clear* when appropriate.

Blocks 41-67



Record the appropriate field measurement in Blocks 41-67. For conductivity measurements, be aware that some of the Horiba U-7 Water Analyzers measure in millimhos and some in micromhos. If the Horiba measures in millimhos, multiply the measurement by 1,000 and enter in Blocks 41-45. If the Horiba measures in micromhos, record the exact number read from the instrument. If Lo-Ion paper is used to measure pH, put an "X" in Block 55 and record the pH in Blocks 52-54. If there is no P-alkalinity measured, record "0" in Block 63.

Blocks 68

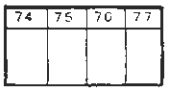


Indicate the *Appearance of the Water* in Block 68. It is important to record the presence of algae at well water sites because algae is an effective trace element scavanger.

Blocks 69-73

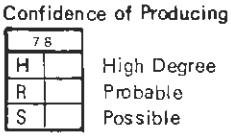
Record the *Discharge* in liters/min in Blocks 69-73. Measure the discharge with a liter bottle directly from the well head. Do not measure the discharge from a pressure or holding tank, rather leave the block blank. If the discharge cannot be measured, ask the user the pumping capacity of the well. Record that figure and enter the fact that the discharge is estimated in the *Remarks Section*.

Blocks 74-77



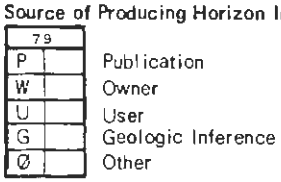
Indicate the *Identification of the Producing Horizon* in Blocks 74-77. The identity should normally be completed in the office from drillers' logs or other sources of information. If an alternate site must be selected, obtain the appropriate geologic code from the list of geologic unit codes.

Block 78



Indicate the *Confidence of the Producing Horizon Identification* in Block 78. If the identity is inferred, then *Possible* should be indicated. If the source of the information is drillers' logs or other sources of published information, then *Probable* or *High Degree* should be indicated Note that if *High Degree* is marked, be absolutely certain of the identity of the producing horizon.

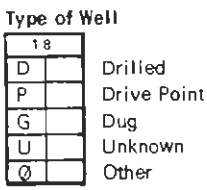
Block 79



Indicate the *Source of the Producing Horizon Identification* in Block 79.

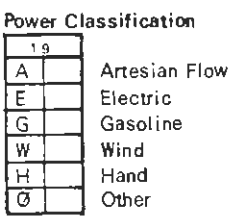
Card 3, Well Water

Block 18



Indicate the *Type of Well* sampled in Block 18. Often, this information can be obtained in the office from drillers' logs prior to going to the field.

Block 19



Indicate the class of power unit used to pump the well in Block 19.

Block 20

Casing

20	
N	None (Below Water Table)
S	Steel
G	Galvanized
P	Plastic
U	Unknown
Ø	Other

Indicate the *Casing* composition in Block 20. It will be necessary to distinguish between *Steel*, iron, or *Galvanized*. Galvanized has a gray color. Steel is the most common casing and looks like iron when rusted. Check for lead casing which can be present in some very old wells. Iron and lead should be marked as *Other* and noted in the *Remarks Section*.

Block 21

Pipe Composition

21	
F	Steel
Z	Galvanized
C	Copper
P	Plastic
U	Unknown
Ø	Other

Indicate the pipe composition in Block 21. Galvanized is the most common.

Blocks 22-24

Sample Location

22	23	24	
			Meters from Well Head H = Holding Tank (Use Remarks)

Indicate the distance between the sample location and the well head in Blocks 22-24. The distance recorded is the total length of the pipe from the well head regardless of how indirect the path of the pipe.

Block 25

Where Sample Taken With Respect To Pressure Tank

25	
B	Before
A	After
N	No Pressure Tank
F	From Pressure Tank (Use Remarks)

Indicate the location of the sample with respect to the pressure tank in Block 25. In the *Remarks Section*, indicate the approximate size, relative age (old or new), and the composition of the tank.

Block 26

Use of Well

26	
M	Municipal
H	Household
S	Stock
I	Irrigation
A	All of above
X	H and S
Y	H and I
Z	S and I
N	None
Ø	Other

Indicate the *Use of Well* in Block 26. If a well is used for several homes, it is considered a municipal well.

Block 27

Frequency of Pumping

27	
C	Constant (hourly)
F	Frequent (daily)
I	Infrequent (weekly)
R	Rare (no recent use)

Indicate the *Frequency of Pumping* in Block 27.

Blocks 28-31

Depth to top of Producing Horizon

28	29	30	31	
				(Meters)

Indicate the *Depth to the Top of the Producing Horizon* in Blocks 28-31. When this information is not available, it is necessary to substitute the total well depth. If the total well depth is unknown and the aquifer is unconfined, the depth to the top of the producing horizon may be approximated by entering the depth to the water in the well when the pump has not been running for a period of time. If the depth has been approximated, it should be so indicated in the *Remarks Section*.

Block 32

Confidence of Producing Depth

32	
H	High
R	Probable
S	Possible

Indicate the confidence of the producing horizon depth in Block 32.

Block 33

Source of Producing Depth Information

33	
P	Publication
W	Owner
U	User
G	Geologic Inference
Ø	Other

Indicate the source of the producing horizon depth information in Block 33.

Blocks 34-37

Total Well Depth

34	35	36	37	
				(Meters)

Indicate the *Total Well Depth* in Blocks 34-37. This information is often available from drillers' logs or publications.

Block 38

Confidence of Total Depth

38	
H	High
R	Probable
S	Possible

Indicate the confidence of the total well depth in Block 38. Only indicate *High* if you are absolutely certain of the total depth.

Block 39

Source of Total Depth Information

39	
P	Publications
W	Owner
U	User
G	Geologic Inference
Ø	Other

Indicate the source of the total well depth information in Block 39.

Card 4, Remarks

1. Print all *Remarks* in upper case, block letters. Be neat to assure accurate transcription.

2. Start the *Remarks Section* with the card and block number that pertain to the remark. End each remark with a colon (:) and then start the next remark (example: 1-60 RECENTLY DRILLED, POSSIBLY CONTAMINATED BY DRILLING MUD: 3-21 LEAD PIPE:).

3. The first entry in the *Remarks Section* should be the exact location from which the sample was obtained. The information required in the description includes:

   a. the name of the *digitizer map* on which the sample is entered,
   b. the well log code (log number or other identifier) if available,
   c. the owner's name and address,
   d. a description of the location of the well including where the sample was actually collected.

   (1-37 JACKSON HILL 7.5 MINUTE MAP, STATE OF IOWA WELL LOG NUMBER 07854, MR JOHN ZLOTECKI, ROUTE 1, COON RAPIDS, IOWA, SAMPLE COLLECTED FROM FAUCET ON PRESSURE TANK, 2 M FROM WELL, WHICH IS LOCATED IN THE WHITE SHED 45 M NORTH OF THE BACK DOOR OF THE HOUSE:)

4. If results are requested by the well owner at any site, use the following format (in addition to the well location format).

   1-78 MR JOHN ZLOTECKI%, ROUTE 1, BOX 65% COON RAPIDS, IOWA 52340:

5. If keying a remark to two or more different boxes, use this format: 1-60 #3-21 WELL WATER MAY BE CONTAMINATED BY LEAD PIPE:

6. Record all information in the *Remarks Section* that helps describe the sample and sampling site. It should be brief but accurate. Small items that seem unimportant at the site may be very significant in interpreting geochemical data.

7. Be neat when crossing out an entry in which an error has been made in the *Remarks Section*.

DIGITIZER MAPS

The accurate location of sites that have been sampled must be done after the samples have been collected. Site locations are plotted on clean unfolded copies of 7-1/2' or 15' topographic maps or, if necessary, on county highway maps. The planning maps prepared in the office for preliminary site selection may be used for navigation and other purposes. The final maps that are to be digitized must be so indicated by writing "DIGITIZER MAP" in the lower right hand corner and by affixing the labels which are provided. An example is shown below.

SAMPLER NAME(S)_____

TYPE MAP _____ DATE _____

QUADRANGLE NAME AND NUMBER _____

_____

PHASE _____ NO. OF SITES _____

PHASE _____ NO. OF SITES _____

Once a sample has been collected, determine the location of the sample site on the *digitizer map* as accurately as possible. Using a red pen, put a dot over the site location and then circle the dot. Next to the sample site location, attach a small sample label that is provided along with the labels for the sample containers. In some cases, the small labels will not be usable, and the six-digit sample number will have to be printed neatly next to the sample location. The sample site location and sample number should be accented using a yellow marking pen if sample number labels are not used.

When all sampling has been completed on either a 7-1/2' or 15' topographic map or on a county highway map, the information must be completed on the label which has been affixed in the margin. The unfolded *digitizer map* should be returned to Oak Ridge to the address indicated in the procedures for shipping maps.

COMPOSITE MAPS

Sample site locations actually sampled should be entered on the 1° x 2° master planning map each day. Accompanying the accurately positioned sample site location will be the sample number and site number. This map must be kept up to date so that it can be used to report monthly progress to the URE Project contract supervisor as well as to correct any discrepancies that may occur on *digitizer maps*.

APPENDIX D

EVALUATION OF CONTAMINATION

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EVALUATION OF CONTAMINATION

Listed below are the sources of contamination most likely to be encountered. Avoid these circumstances, if possible, and always record possible/certain contaminants in the *Remarks Section.*

1. Agricultural Contamination

   Agricultural contamination is generally restricted to the application of fertilizer. As the mid-continent region of the United States contains 70% of the American agricultural production, this is of major importance. Phosphate fertilizers are widely used and contain concentrations of uranium that may potentially enter the groundwater.

2. Corroded Well Casing or Pipes

   Record this upon observation. Ask the landowner or user about the condition of the well.

3. Drilling Grease/Lubricants for New Wells

   Record their presence in the *Remarks Section.*

4. Precipitate Around Pipes and Faucets

   This indicates possible mineralization and should be noted in the *Remarks Section.*

5. Oil-Producing Field

   If samples are being taken in an oil/gas field, record this information although no actual oil film is observed. Brines are used for injection and contain significant trace element concentrations.

APPENDIX E

GENERAL GUIDELINES FOR DATA CONTROL

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GENERAL GUIDELINES FOR DATA CONTROL

1. Site numbers are unique within any 1° x 2° quadrangle, starting at 0001 and progressing to 9999 (however, that many samples are never collected within an individual quadrangle).

2. When potential well sampling sites are identified from well logs and located on 7 1/2' or 15' topographic or county highway maps, a field form should be completed listing the available information.

3. Site numbers should be consecutive, if possible, within any individual base map and should not be repeated within that 1° x 2° quadrangle.

4. When wells have been found for all potential sites and have been identified on a planning map in the office, the field forms completed for those sites should be attached to the base map along with an appropriate number of sample labels (Note: the sequence of sample numbers is not continuous because numbers have been randomly removed for quality control samples.).

5. When samples are collected, the actual sample site should be entered in red ink on a new, clean, unfolded map (not the planning map completed in the office), called a *digitizer map*, using a "00" rapidograph. The sample number label should be attached next to the accurately located sample site as shown below:

   ⊙ 700017

   The *digitizer map* must not be folded because it is the one that goes to the electronic digitizer in Oak Ridge. Folding will distort the position of site locations with respect to coordinates of the maps.

6. If a site cannot be sampled, an alternate site must be sampled to fill that grid point. The new site should be assigned the site number of the one not sampled and a new field form must be completed using the unused site number. The field form for the unsampled site should be placed in a specially designated envelope which will be given to the contractor's field supervisor. On the original planning base map from the office, label the site as one that was not sampled. Enter the new site on the *digitizer map*.

7. When all sampling has been completed for a particular *digitizer map*, complete a label and place it on the lower right corner of the map. The label to be used is shown below:

SAMPLER NAME(S)_____

TYPE MAP _____DATE _____

QUADRANGLE NAME AND NUMBER _____

_____

PHASE _____ NO. OF SITES _____

PHASE _____ NO. OF SITES _____

8. Maintain a 1° x 2° composite map for each quadrangle being sampled, keeping progress up-to-date on a daily basis. The map should indicate site location, sample number, and site number. After sampling is complete in a quadrangle, the map must be turned in to the URE Project's contract supervisor.

9. Ship samples, field forms, and maps to Oak Ridge in the specified manner (See *Sample Shipment Procedures*).

10. Keep an inventory of all boxes, sets of field forms, and *digitizer maps* sent to Oak Ridge including inclusive sample and site ranges as well as dates for each mailing. This inventory should be given to the contractor's field supervisor. A master copy of the shipping inventory for all personnel must be available for the URE Project's contract supervisor as requested.