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ENVIRONMENTAL RESTORATION PROGRAM

Groundwater Quality Monitoring Well Installation for Waste Area Grouping 7 and Solid Waste Storage Area 1 at Oak Ridge National Laboratory, Oak Ridge, Tennessee

J. A. Mortimore
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ORNL/ER-22

Environmental Restoration Division
ORNL Environmental Restoration Program

Groundwater Quality Monitoring Well Installation for Waste Area Grouping 7 and Solid Waste Storage Area 1 at Oak Ridge National Laboratory, Oak Ridge, Tennessee

J. A. Mortimore
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EXECUTIVE SUMMARY

This report documents the drilling and installation of groundwater quality monitoring (GQM) wells on the perimeter of Waste Area Grouping (WAG) 7 and Solid Waste Storage Area (SWSA) 1. WAG 7 is located in Melton Valley and consists of approximately 116 acres. SWSA 1 is located inside the south boundary of the main plant area. The wells at WAG 7 and SWSA 1 were drilled and developed between June 1989 and March 1990. These wells were installed to characterize and assess WAG 7 and SWSA 1 in accordance with applicable Department of Energy, state, and Environmental Protection Agency regulatory requirements.

Well design and placement were performed by Martin Marietta Energy Systems, Inc. (Energy Systems) geologic staff and their subcontractors. The wells were drilled, installed, and developed by Geotek Engineering, Inc., under contract with Energy Systems. The contract was administered by the Energy Systems Engineering Division for the Environmental Restoration (ER) Program. Hydrogeologic support was provided by an environmental subcontractor [ERC Environmental and Energy Services, Inc. (ERCE)] under contract with Energy Systems. (As of January 1, 1992, ERCE started operating under the name of Ogden Environmental and Energy Services Co., Inc.) This contract was administered by ER Division staff. Radiation protection and industrial hygiene support for the drilling program were provided by Energy Systems staff or their subcontractors.

The wells at WAG 7 and SWSA 1 were drilled with auger or air rotary rigs. Depending on the hydrogeologic conditions present at each proposed well location, one of four basic installation methods was utilized. Detailed procedures for well construction were specified by the Engineering Division to ensure that the wells would provide water samples representative of the aquifer. To ensure conformance with the specifications, Energy Systems Construction Engineering and ERCE provided continuous oversight of field activities.

The purpose of the well installation program was to install GQM wells for groundwater characterization at WAG 7 and SWSA 1. Data packages produced during installation activities by the ERCE hydrogeologists are an important product of the program. These packages document the well drilling, installation, and development activities and provide valuable data for well sampling and WAG characterization. The forms contained in the packages include predrilling and postdrilling checklists, drilling and construction logs, development and hydraulic conductivity records, and quality control-related documents.

1. INTRODUCTION

The purpose of this report is to document the drilling and installation of the groundwater quality monitoring (GQM) wells on the perimeter of Waste Area Grouping (WAG) 7 and at Solid Waste Storage Area (SWSA) 1, which is a part of WAG 1. Installation of GQM wells was required at Oak Ridge National Laboratory (ORNL) for regulatory compliance. Data obtained from these wells will be used to characterize and assess groundwater quality at the perimeter of each WAG in accordance with applicable Department of Energy, state, and Environmental Protection Agency regulatory requirements. The wells in WAG 7 and SWSA 1 were drilled and developed during the period from June 1989 to March 1990.

1.1 THE WAG CONCEPT

At ORNL, the solid waste management units (SWMUs) include solid waste storage areas (SWSAs), pipelines, spill sites, buildings, ponds, and experimental test sites that are considered to be potential sources of contamination. The SWMUs are further grouped into WAGs, the boundaries of which are defined by watersheds that contain contaminants derived from similar assemblages of operating facilities and SWMUs. Basically, the wells are located on or near these boundaries to determine whether contaminants have been released from the WAGs.

1.2. DESCRIPTIONS OF WAG 7 AND SWSA 1

WAG 7 consists of approximately 116 acres in Melton Valley; it is bounded on the south and east by White Oak Lake and the floodplain of White Oak Creek [Fig. 1, map pocket (MMES map #C3E20004A084, Rev. B)]. WAG 6 lies to the west of WAG 7 and the two areas are separated by a small tributary of White Oak Creek. WAG 7 includes seven chemical seepage pits and trenches that were used to contain liquid waste during the period from 1951 through 1966. WAG 7 also contains the pipelines leading to the pits and trenches from the main plant, an abandoned decontamination facility (Building 7819), the Homogeneous Reactor Experiment fuel wells, the Hydrofracture Experiment Site I, and five shielded transfer tanks. Sixteen wells were installed along the perimeter of WAG 7 (Fig. 1, map pocket).

SWSA 1 is a solid waste burial ground inside the south boundary of WAG 1, the main plant area (Fig. 1, map pocket). It is located near the intersection of Incinerator Road and Third Street. There were several wells installed around SWSA 1, and the report on the installation of all but two of the wells can be found in the main plant report, *Groundwater Quality Monitoring Well Installation for WAG 1*, ORNL/RAP-47.[1] The last wells installed at SWSA 1 (Wells 946 and 947) were not drilled until after the publication of ORNL/RAP-47,[1] and thus have been included in this report. The location of these two monitoring wells are shown on the Fig. 1 (map pocket).

2. INSTALLATION METHODS

Four basic types of well construction were used during the GQM installation program at ORNL. Schematic diagrams of these four well types are shown on Fig. 2. Three of the four types (A, B, and D) were used at WAG 7 and SWSA 1. These types are described in Sects. 2.1 through 2.3. The specific details of each well installation are included in the monitoring well narratives (Appendix A). The specifications for drilling and well installation can be found in the *Construction Specifications for Monitoring Wells Installation Construction Project*, K-4491G-G12.[2] The proposed well design criteria for the WAG 7 wells can be found in the report *Preliminary Geohydrologic/Site Characterization and Proposed Water Quality Well Locations for WAG 7, WAG 8, and WAG 9*, ORNL/RAP/Sub-86/72139/2.[3] The criteria for the SWSA 1 wells were provided in the report *Preliminary Geohydrologic Site Characterization and Proposed Water Quality Well Locations for WAGs 4, 5, 3, and SWSA 1*, ORNL/RAP/Sub-86/72139/1.[4] The actual completion data for WAG 7 and SWSA 1 wells are listed in Table 1.

2.1 TYPE A WELL

The type A well boring is drilled to total depth with solid-stem augers. Upon completion, the boring is bailed with a steel bailer to remove drill cuttings. The well is completed with 2-in-diam stainless steel screen, casing, and silt trap. Stainless steel centralizers are positioned at the top of the screen and every 20 ft along the casing. A sandpack is poured into the annular space from total depth to 1 ft above the screen. Pelleted bentonite is poured into the annular space to create a 2-ft seal above the sandpack. The top of the bentonite seal is measured with a stainless steel weighted tape. The annular space above the bentonite seal is then grouted to the surface through a tremie pipe.

2.2 TYPE B WELL

The first step in drilling the type B well is to auger a boring from the surface to a depth of 4 ft. A steel diverter casing is installed, and the annulus is grouted up to the surface. The boring is then deepened with a tricone air rotary bit to a minimum depth of 10 ft total and 2 ft into bedrock. Next, a steel surface casing is installed and grouted into place. The air rotary method is used to drill the boring to the required depth. The well is completed with 4-in-diam stainless steel screen and casing. A sandpack, a bentonite seal, and grout are installed in the annular space by the same procedures as used for the type A well.

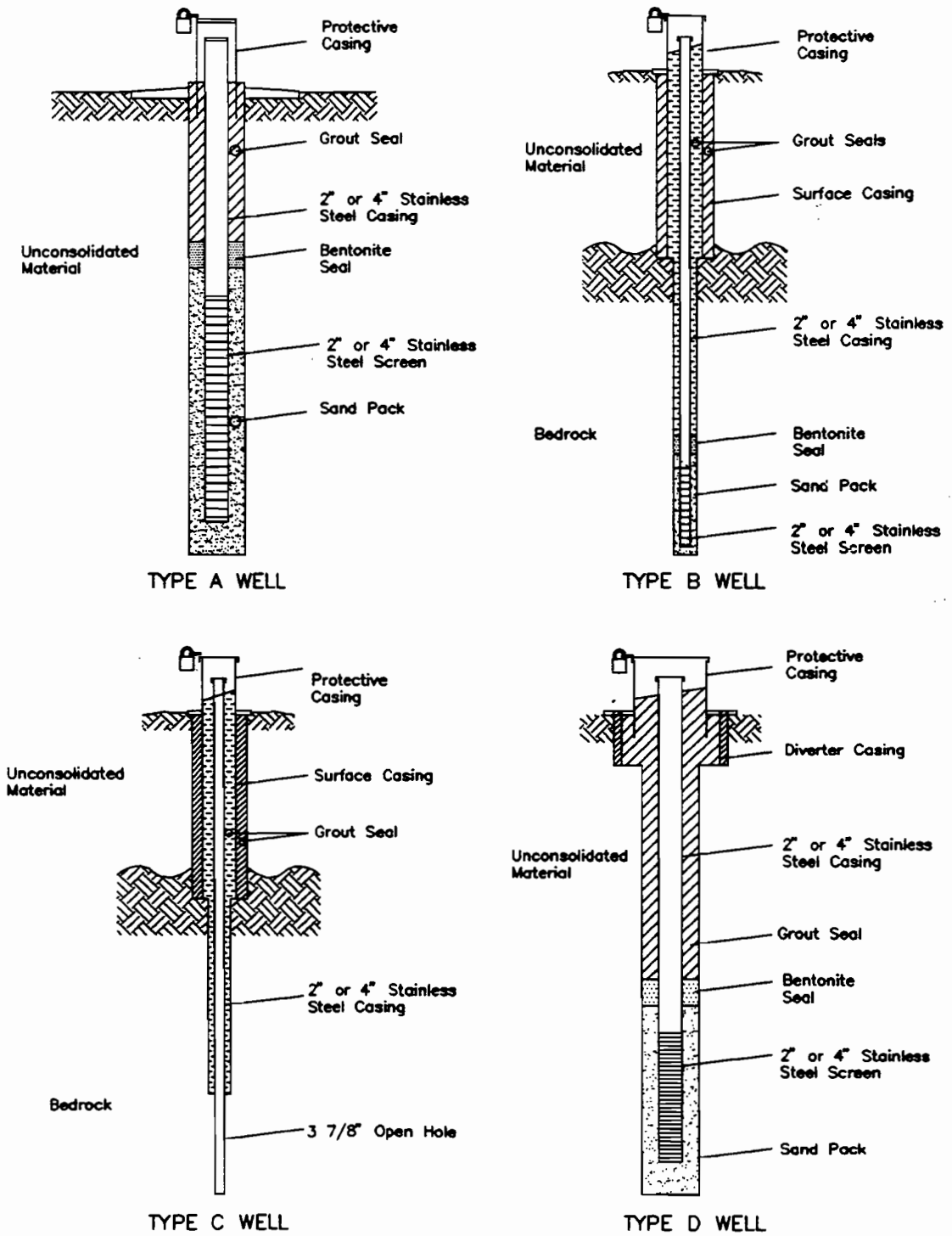


Fig. 2. The four types of well construction used during the Groundwater Quality Monitoring Well Installation Program at Oak Ridge National Laboratory.

2.3 TYPE D WELL

A type D well is a type A well with a diverter casing. If the auger encounters refusal before reaching total depth on a type A well, the boring is reamed with a larger auger to refusal and a steel diverter casing is installed. The annulus is grouted up to surface level. The boring is deepened with a tricone air rotary bit to total depth, and the well is completed with 2-in-diam stainless steel screen and casing. A sandpack, a bentonite seal, and grout are installed in the annular space by the same procedures as those used for the type A well.

Table 1. Actual completion data for WAG 7 and SWSA 1

Well	Depth clean to (ft)[a]	SST casing diam (in.)	Well type	Screened interval (ft)	Water level (ft)[b]
1071	25.0	2	A	9.25-24.25	-3.0
1072	70.0	4	B	55.0-70.0	-14.4
1073	25.6	2	A	15.6-25.6	-4.3
1074	30.0	2	D	15.0-30.0	-2.8
1075	73.0	4	B	57.8-72.8	+1.99
1076	20.0	2	D	9.4-19.4	-2.5
1077	82.6	4	B	67.6-82.6	+2.2
1078	20.0	2	A	8.75-18.75	-2.5
1079	70.0	4	B	55.0-70.0	-6.6
1080	20.0	2	D	9.7-19.7	-2.7
1081	73.5	4	B	58.2-73.2	-0.1
1082	15.0	2	D	5.0-15.0	-3.7
1083	15.0	2	D	2.7-12.9	-1.8
1084	15.1	2	D	9.53-14.83	-2.8
1085	72.8	4	B	57.8-72.8	-3.8
1086	14.75	2	D	4.15-14.55	-5.1
946	12.61	2	D	7.1-12.36	-3.6
947	81.5	4	B	66.3-81.3	-6.7

[a]Total drilled depth may vary from clean-out depth. See data packages (Appendix A).

[b]Predevelopment water level; depth measured from ground surface. (Negative is below surface; positive, above surface.)

3. ENVIRONMENTAL, HEALTH, AND SAFETY REQUIREMENTS

All well drilling at WAG 7 was conducted according to the document *Health, Safety, and Environmental Protection Procedures for Excavating Operations*, ORNL/M-116/R1.[5] Among the procedures set forth by this document is a system for rating proposed well locations according to the degree of probability that contamination will be encountered. Ratings obtained by this system were used to determine the level of personnel training required and health and safety coverage to be used during drilling.

The Superfund Amendment Reauthorization Act required still more stringent health and safety measures for personnel working in waste areas. These workers were required to have 40 h of training for hazardous duty through an ORNL-approved course, 8 h of refresher training each year, 8 h of supervisor's training for field supervisors, a whole-body count, baseline urinalysis, respirator testing and fitting, and medical monitoring. Personnel were also required to take a construction-worker training course covering the basic fundamentals of radioactivity and other types of contamination as well as the other hazards that could be encountered at ORNL. The workers were taught the proper procedures to follow in the event of an on-site emergency.

Special procedures were used during drilling. The ground surface at all drill sites was covered with polyethylene sheeting to prevent contact between the tools and the ground. The sheeting would also have protected the environment in the event of a hydraulic fluid release. Containment was required for all drill cuttings produced. During augering, a metal pan was used to hold cuttings until a health physicist (HP) could determine their proper disposition. During air rotary drilling, cuttings were diverted from the borehole to a special containment box designed by Martin Marietta Energy Systems, Inc. (Energy Systems). The box is a 500-gal, trailer-mounted tank with demister elements and high-efficiency particulate air filters at the air exhaust. In order that appropriate methods of disposal could be determined, the tank contents were checked by the HP for radioactive contamination and by the site hydrogeologist for volatile organics. The operating instructions followed for determining disposition of the cuttings and water produced during drilling and development are included in Appendix B.

4. FIELD SUPPORT

The GQM wells in WAG 7 and SWSA 1 were installed by the construction contractor Geotek Engineering Company, whose contract began in May 1989. The drilling contract was administered by ORNL Engineering through Energy Systems Procurement. The management organization chart for the project can be found in the *Task Management Plan for Groundwater Quality Monitoring Well Installation*, ORNL/RAP/LTR-88/28.[6]

The hydrogeologic support and installation record keeping were supplied through a contract with ERC Environmental and Energy Services Company (ERCE), formerly EDGe/MCI. An ERCE representative was present during all activities that affected the quality of the wells and advised Energy Systems on well construction. ORNL personnel or their subcontractors supplied HP and industrial hygiene support.

Construction engineering support was supplied by Energy Systems personnel. Drawings, excavation permits, well placement in the field, and as-built surveying and calculations were done by the Energy Systems Civil and Architectural Department or by their subcontractor, Adams Craft Herz Walker Engineering Company. The as-built survey coordinates and elevations are included on the well installation/completion form for each well (Appendix A). The as-built coordinates are also summarized in a table on the well location map (Fig. 1).

5. DRILLING RECORDS

A complete data package has been compiled for each of the 16 GQM wells drilled in WAG 7 and the 2 wells at SWSA 1. These data packages can be found in Appendix A listed in numerical order. All original records are retained in the Environmental Restoration (ER) Division Records Control Data Base. The forms included in each well data package are listed here in the order in which they appear in the package:

1. monitor well narrative,
2. predrilling checklist for monitoring wells,
3. decontamination checklist for drilling equipment,
4. well log,
5. well installation/completion form,
6. monitoring well materials certification,
7. post-well completion checklist,
8. monitoring well development form,
9. monitoring well development progress,
10. hydraulic conductivity calculation,
11. nonconformance report (if necessary), and
12. chain of custody forms.

Three additional forms used in the field by the site hydrogeologist but not included in the published data packages are the monitoring well progress form, hydraulic conductivity test field sheet, and containment box checklist. These forms are kept in the ER Division Records Control Data Base.

6. WELL DEVELOPMENT

Wells were developed by pumping. Wells with high initial turbidities were surged beforehand with a workover rig and a stainless steel surge block to facilitate removal of the sediment from the wells. The contents of the wells were then pumped out using Geoguard airlift pumps and oilless air compressors. Development of a well was considered complete when at least three well volumes had been removed and the turbidity was measured at 5 NTUs or less. Several wells had turbidity ratings higher than 5 NTUs even after extensive pumping, but, in order to prevent the pulling in of groundwater from too far away, a maximum limit of 30 to 35 well volumes was determined by Energy Systems hydrogeologists to be the upper limit that should be removed. The contents of the wells were pumped out using Geoguard development pumps. The two-stage Geoguard pumps were converted to dedicated bladder pumps for sampling after development was complete. All development water was contained and disposed of according to the operating instructions in Appendix B.

Of the 18 wells in WAG 7 and SWSA 1, 10 wells had turbidity ratings of less than or equal to 5 NTUs. The number of well volumes removed ranged from 3.5 to 100, with an average of 30.7. The procedure for measuring turbidity included in report ORNL/RAP/LTR-88/28[6] was replaced with a more accurate method. While the method previously used depended on a visual comparison of the sample with prepared standards, the new method employs the Cole-Parmer turbidimeter, which measures NTUs by passing a lens-focused light beam through a test tube filled with the water sample. A photosensor detects the intensity of the exiting light beam, and an analog scale on the instrument displays the turbidity of the sample.

7. SAMPLING DURING INSTALLATION

The ERCE hydrogeologist took samples of soil, rock, and drilling water during well installation and submitted them to the ORNL Analytical Chemistry Division for chemical analysis. Soil and rock samples were taken from the unsaturated and saturated zones. Samples of drilling water were collected from the water pump discharge on the drill rig during air rotary drilling. All samples were transferred using chain-of-custody forms, which are included in the data packages. The sampling procedures are explained in report ORNL/RAP/LTR-88/28[6]. Soil samples were collected from each single well and from one well of each well pair. A drilling-water sample was collected from each air-rotary-drilled boring.

Analyses for 31 chemical elements, gross alpha, gross beta, and ^{40}K were routinely performed on the soil and water samples. Results from these analyses can be found in the ER Division Records Control Data Base.

8. SPECIAL NOTES ON INSTALLATION AND DEVELOPMENT

The following special events took place during the drilling of the GQM wells in WAG 7 and SWSA 1.

8.1 CONTAMINATION DETECTED

- Radioactive contamination was detected by the Energy Systems HP at Well 1078 in WAG 7 and Well 946 at SWSA 1. Readings up to 0.2 mR/h were observed during the drilling of the interval from 0 to 4 ft at Well 946 and in the upper soil interval of Well 1078.

- The ERCE hydrogeologist detected readings of volatile organics (VO) above background (as high 161 ppm) with a Photovac photoionization detector in Well 1081 and in the containment box used at Well 1081. The VO levels in the containment box were found to have decreased to less than 0.5 ppm after several hours.

- A sulfur odor was detected during the development of Well 947.

8.2 DEVIATIONS FROM THE SPECIFICATIONS

- Well 946 was drilled to a specified total depth of 25 ft, but sloughing of the borehole wall filled the boring up to 13.5 ft. Since there was sufficient water in the hole, the well was installed at this depth.

- At Well 1075, a 10-in-diam surface casing was set into the soil/rock interface at 4.4 ft. Subsequently, it was determined that surface casings should be at least 10 ft deep to prevent cross-contamination and "blow-outs" during air rotary drilling. Therefore, the 4.4-ft casing was removed and replaced with a 10-ft casing.

- Well 1086 was drilled to a depth of 15 ft, where the recovery rate was 5 ft per hour. The borehole was deepened to 30 ft without a significant increase in the recharge rate. Hence, the borehole was backfilled with sand and a 2-ft bentonite cap to a depth of 14.75 ft, and the well was completed.

- A water filtration system was designed by ORNL Engineering to facilitate development of slow-recharging wells. The system was tested during the development of Well 1074. It worked by pumping the water produced into a sand-filled stainless steel drum where suspended solids were filtered out. The filtered water was then reintroduced into the well to allow continuous development.

8.3 HYDRAULIC FLUID SPILLS

Hydraulic hose breaks occurred at Wells 1072, 1075, and 1077. No well bore contamination occurred in any of the cases, and all hydraulic fluid was cleaned from the equipment prior to the continuation of drilling.

REFERENCES

1. J. A. Mortimore and M. L. Ebers, *Groundwater Quality Monitoring Well Installation for WAG 1*, ORNL/RAP-47, Martin Marietta Energy Systems, Inc., Oak Ridge National Laboratory, October 1988.

2. Engineering Division, *Construction Specifications for Monitoring Wells Installation Construction Project, Rev. 2*, K-4491G-G1, Martin Marietta Energy Systems, Inc., Oak Ridge National Laboratory, August 1988.

3. MCI Consulting Engineers, Inc., *Preliminary Geohydrologic/Site Characterization and Proposed Water Quality Well Locations for WAG 7, WAG 8, and WAG 9*, ORNL/RAP/Sub/86-72139/2, Martin Marietta Energy Systems, Inc., Oak Ridge National Laboratory, September 1987.

4. MCI Consulting Engineers, Inc., *Preliminary Geohydrologic Site Characterization and Proposed Water Quality Well Locations for WAG 4, 5, 3, and SWSA 1*, ORNL/RAP/Sub-86/72139/1, Martin Marietta Energy Systems, Inc., Oak Ridge National Laboratory, February 1987.

5. Environmental Compliance and Health Protection Division, *Health, Safety, and Environmental Protection Procedures for Excavating Operations*, ORNL/M-116/R1, Martin Marietta Energy Systems, Inc., Oak Ridge National Laboratory, March 3, 1988.

6. J. A. Mortimore, *Task Management Plan for Groundwater Quality Monitoring Well Installation*, ORNL/RAP/LTR-88/28, Martin Marietta Energy Systems, Inc., Oak Ridge National Laboratory, February 1988.

Appendix A

Data Packages

1.0 General Information

1.1 Well Location

Monitoring well number 946 is located in SWSA 1. It is located at the intersection of Incinerator Road and Third Street. Approximately 200' southwest of Building 3544. The location is shown on ORNL drawing number C3E 20004 A075. Survey coordinates for this well are N 21091.0465, E 30646.7597 (X-10 grid) or latitude 35° 55' 25.96" and longitude 84° 18' 58.51". Coordinate data were provided by Martin Marietta Energy Systems. The method used for conversion from X-10 grid to Tennessee-Lambert State Plane Coordinates came from the publication "Tennessee Valley Authority Data Services Branch and Mapping Services Branch, Oak Ridge, Tennessee, DOE Plant Control, November 6, 1985, Field Book: ESS-3115, pp. 1-20." The latitude and longitude were calculated by Adams Craft Herz Walker Engineering, Inc., using methods from the U.S. Coast and Geodetic Survey Publication 62-4, "State Plane Coordinates by Automatic Data Processing."

1.2 Drilling Information

Well number 946 was drilled by Geotek Engineering Company. A Mobile B-50 rig and an Ingersol Rand T-4 rig were used to drill this boring for monitor

well installation under the operation of Larry Ledbetter with the assistance of Freddy Dixon and Rick Herron. Drilling commenced on 7/31/89 and was finished on 8/16/89. Paragraph 2.4.1 includes a detailed discussion of the well installation and a well schematic is included on the well installation/ completion form. A synopsis of the drilling activity follows:*

07/31/89: The auger rig was decontaminated along with the sampling and drilling equipment. The rig was mobilized to the site, plastic was layed down, and the rig was set up. Split spoon samples were taken from the surface to a refusal depth of 9.3'. A 6.0" auger was used to auger from the surface to a refusal depth of 9.5'. Photovac readings of <.05 ppm. A bulk density sample was taken from the interval 7.0 to 7.3'. The length was 3 1/2 inches, diameter 1 1/4 inches and weight of 158.1 grams. Two soil samples from the split spoons were taken. The boring will have to be completed with the air rotary. When the augers were removed, the last 5.0' section was saturated. All cuttings out of the hole were contained in the pan and augers were left on plastic as per

* This information was typed directly from field notes and was edited only when necessary for clarification.

HP (due to possibility of contamination based on location). No contamination was detected. Smears are O.K.

8/1/89: A 22.0 inch diameter boring was augered to 4.0' for the purposes of setting a diverter casing. During augering, C.E. Stooksbury detected contamination. All cuttings were contained in 55 gallon drums. Issue over what should be done with "contaminated" equipment (augers, pan, etc.). Decision made by HP officials and R.C. Williams to leave equipment on site until further notice. At 4', 14 inch diameter diverter casing was installed and grouted. Auger rig was taken to decon area, cleaned and green tagged so Geotek could take it back to their company. Decision made to let material on augers (mud) dry naturally and then smear them again.

8/4/89: The T-4 was deconed along with drilling equipment and mobilized to the site where it was set up. The containment box was hooked up and the boring was completed to 25.0' with an 8.0" tricone. An air and water sample was taken at 15.0'. Chris Wallen supervised drilling from 15.0' to 25.0'. After 1 hour of recharge the water level was at 6.9',

contamination levels were found to be negligible by L.C. Johnson. After the drill rods were removed the boring was measured and found to have collapsed to 17.0'. CAH, Bryn Howze, R.C. Williams and Chris Wallen discussed situation. R.C. Williams suggests that we talk to Bill McMaster before setting the well (to see if boring is deep enough) B. Howze suggest using a temporary casing to assist in cleaning out boring. CAH suggest setting the well at this depth. Well will be set tomorrow. Air sample was checked under an ultraviolet light and found to have no detectable hydrocarbons.

8/15/89: R.C. Williams suggests that the mud be removed by pumping it out. All material will be contained in the containment box or 55 gallon drums pump not strong enough to pump out the thick material. The boring was measured again and was found to have a total depth of 13.5'. Bill McMaster says to set the well at this depth (water coming in at 9.5') He recommends that .5' of sand be placed in the boring and to use a 5.0' screen. Sand (1/2 a bag) was poured to 12.60' and then a 5.51' section of 2.0"

stainless steel screen (cap + screen) and 10.0' section of casing was installed to a total depth of 12.61. A centralizer was placed at 8.0'. Sand (7 3/4 bags) was then poured into the annulus to a depth of 6.2'. 1 bucket of bentonite was poured to a depth of 4.3'.

8/16/89: The annulus was grouted. Three bags of cement and 15 lbs. of bentonite were used. James Lamb of ERC recorded grouting activities.

8/30/89: The 4-inch well casing was cut and filed. Geotek and CAH present.

9/5/89: The well was tested with the "Go-NOGO Gauge". The well passed. R.C. Williams, Geotek and CAH on site.

* Note: The pump and barrels were left on site for later testing. The box, pump and barrels were sampled. The containment box was found to be contaminated with beta. It still remains at decon area. The pump was brown tagged and removed. The augers previously maintained were green tagged and taken to decon area for cleaning.

This well was logged by ERC Environmental and Energy Services Co. (ERC), hydrogeologist C. Allison Hodges. All well construction materials and supplies were from Martin Marietta

Energy Systems approved batches. The batch origin of individual items is shown on the included monitoring Well Materials Certification form.

2.0 Technical Information

2.1 Decontamination Procedures

The drilling rig, down hole tools, surface casing, stainless steel screen, stainless steel casing, centralizers, and stainless steel silt trap underwent the cleaning and decontamination procedures outlined in the drilling specifications (Release Specific Technical Directions For Regulatory Compliance Monitoring Wells Phase 1, Oak Ridge National Laboratory, Oak Ridge, W.O., K-4147, April 1987, pgs. 2-4). A checklist of the cleaned materials is included with this data package.

2.2 Geology

SWSA 1 is located in Melton Valley, which is in the Valley and Ridge Physiographic Province of East Tennessee. SWSA 1 is underlain by limestone, siltstone and calcareous shale of the Ordovician Chickamauga Group. The Chickamauga Group is 1735 feet thick in SWSA 1 and has been separated into eight distinguishable and mappable subdivisions. They are in ascending order lettered A through H. The average angle of dip in SWSA 1 is 36 degrees

dipping to the southeast, and the average direction of strike is north 58 degrees east.

2.3 Sample Collection

Three samples were collected during drilling, placed in I-CHEM specialty cleaned glass containers, sealed and submitted to Sample Receiving, Analytical Chemistry Division, Bldg. 4500S, ORNL. Chain of custody forms for these samples are included with this data package. Soil sample 0946S01 was collected in the split spoon interval from 2.0 feet to 2.5 feet on 7/31/89 and soil sample 0946S02 was collected from the split spoon interval from 7.5 to 9.3 on 7/31/89. Drill water sample 0946W01 was collected from the water pump on the drill rig on 8/14/89. Analytical results for the three samples described above can be obtained from the Remedial Action Program data base at ORNL.

A bulk density soil sample was collected from the split spoon sample interval from 7.0 to 7.3 feet. The sample was measured, and weighed, and a bulk density of 2.43 grams/cm^3 was calculated.

2.4 Installation and Development

2.4.1 Installation

This was a type D well. A six-inch diameter boring was split spooned/augered from ground

surface to auger refusal (9.5 feet). The air rotary method was required to complete the boring to the specified total well depth. A twenty two-inch diameter boring was augered from ground surface to 4.0 feet and a fifteen-inch diverter casing was installed and grouted. An eight inch diameter boring was then drilled with an air rotary tricone roller bit from 9.5 to 25.0 feet. After drilling procedures were completed, the borehole collapsed to 13.5'. Before the casing was installed, one-half bag of sand was poured into the borehole from 12.61' to 13.5' to provide a base for the stainless steel. A two-inch diameter stainless steel screen with welded bottom cap was then installed from 7.1 to 12.36 feet. A two-inch diameter stainless steel casing was installed above the screen at 7.1 feet and extended 2.10 feet above ground surface. A sandpack was then tremied into the annular space from 6.2 to 12.61 feet, with a 1.9-foot bentonite pellet seal poured into the annular space above the sandpack from 6.2 to 4.3 feet. The annular space from the top of the bentonite seal to the surface was tremie-grouted with a cement/bentonite slurry. A detail of the well is included on the well installation/completion form.

2.4.2 Well Development

Well number 946 was developed to remove drill cuttings, silt, and other fines from the

monitoring well. The monitoring well was developed using a Geoguard pump with an air compressor. All pumps were cleaned prior to use according to specified cleaning procedures (see Paragraph 2.1). The well was developed until a measured total of 186 gallons of water had been evacuated and the clarity of the discharge water was approved by the company representative. The final turbidity value measured at completion was >100 NTU's. A development form showing the exact method of development and other pertinent data is appended.

2.4.3 Installation of Dedicated Monitoring Well Pump

After the well was developed, a Geoguard Model No. 5614 dedicated monitoring well pump was installed on 2/14/90 at a depth of 10.1 feet below ground surface. These pumps are decontaminated at American Sigma and are sent prepackaged. A copy of the pump certification is kept on file at ORNL.

2.5 Hydraulic Conductivity Testing

Well number 946 was tested for the determination of hydraulic conductivity of the aquifer in the vicinity of the well screen. This was accomplished by instantaneously adding a known quantity of water to the monitoring well and measuring the recovery of the water level over time. The changing water levels were measured using a Druck 15 psig pressure

transducer and an Ommidata Datapod II data recorder. The hydraulic conductivity value of 3.05×10^{-4} cm/second (shown as permeability on the hydraulic conductivity calculations) was calculated using the Bouwer and Rice method. A computer printout of the hydraulic conductivity calculations is included in this data package.

ERC / EDGE Environmental and Energy Services Co.

WELL No. 946

PRE-DRILLING CHECKLIST FOR MONITORING WELLS

PRE-DRILLING TASKS		COMPLIANCE DATE	COMPLIANCE INITIALS
1.	EXCAVATION PERMIT OBTAINED.	07-31-89	CAH
2.	ALL EQUIPMENT HAS BEEN CLEANED BEFORE DRILLING.	07-31-89	CAH
3a.	SCREEN AND CASINGS HAVE BEEN WASHED, STEAMED, RINSED WITH DE-IONIZED OR DISTILLED WATER, RINSED WITH ISOPROPYL ALCOHOL, WRAPPED WITH PROTECTIVE COVERING AND STORED OFF THE GROUND.	N/A	
3b.	PRE-PACKAGED SCREENS, CASINGS AND CENTRALIZERS WERE USED.	08-15-89	CAH
4.	WORK AREA FOR SAMPLE EXAMINATION COVERED WITH CLEAN POLYETHYLENE.	07-31-89	CAH
5.	CLEAN KNIVES, GLOVES, SAMPLE JARS AND LABELS ON-HAND.	07-31-89	CAH
6.	POLYETHYLENE COVER IN PLACE OVER HOLE.	07-31-89	CAH

ADDITIONAL NOTES/OBSERVATIONS:

OBSERVER SIGNATURE/DATE C. Allison Hodges 08-15-89

C. Allison Hodges

ERC / EDGE
Environmental and Energy Services Co.

WELL No. 946

DECONTAMINATION CHECKLIST
DRILLING EQUIPMENT

EQUIPMENT	SCRAPE	STEAM CLEAN	STEAM RINSE	ISOPROPYL ALCOHOL RINSE	DEIONIZED WATER RINSE
RIG	X	X	X	N/A	N/A
AUGERS	X	X	X	X	X
BITS	X	X	X	X	X
RODS	X	X	X	X	X
SAMPLERS	X	X	X	X	X
PIPES	X	X	X	X	X
WORK TOOLS	X	X	X	X	X
AUGER PINS	X	X	X	X	X

OBSERVER SIGNATURE/DATE C. Allison Hodges 07-31-89
C. Allison Hodges

ERC / EDGE Environmental and Energy Services Co.

WELL No. 946

ORNL MONITORING WELL LOG

LOCATION: SWSA 1

DRILLER: Larry Ledbetter

HELPER: Freddy Dixon /Rick Herron

DRILL: Ingerson Rand T-4

DATE: START: 07-31-89

FINISH: 08-16-89

LOGGED BY: C. Allison Hodges

HEALTH PHYSICIST: L. C. Johnson
C. E. Stooksbury

TYPE DRILLING: Split spoon, auger, air rotary

LUBRICANT TYPE: Green stuff

No. SAMPLES TAKEN: Two

TYPE: Soil

CONTAINMENT TYPE: Plastic, pan, 55 gallon drums, containment box

THICKNESS OF SOIL (REFUSAL DEPTH): 9.3'

DEPTH DRILLED IN ROCK: 15.7'

TOTAL DEPTH OF WELL: 25.0'

DRILLING FLUID SAMPLES:

TYPE: Water DATE: 8-14-89

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
0.0	0.5		25%	Clay, light brown, with roots, wet.
0.5	1.0			Clay. dark brown and dark olive gray, with
				roots, wet.
1.0	2.5	946S01		Clay, dusky brown, with abundant chert frag-
		2.0-2.5'		ments, dark yellowish brown, sand to pea gravel
				sized.
2.5	3.5		85%	Clay, olive gray and moderate brown. Contains
				chert fragments, light gray, flinty, with
				quartz crystals. Clay is moist but brittle
				(crumbly).
3.5	5.0			Clay, mottled, dark yellowish brown and
				brownish gray with shale fragments, dusky
				brown, highly weathered, clay is moist and
				slightly firm.
5.0	7.0		80%	Clay, olive gray, with chert fragments, milky
				white, pea gravel sized. Clay is hard and
				firm.
7.0	7.5			Chert fragments, dark yellowish orange, sand
				to pea gravel sized, coated with clay, olive
				gray. Slightly wet.

ERC / EDGE
Environmental and Energy Services Co.

WELL No. 946

ORNL MONITORING WELL LOG

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
7.5	9.0	946S02 7.5-9.3	75%	Clay, olive gray, with some chert, sandy.
9.0	9.3			Chert, milky white, large fragments, wet.
	9.3			Split spoon refusal.
9.3	9.5			Clay, olive gray and moderate brown with chert
				fragments.
	9.5			Auger refusal on limestone.
9.5	10.0			*Hard, slightly irregular drilling.
10.0	25.0			*Hard, rough, irregular, slow drilling.
	25.0			Total Depth
				*Detail lithologic log could not be provided
				for the interval from 9.5' to 25.0' due to use
				of containment box.
				Less than 0.2 mR per hour (at 1/2") gross beta
				radiation was detected by the HP in the
				interval from 0 to 4'.

EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL No. 946

WELL INSTALLATION/COMPLETION FORM

O.R.N.L. MONITORING WELL PROGRAM

LOGGED BY: C. Allison Hodges
PROOFED BY: Michael L. Ebers

DRILLING COMPANY: Geotek

DRILLER: Larry Ledbetter HELPER: Freddy Dixon

LOCATION WAG1
ORNL GRID COORDINATES
N 21091.0465
E 30646.7597
ELEV. GROUND 777.74
ELEV. TOP STAINLESS STEEL CASING 779.84

DRILLING DATES:
STARTED: 7/31/89
FINISHED: 8/16/89

EQUIPMENT
- ☐ 6.0 INCH AUGER 5.5 L.F.
- ☐ 22.0 INCH AUGER 4.0 L.F.
- ☐ 8.0 INCH ROTARY 15.5 L.F.

MATERIALS USED

EST. VOL.	USED VOL.	
	5.26	FEET OF 2.0 IN. S.S. SCREEN
	9.3	FEET OF 2.0 IN. S.S. CASING
1.5	7.75	SACKS OF SAND
48	50.0	POUNDS OF BENTONITE PELLETS
2.9	3.0	SACKS OF CEMENT
	15.0	POUNDS OF POWDERED BENTONITE
	24	GALLONS OF WATER (CEMENTING)

REASON FOR DIFFERENCES BETWEEN ESTIMATED VOLUMES AND USED VOLUMES

Large washout zone in screen interval

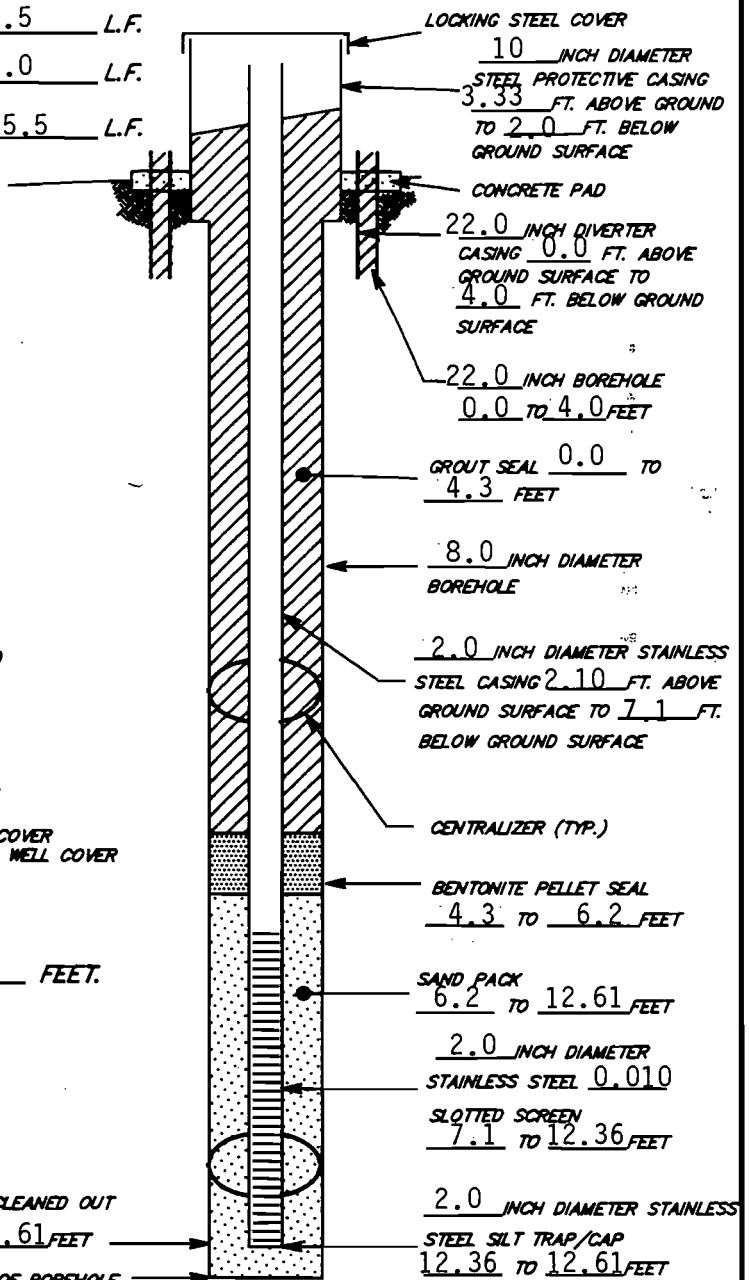
WELL COVER USED
- ☒ LOCKING STEEL COVER
- ☐ FLUSH MOUNTED WELL COVER
- ☐ OTHER

SILT TRAP USED YES ☒ NO ☐

MONITORING WELL PUMP BASE SET AT 10.1 FEET.

CENTRALIZERS AT 8.0' FEET.
_____ FEET.
_____ FEET.

NOTE:
ALL DEPTHS ARE MEASURED FROM GROUND SURFACE UNLESS OTHERWISE NOTED:



TYPE D WELL

NOT TO SCALE

ERC / EDGE
Environmental and Energy Services Co.

WELL No. 946

DATE: 8/15/89

MONITORING WELL MATERIALS CERTIFICATION

ITEM/MATERIAL		DATE USED	BATCH NUMBER
SAND		8/15/89	1
BENTONITE		8/15/89	Stores
STAINLESS STEEL SCREEN	(PREPACKAGED ■ YES ☐ NO)	8/15/89	Stores
STAINLESS STEEL CASING	(PREPACKAGED ■ YES ☐ NO)	8/15/89	Stores
STAINLESS STEEL CENTRALIZERS	(PREPACKAGED ■ YES ☐ NO)	8/15/89	Stores
STAINLESS STEEL CAPS	(PREPACKAGED ■ YES ☐ NO)	8/15/89	Stores
MONITORING WELL PUMP	(PREPACKAGED ■ YES ☐ NO)	2/14/90	3
GROUT		8/16/89	1
WELL COVERS			
SURFACE CASING			

COMMENTS:

OBSERVER SIGNATURE/DATE C. Allison Hodges 8/16/89
C. Allison Hodges

ERC / EDGE
Environmental and Energy Services Co.

WELL No. 946

POST-WELL COMPLETION CHECKLIST

POST-WELL COMPLETION TASKS	COMPLIANCE DATE	COMPLIANCE INITIALS
1. MUD SCRAPED FROM AUGERS, SAMPLERS, AND ALL OTHER EQUIPMENT.	8/15/89	CAH
2. ALL MUD FROM RIG AND EQUIPMENT SCRAPINGS AND CUTTINGS DISPOSED OF IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED.	8/15/89	CAH
3. WELL DEVELOPED IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED AND DETAILS OF THE DEVELOPMENT ACTIVITY RECORDED.	2/14/90	DCL
4. DRILLING SITE PROPERLY CLEANED UP AFTER COMPLETION OF WELL INSTALLATION.	8/15/89	CAH

* RELEASE SPECIFIC TECHNICAL DIRECTIONS FOR REGULATORY COMPLIANCE MONITORING WELLS PHASE I, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, W.O. K-4147, APRIL 1987.

OBSERVER SIGNATURE/DATE C. Allison Hodges 8/15/89
C. Allison Hodges

D. Charles Lytle 2/14/90
D. Charles Lytle

ERC / EDGE Environmental and Energy Services Co.

WELL No. 946

LOCATION: WAG1

MONITORING WELL DEVELOPMENT FORM

DEVELOPMENT DETAILS

METHOD OF DEVELOPMENT: Surging and pumping

DEVELOPMENT BEGAN DATE: 2-12-90 TIME:

DEVELOPMENT ENDING DATE: 2-14-90

DEVELOPMENT OBSERVED BY: D. Charles Lytle

ONE WELL VOLUME: 4.0 GALLONS

TOTAL GALLONS PUMPED: 186 TOTAL WELL VOLUMES PUMPED: 46.5

INITIAL pH: 7.3 FINAL pH: 7.5

INITIAL CONDUCTIVITY (uS): 644 FINAL CONDUCTIVITY (uS): 574

DESCRIPTION OF INITIAL TURBIDITY: Muddy

DESCRIPTION OF FINAL TURBIDITY: Very Cloudy

FINAL MEASURED TURBIDITY: * Greater than 100 NTU's

WELL APPROVED BY: R.C. Williams MMES

ODOR OF WATER: None

WATER DISCHARGED TO:
- ☒ GROUND SURFACE
- ☐ STORM SEWERS
- ☐ DRUMS
- ☐ TANK TRUCK
- ☐ STORAGE TANKS
- ☐ OTHER

INITIAL PRE-DEVELOPMENT WATER DEPTH: 3.6 feet from ground surface

DEVELOPMENT OBSERVATIONS

OBSERVER SIGNATURE/DATE D. Charles Lytle 2-14-90

D. Charles Lytle

ERC / EDGE Environmental and Energy Services Co.

WELL NO. 946
LOCATION: WAG1
DATE: 2-12-90

MONITORING WELL DEVELOPMENT PROGRESS

ONE WELL VOLUME = 4.0 GALLONS

DATE	TIME	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	MEASURED TURBIDITY (NTU'S)	pH	CONDUCTIVITY (µS)	TOTAL GALLONS PUMPED	WELL VOLUMES PUMPED	COMMENTS
2-13-90	1400	100	Muddy		7.3	644	100	25.0	
2-13-90	1530	46	Muddy		7.5	651	146	36.5	
2-14-90	0830	40	Very Cloudy	*	7.5	574	186	46.5	
RESULTS AT END OF DEVELOPMENT			Very Cloudy	*	7.5	574	186	46.5	

COMMENTS Very fast producer, water remained muddy to very cloudy with 46.5, well volumes had to pass and move off hole. * Greater than 100 NTU's

OBSERVER SIGNATURE/DATE D. Charles Lytle 2/14/90
D. Charles Lytle

ERC / EDGE Environmental and Energy Services Co.

WELL No. 946

HYDRAULIC CONDUCTIVITY CALCULATIONS

PROGRAM SLUGT, VERSION 4.1, NOV. 1986

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:

(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3, NO.1 OF WRR ENTITLED "RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER")

(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED "A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS")

WELL NO.: 946 DATE OF TEST: 3/13/90

PROJECT NO.: E221-002 CLIENT: MMES

SITE LOCATION: WAG 7

EDGE, INC. FIELD INVESTIGATOR: BRUCE MCMASTER

INPUT DATA ARE:

INNER CASING DIAMETER = 2.00 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 2.00 INCHES
DIAMETER OF DRILLED HOLE = 8.63 INCHES
LENGTH OF SCREEN OR INTAKE PORTION = 5.26 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 7.96 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 5.26 FEET
DEPTH TO STATIC WATER LEVEL BELOW REF. POINT = 1.05 FEET
ESTIMATED POROSITY OF GRAVEL PACK = .20
FALLING-HEAD INDEX = 1 ("1" IF FALLING,"0" IF RISING)
NUMBER OF DEPTH-TIME DATA POINTS = 32

HO WAS COMPUTED FROM INTERCEPT OF PLOT OF LOG(H) VS. TIME

SUCCESSIVE COMPUTED VALUES FOR HO (FEET)
.6790
.7022

ERC / EDGE Environmental and Energy Services Co.

WELL No. 946

HYDRAULIC CONDUCTIVITY CALCULATIONS

TIME (SEC)	DEPTH TO WATER (FEET)	HEAD (FEET)
5.00	4.840	3.790
10.00	3.830	2.780
15.00	3.090	2.040
20.00	2.630	1.580
25.00	2.240	1.190
30.00	1.970	.920
35.00	1.790	.740
40.00	1.670	.620
45.00	1.560	.510
50.00	1.490	.440
55.00	1.430	.380
60.00	1.390	.340
70.00	1.320	.270
80.00	1.280	.230
90.00	1.250	.200
100.00	1.220	.170
110.00	1.210	.160
120.00	1.190	.140
150.00	1.160	.110
180.00	1.150	.100
210.00	1.130	.080
240.00	1.120	.070
270.00	1.110	.060
300.00	1.100	.050
330.00	1.100	.050
360.00	1.090	.040
420.00	1.090	.040
480.00	1.080	.030
540.00	1.080	.030
600.00	1.070	.020
660.00	1.070	.020
720.00	1.060	.010

****

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

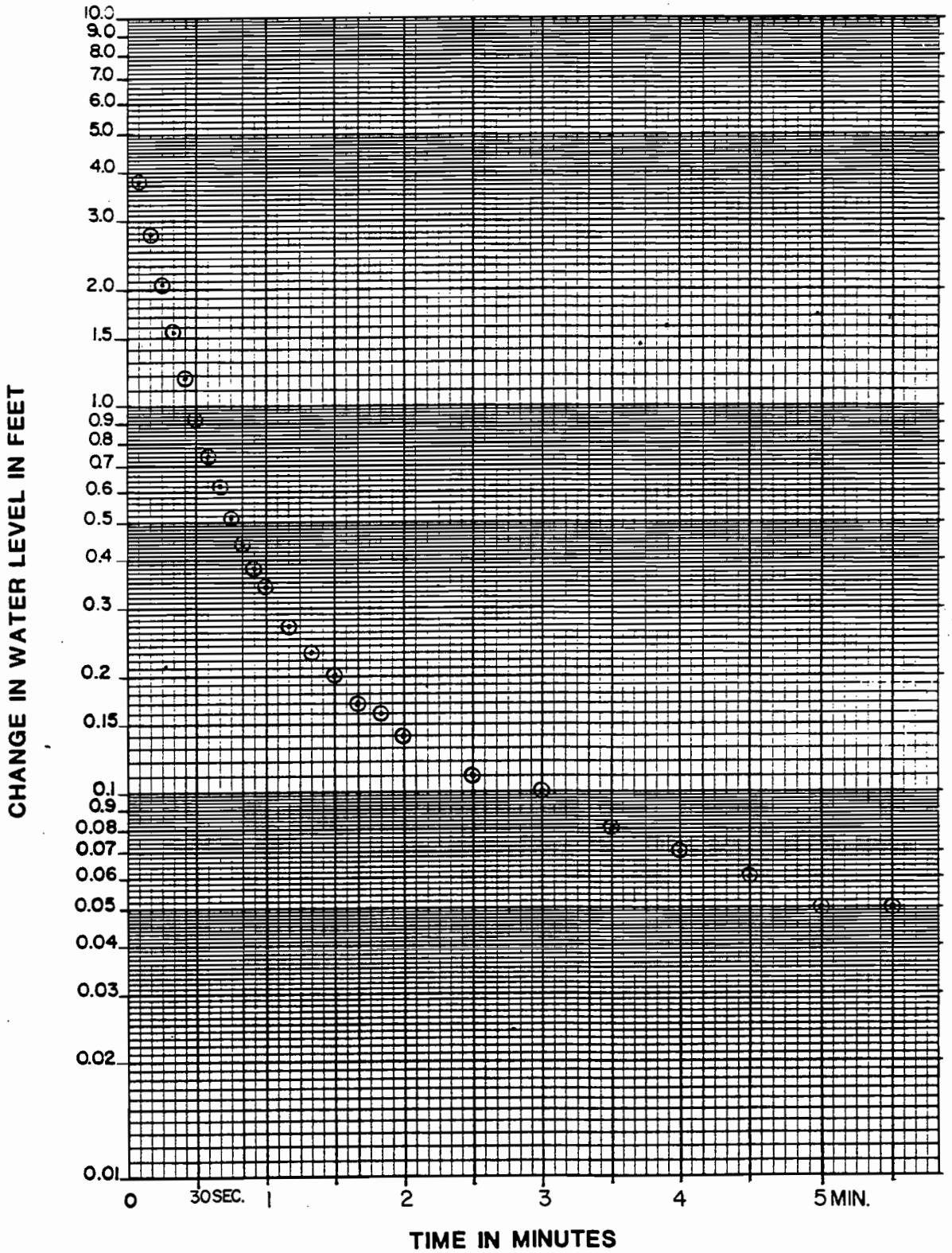
PERMEABILITY = 1.00E-05 FT/SEC = 3.05E-04 CM/SEC

TRANSMISSIVITY = 5.27E-05 FT**2/SEC

ERC / EDGE Environmental and Energy Services Co.

WELL No. 946

HYDRAULIC CONDUCTIVITY CALCULATIONS



EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 946501

WELL NO.	LOCATION:	TYPE:
946	SWSA 1	Soil

SAMPLER: (SIGNATURE)	SAMPLE INTERVAL:	DATE:	TIME:
C. Allen Hodge	2.0 - 2.5	07-31-89	1630

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECEIVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
C. Allen Hodge	9-1-89	940	EDGE	M. Ferguson	9-1-89	9:40	

TYPE OF SAMPLE: ■ SPLIT SPOON CORES–SOIL ☐ AUGER CUTTINGS–SOIL ☐ AUGER CUTTINGS–ROCK
☐ AIR ROTARY CUTTINGS–ROCK ☐ DRILL WATER (NO AIR IN SAMPLE) ☐ OTHER _____

ALL SAMPLES ARE IMMEDIATELY PLACED IN I–CHEM SPECIALTY CLEANED CONTAINERS AND SEALED.

REMARKS: _____

EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 946502

WELL NO.	LOCATION:	TYPE:
946	SWSA 1	Soil

SAMPLER:	SAMPLE INTERVAL:	DATE:	TIME:
C. Allison Hodge (SIGNATURE)	7.5 - 9.3'	07-31-89	1656

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECEIVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
C. Allison Hodge	9-1-89	940	EDGE	M. Ferguson	9-1-89	9:40	

TYPE OF SAMPLE: ■ SPLIT SPOON CORES–SOIL ☐ AUGER CUTTINGS–SOIL ☐ AUGER CUTTINGS–ROCK
☐ AIR ROTARY CUTTINGS–ROCK ☐ DRILL WATER (NO AIR IN SAMPLE) ☐ OTHER _____

ALL SAMPLES ARE IMMEDIATELY PLACED IN I-CHEM SPECIALTY CLEANED CONTAINERS AND SEALED.

REMARKS: _____

EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 946W01

WELL NO.	LOCATION:	TYPE:
946	SWSA -1	Water

SAMPLER:	SAMPLE INTERVAL:	DATE:	TIME:
C. Allen Hodges (SIGNATURE)	N/A	8-14-89	1355

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECEIVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
C. Allen Hodges	8-15-89	8:37	EDGE	J.C. Pirie	8-15-89	0832	

TYPE OF SAMPLE: ☐ SPLIT SPOON CORES–SOIL ☐ AUGER CUTTINGS–SOIL ☐ AUGER CUTTINGS–ROCK
☐ AIR ROTARY CUTTINGS–ROCK ■ DRILL WATER (NO AIR IN SAMPLE) ☐ OTHER _____

ALL SAMPLES ARE IMMEDIATELY PLACED IN I–CHEM SPECIALTY CLEANED CONTAINERS AND SEALED.

REMARKS: _____

1.0 General Information

1.1 Well Location

Monitoring well number 947 is located in SWSA 1. It is located approximately 200' southwest of Building 3544 and south of White Oak Creek at the intersection of Third Street and Incinerator Road. The location is shown on ORNL drawing number C3E 20004 A075. Survey coordinates for this well are N 21061.6652, E 30666.9352 (X-10 grid) or latitude 35° 55' 25.83" and longitude 84° 18' 58.10". Coordinate data were provided by Martin Marietta Energy Systems. The method used for conversion from X-10 grid to Tennessee-Lambert State Plane Coordinates came from the publication "Tennessee Valley Authority Data Services Branch and Mapping Services Branch, Oak Ridge, Tennessee, DOE Plant Control, November 6, 1985, Field Book: ESS-3115, pp. 1-20." The latitude and longitude were calculated by Adams Craft Herz Walker Engineering, Inc., using methods from the U.S. Coast and Geodetic Survey Publication 62-4, "State Plane Coordinates by Automatic Data Processing."

1.2 Drilling Information

Well number 947 was drilled by Geotek Engineering Company. A Mobile B-50 rig and an Ingersol Rand T-4 rig were used to drill this boring for monitor well installation under the operation of Larry Ledbetter with the assistance of George Akins and

Steve Kirk. Drilling commenced on 6/21/89 and was finished on 7/25/89. Paragraph 2.4.1 includes a detailed discussion of the well installation and a well schematic is included on the well installation/ completion form. A synopsis of the drilling activity follows:*

6/21/89: Steam cleaning auger rig, auger, tools, and pan.

6/22/89: Laying down plastic at well site. Stand-by due to rain. Began augering with 22.0" auger to total depth of 4.0' to set 15 1/4" diverter casing. All cuttings contained in 55 gallon drums.

6/23/89: Grouted diverter casing.

7/20/89: Steam cleaning air rotary and tools. Mobilized to site and set up. Augering with 14.0" auger. Encountered rock at 9.8'. Unable to auger past 11.0'. As per R. Williams tricone bit used to cut thru rock, but not air used. Hole will be cleaned out to 12.0' with 14.0" auger.

7/21/89: Cutting and steaming 10.0" surface casing (12.0'). Borehole needs to be cleaned. As per R. Williams borehole bailed before installation of surface casing. The 10.0" surface casing and centralizer were run in the borehole to

* This information was typed directly from field notes and was edited only when necessary for clarification.

a depth of 11.8' (0.2 of cave in) and 3/4 of a bucket of bentonite was used for a seal. The borehole was then grouted using 6 sacks of cement and 30 lbs of bentonite.

7/24/89: Steam cleaning air rotary rig and mobilizing equipment and containment box to site. Check area with photovac; - 1.0 ppm. Drilling with 8.0" tricone bit to 81.5'. Possibly encountered water at 24.5'. At 30.5' photovac reading of 1.2 ppm. Took compressed air sample and drill water sample. No signs of hydrocarbons on air sample under ultraviolet light. Clean borehole after 1 hour recharge, water was at 8.0' approximately 72.0' of water in borehole. Removed rods and set 15.0' of 4.0" stainless steel casing to depth of 81.3'. Tremied 4 bags of sand and poured in one 50 lb bucket of bentonite.

7/25/89: Tremie-grouted borehole using 10 bags of cement and 50 lbs of powdered bentonite.

This well was logged by ERC Environmental and Energy Services Co. (ERC/EDGe), hydrogeologist C. Allison Hodges. All well construction materials and supplies were from Martin Marietta Energy

Systems approved batches. The batch origin of individual items is shown on the included Monitoring Well Materials Certification form.

2.0 Technical Information

2.1 Decontamination Procedures

The drilling rig, down hole tools, surface casing, stainless steel screen, stainless steel casing, centralizers, and stainless steel silt trap underwent the cleaning and decontamination procedures outlined in the drilling specifications (Release Specific Technical Directions For Regulatory Compliance Monitoring Wells Phase 1, Oak Ridge National Laboratory, Oak Ridge, W.O., K-4147, April 1987, pgs. 2-4). A checklist of the cleaned materials is included with this data package.

2.2 Geology

SWSA 1 is located in Melton Valley, which is in the Valley and Ridge Physiographic Province of East Tennessee. SWSA 1 is underlain by limestone, siltstone and calcareous shale of the Ordovician Chickamauga Group. The Chickamauga Group is 1735 feet thick in SWSA 1 and has been separated into eight distinguishable and mappable subdivisions.

They are in ascending order lettered A through H. The average angle of dip in SWSA 1 is 36 degrees dipping to the southeast, and the average direction of strike is north 58 degrees east.

2.3 Sample Collection

A drill water sample was collected from the water pump on the drill rig on 7/24/89. Analytical results for the sample #947W01 can be obtained from the Remedial Action Program data base at ORNL.

2.4 Installation and Development

2.4.1 Installation

This was a type B well. A twenty two-inch diameter boring was augered from ground surface to 4.0'. A fifteen-inch diverter casing was installed and grouted. A fourteen-inch diameter boring was drilled with an auger and a tricone bit to 12.0'. A ten-inch diameter string of decontaminated steel surface casing was installed and tremie grouted in place. The surface casing minimizes potential cross contamination between the regolith and bedrock water bearing zones. The air rotary method was then used to drill an eight-inch diameter boring to a total depth of 81.5 feet. A four-inch diameter stainless steel screen

with welded stainless steel cap was installed from 66.3 to 81.3 feet. A four-inch diameter stainless steel casing was installed from the top of the screen at 66.3 feet and extending 1.89 feet above ground surface. A sandpack was then tremied into the annular space from 63.9 to 81.3 feet, with a 4.0 foot bentonite seal poured into the annular space above the sandpack from 59.9 to 63.9 feet. The annular space from the top of the bentonite seal to the surface was tremie grouted with a cement/bentonite slurry. A detailed schematic of the well is included on the well installation/ completion form.

2.4.2 Well Development

Well number 947 was developed to remove drill cuttings, silt, and other fines from the monitoring well. The monitoring well was developed using a Geoguard pump with an air compressor. All pumps were cleaned prior to use according to specified cleaning procedures (see Paragraph 2.1). The well was developed until a measured total of 179 gallons of water had been evacuated and the clarity of the discharge water was approved by the company representative. The final turbidity value measured at completion was 3.0 NTU's. A development form showing the exact method of development and other pertinent data is appended.

2.4.3 Installation of Dedicated Monitoring Well Pump

After the well was developed, a Geoguard Model No. 5614 dedicated monitoring well pump was installed on 2/12/90 at a depth of 78.4 feet below ground surface. These pumps are decontaminated at American Sigma and are sent prepackaged. A copy of the pump certification is kept on file at ORNL.

2.5 Hydraulic Conductivity Testing

Well number 947 was tested for the determination of hydraulic conductivity of the aquifer in the vicinity of the well screen. This was accomplished by instantaneously adding a known quantity of water to the monitoring well and measuring the recovery of the water level over time. The changing water levels were measured using a Druck 15 psig pressure transducer and an Ommidata Datapod II data recorder. The hydraulic conductivity value of 2.01×10^{-4} cm/second (shown as permeability on the hydraulic conductivity calculations printout attached) was calculated using the Bouwer and Rice method. A computer printout of the hydraulic conductivity calculations is included in this data package.

ERC / EDGE
Environmental and Energy Services Co.

WELL No. 947

PRE-DRILLING CHECKLIST FOR MONITORING WELLS

PRE-DRILLING TASKS		COMPLIANCE DATE	COMPLIANCE INITIALS
1.	EXCAVATION PERMIT OBTAINED.	6/22/89	CAH
2.	ALL EQUIPMENT HAS BEEN CLEANED BEFORE DRILLING.	6/21/89	CAH
3a.	SCREEN AND CASINGS HAVE BEEN WASHED, STEAMED, RINSED WITH DE-IONIZED OR DISTILLED WATER, RINSED WITH ISOPROPYL ALCOHOL, WRAPPED WITH PROTECTIVE COVERING AND STORED OFF THE GROUND.	NA	
3b.	PRE-PACKAGED SCREENS, CASINGS AND CENTRALIZERS WERE USED.	7/24/89	CAH
4.	WORK AREA FOR SAMPLE EXAMINATION COVERED WITH CLEAN POLYETHYLENE.	6/22/89	CAH
5.	CLEAN KNIVES, GLOVES, SAMPLE JARS AND LABELS ON-HAND.	7/21/89	CAH
6.	POLYETHYLENE COVER IN PLACE OVER HOLE.	7/24/89	CAH

ADDITIONAL NOTES/OBSERVATIONS:

OBSERVER SIGNATURE/DATE C. Allison Hodges 7/24/89

C. Allison Hodges

ERC / EDGE
Environmental and Energy Services Co.

WELL No. 947

DECONTAMINATION CHECKLIST
DRILLING EQUIPMENT

EQUIPMENT	SCRAPE	STEAM CLEAN	STEAM RINSE	ISOPROPYL ALCOHOL RINSE	DEIONIZED WATER RINSE
RIG	X	X	X	N/A	N/A
AUGERS	X	X	X	X	X
BITS	X	X	X	X	X
RODS	X	X	X	X	X
SAMPLERS	X	X	X	X	X
PIPES	X	X	X	X	X
WORK TOOLS	X	X	X	X	X
AUGER PINS	X	X	X	X	X

OBSERVER SIGNATURE/DATE C. Allison Hodges 7/21/89
C. Allison Hodges

ERC / EDGE Environmental and Energy Services Co.

WELL No. 947

ORNL MONITORING WELL LOG

PAGE 1 OF 2

LOCATION: SWSA-1

DRILLER: Rick Herron/Larry Ledbetter

HELPER: Freddy Dixon, George Akins/ Steve Kirk

DRILL: B-50 Mobile and Ingersol Rand T-4

DATE: START: 6/22/89
FINISH: 7/25/89

LOGGED BY: C. Allison Hodges

HEALTH PHYSICIST: W.H. Shinpaugh

TYPE DRILLING: Augering and air rotary

LUBRICANT TYPE: Greenstuff

No. SAMPLES TAKEN: NA

TYPE: NA

CONTAINMENT TYPE: Plastic, auger pan, 55 gallon drum, containment box

THICKNESS OF SOIL (REFUSAL DEPTH): 9.8'

DEPTH DRILLED IN ROCK: 71.7'

TOTAL DEPTH OF WELL: 81.5'

DRILLING FLUID SAMPLES:

TYPE: Water DATE: 7/24/89

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
0.0	0.5			Gravel (fill material) and roots
0.5	2.5			Clay, light brown, with small shale fragments
				light gray, siltstone boulder at 2.0' at 1.0'
				auger resistance. Auger walking. Siltstone-
				shale boulder (ledge)
2.5	4.0			Clay, dark yellowish-brown, with some shale
				fragments, weathered, hard firm augering, very
				moist when removing augers from borehole water
				level observed in bottom of borehole at 4.0'
4.0	9.8			Clay, dark yellowish-brown, moist
9.8	12.0			Shale, calcareous, dark yellowish-brown and
				grayish-brown with an outer coating of clay,
				dark yellowish-orange and light gray. Shale
				is bedded and fizzes slightly with acid. Auger
				is saturated at 10.0'
12.0	17.0			* Smooth, fast drilling
17.0	25.0			Hard, rough drilling. Limestone? Possibly
				water at 24.5'.
25.0	63.0			* Hard, slow, regular drilling at 52.0' bit
				locked up and at 53.0', hit a soft spot

ERC / EDGE Environmental and Energy Services Co.

WELL No. 947

ORNL MONITORING WELL LOG

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
63.0	69.5			Smooth, fast drilling
69.5	81.5			Hard, rough, slow drilling. Very irregular
				drilling at 74.5'
	81.5			Total Depth
				* No detailed lithologic logs could be provided
				due to use of containment box for the
				interval from 12.0 to 81.5 feet.

ERC / EDGE Environmental and Energy Services Co.

WELL No. 947

WELL INSTALLATION/COMPLETION FORM

O.R.N.L. MONITORING WELL PROGRAM

LOGGED BY: C. Allison Hodges
PROOFED BY: Michael L. Ebers

DRILLING COMPANY: Geotek

DRILLER: Rick Herron/Larry Ledbetter
HELPER: George Akins/Steve Kirk

DRILLING METHOD:
- ☐ 14.0 INCH AUGER 12.0 L.F.
- ☐ ____ INCH AUGER ____ L.F.
- ☐ ____ INCH ROTARY ____ L.F.
- ☐ 8.0 INCH ROTARY 69.5 L.F.

LOCATION SWSA-1
ORNL GRID COORDINATES
N 21061.6652
E 30666.9352
ELEV. GROUND 778.82
ELEV. TOP STAINLESS STEEL CASING 780.71

DRILLING DATES:
STARTED: 6/21/89
FINISHED: 7/25/89

MATERIALS USED

EST. VOL.	USED VOL.	
	38.0	POUNDS OF BENTONITE PELLETS (SURFACE CASING SEAL)
	12.0	FT. OF 10 3/4 IN. SURFACE CASING
3.8	6.0	SACKS OF CEMENT (SURFACE CASING)
	30.0	POUNDS OF POWERED BENTONITE (SURFACE CASING)
	30.0	GALLONS OF WATER (SURFACE CASING)
	68.2	FT. OF 4 IN. DIA. STAINLESS STEEL CASING
	15.0	FT. OF 4 IN. DIA. STAINLESS STEEL SCREEN
3.7	4.0	SACKS OF SAND
50	50	POUNDS OF BENTONITE PELLETS
9.2	10.0	SACKS OF CEMENT (WELL CASING)
	50.0	POUNDS OF POWERED BENTONITE (WELL CASING)
	50.0	GALLONS OF WATER (WELL CASING)
	3.2	FT. OF 10 IN. STEEL PROTECTIVE CASING

REASON FOR DIFFERENCES BETWEEN ESTIMATED VOLUMES AND USED VOLUMES
Irregular boring diameter & spillage

SURFACE CASING TREMIE GROUTED YES ☒ NO ☐

STAINLESS STEEL CASING TREMIE GROUTED YES ☒ NO ☐

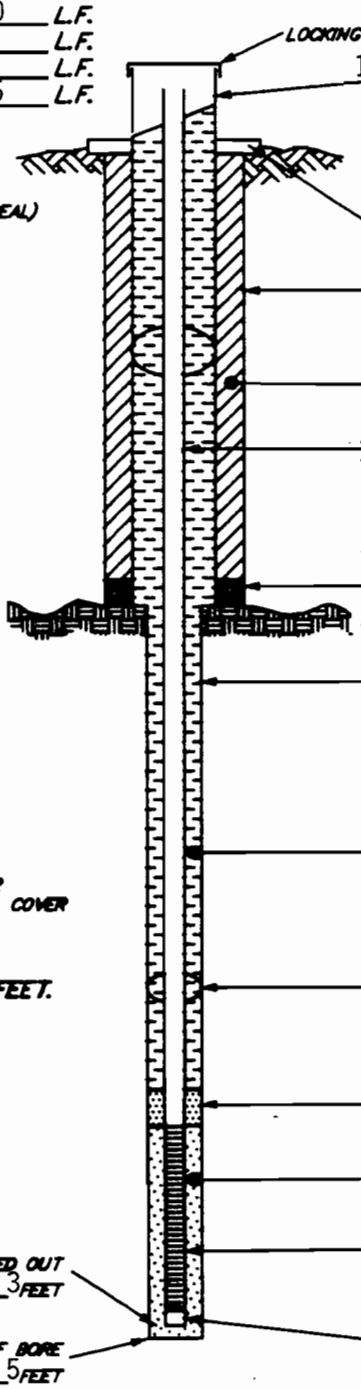
WELL COVER USED
- ☒ LOCKING STEEL COVER
- ☐ FLUSH MOUNTED WELL COVER
- ☐ OTHER

SILT TRAP USED YES ☐ NO ☒

MONITORING WELL PUMP BASE SET AT 78.4 FEET.

CENTRALIZERS AT 5.0 FEET.
30.0 FEET.
55.0 FEET.
80.0 FEET

NOTE:
ALL DEPTHS ARE MEASURED FROM GROUND SURFACE UNLESS OTHERWISE NOTED:



TYPE B WELL

ERC / EDGE Environmental and Energy Services Co.

WELL No. 947

DATE: 7/24/89

MONITORING WELL MATERIALS CERTIFICATION

ITEM/MATERIAL		DATE USED	BATCH NUMBER
SAND		7/24/89	1
BENTONITE		7/24/89	1
STAINLESS STEEL SCREEN	(PREPACKAGED ■ YES ☐ NO)	7/24/89	1
STAINLESS STEEL CASING	(PREPACKAGED ■ YES ☐ NO)	7/24/89	1
STAINLESS STEEL CENTRALIZERS	(PREPACKAGED ■ YES ☐ NO)	7/24/89	1
STAINLESS STEEL CAPS	(PREPACKAGED ■ YES ☐ NO)	7/24/89	1
MONITORING WELL PUMP	(PREPACKAGED ■ YES ☐ NO)	2/12/90	3
GROUT		7/24/89	1
WELL COVERS		7/24/89	1
SURFACE CASING		7/21/89	1

COMMENTS:

OBSERVER SIGNATURE/DATE C. Allison Hodges 7/24/89

C. Allison Hodges

ERC / EDGE Environmental and Energy Services Co.

WELL No. 947

POST-WELL COMPLETION CHECKLIST

POST-WELL COMPLETION TASKS	COMPLIANCE DATE	COMPLIANCE INITIALS
1. MUD SCRAPED FROM AUGERS, SAMPLERS, AND ALL OTHER EQUIPMENT.	6/22/89	CAH
2. ALL MUD FROM RIG AND EQUIPMENT SCRAPINGS AND CUTTINGS DISPOSED OF IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED.	7/24/89	CAH
3. WELL DEVELOPED IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED AND DETAILS OF THE DEVELOPMENT ACTIVITY RECORDED.	2/12/90	DCL
4. DRILLING SITE PROPERLY CLEANED UP AFTER COMPLETION OF WELL INSTALLATION.	7/24/89	CAH

* RELEASE SPECIFIC TECHNICAL DIRECTIONS FOR REGULATORY COMPLIANCE MONITORING WELLS PHASE I, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, W.O. K-4147, APRIL 1987.

OBSERVER SIGNATURE/DATE C. Allison Hodges 7/24/89
C. Allison Hodges

D. Charles Lytle 2/12/90
D. Charles Lytle

ERC / EDGE Environmental and Energy Services Co.

WELL No. 947

LOCATION: WAG1

MONITORING WELL DEVELOPMENT FORM

DEVELOPMENT DETAILS

METHOD OF DEVELOPMENT: Surging and pumping

DEVELOPMENT BEGAN DATE: 2-9-90 TIME:

DEVELOPMENT ENDING DATE: 2-12-90

DEVELOPMENT OBSERVED BY: D. Charles Lytle

ONE WELL VOLUME: 60.5 GALLONS

TOTAL GALLONS PUMPED: 179 TOTAL WELL VOLUMES PUMPED: 30.0

INITIAL pH: 7.6 FINAL pH: 7.6

INITIAL CONDUCTIVITY (uS): 667 FINAL CONDUCTIVITY (uS): 667

DESCRIPTION OF INITIAL TURBIDITY: Crystal clear

DESCRIPTION OF FINAL TURBIDITY: Crystal clear

FINAL MEASURED TURBIDITY: 3.0 NTU's

WELL APPROVED BY: R.C. Williams MMES

ODOR OF WATER: Sulfur smell

WATER DISCHARGED TO:
- ☒ GROUND SURFACE
- ☐ STORM SEWERS
- ☐ DRUMS
- ☐ TANK TRUCK
- ☐ STORAGE TANKS
- ☐ OTHER

INITIAL PRE-DEVELOPMENT WATER DEPTH: 6.7 feet from ground surface

DEVELOPMENT OBSERVATIONS

OBSERVER SIGNATURE/DATE D. Charles Lytle 2-12-90

D. Charles Lytle

ERC / EDGE
Environmental and Energy Services Co.

WELL NO. 947
LOCATION: WAG1
DATE: 2-9-90

MONITORING WELL DEVELOPMENT PROGRESS

ONE WELL VOLUME = 60.5 GALLONS

DATE	TIME	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	MEASURED TURBIDITY (NTU'S)	pH	CONDUC-TIVITY (µS)	TOTAL GALLONS PUMPED	WELL VOLUMES PUMPED	COMMENTS
2-10-90	1300	179	Crystal Clear	3.0	7.6	667	179	30.0	
RESULTS AT END OF DEVELOPMENT		179	Crystal Clear	3.0	7.6	667	179	30.0	

COMMENTS

OBSERVER SIGNATURE/DATE D. Charles Lytle 2-12-90
D. Charles Lytle

MWFORM05.DWG

ERC / EDGE
Environmental
and Energy
Services Co.

WELL No. 947

HYDRAULIC CONDUCTIVITY CALCULATIONS

PROGRAM SLUGT, VERSION 4.1, NOV. 1986

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:

(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3, NO.1 OF WRR ENTITLED "RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER")

(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED "A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS")

WELL NO.: 947 DATE OF TEST: 3/13/90

PROJECT NO.: E221-002 CLIENT: MMES

SITE LOCATION: WAG 7

EDGE, INC. FIELD INVESTIGATOR: BRUCE MCMASTER

INPUT DATA ARE:

INNER CASING DIAMETER = 4.00 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 4.00 INCHES
DIAMETER OF DRILLED HOLE = 8.63 INCHES
LENGTH OF SCREEN OR INTAKE PORTION = 15.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 74.00 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 15.00 FEET
DEPTH TO STATIC WATER LEVEL BELOW REF. POINT = 1.08 FEET
ESTIMATED POROSITY OF GRAVEL PACK = .20
FALLING-HEAD INDEX = 1 ("1" IF FALLING,"0" IF RISING)
NUMBER OF DEPTH-TIME DATA POINTS = 32

HO WAS COMPUTED FROM INTERCEPT OF PLOT OF LOG(H) VS. TIME

SUCCESSIVE COMPUTED
VALUES FOR HO
(FEET)

2.6590
2.6697

ERC / EDGE Environmental and Energy Services Co.

WELL No. 947

HYDRAULIC CONDUCTIVITY CALCULATIONS

TIME (SEC)	DEPTH TO WATER (FEET)	HEAD (FEET)
10.00	3.700	2.620
20.00	3.660	2.580
30.00	3.610	2.530
40.00	3.570	2.490
50.00	3.530	2.450
60.00	3.480	2.400
75.00	3.420	2.340
90.00	3.350	2.270
105.00	3.290	2.210
120.00	3.230	2.150
150.00	3.120	2.040
180.00	3.000	1.920
240.00	2.800	1.720
300.00	2.620	1.540
360.00	2.450	1.370
420.00	2.290	1.210
480.00	2.140	1.060
540.00	2.010	.930
600.00	1.920	.840
720.00	1.740	.660
840.00	1.610	.530
960.00	1.500	.420
1080.00	1.410	.330
1200.00	1.350	.270
1320.00	1.300	.220
1440.00	1.260	.180
1560.00	1.220	.140
1680.00	1.190	.110
1800.00	1.170	.090
1920.00	1.150	.070
2040.00	1.140	.060
2160.00	1.130	.050

****

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

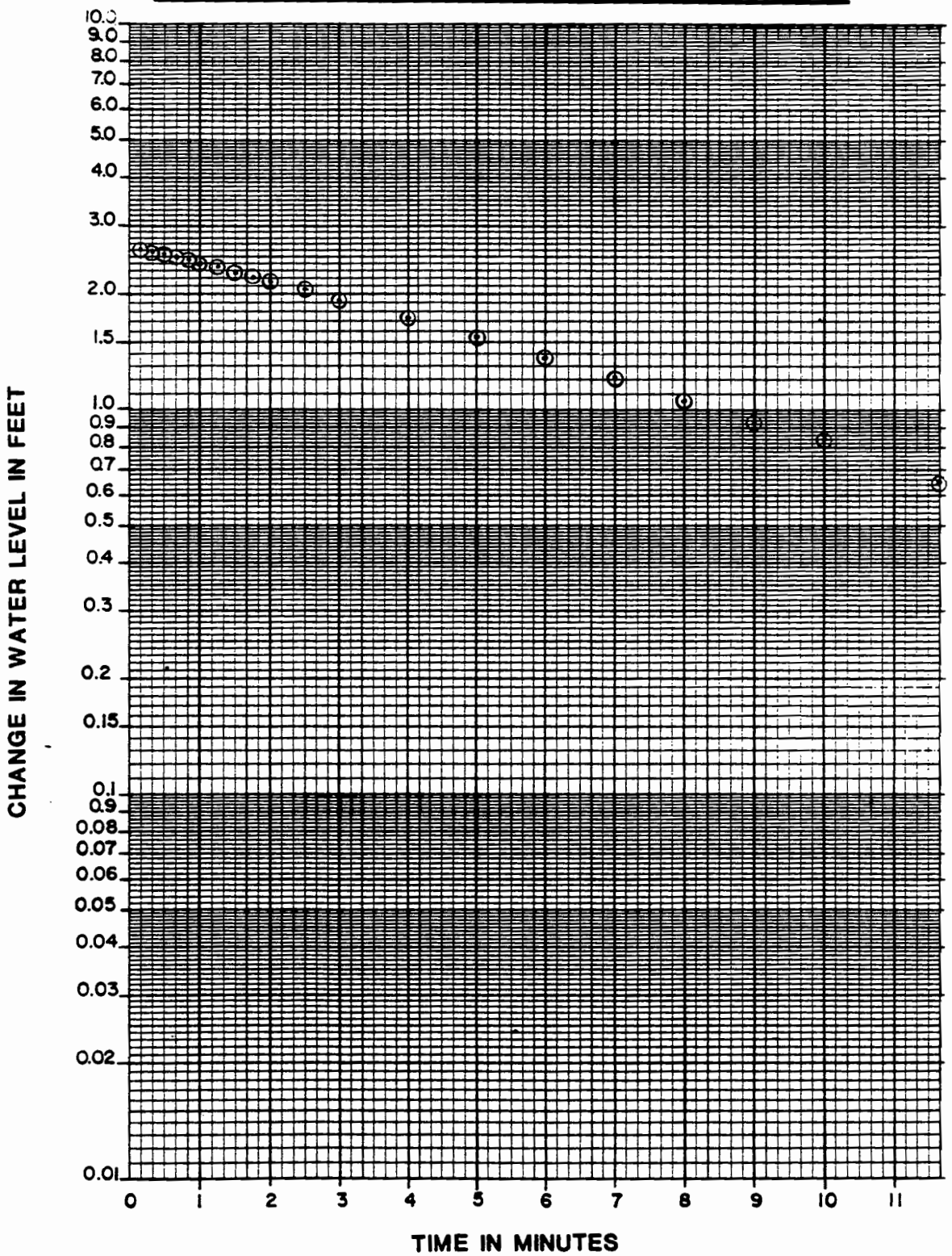
PERMEABILITY = 6.58E-06 FT/SEC = 2.01E-04 CM/SEC

TRANSMISSIVITY = 9.87E-05 FT**2/SEC

ERC / EDGE Environmental and Energy Services Co.

WELL No. 947

HYDRAULIC CONDUCTIVITY CALCULATIONS



EDGE Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 947W01

WELL NO.	LOCATION:	TYPE:
947	SWSA -1	WATER

SAMPLER:	SAMPLE INTERVAL:	DATE:	TIME:
C. Allison Hodge (SIGNATURE)	N/A	07-24-89	1445

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECEIVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
C. Allison Hodge	07-31-89	1430	EDGE	[illegible]	7-31-89	1430	

TYPE OF SAMPLE: ☐ SPLIT SPOON CORES–SOIL ☐ AUGER CUTTINGS–SOIL ☐ AUGER CUTTINGS–ROCK
☐ AIR ROTARY CUTTINGS–ROCK ■ DRILL WATER (NO AIR IN SAMPLE) ☐ OTHER _____

ALL SAMPLES ARE IMMEDIATELY PLACED IN I-CHEM SPECIALTY CLEANED CONTAINERS AND SEALED.

REMARKS: _____

1.0 General Information

1.1 Well Location

Monitoring well number 1071 is located in WAG 7. It is located on the north side of Lagoon Road and is approximately 2500' east of Highway 95. The location is shown on ORNL drawing number C3E 20004 A075. Survey coordinates for this well are N 19302.8549, E 27233.9346 (X-10 grid) or latitude 35° 54' 52.49" and longitude 84° 14' 20.89". Coordinate data were provided by Martin Marietta Energy Systems. The method used for conversion from X-10 grid to Tennessee-Lambert State Plane Coordinates came from the publication "Tennessee Valley Authority Data Services Branch and Mapping Services Branch, Oak Ridge, Tennessee, DOE Plant Control, November 6, 1985, Field Book: ESS-3115, pp. 1-20." The latitude and longitude were calculated by Adams Craft Herz Walker Engineering, Inc., using methods from the U.S. Coast and Geodetic Survey Publication 62-4, "State Plane Coordinates by Automatic Data Processing."

1.2 Drilling Information

Well number 1071 was drilled by Geotek Engineering Company. A Mobile B-50 auger rig was used to drill this boring for monitor well installation under operation of Rick Herron with the assistance of Fred Dixon. Drilling commenced on 7/14/89 and

was finished on 7/17/89. Paragraph 2.4.1 includes a detailed discussion of the well installation and a well schematic is included on the well installation/completion form. A synopsis of the drilling activity follows:*

7/7/89: The equipment necessary to sample and auger the boring was steam cleaned.

7/14/89: The mobile B-50 auger rig was mobilized to the site and set up. The boring was split spooned from 1.5' to 7.5', augered with a 6.0" auger from 0.0' to 8.5', split spooned from 8.5' to 9.5', augered from 8.5' to 10.5' and split spooned from 10.5' to 10.7'. Final split spoon refusal was at 10.7'. The boring was then completed by augering from 10.7' to 25.0' or total depth. The well was allowed to recharge for 4.5 hours. Water level after this time was at 20.2' from surface. The decision was made to bail the hole to remove mud and check recharge rate and then to set the well on Monday.

7/17/89: The water level was at 3.75' from surface which was found sufficient enough to set the well. The borehole

* This information was typed directly from field notes and was edited only when necessary for clarification.

was bailed to dryness and the 2.0" stainless well casing and screen were installed. The sand was tremied into the borehole with 1" PVC pipe and a bentonite seal installed. The bentonite was allowed to hydrate for four hours and then a grout seal completed to within 2.0' of surface.

This well was logged by ERC Environmental and Energy Services Co., Inc., hydrogeologist C. Allison Hodges. All well construction materials and supplies were from Martin Marietta Energy Systems approved batches. The batch origin of individual items is shown on the included Monitoring Well Materials Certification form.

2.0 Technical Information

2.1 Decontamination Procedures

The drilling rig, down hole tools, surface casing, stainless steel screen, stainless steel casing, centralizers, and stainless steel silt trap underwent the cleaning decontamination procedures outlined in the drilling specifications (Release Specific Technical Directions for Regulatory Compliance Monitoring Wells Phase 1, Oak Ridge National Laboratory, Oak Ridge, W.O., K-4147, April 1987, pgs, 2-4). A checklist of the cleaned materials is included with this data package.

2.2 Geology

WAG 7 is located in Melton Valley which is in the Valley and Ridge Physiographic Province of East Tennessee. WAG 7 is underlain by shale, siltstone, and limestone of the Conasauga Group. The Conasauga Group in the Oak Ridge area consists of six formations. They are, in ascending order, the Pumpkin Valley Shale, Rutledge Limestone, Rogersville Shale, Maryville Limestone, Nolichucky Shale and the Maynardville Limestone. These rocks have undergone extensive deformation and contain many folds and faults resulting in varying strike and dips. The average strike and dip appears to be consistent with the regional strike of 56° northeast and dips of about 30° to the southeast.

2.3 Sample Collection

Two soil/weathered rock samples (1071S01 and 1071S02) were collected during drilling, placed in I-CHEM specialty cleaned glass containers, sealed and submitted to Sample Receiving, Analytical Chemistry Division, Bldg. 4500S, ORNL. Chain of custody forms for these samples are included with this data package. Soil sample 1071S01 was collected in the split spoon interval from 2.0' to 3.5' on 7/14/89 and soil sample 1071S02 was collected in the augered interval from 23.0' to 25.0' on 7/14/89. Sample No. 1071S02 included clay (soil) as well as a weathered shale and was collected from the auger stem.

2.4 Installation and Development

2.4.1 Installation

This was a type A well. A two-inch diameter stainless steel screen with welded stainless steel cap was installed from 9.25 to 24.25 feet. A two-inch diameter stainless steel casing was installed above the screen from 9.25 feet to 1.61 feet above ground surface. A sandpack was then tremied into the annular space from 8.10 to 24.25 feet, with a 1.5 foot bentonite pellet seal poured into the annular space above the sandpack from 6.60' to 8.10 feet. The annular space from the top of the bentonite seal to the surface was tremie grouted with a cement/bentonite slurry. A detailed schematic of the well is included on the well installation/completion form.

2.4.2 Well Development

Well number 1071 was developed to remove drill cuttings, silt, and other fines from the monitoring well. The monitoring well was developed using a Geoguard pump with an air compressor. All pumps were cleaned prior to use according to specified cleaning procedures (see Paragraph 2.1). The well was developed until a measured total of 326 gallons of water had been evacuated and the clarity of the discharge water was approved

by the company representative. The final turbidity value measured was 10 NTU's. A development form showing the exact method of development and other pertinent data is appended.

2.4.3 Installation of Dedicated Monitoring Well Pump

After the well was developed, a Geoguard Model No. 5614 dedicated monitoring well pump, was installed on 2/1/90 at a depth of 22.2 feet below ground surface. These pumps are decontaminated at American Sigma and are sent prepackaged. A copy of the pump certification is kept on file at ORNL.

2.5 Hydraulic Conductivity Testing

Well number 1071 was tested for the determination of hydraulic conductivity of the aquifer in the vicinity of the well screen. This was accomplished by instantaneously adding a known quantity of water to the monitoring well and measuring the recovery of the water level over time. The changing water levels were measured using a Druck 15 psig pressure transducer and an Omnidata Datapod II data recorder. The hydraulic conductivity value of 7.32×10^{-6} cm/second (shown as permeability on the hydraulic conductivity calculations) was calculated using the Bouwer and Rice method. A computer printout of the hydraulic conductivity calculations is included in this data package.

ERC / EDGE
Environmental and Energy Services Co.

WELL No. 1071

PRE-DRILLING CHECKLIST FOR MONITORING WELLS

PRE-DRILLING TASKS		COMPLIANCE DATE	COMPLIANCE INITIALS
1.	EXCAVATION PERMIT OBTAINED.	7/14/89	CAH
2.	ALL EQUIPMENT HAS BEEN CLEANED BEFORE DRILLING.	7/7/89	CAH
3a.	SCREEN AND CASINGS HAVE BEEN WASHED, STEAMED, RINSED WITH DE-IONIZED OR DISTILLED WATER, RINSED WITH ISOPROPYL ALCOHOL, WRAPPED WITH PROTECTIVE COVERING AND STORED OFF THE GROUND.	NA	
3b.	PRE-PACKAGED SCREENS, CASINGS AND CENTRALIZERS WERE USED.	7/17/89	CAH
4.	WORK AREA FOR SAMPLE EXAMINATION COVERED WITH CLEAN POLYETHYLENE.	7/14/89	CAH
5.	CLEAN KNIVES, GLOVES, SAMPLE JARS AND LABELS ON-HAND.	7/14/89	CAH
6.	POLYETHYLENE COVER IN PLACE OVER HOLE.	7/14/89	CAH

ADDITIONAL NOTES/OBSERVATIONS:

OBSERVER SIGNATURE/DATE C. Allison Hodges 7/17/89
C. Allison Hodges

ERC / EDGE
Environmental and Energy Services Co.

WELL No. 1071

DECONTAMINATION CHECKLIST
DRILLING EQUIPMENT

EQUIPMENT	SCRAPE	STEAM CLEAN	STEAM RINSE	ISOPROPYL ALCOHOL RINSE	DEIONIZED WATER RINSE
RIG	X	X	X	N/A	N/A
AUGERS	X	X	X	X	X
BITS	X	X	X	X	X
RODS	X	X	X	X	X
SAMPLERS	X	X	X	X	X
PIPES	X	X	X	X	X
WORK TOOLS	X	X	X	X	X
AUGER PINS	X	X	X	X	X

OBSERVER SIGNATURE/DATE C. Allison Hodges 7/17/89
C. Allison Hodges

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1071

ORNL MONITORING WELL LOG

LOCATION: WAG 7

DRILLER: Rick Herron

HELPER: Fred Dixon

DRILL: Mobile B-50 Auger Rig

DATE: START: 7/14/89
FINISH: 7/17/89

LOGGED BY: C. Allison Hodges

HEALTH PHYSICIST: L.C. Johnson

TYPE DRILLING: Split spoon and auger

LUBRICANT TYPE: NA

No. SAMPLES TAKEN: two

TYPE: soil/weathered rock

CONTAINMENT TYPE: Auger pan and plastic

THICKNESS OF SOIL (REFUSAL DEPTH): 25.0'

DEPTH DRILLED IN ROCK: 0.0'

TOTAL DEPTH OF WELL: 25.0'

DRILLING FLUID SAMPLES:

TYPE: NA DATE: NA

NA NA

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
0.0	1.5			Gravel (fill material) no split spoon taken,
				material removed by hand and auger
1.5	2.0	1071S01	80%	Clay, dark yellowish-brown, moist, also contains
		@ 2.0-3.5'		roots
2.0	2.5			Clay, shaley, mottled, pale yellowish-brown and
				light brown, with some shale fragments highly
				weathered, dusky brown, micaceous
2.5	3.5			Clay, shaley, mottled medium light gray, shale
				is more prominent, also contains more mica
3.5	5.5		100%	Shale, highly weathered, slightly clayey,
				moderate yellowish-brown, light olive gray and
				dusky brown, clay is medium light gray, shale
				is brittle, bedded and very micaceous, dry
5.5	6.0		30%	Shale, highly weathered, brownish-gray, dusky
				brown with pale yellowish-orange silt lenses
				and grayish blue and dusky yellow green mica
				lenses. Shale is brittle, bedded and breaks
				at a 45° angle
6.0	7.5		100%	Shale, highly weathered, brownish gray, dusky
				brown with pale yellowish-orange silt lenses

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1071

ORNL MONITORING WELL LOG

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
				and grayish-olive and dusky yellow green mica
				lenses, sample also contains clay lenses,
				medium light gray, mica and silt increasing.
				Shale harder. Sample moist
7.5	9.5		100%	Shale, highly weathered, brownish-gray, dusky
				brown with pale yellowish-orange silt lenses
				and grayish-olive and dusky yellow green mica
				lenses. Shale is very fractured and is broken
				up within split spoon. Dry
10.5	10.7		5%	Siltstone, calcareous, interbedded with shale,
				thinnly laminated. Siltstone is a medium gray
				and shale is a brownish-gray and dusky brown.
				Shale still contains some mica and silt lenses.
				The sample fizzes slightly with acid, very hard
				to push spoon. Sample damp at bottom of
				spoon. Begin augering
10.7	25.0	1071S02		Siltstone, calcareous, interbedded with shale,
		23.0 -25.0'		thinnly laminated. Siltstone is a medium gray
				and shale (highly weathered) is dusky yellowish
				brown. Traces of mica and silt. Augered from
				10.7 to 25.0'
	25.0			Total Depth
				* No bulk density taken because split spoon
				samples were too brittle

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1071

WELL INSTALLATION/COMPLETION FORM

O.R.N.L. MONITORING WELL PROGRAM

LOGGED BY: C. Allison Hodges

PROOFED BY: Michael L. Ebers

DRILLING COMPANY: Geotek

DRILLER: Rick Herron HELPER: Fred Dixon

EQUIPMENT ☐ 6.0 INCH AUGER 25.0 L.F.

☐ _____ INCH AUGER _____ L.F.

LOCATION WAG 7

ORNL GRID COORDINATES

N 19302.8549

E 27233.9346

ELEV. GROUND 809.96

ELEV. TOP STAINLESS STEEL CASING 811.57

DRILLING DATES:

STARTED: 7/14/89

FINISHED: 7/17/89

MATERIALS USED

EST. VOL.	USED VOL.	
	15	FEET OF 2 IN. S.S. SCREEN
	10.9	FEET OF 2 IN. S.S. CASING
3.3	5	SACKS OF SAND
25	25	POUNDS OF BENTONITE PELLETS
.75	1.25	SACKS OF CEMENT
	6.25	POUNDS OF POWDERED BENTONITE
	10.25	GALLONS OF WATER (CEMENTING)

REASON FOR DIFFERENCES BETWEEN ESTIMATED VOLUMES AND USED VOLUMES

Irregular boring diameter

WELL COVER USED ☒ LOCKING STEEL COVER ☐ FLUSH MOUNTED WELL COVER ☐ OTHER

SILT TRAP USED YES ☐ NO ☒

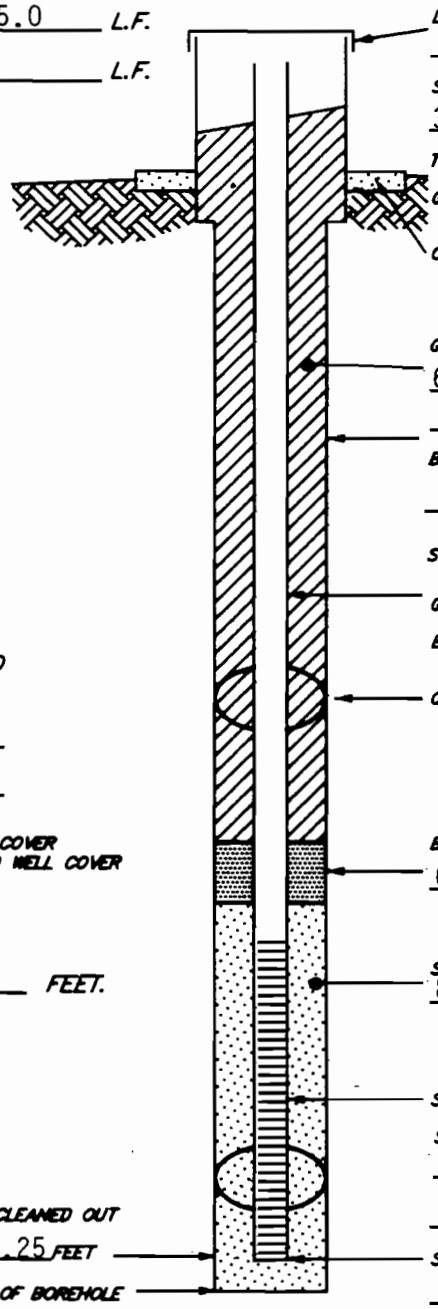
MONITORING WELL PUMP BASE SET AT 22.2 FEET.

CENTRALIZERS AT 9.0 FEET.

24.0 FEET.

_____ FEET.

NOTE:
ALL DEPTHS ARE MEASURED FROM GROUND SURFACE UNLESS OTHERWISE NOTED:



LOCKING STEEL COVER 8 INCH DIAMETER

STEEL PROTECTIVE CASING 3.43 FT. ABOVE GROUND TO 2.0 FT. BELOW GROUND SURFACE

CONCRETE PAD

GROUT SEAL 0.0 TO 6.60 FEET

6.0 INCH DIAMETER BOREHOLE

2 INCH DIAMETER STAINLESS STEEL CASING 1.61 FT. ABOVE GROUND SURFACE TO 9.25 FT. BELOW GROUND SURFACE

CENTRALIZER (TYP.)

BENTONITE PELLET SEAL 6.60 TO 8.10 FEET

SAND PACK 8.10 TO 24.25 FEET

2 INCH DIAMETER STAINLESS STEEL 0.010 SLOTTED SCREEN 9.25 TO 24.25 FEET

NA INCH DIAMETER STAINLESS STEEL SILT TRAP/CAP NA TO NA FEET

HOLE CLEANED OUT TO 24.25 FEET

BOTTOM OF BOREHOLE 25.0 FEET

TYPE A WELL

NOT TO SCALE

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1071

DATE: 7/17/89

MONITORING WELL MATERIALS CERTIFICATION

ITEM/MATERIAL		DATE USED	BATCH NUMBER
SAND		7/17/89	01
BENTONITE		7/17/89	01
STAINLESS STEEL SCREEN	(PREPACKAGED ■ YES ☐ NO)	7/17/89	01
STAINLESS STEEL CASING	(PREPACKAGED ■ YES ☐ NO)	7/17/89	01
STAINLESS STEEL CENTRALIZERS	(PREPACKAGED ■ YES ☐ NO)	7/17/89	01
STAINLESS STEEL CAPS	(PREPACKAGED ■ YES ☐ NO)	7/17/89	01
MONITORING WELL PUMP	(PREPACKAGED ■ YES ☐ NO)	2/1/90	4
GROUT		7/17/89	01
WELL COVERS		7/17/89	01
SURFACE CASING		7/17/89	01

COMMENTS:

OBSERVER SIGNATURE/DATE C. Allison Hodges 7-17-89

C. Allison Hodges

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1071

POST-WELL COMPLETION CHECKLIST

POST-WELL COMPLETION TASKS	COMPLIANCE DATE	COMPLIANCE INITIALS
1. MUD SCRAPED FROM AUGERS, SAMPLERS, AND ALL OTHER EQUIPMENT.	7/17/89	CAH
2. ALL MUD FROM RIG AND EQUIPMENT SCRAPINGS AND CUTTINGS DISPOSED OF IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED.	7/17/89	CAH
3. WELL DEVELOPED IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED AND DETAILS OF THE DEVELOPMENT ACTIVITY RECORDED.	2/1/90	DCL
4. DRILLING SITE PROPERLY CLEANED UP AFTER COMPLETION OF WELL INSTALLATION.	7/17/89	CAH

* RELEASE SPECIFIC TECHNICAL DIRECTIONS FOR REGULATORY COMPLIANCE MONITORING WELLS PHASE I, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, W.O. K-4147, APRIL 1987.

OBSERVER SIGNATURE/DATE C. Allison Hodges 7/17/89
C. Allison Hodges

D. Charles Lytle 2/1/90
D. Charles Lytle

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1071

LOCATION: WAG7

MONITORING WELL DEVELOPMENT FORM

DEVELOPMENT DETAILS

METHOD OF DEVELOPMENT: Surging and pumping

DEVELOPMENT BEGAN DATE: 1-30-90 TIME:

DEVELOPMENT ENDING DATE: 2-1-90

DEVELOPMENT OBSERVED BY: D. Charles Lytle

ONE WELL VOLUME: 9.8 GALLONS

TOTAL GALLONS PUMPED: 326 TOTAL WELL VOLUMES PUMPED: 33.3

INITIAL pH: 7.7 FINAL pH: 7.2

INITIAL CONDUCTIVITY (uS): 667 FINAL CONDUCTIVITY (uS): 620

DESCRIPTION OF INITIAL TURBIDITY: Muddy

DESCRIPTION OF FINAL TURBIDITY: Clear

FINAL MEASURED TURBIDITY: 10 NTU's

WELL APPROVED BY: R.C. Williams MMES

ODOR OF WATER: None

WATER DISCHARGED TO:
- ☒ GROUND SURFACE
- ☐ STORM SEWERS
- ☐ DRUMS
- ☐ TANK TRUCK
- ☐ STORAGE TANKS
- ☐ OTHER

INITIAL PRE-DEVELOPMENT WATER DEPTH: 3.0 feet from ground surface

DEVELOPMENT OBSERVATIONS

OBSERVER SIGNATURE/DATE D. Charles Lytle 2/1/90

D. Charles Lytle

ERC / EDGE Environmental and Energy Services Co.

WELL NO. 1071
LOCATION: WAG7
DATE: 1-30-90

MONITORING WELL DEVELOPMENT PROGRESS

ONE WELL VOLUME = 9.8 GALLONS

DATE	TIME	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	MEASURED TURBIDITY (NTU'S)	pH	CONDUC-TIVITY (uS)	TOTAL GALLONS PUMPED	WELL VOLUMES PUMPED	COMMENTS
1-30-90	1300	46	Muddy		7.7	667	46	4.7	
1-30-90	1600	24	Muddy		7.5	663	70	7.1	
1-31-90	1100	31	Cloudy		7.9	669	101	10.3	
1-31-90	1400	45	Cloudy		7.3	656	146	14.9	
1-31-90	1630	65	Cloudy		7.3	608	211	21.5	
2-1-90	1530	75	Cloudy		7.4	683	286	29.2	
2-1-90	1630	40	Clear	10	7.2	620	326	33.3	
RESULTS AT END OF DEVELOPMENT			Clear	10	7.2	620	326	33.3	

COMMENTS Well was getting close to 30 well volume and remained cloudy.

Did not surge on 2-1-90 water cleared and passed, moved to another well

OBSERVER SIGNATURE/DATE D. Charles Lytle 2-1-90
D. Charles Lytle

MWFORM06.DWG

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1071

HYDRAULIC CONDUCTIVITY CALCULATIONS

PROGRAM SLUGT, VERSION 4.1, NOV. 1986

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:

(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3, NO.1 OF WRR ENTITLED "RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER")

(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED "A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS")

WELL NO.: 1071 DATE OF TEST: 3/09/90

PROJECT NO.: E221-002 CLIENT: MMES

SITE LOCATION: WAG 7

EDGE, INC. FIELD INVESTIGATOR: BRUCE MCMASTER

INPUT DATA ARE:

INNER CASING DIAMETER = 2.00 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 2.00 INCHES
DIAMETER OF DRILLED HOLE = 6.75 INCHES
LENGTH OF SCREEN OR INTAKE PORTION = 15.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 17.95 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 15.00 FEET
DEPTH TO STATIC WATER LEVEL BELOW REF. POINT = 1.00 FEET
ESTIMATED POROSITY OF GRAVEL PACK = .20
FALLING-HEAD INDEX = 1 ("1" IF FALLING,"0" IF RISING)
NUMBER OF DEPTH-TIME DATA POINTS = 32

HO WAS COMPUTED FROM INTERCEPT OF PLOT OF LOG(H) VS. TIME

SUCCESSIVE COMPUTED VALUES FOR HO (FEET)

4.6075
4.6291

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1071

HYDRAULIC CONDUCTIVITY CALCULATIONS

TIME (SEC)	DEPTH TO WATER (FEET)	HEAD (FEET)
10.00	6.040	5.040
20.00	5.960	4.960
30.00	5.890	4.890
40.00	5.830	4.830
50.00	5.780	4.780
60.00	5.740	4.740
75.00	5.670	4.670
90.00	5.620	4.620
105.00	5.560	4.560
120.00	5.510	4.510
150.00	5.410	4.410
180.00	5.330	4.330
240.00	5.170	4.170
300.00	5.040	4.040
360.00	4.910	3.910
420.00	4.810	3.810
480.00	4.710	3.710
540.00	4.620	3.620
600.00	4.540	3.540
720.00	4.390	3.390
840.00	4.270	3.270
960.00	4.160	3.160
1080.00	4.070	3.070
1200.00	3.980	2.980
1320.00	3.910	2.910
1440.00	3.850	2.850
1560.00	3.790	2.790
1680.00	3.740	2.740
1800.00	3.690	2.690
1920.00	3.650	2.650
2040.00	3.610	2.610
2160.00	3.580	2.580

****

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

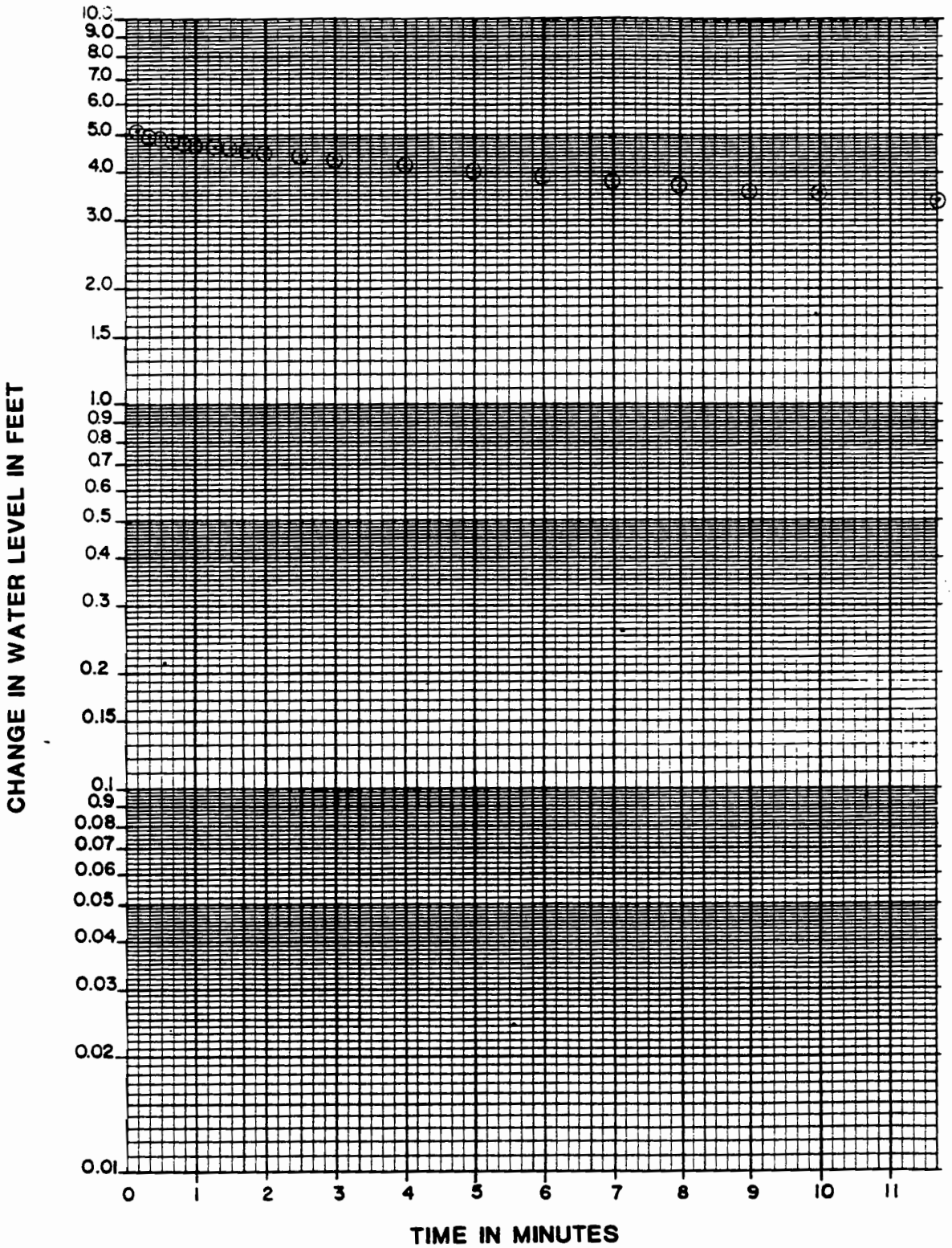
PERMEABILITY = 2.40E-07 FT/SEC = 7.32E-06 CM/SEC

TRANSMISSIVITY = 3.60E-06 FT**2/SEC

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1071

HYDRAULIC CONDUCTIVITY CALCULATIONS



EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 1071S01

WELL NO.	LOCATION:	TYPE:
1071	WAG-7	Soil

SAMPLER:	SAMPLE INTERVAL:	DATE:	TIME:
C. Allison Hodges (SIGNATURE)	2.0 - 3.5	7-14-89	

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECEIVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
C. Allison Hodges	07-14-89	10:24	EDGE	ME Owen	7/19/89	10:25	ORNL ACD CAPA

TYPE OF SAMPLE: ☒ SPLIT SPOON CORES–SOIL ☐ AUGER CUTTINGS–SOIL ☐ AUGER CUTTINGS–ROCK
☐ AIR ROTARY CUTTINGS–ROCK ☐ DRILL WATER (NO AIR IN SAMPLE) ☐ OTHER _____

ALL SAMPLES ARE IMMEDIATELY PLACED IN I-CHEM SPECIALTY CLEANED CONTAINERS AND SEALED.

REMARKS: _____

EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 1071302

WELL NO.	LOCATION:	TYPE:
1071	WAG-7	soil/weathered shale

SAMPLER: (SIGNATURE)	SAMPLE INTERVAL:	DATE:	TIME:
C. Allison Hodges	23-25	07-14-89	1130

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECEIVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
C Allison Hodges	07/14/89	10:24	EDGE	NE Owen	7/19/89	10:25	ORNL ACR (AP)

TYPE OF SAMPLE: ☐ SPLIT SPOON CORES–SOIL ☑ AUGER CUTTINGS–SOIL ☐ AUGER CUTTINGS–ROCK
☐ AIR ROTARY CUTTINGS–ROCK ☐ DRILL WATER (NO AIR IN SAMPLE) ☐ OTHER _____

ALL SAMPLES ARE IMMEDIATELY PLACED IN I-CHEM SPECIALTY CLEANED CONTAINERS AND SEALED.

REMARKS: Sample was scraped of auger, contains soil (clay) and rock (Highly weathered shale)

1.0 General Information

1.1 Well Location

Monitoring well number 1072 is located in WAG 7. It is located approximately 200 feet west past the entrance to SWSA 4 along Lagoon Road, approximately forty feet north of the road surface. The location is shown on ORNL drawing number C3E20004 A075. Survey coordinates for this well are N 19294.2970, E 26168.9893 (X-10 grid) or latitude 35° 54' 46.56" and longitude 84° 19' 31.59". Coordinate data were provided by Martin Marietta Energy Systems. The method used for conversion from X-10 grid to Tennessee-Lambert State Plane Coordinates came from the publication "Tennessee Valley Authority Data Services Branch and Mapping Services Branch, Oak Ridge, Tennessee, DOE Plant Control, November 6, 1985, Field Book: ESS-3115, pp. 1-20." The latitude and longitude were calculated by Adams Craft Herz Walker Engineering, Inc., using methods from the U.S. Coast and Geodetic Survey Publication 62-4, "State Plane Coordinates by Automatic Data Processing."

1.2 Drilling Information

Well number 1072 was drilled by Geotek Engineering Company. A Mobile drill B-50 and an Ingersoll Rand T-4 rig were used to drill this boring for monitor well installation under operation of Larry

Ledbetter with the assistance of Steve Kirk. Drilling commenced on 6/15/89 and was finished on 6/30/89. Paragraph 2.4.1 includes a detailed discussion of the well installation and a well schematic is included on the well installation/ completion form. A synopsis of the drilling activity follows:*

6/15/89: The B-50 mobilized to the staked location and set up on plastic sheeting. The rig augered 0.0'-4.0' with a 22.0" bit. A 4.0' length of diverter casing was installed and grouted.

6/20/89: Air rotary rig mobilizes and sets up on 1072. Drillers begin augering with a 14.0" bit. A rupture in hydraulic hose discontinued drilling. Boring not contaminated. Rig taken to be re-steam cleaned.

6/21/89: Air rotary rig sets up again and augers to 20.0'. Bedrock encountered at 19.0'. Installed 20.0' of 10.0" surface casing using one bucket bentonite pellets and 8.0 sacks cement.

6/28/89: Using containment and a 7 7/8" tricone bit drilled from 20.0' to 70.0'. Borehole cleaned and allowed to recharge for one hour. After one hour 2.3' of water in hole.

* This information was typed directly from field notes and was edited only when necessary for clarification.

6/29/89: Measured 37.5' of water in hole.

6/30/89: Installed 15.0' of 4.5" stainless steel screen from 55.0' to 70.0', stainless riser casing from 2.0' above ground surface to 55.0'. A sand and potable water slurry was tremied into the borehole to form the sandpack. Four sacks sand were used. Tagged top of sandpack at 52.5'. Poured 35 pounds bentonite into borehole. Tagged bentonite at 54.4'. Added additional 50 pounds of bentonite and tagged bentonite at 52.2'. Allowed hydration of bentonite and grouted remaining annulus with 10 sacks cement, 50 pounds powdered bentonite.

This well was logged by ERC Environmental and Energy Services Co., Inc., hydrogeologist Christopher M. Wallen. All well construction materials and supplies were from Martin Marietta Energy Systems approved batches. The batch origin of individual items is shown on the included Monitoring Well Materials Certification form.

2.0 Technical Information

2.1 Decontamination Procedures

The drilling rig, down hole tools, surface casing, stainless steel screen, stainless steel casing, centralizers, and stainless steel silt trap

underwent the cleaning decontamination procedures outlined in the drilling specifications (Release Specific Technical Directions for Regulatory Compliance Monitoring Wells Phase 1, Oak Ridge National Laboratory, Oak Ridge, W.O., K-4147, April 1987, pgs, 2-4). A checklist of the cleaned materials is included with this data package.

2.2 Geology

WAG 7 is located in Melton Valley which is in the Valley and Ridge Physiographic Province of East Tennessee. WAG 7 is underlain by shale, siltstone, and limestone of the Conasauga Group. The Conasauga Group in the Oak Ridge area consists of six formations. They are, in ascending order, the Pumpkin Valley Shale, Rutledge Limestone, Rogersville Shale, Maryville Limestone, Nolichucky Shale and the Maynardville Limestone. These rocks have undergone extensive deformation and contain many folds and faults resulting in varying strike and dips. The average strike and dip appears to be consistent with the regional strike of 56° northeast and dips of about 30° to the southeast.

2.3 Sample Collection

A drill water sample was collected from the water pump on the drill rig on 6/28/89. Analytical results for this sample can be obtained from the Remedial Action Program data base at ORNL.

2.4 Installation and Development

2.4.1 Installation

This was a type B well. The boring was augered from 0.0' to 4.0' with a twenty two-inch bit. Diverter casing was installed and grouted from 0.0' to 4.0'. A fourteen-inch diameter boring was augered from ground surface to bedrock (20.0 feet). A ten-inch diameter string of decontaminated steel surface casing was installed and tremie grouted in place. The surface casing minimizes potential cross contamination between the regolith and bedrock water bearing zones. The air rotary method was then used to drill an eight-inch diameter boring to a total depth of 70.0 feet. A four-inch diameter stainless steel screen with a silt trap was installed from 55.0 feet to 70.0 feet. A four-inch diameter stainless steel casing was installed from the top of the screen at 55.0 feet and extending 1.69 feet above ground surface. A sandpack was then tremied into the annular space from 56.1 to 70.0 feet, with a 3.9 foot bentonite seal poured into the annular space above the sandpack from 52.2 to 56.1 feet. The annular space from the top of the bentonite seal to the surface was tremie grouted with a cement/bentonite slurry. A detailed schematic of the well is included on the well installation/completion form.

2.4.2 Well Development

Well number 1072 was developed to remove drill cuttings, silt, and other fines from the monitoring well. The monitoring well was developed using a Geoguard pump with an air compressor. All pumps were cleaned prior to use according to specified cleaning procedures (see Paragraph 2.1). The well was developed until a measured total of 279 gallons of water had been evacuated and the clarity of the discharge water was approved by the company representative. The final turbidity value measured by completions was 4.0 NTU's. A development form showing the exact method of development and other pertinent data is appended.

2.4.3 Installation of Dedicated Monitoring Well Pump

After the well was developed, a Geoguard Model No. 5614 dedicated monitoring well pump was installed on 2/8/90 at a depth of 67.3 feet below ground surface. These pumps are decontaminated at American Sigma and are sent prepackaged. A copy of the pump certification is kept on file at ORNL.

2.5 Hydraulic Conductivity Testing

Well number 1072 was tested for the determination of hydraulic conductivity of the aquifer in the vicinity of the well screen. This was accomplished by instantaneously adding a known quantity of water to the monitoring well and measuring the recovery of the water level over time. The changing water levels were measured using a Druck 15 psig pressure transducer and an Omnidata Datapod II data recorder. The hydraulic conductivity value of 5.98×10^{-6} cm/second (shown as permeability on the hydraulic conductivity calculations) was calculated using the Bouwer and Rice method. A computer printout of the hydraulic conductivity calculations is included in this data package.

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1072

PRE-DRILLING CHECKLIST FOR MONITORING WELLS

PRE-DRILLING TASKS		COMPLIANCE DATE	COMPLIANCE INITIALS
1.	EXCAVATION PERMIT OBTAINED.	6/15/89	CMW
2.	ALL EQUIPMENT HAS BEEN CLEANED BEFORE DRILLING.	6/15/89	CMW
3a.	SCREEN AND CASINGS HAVE BEEN WASHED, STEAMED, RINSED WITH DE-IONIZED OR DISTILLED WATER, RINSED WITH ISOPROPYL ALCOHOL, WRAPPED WITH PROTECTIVE COVERING AND STORED OFF THE GROUND.	N/A	CMW
3b.	PRE-PACKAGED SCREENS, CASINGS AND CENTRALIZERS WERE USED.	6/30/89	CMW
4.	WORK AREA FOR SAMPLE EXAMINATION COVERED WITH CLEAN POLYETHYLENE.	6/15/89	CMW
5.	CLEAN KNIVES, GLOVES, SAMPLE JARS AND LABELS ON-HAND.	6/15/89	CMW
6.	POLYETHYLENE COVER IN PLACE OVER HOLE.	6/15/89	CMW

ADDITIONAL NOTES/OBSERVATIONS: Air rotary on site 6/20/89 to set casing.

OBSERVER SIGNATURE/DATE Christopher M. Wallen 6/15/89

Christopher M. Wallen

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1072

DECONTAMINATION CHECKLIST
DRILLING EQUIPMENT

EQUIPMENT	SCRAPE	STEAM CLEAN	STEAM RINSE	ISOPROPYL ALCOHOL RINSE	DEIONIZED WATER RINSE
RIG	X	X	X	N/A	N/A
AUGERS	X	X	X	X	X
BITS	X	X	X	X	X
RODS	X	X	X	X	X
SAMPLERS	X	X	X	X	X
PIPES	X	X	X	X	X
WORK TOOLS	X	X	X	X	X
AUGER PINS	X	X	X	X	X

OBSERVER SIGNATURE/DATE Christopher M. Wallen 6/15/89

Christopher M. Wallen

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1072

ORNL MONITORING WELL LOG

LOCATION: X-10 WAG 7
DRILLER: W. Larry Ledbetter
HELPER: Steve Kirk
DRILL: I.R. T-4

DATE: START: 6/15/89
FINISH: 6/30/89
LOGGED BY: Christopher M. Wallen
HEALTH PHYSICIST: Carl Stooksbury

TYPE DRILLING: Auger and Air Rotary
LUBRICANT TYPE: Green Stuff
No. SAMPLES TAKEN: None
TYPE: N/A
CONTAINMENT TYPE: Auger pan, plastic

THICKNESS OF SOIL (REFUSAL DEPTH): 19.0'
DEPTH DRILLED IN ROCK: 51.0'
TOTAL DEPTH OF WELL: 70.0'

DRILLING FLUID SAMPLES:
TYPE: Drill Water DATE: 6/28/89

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
0.0	0.9			Topsoil.
0.9	4.0			Clay, silty, moderate brown, firm, dry.
4.0	14.5			Clay, silty, dark yellowish brown, firm, dry
				with shale fragments, dark yellowish brown.
14.5	19.0			Clay, silty, dark yellowish brown, soft, damp
				with shale, dark yellowish brown/moderate
				yellowish brown, subangular fragments.
19.0	20.0			Shale, dark gray/medium dark gray, with bluish
				gray on freshly exposed surfaces.
20.0	46.5			*Shale, fairly soft drilling.
46.5	48.5			Shale, medium dark gray, slightly ratty.
48.5	70.0			Shale, fairly soft drilling.
				*Detailed lithologic description not available
				for the interval from 20.0' to 70.0' due to
				the use of containment box.

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1072

WELL INSTALLATION/COMPLETION FORM

O.R.N.L. MONITORING WELL PROGRAM

LOGGED BY: Chris Wallen
PROOFED BY: Michael L. Ebers

DRILLING COMPANY: Geotek Engineering

DRILLER: Larry Ledbetter HELPER: Steve Kirk

DRILLING METHOD:
- ☐ 14.0" INCH AUGER 20.0' L.F.
- ☐ _____ INCH AUGER _____ L.F.
- ☐ 7 7/8 INCH ROTARY 50.0 L.F.
- ☐ _____ INCH ROTARY _____ L.F.

LOCATION WAG 7
ORNL GRID COORDINATES
N 19,294.2970
E 26,168.9893
ELEV. GROUND 834.00
ELEV. TOP STAINLESS STEEL CASING 835.69

DRILLING DATES:
STARTED: 6/15/89
FINISHED: 6/30/89

MATERIALS USED

EST. VOL.	USED VOL.	
	100	POUNDS OF BENTONITE PELLETS (SURFACE CASING SEAL)
	20.0	FT. OF 10.0 IN. SURFACE CASING
8.0	8.0	SACKS OF CEMENT (SURFACE CASING)
	50.0	POUNDS OF POWERED BENTONITE (SURFACE CASING)
	60.0	GALLONS OF WATER (SURFACE CASING)
	56.7	FT. OF 4.5 IN. DIA. STAINLESS STEEL CASING
	15.0	FT. OF 4.5 IN. DIA. STAINLESS STEEL SCREEN
4.0	4.0	SACKS OF SAND
50.0	90.0	POUNDS OF BENTONITE PELLETS
11.0	10.0	SACKS OF CEMENT (WELL CASING)
	50.0	POUNDS OF POWERED BENTONITE (WELL CASING)
	60.0	GALLONS OF WATER (WELL CASING)
	3.2	FT. OF 10 IN. STEEL PROTECTIVE CASING

REASON FOR DIFFERENCES BETWEEN ESTIMATED VOLUMES AND USED VOLUMES
Settling of sand pack.

SURFACE CASING TREMIE GROUTED YES ☒ NO ☐

STAINLESS STEEL CASING TREMIE GROUTED YES ☒ NO ☐

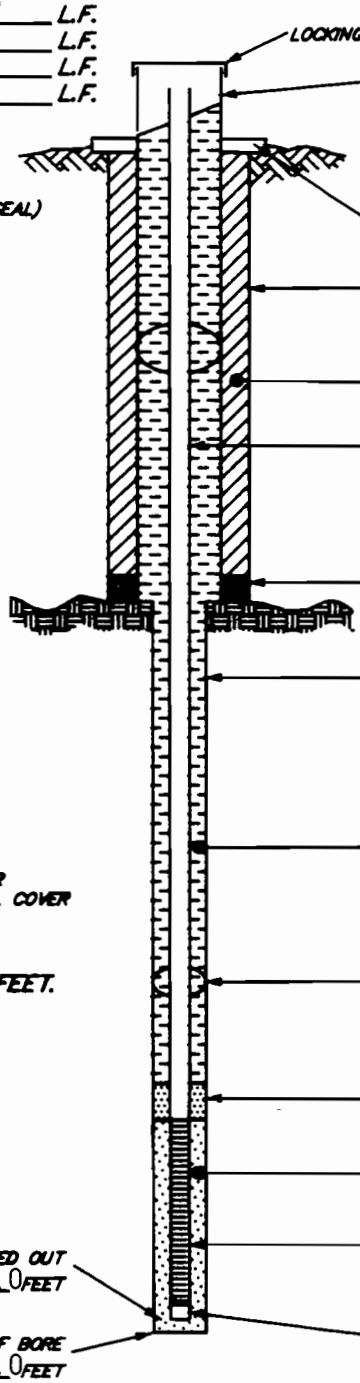
WELL COVER USED
- ☒ LOCKING STEEL COVER
- ☐ FLUSH MOUNTED WELL COVER
- ☐ OTHER

SILT TRAP USED YES ☒ NO ☐

MONITORING WELL PUMP BASE SET AT 67.3 FEET.

CENTRALIZERS AT 14.0 FEET.
34.0 FEET.
54.0 FEET.
70.0

NOTE:
ALL DEPTHS ARE MEASURED FROM GROUND SURFACE UNLESS OTHERWISE NOTED:



TYPE B WELL

ERC / EDGE
Environmental and Energy Services Co.

WELL No. 1072

DATE: 6/15/89

MONITORING WELL MATERIALS CERTIFICATION

ITEM/MATERIAL		DATE USED	BATCH NUMBER
SAND		6/30/89	1
BENTONITE		6/21/89	1
		6/30/89	1
STAINLESS STEEL SCREEN	(PREPACKAGED ☒ YES ☐ NO)	6/30/89	1
STAINLESS STEEL CASING	(PREPACKAGED ☒ YES ☐ NO)	6/30/89	1
STAINLESS STEEL CENTRALIZERS	(PREPACKAGED ☒ YES ☐ NO)	6/30/89	1
STAINLESS STEEL CAPS	(PREPACKAGED ☒ YES ☐ NO)	6/30/89	1
MONITORING WELL PUMP	(PREPACKAGED ☒ YES ☐ NO)	2/08/89	4
GROUT		6/21/89	1
		6/30/89	1
WELL COVERS		6/30/89	1
SURFACE CASING		6/21/89	1

COMMENTS:

OBSERVER SIGNATURE/DATE Christopher M. Wallen 6/21/89
Christopher M. Wallen

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1072

POST-WELL COMPLETION CHECKLIST

POST-WELL COMPLETION TASKS	COMPLIANCE DATE	COMPLIANCE INITIALS
1. MUD SCRAPED FROM AUGERS, SAMPLERS, AND ALL OTHER EQUIPMENT.	7/05/89	CMW
2. ALL MUD FROM RIG AND EQUIPMENT SCRAPINGS AND CUTTINGS DISPOSED OF IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED.	7/05/89	CMW
3. WELL DEVELOPED IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED AND DETAILS OF THE DEVELOPMENT ACTIVITY RECORDED.	2/08/89	DCL
4. DRILLING SITE PROPERLY CLEANED UP AFTER COMPLETION OF WELL INSTALLATION.	7/05/89	CMW

* RELEASE SPECIFIC TECHNICAL DIRECTIONS FOR REGULATORY COMPLIANCE MONITORING WELLS PHASE I, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, W.O. K-4147, APRIL 1987.

OBSERVER SIGNATURE/DATE Christopher M. Wallen 7/05/89
Christopher M. Wallen

D. Charles Lytle 2/08/90
D. Charles Lytle

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1072

LOCATION: WAG 7

MONITORING WELL DEVELOPMENT FORM

DEVELOPMENT DETAILS

METHOD OF DEVELOPMENT: Surging and Pumping

DEVELOPMENT BEGAN DATE: 2-06-90 TIME:

DEVELOPMENT ENDING DATE: 2-08-90

DEVELOPMENT OBSERVED BY: D. Charles Lytle

ONE WELL VOLUME: 45.7 GALLONS

TOTAL GALLONS PUMPED: 279 TOTAL WELL VOLUMES PUMPED: 6.1

INITIAL pH: 8.3 FINAL pH: 7.4

INITIAL CONDUCTIVITY (uS): 770 FINAL CONDUCTIVITY (uS): 563

DESCRIPTION OF INITIAL TURBIDITY: Milky

DESCRIPTION OF FINAL TURBIDITY: Clear

FINAL MEASURED TURBIDITY: 4.0 NTU's

WELL APPROVED BY: R. C. Williams MMES

ODOR OF WATER: None

WATER DISCHARGED TO:
- ☒ GROUND SURFACE
- ☐ STORM SEWERS
- ☐ DRUMS
- ☐ TANK TRUCK
- ☐ STORAGE TANKS
- ☐ OTHER

INITIAL PRE-DEVELOPMENT WATER DEPTH: 14.4 feet from ground surface.

DEVELOPMENT OBSERVATIONS

OBSERVER SIGNATURE/DATE D. Charles Lytle

D. Charles Lytle 2/08/90

ERC / EDGE Environmental and Energy Services Co.

WELL NO. 1072
LOCATION: WAG 7
DATE: 2-06-90

MONITORING WELL DEVELOPMENT PROGRESS

ONE WELL VOLUME = 45.7 GALLONS

DATE	TIME	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	MEASURED TURBIDITY (NTU'S)	pH	CONDUCTIVITY (uS)	TOTAL GALLONS PUMPED	WELL VOLUMES PUMPED	COMMENTS
2-06-90	1530	81	Milky	--	8.3	770	81	1.8	
2-06-90	1700	15	Cloudy	--	8.4	613	96	2.1	
2-08-90	0930	183	Clear	4.0	7.4	563	279	6.1	
RESULTS AT END OF DEVELOPMENT			Clear	4.0	7.4	563	279	6.1	

COMMENTS Water stayed clear even after surging. Passed and moved to new location.

OBSERVER SIGNATURE/DATE D. Charles Lytle 2-08-90
D. Charles Lytle

WWFORMOS.DWG

HYDRAULIC CONDUCTIVITY CALCULATIONS

PROGRAM SLUGT, VERSION 4.1, NOV. 1986

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:

(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3, NO.1 OF WRR ENTITLED "RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER")

(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED "A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS")

WELL NO.: 1072 DATE OF TEST: 3/9/90

PROJECT NO.: E221-002 CLIENT: MMES

SITE LOCATION: WAG7

EDGE, INC. FIELD INVESTIGATOR: BRUCE MCMASTER

INPUT DATA ARE:

INNER CASING DIAMETER = 4.00 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 4.00 INCHES
DIAMETER OF DRILLED HOLE = 8.63 INCHES
LENGTH OF SCREEN OR INTAKE PORTION = 15.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 56.90 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 15.00 FEET
DEPTH TO STATIC WATER LEVEL BELOW REF. POINT = .98 FEET
ESTIMATED POROSITY OF GRAVEL PACK = .20
FALLING-HEAD INDEX = 1 ("1" IF FALLING,"0" IF RISING)
NUMBER OF DEPTH-TIME DATA POINTS = 32

HO WAS COMPUTED FROM INTERCEPT OF PLOT OF LOG(H) VS. TIME

SUCCESSIVE COMPUTED
VALUES FOR HO
(FEET)

2.4513
2.4517

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1072

HYDRAULIC CONDUCTIVITY CALCULATIONS

TIME (SEC)	DEPTH TO WATER (FEET)	HEAD (FEET)
10.00	3.390	2.410
20.00	3.420	2.440
30.00	3.430	2.450
40.00	3.430	2.450
50.00	3.440	2.460
60.00	3.440	2.460
75.00	3.430	2.450
90.00	3.430	2.450
105.00	3.430	2.450
120.00	3.420	2.440
150.00	3.420	2.440
180.00	3.410	2.430
240.00	3.400	2.420
300.00	3.390	2.410
360.00	3.380	2.400
420.00	3.370	2.390
480.00	3.360	2.380
540.00	3.350	2.370
600.00	3.340	2.360
720.00	3.320	2.340
840.00	3.300	2.320
960.00	3.290	2.310
1080.00	3.270	2.290
1200.00	3.260	2.280
1320.00	3.240	2.260
1440.00	3.230	2.250
1560.00	3.220	2.240
1680.00	3.200	2.220
1800.00	3.190	2.210
1920.00	3.190	2.210
2040.00	3.160	2.180
2160.00	3.150	2.170

****

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

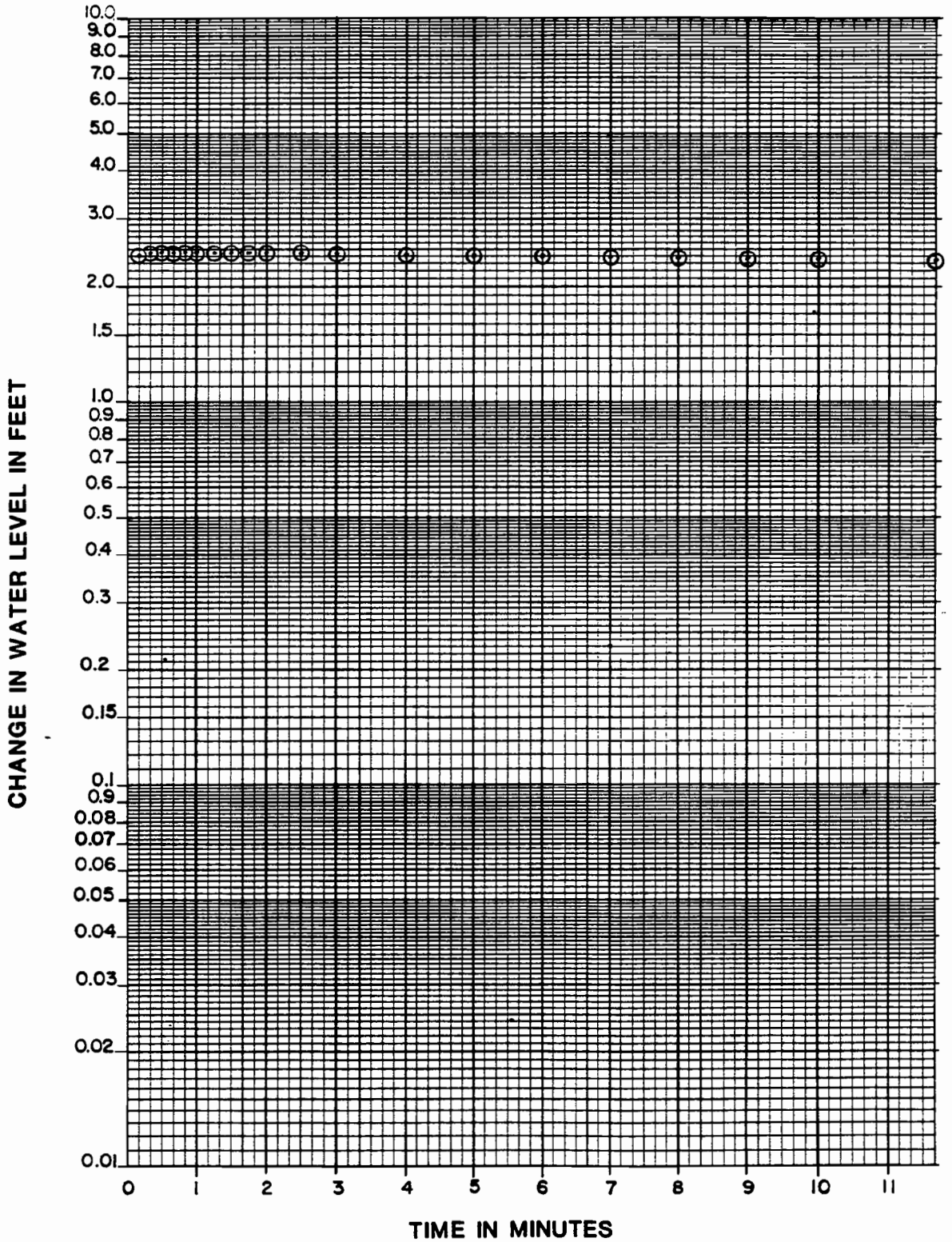
PERMEABILITY = 1.98E-07 FT/SEC = 5.98E-06 CM/SEC

TRANSMISSIVITY = 2.94E-06 FT**2/SEC

ERC / EDGE
Environmental and Energy Services Co.

WELL No. 1072

HYDRAULIC CONDUCTIVITY CALCULATIONS



EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 1072W01

WELL NO.	LOCATION:	TYPE:
1072	WAG 7	DRILL WATER

SAMPLER:	SAMPLE INTERVAL:	DATE:	TIME:
Christopher M. Hallen (SIGNATURE)	53.0'	6/28/89	1:54

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECEIVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
Christopher M. Hallen	6/28/89	16:40	EDGE	Nancy Owen 45005 5-159	6/28/89	16:40	ORNL Analy. Chem. CAPA

TYPE OF SAMPLE: ☐ SPLIT SPOON CORES–SOIL ☐ AUGER CUTTINGS–SOIL ☐ AUGER CUTTINGS–ROCK
☐ AIR ROTARY CUTTINGS–ROCK ☒ DRILL WATER (NO AIR IN SAMPLE) ☐ OTHER _____

ALL SAMPLES ARE IMMEDIATELY PLACED IN I-CHEM SPECIALTY CLEANED CONTAINERS AND SEALED.

REMARKS: _____

1.0 General Information

1.1 Well Location

Monitoring well number 1073 is located in WAG 7. It is located on the north side of Lagoon Road and approximately 1600' east of Highway 95. The location is shown on ORNL drawing number C3E20004 A075. Survey coordinates for this well are N 19270.6148, E 26177.2404 (X-10 grid) or latitude 35° 54' 46.41" and longitude 84° 19' 31.35". Coordinate data were provided by Martin Marietta Energy Systems. The method used for conversion from X-10 grid to Tennessee-Lambert State Plane Coordinates came from the publication "Tennessee Valley Authority Data Services Branch and Mapping Services Branch, Oak Ridge, Tennessee, DOE Plant Control, November 6, 1985, Field Book: ESS-3115, pp. 1-20." The latitude and longitude were calculated by Adams Craft Herz Walker Engineering, Inc., using methods from the U.S. Coast and Geodetic Survey Publication 62-4, "State Plane Coordinates by Automatic Data Processing."

1.2 Drilling Information

Well number 1073 was drilled by Geotek Engineering Company. A Mobile B-50 auger rig was used to drill this boring for monitor well installation under operation of Rick Herron with the assistance of George Akins. Drilling commenced on 7/05/89

and was finished on 7/06/89. Paragraph 2.4.1 includes a detailed discussion of the well installation and a well schematic is included on the well installation/ completion form. A synopsis of the drilling activity follows:*

6/30/89: The equipment necessary to sample and auger the well was steam cleaned.

7/5/89: The Mobile B-50 rig was mobilized to the well site and set up. The boring was split spooned from 1.5' to 5.0', augered with a 6" auger from 5.0 to 5.5', split spooned from 5.5' to 6.0', augered from 6.0' to 6.5', split spooned from 6.5' to 7.5', augered from 7.5' to 12.0', split spooned from 12.0' to 13.0' and augered from 13.0' to 25.6' total depth. Nine feet of water accumulated in the borehole after 1.5 hours. The well was bailed to remove the thick mud that was in borehole.

7/6/89: 2" stainless steel well casing and screen were installed. Sand tremied into borehole above screen, bentonite seal installed and allowed to hydrate 4 hours and then grouted to within 2.0' of surface.

* This information was typed directly from field notes and was edited only when necessary for clarification.

This well was logged by ERC Environmental and Energy Services Co., Inc., hydrogeologist C. Allison Hodges. All well construction materials and supplies were from Martin Marietta Energy Systems approved batches. The batch origin of individual items is shown on the included Monitoring Well Materials Certification form.

2.0 Technical Information

2.1 Decontamination Procedures

The drilling rig, down hole tools, surface casing, stainless steel screen, stainless steel casing, centralizers, and stainless steel silt trap underwent the cleaning decontamination procedures outlined in the drilling specifications (Release Specific Technical Directions for Regulatory Compliance Monitoring Wells Phase 1, Oak Ridge National Laboratory, Oak Ridge, W.O., K-4147, April 1987, pgs, 2-4). A checklist of the cleaned materials is included with this data package.

2.2 Geology

WAG 7 is located in Melton Valley which is in the Valley and Ridge Physiographic Province of East Tennessee. WAG 7 is underlain by shale, siltstone, and limestone of the Conasauga Group. The Conasauga Group in the Oak Ridge area consists

of six formations. They are, in ascending order, the Pumpkin Valley Shale, Rutledge Limestone, Rogersville Shale, Maryville Limestone, Nolichucky Shale and the Maynardville Limestone. These rocks have undergone extensive deformation and contain many folds and faults resulting in varying strike and dips. The average strike and dip appears to be consistent with the regional strike of 56° northeast and dips of about 30° to the southeast.

2.3 Sample Collection

Two (1073S01 and 1073S02) soil/weathered-rock samples were collected during drilling, placed in I-CHEM specialty cleaned glass containers, sealed and submitted to Sample Receiving, Analytical Chemistry Division, Bldg. 4500S, ORNL. Chain of custody forms for these samples are included with this data package. Soil sample 1073S01 was collected in the split spoon interval from 4.0' to 5.0' on 7/05/89 and soil sample 1073S02 was collected in the augered interval from 22.0' to 25.6' on 7/05/89. Sample No. 1073S02 included clay (soil) as well as a weathered shale (rock).

2.4 Installation and Development

2.4.1 Installation

This was a type A well. A two-inch diameter

stainless steel screen with welded stainless steel cap was installed from 15.6 to 25.6 feet. A two-inch diameter stainless steel casing was installed above the screen from 15.6 feet to 2.06 feet above ground surface. A sandpack was then poured into the annular space from 13.9 to 25.6 feet, with a 2.8-foot bentonite pellet seal poured into the annular space above the sandpack from 11.1' to 13.9 feet. The annular space from the top of the bentonite seal to the surface was tremie grouted with a cement/bentonite slurry. A detailed schematic of the well is included on the well installation/completion form.

2.4.2 Well Development

Well number 1073 was developed to remove drill cuttings, silt, and other fines from the monitoring well. The monitoring well was developed using a Geoguard pump with an air compressor. All pumps were cleaned prior to use according to specified cleaning procedures (see Paragraph 2.1). The well was developed until a measured total of 236 gallons of water had been evacuated and the clarity of the discharge water was approved by the company representative. The final turbidity value measured by completions was 3.0 NTU's. A development form showing the exact method of development and other pertinent data is appended.

2.4.3 Installation of Dedicated Monitoring Well Pump

After the well was developed, a Geoguard Model No. 5614 dedicated monitoring well pump was installed on 2/12/90 at a depth of 23.5 feet below ground surface. These pumps are decontaminated at American Sigma and are sent prepackaged. A copy of the pump certification is kept on file at ORNL.

2.5 Hydraulic Conductivity Testing

Well number 1073 was tested for the determination of hydraulic conductivity of the aquifer in the vicinity of the well screen. This was accomplished by instantaneously adding a known quantity of water to the monitoring well and measuring the recovery of the water level over time. The changing water levels were measured using a 15 psig pressure transducer and an Omnidata Datapod II data recorder. The hydraulic conductivity value of 9.32×10^{-6} cm/second (shown as permeability on the hydraulic conductivity calculations) was calculated using the Bouwer and Rice method. A computer printout of the hydraulic conductivity calculations is included in this data package.

ERC / EDGE
Environmental and Energy Services Co.

WELL No. 1073

PRE-DRILLING CHECKLIST FOR MONITORING WELLS

PRE-DRILLING TASKS		COMPLIANCE DATE	COMPLIANCE INITIALS
1.	EXCAVATION PERMIT OBTAINED.	7/5/89	CAH
2.	ALL EQUIPMENT HAS BEEN CLEANED BEFORE DRILLING.	6/30/89	CAH
3a.	SCREEN AND CASINGS HAVE BEEN WASHED, STEAMED, RINSED WITH DE-IONIZED OR DISTILLED WATER, RINSED WITH ISOPROPYL ALCOHOL, WRAPPED WITH PROTECTIVE COVERING AND STORED OFF THE GROUND.	NA	
3b.	PRE-PACKAGED SCREENS, CASINGS AND CENTRALIZERS WERE USED.	7/6/89	CAH
4.	WORK AREA FOR SAMPLE EXAMINATION COVERED WITH CLEAN POLYETHYLENE.	7/5/89	CAH
5.	CLEAN KNIVES, GLOVES, SAMPLE JARS AND LABELS ON-HAND.	7/5/89	CAH
6.	POLYETHYLENE COVER IN PLACE OVER HOLE.	7/5/89	CAH

ADDITIONAL NOTES/OBSERVATIONS:

OBSERVER SIGNATURE/DATE C. Allison Hodges 7/6/89
C. Allison Hodges

ERC / EDGE
Environmental and Energy Services Co.

WELL No. 1073

DECONTAMINATION CHECKLIST
DRILLING EQUIPMENT

EQUIPMENT	SCRAPE	STEAM CLEAN	STEAM RINSE	ISOPROPYL ALCOHOL RINSE	DEIONIZED WATER RINSE
RIG	X	X	X	N/A	N/A
AUGERS	X	X	X	X	X
BITS	X	X	X	X	X
RODS	X	X	X	X	X
SAMPLERS	X	X	X	X	X
PIPES	X	X	X	X	X
WORK TOOLS	X	X	X	X	X
AUGER PINS	X	X	X	X	X

OBSERVER SIGNATURE/DATE C. Allison Hodges 6/30/89
C. Allison Hodges

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1073

ORNL MONITORING WELL LOG

LOCATION: WAG 7
DRILLER: Rick Herron
HELPER: George Akins
DRILL: Mobile B-50

DATE: START: 7/5/89
FINISH: 7/6/89
LOGGED BY: C. Allison Hodges
HEALTH PHYSICIST: L.C. Johnson

TYPE DRILLING: Split spoon and auger
LUBRICANT TYPE: NA
No. SAMPLES TAKEN: two
TYPE: soil/weathered rock
CONTAINMENT TYPE: auger pan and plastic

THICKNESS OF SOIL (REFUSAL DEPTH): 25.6'
DEPTH DRILLED IN ROCK: 0.0'
TOTAL DEPTH OF WELL: 25.6'

DRILLING FLUID SAMPLES:
TYPE: NA DATE: NA
NA NA

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
0.0	1.5			Gravel (fill material) no split spoon taken,
				material was removed by hand and auger
1.5	2.5		75%	Clay, silty, grayish-orange, with roots and
				gravels, wet
2.5	3.5			Clay, light brown, firm, wet
3.5	4.0		60%	Clay, light brown, soft, wet (fall in from
				previous split spoon)
4.0	4.5	1073S01		Clay, mottled, dark yellowish-orange and light
		@ 4.0-5.0'		brown, moist
4.5	5.0			Highly weathered shale, dusky brown and light
				olive gray, with some dark yellowish-orange
				clay, damp
	5.0			Split spoon refusal, auger to 5.5'
5.5	6.0		30%	Shale, highly weathered, light olive gray and
				dusky brown, with some clay, light brown, firm
				damp. Also contains some weathered sandstone,
				ironstained dark yellowish-orange fine grained
	6.0			Split spoon refusal, auger to 6.5'
6.5	7.5		10%	Shale, highly weathered (rotten shale) dusky
				brown and light brown, moist

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1073

ORNL MONITORING WELL LOG

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
	7.5			Split spoon refusal, auger to 12.0
7.5	12.0			Shale, highly weathered, dusky brown and light
				brown, moist, hard drilling
12.0	13.0		50%	Shale, highly weathered, reddish-brown, very
				brittle, contains thin greenish-gray micaceous
				silt lenses and some sand, dark yellowish-
				orange, fine grained, dry
	13.0			Split spoon refusal, auger to 25.6', or TD
13.0	19.0			Shale, highly weathered, reddish-brown, very
				brittle, with greenish-gray mica and sand,
				dark yellowish-orange, fine grained, damp
19.0	25.6	1073S02		Shale, medium dark gray with a bluish green
		@ 22.0-25.6'		tint, micaceous, larger fragments, brittle,
				damp
	25.6			Total Depth

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1073

WELL INSTALLATION/COMPLETION FORM

O.R.N.L. MONITORING WELL PROGRAM

LOGGED BY: C. Allison Hodges

PROOFED BY: Michael L. Ebers

DRILLING COMPANY: Geotek

DRILLER: Rick Herron

HELPER: George Akins

EQUIPMENT ☐ 6.0 INCH AUGER 25.6 L.F.

☐ _____ INCH AUGER _____ L.F.

LOCATION WAG 7

ORNL GRID COORDINATES

N 19270.6148

E 26177.2404

ELEV. GROUND 833.82

ELEV. TOP STAINLESS STEEL CASING 835.88

DRILLING DATES:

STARTED: 7/5/89

FINISHED: 7/6/89

MATERIALS USED

EST. VOL.	USED VOL.	
	10.0	FEET OF 2 IN. S.S. SCREEN
	17.66	FEET OF 2 IN. S.S. CASING
2.2	3.5	SACKS OF SAND
40	50	POUNDS OF BENTONITE PELLETS
1.2	1.6	SACKS OF CEMENT
	8	POUNDS OF POWDERED BENTONITE
	11	GALLONS OF WATER (CEMENTING)

REASON FOR DIFFERENCES BETWEEN ESTIMATED VOLUMES AND USED VOLUMES

Diameter of borehole increased because of irregular augering

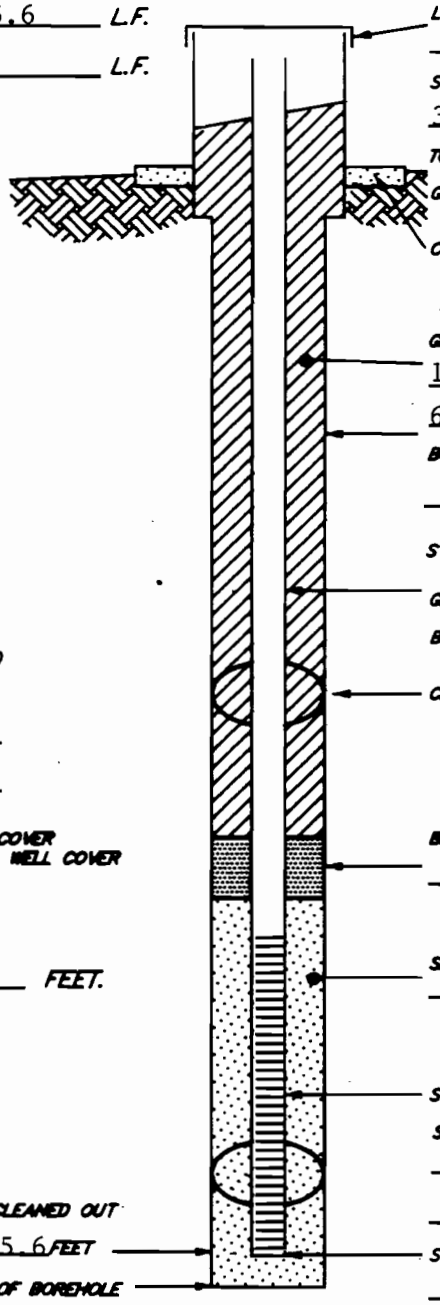
WELL COVER USED ☒ LOCKING STEEL COVER ☐ FLUSH MOUNTED WELL COVER ☐ OTHER

SILT TRAP USED YES ☐ NO ☒

MONITORING WELL PUMP BASE SET AT 23.5 FEET.

CENTRALIZERS AT 10.6 FEET.
25.6 FEET.
_____ FEET.

NOTE:
ALL DEPTHS ARE MEASURED FROM GROUND SURFACE UNLESS OTHERWISE NOTED:



LOCKING STEEL COVER 8 INCH DIAMETER STEEL PROTECTIVE CASING 3.07 FT. ABOVE GROUND TO 2.0 FT. BELOW GROUND SURFACE

CONCRETE PAD

GROUT SEAL 0.0 TO 11.1 FEET

6.0 INCH DIAMETER BOREHOLE

2 INCH DIAMETER STAINLESS STEEL CASING 2.06 FT. ABOVE GROUND SURFACE TO 15.6 FT. BELOW GROUND SURFACE

CENTRALIZER (TYP.)

BENTONITE PELLET SEAL 11.1 TO 13.9 FEET

SAND PACK 13.9 TO 25.6 FEET

2 INCH DIAMETER STAINLESS STEEL 0.010 SLOTTED SCREEN 15.6 TO 25.6 FEET

NA INCH DIAMETER STAINLESS STEEL SILT TRAP/CAP NA TO NA FEET

HOLE CLEANED OUT TO 25.6 FEET

BOTTOM OF BOREHOLE 25.6 FEET

TYPE A WELL

NOT TO SCALE

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1073

DATE: 7/6/89

MONITORING WELL MATERIALS CERTIFICATION

ITEM/MATERIAL		DATE USED	BATCH NUMBER
SAND		7/6/89	01
BENTONITE		7/6/89	01
STAINLESS STEEL SCREEN	(PREPACKAGED ☐ YES ☐ NO)	7/6/89	01
STAINLESS STEEL CASING	(PREPACKAGED ☐ YES ☐ NO)	7/6/89	01
STAINLESS STEEL CENTRALIZERS	(PREPACKAGED ☐ YES ☐ NO)	7/6/89	01
STAINLESS STEEL CAPS	(PREPACKAGED ☐ YES ☐ NO)	7/6/89	01
MONITORING WELL PUMP	(PREPACKAGED ☐ YES ☐ NO)	2/12/90	4
GROUT		7/6/89	01
WELL COVERS		7/6/89	01
SURFACE CASING		7/7/89	01

COMMENTS:

OBSERVER SIGNATURE/DATE C. Allison Hodges 7/7/89

C. Allison Hodges

ERC / EDGE
Environmental and Energy Services Co.

WELL No. 1073

POST-WELL COMPLETION CHECKLIST

POST-WELL COMPLETION TASKS	COMPLIANCE DATE	COMPLIANCE INITIALS
1. MUD SCRAPED FROM AUGERS, SAMPLERS, AND ALL OTHER EQUIPMENT.	7/6/89	CAH
2. ALL MUD FROM RIG AND EQUIPMENT SCRAPINGS AND CUTTINGS DISPOSED OF IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED.	7/6/89	CAH
3. WELL DEVELOPED IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED AND DETAILS OF THE DEVELOPMENT ACTIVITY RECORDED.	2/12/90	DCL
4. DRILLING SITE PROPERLY CLEANED UP AFTER COMPLETION OF WELL INSTALLATION.	7/6/89	CAH

* RELEASE SPECIFIC TECHNICAL DIRECTIONS FOR REGULATORY COMPLIANCE MONITORING WELLS PHASE I, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, W.O. K-4147, APRIL 1987.

OBSERVER SIGNATURE/DATE C. Allison Hodges 7/6/89
C. Allison Hodges

D. Charles Lytle 2/12/90
D. Charles Lytle

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1073

LOCATION: WAG7

MONITORING WELL DEVELOPMENT FORM

DEVELOPMENT DETAILS

METHOD OF DEVELOPMENT: Surging and pumping

DEVELOPMENT BEGAN DATE: 1-26-90 TIME:

DEVELOPMENT ENDING DATE: 2-12-90

DEVELOPMENT OBSERVED BY: D. Charles Lytle

ONE WELL VOLUME: 8.0 GALLONS

TOTAL GALLONS PUMPED: 236 TOTAL WELL VOLUMES PUMPED: 30.0

INITIAL pH: 7.5 FINAL pH: 7.3

INITIAL CONDUCTIVITY (uS): 140 FINAL CONDUCTIVITY (uS): 503

DESCRIPTION OF INITIAL TURBIDITY: Very Muddy

DESCRIPTION OF FINAL TURBIDITY: Clear

FINAL MEASURED TURBIDITY: 3.0

WELL APPROVED BY: R.C. Williams MMES

ODOR OF WATER: None

WATER DISCHARGED TO:
- ☒ GROUND SURFACE
- ☐ STORM SEWERS
- ☐ DRUMS
- ☐ TANK TRUCK
- ☐ STORAGE TANKS
- ☐ OTHER

INITIAL PRE-DEVELOPMENT WATER DEPTH: 4.3 feet from ground surface

DEVELOPMENT OBSERVATIONS

OBSERVER SIGNATURE/DATE D. Charles Lytle 2-12-90

D. Charles Lytle

ERC / EDGE Environmental and Energy Services Co.

WELL NO. 1073
LOCATION: WAG 7
DATE: 1-26-90

MONITORING WELL DEVELOPMENT PROGRESS

ONE WELL VOLUME = 8.0 GALLONS

DATE	TIME	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	MEASURED TURBIDITY (NTU'S)	pH	CONDUCTIVITY (µS)	TOTAL GALLONS PUMPED	WELL VOLUMES PUMPED	COMMENTS
1-26-90									
1-30-90	1300	32	Very Muddy		7.5	140	32	4.0	
2-5-90	0915	36	Muddy		7.2	190	68	8.5	
2-8-90	0930	126	Cloudy		7.6	195	194	24.3	
2-12-90	1000	12	Cloudy		7.4	112	206	25.8	
2-12-90	1100	12	Cloudy				218	27.3	
2-12-90	1300	6	Clear		7.2	354	224	28.0	
2-12-90	1600	12	Clear	3.0	7.3	503	236	30.0	
RESULTS AT END OF DEVELOPMENT			Clear	3.0	7.3	503	236	30.0	

COMMENTS Very poor producer was able to pump 10 to 12 gallons at a time every couple of hours. Cleared up passed and moved off hole

OBSERVER SIGNATURE/DATE D. Charles Lytle 2/12/90
D. Charles Lytle

MWFORM05.DWG

HYDRAULIC CONDUCTIVITY CALCULATIONS

PROGRAM SLUGT, VERSION 4.1, NOV. 1986

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:

(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3, NO.1 OF WRR ENTITLED "RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER")

(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED "A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS")

WELL NO.: 1073 DATE OF TEST: 3/09/90

PROJECT NO.: E221-002 CLIENT: MMES

SITE LOCATION: WAG 7

EDGE, INC. FIELD INVESTIGATOR: BRUCE MCMASTER

INPUT DATA ARE:

INNER CASING DIAMETER = 2.00 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 2.00 INCHES
DIAMETER OF DRILLED HOLE = 6.75 INCHES
LENGTH OF SCREEN OR INTAKE PORTION = 10.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 12.70 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 10.00 FEET
DEPTH TO STATIC WATER LEVEL BELOW REF. POINT = 1.00 FEET
ESTIMATED POROSITY OF GRAVEL PACK = .20
FALLING-HEAD INDEX = 1 ("1" IF FALLING,"0" IF RISING)
NUMBER OF DEPTH-TIME DATA POINTS = 32

HO WAS COMPUTED FROM INTERCEPT OF PLOT OF LOG(H) VS. TIME

SUCCESSIVE COMPUTED VALUES FOR HO (FEET)
7.1253
7.1480

HYDRAULIC CONDUCTIVITY CALCULATIONS

TIME (SEC)	DEPTH TO WATER (FEET)	HEAD (FEET)
10.00	8.680	7.680
20.00	8.490	7.490
30.00	8.410	7.410
40.00	8.350	7.350
50.00	8.290	7.290
60.00	8.240	7.240
75.00	8.160	7.160
90.00	8.080	7.080
105.00	8.020	7.020
120.00	7.950	6.950
150.00	7.830	6.830
180.00	7.710	6.710
240.00	7.480	6.480
300.00	7.300	6.300
360.00	7.140	6.140
420.00	7.000	6.000
480.00	6.870	5.870
540.00	6.750	5.750
600.00	6.630	5.630
720.00	6.430	5.430
840.00	6.240	5.240
960.00	6.080	5.080
1080.00	5.930	4.930
1200.00	5.790	4.790
1320.00	5.660	4.660
1440.00	5.540	4.540
1560.00	5.430	4.430
1680.00	5.320	4.320
1800.00	5.220	4.220
1920.00	5.140	4.140
2040.00	5.050	4.050
2160.00	4.980	3.980

****

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

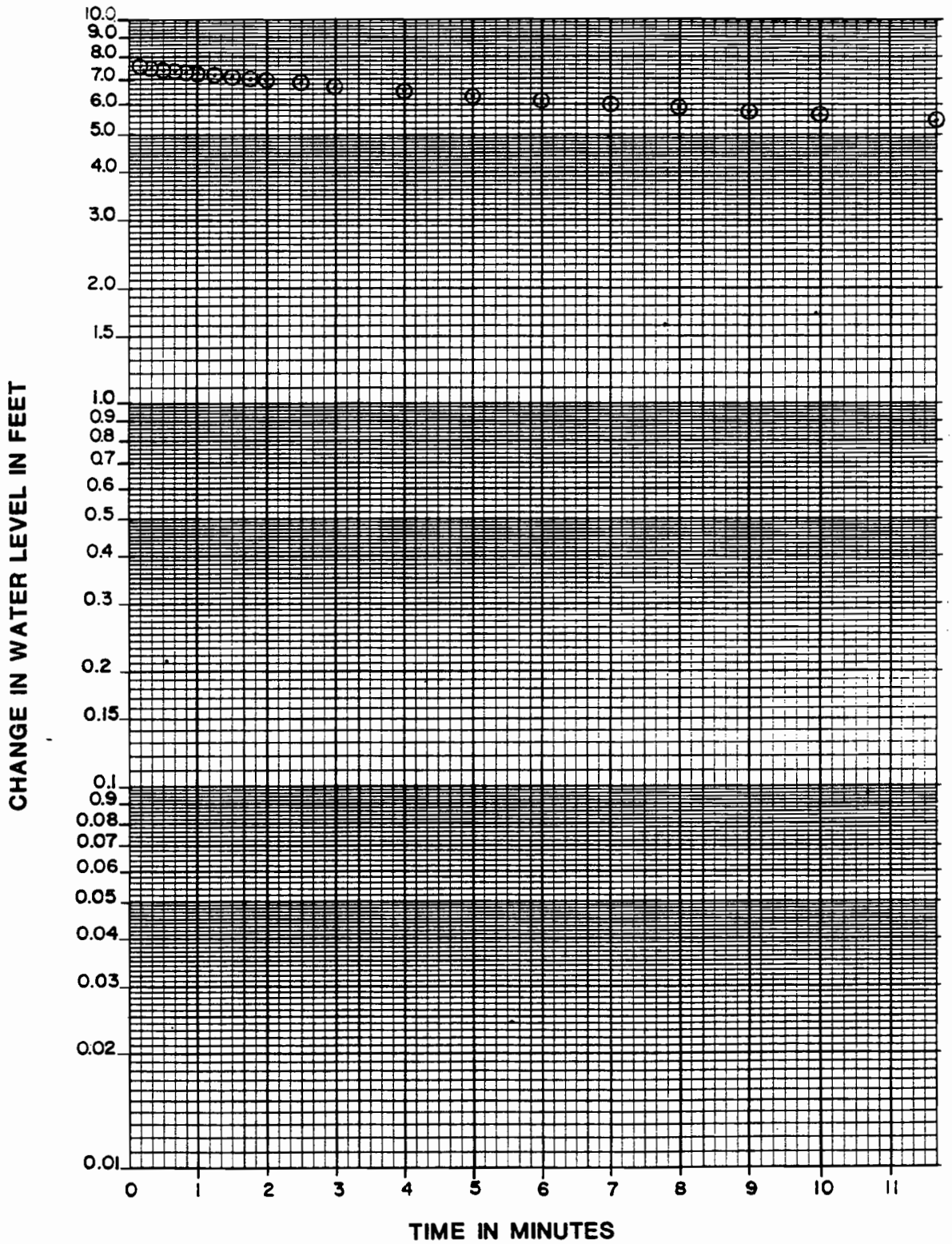
PERMEABILITY = 3.06E-07 FT/SEC = 9.32E-06 CM/SEC

TRANSMISSIVITY = 3.06E-06 FT**2/SEC

ERC / EDGE
Environmental and Energy Services Co.

WELL No. 1073

HYDRAULIC CONDUCTIVITY CALCULATIONS



EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 1073S01

WELL NO.	LOCATION:	TYPE:
1073	WAG 7	SOIL

SAMPLER:	SAMPLE INTERVAL:	DATE:	TIME:
C. Allison Hodges (SIGNATURE)	4.0-5.0'	07-05-89	1105

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECEIVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
C. Allison Hodges	07-11-89	0838	EDGE	RE Owen	7-11-89	8:38	ORNL

TYPE OF SAMPLE: ☑ SPLIT SPOON CORES–SOIL ☐ AUGER CUTTINGS–SOIL ☐ AUGER CUTTINGS–ROCK
☐ AIR ROTARY CUTTINGS–ROCK ☐ DRILL WATER (NO AIR IN SAMPLE) ☐ OTHER _____

ALL SAMPLES ARE IMMEDIATELY PLACED IN I-CHEM SPECIALTY CLEANED CONTAINERS AND SEALED.

REMARKS: _____

EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 1073302

WELL NO.	LOCATION:	TYPE:
1073	WAG-7	Soil / Rock

SAMPLER:	SAMPLE INTERVAL:	DATE:	TIME:
C. Allen Hodge (SIGNATURE)	22.0' to 25.0'	07-05-89	1156

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECEIVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
C. Allen Hodge	07-11-89	0839	EDGE	NE Owen	7-11-89	8:39	ORNL

TYPE OF SAMPLE: ☐ SPLIT SPOON CORES–SOIL ☑ AUGER CUTTINGS–SOIL ☐ AUGER CUTTINGS–ROCK
☐ AIR ROTARY CUTTINGS–ROCK ☐ DRILL WATER (NO AIR IN SAMPLE) ☐ OTHER _____

ALL SAMPLES ARE IMMEDIATELY PLACED IN I-CHEM SPECIALTY CLEANED CONTAINERS AND SEALED.

REMARKS: Auger cuttings are a highly weathered shale (rock) and clay

1.0 General Information

1.1 Well Location

Monitoring well number 1074 is located in WAG 7. It is located approximately 800' southwest of chemical waste pit #1 and approximately 600' northwest of abandoned waste pit #3. The location is shown on ORNL drawing number C3E20004 A075. Survey coordinates for this well are N 18128.056, E 25707.528 (X-10 grid) or latitude 35° 54' 34.44" and longitude 84° 19' 28.37". Coordinate data were provided by Martin Marietta Energy Systems. The method used for conversion from X-10 grid to Tennessee-Lambert State Plane Coordinates came from the publication "Tennessee Valley Authority Data Services Branch and Mapping Services Branch, Oak Ridge, Tennessee, DOE Plant Control, November 6, 1985, Field Book: ESS-3115, pp. 1-20." The latitude and longitude were calculated by Adams Craft Herz Walker Engineering, Inc., using methods from the U.S. Coast and Geodetic Survey Publication 62-4, "State Plane Coordinates by Automatic Data Processing."

1.2 Drilling Information

Well number 1074 was drilled by Geotek Engineering Company. A Mobile B-50 rig and an Ingersol Rand T-4 rig were used to drill this boring for monitor well installation under operation of Rick Herron

and Larry Ledbetter with the assistance of George Akins and Freddy Dixon. Drilling commenced on 6/30/89 and was finished on 8/10/89. Paragraph 2.4.1 includes a detailed discussion of the well installation and a well schematic is included on the well installation/ completion form. A synopsis of the drilling activity follows:*

6/30/89: The auger rig, sampling equipment and tools were deconed. The rig was mobilized to the site, plastic was layed down and the rig was set up. Split spoon samples were taken from .5 to 3.1 or refusal. A bulk density sample was taken from .75' to 1.25'. The length was 2 1/4", diameter 1 1/4 and weight of 101.0 grams. Two soil/rock samples were taken from the split spoons. A 6.0" boring was augered from the surface to 2.6' or refusal. By approval from R.C. Williams, the boring location was moved 5.0' behind the original location. Refusal was met at 2.5' where limestone was encountered. The boring location needs to be moved at least 20 or 30' to the right (the main road direction). Approval needs to be given by Steve Laman, Jill Greene and Bill McMaster.

* This information was typed directly from field notes and was edited only when necessary for clarification.

7/6/89: Well location has been moved. The auger rig, sampling equipment and tools were deconed. The rig was mobilized to the site and set up. A 6" boring was augered to 4.0'. No refusal was met and the decision was made to split spoon and auger to refusal in case there was a possibility of completing the well to total depth. However, split spoon and auger refusal were encountered at 7.1'. A 22.0" boring was then augered to 4.0' and a 15 1/4" diverter casing was installed and grouted.

8/9/89: The T-4 and drilling equipment were deconed and mobilized to the site. The T-4 was set up and a containment box hooked up. The boring was drilled with an 8.0" tricone bit to 27.5'. After 1 hour recharge time the water level was only at 23.5'. Recharge was continued another hour, after which time the water level was at 23.3'. R.C. Williams agrees with ERC to drill to 30.0'. The boring depth was increased to 30.0' and allowed to recharge 20 minutes. The water level then was at 22.2'. Based on information from well 1075, the water level is expected to rise. The boring is considered to be a slow "recharger". An air and water sample were taken at 30.0'. The boring was cleaned and the rods removed. The well will be set at

this depth. Fifteen feet of two-inch stainless steel screen and 20.0' of casing were installed to a TD of 30.0'. Centralizers were placed at 30.0', 15.0', and 5.0'. 5.5 bags of sand were tremied in using water to a depth of 13.65'. A 50 lb bucket of bentonite was poured into the annulus to a depth of 11.55'. The air sample was tested under an ultra violet light and no detectable hydrocarbons were found.

8/10/89: The annulus was grouted with 4 bags of cement and 20 lbs of bentonite to within 2.0' of the surface casing. James Lamb of ERC documented the grouting.

8/30/89: The casing was filed to remove the rough edges Geotek and CAH were on site.

9/5/89: The casing was tested with the "Go-NoGo gauge". It was passed by R.C. Williams.

This well was logged by ERC Environmental and Energy Services Co., Inc., hydrogeologist C. Allison Hodges. All well construction materials and supplies were from Martin Marietta Energy Systems approved batches. The batch origin of individual items is shown on the included Monitoring Well Materials Certification form.

2.0 Technical Information

2.1 Decontamination Procedures

The drilling rig, down hole tools, surface casing, stainless steel screen, stainless steel casing, centralizers, and stainless steel silt trap underwent the cleaning decontamination procedures outlined in the drilling specifications (Release Specific Technical Directions for Regulatory Compliance Monitoring Wells Phase 1, Oak Ridge National Laboratory, Oak Ridge, W.O., K-4147, April 1987, pgs, 2-4). A checklist of the cleaned materials is included with this data package.

2.2 Geology

WAG 7 is located in Melton Valley which is in the Valley and Ridge Physiographic Province of East Tennessee. WAG 7 is underlain by shale, siltstone, and limestone of the Conasauga Group. The Conasauga Group in the Oak Ridge area consists of six formations. They are, in ascending order, the Pumpkin Valley Shale, Rutledge Limestone, Rogersville Shale, Maryville Limestone, Nolichucky Shale and the Maynardville Limestone. These rocks have undergone extensive deformation and contain many folds and faults resulting in varying strike and dips. The average strike and dip appears to be consistent with the regional strike of 56° northeast and dips of about 30° to the southeast.

2.3 Sample Collection

Three samples were collected during drilling, placed in I-CHEM specialty cleaned glass containers, sealed and submitted to Sample Receiving, Analytical Chemistry Division, Bldg. 4500S, ORNL. Chain of custody forms for these samples are included with this data package. Soil sample 1074S01 was collected in the split spoon interval from 1.0' to 1.5' on 6/30/89 and soil sample 1074S02 was collected in the augered interval from 2.5' to 3.0' on 6/30/89. A drill water sample 1074W01 was collected from the water pump on the drill rig on 8/9/89. Analytical results for the split spoon and drill water samples described above can be obtained from the Remedial Action Program data base at ORNL.

A bulk density soil sample was collected from the split spoon sample interval from .75' to 1.0'. The sample was measured, and weighed, and a bulk density of 2.42 grams/cm^3 was calculated.

2.4 Installation and Development

2.4.1 Installation

This was a type D well. A six-inch diameter boring was split spooned and augered from ground surface to auger refusal (7.1 feet). The air rotary method was required to complete the boring

to the specified total well depth. A twenty two-inch diameter boring was augered from ground surface to 4.0 feet and a fifteen-inch diverter casing was installed and grouted. An eight-inch diameter boring was then drilled with an air rotary tricone roller bit from 7.1 to 30.0 feet. A two-inch diameter stainless steel screen with welded bottom cap was installed from 15.0 to 30.0 feet. A two-inch diameter stainless steel casing was installed above the screen at 15.0 feet and extended 2.20 feet above ground surface. A sandpack was then tremied into the annular space from 13.65 to 30.0 feet, with a 2.1-foot bentonite pellet seal poured into the annular space above the sandpack from 11.55 to 13.65 feet. The annular space from the top of the bentonite seal to the surface was tremie-grouted with a cement/bentonite slurry. A detail of the well is included on the well installation/completion form.

2.4.2 Well Development

Well number 1074 was developed to remove drill cuttings, silt, and other fines from the monitoring well. The monitoring well was developed using a Geoguard pump with an air compressor. All pumps were cleaned prior to use according to specified cleaning procedures (see Paragraph 2.1). The well was developed until a measured total of 328 gallons of water had been evacuated and the clarity of the discharge water

was approved by the company representative. The final turbidity value measured by completions was 70 NTU's. A development form showing the exact method of development and other pertinent data is appended.

2.4.3 Installation of Dedicated Monitoring Well Pump

After the well was developed, a Geoguard Model No. 5614 dedicated monitoring well pump was installed on 2/8/90 at a depth of 28.7 feet below ground surface. These pumps are decontaminated at American Sigma and are sent prepackaged. A copy of the pump certification is kept on file at ORNL.

2.5 Hydraulic Conductivity Testing

Well number 1074 was tested for the determination of hydraulic conductivity of the aquifer in the vicinity of the well screen. This was accomplished by instantaneously adding a known quantity of water to the monitoring well and measuring the recovery of the water level over time. The changing water levels were measured using a Druck 15 psig pressure transducer and an Omnidata Datapod II data recorder. The hydraulic conductivity value of 1.59×10^{-6} cm/second (shown

as permeability on the hydraulic conductivity calculations) was calculated using the Bouwer and Rice method. A computer printout of the hydraulic conductivity calculations is included in this data package.

ERC / EDGE
Environmental and Energy Services Co.

WELL No. 1074

PRE-DRILLING CHECKLIST FOR MONITORING WELLS

PRE-DRILLING TASKS		COMPLIANCE DATE	COMPLIANCE INITIALS
1.	EXCAVATION PERMIT OBTAINED.	6-30-89	CAH
2.	ALL EQUIPMENT HAS BEEN CLEANED BEFORE DRILLING.	6-30-89	CAH
3a.	SCREEN AND CASINGS HAVE BEEN WASHED, STEAMED, RINSED WITH DE-IONIZED OR DISTILLED WATER, RINSED WITH ISOPROPYL ALCOHOL, WRAPPED WITH PROTECTIVE COVERING AND STORED OFF THE GROUND.	N/A	
3b.	PRE-PACKAGED SCREENS, CASINGS AND CENTRALIZERS WERE USED.	8-09-89	CAH
4.	WORK AREA FOR SAMPLE EXAMINATION COVERED WITH CLEAN POLYETHYLENE.	6-30-89	CAH
5.	CLEAN KNIVES, GLOVES, SAMPLE JARS AND LABELS ON-HAND.	6-30-89	CAH
6.	POLYETHYLENE COVER IN PLACE OVER HOLE.	6-30-89	CAH

ADDITIONAL NOTES/OBSERVATIONS:

OBSERVER SIGNATURE/DATE C. Allison Hodges 8-09-89
C. Allison Hodges

ERC / EDGE
Environmental and Energy Services Co.

WELL No. 1074

DECONTAMINATION CHECKLIST
DRILLING EQUIPMENT

EQUIPMENT	SCRAPE	STEAM CLEAN	STEAM RINSE	ISOPROPYL ALCOHOL RINSE	DEIONIZED WATER RINSE
RIG	X	X	X	N/A	N/A
AUGERS	X	X	X	X	X
BITS	X	X	X	X	X
RODS	X	X	X	X	X
SAMPLERS	X	X	X	X	X
PIPES	X	X	X	X	X
WORK TOOLS	X	X	X	X	X
AUGER PINS	X	X	X	X	X

OBSERVER SIGNATURE/DATE C. Allison Hodges 6-30-89
C. Allison Hodges

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1074

ORNL MONITORING WELL LOG

LOCATION: WAG 7
DRILLER: Rick Herron/Larry Ledbetter
HELPER: George Akin/Freddy Dixon
DRILL: Mobil B-50, Ingersol Rand T-4

DATE: START: 06-30-89
FINISH: 08-10-89
LOGGED BY: C. Allison Hodges
HEALTH PHYSICIST: W. H. Shinpaugh

TYPE DRILLING: Split Spoon, Auger, Air Rotary
LUBRICANT TYPE: Green Stuff
No. SAMPLES TAKEN: Two
TYPE: Soil/Rock
CONTAINMENT TYPE: Plastic, pan, containment box

THICKNESS OF SOIL (REFUSAL DEPTH): 7.1
DEPTH DRILLED IN ROCK: 22.9
TOTAL DEPTH OF WELL: 30.0

DRILLING FLUID SAMPLES:
TYPE: Water
DATE: 08-09-89

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
0.0	.5			Gravel (fill material).
.5	1.5	1074-S01 1.0-1.5'	100%	Clay, shaley, dark yellowish orange and light
				olive brown, shale is dusky yellowish brown
				and brittle.
1.5	2.5			Shale, olive gray, very brittle, moist.
2.5	3.1	1074-S02 2.5-3.0	10%	Shale, olive gray and brownish black, hard and
				brittle.
*	3.1			Split spoon refusal, limestone, fine grained.
3.1	4.0			Clay, silty, light brown, with shale, dusky
				brown. Augered interval.
4.0	6.0		70%	Clay, silty, light olive brown, with shale,
				dusky brown.
6.0	7.1		30%	Clay, silty and micaceous, light olive brown,
				with shale, dusky brown.
*	7.1			Split spoon and auger refusal.

*NOTE: Two seperate locations were split spooned and augered. The first boring was split spooned and augered to 3.1' or refusal depth. The second boring was augered to 4.0' and then split spooned and augered to 7.1' or refusal. The well was set at the second location.

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1074

ORNL MONITORING WELL LOG

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
7.1	10.5			*Smooth, even, fast drilling.
10.5	12.0			Hard uneven drilling, slow drilling @ 11.5 - bit
				locked up.
12.0	14.5			Smooth, regular, fast drilling.
14.5	21.0			Hard, irregular, slow drilling @ 20.5 - bit
				locked up.
21.0	22.5			Smooth, even drilling.
22.5	27.5			Hard, uneven drilling.
27.5	30.0			Hard, uneven drilling.
	30.0			Total Depth
				*No detailed lithologic log could be provided
				from 7.1 to 30.0' due to total containment.

EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL No. 1074

WELL INSTALLATION/COMPLETION FORM

O.R.N.L. MONITORING WELL PROGRAM

LOGGED BY: C. A. Hodges
PROOFED BY: Michael L. Ebers

DRILLING COMPANY: Geotek
DRILLER: Rick Herron / Larry Ledbetter
HELPER: George Akin / Freddy Dixon

LOCATION WAG 7
ORNL GRID COORDINATES
N 18,128,056
E 25,707,528
ELEV. GROUND 769.75
ELEV. TOP STAINLESS STEEL CASING 771.95

DRILLING DATES:
STARTED: 6-30-89
FINISHED: 8-10-89

EQUIPMENT
- ☒ 6.0 INCH AUGER 3.1 L.F.
- ☒ 22.0 INCH AUGER 4.0 L.F.
- ☒ 8.0 INCH ROTARY 22.9 L.F.

MATERIALS USED

EST. VOL.	USED VOL.	
	15.0	FEET OF 2.0 IN. S.S. SCREEN
	17.2	FEET OF 2.0 IN. S.S. CASING
3.8	5.5	SACKS OF SAND
50	500	POUNDS OF BENTONITE PELLETS
3.0	4.0	SACKS OF CEMENT
	20.0	POUNDS OF POWDERED BENTONITE
	30.0	GALLONS OF WATER (CEMENTING)

REASON FOR DIFFERENCES BETWEEN ESTIMATED VOLUMES AND USED VOLUMES
Wash out zones, irregular boring diameter.

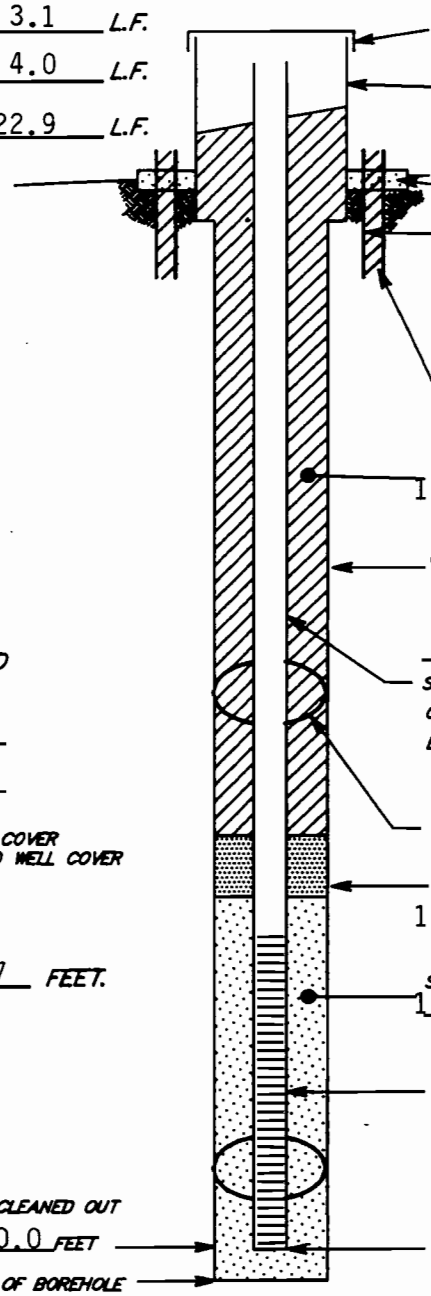
WELL COVER USED
- ☒ LOCKING STEEL COVER
- ☐ FLUSH MOUNTED WELL COVER
- ☐ OTHER

SILT TRAP USED YES ☐ NO ☒

MONITORING WELL PUMP BASE SET AT 28.7 FEET.

CENTRALIZERS AT 5.0 FEET.
15.0 FEET.
30.0 FEET.

NOTE:
ALL DEPTHS ARE MEASURED FROM GROUND SURFACE UNLESS OTHERWISE NOTED:



LOCKING STEEL COVER
8 INCH DIAMETER STEEL PROTECTIVE CASING 3.18 FT. ABOVE GROUND TO 2.0 FT. BELOW GROUND SURFACE
CONCRETE PAD
15 1/4 INCH DIVERTER CASING 0.0 FT. ABOVE GROUND SURFACE TO 4.0 FT. BELOW GROUND SURFACE
22 INCH BOREHOLE 0.0 TO 4.0 FEET
GROUT SEAL 0.0 TO 11.55 FEET
8.0 INCH DIAMETER BOREHOLE
2.0 INCH DIAMETER STAINLESS STEEL CASING 2.20 FT. ABOVE GROUND SURFACE TO 15.0 FT. BELOW GROUND SURFACE
CENTRALIZER (TYP.)
BENTONITE PELLET SEAL 11.55 TO 13.65 FEET
SAND PACK 13.65 TO 30.0 FEET
2.0 INCH DIAMETER STAINLESS STEEL 0.010 SLOTTED SCREEN 15.0 TO 30.0 FEET
N/A INCH DIAMETER STAINLESS STEEL SILT TRAP/CAP N/A TO N/A FEET
HOLE CLEANED OUT TO 30.0 FEET
BOTTOM OF BOREHOLE 30.0 FEET

TYPE D WELL

NOT TO SCALE

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1074

DATE: 8-09-89

MONITORING WELL MATERIALS CERTIFICATION

ITEM/MATERIAL		DATE USED	BATCH NUMBER
SAND		8-09-89	1
BENTONITE		8-09-89	1
STAINLESS STEEL SCREEN	(PREPACKAGED ■ YES ☐ NO)	8-09-89	1
STAINLESS STEEL CASING	(PREPACKAGED ■ YES ☐ NO)	8-09-89	1
STAINLESS STEEL CENTRALIZERS	(PREPACKAGED ■ YES ☐ NO)	8-09-89	1
STAINLESS STEEL CAPS	(PREPACKAGED ■ YES ☐ NO)	8-09-89	1
MONITORING WELL PUMP	(PREPACKAGED ■ YES ☐ NO)	2-08-90	4
GROUT		8-10-89	1
WELL COVERS		8-09-89	1
SURFACE CASING			

COMMENTS:

OBSERVER SIGNATURE/DATE C. Allison Hodges 8-10-89

C. Allison Hodges

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1074

POST-WELL COMPLETION CHECKLIST

POST-WELL COMPLETION TASKS	COMPLIANCE DATE	COMPLIANCE INITIALS
1. MUD SCRAPED FROM AUGERS, SAMPLERS, AND ALL OTHER EQUIPMENT.	8-09-89	CAH
2. ALL MUD FROM RIG AND EQUIPMENT SCRAPINGS AND CUTTINGS DISPOSED OF IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED.	8-09-89	CAH
3. WELL DEVELOPED IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED AND DETAILS OF THE DEVELOPMENT ACTIVITY RECORDED.	2-08-90	DCL
4. DRILLING SITE PROPERLY CLEANED UP AFTER COMPLETION OF WELL INSTALLATION.	8-09-89	CAH

* RELEASE SPECIFIC TECHNICAL DIRECTIONS FOR REGULATORY COMPLIANCE MONITORING WELLS PHASE I, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, W.O. K-4147, APRIL 1987.

OBSERVER SIGNATURE/DATE C. Allison Hodges 8-09-89
C. Allison Hodges

D. Charles Lytle 2-08-90
D. Charles Lytle

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1074

LOCATION: WAG 7

MONITORING WELL DEVELOPMENT FORM

DEVELOPMENT DETAILS

METHOD OF DEVELOPMENT: Surging and Pumping

DEVELOPMENT BEGAN DATE: 2-06-90 TIME:

DEVELOPMENT ENDING DATE: 2-08-90

DEVELOPMENT OBSERVED BY: D. Charles Lytle

ONE WELL VOLUME: 10.8 GALLONS

TOTAL GALLONS PUMPED: 328 TOTAL WELL VOLUMES PUMPED: 30.4

INITIAL pH: 8.2 FINAL pH: 7.3

INITIAL CONDUCTIVITY (uS): 047 FINAL CONDUCTIVITY (uS): 935

DESCRIPTION OF INITIAL TURBIDITY: Milky

DESCRIPTION OF FINAL TURBIDITY: Cloudy

FINAL MEASURED TURBIDITY: 70 NTU's

WELL APPROVED BY: R. C. Williams MMES

ODOR OF WATER: None

WATER DISCHARGED TO:
- ☒ GROUND SURFACE
- ☐ STORM SEWERS
- ☐ DRUMS
- ☐ TANK TRUCK
- ☐ STORAGE TANKS
- ☐ OTHER

INITIAL PRE-DEVELOPMENT WATER DEPTH: 2.8 feet from ground surface.

DEVELOPMENT OBSERVATIONS

OBSERVER SIGNATURE/DATE D. Charles Lytle 2-08-90

D. Charles Lytle

ERC / EDGE Environmental and Energy Services Co.

WELL NO. 1074
LOCATION: WAG 7
DATE: 2-06-90

MONITORING WELL DEVELOPMENT PROGRESS

ONE WELL VOLUME = 10.8 GALLONS

DATE	TIME	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	MEASURED TURBIDITY (NTU'S)	pH	CONDUCTIVITY (µS)	TOTAL GALLONS PUMPED	WELL VOLUMES PUMPED	COMMENTS
2-06-90	1400	50	Milky	--	8.2	047	50	4.6	
2-06-90	1530	88	Milky	--	8.1	969	138	12.7	
2-06-90	1700	30	Milky	--	7.5	966	168	15.5	
2-08-90	0930	92	Milky	--	7.6	930	260	24.1	
2-08-90	1130	30	Cloudy	--	7.4	924	290	26.9	
2-08-90	1330	38	Cloudy	70	7.3	935	328	30.4	
RESULTS AT END OF DEVELOPMENT			Cloudy	70	7.3	935	328	30.4	

COMMENTS Water was coming out pretty dirty, had to pump and surge again and use a filteration system, water cleaned up somewhat but remains cloudy. With 30.4 well volumes had to pass and move off hole.

OBSERVER SIGNATURE/DATE D Charles Lytle 2-08-90
D. Charles Lytle

MWFORM05.DWG

HYDRAULIC CONDUCTIVITY CALCULATIONS

PROGRAM SLUGT, VERSION 4.1, NOV. 1986

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:

(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3, NO.1 OF WRR ENTITLED "RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER")

(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED "A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS")

WELL NO.: 1074 DATE OF TEST: 2/28/90

PROJECT NO.: E221-002 CLIENT: MMES

SITE LOCATION: WAG 7

EDGE, INC. FIELD INVESTIGATOR: BRUCE MCMASTER

INPUT DATA ARE:

INNER CASING DIAMETER = 2.00 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 2.00 INCHES
DIAMETER OF DRILLED HOLE = 8.00 INCHES
LENGTH OF SCREEN OR INTAKE PORTION = 15.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 22.40 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 15.00 FEET
DEPTH TO STATIC WATER LEVEL BELOW REF. POINT = 1.00 FEET
ESTIMATED POROSITY OF GRAVEL PACK = .20
FALLING-HEAD INDEX = 1 ("1" IF FALLING,"0" IF RISING)
NUMBER OF DEPTH-TIME DATA POINTS = 32

HO WAS COMPUTED FROM INTERCEPT OF PLOT OF LOG(H) VS. TIME

SUCCESSIVE COMPUTED VALUES FOR HO (FEET)
3.4739
3.4782

ERC / EDGE
Environmental and Energy Services Co.

WELL No. 1074

HYDRAULIC CONDUCTIVITY CALCULATIONS

TIME (SEC)	DEPTH TO WATER (FEET)	HEAD (FEET)
10.00	4.580	3.580
20.00	4.560	3.560
30.00	4.540	3.540
40.00	4.530	3.530
50.00	4.520	3.520
60.00	4.510	3.510
75.00	4.500	3.500
90.00	4.480	3.480
105.00	4.470	3.470
120.00	4.460	3.460
150.00	4.440	3.440
180.00	4.420	3.420
240.00	4.390	3.390
300.00	4.360	3.360
360.00	4.330	3.330
420.00	4.310	3.310
480.00	4.290	3.290
540.00	4.270	3.270
600.00	4.260	3.260
720.00	4.230	3.230
840.00	4.210	3.210
960.00	4.190	3.190
1080.00	4.180	3.180
1200.00	4.160	3.160
1320.00	4.140	3.140
1440.00	4.130	3.130
1560.00	4.120	3.120
1680.00	4.110	3.110
1800.00	4.100	3.100
1920.00	4.090	3.090
2040.00	4.090	3.090
2160.00	4.080	3.080

****

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

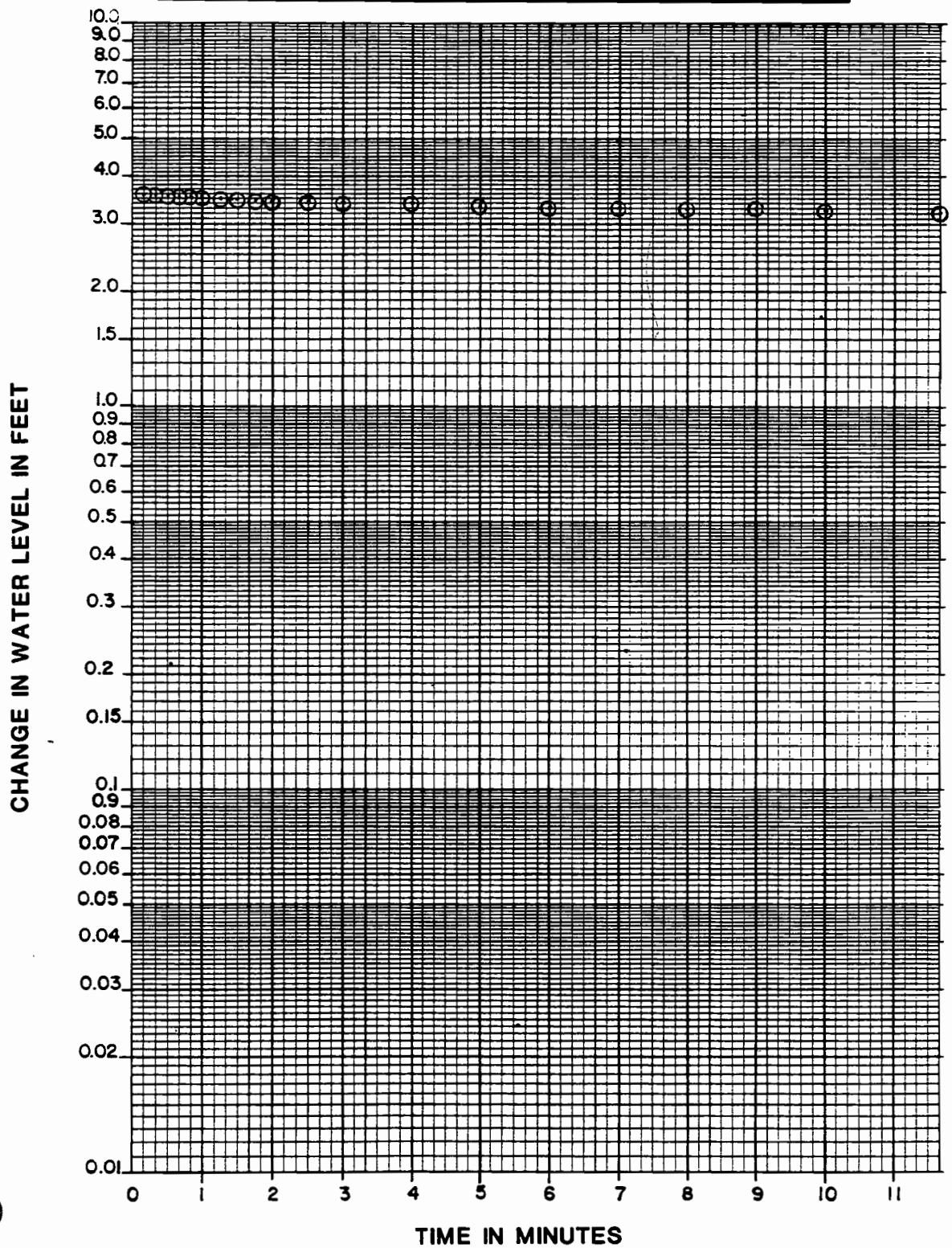
PERMEABILITY = 5.22E-08 FT/SEC = 1.59E-06 CM/SEC

TRANSMISSIVITY = 7.83E-07 FT**2/SEC

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1074

HYDRAULIC CONDUCTIVITY CALCULATIONS



EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 1074 S01

WELL NO.	LOCATION:	TYPE:
1074	WAG-7	Soil / Rock

SAMPLER:	SAMPLE INTERVAL:	DATE:	TIME:
L. Allison Hodges (SIGNATURE)	1.0 - 1.5'	06-30-89	1000

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECEIVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
L. Allison Hodges	07-05-89	1350	EDGE	Christopher M. Kelley	7/5/89	2:05	EDGe
Christopher M. Kelley	7/5/89	2:28	EDGe	M. Ferguson	7/5/89	2:28	

TYPE OF SAMPLE: ☐ SPLIT SPOON CORES–SOIL ☐ AUGER CUTTINGS–SOIL ☐ AUGER CUTTINGS–ROCK
☐ AIR ROTARY CUTTINGS–ROCK ☐ DRILL WATER (NO AIR IN SAMPLE) ☑ OTHER Split Spoon Soil / Rock

ALL SAMPLES ARE IMMEDIATELY PLACED IN I-CHEM SPECIALTY CLEANED CONTAINERS AND SEALED.

REMARKS:

EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 1074 S02

WELL NO.	LOCATION:	TYPE:
1074	WAG-7	Soil / Rock

SAMPLER:	SAMPLE INTERVAL:	DATE:	TIME:
C. Allison Hodgson (SIGNATURE)	2.5-3.0	06-30-89	1005

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECEIVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
C. Allison Hodgson	07-05-89	1350	EDGe	Christopher M. Waller	7/5/89	2:05	EDGe
Christopher M. Waller	7/5/89	2:28	EDGe	M. Ferguson	7/5/89	2:28	

TYPE OF SAMPLE: ☐ SPLIT SPOON CORES–SOIL ☐ AUGER CUTTINGS–SOIL ☐ AUGER CUTTINGS–ROCK
☐ AIR ROTARY CUTTINGS–ROCK ☐ DRILL WATER (NO AIR IN SAMPLE) ☒ OTHER Split Spoon Soil / Rock

ALL SAMPLES ARE IMMEDIATELY PLACED IN I-CHEM SPECIALTY CLEANED CONTAINERS AND SEALED.

REMARKS:

EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 1074-W01

WELL NO.	LOCATION:	TYPE:
1074	WAG-7	Water

SAMPLER:	SAMPLE INTERVAL:	DATE:	TIME:
C. Allison Hodges (SIGNATURE)		08-09-89	1208

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECEIVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
C. Allison Hodges	8-15-89	8:37	EDGE	J.C. Pruis	8-15-89	0837	

TYPE OF SAMPLE: ☐ SPLIT SPOON CORES–SOIL ☐ AUGER CUTTINGS–SOIL ☐ AUGER CUTTINGS–ROCK
☐ AIR ROTARY CUTTINGS–ROCK ■ DRILL WATER (NO AIR IN SAMPLE) ☐ OTHER _____

ALL SAMPLES ARE IMMEDIATELY PLACED IN I-CHEM SPECIALTY CLEANED CONTAINERS AND SEALED.

REMARKS: _____

1.0 General Information

1.1 Well Location

Monitoring well number 1075 is located in WAG 7. It is along the west side of WAG 7 approximately 800' west of chemical waste pit road. The location is shown on ORNL drawing number C3E20004 A075. Survey coordinates for this well are N 18135.019, E 25697.460 (X-10 grid) or latitude 35° 54' 34.44" and longitude 84° 19' 28.52". Coordinate data were provided by Martin Marietta Energy Systems. The method used for conversion from X-10 grid to Tennessee-Lambert State Plane Coordinates came from the publication "Tennessee Valley Authority Data Services Branch and Mapping Services Branch, Oak Ridge, Tennessee, DOE Plant Control, November 6, 1985, Field Book: ESS-3115, pp. 1-20." The latitude and longitude were calculated by Adams Craft Herz Walker Engineering, Inc., using methods from the U.S. Coast and Geodetic Survey Publication 62-4, "State Plane Coordinates by Automatic Data Processing."

1.2 Drilling Information

Well number 1075 was drilled by Geotek Engineering Company. A Mobile B-50 rig and an Ingersol Rand T-4 rig were used to drill this boring for monitor well installation under operation of Rick Herron and Larry Ledbetter with the assistance of Steve

Kirk, James Shelton and Freddy Dixon. Drilling commenced on 6/14/89 and was finished on 8/8/89. Paragraph 2.4.1 includes a detailed discussion of the well installation and a well schematic is included on the well installation/completion form. A synopsis of the drilling activity follows:*

6/4/89: The auger rig and tools were deconed, mobilized to site and set up. A 22.0" boring was augered to 4.0' and a 15 1/4" diverter casing installed.

6/21/89: The air rotary rig and tools were deconed.

6/22/89: The air rotary rig was mobilized to the site and set up. Refusal was encountered at 4.4'. A 10.0" surface casing was installed to a depth of 4.4'. A bentonite seal was installed and the borehole/annulus covered with plastic.

7/28/89: The air rotary was deconed, mobilized to the site and set up along with the containment box. The previously set surface casing was removed because it was not set deep enough. A minimum standard to 10.0' for the surface casing was established. A 14.0" borehole was advanced to 10.0' with a tricone bit while drilling, holes began to develop in the diverter casing pad and cuttings

* This information was typed directly from field notes and was edited only when necessary for clarification.

began to come out through the openings. The boring was cleaned and the rods removed. The surface casing will be set on Monday.

7/31/89: Chris Wallen on site to supervise installation of surface casing. The casing was cut, deconed, and installed to a depth of 10.0'. A bentonite seal was added and the annulus was grouted.

8/2/89: The water pump on the rig was replaced and the rig was then deconed, mobilized to the site and set up. The containment box was connected and an eight-inch tricone bit was used to drill. While drilling, the "blooey line" blew off at the diverter head/containment hose connection. The containment hose came apart from the coupling. A new hose was attached and drilling commenced. Water and air samples were taken at 48.0'. During drilling (at 49.0') the air circulation through the rods and down the borehole became blocked. The rods were removed and the bottom of the bit was found to be plugged with cuttings. The cuttings were removed and drilling began again. At 1205 the "blooey" line blew off again, but came off at the containment box connection. It also came apart from the coupling. James

Shelton was injured when the cuttings sprayed out of the "blooey" line, blew off his safety glasses and went into his eyes. He was taken to medical, treated and sent home. Rudy Williams was called and instructed everyone to leave things the way there were. Safety was called and an investigation was conducted. All drilling activities were cancelled for the day. A safety meeting was held at which time it was decided that each "blooey" line should have "C" clamps and additional safety lines attached. An accident report was filed by Duane Bias and sent to the DOE.

8/4/89: The "blooey" lines were replaced and the "C" clamps and safety lines were attached and approved by R.C. Williams. The rig was set up and the boring was completed to a total depth of 73.0'.

8/7/89: The water level was measured and found to be 8.4' below land surface. The boring was cleaned and the rods removed. While removing the rods a hydraulic hose developed a leak. The borehole was covered and the rig was moved to the steam cleaning area for repairs. The rig was then deconed and taken back to the site to set the 4.0" stainless steel screen and casing. The stainless steel

was installed to a depth of 72.8'. Sand was then tremied to 52.0' and bentonite poured to a level of 49.6'.

8/8/89: James Lamb documented the grouting of the annulus.

9/5/89: The well was tested with the "Go-NoGo" gauge and passed by R.C. Williams.

This well was logged by ERC Environmental and Energy Services Co., Inc., hydrogeologists Christopher Wallen and C. Allison Hodges. All well construction materials and supplies were from Martin Marietta Energy Systems approved batches. The batch origin of individual items is shown on the included Monitoring Well Materials Certification form.

2.0 Technical Information

2.1 Decontamination Procedures

The drilling rig, down hole tools, surface casing, stainless steel screen, stainless steel casing, centralizers, and stainless steel silt trap underwent the cleaning decontamination procedures outlined in the drilling specifications (Release Specific Technical Directions for Regulatory Compliance Monitoring Wells Phase 1, Oak Ridge National Laboratory, Oak Ridge, W.O., K-4147, April 1987, pgs, 2-4). A checklist of the cleaned materials is included with this data package.

2.2 Geology

WAG 7 is located in Melton Valley which is in the Valley and Ridge Physiographic Province of East Tennessee. WAG 7 is underlain by shale, siltstone, and limestone of the Conasauga Group. The Conasauga Group in the Oak Ridge area consists of six formations. They are, in ascending order, the Pumpkin Valley Shale, Rutledge Limestone, Rogersville Shale, Maryville Limestone, Nolichucky Shale and the Maynardville Limestone. These rocks have undergone extensive deformation and contain many folds and faults resulting in varying strike and dips. The average strike and dip appears to be consistent with the regional strike of 56° northeast and dips of about 30° to the southeast.

2.3 Sample Collection

One water sample was collected during drilling, placed in an I-CHEM specialty cleaned glass container, sealed and submitted to Sample Receiving, Analytical Chemistry Division, Bldg. 4500S, ORNL. This drill water sample, 1075W01, was collected from the water pump on the drill rig on 8/2/89. Analytical results for this sample can be obtained from the Remedial Action Program data base at ORNL.

2.4 Installation and Development

2.4.1 Installation

This was a type B well. A twenty two-inch diameter boring was augered from ground surface to 4.0. A fifteen-inch diverter casing was installed from 0.0 feet to 4.0 feet below ground surface and grouted in place. A fourteen-inch diameter boring was augered from 4.0 feet to 4.3 feet or auger refusal depth. The boring was then extended past the refusal depth with a fourteen-inch air rotary tricone roller bit from 4.3 feet to 10.0 feet. A ten-inch diameter string of decontaminated steel surface casing was installed from 0.0 feet to 10.0 feet, sealed with a 1.9 foot bentonite pellet layer from 8.0 feet to 10.0 feet, and tremie grouted in place. The surface casing minimizes potential cross contamination between the regolith and bedrock water bearing zones. After the surface casing was installed, the air rotary method was used again to drill an eight-inch diameter boring to a total depth of 73.0 feet. A four-inch diameter stainless steel screen with welded bottom cap was installed from 57.8 feet to 72.8 feet. A four-inch diameter stainless steel casing was installed from the top of the screen at 57.8 feet and extended 1.99 feet above ground surface. A sandpack was then tremied into the

annular space from 72.8 to 52.0 feet, with a 2.4 foot bentonite pellet seal poured into the annular space above the sandpack from 49.6 to 52.0 feet. The annular space from the top of the bentonite seal to the surface was tremie grouted with a cement/bentonite slurry. A detailed schematic of the well is included on the well installation/completion form.

2.4.2 Well Development

Well number 1075 was developed to remove drill cuttings, silt, and other fines from the monitoring well. The monitoring well was developed using a Geoguard pump with an air compressor. All pumps were cleaned prior to use according to specified cleaning procedures (see Paragraph 2.1). The well was developed until a measured total of 233 gallons of water had been evacuated and the clarity of the discharge water was approved by the company representative. The final turbidity value measured was 5.0 NTU's. A development form showing the exact method of development and other pertinent data is appended.

2.4.3 Installation of Dedicated Monitoring Well Pump

After the well was developed, a Geoguard Model No. 5614 dedicated monitoring well pump was installed

on 2/12/90 at a depth of 70.1 feet below ground surface. These pumps are decontaminated at American Sigma and are sent prepackaged. A copy of the pump certification is kept on file at ORNL.

2.5 Hydraulic Conductivity Testing

Well number 1075 was tested for the determination of hydraulic conductivity of the aquifer in the vicinity of the well screen. This was accomplished by instantaneously adding a known quantity of water to the monitoring well and measuring the recovery of the water level over time. The changing water levels were measured using a Druck 15 psig pressure transducer and an Omnidata Datapod II data recorder. The hydraulic conductivity value of 6.46×10^{-7} cm/second (shown as permeability on the hydraulic conductivity calculations) was calculated using the Bouwer and Rice method. A computer printout of the hydraulic conductivity calculations is included in this data package.

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1075

PRE-DRILLING CHECKLIST FOR MONITORING WELLS

PRE-DRILLING TASKS		COMPLIANCE DATE	COMPLIANCE INITIALS
1.	EXCAVATION PERMIT OBTAINED.	6-22-89	CMW
2.	ALL EQUIPMENT HAS BEEN CLEANED BEFORE DRILLING.	6-21-89	CMW
3a.	SCREEN AND CASINGS HAVE BEEN WASHED, STEAMED, RINSED WITH DE-IONIZED OR DISTILLED WATER, RINSED WITH ISOPROPYL ALCOHOL, WRAPPED WITH PROTECTIVE COVERING AND STORED OFF THE GROUND.	N/A	
3b.	PRE-PACKAGED SCREENS, CASINGS AND CENTRALIZERS WERE USED.	8-07-89	CMW
4.	WORK AREA FOR SAMPLE EXAMINATION COVERED WITH CLEAN POLYETHYLENE.	6-22-89	CMW
5.	CLEAN KNIVES, GLOVES, SAMPLE JARS AND LABELS ON-HAND.	6-22-89	CMW
6.	POLYETHYLENE COVER IN PLACE OVER HOLE.	6-22-89	CMW

ADDITIONAL NOTES/OBSERVATIONS:

OBSERVER SIGNATURE/DATE Christopher M. Wallen 6-22-89

Christopher M. Wallen

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1075

DECONTAMINATION CHECKLIST
DRILLING EQUIPMENT

EQUIPMENT	SCRAPE	STEAM CLEAN	STEAM RINSE	ISOPROPYL ALCOHOL RINSE	DEIONIZED WATER RINSE
RIG	X	X	X	N/A	N/A
AUGERS	X	X	X	X	X
BITS	X	X	X	X	X
RODS	X	X	X	X	X
SAMPLERS	X	X	X	X	X
PIPES	X	X	X	X	X
WORK TOOLS	X	X	X	X	X
AUGER PINS	X	X	X	X	X

OBSERVER SIGNATURE/DATE Christopher M. Wallen 6-22-89
Christopher M. Wallen

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1075

ORNL MONITORING WELL LOG

LOCATION: WAG 7

DRILLER: Rick Herron/Larry Ledbetter

HELPER: Steve Kirk/Rick Herron/ Freddy Dixson/James Shelton

DRILL: Mobile B-50/Ingersol Rand T-4

DATE: START: 6-14-89

FINISH: 8-08-89

LOGGED BY: Christopher M. Wallen/ C. Allison Hodges

HEALTH PHYSICIST: W. Shimpaugh/ C. E. Stooksbury

TYPE DRILLING: Auger/Air Rotary

LUBRICANT TYPE: Green Stuff

No. SAMPLES TAKEN: N/A

TYPE: N/A

CONTAINMENT TYPE: Plastic, Pan, Containment Box

THICKNESS OF SOIL (REFUSAL DEPTH): 4.5

DEPTH DRILLED IN ROCK: 68.5

TOTAL DEPTH OF WELL: 73.0

DRILLING FLUID SAMPLES:

TYPE: Water DATE: 8-02-89

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
0.0	4.5			Gravel (fill material), clay with roots.
4.5	7.5			*Hard, rough, irregular drilling. Bit locked
				up at 7.0'.
7.5	8.0			Very hard drilling.
8.0	43.0			Smooth regular drilling. Fast.
43.0	48.0			Hard, irregular drilling. Slow.
48.0	54.5			Hard, regular drilling, fast.
54.5	58.0			Hard, irregular, rough drilling.
58.0	60.0			Hard drilling, regular.
60.0	63.5			Hard, irregular, rough, slow drilling.
63.5	73.0			Smooth, regular drilling, fast.
	73.0			Total Depth
				*No detailed lithologic log could be provided
				from 4.5' to 73.0' due to total containment.

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1075

WELL INSTALLATION/COMPLETION FORM

O.R.N.L. MONITORING WELL PROGRAM

LOGGED BY: Christopher M. Wallen / C. Allison Hodges

PROOFED BY: Michael L. Ebers

DRILLING COMPANY: Geotek

DRILLER: Rick Herron/ Larry Ledbetter

HELPER: Steve Kirk/James Shelton/ Freddy Dixon

LOCATION: WAG 7

ORNL GRID COORDINATES
N 18,135.019
E 25,697.460

ELEV. GROUND 768.98

ELEV. TOP STAINLESS STEEL CASING 770.97

DRILLING DATES:
STARTED: 6-14-89
FINISHED: 8-08-89

DRILLING METHOD:
- ☐ 220 INCH AUGER 4.0 L.F.
- ☐ INCH AUGER L.F.
- ☐ 14.0 INCH ROTARY 6.0 L.F.
- ☐ 8.0 INCH ROTARY 63.0 L.F.

MATERIALS USED

EST. VOL	USED VOL	
	50.0	POUNDS OF BENTONITE PELLETS (SURFACE CASING SEAL)
	10.0	FT. OF 10.0 IN. SURFACE CASING
3.0	5.0	SACKS OF CEMENT (SURFACE CASING)
	25.0	POUNDS OF POWERED BENTONITE (SURFACE CASING)
	40.0	GALLONS OF WATER (SURFACE CASING)
	59.8	FT. OF 4.0 IN. DIA. STAINLESS STEEL CASING
	15.0	FT. OF 4.0 IN. DIA. STAINLESS STEEL SCREEN
5.0	5.5	SACKS OF SAND
50	50.0	POUNDS OF BENTONITE PELLETS
7.1	8.0	SACKS OF CEMENT (WELL CASING)
	40.0	POUNDS OF POWERED BENTONITE (WELL CASING)
	65.0	GALLONS OF WATER (WELL CASING)
	3.2	FT. OF 10 IN. STEEL PROTECTIVE CASING

REASON FOR DIFFERENCES BETWEEN ESTIMATED VOLUMES AND USED VOLUMES: Spillage.

SURFACE CASING TREMIE GROUTED: YES ☐ NO ☒

STAINLESS STEEL CASING TREMIE GROUTED: YES ☒ NO ☐

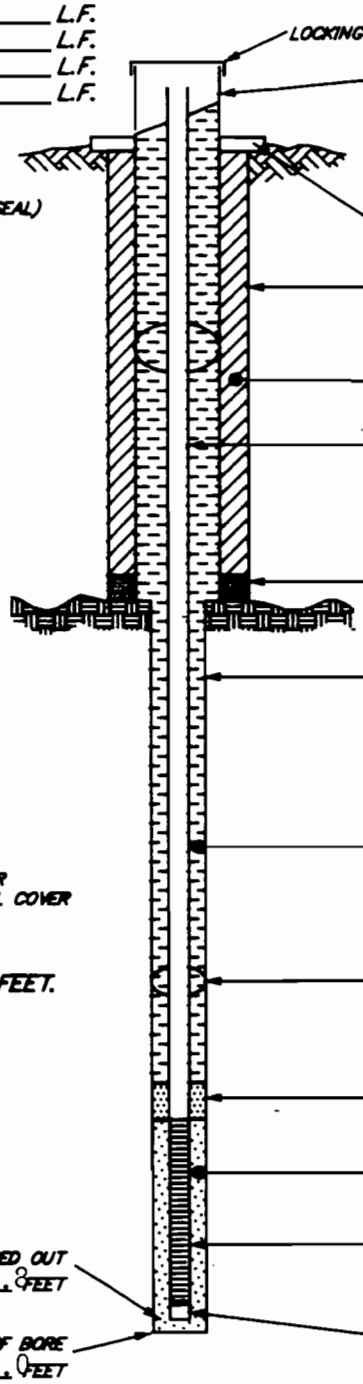
WELL COVER USED:
- ☒ LOCKING STEEL COVER
- ☐ FLUSH MOUNTED WELL COVER
- ☐ OTHER

SILT TRAP USED: YES ☐ NO ☒

MONITORING WELL PUMP BASE SET AT 70.1 FEET.

CENTRALIZERS AT 20.0 FEET.
35.0 FEET.
55.0 FEET.
70.0 FEET

NOTE:
ALL DEPTHS ARE MEASURED FROM GROUND SURFACE UNLESS OTHERWISE NOTED:



LOCKING CAP

10.0 IN. DIA. SURFACE/PROTECTIVE CASING 3.18 FEET ABOVE GROUND SURFACE TO 10.0 FEET BELOW GROUND SURFACE

CONCRETE PAD

14.0 IN. DIA. BORE HOLE 4.0 TO 10.0 FEET

GROUT SEAL 0.0 TO 8.0 FEET

4.0 IN. STAINLESS STEEL CASING 1.99 FEET ABOVE GROUND SURFACE TO 57.8 FEET BELOW GROUND SURFACE

Bentonite SEAL 8.0 TO 10.0 FEET

BEDROCK LEVEL 4.5

8.0 IN. DIA. BORE HOLE

GROUT SEAL 0.0 TO 49.6 FEET

CENTRALIZER

BENTONITE PELLET SEAL 49.6 TO 52.0 FEET

SAND PACK 52.0 TO 72.8 FEET

4.0 IN. DIA. STAINLESS STEEL SLOTTED SCREEN 57.8 TO 72.8 FEET

N/A IN. DIA. STAINLESS STEEL SILT TRAP/CAP N/A TO N/A FEET

HOLE CLEANED OUT TO 72.8 FEET

BOTTOM OF BORE HOLE 73.0 FEET

TYPE B WELL

ERC / EDGE
Environmental and Energy Services Co.

WELL No. 1075

DATE: 7-31-89

MONITORING WELL MATERIALS CERTIFICATION

ITEM/MATERIAL		DATE USED	BATCH NUMBER
SAND			
		8-07-89	1
BENTONITE		7-31-89	1
STAINLESS STEEL SCREEN	(PREPACKAGED ☒ YES ☐ NO)	8-07-89	1
STAINLESS STEEL CASING	(PREPACKAGED ☒ YES ☐ NO)	8-07-89	1
STAINLESS STEEL CENTRALIZERS	(PREPACKAGED ☒ YES ☐ NO)	8-07-89	1
STAINLESS STEEL CAPS	(PREPACKAGED ☒ YES ☐ NO)	8-07-89	1
MONITORING WELL PUMP	(PREPACKAGED ☒ YES ☐ NO)	2-12-90	4
GROUT		7-31-89	1
		8-08-89	
WELL COVERS		8-07-89	1
SURFACE CASING			

COMMENTS:

OBSERVER SIGNATURE/DATE Christopher M. Wallen 7-31-89

Christopher M. Wallen

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1075

POST-WELL COMPLETION CHECKLIST

POST-WELL COMPLETION TASKS	COMPLIANCE DATE	COMPLIANCE INITIALS
1. MUD SCRAPED FROM AUGERS, SAMPLERS, AND ALL OTHER EQUIPMENT.	8-07-89	CAH
2. ALL MUD FROM RIG AND EQUIPMENT SCRAPINGS AND CUTTINGS DISPOSED OF IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED.	8-07-89	CAH
3. WELL DEVELOPED IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED AND DETAILS OF THE DEVELOPMENT ACTIVITY RECORDED.	2-12-90	DCL
4. DRILLING SITE PROPERLY CLEANED UP AFTER COMPLETION OF WELL INSTALLATION.	8-08-89	CAH

* RELEASE SPECIFIC TECHNICAL DIRECTIONS FOR REGULATORY COMPLIANCE MONITORING WELLS PHASE I, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, W.O. K-4147, APRIL 1987.

OBSERVER SIGNATURE/DATE C. Allison Hodges 8-08-89
C. Allison Hodges

D. Charles Lytle 2-12-90
D. Charles Lytle

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1075

LOCATION: WAG

MONITORING WELL DEVELOPMENT FORM

DEVELOPMENT DETAILS

METHOD OF DEVELOPMENT: Surging and Pumping

DEVELOPMENT BEGAN DATE: 2-06-90 TIME:

DEVELOPMENT ENDING DATE: 2-12-89

DEVELOPMENT OBSERVED BY: D. Charles Lytle

ONE WELL VOLUME: 63.4 GALLONS

TOTAL GALLONS PUMPED: 233 TOTAL WELL VOLUMES PUMPED: 3.7

INITIAL pH: 7.5 FINAL pH: 7.4

INITIAL CONDUCTIVITY (uS): 376 FINAL CONDUCTIVITY (uS): 370

DESCRIPTION OF INITIAL TURBIDITY: Cloudy

DESCRIPTION OF FINAL TURBIDITY: Clear

FINAL MEASURED TURBIDITY: 5.0

WELL APPROVED BY: R. C. Williams MMES

ODOR OF WATER: None

WATER DISCHARGED TO:
- ☒ GROUND SURFACE
- ☐ STORM SEWERS
- ☐ DRUMS
- ☐ TANK TRUCK
- ☐ STORAGE TANKS
- ☐ OTHER

INITIAL PRE-DEVELOPMENT WATER DEPTH: +1.99 feet above ground surface.

DEVELOPMENT OBSERVATIONS

OBSERVER SIGNATURE/DATE D. Charles Lytle 2-12-90

D. Charles Lytle

ERC / EDGE Environmental and Energy Services Co.

WELL NO. 1075
LOCATION: WAG 7
DATE: 2-06-90

MONITORING WELL DEVELOPMENT PROGRESS

ONE WELL VOLUME = 63.4 GALLONS

DATE	TIME	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	MEASURED TURBIDITY (NTU'S)	pH	CONDUCTIVITY (µS)	TOTAL GALLONS PUMPED	WELL VOLUMES PUMPED	COMMENTS
2-06-90	1400	14	Cloudy	--	7.5	376	14		
2-06-90	1530	10	Cloudy	--	7.4	342	24		
2-06-90	1700	12	Cloudy	--	7.4	336	36	.57	
2-07-90	1030	55	Cloudy	--			91	1.4	
2-08-90	0930	37	Cloudy	--	7.8	298	128	2.0	
2-08-90	1130	18	Cloudy	--	7.3	317	146	2.3	
2-08-90	1330	32	Cloudy	--	7.6	299	178	2.8	
2-12-90	1000	12	Cloudy	--	7.4	302	190	3.0	
2-12-90	1100	13	Clear	9.0	7.4	328	203	3.2	
2-12-90	1600	30	Clear	5.0	7.4	370	233	3.7	
RESULTS AT END OF DEVELOPMENT			Clear	5.0	7.4	370	233	3.7	

COMMENTS Poor producer finally cleared up, passed and moved off hole.

OBSERVER SIGNATURE/DATE D. Charles Lytle 2-12-90
D. Charles Lytle

HYDRAULIC CONDUCTIVITY CALCULATIONS

PROGRAM SLUGT, VERSION 4.1, NOV. 1986

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:

(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3, NO.1 OF WRR ENTITLED "RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER")

(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED "A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS")

WELL NO.: 1075 DATE OF TEST: 3/21/90

PROJECT NO.: E221-002 CLIENT: MMES

SITE LOCATION: WAG 7

EDGE, INC. FIELD INVESTIGATOR: BRUCE MCMASTER

INPUT DATA ARE:

INNER CASING DIAMETER = 4.00 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 4.00 INCHES
DIAMETER OF DRILLED HOLE = 8.63 INCHES
LENGTH OF SCREEN OR INTAKE PORTION = 15.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 69.80 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 15.00 FEET
DEPTH TO STATIC WATER LEVEL BELOW REF. POINT = .93 FEET
ESTIMATED POROSITY OF GRAVEL PACK = .20
FALLING-HEAD INDEX = 1 ("1" IF FALLING,"0" IF RISING)
NUMBER OF DEPTH-TIME DATA POINTS = 32

HO WAS COMPUTED FROM INTERCEPT OF PLOT OF LOG(H) VS. TIME

SUCCESSIVE COMPUTED
VALUES FOR HO
(FEET)

3.3053
3.3056

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1075

HYDRAULIC CONDUCTIVITY CALCULATIONS

TIME (SEC)	DEPTH TO WATER (FEET)	HEAD (FEET)
10.00	4.240	3.310
20.00	4.240	3.310
30.00	4.240	3.310
40.00	4.240	3.310
50.00	4.240	3.310
60.00	4.240	3.310
75.00	4.240	3.310
90.00	4.240	3.310
105.00	4.230	3.300
120.00	4.230	3.300
150.00	4.230	3.300
180.00	4.230	3.300
240.00	4.230	3.300
300.00	4.230	3.300
360.00	4.220	3.290
420.00	4.220	3.290
480.00	4.220	3.290
540.00	4.220	3.290
600.00	4.220	3.290
720.00	4.220	3.290
840.00	4.210	3.280
960.00	4.210	3.280
1080.00	4.210	3.280
1200.00	4.210	3.280
1320.00	4.210	3.280
1440.00	4.210	3.280
1560.00	4.210	3.280
1680.00	4.200	3.270
1800.00	4.200	3.270
1920.00	4.200	3.270
2040.00	4.200	3.270
2160.00	4.200	3.270

(**********

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

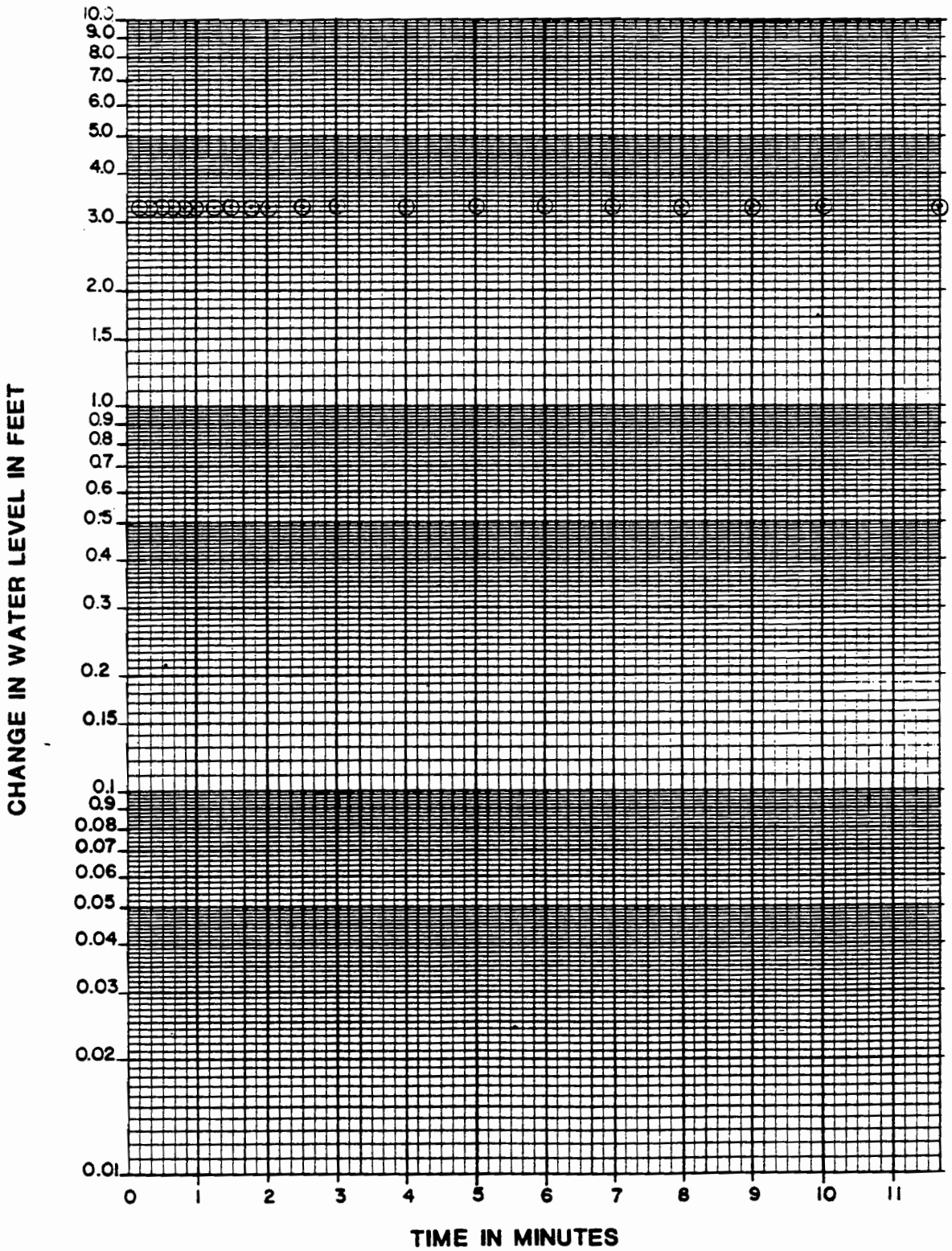
PERMEABILITY = 2.12E-08 FT/SEC = 6.46E-07 CM/SEC

TRANSMISSIVITY = 3.18E-07 FT**2/SEC

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1075

HYDRAULIC CONDUCTIVITY CALCULATIONS



EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 1075W01

WELL NO.	LOCATION:	TYPE:
1075	WAG-7	WATER

SAMPLER:	SAMPLE INTERVAL:	DATE:	TIME:
C. Allison Hodge (SIGNATURE)		08-07-89	1058

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECEIVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
C. Allison Hodge	8-15-89	8:37	EDGE	J. Price	8-15-89	0837	

TYPE OF SAMPLE: ☐ SPLIT SPOON CORES–SOIL ☐ AUGER CUTTINGS–SOIL ☐ AUGER CUTTINGS–ROCK
☐ AIR ROTARY CUTTINGS–ROCK ■ DRILL WATER (NO AIR IN SAMPLE) ☐ OTHER _____

ALL SAMPLES ARE IMMEDIATELY PLACED IN I-CHEM SPECIALTY CLEANED CONTAINERS AND SEALED.

REMARKS: _____

1.0 General Information

1.1 Well Location

Monitoring well number 1076 is located in WAG 7. It is located approximately 150' northwest of abandoned waste pit #2 and 350' west of abandoned waste pit #3. The location is shown on ORNL drawing number C3E20004 A075. Survey coordinates for this well are N 17882.744, E 25858.893 (X-10 grid) or latitude 35° 54' 33.26" and longitude 84° 19' 25.18". Coordinate data were provided by Martin Marietta Energy Systems. The method used for conversion from X-10 grid to Tennessee-Lambert State Plane Coordinates came from the publication "Tennessee Valley Authority Data Services Branch and Mapping Services Branch, Oak Ridge, Tennessee, DOE Plant Control, November 6, 1985, Field Book: ESS-3115, pp. 1-20." The latitude and longitude were calculated by Adams Craft Herz Walker Engineering, Inc., using methods from the U.S. Coast and Geodetic Survey Publication 62-4, "State Plane Coordinates by Automatic Data Processing."

1.2 Drilling Information

Well number 1075 was drilled by Geotek Engineering Company. A Mobile B-50 rig and an Ingersol Rand T-4 rig were used to drill this boring for monitor well installation under operation of Rick Herron and Larry Ledbetter with the assistance of Freddy

Dixon. Drilling commenced on 6/29/89 and was finished on 8/14/89. Paragraph 2.4.1 includes a detailed discussion of the well installation and a well schematic is included on the well installation/completion form. A synopsis of the drilling activity follows:*

6/29/89: The auger rig, tools, and equipment necessary to sample with were deconed and mobilized to site. It was agreed upon by ERC, R.C. Williams and Mike McLoughlin to drill this well (type A) before 1077 (type B) because there was enough distance between the two that there should be no interference when drilling 1077. Plastic was placed over the drilling area and the rig was set up. Split spoons were taken from 1.5' to 12.0' or auger refusal. Two soil samples and a bulk density sample were taken. Photovac readings are 0.1 ppm. No contamination detected. A six-inch boring was augered from ground surface to a refusal depth of 12.0'. This boring will have to be completed to total depth with the air rotary, therefore a diverter casing will have to be set. The six-inch augers were

* This information was typed directly from field notes and was edited only when necessary for clarification.

removed and a 22.0" boring was completed to 4.0'. A 15 1/4" diverter casing was then installed and grouted. The drilling area has been deregulated by Jerry Gray from a Class II to a Class I.

8/11/89: The T-4 and drilling equipment were deconed.

8/14/89: The rig and drilling equipment were mobilized to the site and set up along with the containment box. An 8.0" tricone bit was used to drill to a total depth of 20.0'. Photovac readings were negligible. Air and water samples were taken at 20.0'. The boring was cleaned and allowed to recharge for 1 hour after which time the water level was measured and found to be 7.5' from surface. There is sufficient water so the well will be set at this depth. The boring was cleaned and the rods removed. A 10.0' section of 2.0" stainless steel screen and a 12.0' section of 2.0" stainless steel casing were installed to a depth of 19.4'. The sandpack was tremied into the annulus thru 1.0" tremie line with water to a depth of 7.8'. The bentonite was then poured to a depth of 6.1'. There were 5 bags of sand and 1 bucket of bentonite used. The annulus was grouted with 5 bags of

cement and 25 lbs of bentonite. The air sample was checked under an ultra violet light and was found to have no detectable hydrocarbons.

This well was logged by ERC Environmental and Energy Services Co., Inc., hydrogeologist C. Allison Hodges. All well construction materials and supplies were from Martin Marietta Energy Systems approved batches. The batch origin of individual items is shown on the included Monitoring Well Materials Certification form.

2.0 Technical Information

2.1 Decontamination Procedures

The drilling rig, down hole tools, surface casing, stainless steel screen, stainless steel casing, centralizers, and stainless steel silt trap underwent the cleaning decontamination procedures outlined in the drilling specifications (Release Specific Technical Directions for Regulatory Compliance Monitoring Wells Phase 1, Oak Ridge National Laboratory, Oak Ridge, W.O., K-4147, April 1987, pgs, 2-4). A checklist of the cleaned materials is included with this data package.

2.2 Geology

WAG 7 is located in Melton Valley which is in the Valley and Ridge Physiographic Province of East

Tennessee. WAG 7 is underlain by shale, siltstone, and limestone of the Conasauga Group. The Conasauga Group in the Oak Ridge area consists of six formations. They are, in ascending order, the Pumpkin Valley Shale, Rutledge Limestone, Rogersville Shale, Maryville Limestone, Nolichucky Shale and the Maynardville Limestone. These rocks have undergone extensive deformation and contain many folds and faults resulting in varying strike and dips. The average strike and dip appears to be consistent with the regional strike of 56° northeast and dips of about 30° to the southeast.

2.3 Sample Collection

Four samples were collected during drilling, placed in I-CHEM specialty cleaned glass containers, sealed and submitted to Sample Receiving, Analytical Chemistry Division, Bldg. 4500S, ORNL. Chain of custody forms for these samples are included with this data package. Soil sample 1076S01 was collected in the split spoon interval from 2.5' to 3.0' on 6/29/89, soil sample 1076S02 was collected in the augered interval from 9.0' to 9.5' on 6/29/89 and soil sample 1076S03 was collected in the split spoon interval from 11.5' to 12.0' on 6/29/89. A drill water sample 1076W01 was collected from the water pump on the drill rig on 8/14/89. Analytical results for the four split spoon and drill water samples described above can be obtained from the Remedial Action Program data base at ORNL.

A bulk density soil sample was collected from the split spoon sample interval from 8' 2" to 8' 5". The sample was measured, and weighed, and a bulk density of 2.39 grams/cm^3 was calculated.

2.4 Installation and Development

2.4.1 Installation

This was a type D well. A six-inch diameter boring was split spooned/augered from ground surface to auger refusal (12.0 feet). The air rotary method was required to complete the boring to the specified total well depth. A twenty two-inch diameter boring was augered from ground surface to 4.0 feet and a fifteen-inch diverter casing was installed and grouted. An eight-inch diameter boring was then drilled with an air rotary tricone roller bit from 12.0 to 20.0 feet. A two-inch diameter stainless steel screen with welded bottom cap was installed from 9.4 to 19.4 feet. A two-inch diameter stainless steel casing was installed above the screen at 9.4 feet and extended 2.06 feet above ground surface. A sandpack was then tremied into the annular space from 7.8 to 19.4 feet, with a 1.7-foot bentonite pellet seal poured into the annular space above the sandpack from 6.1 to 7.8 feet. The annular space from the top of the bentonite seal to the surface was tremie-grouted with a cement/bentonite slurry. A detail of the well is included on the well installation/completion form.

2.4.2 Well Development

Well number 1076 was developed to remove drill cuttings, silt, and other fines from the monitoring well. The monitor well was developed using a Geoguard pump with an air compressor. All pumps and/or bailers were cleaned prior to use according to specified cleaning procedures (see Paragraph 2.1). The well was developed until a measured total of 612 gallons of water had been evacuated and the clarity of the discharge water was approved by the company representative. The final turbidity value measured was 20 NTU's. A development form showing the exact method of development and other pertinent data is appended.

2.4.3 Installation of Dedicated Monitoring Well Pump

After the well was developed, a Geoguard Model No. 5614 dedicated monitoring well pump was installed on 2/1/90 at a depth of 17.2 feet below ground surface. These pumps are decontaminated at American Sigma and are sent prepackaged. A copy of the pump certification is kept on file at ORNL.

2.5 Hydraulic Conductivity Testing

Well number 1076 was tested for the determination of hydraulic conductivity of the aquifer in the

vicinity of the well screen. This was accomplished by instantaneously adding a known quantity of water to the monitoring well and measuring the recovery of the water level over time. The changing water levels were measured using a Druck 15 psig pressure transducer and an Omnidata Datapod II data recorder. The hydraulic conductivity value of 3.52×10^{-5} cm/second (shown as permeability on the hydraulic conductivity calculations) was calculated using the Bouwer and Rice method. A computer printout of the hydraulic conductivity calculations is included in this data package.

ERC / EDGE
Environmental and Energy Services Co.

WELL No. 1076

PRE-DRILLING CHECKLIST FOR MONITORING WELLS

PRE-DRILLING TASKS		COMPLIANCE DATE	COMPLIANCE INITIALS
1.	EXCAVATION PERMIT OBTAINED.	6-29-89	CAH
2.	ALL EQUIPMENT HAS BEEN CLEANED BEFORE DRILLING.	6-29-89	CAH
3a.	SCREEN AND CASINGS HAVE BEEN WASHED, STEAMED, RINSED WITH DE-IONIZED OR DISTILLED WATER, RINSED WITH ISOPROPYL ALCOHOL, WRAPPED WITH PROTECTIVE COVERING AND STORED OFF THE GROUND.	N/A	
3b.	PRE-PACKAGED SCREENS, CASINGS AND CENTRALIZERS WERE USED.	8-14-89	CAH
4.	WORK AREA FOR SAMPLE EXAMINATION COVERED WITH CLEAN POLYETHYLENE.	6-29-89	CAH
5.	CLEAN KNIVES, GLOVES, SAMPLE JARS AND LABELS ON-HAND.	6-29-89	CAH
6.	POLYETHYLENE COVER IN PLACE OVER HOLE.	6-24-89	CAH

ADDITIONAL NOTES/OBSERVATIONS:

OBSERVER SIGNATURE/DATE C. Allison Hodges 8-14-89
C. Allison Hodges

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1076

DECONTAMINATION CHECKLIST
DRILLING EQUIPMENT

EQUIPMENT	SCRAPE	STEAM CLEAN	STEAM RINSE	ISOPROPYL ALCOHOL RINSE	DEIONIZED WATER RINSE
RIG	X	X	X	N/A	N/A
AUGERS	X	X	X	X	X
BITS	X	X	X	X	X
RODS	X	X	X	X	X
SAMPLERS	X	X	X	X	X
PIPES	X	X	X	X	X
WORK TOOLS	X	X	X	X	X
AUGER PINS	X	X	X	X	X

OBSERVER SIGNATURE/DATE C. Allison Hodges 6-29-89

C. Allison Hodges

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1076

ORNL MONITORING WELL LOG

LOCATION: WAG 7
DRILLER: Rick Herron/Larry Ledbetter
HELPER: Freddy Dixon
DRILL: Mobile B-50/Ingersol Rand T-4

DATE: START: 6-29-89
FINISH: 8-14-89
LOGGED BY: C. Allison Hodges
HEALTH PHYSICIST: W. H. Shinpaugh/ L. C. Johnson

TYPE DRILLING: Split Spoon, Auger, Air Rotary
LUBRICANT TYPE: Green Stuff
No. SAMPLES TAKEN: Two
TYPE: Soil
CONTAINMENT TYPE: Plastic, Pan, Containment Box

THICKNESS OF SOIL (REFUSAL DEPTH): 12.0
DEPTH DRILLED IN ROCK: 8.0
TOTAL DEPTH OF WELL: 20.0

DRILLING FLUID SAMPLES:
TYPE: Water
DATE: 8-14-89

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
0.0	1.5			Gravel. (fill material)
1.5	1.7	1076S01 2.5-3.0	40%	Gravel in spoon. (fill material)
1.7	3.5			Clay, mottled, dark yellowish orange and dark
				yellowish brown, with some weathered shale frag-
				ments. Also contains roots. Slightly moist.
				Very easu push.
3.5	5.5		0%	Nothing in spoon.
5.5	7.5		100%	Clay, mottled (spotted), light olive gray,
				greenish gray, dark yellowish orange, with
				a dark mineral (flakes) dusky yellowish brown.
				Clay is firm and moist.
7.5	9.2	1076S02 9.0-9.5	100%	Clay, mottled (spotted), light olive gray,
				greenish gray, dark yellowish orange, with a
				dark mineral (in flakes), dusky yellowish
				brown. Clay is very firm.
9.2	9.5			Shale, dusky brown, weathered and brittle.
				Spoon is hard to push.
9.5	11.5		100%	Clay, mottled (spotted), light olive gray,
				greenish gray, dark yellowish orange, with a
				dark mineral (in flakes), dusky yellowish
				brown, and shale (30%), dusky brown, (cont. pg 2)

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1076

ORNL MONITORING WELL LOG

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
9.5	11.5			(cont. from page 1 of 2) weathered and brittle,
				laminated larger fragments very moist from
				10.5 to 10.8.
11.5	11.8		75%	Clay, moderate olive brown with shale, dusky
				brown, weathered, and laminated.
11.8	12.0			Shale, olive gray, laminated. Water in spoon.
	12.0			Split spoon refusal and auger refusal.
12.0	13.5			*Uneven, semi-hard drilling. Fast.
13.5	16.0			Hard drilling, rough and irregular at 14.5, bit
				locked up.
16.0	18.0			Smooth, even, fast drilling.
18.0	20.0			Hard, rough, irregular drilling.
	20.0			Total Depth
				*No detailed lithologic log could be provided
				from 12.0' to 20.0' because containment box
				was used.

EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL No. 1076

WELL INSTALLATION/COMPLETION FORM

O.R.N.L. MONITORING WELL PROGRAM

LOGGED BY: C. Allison Hodges
PROOFED BY: Michael L. Ebers

DRILLING COMPANY: Geotek
DRILLER: Rick Herron/ Larry Ledbetter
HELPER: Freddy Dixon

LOCATION WAG 7
ORNL GRID COORDINATES
N 17,882.744
E 25,858.893
ELEV. GROUND 779.09
ELEV. TOP STAINLESS STEEL CASING 781.15
DRILLING DATES:
STARTED: 6-29-89
FINISHED: 8-14-89

EQUIPMENT
- ☒ 6.0 INCH AUGER 8.0 L.F.
- ☒ 22.0 INCH AUGER 4.0 L.F.
- ☒ 80 INCH ROTARY 8.0 L.F.

MATERIALS USED

EST. VOL.	USED VOL.	
	10.0	FEET OF 2.0 IN. S.S. SCREEN
	11.46	FEET OF 2.0 IN. S.S. CASING
2.7	5.0	SACKS OF SAND
4.2	50	POUNDS OF BENTONITE PELLETS
3.5	5.0	SACKS OF CEMENT
	25.0	POUNDS OF POWDERED BENTONITE
	30.0	GALLONS OF WATER (CEMENTING)

REASON FOR DIFFERENCES BETWEEN ESTIMATED VOLUMES AND USED VOLUMES
Wash out zones.

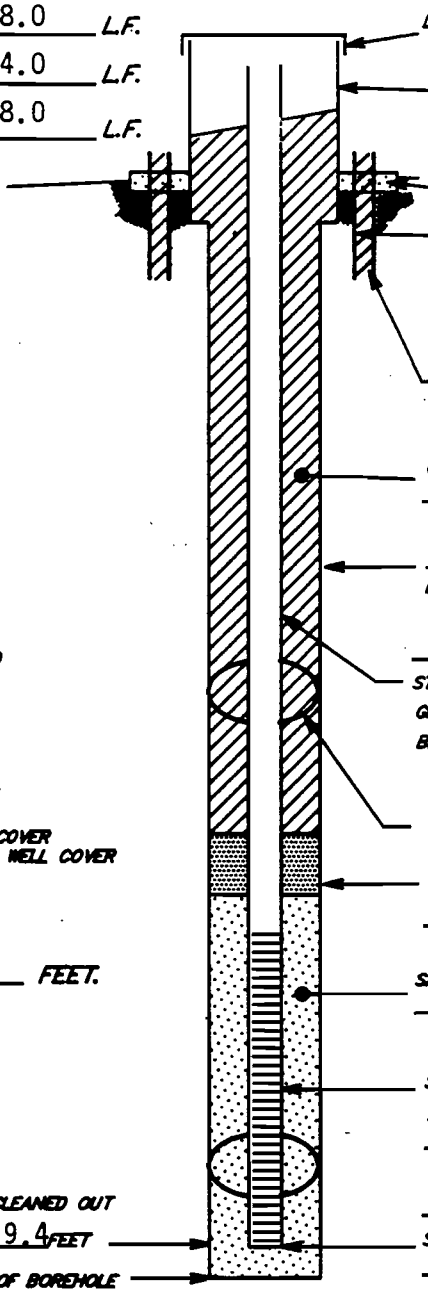
WELL COVER USED
- ☒ LOCKING STEEL COVER
- ☐ FLUSH MOUNTED WELL COVER
- ☐ OTHER

SILT TRAP USED YES ☐ NO ☒

MONITORING WELL PUMP BASE SET AT 17.2 FEET.

CENTRALIZERS AT 5.0 FEET.
20.0 FEET.
FEET.

NOTE:
ALL DEPTHS ARE MEASURED FROM GROUND SURFACE UNLESS OTHERWISE NOTED:



LOCKING STEEL COVER
10 INCH DIAMETER STEEL PROTECTIVE CASING 3.22 FT. ABOVE GROUND TO 2.0 FT. BELOW GROUND SURFACE

CONCRETE PAD

15 1/2 INCH DIVERTER CASING 0.0 FT. ABOVE GROUND SURFACE TO 4.0 FT. BELOW GROUND SURFACE

22 INCH BOREHOLE 0.0 TO 4.0 FEET

GROUT SEAL 0.0 TO 6.1 FEET

8.0 INCH DIAMETER BOREHOLE

2.0 INCH DIAMETER STAINLESS STEEL CASING 2.06 FT. ABOVE GROUND SURFACE TO 9.4 FT. BELOW GROUND SURFACE

CENTRALIZER (TYP.)

BENTONITE PELLET SEAL 6.1 TO 7.8 FEET

SAND PACK 7.8 TO 19.4 FEET

2.0 INCH DIAMETER STAINLESS STEEL 0.010 SLOTTED SCREEN 9.4 TO 19.4 FEET

N/A INCH DIAMETER STAINLESS STEEL SILT TRAP/CAP N/A TO N/A FEET

HOLE CLEANED OUT TO 19.4 FEET

BOTTOM OF BOREHOLE 20.0 FEET

TYPE D WELL

NOT TO SCALE

ERC / EDGE
Environmental and Energy Services Co.

WELL No. 1076

DATE: 8-14-89

MONITORING WELL MATERIALS CERTIFICATION

ITEM/MATERIAL		DATE USED	BATCH NUMBER
SAND		8-14-89	1
BENTONITE		8-14-89	1
STAINLESS STEEL SCREEN	(PREPACKAGED ☒ YES ☐ NO)	8-14-89	1
STAINLESS STEEL CASING	(PREPACKAGED ☒ YES ☐ NO)	8-14-89	1
STAINLESS STEEL CENTRALIZERS	(PREPACKAGED ☒ YES ☐ NO)	8-14-89	1
STAINLESS STEEL CAPS	(PREPACKAGED ☒ YES ☐ NO)	8-14-89	1
MONITORING WELL PUMP	(PREPACKAGED ☒ YES ☐ NO)	2-01-90	4
GROUT		8-14-89	1
WELL COVERS		8-14-89	1
SURFACE CASING			

COMMENTS:

OBSERVER SIGNATURE/DATE C. Allison Hodges 8-14-89
C. Allison Hodges

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1076

POST-WELL COMPLETION CHECKLIST

POST-WELL COMPLETION TASKS	COMPLIANCE DATE	COMPLIANCE INITIALS
1. MUD SCRAPED FROM AUGERS, SAMPLERS, AND ALL OTHER EQUIPMENT.	6-29-89	CAH
2. ALL MUD FROM RIG AND EQUIPMENT SCRAPINGS AND CUTTINGS DISPOSED OF IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED.	6-29-89	CAH
3. WELL DEVELOPED IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED AND DETAILS OF THE DEVELOPMENT ACTIVITY RECORDED.	2-01-90	DCL
4. DRILLING SITE PROPERLY CLEANED UP AFTER COMPLETION OF WELL INSTALLATION.	6-29-89	CAH

* RELEASE SPECIFIC TECHNICAL DIRECTIONS FOR REGULATORY COMPLIANCE MONITORING WELLS PHASE I, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, W.O. K-4147, APRIL 1987.

OBSERVER SIGNATURE/DATE C. Allison Hodges 6-29-89
C. Allison Hodges

D. Charles Lytle 2-01-90
D. Charles Lytle

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1076

LOCATION: WAG 1

MONITORING WELL DEVELOPMENT FORM

DEVELOPMENT DETAILS

METHOD OF DEVELOPMENT: Surging and Pumping

DEVELOPMENT BEGAN DATE: 1-30-90 TIME:

DEVELOPMENT ENDING DATE: 2-01-90

DEVELOPMENT OBSERVED BY: D. Charles Lytle

ONE WELL VOLUME: 7.3 GALLONS

TOTAL GALLONS PUMPED: 612 TOTAL WELL VOLUMES PUMPED: 77.0

INITIAL pH: 7.2 FINAL pH: 7.1

INITIAL CONDUCTIVITY (uS): 912 FINAL CONDUCTIVITY (uS): 825

DESCRIPTION OF INITIAL TURBIDITY: Muddy

DESCRIPTION OF FINAL TURBIDITY: Clear

FINAL MEASURED TURBIDITY: 20 NTU's

WELL APPROVED BY: R. C. Williams MMES

ODOR OF WATER: None

WATER DISCHARGED TO:
- ☒ GROUND SURFACE
- ☐ STORM SEWERS
- ☐ DRUMS
- ☐ TANK TRUCK
- ☐ STORAGE TANKS
- ☐ OTHER

INITIAL PRE-DEVELOPMENT WATER DEPTH: 2.5 feet from ground surface.

DEVELOPMENT OBSERVATIONS

OBSERVER SIGNATURE/DATE D. Charles Lytle 2-01-90

D. Charles Lytle

ERC / EDGE Environmental and Energy Services Co.

WELL NO. 1076
LOCATION: WAG 7
DATE: 1-30-90

MONITORING WELL DEVELOPMENT PROGRESS

ONE WELL VOLUME = 7.3 GALLONS

DATE	TIME	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	MEASURED TURBIDITY (NTU'S)	pH	CONDUCTIVITY (µS)	TOTAL GALLONS PUMPED	WELL VOLUMES PUMPED	COMMENTS
1-30-90	1300	98	Muddy	--	7.2	912	98	13.4	
1-30-90	1600	58	Muddy	--	7.2	822	156	21.4	
1-31-90	1100	130	Muddy	--	7.1	887	286	39.2	
1-31-90	1500	56	Muddy	--	7.0	887	342	46.8	
2-01-90	1530	220	Clear	20	7.1	825	562	77.0	
RESULTS AT END OF DEVELOPMENT		220	Clear	20	7.1	825	562	77.0	

COMMENTS Well was fast rechanger pumped more water than we could keep up with, passed and moved on.

OBSERVER SIGNATURE/DATE D. Charles Lytle 2-01-90
D. Charles Lytle

HYDRAULIC CONDUCTIVITY CALCULATIONS

PROGRAM SLUGT, VERSION 4.1, NOV. 1986

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:

(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3, NO.1 OF WRR ENTITLED "RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER")

(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED "A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS")

WELL NO.: 1076 DATE OF TEST: 3/09/90

PROJECT NO.: E221-002 CLIENT: MMES

SITE LOCATION: WAG 7

EDGE, INC. FIELD INVESTIGATOR: BRUCE MCMASTER

INPUT DATA ARE:

INNER CASING DIAMETER = 2.00 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 2.00 INCHES
DIAMETER OF DRILLED HOLE = 8.63 INCHES
LENGTH OF SCREEN OR INTAKE PORTION = 10.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 16.16 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 10.00 FEET
DEPTH TO STATIC WATER LEVEL BELOW REF. POINT = .96 FEET
ESTIMATED POROSITY OF GRAVEL PACK = .20
FALLING-HEAD INDEX = 1 ("1" IF FALLING,"0" IF RISING)
NUMBER OF DEPTH-TIME DATA POINTS = 32

HO WAS COMPUTED FROM INTERCEPT OF PLOT OF LOG(H) VS. TIME

SUCCESSIVE COMPUTED VALUES FOR HO (FEET)

1.8708
1.9087

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1076

HYDRAULIC CONDUCTIVITY CALCULATIONS

TIME (SEC)	DEPTH TO WATER (FEET)	HEAD (FEET)
10.00	3.830	2.870
20.00	3.630	2.670
30.00	3.490	2.530
40.00	3.370	2.410
50.00	3.260	2.300
60.00	3.160	2.200
75.00	3.040	2.080
90.00	2.930	1.970
105.00	2.830	1.870
120.00	2.740	1.780
150.00	2.590	1.630
180.00	2.460	1.500
240.00	2.250	1.290
300.00	2.090	1.130
360.00	1.940	.980
420.00	1.830	.870
480.00	1.730	.770
540.00	1.660	.700
600.00	1.590	.630
720.00	1.490	.530
840.00	1.450	.490
960.00	1.400	.440
1080.00	1.360	.400
1200.00	1.340	.380
1320.00	1.310	.350
1440.00	1.290	.330
1560.00	1.270	.310
1680.00	1.260	.300
1800.00	1.250	.290
1920.00	1.240	.280
2040.00	1.220	.260
2160.00	1.210	.250

****

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

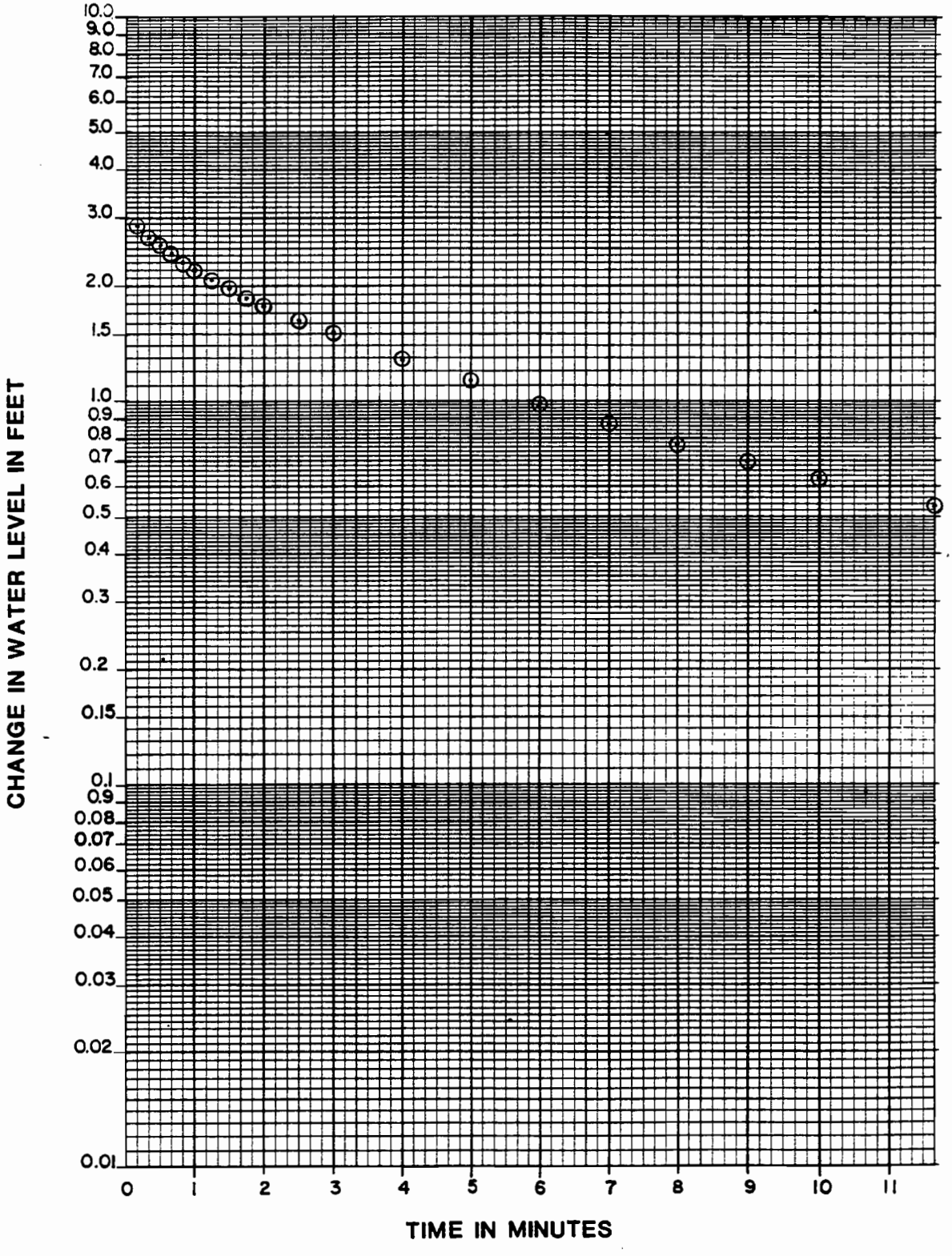
PERMEABILITY = 1.15E-06 FT/SEC = 3.52E-05 CM/SEC

TRANSMISSIVITY = 1.15E-05 FT**2/SEC

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1076

HYDRAULIC CONDUCTIVITY CALCULATIONS



EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 1076501

WELL NO.	LOCATION:	TYPE:
1076	WAG-7	Soil

SAMPLER:	SAMPLE INTERVAL:	DATE:	TIME:
C. Allison Hodgson (SIGNATURE)	2.5' - 3.0'	06-29-89	1055

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECEIVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
C. Allison Hodgson	07-05-89	2:05	EDGE	Christopher M. Walker	7/5/89	2:05	EDGe
Christopher M. Walker	7/5/89	2:28	EDGe	M. Ferguson	7/5/89	2:28	

TYPE OF SAMPLE: ☒ SPLIT SPOON CORES–SOIL ☐ AUGER CUTTINGS–SOIL ☐ AUGER CUTTINGS–ROCK
☐ AIR ROTARY CUTTINGS–ROCK ☐ DRILL WATER (NO AIR IN SAMPLE) ☐ OTHER _____

ALL SAMPLES ARE IMMEDIATELY PLACED IN I-CHEM SPECIALTY CLEANED CONTAINERS AND SEALED.

REMARKS: _____

EDGe Engineering, Design & Geosciences Group, Inc.
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P.O. Box 23010 Knoxville, Tn 37933-1010

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 1076 S02

WELL NO.	LOCATION:	TYPE:	
1076	WAG-7	Soil	
SAMPLER: C. Allison Hodges (SIGNATURE)	SAMPLE INTERVAL: 9.0 - 9.5	DATE: 06-29-89	TIME: 1137

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECEIVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
C. Allison Hodges	07-05-89	2:05	EDGe	Christopher M Walker	7/5/89	2:05	EDGe
Christopher M Walker	7/5/89	2:28	EDGe	M. Ferguson	7/5/89	2:28	

TYPE OF SAMPLE: ☑ SPLIT SPOON CORES–SOIL ☐ AUGER CUTTINGS–SOIL ☐ AUGER CUTTINGS–ROCK
☐ AIR ROTARY CUTTINGS–ROCK ☐ DRILL WATER (NO AIR IN SAMPLE) ☐ OTHER _____

ALL SAMPLES ARE IMMEDIATELY PLACED IN I-CHEM SPECIALTY CLEANED CONTAINERS AND SEALED.

REMARKS: _____

EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 1076 S03

WELL NO.	LOCATION:	TYPE:
1076	WAG - 7	Soil

SAMPLER:	SAMPLE INTERVAL:	DATE:	TIME:
C. Allison Hodges (SIGNATURE)	11.5-12.0	06-29-89	1150

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECEIVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
C. Allison Hodges	07-05-89	2:05	EDGE	Christopher M. Waller	7/5/89	2:05	EDGe
Christopher M. Waller	7/5/89	2:28	EDGe	M. Ferguson	7/5/89	2:28	

TYPE OF SAMPLE: ☒ SPLIT SPOON CORES–SOIL ☐ AUGER CUTTINGS–SOIL ☐ AUGER CUTTINGS–ROCK
☐ AIR ROTARY CUTTINGS–ROCK ☐ DRILL WATER (NO AIR IN SAMPLE) ☐ OTHER _____

ALL SAMPLES ARE IMMEDIATELY PLACED IN I–CHEM SPECIALTY CLEANED CONTAINERS AND SEALED.

REMARKS: _____

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CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 1076W01

WELL NO.	LOCATION:	TYPE:
1076	WAG-7	WATER

SAMPLER:	SAMPLE INTERVAL:	DATE:	TIME:
C. Allison Hodge (SIGNATURE)	N/A	08-14-89	0920

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECEIVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
C. Allison Hodge	8-15-89	8:30	EDGE	J.C. Pruitt	8-15-89	0837	

TYPE OF SAMPLE: ☐ SPLIT SPOON CORES–SOIL ☐ AUGER CUTTINGS–SOIL ☐ AUGER CUTTINGS–ROCK
☐ AIR ROTARY CUTTINGS–ROCK ■ DRILL WATER (NO AIR IN SAMPLE) ☐ OTHER _____

ALL SAMPLES ARE IMMEDIATELY PLACED IN I-CHEM SPECIALTY CLEANED CONTAINERS AND SEALED.

REMARKS: _____

1.0 General Information

1.1 Well Location

Monitoring well number 1077 is located in WAG 7. It is located approximately 150' northwest of abandoned waste pit #2 and approximately 350' west of abandoned waste pit #3. The location is shown on ORNL drawing number C3E20004 A075. Survey coordinates for this well are N 17872.008, E 25815.088 (X-10 grid) or latitude 35° 54' 32.93" and longitude 84° 19' 25.55". Coordinate data were provided by Martin Marietta Energy Systems. The method used for conversion from X-10 grid to Tennessee-Lambert State Plane Coordinates came from the publication "Tennessee Valley Authority Data Services Branch and Mapping Services Branch, Oak Ridge, Tennessee, DOE Plant Control, November 6, 1985, Field Book: ESS-3115, pp. 1-20." The latitude and longitude were calculated by Adams Craft Herz Walker Engineering, Inc., using methods from the U.S. Coast and Geodetic Survey Publication 62-4, "State Plane Coordinates by Automatic Data Processing."

1.2 Drilling Information

Well number 1077 was drilled by Geotek Engineering Company. A Mobile B-50 rig and an Ingersol Rand T-4 rig were used to drill this boring for monitor well installation under operation of Rick Herron

and Larry Ledbetter with the assistance of Freddy Dixon and James Shelton. Drilling commenced on 6/21/89 and was finished on 8/8/89. Paragraph 2.4.1 includes a detailed discussion of the well installation and a well schematic is included on the well installation/completion form. A synopsis of the drilling activity follows:*

6/19/89: Auger rig, tools and pan were deconed and mobilized to the site. Plastic was placed over work area and the rig was set up. A 22.0" auger was used to auger to 4.0' in order to set a 15 1/4" diverter casing. No radiation detected. HP says its o.k. and cuttings do not have to be contained. Photovac reading down borehole are 0.03 ppm. Auger cuttings read 0.01 ppm. The augers were removed and the diverter casing was installed and grouted.

7/27/89: The T-4 and drilling equipment were deconed, mobilized to the site and set up. A containment box was hooked up and a 14.0" borehole was drilled from 4.0' to 11.5'. Drilling was stopped because the water pump broke.

7/28/89: The water pump was repaired and the borehole was extended to a total depth

* This information was typed directly from field notes and was edited only when necessary for clarification.

of 14.0'. The 10.0" surface casing was installed to a total depth of 14.0' with a bentonite seal to 11.1'. The 10.0" was then grouted using 6 bags of cement and 30 lbs. of bentonite.

8/8/89: The rig and equipment were deconed, mobilized to the site and set up along with the containment box. An 8.0" tricone bit was used to drill with. While loading a rod during drilling, a leak developed in a hydraulic hose. The hose only leaks when the carousel is in motion. No fluid has leaked into the borehole. The hose was repair on site as per R.C. Williams. The hole was covered and the mast was let down so the hose could be repaired without jeopardizing the integrity of the well. After the hose was repaired, drilling continued and the borehole was extended to a depth of 72.5'. Water and air samples were taken at 47.0'. The borehole was cleaned and allowed to recharge for 1 hour. When the water level was checked, no water was detected. As per ERC and R.C. Williams the boring was drilled 10.0' more to 82.5'. After 30 minutes of recharge, the water level was at 36.0' below surface and rising. The borehole was cleaned and the rods removed. Mike Ebers was on site to complete the well.

Fifteen feet of 4.0" stainless steel screen and 70.0' of 4.0" stainless steel casing were installed to a depth of 82.60', centralizers were placed at 82, 64, 44, 24 and 4.0'. The sand was tremied in with water to 63.3'. Bentonite was poured into a depth of 60.3', 4.3 sacks of sand and 1 bucket of bentonite were used. When the air sample was checked under the ultraviolet light, some possible oil stains were detected. J. Greene sent them to the lab to be analyzed.

8/9/89: The borehole was tremied grouted under the supervision of James Lamb. Twelve bags of cement and 60 lbs. of bentonite were used.

9/5/89: The well was tested with the Go-NoGo" gauge. The gauge would not go past 74.5'.

9/6/89: The well was tested with a water pump to see if it would fit. The pump went to the total depth and was passed by R.C. Williams.

This well was logged by ERC Environmental and Energy Services Co., Inc., hydrogeologist C. Allison Hodges. All well construction materials and supplies were from Martin Marietta Energy Systems approved batches. The batch origin of individual items is shown on the included Monitoring Well Materials Certification form.

2.0 Technical Information

2.1 Decontamination Procedures

The drilling rig, down hole tools, surface casing, stainless steel screen, stainless steel casing, centralizers, and stainless steel silt trap underwent the cleaning decontamination procedures outlined in the drilling specifications (Release Specific Technical Directions for Regulatory Compliance Monitoring Wells Phase 1, Oak Ridge National Laboratory, Oak Ridge, W.O., K-4147, April 1987, pgs, 2-4). A checklist of the cleaned materials is included with this data package.

2.2 Geology

WAG 7 is located in Melton Valley, which is in the Valley and Ridge Physiographic Province of East Tennessee. WAG 7 is underlain by shale, siltstone, and limestone of the Conasauga Group. The Conasauga Group in the Oak Ridge area consists of six formations. They are, in ascending order, the Pumpkin Valley Shale, Rutledge Limestone, Rogersville Shale, Maryville Limestone, Nolichucky Shale and the Maynardville Limestone. These rocks have undergone extensive deformation and contain many folds and faults resulting in varying strike and dips. The average strike and dip appears to be consistent with the regional strike of 56° northeast and dips of about 30° to the southeast.

2.3 Sample Collection

One sample was collected during drilling, placed in an I-CHEM specialty cleaned glass container, sealed and submitted to Sample Receiving, Analytical Chemistry Division, Bldg. 4500S, ORNL. This drill water sample, 1077W01, was collected from the water pump on the drill rig on 8/8/89. Analytical results for the water sample described above can be obtained from the Remedial Action Program data base at ORNL.

2.4 Installation and Development

2.4.1 Installation

This was a type B well. A twenty two-inch diameter boring was augered from ground surface to 4.0 feet. A fifteen-inch diverter casing was installed from surface to 4.0 feet below ground surface and grouted in place. The boring was then extended using a fourteen-inch air rotary tricone roller bit from 4.0 feet to 14.0 feet. A ten-inch diameter string of decontaminated steel surface casing was installed from 0.0 feet to 14.0 feet, sealed with a 2.9-foot bentonite pellet layer from 11.1 feet to 14.0 feet, and tremie grouted in place. The surface casing minimizes potential cross contamination between the regolith and bedrock water bearing zones. After the

surface casing was installed, the air rotary method was used to drill an eight-inch diameter boring to a total depth of 82.6 feet. A four-inch diameter stainless steel screen with welded bottom cap was installed from 67.6 feet to 82.6 feet. A four-inch diameter stainless steel casing was installed from the top of the screen at 67.6 feet and extended 2.27 feet above ground surface. A sandpack was tremied into the annular space from 63.3 to 82.6 feet, with a 3.0-foot bentonite pellet seal poured into the annular space above the sandpack from 60.3 to 63.3 feet. The annular space from the top of the bentonite seal to the surface was tremie grouted with a cement/bentonite slurry. A detailed schematic of the well is included on the well installation/completion form.

2.4.2 Well Development

Well number 1077 was developed to remove drill cuttings, silt, and other fines from the monitoring well. The monitoring well was developed using a Geoguard pump with an air compressor. All pumps were cleaned prior to use according to specified cleaning procedures (see Paragraph 2.1). The well was developed until a measured total of 240 gallons of water had been evacuated and the clarity of the discharge water was approved by the company representative. The final turbidity value measured was 4.0 NTU's. A development form showing the exact method of development and other pertinent data is appended.

2.4.3 Installation of Dedicated Monitoring Well Pump

After the well was developed, a Geoguard Model No. 5614 dedicated monitoring well pump was installed on 2/8/90 at a depth of 80.1 feet below ground surface. These pumps are decontaminated at American Sigma and are sent prepackaged. A copy of the pump certification is kept on file at ORNL.

2.5 Hydraulic Conductivity Testing

Well number 1077 was tested for the determination of hydraulic conductivity of the aquifer in the vicinity of the well screen. This was accomplished by instantaneously removing a known quantity of water from the monitoring well and measuring the recovery of the water level over time. The changing water levels were measured using a Druck 15 psig pressure transducer and an Omnidata Datapod II data recorder. The hydraulic conductivity value of 2.56×10^{-6} cm/second (shown as permeability on the hydraulic conductivity calculations) was calculated using the Bouwer and Rice method. A computer printout of the hydraulic conductivity calculations is included in this data package.

ERC / EDGE
Environmental and Energy Services Co.

WELL No. 1077

PRE-DRILLING CHECKLIST FOR MONITORING WELLS

PRE-DRILLING TASKS		COMPLIANCE DATE	COMPLIANCE INITIALS
1.	EXCAVATION PERMIT OBTAINED.	6-21-89	CAH
2.	ALL EQUIPMENT HAS BEEN CLEANED BEFORE DRILLING.	6-19-89	CAH
3a.	SCREEN AND CASINGS HAVE BEEN WASHED, STEAMED, RINSED WITH DE-IONIZED OR DISTILLED WATER, RINSED WITH ISOPROPYL ALCOHOL, WRAPPED WITH PROTECTIVE COVERING AND STORED OFF THE GROUND.	N/A	
3b.	PRE-PACKAGED SCREENS, CASINGS AND CENTRALIZERS WERE USED.	8-08-89	CAH
4.	WORK AREA FOR SAMPLE EXAMINATION COVERED WITH CLEAN POLYETHYLENE.	6-21-89	CAH
5.	CLEAN KNIVES, GLOVES, SAMPLE JARS AND LABELS ON-HAND.	6-21-89	CAH
6.	POLYETHYLENE COVER IN PLACE OVER HOLE.	6-21-89	CAH

ADDITIONAL NOTES/OBSERVATIONS:

OBSERVER SIGNATURE/DATE C. Allison Hodges 6-21-89

C. Allison Hodges

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1077

DECONTAMINATION CHECKLIST
DRILLING EQUIPMENT

EQUIPMENT	SCRAPE	STEAM CLEAN	STEAM RINSE	ISOPROPYL ALCOHOL RINSE	DEIONIZED WATER RINSE
RIG	X	X	X	N/A	N/A
AUGERS	X	X	X	X	X
BITS	X	X	X	X	X
RODS	X	X	X	X	X
SAMPLERS	X	X	X	X	X
PIPES	X	X	X	X	X
WORK TOOLS	X	X	X	X	X
AUGER PINS	X	X	X	X	X

OBSERVER SIGNATURE/DATE C. Allison Hodges 6-19-89

C. Allison Hodges

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1077

ORNL MONITORING WELL LOG

LOCATION: WAG 7
DRILLER: Rick Herron/Larry Ledbetter
HELPER: Freddy Dixon/ James Shelton
DRILL: Mobile B-50/Ingersol Rand T-4

DATE: START: 6-21-89
FINISH: 8-08-89
LOGGED BY: C. Allison Hodges
HEALTH PHYSICIST: W. H. Shinpaugh/ L. C. Johnson

TYPE DRILLING: Auger/Air Rotary
LUBRICANT TYPE: Green Stuff
No. SAMPLES TAKEN: None
TYPE: N/A
CONTAINMENT TYPE: Plastic, Pan, Containment Box

THICKNESS OF SOIL (REFUSAL DEPTH): 9.5'
DEPTH DRILLED IN ROCK: 73.1'
TOTAL DEPTH OF WELL: 82.6'

DRILLING FLUID SAMPLES:
TYPE: Water
DATE: 8-08-89

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
0.0	1.0			Gravel (fill material) and roots.
1.0	3.0			Clay, mottled, dark yellowish brown and dark
				yellowish orange, moist - Augered.
3.0	4.0			Clay, moderate yellowish brown, with shale
				fragments (shale), very moist.
4.0	9.5			*Soft, regular, fast drilling.
9.5	14.0			Hard, rough, slow drilling: limestone. Bit
				locked up at 11.0.
14.0	20.0			Hard, regular, fast drilling. Limestone.
20.0	31.5			Hard irregular drilling. Slower.
31.5	32.5			Very hard drilling. Slow at 32.0', bit bouncing.
32.5	47.0			Smooth, even, fast drilling.
47.0	59.0			Hard, even drilling, fast.
59.0	62.0			Very hard, even drilling, slow.
62.0	67.5			Hard, rough, uneven drilling.
67.5	74.0			Hard, even, fast drilling. Bit locked up at
				74.0'.
74.0	78.0			Hard, irregular, drilling. Slow.
78.0	82.6			Hard, even drilling, fast.
	82.6			Total Depth

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1077

ORNL MONITORING WELL LOG

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
				*No detailed lithologic logs could be pro-
				vided for the interval from 4.0' to 82.6' T. D.
				due to the use of a containment box.

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1077

WELL INSTALLATION/COMPLETION FORM

O.R.N.L. MONITORING WELL PROGRAM

LOGGED BY: C. Allison Hodges
PROOFED BY: Michael L. Ebers

DRILLING COMPANY: Geotek
DRILLER: Rick Herron/ Larry Ledbetter
HELPER: James Shelton/ Freddy Dixon

DRILLING METHOD:
- ☒ 22.0 INCH AUGER 4.0' L.F.
- ☐ _____ INCH AUGER _____ L.F.
- ☒ 8.0 INCH ROTARY 78.6 L.F.
- ☐ _____ INCH ROTARY _____ L.F.

LOCATION: WAG 7
ORNL GRID COORDINATES
N 17,872.008
E 25,815.088
ELEV. GROUND 776.27
ELEV. TOP STAINLESS STEEL CASING 778.54

DRILLING DATES:
STARTED: 6-19-89
FINISHED: 8-09-89

MATERIALS USED

EST. VOL	USED VOL	
	25.0'	POUNDS OF BENTONITE PELLETS (SURFACE CASING SEAL)
	14.0	FT. OF 10.0 IN. SURFACE CASING
3.4	6.0	SACKS OF CEMENT (SURFACE CASING)
	30.0	POUNDS OF POWERED BENTONITE (SURFACE CASING)
	45.0	GALLONS OF WATER (SURFACE CASING)
	70.0	FT. OF 4 IN. DIA. STAINLESS STEEL CASING
	15.0	FT. OF 4 IN. DIA. STAINLESS STEEL SCREEN
4.8	4.3	SACKS OF SAND
50.0	50.0	POUNDS OF BENTONITE PELLETS
9.0	12.0	SACKS OF CEMENT (WELL CASING)
	60	POUNDS OF POWERED BENTONITE (WELL CASING)
	84	GALLONS OF WATER (WELL CASING)
	3.1	FT. OF 10 IN. STEEL PROTECTIVE CASING

REASON FOR DIFFERENCES BETWEEN ESTIMATED VOLUMES AND USED VOLUMES
Irregular boring diameter and spillage.

SURFACE CASING TREMIE GROUTED YES ☒ NO ☐

STAINLESS STEEL CASING TREMIE GROUTED YES ☒ NO ☐

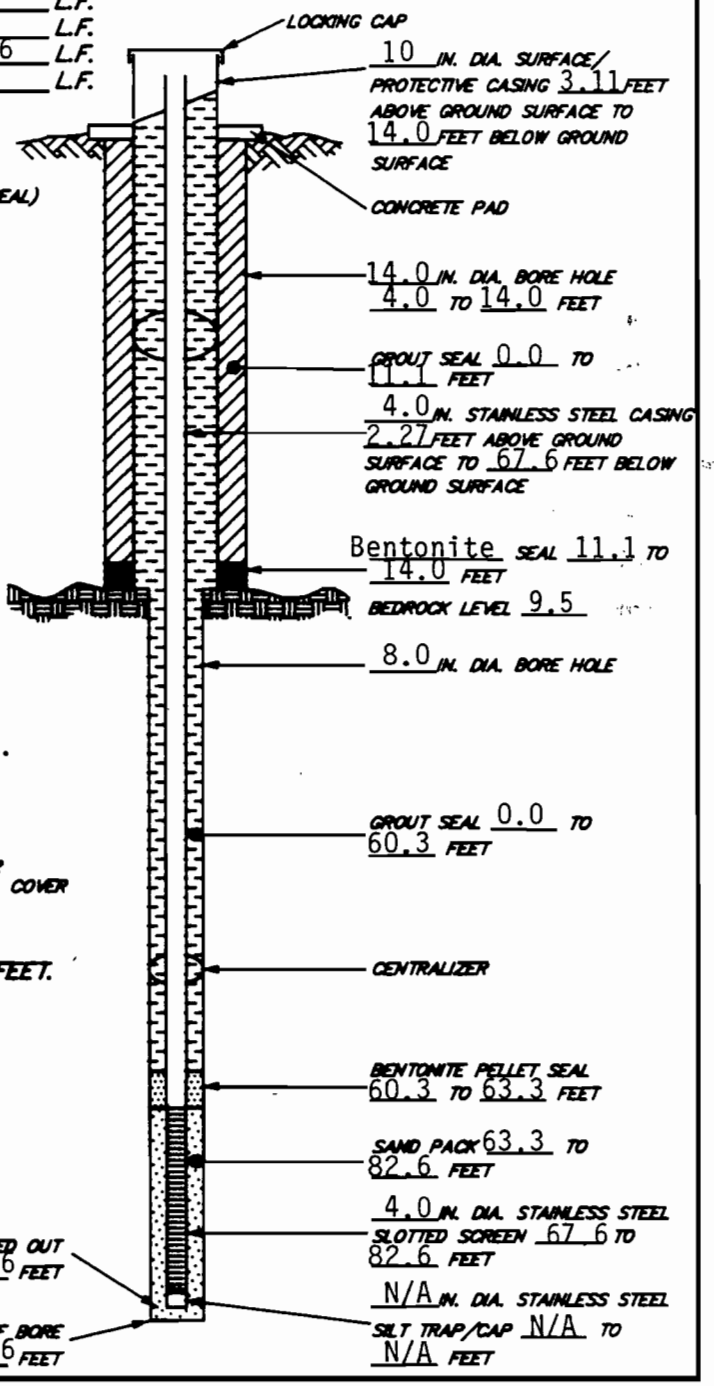
WELL COVER USED
- ☒ LOCKING STEEL COVER
- ☐ FLUSH MOUNTED WELL COVER
- ☐ OTHER

SILT TRAP USED YES ☐ NO ☒

MONITORING WELL PUMP BASE SET AT 80.1 FEET.

CENTRALIZERS AT 4.0 FEET.
24.0 FEET.
44.0 FEET.
64.0 FEET
82.0 FEET

NOTE:
ALL DEPTHS ARE MEASURED FROM GROUND SURFACE UNLESS OTHERWISE NOTED:



TYPE B WELL

ERC / EDGE
Environmental and Energy Services Co.

WELL No. 1077

DATE: 7-28-89

MONITORING WELL MATERIALS CERTIFICATION

ITEM/MATERIAL		DATE USED	BATCH NUMBER
SAND		8-08-89	1
BENTONITE		7-28-89	1
STAINLESS STEEL SCREEN	(PREPACKAGED ☒ YES ☐ NO)	8-08-89	1
STAINLESS STEEL CASING	(PREPACKAGED ☒ YES ☐ NO)	8-08-89	1
STAINLESS STEEL CENTRALIZERS	(PREPACKAGED ☒ YES ☐ NO)	8-08-89	1
STAINLESS STEEL CAPS	(PREPACKAGED ☒ YES ☐ NO)	8-08-89	1
MONITORING WELL PUMP	(PREPACKAGED ☒ YES ☐ NO)	2-08-90	4
GROUT		7-28-89	1
		8-09-89	1
WELL COVERS		8-08-89	1
SURFACE CASING		7-28-89	1

COMMENTS:

OBSERVER SIGNATURE/DATE C. Allison Hodges 8-09-89

C Allison Hodges

ERC / EDGE
Environmental and Energy Services Co.

WELL No. 1077

POST-WELL COMPLETION CHECKLIST

POST-WELL COMPLETION TASKS	COMPLIANCE DATE	COMPLIANCE INITIALS
1. MUD SCRAPED FROM AUGERS, SAMPLERS, AND ALL OTHER EQUIPMENT.	6-21-89	CAH
2. ALL MUD FROM RIG AND EQUIPMENT SCRAPINGS AND CUTTINGS DISPOSED OF IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED.	6-21-89	CAH
3. WELL DEVELOPED IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED AND DETAILS OF THE DEVELOPMENT ACTIVITY RECORDED.	2-08-90	DCL
4. DRILLING SITE PROPERLY CLEANED UP AFTER COMPLETION OF WELL INSTALLATION.	8-09-89	CAH

* RELEASE SPECIFIC TECHNICAL DIRECTIONS FOR REGULATORY COMPLIANCE MONITORING WELLS PHASE I, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, W.O. K-4147, APRIL 1987.

OBSERVER SIGNATURE/DATE C. Allison Hodges 8-09-89
C. Allison Hodges

D. Charles Lytle 2-08-90
D. Charles Lytle

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1077

LOCATION: WAG 7

MONITORING WELL DEVELOPMENT FORM

DEVELOPMENT DETAILS

METHOD OF DEVELOPMENT: Surging and Pumping

DEVELOPMENT BEGAN DATE: 2-01-90 TIME:

DEVELOPMENT ENDING DATE: 2-08-90

DEVELOPMENT OBSERVED BY: D. Charles Lytle

ONE WELL VOLUME: 68.8 GALLONS

TOTAL GALLONS PUMPED: 240 TOTAL WELL VOLUMES PUMPED: 3.5

INITIAL pH: 8.1 FINAL pH: 7.3

INITIAL CONDUCTIVITY (uS): 630 FINAL CONDUCTIVITY (uS): 615

DESCRIPTION OF INITIAL TURBIDITY: Cloudy

DESCRIPTION OF FINAL TURBIDITY: Clear

FINAL MEASURED TURBIDITY: 4.0 NTU's

WELL APPROVED BY: R. C. Williams MMES

ODOR OF WATER: None

WATER DISCHARGED TO:
- ☒ GROUND SURFACE
- ☐ STORM SEWERS
- ☐ DRUMS
- ☐ TANK TRUCK
- ☐ STORAGE TANKS
- ☐ OTHER

INITIAL PRE-DEVELOPMENT WATER DEPTH: +2.2 feet above ground surface.

DEVELOPMENT OBSERVATIONS

OBSERVER SIGNATURE/DATE D. Charles Lytle

D. Charles Lytle 2-08-90

ERC / EDGE Environmental and Energy Services Co.

WELL NO. 1077
LOCATION: WAG 7
DATE: 02-01-90

MONITORING WELL DEVELOPMENT PROGRESS

ONE WELL VOLUME = 68.8 GALLONS

DATE	TIME	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	MEASURED TURBIDITY (NTU'S)	pH	CONDUC-TIVITY (uS)	TOTAL GALLONS PUMPED	WELL VOLUMES PUMPED	COMMENTS
2-01-90	1530	24	Cloudy	--	8.1	630	24		
2-02-90	1405	84	Cloudy	--	7.3	671	108	1.6	
2-05-90	0915	48	Cloudy	--	8.4	579	156	2.3	
2-06-90	1400	74	Slightly Cloudy	--	7.5	756	230	3.3	
2-08-90	1500	10	Clear	3.0	7.3	615	240	3.5	
RESULTS AT END OF DEVELOPMENT			Clear	3.0	7.3	615	240	3.5	

COMMENTS Water cleared even after surging; passed and moved off hole.

OBSERVER SIGNATURE/DATE D. Charles Lytle 2-08-90
D. Charles Lytle

MWFORM06.DWG

HYDRAULIC CONDUCTIVITY CALCULATIONS

PROGRAM SLUGT, VERSION 4.1, NOV. 1986

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:

(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3, NO.1 OF WRR ENTITLED "RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER")

(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, N0.3 OF WRR ENTITLED "A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS")

WELL NO.: 1077 DATE OF TEST: 3/19/90

PROJECT NO.: E221-002 CLIENT: MMES

SITE LOCATION: WAG 7

EDGE, INC. FIELD INVESTIGATOR: BRUCE MCMASTER

INPUT DATA ARE:

INNER CASING DIAMETER = 4.00 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 4.00 INCHES
DIAMETER OF DRILLED HOLE = 8.63 INCHES
LENGTH OF SCREEN OR INTAKE PORTION = 15.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 84.80 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 15.00 FEET
DEPTH TO STATIC WATER LEVEL BELOW REF. POINT = 9.99 FEET
ESTIMATED POROSITY OF GRAVEL PACK = .20
FALLING-HEAD INDEX = 0 ("1" IF FALLING,"0" IF RISING)
NUMBER OF DEPTH-TIME DATA POINTS = 32

H0 WAS COMPUTED FROM INTERCEPT OF PLOT OF LOG(H) VS. TIME

SUCCESSIVE COMPUTED
VALUES FOR H0
(FEET)

8.9696
8.9706

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1077

HYDRAULIC CONDUCTIVITY CALCULATIONS

TIME (SEC)	DEPTH TO WATER (FEET)	HEAD (FEET)
10.00	1.000	8.990
20.00	1.010	8.980
30.00	1.010	8.980
40.00	1.010	8.980
50.00	1.020	8.970
60.00	1.020	8.970
75.00	1.030	8.960
90.00	1.030	8.960
105.00	1.040	8.950
120.00	1.040	8.950
150.00	1.050	8.940
180.00	1.060	8.930
240.00	1.080	8.910
300.00	1.100	8.890
360.00	1.100	8.890
420.00	1.120	8.870
480.00	1.140	8.850
540.00	1.150	8.840
600.00	1.160	8.830
720.00	1.180	8.810
840.00	1.210	8.780
960.00	1.240	8.750
1080.00	1.260	8.730
1200.00	1.280	8.710
1320.00	1.300	8.690
1440.00	1.320	8.670
1560.00	1.350	8.640
1680.00	1.370	8.620
1800.00	1.380	8.610
1920.00	1.400	8.590
2040.00	1.420	8.570
2160.00	1.440	8.550

****

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

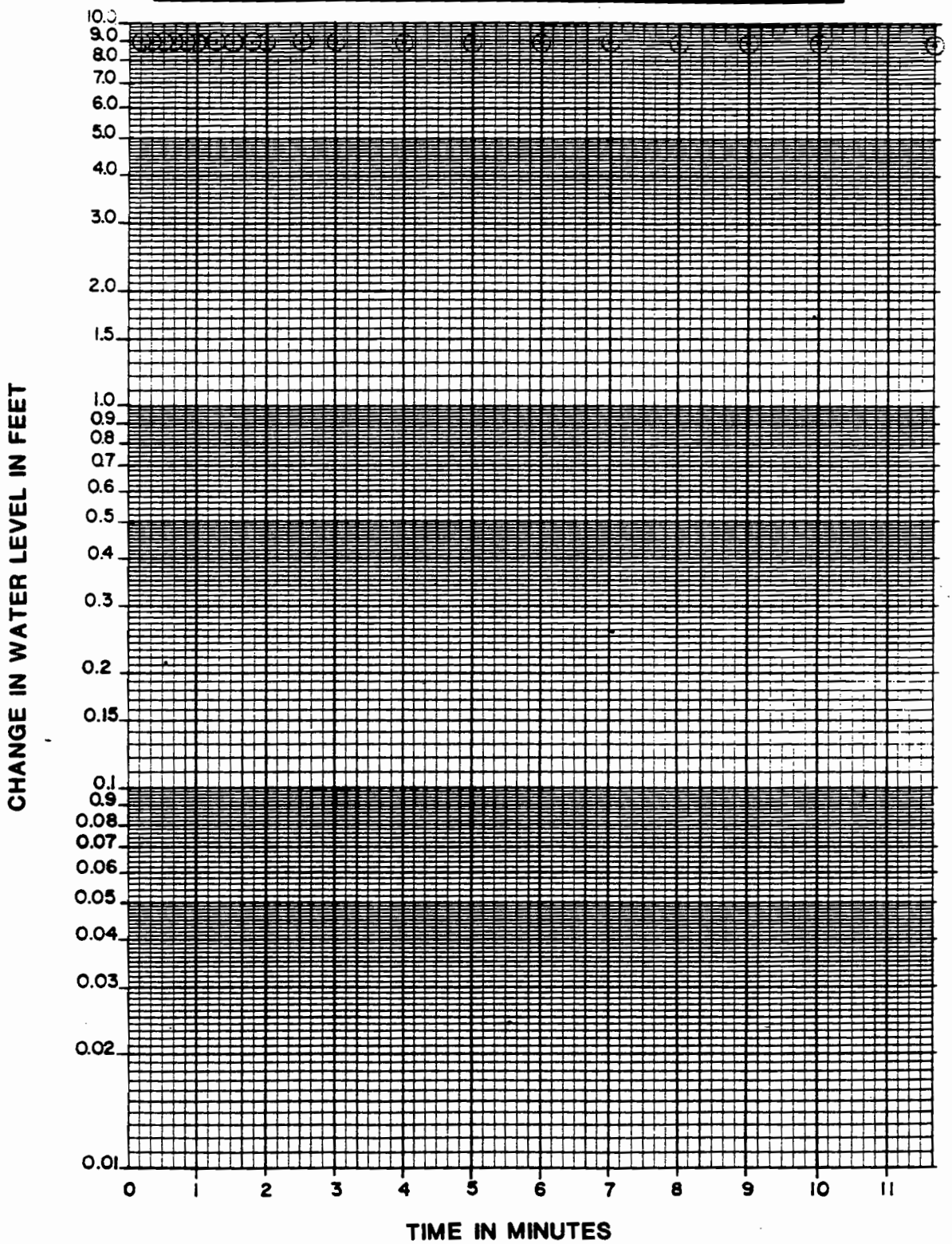
PERMEABILITY = 8.41E-08 FT/SEC = 2.56E-06 CM/SEC

TRANSMISSIVITY = 1.26E-06 FT**2/SEC

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1077

HYDRAULIC CONDUCTIVITY CALCULATIONS



EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 1077w01

WELL NO.	LOCATION:	TYPE:
1077	WAG-7	WATER

SAMPLER:	SAMPLE INTERVAL:	DATE:	TIME:
C. Allison Hodgson (SIGNATURE)		08-08-89	1325

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECEIVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
C. Allison Hodgson	8-15-89	8:37	EDGE	J.C. Pruit	8-15-89	08:37	

TYPE OF SAMPLE: ☐ SPLIT SPOON CORES–SOIL ☐ AUGER CUTTINGS–SOIL ☐ AUGER CUTTINGS–ROCK
☐ AIR ROTARY CUTTINGS–ROCK ■ DRILL WATER (NO AIR IN SAMPLE) ☐ OTHER _____

ALL SAMPLES ARE IMMEDIATELY PLACED IN I-CHEM SPECIALTY CLEANED CONTAINERS AND SEALED.

REMARKS: _____

1.0 General Information

1.1 Well Location

Monitoring well number 1078 is located in WAG 7. It is located along the west side of WAG 7 approximately 400' northwest of chemical waste pit #4. The location is shown on ORNL drawing number C3E20004 A075. Survey coordinates for this well are N 17406.937, E 25613.689 (X-10 grid) or latitude 35° 54' 28.00" and longitude 84° 19' 24.44". Coordinate data were provided by Martin Marietta Energy Systems. The method used for conversion from X-10 grid to Tennessee-Lambert State Plane Coordinates came from the publication "Tennessee Valley Authority Data Services Branch and Mapping Services Branch, Oak Ridge, Tennessee, DOE Plant Control, November 6, 1985, Field Book: ESS-3115, pp. 1-20." The latitude and longitude were calculated by Adams Craft Herz Walker Engineering, Inc., using methods from the U.S. Coast and Geodetic Survey Publication 62-4, "State Plane Coordinates by Automatic Data Processing."

1.2 Drilling Information

Well number 1078 was drilled by Geotek Engineering Company. A Mobile B-50 rig and an Ingersol Rand rig were used to drill this boring for monitor well installation under operation of George Akins and Larry Ledbetter with the assistance of Rick Herron and Freddy Dixon.

Drilling commenced on 7/10/89 and was finished on 8/15/89. Paragraph 2.4.1 includes a detailed discussion of the well installation and a well schematic is included on the well installation/ completion form. A synopsis of the drilling activity follows:*

7/7/89: The auger rig, tools, pan, and sampling equipment were deconed.

7/10/89: The rig was mobilized to the site, plastic placed on the ground over the work area. Split spoons were pushed from .5' to 16.5'. Three samples were taken from the spoons. No bulk density samples could be taken because the samples were not uniform enough. A six-inch boring was then augered to 20.0' (total depth). While drilling L.C. Johnson detected higher background readings within the borehole on the left side (the side closest to the trench line). However, the soil readings showed nothing. The well cannot be installed at this date because the deep well (1079) has not been installed. There is a possibility that the air rotary drilling will interfere with this well if it is installed first. Borehole was covered with plastic.

* This information was typed directly from field notes and was edited only when necessary for clarification.

7/31/89: Auger rig and drilling equipment were deconed and mobilized to the site. The boring has caved and is filled with mud and water to 2.0' from surface. The boring needs to be cleaned before the well is set. Before the rig was set up, the boring was checked for contamination. Carl Stooksbury checked the area and found 0.2 mR/Hr (at 1/2") levels of radionuclide contamination at the boring. Before drilling is allowed, the water must be sampled. When drilling is allowed all materials out of the boring must be contained.

8/15/89: The T-4 and drilling equipment were mobilized to the site and set up. Boring has caved to 9.0' and the water level is 1.0' below surface. Most of the water in the borehole was removed by using a pump. All the water was contained in 55-gallon drums. The cuttings and thick mud were removed by using a bailer. All of the mud and cuttings were also contained. The borehole was cleaned out to 19.0'. A 10-ft. section of 2-inch stainless steel screen was then installed along with a 10 ft. section of 2-inch stainless steel casing to a depth of 18.75'. Centralizers were placed at 18.0' and

5.0'. Sand was then tremied in with water to 7.50'. Bentonite was poured into the annulus to 5.50'. Five bags of sand and 50 lbs. of bentonite were used.

8/16/89: The annulus was grouted to within 2.0' of the surface using 2 bags of cement and 10 lbs. of bentonite. James Lamb of ERC documented the activities. * The barrels were sampled and found to have Beta contamination.

8/30/89: The 2-inch casing was cut and filed. Geotek and CAH were present.

9/5/89: The well was tested with the "Go-NoGo" gauge and passed by R.C. Williams.

This well was logged by ERC Environmental and Energy Services Co., Inc., hydrogeologist C. Allison Hodges. All well construction materials and supplies were from Martin Marietta Energy Systems approved batches. The batch origin of individual items is shown on the included Monitoring Well Materials Certification form.

2.0 Technical Information

2.1 Decontamination Procedures

The drilling rig, down hole tools, surface casing, stainless steel screen, stainless steel casing, centralizers, and stainless steel silt trap

underwent the cleaning decontamination procedures outlined in the drilling specifications (Release Specific Technical Directions for Regulatory Compliance Monitoring Wells Phase 1, Oak Ridge National Laboratory, Oak Ridge, W.O., K-4147, April 1987, pgs, 2-4). A checklist of the cleaned materials is included with this data package.

2.2 Geology

WAG 7 is located in Melton Valley which is in the Valley and Ridge Physiographic Province of East Tennessee. WAG 7 is underlain by shale, siltstone, and limestone of the Conasauga Group. The Conasauga Group in the Oak Ridge area consists of six formations. They are, in ascending order, the Pumpkin Valley Shale, Rutledge Limestone, Rogersville Shale, Maryville Limestone, Nolichucky Shale and the Maynardville Limestone. These rocks have undergone extensive deformation and contain many folds and faults resulting in varying strike and dips. The average strike and dip appears to be consistent with the regional strike of 56° northeast and dips of about 30° to the southeast.

2.3 Sample Collection

Three soil samples were collected during drilling, placed in I-CHEM specialty cleaned glass containers, sealed and submitted to Sample

Receiving, Analytical Chemistry Division, Bldg. 4500S, ORNL. Chain of custody forms for these samples are included with this data package. Soil sample 1078S01 was collected in the split spoon interval from .5' to 2.5' on 7/10/89, soil sample 1078S02 was collected in the split spoon interval from 12.0' to 14.0' on 7/10/89, and soil sample 1078S03 was collected in the split spoon interval from 14.0' to 16.0'. Analytical results for the three soil samples described above can be obtained from the Remedial Action Program data base at ORNL.

2.4 Installation and Development

2.4.1 Installation

This was a type A well. A six-inch diameter boring was split spooned and augered from ground surface to a total depth of 20.0 feet. A two-inch diameter stainless steel screen with welded bottom cap was installed from 8.75 feet to 18.75 feet. A two-inch diameter stainless steel casing was installed above the screen from 8.75 feet to 1.78 feet above ground surface. A sandpack was then tremied into the annular space from 7.50 to 18.75 feet, with a 2.0-foot bentonite pellet seal poured into the annular space above the sandpack from 5.50 to 7.50 feet. The annular space from the top of the bentonite seal to the surface was

tremie grouted with a cement/bentonite slurry. A detailed schematic of the well is included on the well installation/completion form.

2.4.2 Well Development

Well number 1078 was developed to remove drill cuttings, silt, and other fines from the monitoring well. The monitoring well was developed using a Geoguard pump with an air compressor. All pumps were cleaned prior to use according to specified cleaning procedures (see Paragraph 2.1). The well was developed until a measured total of 256 gallons of water had been evacuated and the clarity of the discharge water was approved by the company representative. The final turbidity value measured was 30 NTU's. A development form showing the exact method of development and other pertinent data is appended.

2.4.3 Installation of Dedicated Monitoring Well Pump

After the well was developed, a Geoguard Model No. 5614 dedicated monitoring well pump was installed on 2/14/90 at a depth of 16.8 feet below ground surface. These pumps are decontaminated at American Sigma and are sent prepackaged. A copy of the pump certification is kept on file at ORNL.

2.5 Hydraulic Conductivity Testing

Well number 1078 was tested for the determination of hydraulic conductivity of the aquifer in the vicinity of the well screen. This was accomplished by instantaneously removing a known quantity of water from the monitoring well and measuring the recovery of the water level over time. The changing water levels were measured using a Druck 15 psig pressure transducer and an Omnidata Datapod II data recorder. The hydraulic conductivity value of 1.23×10^{-5} cm/second (shown as permeability on the hydraulic conductivity calculations) was calculated using the Bouwer and Rice method. A computer printout of the hydraulic conductivity calculations is included in this data package.

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1078

PRE-DRILLING CHECKLIST FOR MONITORING WELLS

PRE-DRILLING TASKS		COMPLIANCE DATE	COMPLIANCE INITIALS
1.	EXCAVATION PERMIT OBTAINED.	7-10-89	CAH
2.	ALL EQUIPMENT HAS BEEN CLEANED BEFORE DRILLING.	7-09-89	CAH
3a.	SCREEN AND CASINGS HAVE BEEN WASHED, STEAMED, RINSED WITH DE-IONIZED OR DISTILLED WATER, RINSED WITH ISOPROPYL ALCOHOL, WRAPPED WITH PROTECTIVE COVERING AND STORED OFF THE GROUND.	N/A	
3b.	PRE-PACKAGED SCREENS, CASINGS AND CENTRALIZERS WERE USED.	8-15-89	CAH
4.	WORK AREA FOR SAMPLE EXAMINATION COVERED WITH CLEAN POLYETHYLENE.	7-10-89	CAH
5.	CLEAN KNIVES, GLOVES, SAMPLE JARS AND LABELS ON-HAND.	7-10-89	CAH
6.	POLYETHYLENE COVER IN PLACE OVER HOLE.	7-10-89	CAH

ADDITIONAL NOTES/OBSERVATIONS:

OBSERVER SIGNATURE/DATE C. Allison Hodges 8-15-89

C. Allison Hodges

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1078

DECONTAMINATION CHECKLIST
DRILLING EQUIPMENT

EQUIPMENT	SCRAPE	STEAM CLEAN	STEAM RINSE	ISOPROPYL ALCOHOL RINSE	DEIONIZED WATER RINSE
RIG	X	X	X	N/A	N/A
AUGERS	X	X	X	X	X
BITS	X	X	X	X	X
RODS	X	X	X	X	X
SAMPLERS	X	X	X	X	X
PIPES	X	X	X	X	X
WORK TOOLS	X	X	X	X	X
AUGER PINS	X	X	X	X	X

OBSERVER SIGNATURE/DATE C. Allison Hodges 7-07-89
C. Allison Hodges

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1078

ORNL MONITORING WELL LOG

PAGE 1 OF 2

LOCATION: WAG 7

DRILLER: George Akin/Larry Ledbetter

HELPER: Rick Herron/Freddy Dixon

DRILL: Mobile B-50/Ingersol Rand T-4

DATE: START: 7-10-89

FINISH: 8-15-89

LOGGED BY: C. Allison Hodges

HEALTH PHYSICIST: L. C. Johnson/ L. E. Stooksbury

TYPE DRILLING: Split Spoon and Auger

LUBRICANT TYPE: Green Stuff

No. SAMPLES TAKEN: Three

TYPE: Soil

CONTAINMENT TYPE: Plastic, Pan, Containment Box, 55 Gallon Drums

THICKNESS OF SOIL (REFUSAL DEPTH): 20.0

DEPTH DRILLED IN ROCK: 0

TOTAL DEPTH OF WELL: 20.0

DRILLING FLUID SAMPLES:

TYPE: N/A DATE: N/A

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
0.0	0.5			Gravel. (fill material)
0.5	2.5	1078S01 .5-2.5	100%	Clay, shaley. Clay is mottled dark yellowish
				orange and light brown and firm. The shale
				is dusky brown and highly weathered. It also
				contains greenish gray mica. Brittle and damp.
2.5	4.5		100%	Shale, highly weathered, moderate brown and
				speckled dusky brown. Micaceous (green tint).
				Dry and brittle.
4.5	5.0		100%	Shale, clayey, dusky brown.
5.0	5.6			Shale, highly weathered, crumbly, moderate
				brown, dark yellowish orange, and light olive
				gray, micaceous with silt lenses. Dry.
5.6	6.0			Shale, highly weathered, moderate brown and
				light olive gray, micaceous. Dry.
				*Augered interval.
6.0	6.5		100%	Clay, light brown and dark yellowish orange,
				with shale, dusky brown.
6.5	7.8			Clay, light olive brown, firm with shale, dusky
				brown, brittle (crumbly) with mica and silt
				lenses. Dry.

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1078

ORNL MONITORING WELL LOG

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
7.8	8.5			Clay, light brown, with shale, highly
				weathered dusky brown, micaceous.
				*Augered interval.
8.5	10.0		100%	Clay, light brown and light olive brown with
				shale, dusky brown, bedded (breaking at 4-5°
				angle), with silt and mica lenses, greenish
				gray. Dry.
10.0	12.0		100%	Clay, light olive brown, with hsale, dusky
				brown, brittle, bedded, with silt and mica
				lenses. Wet from 11.0' to 11.3'.
12.0	14.0	1078S02 12.0-14.0	100%	Clay, light olive brown, with shale, dusky
				brown, weathered, bedded with silt and mica
				lenses. Wet but not saturated. Some water
				from 13.5 to 14.0'. Soft push on two split
				spoons.
14.0	16.0	1078S03 14.0-16.0	30%	Shale, dusky brown and olive gray, bedded,
				weathered, with silt and mica lenses.
				Saturated (water came out of tube) very soft
				to push.
16.0	16.5		100%	Shale, dusky brown and olive gray, bedded,
				weathered, with silt and mica lenses.
16.5	20.0			Shale, olive gray, with silt and mica, also
				some clay, light olive brown. Wet.
				*Augered interval.
	20.0			Total Depth
			*While augering L. C. Johnson detected a higher background	
			reading within the borehole on the left side (the trench	
			line runs along this side) but nothing was found on the	
			soil or augers. The boring (water and mud) was found to	
			be contaminated on 7-31-89. The level of radionuclide	
			contamination was 0.2 mR per hour at 1/2 inch.	

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1078

WELL INSTALLATION/COMPLETION FORM

O.R.N.L. MONITORING WELL PROGRAM

LOGGED BY: C. Allison Hodges
PROOFED BY: Michael L. Ebers

DRILLING COMPANY: Geotek
DRILLER: Larry Ledbetter/ George Akins
HELPER: Rick Herron/ Freddy Dixon

LOCATION WAG 7
ORNL GRID COORDINATES
N 17,406.937
E 25,613.689
ELEV. GROUND 769.00
ELEV. TOP STAINLESS STEEL CASING 770.78

DRILLING DATES:
STARTED: 7-10-89
FINISHED: 8-16-89

EQUIPMENT
☒ 6.0 INCH AUGER 20.0 L.F.
☐ _____ INCH AUGER _____ L.F.

MATERIALS USED

EST. VOL.	USED VOL.	
	10.0	FEET OF 2.0 IN. S.S. SCREEN
	10.0	FEET OF 2.0 IN. S.S. CASING
1.5	5.0	SACKS OF SAND
30.0	50.0	POUNDS OF BENTONITE PELLETS
.5	2.0	SACKS OF CEMENT
	10.0	POUNDS OF POWDERED BENTONITE
	15.0	GALLONS OF WATER (CEMENTING)

REASON FOR DIFFERENCES BETWEEN ESTIMATED VOLUMES AND USED VOLUMES
Irregular boring diameter and caving.

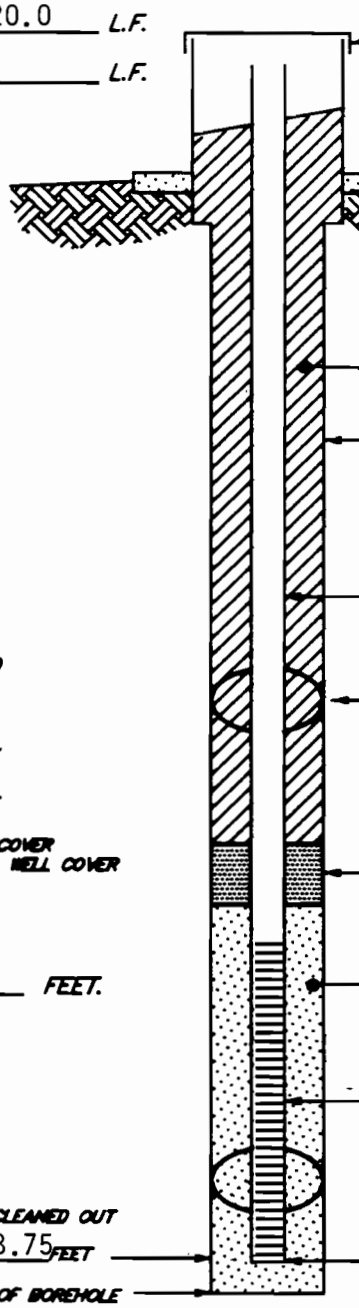
WELL COVER USED
■ LOCKING STEEL COVER
☐ FLUSH MOUNTED WELL COVER
☐ OTHER

SILT TRAP USED YES ☐ NO ■

MONITORING WELL PUMP BASE SET AT 16.8 FEET.

CENTRALIZERS AT 5.0 FEET.
18.0 FEET.
_____ FEET.

NOTE:
ALL DEPTHS ARE MEASURED FROM GROUND SURFACE UNLESS OTHERWISE NOTED:



LOCKING STEEL COVER
10 INCH DIAMETER
STEEL PROTECTIVE CASING
3.29 FT. ABOVE GROUND
TO 2.0 FT. BELOW
GROUND SURFACE
CONCRETE PAD

GROUT SEAL 0.0 TO
5.50 FEET
6.0 INCH DIAMETER
BOREHOLE
2.0 INCH DIAMETER STAINLESS
STEEL CASING 1.78 FT. ABOVE
GROUND SURFACE TO 8.75 FT.
BELOW GROUND SURFACE
CENTRALIZER (TYP.)

BENTONITE PELLET SEAL
5.50 TO 7.50 FEET

SAND PACK
7.50 TO 18.75 FEET

2.0 INCH DIAMETER
STAINLESS STEEL 0.010
SLOTTED SCREEN
8.75 TO 18.75 FEET

N/A INCH DIAMETER STAINLESS
STEEL SILT TRAP/CAP
N/A TO N/A FEET

HOLE CLEANED OUT TO 18.75 FEET

BOTTOM OF BOREHOLE 20.0 FEET

TYPE A WELL

NOT TO SCALE

ERC / EDGE
Environmental and Energy Services Co.

WELL No. 1078

DATE: 8-15-89

MONITORING WELL MATERIALS CERTIFICATION

ITEM/MATERIAL		DATE USED	BATCH NUMBER
SAND		8-15-89	1
BENTONITE		8-15-89	1
STAINLESS STEEL SCREEN	(PREPACKAGED ☒ YES ☐ NO)	8-15-89	1
STAINLESS STEEL CASING	(PREPACKAGED ☒ YES ☐ NO)	8-15-89	1
STAINLESS STEEL CENTRALIZERS	(PREPACKAGED ☒ YES ☐ NO)	8-15-89	1
STAINLESS STEEL CAPS	(PREPACKAGED ☒ YES ☐ NO)	8-15-89	1
MONITORING WELL PUMP	(PREPACKAGED ☒ YES ☐ NO)	2-14-89	4
GROUT		8-16-89	1
WELL COVERS		8-15-89	1
SURFACE CASING			

COMMENTS:

OBSERVER SIGNATURE/DATE C. Allison Hodges 8-16-89
C. Allison Hodges

ERC / EDGE
Environmental and Energy Services Co.

WELL No. 1078

POST-WELL COMPLETION CHECKLIST

POST-WELL COMPLETION TASKS	COMPLIANCE DATE	COMPLIANCE INITIALS
1. MUD SCRAPED FROM AUGERS, SAMPLERS, AND ALL OTHER EQUIPMENT.	7-10-89	CAH
2. ALL MUD FROM RIG AND EQUIPMENT SCRAPINGS AND CUTTINGS DISPOSED OF IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED.	7-10-89	CAH
3. WELL DEVELOPED IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED AND DETAILS OF THE DEVELOPMENT ACTIVITY RECORDED.	2-14-90	DCL
4. DRILLING SITE PROPERLY CLEANED UP AFTER COMPLETION OF WELL INSTALLATION.	8-16-89	CAH

* RELEASE SPECIFIC TECHNICAL DIRECTIONS FOR REGULATORY COMPLIANCE MONITORING WELLS PHASE I, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, W.O. K-4147, APRIL 1987.

OBSERVER SIGNATURE/DATE C. Allison Hodges 8-16-89
C. Allison Hodges

D. Charles Lytle 2-14-90
D. Charles Lytle

ERC / EDGE
Environmental and Energy Services Co.

WELL No. 1078

LOCATION: WAG

MONITORING WELL DEVELOPMENT FORM

DEVELOPMENT DETAILS

METHOD OF DEVELOPMENT: Surging and Pumping

DEVELOPMENT BEGAN DATE: 2-13-90 TIME:

DEVELOPMENT ENDING DATE: 2-14-90

DEVELOPMENT OBSERVED BY: D. Charles Lytle

ONE WELL VOLUME: 7.6 GALLONS

TOTAL GALLONS PUMPED: 256 TOTAL WELL VOLUMES PUMPED: 33.7

INITIAL pH: 7.8 FINAL pH: 7.6

INITIAL CONDUCTIVITY (uS): 922 FINAL CONDUCTIVITY (uS): 947

DESCRIPTION OF INITIAL TURBIDITY: Muddy

DESCRIPTION OF FINAL TURBIDITY: Cloudy

FINAL MEASURED TURBIDITY: 30 NTU's

WELL APPROVED BY: R. C. Williams MMES

ODOR OF WATER: None

WATER DISCHARGED TO:
- ☒ GROUND SURFACE
- ☐ STORM SEWERS
- ☐ DRUMS
- ☐ TANK TRUCK
- ☐ STORAGE TANKS
- ☐ OTHER

INITIAL PRE-DEVELOPMENT WATER DEPTH: 2.5 feet from ground surface.

DEVELOPMENT OBSERVATIONS

OBSERVER SIGNATURE/DATE D. Charles Lytle 2-14-90

D. Charles Lytle

ERC / EDGE Environmental and Energy Services Co.

WELL NO. 1078
LOCATION: WAG 7
DATE: 2-13-90

MONITORING WELL DEVELOPMENT PROGRESS

ONE WELL VOLUME = 7.6 GALLONS

DATE	TIME	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	MEASURED TURBIDITY (NTU'S)	pH	CONDUC-TIVITY (uS)	TOTAL GALLONS PUMPED	WELL VOLUMES PUMPED	COMMENTS
2-13-90	1400	75	Muddy	--	7.8	922	75	9.8	
2-14-90	0830	90	Muddy	--	7.4	911	165	21.7	
2-14-90	1300	91	Cloudy	30	7.6	947	256	33.7	
RESULTS AT END OF DEVELOPMENT			Cloudy	30	7.6	947	256	33.7	

COMMENTS Fast producer; water remained cloudy; had to pass and move off hole.

OBSERVER SIGNATURE/DATE D. Charles Lytle 2-14-90
D. Charles Lytle

MWFORM05.DWG

HYDRAULIC CONDUCTIVITY CALCULATIONS

PROGRAM SLUGT, VERSION 4.1, NOV. 1986

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:

(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3, NO.1 OF WRR ENTITLED "RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER")

(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED "A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS")

WELL NO.: 1078 DATE OF TEST: 3/09/90

PROJECT NO.: E221-002 CLIENT: MMES

SITE LOCATION: WAG 7

EDGE, INC. FIELD INVESTIGATOR: BRUCE MCMASTER

INPUT DATA ARE:

INNER CASING DIAMETER = 2.00 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 2.00 INCHES
DIAMETER OF DRILLED HOLE = 6.75 INCHES
LENGTH OF SCREEN OR INTAKE PORTION = 10.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 19.55 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 10.00 FEET
DEPTH TO STATIC WATER LEVEL BELOW REF. POINT = 7.01 FEET
ESTIMATED POROSITY OF GRAVEL PACK = .20
FALLING-HEAD INDEX = 0 ("1" IF FALLING,"0" IF RISING)
NUMBER OF DEPTH-TIME DATA POINTS = 33

HO WAS COMPUTED FROM INTERCEPT OF PLOT OF LOG(H) VS. TIME

SUCCESSIVE COMPUTED
VALUES FOR HO
(FEET)

5.6879
5.6642

HYDRAULIC CONDUCTIVITY CALCULATIONS

TIME (SEC)	DEPTH TO WATER (FEET)	HEAD (FEET)
5.00	1.890	5.120
10.00	1.790	5.220
15.00	1.700	5.310
20.00	1.620	5.390
25.00	1.540	5.470
30.00	1.480	5.530
35.00	1.410	5.600
40.00	1.370	5.640
45.00	1.310	5.700
50.00	1.260	5.750
55.00	1.210	5.800
60.00	1.180	5.830
70.00	1.100	5.910
80.00	1.020	5.990
90.00	.970	6.040
100.00	.900	6.110
110.00	.850	6.160
120.00	.800	6.210
150.00	.680	6.330
180.00	.590	6.420
210.00	.510	6.500
240.00	.450	6.560
270.00	.400	6.610
300.00	.350	6.660
330.00	.320	6.690
360.00	.290	6.720
420.00	.240	6.770
480.00	.210	6.800
540.00	.180	6.830
600.00	.160	6.850
660.00	.140	6.870
720.00	.130	6.880
780.00	.120	6.890

****

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

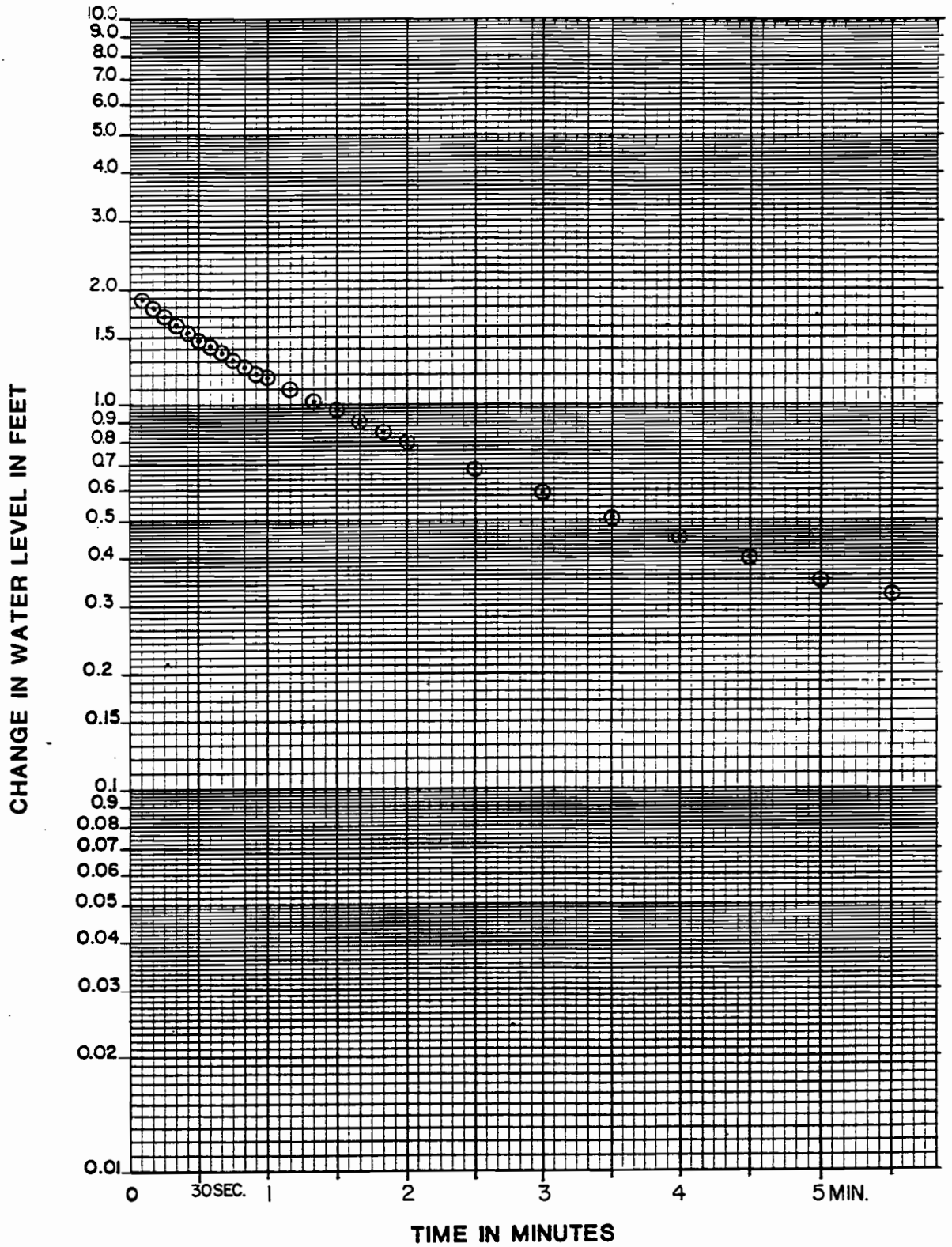
PERMEABILITY = 4.04E-07 FT/SEC = 1.23E-05 CM/SEC

TRANSMISSIVITY = 4.04E-06 FT**2/SEC

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1078

HYDRAULIC CONDUCTIVITY CALCULATIONS



EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 1078S1

WELL NO.	LOCATION:	TYPE:
1078	WAG-7	Soil

SAMPLER:	SAMPLE INTERVAL:	DATE:	TIME:
[illegible] (SIGNATURE)	.5 to 2.5'	07-10-89	1000

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECEIVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
[illegible]	07-19-89	10:29	EDGE	NE Owen	7/19/89	10:25	ORNL ACD CAPA

TYPE OF SAMPLE: ☒ SPLIT SPOON CORES–SOIL ☐ AUGER CUTTINGS–SOIL ☐ AUGER CUTTINGS–ROCK
☐ AIR ROTARY CUTTINGS–ROCK ☐ DRILL WATER (NO AIR IN SAMPLE) ☐ OTHER _____

ALL SAMPLES ARE IMMEDIATELY PLACED IN I-CHEM SPECIALTY CLEANED CONTAINERS AND SEALED.

REMARKS: _____

EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 107852

WELL NO.	LOCATION:	TYPE:
1078	WAG-7	Soil / weathered shale

SAMPLER: (SIGNATURE)	SAMPLE INTERVAL:	DATE:	TIME:
C. Allison Hodge	12.0 to 14.0'	07-10-89	1100

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECEIVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
C. Allison Hodge	07-19-89	10:24	EDGE	N E Owen	7/19/89	10:25	ORNL ACD CAPA

TYPE OF SAMPLE: ☒ SPLIT SPOON CORES–SOIL ☐ AUGER CUTTINGS–SOIL ☐ AUGER CUTTINGS–ROCK
☐ AIR ROTARY CUTTINGS–ROCK ☐ DRILL WATER (NO AIR IN SAMPLE) ☐ OTHER _____

ALL SAMPLES ARE IMMEDIATELY PLACED IN I-CHEM SPECIALTY CLEANED CONTAINERS AND SEALED.

REMARKS: Samples are soil (clay) and weathered shale (coal)

EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 1078503

WELL NO.	LOCATION:	TYPE:
1078	WAG-7	Soil / weathered shale

SAMPLER:	SAMPLE INTERVAL:	DATE:	TIME:
C. Allison Hodges (SIGNATURE)	14.0 to 16.0'	07-10-89	1110

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECEIVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
C. Allison Hodges	07-10-89	10:23	EDGE	N E Owen	7/19/89	10:24	ORNL ACD CAPA

TYPE OF SAMPLE: ☑ SPLIT SPOON CORES–SOIL ☐ AUGER CUTTINGS–SOIL ☐ AUGER CUTTINGS–ROCK
☐ AIR ROTARY CUTTINGS–ROCK ☐ DRILL WATER (NO AIR IN SAMPLE) ☐ OTHER _____

ALL SAMPLES ARE IMMEDIATELY PLACED IN I-CHEM SPECIALTY CLEANED CONTAINERS AND SEALED.

REMARKS: Samples are Soil (clay) and weathered shale (rock)

1.0 General Information

1.1 Well Location

Monitoring well number 1079 is located in WAG 7. It is located approximately 2500' southwest of the entrance to WAG 7 and 400' northwest of chemical waste pit #4. The location is shown on ORNL drawing number 03E20004 A075. Survey coordinates for this well are N 17389.589, E 25612.662 (X-10 grid) or latitude 35° 54' 27.85" and longitude 84° 19' 24.33". Coordinate data were provided by Martin Marietta Energy Systems. The method used for conversion from X-10 grid to Tennessee-Lambert State Plane Coordinates came from the publication "Tennessee Valley Authority Data Services Branch and Mapping Services Branch, Oak Ridge, Tennessee, DOE Plant Control, November 6, 1985, Field Book: ESS-3115, pp. 1-20." The latitude and longitude were calculated by Adams Craft Herz Walker Engineering, Inc., using methods from the U.S. Coast and Geodetic Survey Publication 62-4, "State Plane Coordinates by Automatic Data Processing."

1.2 Drilling Information

Well number 1079 was drilled by Geotek Engineering Company. A mobile B-50 rig and an Ingersol Rand T-4 rig were used to drill this boring for monitor well installation under operation of Larry Ledbetter with the assistance of Steve Kirk and Rick Herron.

Drilling commenced on 6/19/89 and was finished on 7/20/89. Paragraph 2.4.1 includes a detailed discussion of the well installation and a well schematic is included on the well installation/ completion form. A synopsis of the drilling activity follows:*

6/19/89: Steam cleaning auger rig and mobilizing to site. Auger to 4.0' with 22.0" auger to set 15 1/4" diverter casing. Covered with plastic.

6/21/89: Borehole caved and needs to be reaugered. Mobile B-50 auger rig steamed cleaned along with equipment. Auger rig mobilized to site and diverter casing removed. The borehole was then reaugered with all cuttings and water being contained in 55 gallon drums as per Jerry Gray and labeled as contaminated until tested. The diverter casing was then placed into borehole and grouted.

6/23/89: Air rotary rig steamed cleaned and mobilized to site. Begin augering with 14.0" auger to depth of 6.9' where refusal was met at bedrock (limestone).

6/26/89: Air rotary rig and equipment steamed cleaned and mobilized to site. A

* This information was typed directly from field notes and was edited only when necessary for clarification.

containment box was also taken. The hole was drilled with a 14.0" tricone bit to a depth of 12.0'.

6/27/89: Overnight borehole partially collapsed. Drillers cleaned out borehole and installed 11.9' of surface casing. Surface casing tremie grouted using 7 sacks of cement and 45 gallons of water with 20 lbs. of powdered bentonite.

7/5/89: Mobilizing rig and containment box to location. At 27.0' drilling discontinued due to mechanical problems. Rig moved from site for repairs.

7/19/89: The Ingersol Rand T-4 and equipment necessary to drill with were steam cleaned. The rig and containment box were mobilized to the site. Drilling was delayed two hours due to a thunderstorm. When drilling commenced all cuttings and water were contained in a containment box. An air and drilling water sample were taken. The borehole was drilled to a total depth of 70.0'. The hole was cleaned and allowed to recharge. Ten and a half feet of water accumulated in the borehole after 1 hour. The hole was allowed to recharge. The air sample was checked with an ultra violet light and was found to be free of oil.

7/20/89: Blew hole and check water level. Boring had 30.0' of water. The hole was cleaned and 15.0' of 4.0" screen and 65.0' of 4.0" stainless steel casing were installed. Five bags of sand was tremied thru 1" PVC to a level of 48.5'. One 50 lb. bucket of bentonite was poured in borehole to a level of 44.6'. The well was grouted after allowing the bentonite to hydrate for four hours. Fifteen bags of cement and 75 lbs. of powdered bentonite were used.

This well was logged by ERC Environmental and Energy Services Co., Inc., hydrogeologists Christopher M. Wallen and C. Allison Hodges. All well construction materials and supplies were from Martin Marietta Energy Systems approved batches. The batch origin of individual items is shown on the included Monitoring Well Materials Certification form.

2.0 Technical Information

2.1 Decontamination Procedures

The drilling rig, down hole tools, surface casing, stainless steel screen, stainless steel casing, centralizers, and stainless steel silt trap underwent the cleaning decontamination procedures

outlined in the drilling specifications (Release Specific Technical Directions for Regulatory Compliance Monitoring Wells Phase 1, Oak Ridge National Laboratory, Oak Ridge, W.O., K-4147, April 1987, pgs, 2-4). A checklist of the cleaned materials is included with this data package.

2.2 Geology

WAG 7 is located in Melton Valley which is in the Valley and Ridge Physiographic Province of East Tennessee. WAG 7 is underlain by shale, siltstone, and limestone of the Conasauga Group. The Conasauga Group in the Oak Ridge area consists of six formations. They are, in ascending order, the Pumpkin Valley Shale, Rutledge Limestone, Rogersville Shale, Maryville Limestone, Nolichucky Shale and the Maynardville Limestone. These rocks have undergone extensive deformation and contain many folds and faults resulting in varying strike and dips. The average strike and dip appears to be consistent with the regional strike of 56° northeast and dips of about 30° to the southeast.

2.3 Sample Collection

A drill water sample was collected from the water pump on the drill rig on 7/19/89. Analytical results for sample # 1079W01 can be obtained from the Remedial Action Program data base at ORNL.

2.4 Installation and Development

2.4.1 Installation

This was a type B well. A twenty two-inch diameter boring was augered from ground surface to 4.0 feet. A fifteen-inch diverter casing was installed and grouted. A fourteen-inch diameter boring was drilled with an auger and a tricone bit to 12.0'. A ten-inch diameter string of decontaminated steel surface casing was installed and tremie grouted in place. The surface casing minimizes potential cross contamination between the regolith and bedrock water bearing zones. The air rotary method was used to drill an eight-inch diameter boring to a total depth of 70.0 feet. A four-inch diameter stainless steel screen with welded bottom cap was installed from 55.0 feet to 70.0 feet. A four-inch diameter stainless steel casing was installed from the top of the screen at 55.0 feet and extended 1.88 feet above ground surface. A sandpack was tremied into the annular space from 49.0 to 70.0 feet, with a 3.9-foot bentonite pellet seal poured into the annular space above the sandpack from 45.1 to 49.0 feet. The annular space from the top of the bentonite seal to the surface was tremie grouted with a cement/bentonite slurry. A detailed schematic of the well is included on the well installation/completion form.

2.4.2 Well Development

Well number 1079 was developed to remove drill cuttings, silt, and other fines from the monitoring well. The monitoring well was developed using a Geoguard pump with an air compressor. All pumps were cleaned prior to use according to specified cleaning procedures (see Paragraph 2.1). The well was developed until a measured total of 220 gallons of water had been evacuated and the clarity of the discharge water was approved by the company representative. The final turbidity value measured was 5.0 NTU's. A development form showing the exact method of development and other pertinent data is appended.

2.4.3 Installation of Dedicated Monitoring Well Pump

After the well was developed, a Geoguard Model No. 5614 dedicated monitoring well pump was installed on 3/1/90 at a depth of 68.6 feet below ground surface. These pumps are decontaminated at American Sigma and are sent prepackaged. A copy of the pump certification is kept on file at ORNL.

2.5 Hydraulic Conductivity Testing

Well number 1079 was tested for the determination of hydraulic conductivity of the aquifer in the

vicinity of the well screen. This was accomplished by instantaneously adding a known quantity of water to the monitoring well and measuring the recovery of the water level over time. The changing water levels were measured using a Druck 15 psig pressure transducer and an Omnidata Datapod II data recorder. The hydraulic conductivity value of 3.98×10^{-6} cm/second (shown as permeability on the hydraulic conductivity calculations) was calculated using the Bouwer and Rice method. A computer printout of the hydraulic conductivity calculations is included in this data package.

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1079

PRE-DRILLING CHECKLIST FOR MONITORING WELLS

PRE-DRILLING TASKS		COMPLIANCE DATE	COMPLIANCE INITIALS
1.	EXCAVATION PERMIT OBTAINED.	6-19-89	CMW
2.	ALL EQUIPMENT HAS BEEN CLEANED BEFORE DRILLING.	6-19-89	CMW
3a.	SCREEN AND CASINGS HAVE BEEN WASHED, STEAMED, RINSED WITH DE-IONIZED OR DISTILLED WATER, RINSED WITH ISOPROPYL ALCOHOL, WRAPPED WITH PROTECTIVE COVERING AND STORED OFF THE GROUND.	N/A	
3b.	PRE-PACKAGED SCREENS, CASINGS AND CENTRALIZERS WERE USED.	7-20-89	CMW
4.	WORK AREA FOR SAMPLE EXAMINATION COVERED WITH CLEAN POLYETHYLENE.	6-19-89	CMW
5.	CLEAN KNIVES, GLOVES, SAMPLE JARS AND LABELS ON-HAND.	6-19-89	CMW
6.	POLYETHYLENE COVER IN PLACE OVER HOLE.	6-19-89	CMW

ADDITIONAL NOTES/OBSERVATIONS:

OBSERVER SIGNATURE/DATE Christopher M. Wallen 6-19-89

Christopher M. Wallen

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1079

DECONTAMINATION CHECKLIST
DRILLING EQUIPMENT

EQUIPMENT	SCRAPE	STEAM CLEAN	STEAM RINSE	ISOPROPYL ALCOHOL RINSE	DEIONIZED WATER RINSE
RIG	X	X	X	N/A	N/A
AUGERS	X	X	X	X	X
BITS	X	X	X	X	X
RODS	X	X	X	X	X
SAMPLERS	X	X	X	X	X
PIPES	X	X	X	X	X
WORK TOOLS	X	X	X	X	X
AUGER PINS	X	X	X	X	X

OBSERVER SIGNATURE/DATE Christopher M. Wallen 6-19-89
Christopher M. Wallen

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1079

ORNL MONITORING WELL LOG

LOCATION: X-10 WAG 7

DRILLER: Rick Herron/Larry Ledbetter

HELPER: George Akins/Steve Kirk

DRILL: Mobile B-50 Auger Rig/IR T-4 Air Rotary

DATE: START: 6-19-89

FINISH: 7-20-89

LOGGED BY: Christopher M. Wallen/ C. Allison Hodges

HEALTH PHYSICIST: Carl Stooksbury/ Linton C. Johnson

TYPE DRILLING: Auger, Air Rotary

LUBRICANT TYPE: Green Stuff

No. SAMPLES TAKEN: N/A

TYPE: N/A

CONTAINMENT TYPE: Containment Box, Plastic, Auger Pan, 55 Gallon Drum

THICKNESS OF SOIL (REFUSAL DEPTH): 6.9'

DEPTH DRILLED IN ROCK: 63.1

TOTAL DEPTH OF WELL: 70.0

DRILLING FLUID SAMPLES:

TYPE: Drill Water DATE: 7-19-89

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
0.0	0.9			Topsoil.
0.9	6.9			Clay, silty, moderate brown, firm, damp.
6.9	12.0			*Limestone, medium gray, massive with calcite,
				white.
12.0	14.0			Limestone, hard drilling.
14.0	21.5			Limestone, medium hard.
21.5	23.5			Limestone, hard.
23.5	26.0			Limestone, medium hard.
26.0	27.0			Limestone, medium hard.
27.0	31.0			*Hard, even drilling, bit locked up at 31.0'.
31.0	35.0			Softer drilling.
35.0	36.0			Soft spot, rod dropped, drilling fast.
36.0	37.0			Hard, irregular drilling.
37.0	38.5			Smooth, regular drilling.
38.5	59.5			Rough irregular drilling, bit locked up at 60.5
59.5	60.5			Smooth, easy drilling.
60.5	61.5			Rough, irregular drilling.
61.5	70.0			Smooth, regular, fast drilling.
	70.0			Total Depth
		*No detailed lithologic logs could be provided due to use of containment box.		

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1079

WELL INSTALLATION/COMPLETION FORM

O.R.N.L. MONITORING WELL PROGRAM

LOGGED BY: Christopher M. Wallen/C. Allison Hodges
PROOFED BY: Michael L. Ebers

DRILLING COMPANY: Geotek Engineering Company

DRILLER: Larry Ledbetter HELPER: Steve Kirk/Rick Herron

DRILLING METHOD:
- ☒ 14.0 INCH AUGER 6.9 L.F.
- ☐ INCH AUGER L.F.
- ☒ 14.0 INCH ROTARY 5.1 L.F.
- ☒ 8.0 INCH ROTARY 58.0 L.F.

LOCATION WAG 7
ORNL GRID COORDINATES
N 17,389.589
E 25,612.662
ELEV. GROUND 768.40
ELEV. TOP STAINLESS STEEL CASING 770.28

DRILLING DATES:
STARTED: 6-19-89
FINISHED: 6-27-89

MATERIALS USED

EST. VOL	USED VOL	
	N/A	POUNDS OF BENTONITE PELLETS (SURFACE CASING SEAL)
	11.9	FT. OF 10.0 IN. SURFACE CASING
6.0	7.0	SACKS OF CEMENT (SURFACE CASING)
	20.0	POUNDS OF POWERED BENTONITE (SURFACE CASING)
	45.0	GALLONS OF WATER (SURFACE CASING)
	57.3	FT. OF 4.0 IN. DIA. STAINLESS STEEL CASING
	15.0	FT. OF 4.0 IN. DIA. STAINLESS STEEL SCREEN
4.5	5	SACKS OF SAND
40	50	POUNDS OF BENTONITE PELLETS
6.9	15	SACKS OF CEMENT (WELL CASING)
	75	POUNDS OF POWERED BENTONITE (WELL CASING)
	75	GALLONS OF WATER (WELL CASING)
	3.4	FT. OF 10 IN. STEEL PROTECTIVE CASING

REASON FOR DIFFERENCES BETWEEN ESTIMATED VOLUMES AND USED VOLUMES
Irregular boring diameter.

SURFACE CASING TREMIE GROUTED YES ☒ NO ☐

STAINLESS STEEL CASING TREMIE GROUTED YES ☒ NO ☐

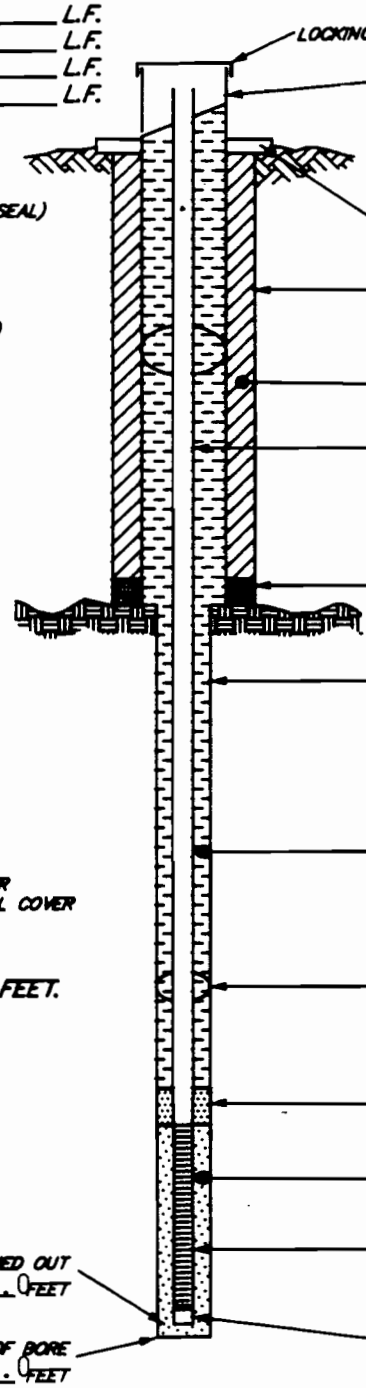
WELL COVER USED
- ☒ LOCKING STEEL COVER
- ☐ FLUSH MOUNTED WELL COVER
- ☐ OTHER

SILT TRAP USED YES ☐ NO ☒

MONITORING WELL PUMP BASE SET AT 68.6 FEET.

CENTRALIZERS AT 10.0 FEET.
30.0 FEET.
50.0 FEET.
70.0 Feet

NOTE:
ALL DEPTHS ARE MEASURED FROM GROUND SURFACE UNLESS OTHERWISE NOTED:



LOCKING CAP
10 IN. DIA. SURFACE/PROTECTIVE CASING 3.38 FEET ABOVE GROUND SURFACE TO 11.9 FEET BELOW GROUND SURFACE
CONCRETE PAD
14.0 IN. DIA. BORE HOLE 0.0 TO 12.0 FEET
GROUT SEAL 0.0 TO 11.9 FEET
4 IN. STAINLESS STEEL CASING 1.88 FEET ABOVE GROUND SURFACE TO 55.0 FEET BELOW GROUND SURFACE
N/A SEAL N/A TO N/A FEET
BEDROCK LEVEL 6.9
8 IN. DIA. BORE HOLE
GROUT SEAL 0.0 TO 45.1 FEET
CENTRALIZER
BENTONITE PELLET SEAL 45.1 TO 49.0 FEET
SAND PACK 49.0 TO 70.0 FEET
4.0 IN. DIA. STAINLESS STEEL SLOTTED SCREEN 55.0 TO 70.0 FEET
N/A IN. DIA. STAINLESS STEEL SILT TRAP/CAP N/A TO N/A FEET
HOLE CLEANED OUT TO 70.0 FEET
BOTTOM OF BORE HOLE 70.0 FEET

TYPE B WELL

ERC / EDGE
Environmental and Energy Services Co.

WELL No. 1079

DATE: 7-20-89

MONITORING WELL MATERIALS CERTIFICATION

ITEM/MATERIAL		DATE USED	BATCH NUMBER
SAND			
		7-20-89	1
BENTONITE		6-27-89	1
		7-20-89	1
STAINLESS STEEL SCREEN	(PREPACKAGED ☒ YES ☐ NO)	7-20-89	1
STAINLESS STEEL CASING	(PREPACKAGED ☒ YES ☐ NO)	7-20-89	1
STAINLESS STEEL CENTRALIZERS	(PREPACKAGED ☒ YES ☐ NO)	7-20-89	1
STAINLESS STEEL CAPS	(PREPACKAGED ☒ YES ☐ NO)	7-20-89	1
MONITORING WELL PUMP	(PREPACKAGED ☒ YES ☐ NO)	3-01-90	4
GROUT		6-27-89	1
		7-20-89	1
WELL COVERS		7-20-89	1
SURFACE CASING		6-27-89	1

COMMENTS:

OBSERVER SIGNATURE/DATE C. Allison Hodges 7-20-89

C. Allison Hodges

ERC / EDGE
Environmental and Energy Services Co.

WELL No. 1079

POST-WELL COMPLETION CHECKLIST

POST-WELL COMPLETION TASKS	COMPLIANCE DATE	COMPLIANCE INITIALS
1. MUD SCRAPED FROM AUGERS, SAMPLERS, AND ALL OTHER EQUIPMENT.	7-20-89	CAH
2. ALL MUD FROM RIG AND EQUIPMENT SCRAPINGS AND CUTTINGS DISPOSED OF IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED.	7-20-89	CAH
3. WELL DEVELOPED IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED AND DETAILS OF THE DEVELOPMENT ACTIVITY RECORDED.	3-01-90	DCL
4. DRILLING SITE PROPERLY CLEANED UP AFTER COMPLETION OF WELL INSTALLATION.	7-20-89	CAH

* RELEASE SPECIFIC TECHNICAL DIRECTIONS FOR REGULATORY COMPLIANCE MONITORING WELLS PHASE I, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, W.O. K-4147, APRIL 1987.

OBSERVER SIGNATURE/DATE C. Allison Hodges 7-20-89
C. Allison Hodges

D. Charles Lytle 3-01-90
D. Charles Lytle

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1079

LOCATION: WAG 7

MONITORING WELL DEVELOPMENT FORM

DEVELOPMENT DETAILS

METHOD OF DEVELOPMENT: Surging and Pumping

DEVELOPMENT BEGAN DATE: 2-13-90 TIME:

DEVELOPMENT ENDING DATE: 3-01-90

DEVELOPMENT OBSERVED BY: D. Charles Lytle

ONE WELL VOLUME: 55.7 GALLONS

TOTAL GALLONS PUMPED: 220 TOTAL WELL VOLUMES PUMPED: 4.0

INITIAL pH: 7.4 FINAL pH: 7.2

INITIAL CONDUCTIVITY (uS): 436 FINAL CONDUCTIVITY (uS): 460

DESCRIPTION OF INITIAL TURBIDITY: Muddy

DESCRIPTION OF FINAL TURBIDITY: Clear

FINAL MEASURED TURBIDITY: 5.0 NTU's

WELL APPROVED BY: R. C. Williams MMES

ODOR OF WATER: None

WATER DISCHARGED TO:
- ☒ GROUND SURFACE
- ☐ STORM SEWERS
- ☐ DRUMS
- ☐ TANK TRUCK
- ☐ STORAGE TANKS
- ☐ OTHER

INITIAL PRE-DEVELOPMENT WATER DEPTH: 6.6 feet from ground surface.

DEVELOPMENT OBSERVATIONS

OBSERVER SIGNATURE/DATE D. Charles Lytle

D. Charles Lytle 3-01-90

ERC / EDGE Environmental and Energy Services Co.

WELL NO. 1079
LOCATION: WAG 7
DATE: 2-13-90

MONITORING WELL DEVELOPMENT PROGRESS

ONE WELL VOLUME = 55.7 GALLONS

DATE	TIME	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	MEASURED TURBIDITY (NTU'S)	pH	CONDUCTIVITY (uS)	TOTAL GALLONS PUMPED	WELL VOLUMES PUMPED	COMMENTS
2-13-90	1400	51	Muddy	--	7.4	436	51		
2-13-90	1530	12	Muddy	--	7.5	484	63	1.1	
2-14-90	0830	22	Very Cloudy	--	7.4	463	85	1.5	
2-14-90	1300	24	Cloudy	--	7.4	495	109	1.9	
2-14-90	1500	14	Cloudy	--	7.5	525	123	2.2	
2-15-90	1500	24	Cloudy	--	7.1	521	147	2.6	
2-15-90	1600	16	Cloudy	--	7.3	539	163	3.0	
2-16-90	1400	25	Cloudy	--	7.1	492	188	3.4	
2-20-90	1530	12	Cloudy	--	7.1	481	200	3.6	
3-01-90	0930	20	Clear	5.0	7.2	460	220	4.0	
RESULTS AT END OF DEVELOPMENT			Clear	5.0	7.2	460	220	4.0	

COMMENTS Very poor producer, finally water cleared to 5.0 NTU's, passed and moved off hole.

OBSERVER SIGNATURE/DATE D. Charles Lytle 3-01-90
D. Charles Lytle

MWFORM05.DWG

HYDRAULIC CONDUCTIVITY CALCULATIONS

PROGRAM SLUGT, VERSION 4.1, NOV. 1986

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:

(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3, NO.1 OF WRR ENTITLED "RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER")

(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED "A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS")

WELL NO.: 1079 DATE OF TEST: 3/9/90

PROJECT NO.: E221-002 CLIENT: MMES

SITE LOCATION: WAG 7

EDGE, INC. FIELD INVESTIGATOR: BRUCE MCMASTER

INPUT DATA ARE:

INNER CASING DIAMETER = 4.00 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 4.00 INCHES
DIAMETER OF DRILLED HOLE = 8.63 INCHES
LENGTH OF SCREEN OR INTAKE PORTION = 15.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 59.95 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 15.00 FEET
DEPTH TO STATIC WATER LEVEL BELOW REF. POINT = 1.00 FEET
ESTIMATED POROSITY OF GRAVEL PACK = .20
FALLING-HEAD INDEX = 1 ("1" IF FALLING,"0" IF RISING)
NUMBER OF DEPTH-TIME DATA POINTS = 32

HO WAS COMPUTED FROM INTERCEPT OF PLOT OF LOG(H) VS. TIME

SUCCESSIVE COMPUTED
VALUES FOR HO
(FEET)

2.5051
2.5054

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1079

HYDRAULIC CONDUCTIVITY CALCULATIONS

TIME (SEC)	DEPTH TO WATER (FEET)	HEAD (FEET)
10.00	3.520	2.520
20.00	3.510	2.510
30.00	3.510	2.510
40.00	3.510	2.510
50.00	3.510	2.510
60.00	3.500	2.500
75.00	3.500	2.500
90.00	3.500	2.500
105.00	3.490	2.490
120.00	3.490	2.490
150.00	3.490	2.490
180.00	3.490	2.490
240.00	3.480	2.480
300.00	3.470	2.470
360.00	3.460	2.460
420.00	3.460	2.460
480.00	3.450	2.450
540.00	3.450	2.450
600.00	3.440	2.440
720.00	3.430	2.430
840.00	3.420	2.420
960.00	3.410	2.410
1080.00	3.400	2.400
1200.00	3.390	2.390
1320.00	3.380	2.380
1440.00	3.370	2.370
1560.00	3.360	2.360
1680.00	3.350	2.350
1800.00	3.340	2.340
1920.00	3.330	2.330
2040.00	3.320	2.320
2160.00	3.310	2.310

****

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

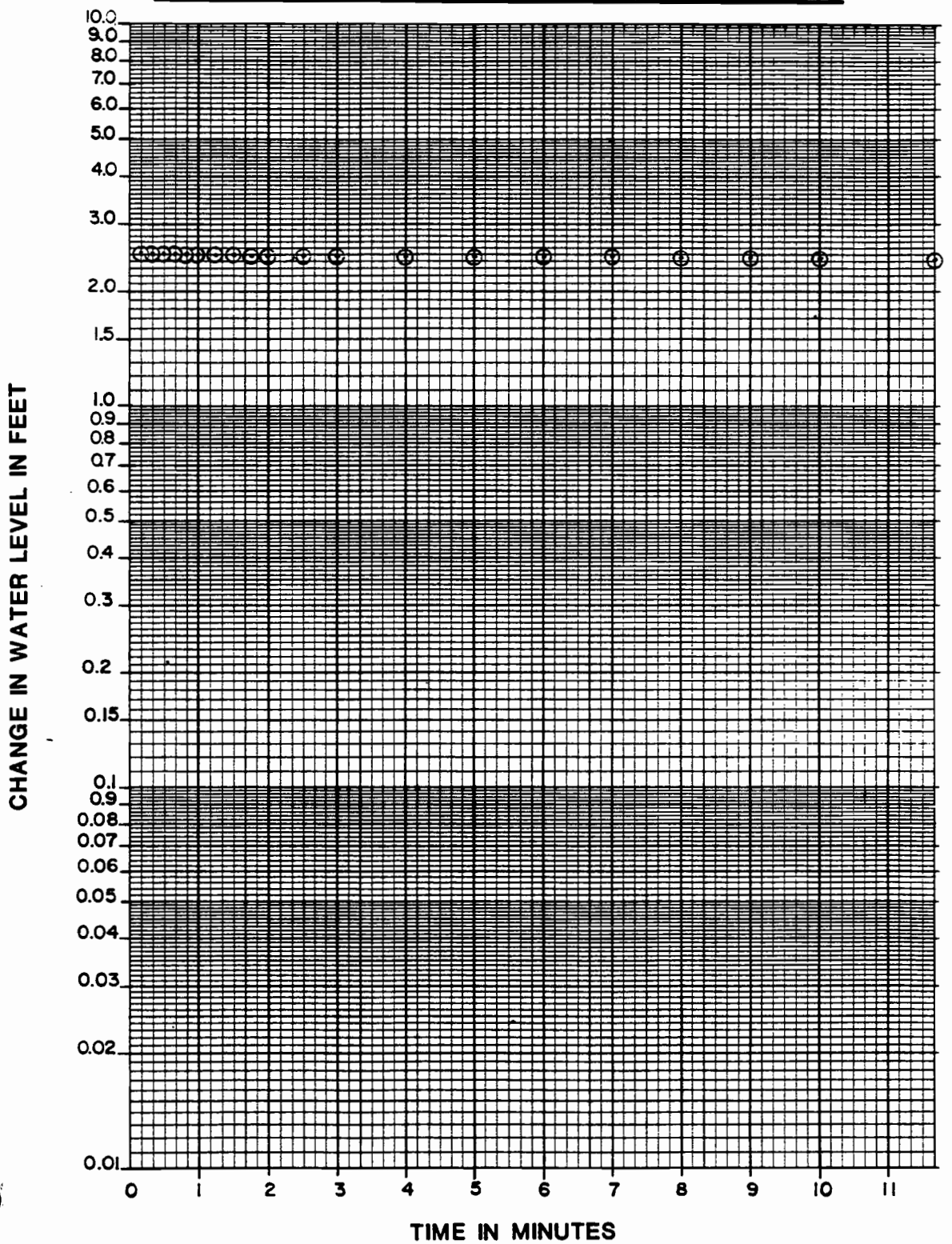
PERMEABILITY = 1.31E-07 FT/SEC = 3.98E-06 CM/SEC

TRANSMISSIVITY = 1.96E-06 FT**2/SEC

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1079

HYDRAULIC CONDUCTIVITY CALCULATIONS



EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 1079W01

WELL NO.	LOCATION:	TYPE:
1079	WAG-7	WATER

SAMPLER: (SIGNATURE)	SAMPLE INTERVAL:	DATE:	TIME:
C. Allison Hodges	N/A	07-19-89	1430

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECEIVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
C. Allison Hodges	07-19-89		EDGE	J. P. [illegible]	7-31-89	1430	

TYPE OF SAMPLE: ☐ SPLIT SPOON CORES–SOIL ☐ AUGER CUTTINGS–SOIL ☐ AUGER CUTTINGS–ROCK
☐ AIR ROTARY CUTTINGS–ROCK ☑ DRILL WATER (NO AIR IN SAMPLE) ☐ OTHER _____

ALL SAMPLES ARE IMMEDIATELY PLACED IN I-CHEM SPECIALTY CLEANED CONTAINERS AND SEALED.

REMARKS: _____

1.0 General Information

1.1 Well Location

Monitoring well number 1080 is located in WAG 7. It is located approximately 800' southwest of chemical waste pit 5 and approximately 400' due south from chemical waste pit #4. The location is shown on ORNL drawing number C3E20004 A075. Survey coordinates for this well are N 16854.853, E 25971.362 (X-10 grid) or latitude 35° 54' 25.43" and longitude 84° 19' 17.09". Coordinate data were provided by Martin Marietta Energy Systems. The method used for conversion from X-10 grid to Tennessee-Lambert State Plane Coordinates came from the publication "Tennessee Valley Authority Data Services Branch and Mapping Services Branch, Oak Ridge, Tennessee, DOE Plant Control, November 6, 1985, Field Book: ESS-3115, pp. 1-20." The latitude and longitude were calculated by Adams Craft Herz Walker Engineering, Inc., using methods from the U.S. Coast and Geodetic Survey Publication 62-4, "State Plane Coordinates by Automatic Data Processing."

1.2 Drilling Information

Well number 1080 was drilled by Geotek Engineering Company. A Mobile B-50 rig and an Ingersol Rand T-4 rig were used to drill this boring for monitor well installation under operation of Rick Herron

and Larry Ledbetter with the assistance of George Akins and James Shelton. Drilling commenced on 6/26/89 and was finished on 7/28/89. Paragraph 2.4.1 includes a detailed discussion of the well installation and a well schematic is included on the well installation/ completion form. A synopsis of the drilling activity follows:*

6/26/89: Mobilized B-50 auger rig to site, covered area with plastic and set up equipment. Split spooned to refusal at 5.3' sample 1080S01 and 1080S02 were taken. A bulk density was also taken. Augered with a 6.0" auger to refusal at 10.0'. Sample 1080S03 was taken from the auger. Because borehole could not be completed to specified total depth with an auger, the air rotary method was utilized. A 22.0" auger was used to auger 4.0' in order to install the 15 1/4" diverter casing necessary for the air rotary method. The casing was installed and grouted.

7/27/89: The air rotary rig and tools were steam cleaned and mobilized to the site along with the containment box. Mike Ebers supervised drilling activities. The borehole was drilled with an 8.0"

* This information was typed directly from field notes and was edited only when necessary for clarifications.

tricone bit from 4.0' to a total depth of 20.0'. The boring was then cleaned. After a 1 hour recharge period, the borehole had 11.5' of water. The boring was then cleaned again. A 10.0' section of 2.0" stainless steel screen and a 12.3' section of 2.0" stainless casing was then placed into the borehole. Nine sacks of sand were tremied using 1.0" PVC pipe and water. One bucket of bentonite was also used. A rag sample of the compressed air was taken and checked with a ultraviolet light. No signs of hydrocarbons were detected. A drill water sample was also collected at 15.0'.

7/28/89: The borehole was tremie grouted using 3 bags of cement and 15 lbs. of powdered bentonite.

8/30/89: Casing filed; Geotek and ERC present.

9/5/89: Passed the "Go-NoGo" gauge inspection R.C. Williams and Geotek present.

This well was logged by ERC Environmental and Energy Services Co., Inc., hydrogeologists C. Allison Hodges and Michael L. Ebers. All well construction materials and supplies were from Martin Marietta Energy Systems approved batches. The batch origin of individual items is shown on the included Monitoring Well Materials Certification form.

2.0 Technical Information

2.1 Decontamination Procedures

The drilling rig, down hole tools, surface casing, stainless steel screen, stainless steel casing, centralizers, and stainless steel silt trap underwent the cleaning decontamination procedures outlined in the drilling specifications (Release Specific Technical Directions for Regulatory Compliance Monitoring Wells Phase 1, Oak Ridge National Laboratory, Oak Ridge, W.O., K-4147, April 1987, pgs, 2-4). A checklist of the cleaned materials is included with this data package.

2.2 Geology

WAG 7 is located in Melton Valley, which is in the Valley and Ridge Physiographic Province of East Tennessee. WAG 7 is underlain by shale, siltstone, and limestone of the Conasauga Group. The Conasauga Group in the Oak Ridge area consists of six formations. They are, in ascending order, the Pumpkin Valley Shale, Rutledge Limestone, Rogersville Shale, Maryville Limestone, Nolichucky Shale and the Maynardville Limestone. These rocks have undergone extensive deformation and contain many folds and faults resulting in varying strike and dips. The average strike and dip appears to be consistent with the regional strike of 56° northeast and dips of about 30° to the southeast.

2.3 Sample Collection

Three soil samples (1080S01, 1080S02 and 1080S03) were collected during drilling, placed in I-CHEM specialty cleaned glass containers, sealed and submitted to Sample Receiving, Analytical Chemistry Division, Bldg. 4500S, ORNL. Chain of custody forms for these samples are included with this data package. Soil sample 1080S01 was collected in the split spoon interval from 2.5 to 2.9 on 6/26/89, soil sample 1080S02 was collected in the split spoon interval from 4.9 to 5.2 on 6/26/89, and soil sample 1080S03 was collected in the augered interval from 9.7 to 10.0' on 6/26/89. A drill water sample was collected from the water pump on the drill rig on 7/27/89. Analytical results for the three soil and one water samples described above can be obtained from the Remedial Action Program data base at ORNL.

A bulk density soil sample was collected from the split spoon sample interval from 3.1' to 3.4'. The sample was measured, and weighed, and a bulk density of 2.1 grams/cm^3 was calculated.

2.4 Installation and Development

2.4.1 Installation

This was a type D well. A six-inch diameter boring was augered from ground surface to auger

refusal (10.0 feet). The air rotary method was required to complete the well because the augers refused before the specified total well depth was reached. Therefore a twenty two-inch diameter boring was augered from ground surface to 4.0' and a fifteen-inch diverter casing was installed and grouted. The air rotary method was then used to drill an eight-inch diameter boring to a total depth of 20.0 feet. A two-inch diameter stainless steel screen with welded stainless steel cap was installed from 9.7 to 19.7 feet. A two-inch diameter stainless steel casing was installed above the screen at 9.7 feet and extended 2.04 feet above ground surface. A sandpack was then poured into the annular space from 7.8 to 19.7 feet, with a 1.1-foot bentonite seal poured into the annular space above the sandpack from 6.7 to 7.8 feet. The annular space from the top of the bentonite seal to the surface was tremie grouted with a cement/bentonite slurry. A detailed schematic of the well is included on the well installation/completion form.

2.4.2 Well Development

Well number 1080 was developed to remove drill cuttings, silt, and other fines from the monitoring well. The monitoring well was developed using a Geoguard pump with an air compressor. All pumps were cleaned prior to use according to specified cleaning procedures (see Paragraph 2.1). The well was developed until a

measured total of 760 gallons of water had been evacuated and the clarity of the discharge water was approved by the company representative. The final turbidity value measured was 3.0 NTU's. A development form showing the exact method of development and other pertinent data is appended.

2.4.3 Installation of Dedicated Monitoring Well Pump

After the well was developed, a Geoguard Model No. 5614 dedicated monitoring well pump was installed on 1/30/90 at a depth of 17.9 feet below ground surface. These pumps are decontaminated at American Sigma and are sent prepackaged. A copy of the pump certification is kept on file at ORNL.

2.5 Hydraulic Conductivity Testing

Well number 1080 was tested for the determination of hydraulic conductivity of the aquifer in the vicinity of the well screen. This was accomplished by instantaneously adding a known quantity of water to the monitoring well and measuring the recovery of the water level over time. The changing water levels were measured using a Druck 15 psig pressure transducer and an Omnidata Datapod II data recorder. The hydraulic conductivity value of 4.62×10^{-5} cm/second (shown as permeability on the hydraulic conductivity

calculations) was calculated using the Bouwer and Rice method. A computer printout of the hydraulic conductivity calculations is included in this data package.

ERC / EDGE
Environmental and Energy Services Co.

WELL No. 1080

PRE-DRILLING CHECKLIST FOR MONITORING WELLS

PRE-DRILLING TASKS		COMPLIANCE DATE	COMPLIANCE INITIALS
1.	EXCAVATION PERMIT OBTAINED.	6-26-89	CAH
2.	ALL EQUIPMENT HAS BEEN CLEANED BEFORE DRILLING.	6-26-89	CAH
3a.	SCREEN AND CASINGS HAVE BEEN WASHED, STEAMED, RINSED WITH DE-IONIZED OR DISTILLED WATER, RINSED WITH ISOPROPYL ALCOHOL, WRAPPED WITH PROTECTIVE COVERING AND STORED OFF THE GROUND.	N/A	
3b.	PRE-PACKAGED SCREENS, CASINGS AND CENTRALIZERS WERE USED.	7-27-89	CAH
4.	WORK AREA FOR SAMPLE EXAMINATION COVERED WITH CLEAN POLYETHYLENE.	6-26-89	CAH
5.	CLEAN KNIVES, GLOVES, SAMPLE JARS AND LABELS ON-HAND.	6-26-89	CAH
6.	POLYETHYLENE COVER IN PLACE OVER HOLE.	6-26-89	CAH

ADDITIONAL NOTES/OBSERVATIONS:

OBSERVER SIGNATURE/DATE C. Allison Hodges 7-28-89
C. Allison Hodges

ERC / EDGE
Environmental and Energy Services Co.

WELL No. 1080

DECONTAMINATION CHECKLIST
DRILLING EQUIPMENT

EQUIPMENT	SCRAPE	STEAM CLEAN	STEAM RINSE	ISOPROPYL ALCOHOL RINSE	DEIONIZED WATER RINSE
RIG	X	X	X	N/A	N/A
AUGERS	X	X	X	X	X
BITS	X	X	X	X	X
RODS	X	X	X	X	X
SAMPLERS	X	X	X	X	X
PIPES	X	X	X	X	X
WORK TOOLS	X	X	X	X	X
AUGER PINS	X	X	X	X	X

OBSERVER SIGNATURE/DATE C. Allison Hodges 6-26-89
C. Allison Hodges

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1080

ORNL MONITORING WELL LOG

LOCATION: WAG 7

DRILLER: Rick Herron/Larry Ledbetter

HELPER: George Akins/James Shelton

DRILL: Mobile B-50/Ingersol Rand T-4

DATE: START: 6-26-89

FINISH: 7-28-89

LOGGED BY: C. A. Hodges/Michael Ebers

HEALTH PHYSICIST: W. H. Shinpaugh/ Carl Stooksbury

TYPE DRILLING: Auger and Air Rotary

LUBRICANT TYPE: Green Stuff

No. SAMPLES TAKEN: 2

TYPE: Soil

CONTAINMENT TYPE: Plastic, Pan, Containment Box

THICKNESS OF SOIL (REFUSAL DEPTH): 10.0'

DEPTH DRILLED IN ROCK: 10.0'

TOTAL DEPTH OF WELL: 20.0'

DRILLING FLUID SAMPLES:

TYPE: Water DATE: 7-27-89

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
0.0	0.5			Gravel. (fill material)
0.5	2.5		0%	Gravel obstructing split spoon opening.
2.5	4.5	1080S01 2.5-2.9	90%	Shale, highly weathered, mottled light olive
				gray and moderate olive brown, with silt. Dry.
4.5	5.2	1080S02 4.9-5.2	100%	Shale, highly weathered, light olive gray, with
				silt, dry.
5.2	5.3			Shale, olive gray, hard, bedded split spoon
				refusal at 5.3'.
5.3	10.0	1080S03 9.7-10.0		Shale, slightly weathered, olive gray, damp
				and clayey at 10.0' tough drilling. Auger
				refusal at 10.0'. (Possibly hit limestone)
10.0	14.5			*Shale, soft, few thin hard streaks.
14.5	16.0			*Limestone, fairly hard, ratty drilling.
16.0	20.0			*Shale, soft, easy drilling.
	20.0			Total Depth
				*No detailed lithologic logs could be provided
				due to use of containment box for the interval
				from 10.0 to 20.0.

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1080

WELL INSTALLATION/COMPLETION FORM

O.R.N.L. MONITORING WELL PROGRAM

LOGGED BY: Michael Ebers

PROOFED BY: C. Allison Hodges

DRILLING COMPANY: Geotek

DRILLER: W. Larry Ledbetter HELPER: James Shelton

EQUIPMENT ☐ 22.0 INCH AUGER 4.0 L.F.

☐ 8.0 INCH AUGER 16.0 L.F.

LOCATION WAG 7

ORNL GRID COORDINATES

N 16,854.853

E 25,971.362

ELEV. GROUND 757.61

ELEV. TOP STAINLESS STEEL CASING 759.65

DRILLING DATES:

STARTED: 6-26-89

FINISHED: 7-28-89

MATERIALS USED

EST. VOL.	USED VOL.	
	10.0	FEET OF 2 IN. S.S. SCREEN
	12.3	FEET OF 2 IN. S.S. CASING
3.5	9.0	SACKS OF SAND
50.0	50.0	POUNDS OF BENTONITE PELLETS
2.25	3	SACKS OF CEMENT
	15	POUNDS OF POWDERED BENTONITE
	15	GALLONS OF WATER (CEMENTING)

REASON FOR DIFFERENCES BETWEEN ESTIMATED VOLUMES AND USED VOLUMES

Irregular boring diameter and spillage.

WELL COVER USED ■ LOCKING STEEL COVER ☐ FLUSH MOUNTED WELL COVER ☐ OTHER

SILT TRAP USED YES ☐ NO ■

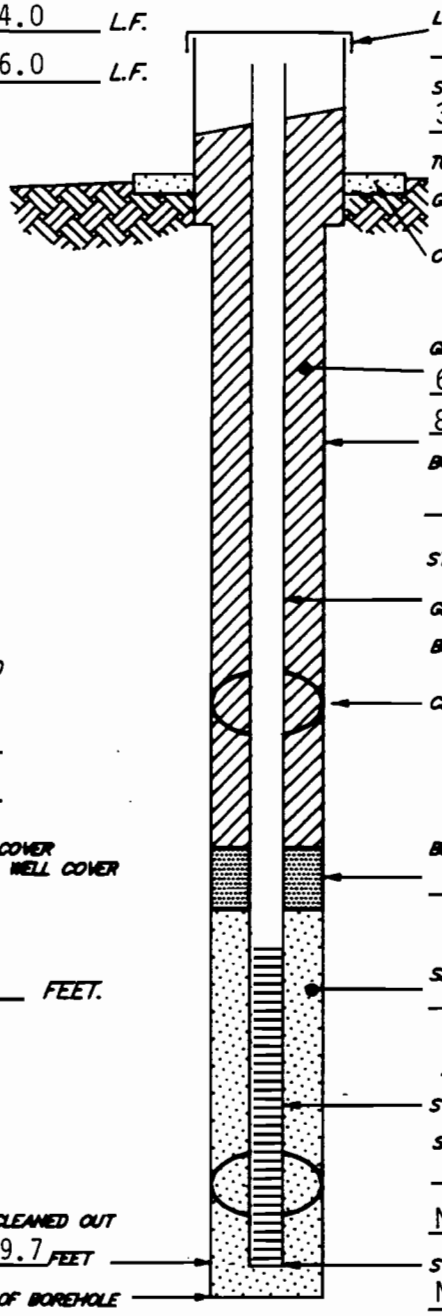
MONITORING WELL PUMP BASE SET AT 17.9 FEET.

CENTRALIZERS AT 5.0 FEET.

19.0 FEET.

____ FEET.

NOTE:
ALL DEPTHS ARE MEASURED FROM GROUND SURFACE UNLESS OTHERWISE NOTED:



TYPE A WELL

NOT TO SCALE

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1080

DATE: 7-27-89

MONITORING WELL MATERIALS CERTIFICATION

ITEM/MATERIAL		DATE USED	BATCH NUMBER
SAND		7-27-89	1
BENTONITE		7-27-89	1
STAINLESS STEEL SCREEN	(PREPACKAGED ☒ YES ☐ NO)	7-27-89	1
STAINLESS STEEL CASING	(PREPACKAGED ☒ YES ☐ NO)	7-27-89	1
STAINLESS STEEL CENTRALIZERS	(PREPACKAGED ☒ YES ☐ NO)	7-27-89	1
STAINLESS STEEL CAPS	(PREPACKAGED ☒ YES ☐ NO)	7-27-89	1
MONITORING WELL PUMP	(PREPACKAGED ☒ YES ☐ NO)	1-31-90	4
GROUT		7-28-89	1
WELL COVERS			
SURFACE CASING			

COMMENTS:

OBSERVER SIGNATURE/DATE C. Allison Hodges 7-28-89

C. Allison Hodges

ERC / EDGE
Environmental and Energy Services Co.

WELL No. 1080

POST-WELL COMPLETION CHECKLIST

POST-WELL COMPLETION TASKS	COMPLIANCE DATE	COMPLIANCE INITIALS
1. MUD SCRAPED FROM AUGERS, SAMPLERS, AND ALL OTHER EQUIPMENT.	6-26-89	CAH
2. ALL MUD FROM RIG AND EQUIPMENT SCRAPINGS AND CUTTINGS DISPOSED OF IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED.	6-26-89	CAH
3. WELL DEVELOPED IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED AND DETAILS OF THE DEVELOPMENT ACTIVITY RECORDED.	1-31-90	DCL
4. DRILLING SITE PROPERLY CLEANED UP AFTER COMPLETION OF WELL INSTALLATION.	7-27-89	CAH

* RELEASE SPECIFIC TECHNICAL DIRECTIONS FOR REGULATORY COMPLIANCE MONITORING WELLS PHASE I, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, W.O. K-4147, APRIL 1987.

OBSERVER SIGNATURE/DATE C. Allison Hodges 7-27-89
C. Allison Hodges

D. Charles Lytle 1-31-90
D. Charles Lytle

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1080

LOCATION: WAG 7

MONITORING WELL DEVELOPMENT FORM

DEVELOPMENT DETAILS

METHOD OF DEVELOPMENT: Surging and Pumping

DEVELOPMENT BEGAN DATE: 1-30-90 TIME:

DEVELOPMENT ENDING DATE: 1-31-90

DEVELOPMENT OBSERVED BY: D. Charles Lytle

ONE WELL VOLUME: 7.5 GALLONS

TOTAL GALLONS PUMPED: 760 TOTAL WELL VOLUMES PUMPED: 100.0

INITIAL pH: 7.2 FINAL pH: 7.0

INITIAL CONDUCTIVITY (uS): 456 FINAL CONDUCTIVITY (uS): 375

DESCRIPTION OF INITIAL TURBIDITY: Muddy

DESCRIPTION OF FINAL TURBIDITY: Clear

FINAL MEASURED TURBIDITY: 3.0

WELL APPROVED BY: R. C. Williams MMES

ODOR OF WATER: None

WATER DISCHARGED TO:
- ☒ GROUND SURFACE
- ☐ STORM SEWERS
- ☐ DRUMS
- ☐ TANK TRUCK
- ☐ STORAGE TANKS
- ☐ OTHER

INITIAL PRE-DEVELOPMENT WATER DEPTH: 2.7 feet from ground surface.

DEVELOPMENT OBSERVATIONS

OBSERVER SIGNATURE/DATE D. Charles Lytle 2-01-90

D. Charles Lytle

ERC / EDGE Environmental and Energy Services Co.

WELL NO. 1080
LOCATION: WAG 7
DATE: 1-30-90

MONITORING WELL DEVELOPMENT PROGRESS

ONE WELL VOLUME = 7.5 GALLONS

DATE	TIME	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	MEASURED TURBIDITY (NTU'S)	pH	CONDUC-TIVITY (uS)	TOTAL GALLONS PUMPED	WELL VOLUMES PUMPED	COMMENTS
1-30-90	1500	414	Muddy	--	7.2	456	414	55.2	
1-31-90	1400	336	Clear	3.0	7.0	375	760	100.0	
RESULTS AT END OF DEVELOPMENT			Clear	3.0	7.0	375	760	100.0	

COMMENTS Well was fast recharger. Passed and moved on.

OBSERVER SIGNATURE/DATE D. Charles Lytle 2-01-90
D. Charles Lytle

MWFORM05.DWG

HYDRAULIC CONDUCTIVITY CALCULATIONS

PROGRAM SLUGT, VERSION 4.1, NOV. 1986

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:

(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3, NO.1 OF WRR ENTITLED "RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER")

(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED "A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS")

WELL NO.: 1080 DATE OF TEST: 2/28/90

PROJECT NO.: E221-002 CLIENT: MMES

SITE LOCATION: WAG 7

EDGE, INC. FIELD INVESTIGATOR: BRUCE MCMASTER

INPUT DATA ARE:

INNER CASING DIAMETER = 2.00 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 2.00 INCHES
DIAMETER OF DRILLED HOLE = 6.75 INCHES
LENGTH OF SCREEN OR INTAKE PORTION = 10.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 13.85 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 10.00 FEET
DEPTH TO STATIC WATER LEVEL BELOW REF. POINT = .92 FEET
ESTIMATED POROSITY OF GRAVEL PACK = .20
FALLING-HEAD INDEX = 1 ("1" IF FALLING,"0" IF RISING)
NUMBER OF DEPTH-TIME DATA POINTS = 32

HO WAS COMPUTED FROM INTERCEPT OF PLOT OF LOG(H) VS. TIME

SUCCESSIVE COMPUTED VALUES FOR HO (FEET)
.4643
.4732

HYDRAULIC CONDUCTIVITY CALCULATIONS

TIME (SEC)	DEPTH TO WATER (FEET)	HEAD (FEET)
5.00	4.290	3.370
10.00	2.470	1.550
15.00	1.680	.760
20.00	1.450	.530
25.00	1.380	.460
30.00	1.350	.430
35.00	1.320	.400
40.00	1.310	.390
45.00	1.300	.380
50.00	1.280	.360
55.00	1.270	.350
60.00	1.260	.340
75.00	1.240	.320
90.00	1.230	.310
105.00	1.210	.290
120.00	1.190	.270
150.00	1.170	.250
180.00	1.170	.250
210.00	1.160	.240
240.00	1.150	.230
270.00	1.150	.230
300.00	1.150	.230
330.00	1.160	.240
360.00	1.150	.230
420.00	1.150	.230
480.00	1.140	.220
540.00	1.140	.220
600.00	1.150	.230
660.00	1.140	.220
720.00	1.130	.210
780.00	1.130	.210
840.00	1.130	.210

****

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

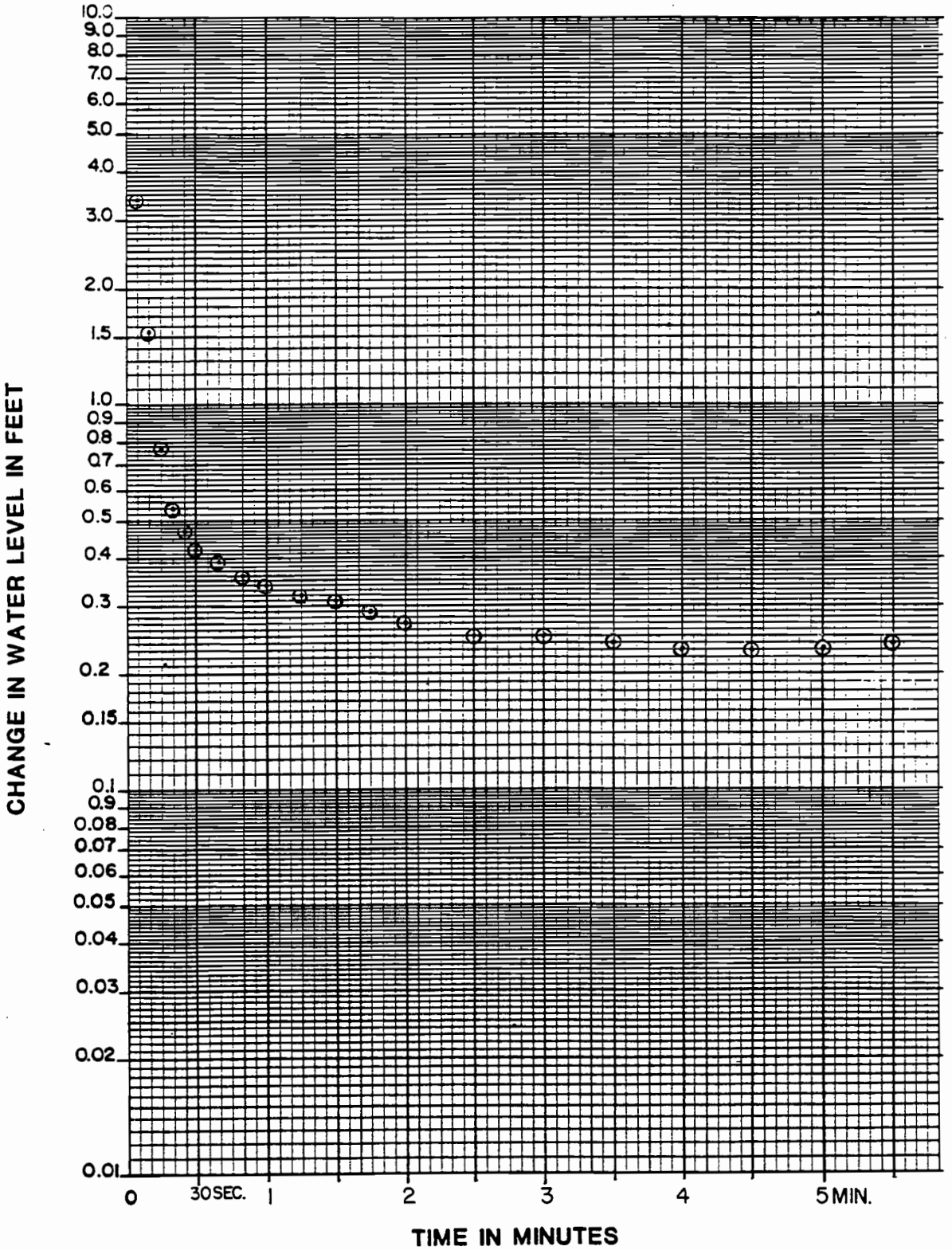
PERMEABILITY = 1.52E-06 FT/SEC = 4.62E-05 CM/SEC

TRANSMISSIVITY = 1.52E-05 FT**2/SEC

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1080

HYDRAULIC CONDUCTIVITY CALCULATIONS



EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 1080 S01

WELL NO.	LOCATION:	TYPE:
1080	WAG 7	SOIL

SAMPLER:	SAMPLE INTERVAL:	DATE:	TIME:
C. Allison Hodges (SIGNATURE)	2.5 to 2.9	06-26-89	0925

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECEIVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
C. Allison Hodges	07-058	2:05	EDGE	Christopher M. Waller	7/5/89	2:05	EDGe
Christopher M. Waller	7/5/89	2:28	EDGe	M. Ferguson	7/5/89	2:28	

TYPE OF SAMPLE: ☒ SPLIT SPOON CORES–SOIL ☐ AUGER CUTTINGS–SOIL ☐ AUGER CUTTINGS–ROCK
☐ AIR ROTARY CUTTINGS–ROCK ☐ DRILL WATER (NO AIR IN SAMPLE) ☐ OTHER _____

ALL SAMPLES ARE IMMEDIATELY PLACED IN I-CHEM SPECIALTY CLEANED CONTAINERS AND SEALED.

REMARKS: _____

EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 1080 S02

WELL NO.	LOCATION:	TYPE:
1080	WAG-7	SOIL

SAMPLER:	SAMPLE INTERVAL:	DATE:	TIME:
C. Allison Hodges (SIGNATURE)	4.9 to 5.2'	06-26-89	0935

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECEIVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
C. Allison Hodges	07-05-89	2:05	EDGe	Christopher M. Haller	7/5/89	2:05	EDGe
Christopher M. Haller	7/5/89	2:28	EDGe	M. Ferguson	7/5/89	2:28	

TYPE OF SAMPLE: ☑ SPLIT SPOON CORES--SOIL ☐ AUGER CUTTINGS--SOIL ☐ AUGER CUTTINGS--ROCK
☐ AIR ROTARY CUTTINGS--ROCK ☐ DRILL WATER (NO AIR IN SAMPLE) ☐ OTHER _____

ALL SAMPLES ARE IMMEDIATELY PLACED IN I-CHEM SPECIALTY CLEANED CONTAINERS AND SEALED.

REMARKS: _____

EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 1080503

WELL NO.	LOCATION:	TYPE:
P80	WAG - 7	Soil

SAMPLER: (SIGNATURE)	SAMPLE INTERVAL:	DATE:	TIME:
C. Allison Hodges	9.7' - 10.0'	06-26-89	1000

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECEIVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
C. Allison Hodges	07-05-89	2:05	EDGE	Christopher M. Waller	7/5/89	2:05	EDGe
Christopher M. Waller	7/5/89	2:28	EDGe	M. Ferguson	7/5/89	2:28	

TYPE OF SAMPLE: ☐ SPLIT SPOON CORES–SOIL ☒ AUGER CUTTINGS–SOIL ☐ AUGER CUTTINGS–ROCK
☐ AIR ROTARY CUTTINGS–ROCK ☐ DRILL WATER (NO AIR IN SAMPLE) ☐ OTHER _____

ALL SAMPLES ARE IMMEDIATELY PLACED IN I–CHEM SPECIALTY CLEANED CONTAINERS AND SEALED.

REMARKS: _____

EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 1080W01

WELL NO.	LOCATION:	TYPE:	
1080	WAG-7	WATER	
SAMPLER: C. Allison Hodge (SIGNATURE)	SAMPLE INTERVAL: N/A	DATE: 07-27-89	TIME: 1230

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECEIVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
C. Allison Hodge	07-27-89		EDGE	JCPuri	7-31-89	1430	

TYPE OF SAMPLE: ☐ SPLIT SPOON CORES–SOIL ☐ AUGER CUTTINGS–SOIL ☐ AUGER CUTTINGS–ROCK
☐ AIR ROTARY CUTTINGS–ROCK ■ DRILL WATER (NO AIR IN SAMPLE) ☐ OTHER _____

ALL SAMPLES ARE IMMEDIATELY PLACED IN I-CHEM SPECIALTY CLEANED CONTAINERS AND SEALED.

REMARKS: _____

1.0 General Information

1.1 Well Location

Monitoring well number 1081 is located in WAG 7. It is located approximately 400' southeast of chemical waste pit #4 and approximately 400' southwest of chemical waste pit #5. The location is shown on ORNL drawing number C3E20004 A075. Survey coordinates for this well are N 16919.8128, E 26322.6693 (X-10 grid) or latitude 35° 54' 27.90" and longitude 84° 19' 13.98". Coordinate data were provided by Martin Marietta Energy Systems. The method used for conversion from X-10 grid to Tennessee-Lambert State Plane Coordinates came from the publication "Tennessee Valley Authority Data Services Branch and Mapping Services Branch, Oak Ridge, Tennessee, DOE Plant Control, November 6, 1985, Field Book: ESS-3115, pp. 1-20." The latitude and longitude were calculated by Adams Craft Herz Walker Engineering, Inc., using methods from the U.S. Coast and Geodetic Survey Publication 62-4, "State Plane Coordinates by Automatic Data Processing."

1.2 Drilling Information

Well number 1081 was drilled by Geotek Engineering Company. An Ingersol Rand T-4 rig was used to drill this boring for monitor well installation under operation of Larry Ledbetter with the assistance of Freddy Dixon. Drilling commenced on

8/16/89 and was finished on 8/21/89. Paragraph 2.4.1 includes a detailed discussion of the well installation and a well schematic is included on the well installation/ completion form. A synopsis of the drilling activity follows:*

8/16/89: The auger rig, augers, pan and equipment were deconed and mobilized to the site. Plastic was placed over the work area and the auger rig was set up. A 22.0" boring was augered to 4.0' and a 15 1/4" diverter casing was installed and grouted.

8/17/89: The T-4 and tools were deconed, mobilized to the site and set up. A 14.0" boring was augered to 9.65' at which point refusal was met on limestone. Photovac readings are 25.15 ppm around outside of borehole and 161 ppm inside, possibly the high reading are due to the "heat" that the augers are generating while trying to cut thru the soil. The boring needs to extend into the bedrock, therefore the air rotary method was used to extend the borehole to 12.75'. A containment box and 14.0" tricone bit were used during drilling. A 10.0" surface casing was

* This information was typed directly from field notes and was edited only when necessary for clarification.

installed to a depth of 12.75' and a bentonite seal was installed to a depth of 10.95'.

8/18/89: The surface casing was grouted with 5 sacks of cement and 25 lbs. of bentonite.

8/21/89: The surface casing was cut and then drilling proceeded using an 8.0" tricone bit to drill to a total depth of 73.5'. Water and air samples were taken at 44.0'. The boring was allowed to recharge for 1 hour. During this time Doug Connery asked CAH to check the containment boxes (used in 1081) so they could be cleared. The photovac gave unusually high readings of 81.0 ppm. Possible sources suspected were the rubbers used for the diverter attachment. I refused to let them dump it and called J. Greene to see what the limitations were. She said she would get back with me. The water level was checked and found to be 39.0 from surface. The boring was cleaned and the rods were removed. A 15.0' stainless steel 4.0" screen and 60.0' of 4.0" casing was installed to a depth of 72.20'. The sand was tremied in with water to a depth of 53.20'. The bentonite seal was brought to a level of 51.50'. Five bags of sand and 1 bucket

of bentonite were used. The air sample was checked under the ultraviolet light, and no hydrocarbons were detected. The annulus was then tremied grouted after a 4 hour hydration time for the bentonite. Nine bags of cement and 45 lbs. of bentonite were used. The previously mentioned containment box was checked at the decon area at which time only .5 ppm were detected. Volatiles possibly volitized? I contacted J. Greene. She said not to dump the box until she found out what the limitations were. She also might have them sampled.

* The boxes were not sampled. They were allowed to be dumped and cleaned so they could be used for next well site.

8/30/89: The casing was filed with Geotek and CAH present.

9/5/89: The well passed the "Go-NoGo" gauge test. R.C. Williams, Doug Connery and CAH present.

This well was logged by ERC Environmental and Energy Services Co., Inc., hydrogeologist C. Allison Hodges. All well construction materials and supplies were from Martin Marietta Energy Systems approved batches. The batch origin of individual items is shown on the included Monitoring Well Materials Certification form.

2.0 Technical Information

2.1 Decontamination Procedures

The drilling rig, down hole tools, surface casing, stainless steel screen, stainless steel casing, centralizers, and stainless steel silt trap underwent the cleaning decontamination procedures outlined in the drilling specifications (Release Specific Technical Directions for Regulatory Compliance Monitoring Wells Phase 1, Oak Ridge National Laboratory, Oak Ridge, W.O., K-4147, April 1987, pgs, 2-4). A checklist of the cleaned materials is included with this data package.

2.2 Geology

WAG 7 is located in Melton Valley, which is in the Valley and Ridge Physiographic Province of East Tennessee. WAG 7 is underlain by shale, siltstone, and limestone of the Conasauga Group. The Conasauga Group in the Oak Ridge area consists of six formations. They are, in ascending order, the Pumpkin Valley Shale, Rutledge Limestone, Rogersville Shale, Maryville Limestone, Nolichucky Shale and the Maynardville Limestone. These rocks have undergone extensive deformation and contain many folds and faults resulting in varying strike and dips. The average strike and dip appears to be consistent with the regional strike of 56° northeast and dips of about 30° to the southeast.

2.3 Sample Collection

One sample was collected during drilling, placed in an I-CHEM specialty cleaned glass container, sealed and submitted to Sample Receiving, Analytical Chemistry Division, Bldg. 4500S, ORNL. This drill water sample, 1081W01, was collected from the water pump on the drill rig on 8/21/89. Analytical results for the drill water sample can be obtained from the Remedial Action Program data base at ORNL.

2.4 Installation and Development

2.4.1 Installation

This was a type B well. A twenty two-inch diameter boring was augered from ground surface to 4.0 feet. A fifteen-inch diverter casing was installed from surface to 4.0 feet below ground surface and grouted in place. A fourteen-inch diameter boring was augered from 4.0 feet to 9.65 feet (auger refusal). The boring was then extended past the refusal depth with an eight-inch air rotary tricone roller bit from 9.65 feet to 12.75 feet. A ten-inch diameter string of decontaminated steel surface casing was installed from 0.0 feet to 12.75 feet, sealed with a 1.8-foot bentonite pellet layer from 10.95 feet to 12.75 feet, and tremie grouted in place. The surface casing minimizes potential cross

contamination between the regolith and bedrock water bearing zones. After the surface casing was installed, the air rotary method was used to drill an eight-inch diameter boring to a total depth of 73.50 feet. A four-inch diameter stainless steel screen with welded bottom cap was installed from 58.20 feet to 73.20 feet. A four-inch diameter stainless steel casing was installed from the top of the screen at 58.20 feet and extended 1.61 feet above ground surface. A sandpack was tremied into the annular space from 53.20 to 73.20 feet, with a 1.70 foot bentonite pellet seal poured into the annular space above the sandpack from 53.20 to 73.20 feet. The annular space from the top of the bentonite seal to the surface was tremie grouted with a cement/bentonite slurry. A detailed schematic of the well is included on the well installation/completion form.

2.4.2 Well Development

Well number 1081 was developed to remove drill cuttings, silt, and other fines from the monitoring well. The monitoring well was developed using a Geoguard pump with an air compressor. All pumps were cleaned prior to use according to specified cleaning procedures (see Paragraph 2.1). The well was developed until a measured total of 223 gallons of water had been evacuated and the clarity of the discharge water was approved by the company representative. The

final turbidity value measured by completions was 2.0 NTU's. A development form showing the exact method of development and other pertinent data is appended.

2.4.3 Installation of Dedicated Monitoring Well Pump

After the well was developed, a Geoguard Model No. 5614 dedicated monitoring well pump was installed on 2/2/90 at a depth of 71.2 feet below ground surface. These pumps are decontaminated at American Sigma and are sent prepackaged. A copy of the pump certification is kept on file at ORNL.

2.5 Hydraulic Conductivity Testing

Well number 1081 was tested for the determination of hydraulic conductivity of the aquifer in the vicinity of the well screen. This was accomplished by instantaneously adding a known quantity of water to the monitoring well and measuring the recovery of the water level over time. The changing water levels were measured using a Druck 15 psig pressure transducer and an Omnidata Datapod II data recorder. The hydraulic conductivity value of 7.96×10^{-6} cm/second (shown as permeability on the hydraulic conductivity calculations) was calculated using the Bouwer and Rice method. A computer printout of the hydraulic conductivity calculations is included in this data package.

ERC / EDGE
Environmental and Energy Services Co.

WELL No. 1081

PRE-DRILLING CHECKLIST FOR MONITORING WELLS

PRE-DRILLING TASKS		COMPLIANCE DATE	COMPLIANCE INITIALS
1.	EXCAVATION PERMIT OBTAINED.	8-16-89	CAH
2.	ALL EQUIPMENT HAS BEEN CLEANED BEFORE DRILLING.	8-16-89	CAH
3a.	SCREEN AND CASINGS HAVE BEEN WASHED, STEAMED, RINSED WITH DE-IONIZED OR DISTILLED WATER, RINSED WITH ISOPROPYL ALCOHOL, WRAPPED WITH PROTECTIVE COVERING AND STORED OFF THE GROUND.	N/A	
3b.	PRE-PACKAGED SCREENS, CASINGS AND CENTRALIZERS WERE USED.	8-21-89	CAH
4.	WORK AREA FOR SAMPLE EXAMINATION COVERED WITH CLEAN POLYETHYLENE.	8-16-89	CAH
5.	CLEAN KNIVES, GLOVES, SAMPLE JARS AND LABELS ON-HAND.	8-17-89	CAH
6.	POLYETHYLENE COVER IN PLACE OVER HOLE.	8-21-89	CAH

ADDITIONAL NOTES/OBSERVATIONS:

OBSERVER SIGNATURE/DATE C. Allison Hodges 8-21-89
C. Allison Hodges

ERC / EDGE
Environmental and Energy Services Co.

WELL No. 1081

DECONTAMINATION CHECKLIST
DRILLING EQUIPMENT

EQUIPMENT	SCRAPE	STEAM CLEAN	STEAM RINSE	ISOPROPYL ALCOHOL RINSE	DEIONIZED WATER RINSE
RIG	X	X	X	N/A	N/A
AUGERS	X	X	X	X	X
BITS	X	X	X	X	X
RODS	X	X	X	X	X
SAMPLERS	X	X	X	X	X
PIPES	X	X	X	X	X
WORK TOOLS	X	X	X	X	X
AUGER PINS	X	X	X	X	X

OBSERVER SIGNATURE/DATE C. Allison Hodges 8-17-89
C. Allison Hodges

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1081

ORNL MONITORING WELL LOG

LOCATION: WAG 7
DRILLER: Larry Ledbetter
HELPER: Freddy Dixon
DRILL: Ingersol Rand T-4

DATE: START: 8-16-89
FINISH: 8-21-89
LOGGED BY: C. Allison Hodges
HEALTH PHYSICIST: W. H. Shinpaugh

TYPE DRILLING: Auger and Air Rotary
LUBRICANT TYPE: Green Stuff
No. SAMPLES TAKEN: N/A
TYPE: N/A
CONTAINMENT TYPE: Plastic, Pan, Containment Box

THICKNESS OF SOIL (REFUSAL DEPTH): 9.50
DEPTH DRILLED IN ROCK: 63.70
TOTAL DEPTH OF WELL: 73.20

DRILLING FLUID SAMPLES:
TYPE: Water
DATE: 8-21-89

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
0.0	2.0			Gravel. (fill material)
2.0	5.0			Topsoil, clay and roots.
5.0	9.50			Clay, medium brown, with shale.
9.50	9.65			Limestone, light gray, fine to medium grained,
				with shale, laminated, hard.
	9.65			*Auger refusal.
9.65	15.0			Hard, uneven drilling (limestone).
15.0	19.0			Hard, regular drilling, fast.
19.0	21.5			Smooth, easy drilling, very fast.
21.5	25.5			Rough, irregular drilling.
25.5	31.0			Smooth, even drilling. Slow. Bit locked up at
				30.5'.
31.0	36.5			Hard irregular drilling. Bit locked up at 36.0'.
36.5	73.5			Very hard, rough, irregular drilling, slow. Bit
				locked up at 44.0.
	73.5			Total Depth
				*Lithologic description of rock drilled from
				9.65' to 73.5' not available due to the use of
				a containment box.

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1081

WELL INSTALLATION/COMPLETION FORM

O.R.N.L. MONITORING WELL PROGRAM

LOGGED BY: C. Allison Hodges
PROOFED BY: Michael L. Ebers

DRILLING COMPANY: Geotek

DRILLER: Larry Ledbetter HELPER: Freddy Dixon

DRILLING METHOD:
- ☒ 22.0 INCH AUGER 4.0 L.F.
- ☒ 14.0 INCH AUGER 5.65 L.F.
- ☒ 8.0 INCH ROTARY 63.55 L.F.
- ☐ _____ INCH ROTARY _____ L.F.

LOCATION WAG 7
ORNL GRID COORDINATES
N 16,919.8128
E 26,322.6693
ELEV. GROUND 758.33
ELEV. TOP STAINLESS STEEL CASING 759.94

DRILLING DATES:
STARTED: 8-16-81
FINISHED: 8-21-81

MATERIALS USED

EST. VOL.	USED VOL.	
	50	POUNDS OF BENTONITE PELLETS (SURFACE CASING SEAL)
	12.75	FT. OF 10.0 IN. SURFACE CASING
3.3	5.0	SACKS OF CEMENT (SURFACE CASING)
	25.0	POUNDS OF POWDERED BENTONITE (SURFACE CASING)
	40	GALLONS OF WATER (SURFACE CASING)
	60.0	FT. OF 4.0 IN. DIA. STAINLESS STEEL CASING
	15.0	FT. OF 4.0 IN. DIA. STAINLESS STEEL SCREEN
5.0	5.0	SACKS OF SAND
35.0	50.0	POUNDS OF BENTONITE PELLETS
7.7	9.0	SACKS OF CEMENT (WELL CASING)
	45.0	POUNDS OF POWDERED BENTONITE (WELL CASING)
	65	GALLONS OF WATER (WELL CASING)
	3.2	FT. OF 10 IN. STEEL PROTECTIVE CASING

REASON FOR DIFFERENCES BETWEEN ESTIMATED VOLUMES AND USED VOLUMES
Irregular Auger Boring and Spillage

SURFACE CASING TREMIE GROUTED YES ☐ NO ☒

STAINLESS STEEL CASING TREMIE GROUTED YES ☒ NO ☐

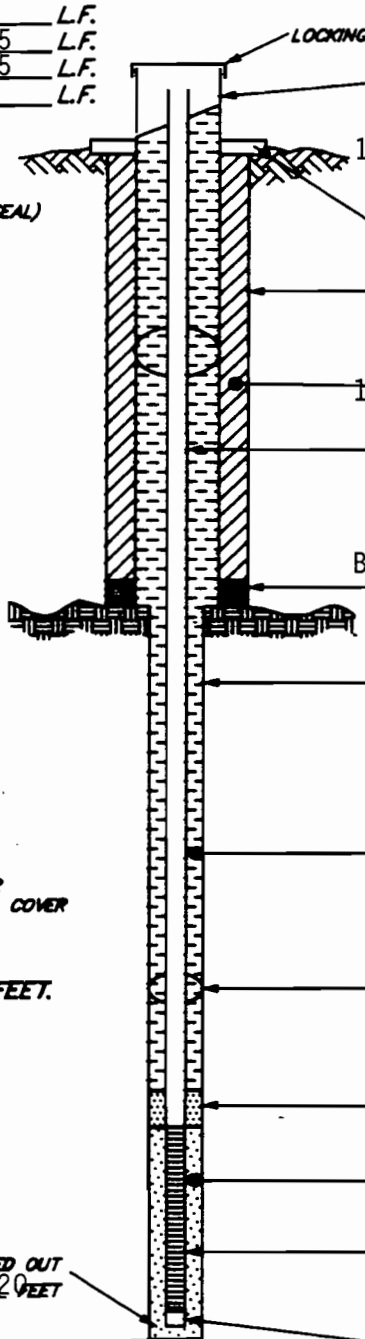
WELL COVER USED
- ☐ LOCKING STEEL COVER
- ☒ FLUSH MOUNTED WELL COVER
- ☐ OTHER

SILT TRAP USED YES ☐ NO ☒

MONITORING WELL PUMP BASE SET AT 71.2 FEET.

CENTRALIZERS AT 30.0 FEET.
50.0 FEET.
70.0 FEET.

NOTE:
ALL DEPTHS ARE MEASURED FROM GROUND SURFACE UNLESS OTHERWISE NOTED:



TYPE B WELL

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1081

DATE: 8-17-89

MONITORING WELL MATERIALS CERTIFICATION

ITEM/MATERIAL		DATE USED	BATCH NUMBER
SAND			
		8-21-89	1
BENTONITE		8-17-89	1
		8-21-89	1
STAINLESS STEEL SCREEN	(PREPACKAGED ☒ YES ☐ NO)	8-21-89	1
STAINLESS STEEL CASING	(PREPACKAGED ☒ YES ☐ NO)	8-21-89	1
STAINLESS STEEL CENTRALIZERS	(PREPACKAGED ☒ YES ☐ NO)	8-21-89	1
STAINLESS STEEL CAPS	(PREPACKAGED ☒ YES ☐ NO)	8-21-89	1
MONITORING WELL PUMP	(PREPACKAGED ☒ YES ☐ NO)	2-02-90	4
GROUT		8-17-89	1
		8-21-89	1
WELL COVERS		8-21-89	1
SURFACE CASING		8-17-89	1

COMMENTS:

OBSERVER SIGNATURE/DATE C. Allison Hodges 8-21-89

C. Allison Hodges

ERC / EDGE
Environmental and Energy Services Co.

WELL No. 1081

POST-WELL COMPLETION CHECKLIST

POST-WELL COMPLETION TASKS	COMPLIANCE DATE	COMPLIANCE INITIALS
1. MUD SCRAPED FROM AUGERS, SAMPLERS, AND ALL OTHER EQUIPMENT.	8-21-89	CAH
2. ALL MUD FROM RIG AND EQUIPMENT SCRAPINGS AND CUTTINGS DISPOSED OF IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED.	8-21-89	CAH
3. WELL DEVELOPED IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED AND DETAILS OF THE DEVELOPMENT ACTIVITY RECORDED.	2-02-90	DCL
4. DRILLING SITE PROPERLY CLEANED UP AFTER COMPLETION OF WELL INSTALLATION.	8-21-89	CAH

* RELEASE SPECIFIC TECHNICAL DIRECTIONS FOR REGULATORY COMPLIANCE MONITORING WELLS PHASE I, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, W.O. K-4147, APRIL 1987.

OBSERVER SIGNATURE/DATE C. Allison Hodges 8-21-89
C. Allison Hodges

D. Charles Lytle 2-02-90
D. Charles Lytle

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1081

LOCATION: WAG 7

MONITORING WELL DEVELOPMENT FORM

DEVELOPMENT DETAILS

METHOD OF DEVELOPMENT: Surging and Pumping

DEVELOPMENT BEGAN DATE: 2-01-90 TIME:

DEVELOPMENT ENDING DATE: 2-02-90

DEVELOPMENT OBSERVED BY: D. Charles Lytle

ONE WELL VOLUME: 61.3 GALLONS

TOTAL GALLONS PUMPED: 22.3 TOTAL WELL VOLUMES PUMPED: 3.6

INITIAL pH: 7.4 FINAL pH: 7.3

INITIAL CONDUCTIVITY (uS): 641 FINAL CONDUCTIVITY (uS): 532

DESCRIPTION OF INITIAL TURBIDITY: Crystal Clear

DESCRIPTION OF FINAL TURBIDITY: Crystal Clear

FINAL MEASURED TURBIDITY: 2.0

WELL APPROVED BY: R. C. Williams MMES

ODOR OF WATER: None

WATER DISCHARGED TO:
- ☒ GROUND SURFACE
- ☐ STORM SEWERS
- ☐ DRUMS
- ☐ TANK TRUCK
- ☐ STORAGE TANKS
- ☐ OTHER

INITIAL PRE-DEVELOPMENT WATER DEPTH: .1 feet from ground surface.

DEVELOPMENT OBSERVATIONS

OBSERVER SIGNATURE/DATE D. Charles Lytle 2-02-90

D. Charles Lytle

ERC / EDGE Environmental and Energy Services Co.

WELL NO. 1081
LOCATION: WAG 7
DATE: 2-01-90

MONITORING WELL DEVELOPMENT PROGRESS

ONE WELL VOLUME = 61.3 GALLONS

DATE	TIME	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	MEASURED TURBIDITY (NTU'S)	pH	CONDUCTIVITY (uS)	TOTAL GALLONS PUMPED	WELL VOLUMES PUMPED	COMMENTS
2-01-90	1530	86	Crystal Clear	2.0	7.4	641	86	1.4	
2-02-90	1405	87	Crystal Clear	3.0	7.2	549	173	2.8	
2-02-90	1530	50	Crystal Clear	2.0	7.3	532	223	3.6	
RESULTS AT END OF DEVELOPMENT			Crystal Clear	2.0	7.3	532	223	3.6	

COMMENTS Water remained crystal clear even after surging and pumping with work over rig pumped a couple of days to get 3 well volumes and passed.

OBSERVER SIGNATURE/DATE D. Charles Lytle
D. Charles Lytle 2-02-90

MWFORM05.DWG

HYDRAULIC CONDUCTIVITY CALCULATIONS

PROGRAM SLUGT, VERSION 4.1, NOV. 1986

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:

(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3, NO.1 OF WRR ENTITLED "RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER")

(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED "A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS")

WELL NO.: 1081 DATE OF TEST: 3/14/90

PROJECT NO.: E221-002 CLIENT: MMES

SITE LOCATION: WAG 7

EDGE, INC. FIELD INVESTIGATOR: BRUCE MCMASTER

INPUT DATA ARE:

INNER CASING DIAMETER = 4.00 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 4.00 INCHES
DIAMETER OF DRILLED HOLE = 8.63 INCHES
LENGTH OF SCREEN OR INTAKE PORTION = 15.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 69.20 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 15.00 FEET
DEPTH TO STATIC WATER LEVEL BELOW REF. POINT = .92 FEET
ESTIMATED POROSITY OF GRAVEL PACK = .20
FALLING-HEAD INDEX = 1 ("1" IF FALLING,"0" IF RISING)
NUMBER OF DEPTH-TIME DATA POINTS = 30

HO WAS COMPUTED FROM INTERCEPT OF PLOT OF LOG(H) VS. TIME

SUCCESSIVE COMPUTED
VALUES FOR HO
(FEET)

4.2597
4.2628

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1081

HYDRAULIC CONDUCTIVITY CALCULATIONS

TIME (SEC)	DEPTH TO WATER (FEET)	HEAD (FEET)
30.00	5.220	4.300
40.00	5.230	4.310
50.00	5.210	4.290
60.00	5.210	4.290
75.00	5.200	4.280
90.00	5.190	4.270
105.00	5.180	4.260
120.00	5.160	4.240
150.00	5.140	4.220
180.00	5.120	4.200
240.00	5.080	4.160
300.00	5.060	4.140
360.00	5.040	4.120
420.00	5.010	4.090
480.00	4.990	4.070
540.00	4.970	4.050
600.00	4.940	4.020
720.00	4.920	4.000
840.00	4.880	3.960
960.00	4.830	3.910
1080.00	4.810	3.890
1200.00	4.790	3.870
1320.00	4.760	3.840
1440.00	4.730	3.810
1560.00	4.710	3.790
1680.00	4.690	3.770
1800.00	4.660	3.740
1920.00	4.650	3.730
2040.00	4.630	3.710
2160.00	4.600	3.680

****

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

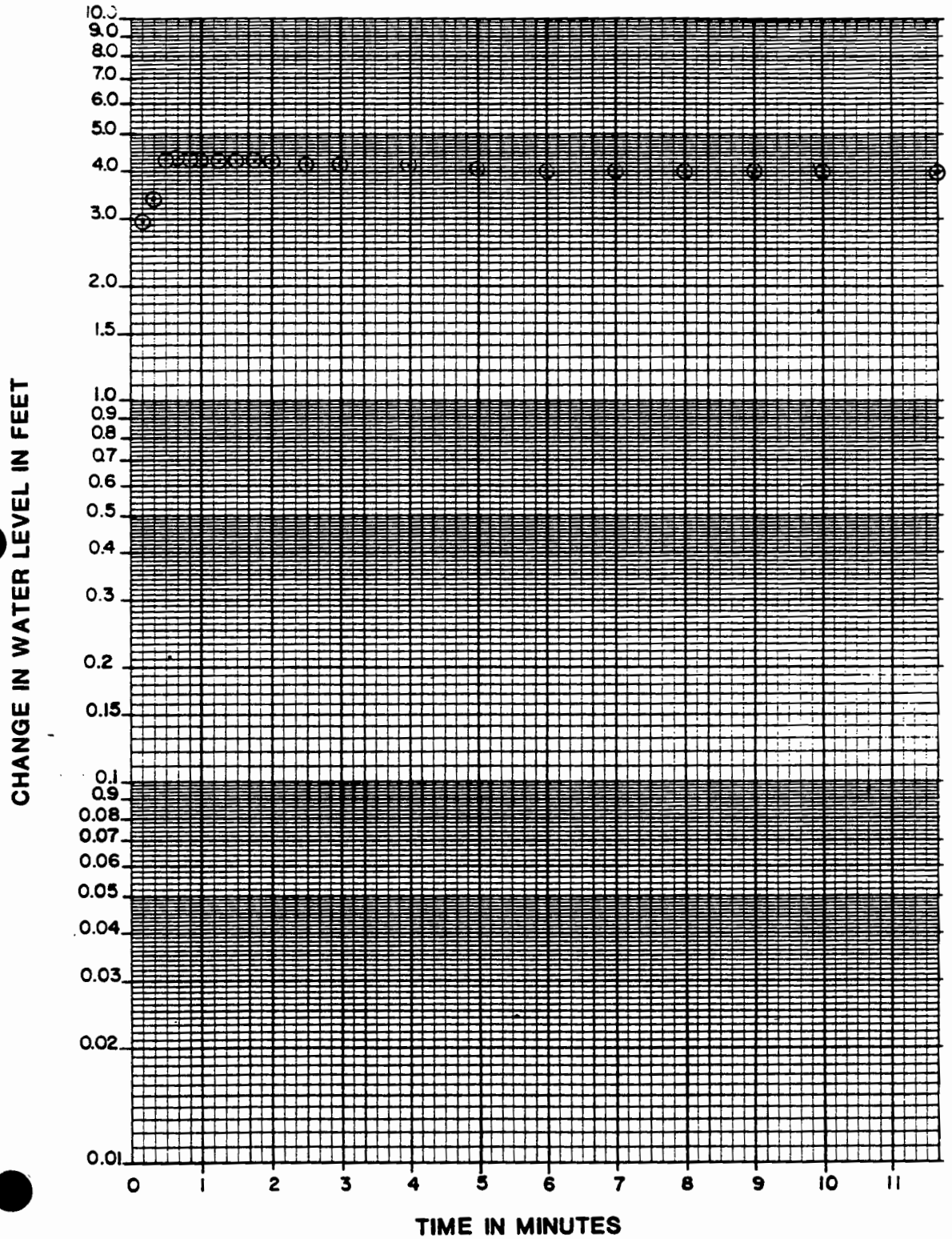
PERMEABILITY = 2.62E-07 FT/SEC = 7.97E-06 CM/SEC

TRANSMISSIVITY = 3.92E-06 FT**2/SEC

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1081

HYDRAULIC CONDUCTIVITY CALCULATIONS



EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 1081W01

WELL NO.	LOCATION:	TYPE:
1081	WAG-7	WATER

SAMPLER:	SAMPLE INTERVAL:	DATE:	TIME:
C. Allison Hodge (SIGNATURE)	N/A	8-26-89	1038

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECEIVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
C. Allison Hodge	9-1-89	940	EDGE	M. Ferguson	9-1-89	9:40	

TYPE OF SAMPLE: ☐ SPLIT SPOON CORES–SOIL ☐ AUGER CUTTINGS–SOIL ☐ AUGER CUTTINGS–ROCK
☐ AIR ROTARY CUTTINGS–ROCK ■ DRILL WATER (NO AIR IN SAMPLE) ☐ OTHER _____

ALL SAMPLES ARE IMMEDIATELY PLACED IN I-CHEM SPECIALTY CLEANED CONTAINERS AND SEALED.

REMARKS: _____

1.0 General Information

1.1 Well Location

Monitoring well number 1082 is located in WAG 7. It is located approximately 400' southeast of chemical waste pit #4 and approximately 400' southwest of chemical waste pit #5. The location is shown on ORNL drawing number C3E20004 A075. Survey coordinates for this well are N 16911.0372, E 26347.5839 (X-10 grid) or latitude 35° 54' 27.96" and longitude 84° 19' 13.67". Coordinate data were provided by Martin Marietta Energy Systems. The method used for conversion from X-10 grid to Tennessee-Lambert State Plane Coordinates came from the publication "Tennessee Valley Authority Data Services Branch and Mapping Services Branch, Oak Ridge, Tennessee, DOE Plant Control, November 6, 1985, Field Book: ESS-3115, pp. 1-20." The latitude and longitude were calculated by Adams Craft Herz Walker Engineering, Inc., using methods from the U.S. Coast and Geodetic Survey Publication 62-4, "State Plane Coordinates by Automatic Data Processing."

1.2 Drilling Information

Well number 1082 was drilled by Geotek Engineering Company. An Ingersol Rand T-4 Air Rotary rig was used to drill this boring for monitor well installation under operation of Larry Ledbetter with the assistance of Freddy Dixon and Rick

Herron. Drilling commenced on 8/23/89 and was finished on 8/25/89. Paragraph 2.4.1 includes a detailed discussion of the well installation and a well schematic is included on the well installation/completion form. A synopsis of the drilling activity follows:*

8/23/89: The rig and equipment necessary to sample and drill with were deconed and mobilized to the site. Plastic was layed down and the T-4 was set up. Split spoon samples were taken from 2.0' to 9.3' (split spoon refusal). One split spoon soil sample was taken. A bulk density sample was also calculated. A 6.0" auger was then used to drill to 11.5' or auger refusal. Because the boring cannot be completed to total depth, the air rotary method will have to be used. Therefore a 14.0" auger was used to drill to 5.0' for the purpose of installing a 10.0" diverter casing. The casing was installed and grouted.

8/24/89: The diverter head and containment box were attached and the boring was extended from 11.5' to 15.0' with an 8-inch tricone bit. Air and water samples

* This information was typed directly from field notes and was edited only when necessary for clarification.

were taken at 15.0'. The boring was allowed to recharge 30 minutes. When trying to check the water level, the probe on the water level meter would not go down the borehole. It was decided to blow the hole again and try to remove the blockage. Upon doing this the containment hose became blocked and the borehole began to cave in around the diverter head pad. The containment hose was cleaned out. The boring was cleaned out by using as little water and air as possible to prevent further caving. The water level was checked after 10 minutes and found to be 9.52 feet below surface. Due to caving problems, the decision was made to set the well even though the boring only had 5.48' of water. The decision was based on the water level in the well 1081 (2.0' below surface) and the location which is next to a creek. The rods were removed and a 10.0' section of 2.0" stainless steel screen and a 10.0' section of 2.0" stainless steel casing were installed to a depth of 15.0'. A centralizer was placed at 10.0'. Sand was tremied with water to a level of 4.0', and bentonite was poured to a level of 2.9'. Four and one half bags of sand and 3/4 bucket bentonite

were used. The air sample was checked under a ultraviolet light and had no detectable hydrocarbons.

8/25/89: The annulus was grouted with 1 sack of cement and 5 lbs. of bentonite. No photovac readings could be taken due to the rain.

8/30/89: The casing was filed to remove the rough edges. Geotek and CAH were present.

9/5/89: The well was checked with the "Go-NoGo" gauge. The gauge went to total depth but encountered a tight fit near the bottom. R.C. Williams, Geotek and ERC present.

9/6/89: R.C. Williams passed the well after it was determined that the pump could go down the casing.

This well was logged by ERC Environmental and Energy Services Co., Inc., hydrogeologist C. Allison Hodges. All well construction materials and supplies were from Martin Marietta Energy Systems approved batches. The batch origin of individual items is shown on the included Monitoring Well Materials Certification form.

2.0 Technical Information

2.1 Decontamination Procedures

The drilling rig, down hole tools, surface casing, stainless steel screen, stainless steel casing, centralizers, and stainless steel silt trap

underwent the cleaning decontamination procedures outlined in the drilling specifications (Release Specific Technical Directions for Regulatory Compliance Monitoring Wells Phase 1, Oak Ridge National Laboratory, Oak Ridge, W.O., K-4147, April 1987, pgs, 2-4). A checklist of the cleaned materials is included with this data package.

2.2 Geology

WAG 7 is located in Melton Valley, which is in the Valley and Ridge Physiographic Province of East Tennessee. WAG 7 is underlain by shale, siltstone, and limestone of the Conasauga Group. The Conasauga Group in the Oak Ridge area consists of six formations. They are, in ascending order, the Pumpkin Valley Shale, Rutledge Limestone, Rogersville Shale, Maryville Limestone, Nolichucky Shale and the Maynardville Limestone. These rocks have undergone extensive deformation and contain many folds and faults resulting in varying strike and dips. The average strike and dip appears to be consistent with the regional strike of 56° northeast and dips of about 30° to the southeast.

2.3 Sample Collection

One soil sample (1082S01) was collected during drilling, placed in an I-CHEM specialty cleaned glass container, sealed and submitted to Sample Receiving, Analytical Chemistry Division, Bldg.

4500S, ORNL. A chain of custody form for this sample is included with this data package. This soil sample was collected in the split spoon interval from 9.0 to 9.3 feet on 8/23/89. A drill water sample (1082W01) was collected from the water pump on the drill rig on 8/24/89. Analytical results for the soil and drill water samples described above can be obtained from the Remedial Action Program data base at ORNL.

A bulk density soil sample was collected from the split spoon sample interval from 8.0' to 8.15'. The sample was measured, and weighed, and a bulk density of 2.1 grams/cm^3 was calculated.

2.4 Installation and Development

2.4.1 Installation

This was a type D well. A six-inch diameter boring was augered from ground surface to auger refusal (11.5 feet). The air rotary method was required to complete the boring to the specified total well depth. A fourteen-inch diameter boring was augered from ground surface to 5.0 feet and a ten-inch diverter casing was installed and grouted. An eight-inch diameter boring was then drilled with an air rotary tricone roller bit from 11.5 to 15.0 feet. A two-inch diameter stainless steel screen with welded stainless steel cap was

installed from 5.0 to 15.0 feet. A two-inch diameter stainless steel casing was installed above the screen at 5.0 feet and extended 1.84 feet above ground surface. A sandpack was then poured into the annular space from 4.0 to 15.0 feet, with a 1.1-foot bentonite seal poured into the annular space above the sandpack from 2.9 to 4.0 feet. The annular space from the top of the bentonite seal to the surface was tremie grouted with a cement/bentonite slurry. A detailed schematic of the well is included on the well installation/completion form.

2.4.2 Well Development

Well number 1082 was developed to remove drill cuttings, silt, and other fines from the monitoring well. The monitoring well was developed using a Geoguard pump with an air compressor. All pumps were cleaned prior to use according to specified cleaning procedures (see Paragraph 2.1). The well was developed until a measured total of 271 gallons of water had been evacuated and the clarity of the discharge water was approved by the company representative. The final turbidity value measured by completions was 5.0 NTU's. A development form showing the exact method of development and other pertinent data is appended.

2.4.3 Installation of Dedicated Monitoring Well Pump

After the well was developed, a Geoguard Model No. 5614 dedicated monitoring well pump was installed on 2/5/90 at a depth of 13.6 feet below ground surface. These pumps are decontaminated at American Sigma and are sent prepackaged. A copy of the pump certification is kept on file at ORNL.

2.5 Hydraulic Conductivity Testing

Well number 1082 was tested for the determination of hydraulic conductivity of the aquifer in the vicinity of the well screen. This was accomplished by instantaneously removing a known quantity of water from the monitoring well and measuring the recovery of the water level over time. The changing water levels were measured using a Druck 15 psig pressure transducer and an Omnidata Datapod II data recorder. The hydraulic conductivity value of 3.70×10^{-4} cm/second (shown as permeability on the hydraulic conductivity calculations) was calculated using the Bouwer and Rice method. A computer printout of the hydraulic conductivity calculations is included in this data package.

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1082

PRE-DRILLING CHECKLIST FOR MONITORING WELLS

PRE-DRILLING TASKS	COMPLIANCE DATE	COMPLIANCE INITIALS
1. EXCAVATION PERMIT OBTAINED.	8-23-89	CAH
2. ALL EQUIPMENT HAS BEEN CLEANED BEFORE DRILLING.	8-23-89	CAH
3a. SCREEN AND CASINGS HAVE BEEN WASHED, STEAMED, RINSED WITH DE-IONIZED OR DISTILLED WATER, RINSED WITH ISOPROPYL ALCOHOL, WRAPPED WITH PROTECTIVE COVERING AND STORED OFF THE GROUND.	N/A	
3b. PRE-PACKAGED SCREENS, CASINGS AND CENTRALIZERS WERE USED.	8-24-89	CAH
4. WORK AREA FOR SAMPLE EXAMINATION COVERED WITH CLEAN POLYETHYLENE.	8-23-89	CAH
5. CLEAN KNIVES, GLOVES, SAMPLE JARS AND LABELS ON-HAND.	8-23-89	CAH
6. POLYETHYLENE COVER IN PLACE OVER HOLE.	8-23-89	CAH

ADDITIONAL NOTES/OBSERVATIONS:

OBSERVER SIGNATURE/DATE C. Allison Hodges 8-24-89

C. Allison Hodges

ERC / EDGE
Environmental and Energy Services Co.

WELL No. 1082

DECONTAMINATION CHECKLIST
DRILLING EQUIPMENT

EQUIPMENT	SCRAPE	STEAM CLEAN	STEAM RINSE	ISOPROPYL ALCOHOL RINSE	DEIONIZED WATER RINSE
RIG	X	X	X	N/A	N/A
AUGERS	X	X	X	X	X
BITS	X	X	X	X	X
RODS	X	X	X	X	X
SAMPLERS	X	X	X	X	X
PIPES	X	X	X	X	X
WORK TOOLS	X	X	X	X	X
AUGER PINS	X	X	X	X	X

OBSERVER SIGNATURE/DATE C. Allison Hodges 8-23-89
C. Allison Hodges

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1082

ORNL MONITORING WELL LOG

LOCATION: WAG 7
DRILLER: Larry Ledbetter
HELPER: Fred Dixon
DRILL: Ingersol Rand T-4

DATE: START: 8-23-89
FINISH: 8-24-89
LOGGED BY: C. Allison Hodges
HEALTH PHYSICIST: W. H. Shinpaugh

TYPE DRILLING: Split Spoon/Auger/Air Rotary
LUBRICANT TYPE: Green Stuff
No. SAMPLES TAKEN: 1
TYPE: Soil
CONTAINMENT TYPE: Plastic, Pan, Containment Box

THICKNESS OF SOIL (REFUSAL DEPTH): 9.3'
DEPTH DRILLED IN ROCK: 5.7'
TOTAL DEPTH OF WELL: 15.0'

DRILLING FLUID SAMPLES:
TYPE: Water
DATE: 8-24-89

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
0.0	2.0			Gravel. (fill material)
2.0	3.0		90%	Clay, light brown, with shale (2°10), highly
				weathered, dusky brown and light olive gray.
				Also contains roots.
3.0	4.0			Clay, mottled, light olive gray and pale
				brown, with shale, slightly weathered, dusky
				brown. Damp.
4.0	5.0		75%	Clay, mottled, moderate yellowish brown and
				olive gray. Clay is plastic and moist.
5.0	5.2			Clay, mottled, moderate yellowish brown and
				dark yellowish orange. Also contains limestone
				fragments, light gray, also roots.
5.2	6.0			Clay, mottled, dark yellowish orange and olive
				gray, with shale, dusky brown and dark yellow-
				ish brown. The shale is thinly bedded and
				fragmented. The clay is hard and moist.
5.6	6.0			Clay, olive gray, with shale, dusky brown.
				The clay and shale are weathered and inter-
				bedded in thin beds. The sample is wet.
6.0	7.6		50%	Clay, mottled, dark yellowish brown and olive
				gray. Moist.

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WELL No. 1082

ORNL MONITORING WELL LOG

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
7.6	8.0			Limestone, light gray. Large fragments,
				medium grained. Moist.
8.0	8.8		40%	Clay, mottled, dark yellowish brown and light
				olive gray.
8.8	9.0			Clay, light olive gray, shale, highly
				weathered, dusky brown, and limestone, light
				gray. The clay and shale are laminated and
				are interbedded with the limestone. The sample
				is wet.
9.0	9.2	1082S01	75%	Clay, mottled, light olive gray and light olive
				brown.
9.2	9.3			Limestone, light gray, with shale, highly
				weathered, light olive gray. Saturated.
	9.3			Split Spoon Refusal.
9.3	11.5			Interbedded clay, shale and limestone.
11.5	15.0			Hard, even drilling (limestone).
	15.0			Total Depth

EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL No. 1082

WELL INSTALLATION/COMPLETION FORM

O.R.N.L. MONITORING WELL PROGRAM

LOGGED BY: C. Allison Hodges
PROOFED BY: Michael L. Ebers

DRILLING COMPANY: Geotek

DRILLER: Larry Ledbetter HELPER: Freddy Dixon, Rick Herron

EQUIPMENT
- ☒ 6.0 INCH AUGER 11.5 L.F.
- ☒ 14.0 INCH AUGER 5.0 L.F.
- ☒ 8.0 INCH ROTARY 3.5 L.F.

LOCATION WAG 7
ORNL GRID COORDINATES
N 16,911.0372
E 26,347.5839
ELEV. GROUND 758.22
ELEV. TOP STAINLESS STEEL CASING 760.06

DRILLING DATES:
STARTED: 8-23-89
FINISHED: 8-25-89

MATERIALS USED

EST. VOL.	USED VOL.	
	10.0	FEET OF 2.0 IN. S.S. SCREEN
	6.84	FEET OF 2.0 IN. S.S. CASING
3.5	4.5	SACKS OF SAND
30.0	40.0	POUNDS OF BENTONITE PELLETS
1	1	SACKS OF CEMENT
	5.0	POUNDS OF POWDERED BENTONITE
	8.0	GALLONS OF WATER (CEMENTING)

REASON FOR DIFFERENCES BETWEEN ESTIMATED VOLUMES AND USED VOLUMES
Irregular boring diameter due to caving.

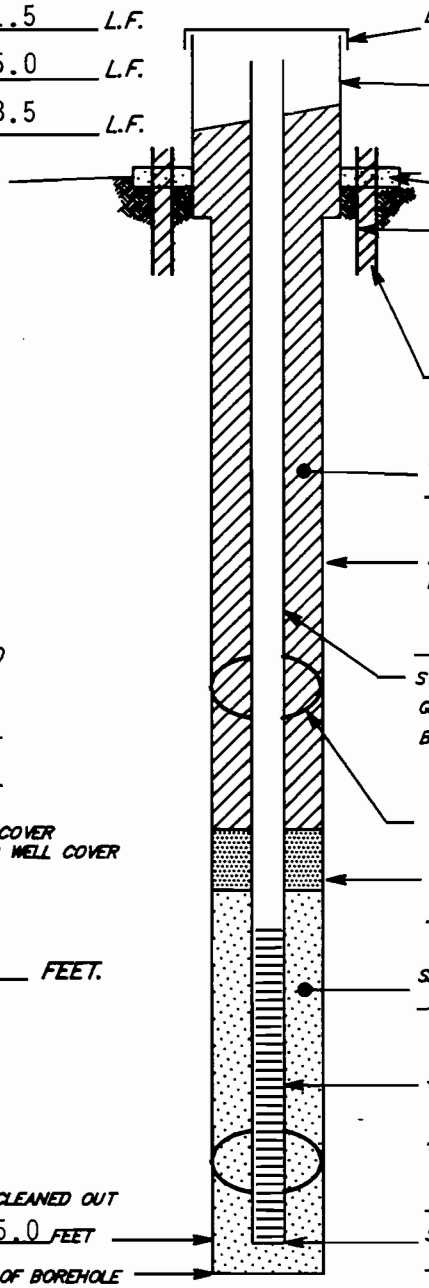
WELL COVER USED
- ☒ LOCKING STEEL COVER
- ☐ FLUSH MOUNTED WELL COVER
- ☐ OTHER

SILT TRAP USED YES ☐ NO ☒

MONITORING WELL PUMP BASE SET AT 13.6 FEET.

CENTRALIZERS AT 10.0 FEET.
_____ FEET.
_____ FEET.

NOTE:
ALL DEPTHS ARE MEASURED FROM GROUND SURFACE UNLESS OTHERWISE NOTED:



LOCKING STEEL COVER
10 INCH DIAMETER STEEL PROTECTIVE CASING 3.13 FT. ABOVE GROUND TO 2.0 FT. BELOW GROUND SURFACE

CONCRETE PAD

10.0 INCH DIVERTER CASING 0.0 FT. ABOVE GROUND SURFACE TO 5.0 FT. BELOW GROUND SURFACE

14 INCH BOREHOLE 0.0 TO 5.0 FEET

GROUT SEAL 0.0 TO 2.9 FEET

8.0 INCH DIAMETER BOREHOLE

2.0 INCH DIAMETER STAINLESS STEEL CASING 1.84 FT. ABOVE GROUND SURFACE TO 5.0 FT. BELOW GROUND SURFACE

CENTRALIZER (TYP.)

BENTONITE PELLET SEAL 2.9 TO 4.0 FEET

SAND PACK 4.0 TO 15.0 FEET

2.0 INCH DIAMETER STAINLESS STEEL .010 SLOTTED SCREEN 5.0 TO 15.0 FEET

N/A INCH DIAMETER STAINLESS STEEL SILT TRAP/CAP N/A TO N/A FEET

HOLE CLEANED OUT TO 15.0 FEET

BOTTOM OF BOREHOLE 15.0 FEET

TYPE D WELL

NOT TO SCALE

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1082

DATE: 8-23-89

MONITORING WELL MATERIALS CERTIFICATION

ITEM/MATERIAL		DATE USED	BATCH NUMBER
SAND			
		8-24-89	1
BENTONITE			
		8-24-89	1
STAINLESS STEEL SCREEN	(PREPACKAGED ☒ YES ☐ NO)	8-24-89	1
STAINLESS STEEL CASING	(PREPACKAGED ☒ YES ☐ NO)	8-24-89	1
STAINLESS STEEL CENTRALIZERS	(PREPACKAGED ☒ YES ☐ NO)	8-24-89	1
STAINLESS STEEL CAPS	(PREPACKAGED ☒ YES ☐ NO)	8-24-89	1
MONITORING WELL PUMP	(PREPACKAGED ☒ YES ☐ NO)	2-05-90	4
GROUT		8-23-89	1
		8-24-89	1
WELL COVERS			
SURFACE CASING			

COMMENTS:

OBSERVER SIGNATURE/DATE C. Allison Hodges 8-24-89

C. Allison Hodges

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1082

POST-WELL COMPLETION CHECKLIST

POST-WELL COMPLETION TASKS	COMPLIANCE DATE	COMPLIANCE INITIALS
1. MUD SCRAPED FROM AUGERS, SAMPLERS, AND ALL OTHER EQUIPMENT.	8-24-89	CAH
2. ALL MUD FROM RIG AND EQUIPMENT SCRAPINGS AND CUTTINGS DISPOSED OF IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED.	8-24-89	CAH
3. WELL DEVELOPED IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED AND DETAILS OF THE DEVELOPMENT ACTIVITY RECORDED.	2-05-90	DCL
4. DRILLING SITE PROPERLY CLEANED UP AFTER COMPLETION OF WELL INSTALLATION.	8-24-89	CAH

* RELEASE SPECIFIC TECHNICAL DIRECTIONS FOR REGULATORY COMPLIANCE MONITORING WELLS PHASE I, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, W.O. K-4147, APRIL 1987.

OBSERVER SIGNATURE/DATE C. Allison Hodges 8-24-89

C. Allison Hodges

D. Charles Lytle 2-05-90

D. Charles Lytle

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1082

LOCATION: WAG 7

MONITORING WELL DEVELOPMENT FORM

DEVELOPMENT DETAILS

METHOD OF DEVELOPMENT: Surging and Pumping

DEVELOPMENT BEGAN DATE: 1-31-90 TIME:

DEVELOPMENT ENDING DATE: 2-05-90

DEVELOPMENT OBSERVED BY: D. Charles Lytle

ONE WELL VOLUME: 6.2 GALLONS

TOTAL GALLONS PUMPED: 271 TOTAL WELL VOLUMES PUMPED: 43.7

INITIAL pH: 7.2 FINAL pH: 7.3

INITIAL CONDUCTIVITY (uS): 616 FINAL CONDUCTIVITY (uS): 613

DESCRIPTION OF INITIAL TURBIDITY: Muddy

DESCRIPTION OF FINAL TURBIDITY: Clear

FINAL MEASURED TURBIDITY: 5.0

WELL APPROVED BY: R. C. Williams MMES

ODOR OF WATER: None

WATER DISCHARGED TO:
- ☒ GROUND SURFACE
- ☐ STORM SEWERS
- ☐ DRUMS
- ☐ TANK TRUCK
- ☐ STORAGE TANKS
- ☐ OTHER

INITIAL PRE-DEVELOPMENT WATER DEPTH: 3.7 feet from ground surface.

DEVELOPMENT OBSERVATIONS

OBSERVER SIGNATURE/DATE D. Charles Lytle 2-05-90

D. Charles Lytle

ERC / EDGE Environmental and Energy Services Co.

WELL NO. 1082
LOCATION: WAG 7
DATE: 1-31-90

MONITORING WELL DEVELOPMENT PROGRESS

ONE WELL VOLUME = 6.2 GALLONS

DATE	TIME	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	MEASURED TURBIDITY (NTU'S)	pH	CONDUCTIVITY (µS)	TOTAL GALLONS PUMPED	WELL VOLUMES PUMPED	COMMENTS
1-31-90	1430	32	Muddy	--	7.2	616	32		
2-01-90		49					81		
2-02-90	1405	80	Cloudy	--	7.2	660	161	25.9	
2-02-90	1530	69	Slightly Cloudy	--	7.3	644	230	37.1	
2-05-90	0915	21	Slightly Cloudy	--	7.3	602	251	40.5	
2-05-90	1100	20	Clear	5.0	7.3	613	271	43.7	
RESULTS AT END OF DEVELOPMENT			Clear	5.0	7.3	613	271	43.7	

COMMENTS Water cleared at 43.7 well volumes passed and moved on.

OBSERVER SIGNATURE/DATE D. Charles Lytle 2-05-90
D. Charles Lytle

HYDRAULIC CONDUCTIVITY CALCULATIONS

PROGRAM SLUGT, VERSION 4.1, NOV. 1986

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:

(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3, NO.1 OF WRR ENTITLED "RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER")

(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED "A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS")

WELL NO.: 1082 DATE OF TEST: 2/28/90

PROJECT NO.: E221-002 CLIENT: MMES

SITE LOCATION: WAG 7

EDGE, INC. FIELD INVESTIGATOR: BRUCE MCMASTER

INPUT DATA ARE:

INNER CASING DIAMETER = 2.00 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 2.00 INCHES
DIAMETER OF DRILLED HOLE = 8.63 INCHES
LENGTH OF SCREEN OR INTAKE PORTION = 10.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 9.45 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 10.00 FEET
DEPTH TO STATIC WATER LEVEL BELOW REF. POINT = 7.50 FEET
ESTIMATED POROSITY OF GRAVEL PACK = .20
FALLING-HEAD INDEX = 0 ("1" IF FALLING,"0" IF RISING)
NUMBER OF DEPTH-TIME DATA POINTS = 26

HO WAS COMPUTED FROM INTERCEPT OF PLOT OF LOG(H) VS. TIME

SUCCESSIVE COMPUTED
VALUES FOR HO
(FEET)

.7860
.7998

HYDRAULIC CONDUCTIVITY CALCULATIONS

TIME (SEC)	DEPTH TO WATER (FEET)	HEAD (FEET)
5.00	6.350	1.150
10.00	6.560	.940
15.00	6.660	.840
20.00	6.710	.790
25.00	6.740	.760
30.00	6.770	.730
35.00	6.790	.710
40.00	6.800	.700
45.00	6.830	.670
50.00	6.840	.660
55.00	6.860	.640
60.00	6.870	.630
70.00	6.890	.610
80.00	6.920	.580
90.00	6.930	.570
100.00	6.950	.550
110.00	6.970	.530
120.00	6.990	.510
150.00	7.040	.460
180.00	7.070	.430
210.00	7.100	.400
240.00	7.130	.370
300.00	7.170	.330
360.00	7.200	.300
420.00	7.230	.270
480.00	7.250	.250

(**********

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

PERMEABILITY = 1.21E-05 FT/SEC = 3.70E-04 CM/SEC

TRANSMISSIVITY = 1.21E-04 FT**2/SEC

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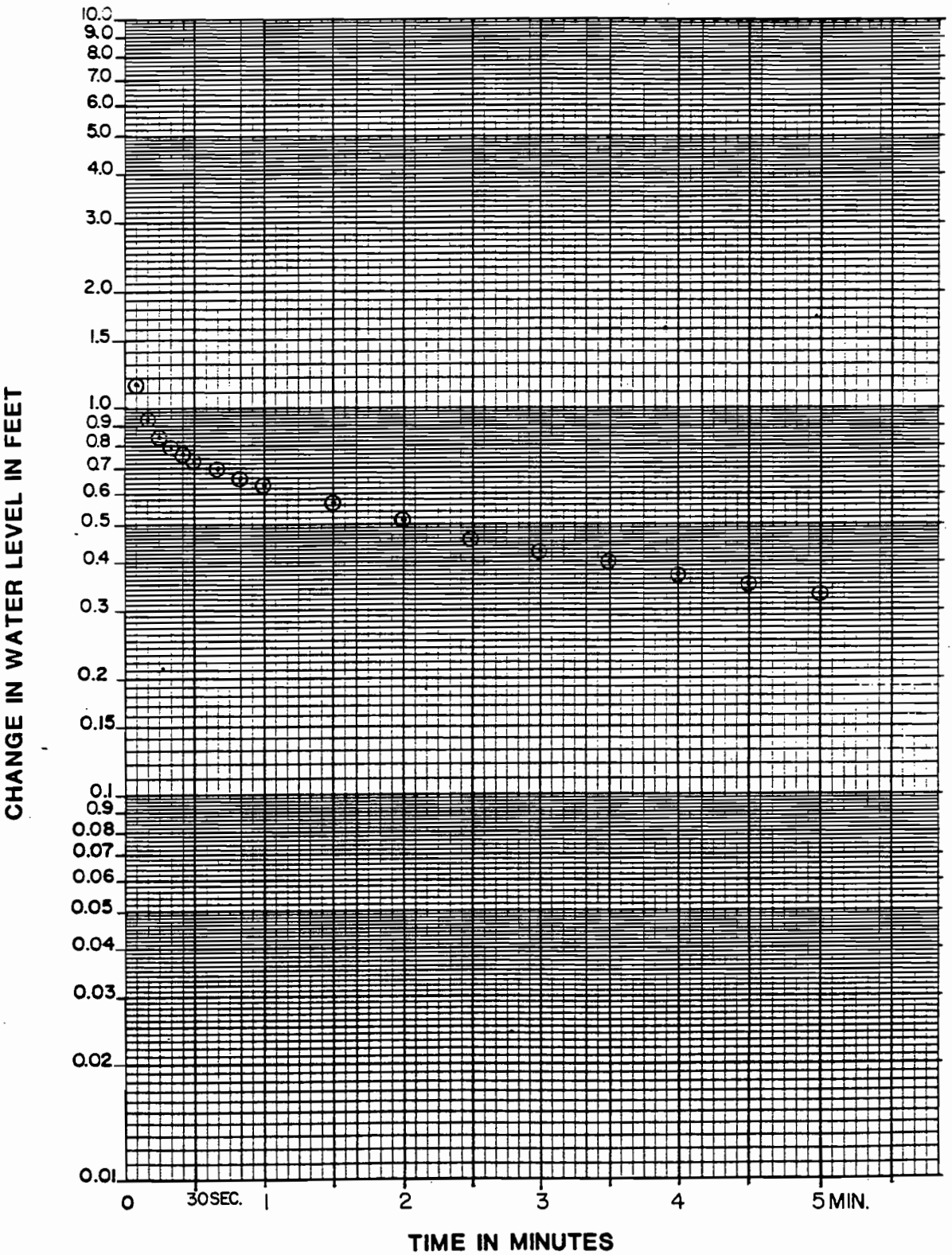
and Energy
Services Co.

WELL No. 1082

HYDRAULIC CONDUCTIVITY CALCULATIONS



EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 1082S01

WELL NO.	LOCATION:	TYPE:
1082	WAG-7	Soil

SAMPLER:	SAMPLE INTERVAL:	DATE:	TIME:
C. Allison Hodgen (SIGNATURE)	9.0-9.3	8-23-89	1117

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECEIVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
C. Allison Hodgen	9-1-89	0940	EDGE	M. Ferguson	9-1-89	9:40	

TYPE OF SAMPLE: ■ SPLIT SPOON CORES–SOIL ☐ AUGER CUTTINGS–SOIL ☐ AUGER CUTTINGS–ROCK
☐ AIR ROTARY CUTTINGS–ROCK ☐ DRILL WATER (NO AIR IN SAMPLE) ☐ OTHER _____

ALL SAMPLES ARE IMMEDIATELY PLACED IN I-CHEM SPECIALTY CLEANED CONTAINERS AND SEALED.

REMARKS: _____

EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 1082W01

WELL NO.	LOCATION:	TYPE:
1082	WAG-7	WATER

SAMPLER:	SAMPLE INTERVAL:	DATE:	TIME:
C. Allison Hodge (SIGNATURE)	N/A	8-24-89	1301

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECEIVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
C. Allison Hodge	9-1-89	940	EDGE	M. Ferguson	9-1-89	9:40	

TYPE OF SAMPLE: ☐ SPLIT SPOON CORES–SOIL ☐ AUGER CUTTINGS–SOIL ☐ AUGER CUTTINGS–ROCK
☐ AIR ROTARY CUTTINGS–ROCK ■ DRILL WATER (NO AIR IN SAMPLE) ☐ OTHER _____

ALL SAMPLES ARE IMMEDIATELY PLACED IN I-CHEM SPECIALTY CLEANED CONTAINERS AND SEALED.

REMARKS: _____

1.0 General Information

1.1 Well Location

Monitoring well number 1083 is located in WAG 7. It is along the southern boundary of WAG 7, approximately 500' southwest of chemical waste pit #7. The location is shown on ORNL drawing number C3E20004 A075. Survey coordinates for this well are N 16997.5168, E 27175.9250 (X-10 grid) or latitude 35° 54' 33.23" and longitude 84° 19' 05.89". Coordinate data were provided by Martin Marietta Energy Systems. The method used for conversion from X-10 grid to Tennessee-Lambert State Plane Coordinates came from the publication "Tennessee Valley Authority Data Services Branch and Mapping Services Branch, Oak Ridge, Tennessee, DOE Plant Control, November 6, 1985, Field Book: ESS-3115, pp. 1-20." The latitude and longitude were calculated by Adams Craft Herz Walker Engineering, Inc., using methods from the U.S. Coast and Geodetic Survey Publication 62-4, "State Plane Coordinates by Automatic Data Processing."

1.2 Drilling Information

Well number 1083 was drilled by Geotek Engineering Company. An Mobile B-50 and an Ingersol Rand T-4 rig were used to drill this boring for monitor well installation under operation of Rick Herron and Larry Ledbetter with the assistance of Freddy Dixon and Steve Kirk.

Drilling commenced on 6/27/89 and was finished on 8/11/89. Paragraph 2.4.1 includes a detailed discussion of the well installation and a well schematic is included on the well installation/ completion form. A synopsis of the drilling activity follows:*

6/26/89: The augering rig, augers, pan and sampling equipment were deconed.

6/27/89: The rig and equipment were mobilized to the site, plastic was placed on the ground over the work area and the rig was set up. Split spoons were taken from 1.4 to 5.7' or refusal. Two soil samples were taken. No bulk density sample could be taken because the soil was not uniform enough. A 6-inch borehole was augered from 0.0' to 5.7' to auger refusal, water was encountered at this depth with the augers and the borehole began to fill with water. The HP detected high background readings and recommended that we stay on the plastic. No reading were detected in the soil. Photovac readings were less than 1 ppm. Because the boring cannot be completed with the augers the air rotary method

* This information was typed directly from field notes and was edited only when necessary for clarification.

will be used. A 22.0" boring was augered to 4.0' and a 15 1/4" diverter casing was installed and grouted.

7/21/89: The T-4 and equipment were deconed, mobilized to the site and set up. The diverter head was attached and the containment box hooked up. An 8-inch boring was advanced to 15.0'. While drilling, smoke began coming out the top of the HEPA filter on the containment box. The photovac detected 25 ppm. The rig was shut down until the situation could be evaluated. The smoke is probably coming from the rubbers that are used with the diverter attachment. HP C.E. Stooksbury says to continue drilling. After waiting 1-hour for recharge the water level was at 5.5' below surface. The boring was then cleaned again due to the remaining thick mud and cuttings. While cleaning the boring, the diverter casing pad broke and the cuttings began to blow out of the broken seal. Activities were halted until a decision could be made on how to complete the well.

7/24/89: Decision made to remove cuttings by bailing. The bailer was deconed and taken to the site. The bailer however did not work because the boring had caved to 9.0' and it could not remove the blockage. The air rotary method was

tried again, but too much material came out of the broken seal. Activities were halted again.

8/10/89: Decision was made to try and remove mud with a pump. The boring was pumped with a 1-inch centrifical pump. All the material was pumped into 55 gallon drums. The well was recharging as fast as the material was being pumped out. Most of the water was removed but the cuttings remained. The boring is still blocked at 9.0'. Augering with 6-inch augers was tried next, but failed because cuttings are too fine and saturated. Both bailing and pumping were tried again but neither method worked. The boring remains blocked at 9.0'. A meeting to discuss the problem was called by R.C. Williams and will be held tomorrow.

8/11/89: R.C. Williams, Mike Ebers, J. Greene, Doug Connery, Bill McMaster and C.A. Hodges present for meeting. McMaster says that boring needs to be completed to 15.0'. It was decided to blow the borehole with the air rotary, but J. Greene will have to receive permission. Permission was given, but respirators will have to be worn, air samples will have to be taken and fabric and plastic

will have to be placed over existing plastic. Respirators were worn by the drillers and the borehole was blown with the air rotary. No contamination was detected and after drilling activities were completed the respirators were removed. The boring was cleaned out to a depth of 13.15' and the 2-inch stainless steel and screen were set. Sand was then poured in and a bentonite seal set. The annulus was then grouted.

8/30/89: The 2-inch casing was cut to the specified height and filed to remove the rough edges. Geotek and C.A.H. were present.

9/5/89: The well was tested with the "Go-NoGo" gauge and passed by R.C. Williams.

This well was logged by ERC Environmental and Energy Services Co., Inc., hydrogeologist C. Allison Hodges. All well construction materials and supplies were from Martin Marietta Energy Systems approved batches. The batch origin of individual items is shown on the included Monitoring Well Materials Certification form.

2.0 Technical Information

2.1 Decontamination Procedures

The drilling rig, down hole tools, surface casing, stainless steel screen, stainless steel casing, centralizers, and stainless steel silt trap underwent the cleaning decontamination procedures outlined in the drilling specifications (Release Specific Technical Directions for Regulatory Compliance Monitoring Wells Phase 1, Oak Ridge National Laboratory, Oak Ridge, W.O., K-4147, April 1987, pgs, 2-4). A checklist of the cleaned materials is included with this data package.

2.2 Geology

WAG 7 is located in Melton Valley, which is in the Valley and Ridge Physiographic Province of East Tennessee. WAG 7 is underlain by shale, siltstone, and limestone of the Conasauga Group. The Conasauga Group in the Oak Ridge area consists of six formations. They are, in ascending order, the Pumpkin Valley Shale, Rutledge Limestone, Rogersville Shale, Maryville Limestone, Nolichucky Shale and the Maynardville Limestone. These rocks have undergone extensive deformation and contain many folds and faults resulting in varying strike and dips. The average strike and dip appears to be consistent with the regional strike of 56° northeast and dips of about 30° to the southeast.

2.3 Sample Collection

Two samples were collected during drilling, placed in I-CHEM specialty cleaned glass containers, sealed and submitted to Sample Receiving, Analytical Chemistry Division, Bldg. 4500S, ORNL. Chain of custody forms for these samples are included with this data package. Soil sample 1083S01 was collected in the split spoon interval from 1.4 to 1.8 on 6/27/89 and soil sample 1082S02 was collected in the split spoon interval from 5.4 to 5.7 on 6/27/89. Analytical results for the two soil samples described above can be obtained from the Remedial Action Program data base at ORNL.

2.4 Installation and Development

2.4.1 Installation

This was a type D well. A six-inch diameter boring was augered from ground surface to auger refusal (5.7 feet). The air rotary method was required to complete the boring because the augers refused before the specified total well depth was reached. Therefore, a twenty two-inch diameter boring was augered from ground surface to 4.0 feet and fifteen-inch diverter casing was installed and grouted. An eight-inch diameter boring was then drilled with an air rotary tricone roller bit from 5.7 to 15.0 feet. A two-inch diameter stainless steel silt trap was installed from 12.91 to 13.15

feet. Above the silt trap a two-inch diameter stainless steel screen was installed from 2.27 to 12.91 feet. A two-inch diameter stainless steel casing was installed above the screen at 2.27 feet and extended 2.12 feet above ground surface. A sandpack was then poured into the annular space from 1.95 to 13.15 feet, with a .45 foot bentonite pellet seal poured into the annular space above the sandpack from 1.5 to 1.95 feet. The annular space from the top of the bentonite seal to the surface was tremie-grouted with a cement/bentonite slurry. A detail of the well is included on the well installation/completion form.

2.4.2 Well Development

Well number 1083 was developed to remove drill cuttings, silt, and other fines from the monitoring well. The monitoring well was developed using a Geoguard pump with an air compressor. All pumps were cleaned prior to use according to specified cleaning procedures (see Paragraph 2.1). The well was developed until a measured total of 239 gallons of water had been evacuated and the clarity of the discharge water was approved by the company representative. The final turbidity value measured was 10 NTU's. A development form showing the exact method of development and other pertinent data is appended.

2.4.3 Installation of Dedicated Monitoring Well Pump

After the well was developed, a Geoguard Model No. 5614 dedicated monitoring well pump was installed on 2/5/90 at a depth of 11.2 feet below ground surface. These pumps are decontaminated at American Sigma and are sent prepackaged. A copy of the pump certification is kept on file at ORNL.

2.5 Hydraulic Conductivity Testing

Well number 1083 was tested for the determination of hydraulic conductivity of the aquifer in the vicinity of the well screen. This was accomplished by instantaneously adding a known quantity of water to the monitoring well and measuring the recovery of the water level over time. The changing water levels were measured using a Druck 15 psig pressure transducer and an Omnidata Datapod II data recorder. The hydraulic conductivity value of 3.61×10^{-3} cm/second (shown as permeability on the hydraulic conductivity calculations) was calculated using the Bouwer and Rice method. A computer printout of the hydraulic conductivity calculations is included in this data package.

ERC / EDGE
Environmental and Energy Services Co.

WELL No. 1083

PRE-DRILLING CHECKLIST FOR MONITORING WELLS

PRE-DRILLING TASKS		COMPLIANCE DATE	COMPLIANCE INITIALS
1.	EXCAVATION PERMIT OBTAINED.	6-27-89	CAH
2.	ALL EQUIPMENT HAS BEEN CLEANED BEFORE DRILLING.	6-27-89	CAH
3a.	SCREEN AND CASINGS HAVE BEEN WASHED, STEAMED, RINSED WITH DE-IONIZED OR DISTILLED WATER, RINSED WITH ISOPROPYL ALCOHOL, WRAPPED WITH PROTECTIVE COVERING AND STORED OFF THE GROUND.	N/A	
3b.	PRE-PACKAGED SCREENS, CASINGS AND CENTRALIZERS WERE USED.	8-11-89	CAH
4.	WORK AREA FOR SAMPLE EXAMINATION COVERED WITH CLEAN POLYETHYLENE.	6-27-89	CAH
5.	CLEAN KNIVES, GLOVES, SAMPLE JARS AND LABELS ON-HAND.	6-27-89	CAH
6.	POLYETHYLENE COVER IN PLACE OVER HOLE.	8-10-89	CAH

ADDITIONAL NOTES/OBSERVATIONS:

OBSERVER SIGNATURE/DATE C. Allison Hodges 8-11-89
C. Allison Hodges

ERC / EDGE
Environmental and Energy Services Co.

WELL No. 1083

DECONTAMINATION CHECKLIST
DRILLING EQUIPMENT

EQUIPMENT	SCRAPE	STEAM CLEAN	STEAM RINSE	ISOPROPYL ALCOHOL RINSE	DEIONIZED WATER RINSE
RIG	X	X	X	N/A	N/A
AUGERS	X	X	X	X	X
BITS	X	X	X	X	X
RODS	X	X	X	X	X
SAMPLERS	X	X	X	X	X
PIPES	X	X	X	X	X
WORK TOOLS	X	X	X	X	X
AUGER PINS	X	X	X	X	X

OBSERVER SIGNATURE/DATE C. Allison Hodges 6-27-89
C. Allison Hodges

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1083

ORNL MONITORING WELL LOG

LOCATION: WAG 7

DRILLER: Rick Herron/Larry Ledbetter

HELPER: Freddy Dixon/Steve Kirk

DRILL: Mobile B-50/IR T-4

DATE: START: 6-27-89

FINISH: 8-11-89

LOGGED BY: C. Allison Hodges

HEALTH PHYSICIST: W. H. Shinpaugh/ L. C. Johnson

TYPE DRILLING: Split Spoon, Auger, Air Rotary

LUBRICANT TYPE: Green Stuff

No. SAMPLES TAKEN: Two

TYPE: Soil

CONTAINMENT TYPE: Plastic, Pan, Containment Box

THICKNESS OF SOIL (REFUSAL DEPTH): 5.7'

DEPTH DRILLED IN ROCK: 9.3'

TOTAL DEPTH OF WELL: 15.0'

DRILLING FLUID SAMPLES:

TYPE: _____ DATE: _____

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
0.0	1.4			Gravel. (fill material)
1.4	3.4		15%	Clay, moderate yellowish brown, slightly moist.
				Contains gravel and roots.
3.4	5.3	1083S01	75%	Clay, mottled, pale yellowish brown, moderate
				yellowish brown, and medium gray. Contains
				some weathered shale, medium gray. Clay is
				moist.
5.3	5.4			Shale, moderate olive brown. Highly
				weathered, hard, fractured.
5.4	5.6	1083S02	100%	Clay, light brown, with weathered shale, medium
				gray.
5.6	5.7			Limestone, light gray, fine grained, wet.
	5.7			Split spoon/Auger refusal. Encountered water
				with auger at 5.7'.
5.7	7.0			*Smooth, even drilling. Fast.
7.0	10.5			Hard, even drilling.
10.5	15.0			Hard, uneven, rough, drilling.
	15.0			Total Depth

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1083

ORNL MONITORING WELL LOG

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
				Notes:
				*Lithologic description of rock drilled from
				5.7' to 15.0' not available due to the use of
				a containment box.
				Bulk density not determined due to poor
				quality of split spoon samples.

EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL No. 1083

WELL INSTALLATION/COMPLETION FORM

O.R.N.L. MONITORING WELL PROGRAM

LOGGED BY: C. Allison Hodges
PROOFED BY: Michael L. Ebers

DRILLING COMPANY: Geotek

DRILLER: Larry Ledbetter HELPER: Freddy Dixon/ Rick Herron

EQUIPMENT
- ☒ 6 INCH AUGER 1.7 L.F.
- ☒ 22 INCH AUGER 4 L.F.
- ☒ 8 INCH ROTARY 9.3 L.F.

LOCATION WAG 7
ORNL GRID COORDINATES
N 16,997.5168
E 27,175.9250
ELEV. GROUND 754.27
ELEV. TOP STAINLESS STEEL CASING 756.39

DRILLING DATES:
STARTED: 6-27-89
FINISHED: 8-11-89

MATERIALS USED

EST. VOL.	USED VOL.	
	10.1	FEET OF 2.0 IN. S.S. SCREEN
	4.4	FEET OF 2.0 IN. S.S. CASING
3	6	SACKS OF SAND
1	50	POUNDS OF BENTONITE PELLETS
1 1/4	1 1/4	SACKS OF CEMENT
	6 1/4	POUNDS OF POWDERED BENTONITE
	10.0	GALLONS OF WATER (CEMENTING)

REASON FOR DIFFERENCES BETWEEN ESTIMATED VOLUMES AND USED VOLUMES
Wash out zones and spillage.

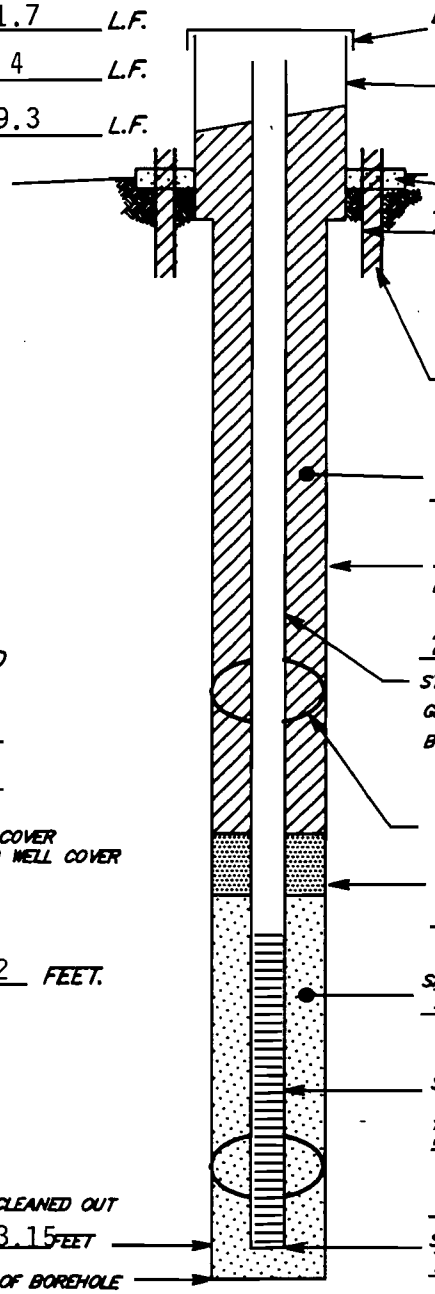
WELL COVER USED
- ☐ LOCKING STEEL COVER
- ☒ FLUSH MOUNTED WELL COVER
- ☐ OTHER

SILT TRAP USED YES ☐ NO ☒

MONITORING WELL PUMP BASE SET AT 11.2 FEET.

CENTRALIZERS AT 8.0 FEET.
_____ FEET.
_____ FEET.

NOTE:
ALL DEPTHS ARE MEASURED FROM GROUND SURFACE UNLESS OTHERWISE NOTED:



LOCKING STEEL COVER
10 INCH DIAMETER STEEL PROTECTIVE CASING 3.19 FT. ABOVE GROUND TO 2.0 FT. BELOW GROUND SURFACE

CONCRETE PAD

15 1/4 INCH DIVERTER CASING 0.0 FT. ABOVE GROUND SURFACE TO 4.0 FT. BELOW GROUND SURFACE

22 INCH BOREHOLE 0.0 TO 4.0 FEET

GROUT SEAL 0.0 TO 1.5 FEET

8.0 INCH DIAMETER BOREHOLE

2.0 INCH DIAMETER STAINLESS STEEL CASING 2.12 FT. ABOVE GROUND SURFACE TO 2.27 FT. BELOW GROUND SURFACE

CENTRALIZER (TYP.)

BENTONITE PELLET SEAL 1.5 TO 1.95 FEET

SAND PACK 1.95 TO 13.15 FEET

2.0 INCH DIAMETER STAINLESS STEEL 0.010 SLOTTED SCREEN 2.27 TO 12.91 FEET

2.0 INCH DIAMETER STAINLESS STEEL SILT TRAP/CAP 12.91 TO 13.15 FEET

HOLE CLEANED OUT TO 13.15 FEET

BOTTOM OF BOREHOLE 15.0 FEET

TYPE D WELL

NOT TO SCALE

ERC / EDGE
Environmental and Energy Services Co.

WELL No. 1083

DATE: 8-11-89

MONITORING WELL MATERIALS CERTIFICATION

ITEM/MATERIAL		DATE USED	BATCH NUMBER
SAND		8-11-89	Stores
BENTONITE		8-11-89	Stores
STAINLESS STEEL SCREEN	(PREPACKAGED ■ YES ☐ NO)	8-11-89	Stores
STAINLESS STEEL CASING	(PREPACKAGED ■ YES ☐ NO)	8-11-89	Stores
STAINLESS STEEL CENTRALIZERS	(PREPACKAGED ■ YES ☐ NO)	8-11-89	Stores
STAINLESS STEEL CAPS	(PREPACKAGED ■ YES ☐ NO)	8-11-89	Stores
MONITORING WELL PUMP	(PREPACKAGED ■ YES ☐ NO)	2-05-90	4
GROUT		8-11-89	1
WELL COVERS		8-11-89	1
SURFACE CASING			

COMMENTS:

OBSERVER SIGNATURE/DATE C. Allison Hodges 8-11-89

C. Allison Hodges

ERC / EDGE
Environmental and Energy Services Co.

WELL No. 1083

POST-WELL COMPLETION CHECKLIST

POST-WELL COMPLETION TASKS	COMPLIANCE DATE	COMPLIANCE INITIALS
1. MUD SCRAPED FROM AUGERS, SAMPLERS, AND ALL OTHER EQUIPMENT.	6-27-89	CAH
2. ALL MUD FROM RIG AND EQUIPMENT SCRAPINGS AND CUTTINGS DISPOSED OF IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED.	6-27-89	CAH
3. WELL DEVELOPED IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED AND DETAILS OF THE DEVELOPMENT ACTIVITY RECORDED.	2-05-90	DCL
4. DRILLING SITE PROPERLY CLEANED UP AFTER COMPLETION OF WELL INSTALLATION.	8-11-89	CAH

* RELEASE SPECIFIC TECHNICAL DIRECTIONS FOR REGULATORY COMPLIANCE MONITORING WELLS PHASE I, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, W.O. K-4147, APRIL 1987.

OBSERVER SIGNATURE/DATE C. Allison Hodges 8-11-89
C. Allison Hodges

D. Charles Lytle 2-05-90
D. Charles Lytle

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1083

LOCATION: WAG 7

MONITORING WELL DEVELOPMENT FORM

DEVELOPMENT DETAILS

METHOD OF DEVELOPMENT: Surging and Pumping

DEVELOPMENT BEGAN DATE: 2-02-90 TIME:

DEVELOPMENT ENDING DATE: 2-05-90

DEVELOPMENT OBSERVED BY: D. Charles Lytle

ONE WELL VOLUME: 6.3 GALLONS

TOTAL GALLONS PUMPED: 239 TOTAL WELL VOLUMES PUMPED: 38.0

INITIAL pH: 7.0 FINAL pH: 7.0

INITIAL CONDUCTIVITY (uS): 545 FINAL CONDUCTIVITY (uS): 503

DESCRIPTION OF INITIAL TURBIDITY: Muddy

DESCRIPTION OF FINAL TURBIDITY: Semi Clear

FINAL MEASURED TURBIDITY: 10

WELL APPROVED BY: R. C. Williams MMES

ODOR OF WATER: None

WATER DISCHARGED TO:
- ☒ GROUND SURFACE
- ☐ STORM SEWERS
- ☐ DRUMS
- ☐ TANK TRUCK
- ☐ STORAGE TANKS
- ☐ OTHER

INITIAL PRE-DEVELOPMENT WATER DEPTH: 1.8 feet from ground surface.

DEVELOPMENT OBSERVATIONS

OBSERVER SIGNATURE/DATE D. Charles Lytle 2-05-90

D. Charles Lytle

ERC / EDGE Environmental and Energy Services Co.

WELL NO. 1083
LOCATION: WAG 7
DATE: 2-02-90

MONITORING WELL DEVELOPMENT PROGRESS

ONE WELL VOLUME = 6.3 GALLONS

DATE	TIME	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	MEASURED TURBIDITY (NTU'S)	pH	CONDUC-TIVITY (uS)	TOTAL GALLONS PUMPED	WELL VOLUMES PUMPED	COMMENTS
2-02-90	1405	123	Muddy	--	7.0	545	123	19.5	
2-02-90	1530	55	Muddy	--	7.4	527	178	28.3	
2-05-90	0915	31	Cloudy	--	7.3	441	209	33.2	
2-05-90	1030	10	Slightly Cloudy	30	7.2	461	219	34.8	
2-05-90	1100	20	Semi Clear	10	7.0	503	239	38.0	
RESULTS AT END OF DEVELOPMENT			Semi Clear	10	7.0	503	239	38.0	

COMMENTS Water wouldn't clear up completely. After 38 well volumes, passed and moved on.

OBSERVER SIGNATURE/DATE D. Charles Lytle 2-05-90
D. Charles Lytle

HYDRAULIC CONDUCTIVITY CALCULATIONS

PROGRAM SLUGT, VERSION 4.1, NOV. 1986

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:

(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3, NO.1 OF WRR ENTITLED "RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER")

(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED "A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS")

WELL NO.: 1083 DATE OF TEST: 3/05/90

PROJECT NO.: E221-005 CLIENT: MMES

SITE LOCATION: WAG 7

EDGE, INC. FIELD INVESTIGATOR: BRUCE MCMASTER

INPUT DATA ARE:

INNER CASING DIAMETER = 2.00 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 2.00 INCHES
DIAMETER OF DRILLED HOLE = 8.63 INCHES
LENGTH OF SCREEN OR INTAKE PORTION = 10.63 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 10.55 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 10.63 FEET
DEPTH TO STATIC WATER LEVEL BELOW REF. POINT = 8.30 FEET
ESTIMATED POROSITY OF GRAVEL PACK = .20
FALLING-HEAD INDEX = 0 ("1" IF FALLING,"0" IF RISING)
NUMBER OF DEPTH-TIME DATA POINTS = 21

HO WAS COMPUTED FROM INTERCEPT OF PLOT OF LOG(H) VS. TIME

SUCCESSIVE COMPUTED VALUES FOR HO (FEET)
.5413
.5073
.4984

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1083

HYDRAULIC CONDUCTIVITY CALCULATIONS

TIME (SEC)	DEPTH TO WATER (FEET)	HEAD (FEET)
5.00	7.820	.480
10.00	7.950	.350
15.00	8.020	.280
20.00	8.080	.220
25.00	8.090	.210
30.00	8.110	.190
35.00	8.130	.170
40.00	8.140	.160
45.00	8.160	.140
50.00	8.180	.120
55.00	8.190	.110
60.00	8.210	.090
65.00	8.220	.080
70.00	8.240	.060
75.00	8.240	.060
80.00	8.260	.040
85.00	8.260	.040
90.00	8.270	.030
95.00	8.280	.020
100.00	8.280	.020
105.00	8.290	.010

****

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

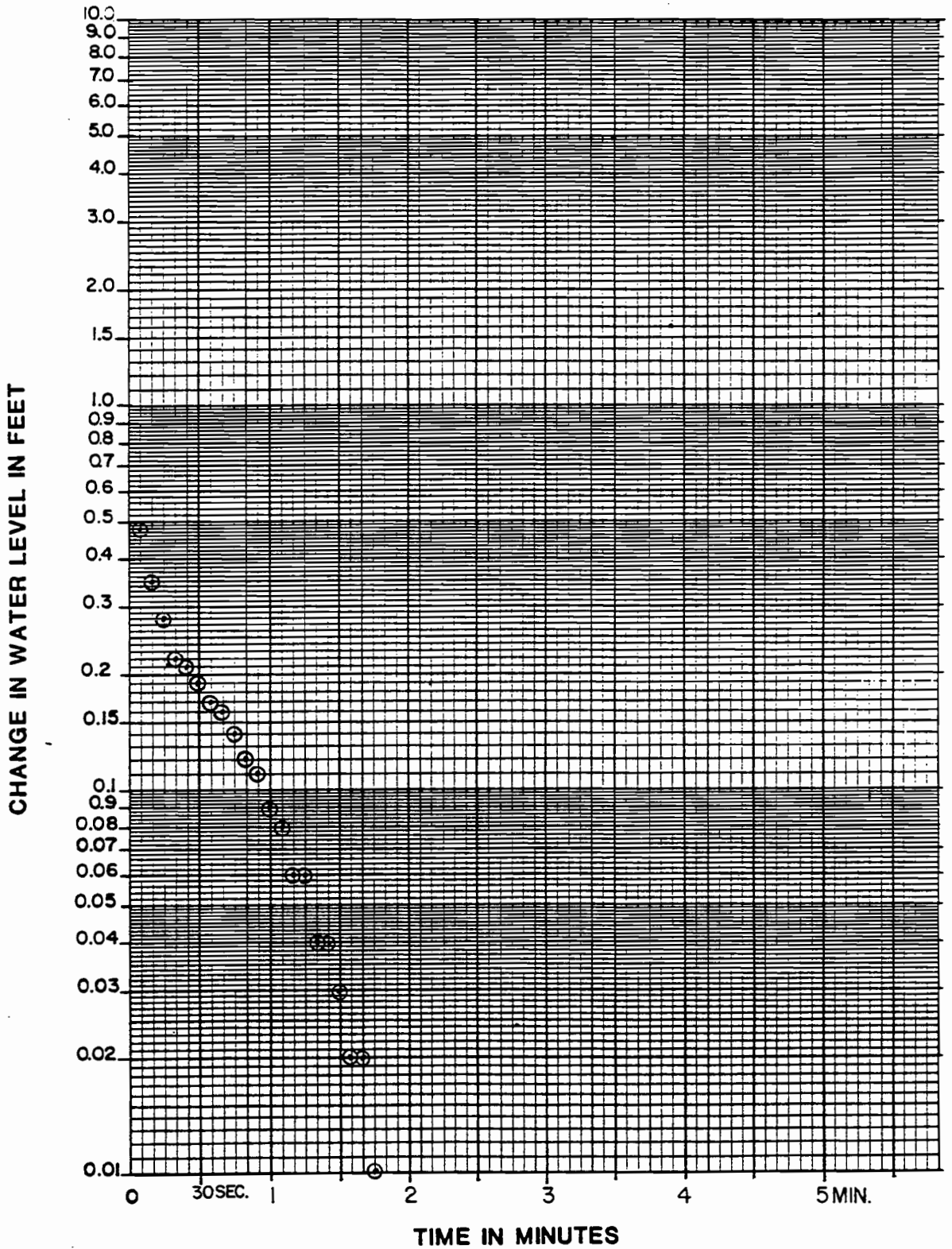
PERMEABILITY = 1.18E-04 FT/SEC = 3.61E-03 CM/SEC

TRANSMISSIVITY = 1.26E-03 FT**2/SEC

ERC / EDGE
Environmental and Energy Services Co.

WELL No. 1083

HYDRAULIC CONDUCTIVITY CALCULATIONS



EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 1083501

WELL NO.	LOCATION:	TYPE:
1083	WAG-7	Soil

SAMPLER:	SAMPLE INTERVAL:	DATE:	TIME:
C. Allison Hodgson (SIGNATURE)	1.4' to 1.8'	06-27-89	0935

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECEIVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
C. Allison Hodgson	07-05-89	2:05	EDGe	Christopher M. Waller	7/5/89	2:05	EDGe
Christopher M. Waller	7/5/89	2:28	EDGe	M. Ferguson	7/5/89	2:28	

TYPE OF SAMPLE: ☑ SPLIT SPOON CORES–SOIL ☐ AUGER CUTTINGS–SOIL ☐ AUGER CUTTINGS–ROCK
☐ AIR ROTARY CUTTINGS–ROCK ☐ DRILL WATER (NO AIR IN SAMPLE) ☐ OTHER _____

ALL SAMPLES ARE IMMEDIATELY PLACED IN I-CHEM SPECIALTY CLEANED CONTAINERS AND SEALED.

REMARKS: _____

EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 1083 S02

WELL NO.	LOCATION:	TYPE:	
1083	WAG-7	Soil	
SAMPLER: [signature] (SIGNATURE)	SAMPLE INTERVAL: 5.4' to 5.7'	DATE: 06-27-89	TIME: 0950

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECEIVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
[signature]	07-05-89	2:05	EDGE	[signature]	7/5/89	2:05	EDGe
[signature]	7/5/89	2:28	EDGe	M. Ferguson	7/5/89	2:28	

TYPE OF SAMPLE: ☑ SPLIT SPOON CORES–SOIL ☐ AUGER CUTTINGS–SOIL ☐ AUGER CUTTINGS–ROCK
☐ AIR ROTARY CUTTINGS–ROCK ☐ DRILL WATER (NO AIR IN SAMPLE) ☐ OTHER _____

ALL SAMPLES ARE IMMEDIATELY PLACED IN I-CHEM SPECIALTY CLEANED CONTAINERS AND SEALED.

REMARKS: _____

1.0 General Information

1.1 Well Location

Monitoring well number 1084 is located in WAG 7. It is in the southeast corner of WAG 7, approximately 300' east of chemical waste pit #7. The location is shown on ORNL drawing number C3E20004 A075. Survey coordinates for this well are N 17282.3522, E 27852.1449 (X-10 grid) or latitude 35° 54' 39.29" and longitude 84° 19' 00.99". Coordinate data were provided by Martin Marietta Energy Systems. The method used for conversion from X-10 grid to Tennessee-Lambert State Plane Coordinates came from the publication "Tennessee Valley Authority Data Services Branch and Mapping Services Branch, Oak Ridge, Tennessee, DOE Plant Control, November 6, 1985, Field Book: ESS-3115, pp. 1-20." The latitude and longitude were calculated by Adams Craft Herz Walker Engineering, Inc., using methods from the U.S. Coast and Geodetic Survey Publication 62-4, "State Plane Coordinates by Automatic Data Processing."

1.2 Drilling Information

Well number 1084 was drilled by Geotek Engineering Company. A Mobile B-50 and an Ingersol Rand T-4 rig were used to drill this boring for monitor well installation under operation of Rick Herron and Larry Ledbetter with the assistance of Freddy

Dixon. Drilling commenced on 6/27/89 and was finished on 8/11/89. Paragraph 2.4.1 includes a detailed discussion of the well installation and a well schematic is included on the well installation/completion form. A synopsis of the drilling activity follows:*

7/6/89: The auger rig and the equipment necessary to drill and sample with were deconed. The rig and equipment were mobilized to the site, plastic was layed down over the work area and the rig was set up. Split spoons were taken from .5' to 9.5' or refusal. Two soil samples and a bulk density sample were taken. A 6-inch boring was augered to 10.0' or refusal. Photovac readings were less than 1 ppm inside and outside the borehole. The air rotary method will be required to complete the boring. A 22.0" borehole was augered to 4.0' and a 15 1/4" diverter casing was installed and grouted.

8/9/89: The T-4 was deconed along with the drilling equipment and mobilized to the site. The diverter head was attached and a containment box was connected.

* This information was typed directly from field notes and was edited only when necessary for clarification.

The boring was completed to 15.10' with an 8.0" tricone bit. An air and water sample were taken at 15.0'. After waiting 1 hour for recharge, the water was measured at 4.10 feet below surface. The boring was cleaned, the rods removed and the rig moved off the hole. The 2.0" stainless steel screen and casing were installed to a depth of 15.08'. Sand was then tremied in with water to 7.75' and a bentonite seal was poured into a level of 5.53'. Three bags of sand and 50 lbs. of bentonite were used. The annulus was grouted using 1 bag of cement and 5 lbs of bentonite. Grouting procedures were documented by James Lamb of ERC. The air sample was checked under an ultraviolet light. No hydrocarbons were detected.

8/30/89: The 2.0" casing was cut to the specified height and filed to remove the rough edges. Geotek and C.A.H. were present.

9/5/89: The well was tested with the "Go-NoGo" gauge and passed by R.C. Williams. Geotek and C.A.H. were also present.

This well was logged by ERC Environmental and Energy Services Co., Inc., hydrogeologist C. Allison Hodges. All well construction materials

and supplies were from Martin Marietta Energy Systems approved batches. The batch origin of individual items is shown on the included Monitoring Well Materials Certification form.

2.0 Technical Information

2.1 Decontamination Procedures

The drilling rig, down hole tools, surface casing, stainless steel screen, stainless steel casing, centralizers, and stainless steel silt trap underwent the cleaning decontamination procedures outlined in the drilling specifications (Release Specific Technical Directions for Regulatory Compliance Monitoring Wells Phase 1, Oak Ridge National Laboratory, Oak Ridge, W.O., K-4147, April 1987, pgs, 2-4). A checklist of the cleaned materials is included with this data package.

2.2 Geology

WAG 7 is located in Melton Valley, which is in the Valley and Ridge Physiographic Province of East Tennessee. WAG 7 is underlain by shale, siltstone, and limestone of the Conasauga Group. The Conasauga Group in the Oak Ridge area consists of six formations. They are, in ascending order, the Pumpkin Valley Shale, Rutledge Limestone,

Rogersville Shale, Maryville Limestone, Nolichucky Shale and the Maynardville Limestone. These rocks have undergone extensive deformation and contain many folds and faults resulting in varying strike and dips. The average strike and dip appears to be consistent with the regional strike of 56° northeast and dips of about 30° to the southeast.

2.3 Sample Collection

Three samples were collected during drilling, placed in I-CHEM specialty cleaned glass containers, sealed and submitted to Sample Receiving, Analytical Chemistry Division, Bldg. 4500S, ORNL. Chain of custody forms for these samples are included with this data package. Soil sample 1084S01 was collected in the split spoon interval from .5 to 2.5 on 7/7/89, soil sample 1084S02 was collected in the split spoon interval from 8.5 to 9.5 on 7/7/89 and drill water sample 1084W01 was collected from the water pump on the drill rig on 8/9/89. Analytical results for the soil and drill water samples described above can be obtained from the Remedial Action Program data base at ORNL.

A bulk density soil sample was collected from the split spoon sample interval from 6.7 to 7.3. The sample was measured, and weighed, and a bulk density of 2.02 grams/cm^3 was calculated.

2.4 Installation and Development

2.4.1 Installation

This was a type D well. A six-inch diameter boring was augered from ground surface to auger refusal (10.0 feet). The air rotary method was required to complete the boring because the augers refused before the specified total well depth was reached. Therefore, a twenty two-inch diameter boring was augered from ground surface to 4.0 feet and fifteen-inch diverter casing was installed and grouted. An eight-inch diameter boring was then drilled with an air rotary tricone roller bit from 10.0 to 15.10 feet. A two-inch diameter stainless steel silt trap was installed from 14.83 to 15.08 feet. Above the silt trap a two-inch diameter stainless steel screen was installed from 9.53 to 14.83 feet. A two-inch diameter stainless steel casing was installed above the screen at 9.53 feet and extended 1.91 feet above ground surface. A sandpack was then poured into the annular space from 7.75 to 15.08 feet, with a 2.22-foot bentonite pellet seal poured into the annular space above the sandpack from 5.53 to 7.75 feet. The annular space from the top of the bentonite seal to the surface was tremie grouted with a cement/bentonite slurry. A detail of the well is included on the well installation/completion form.

2.4.2 Well Development

Well number 1084 was developed to remove drill cuttings, silt, and other fines from the monitoring well. The monitoring well was developed using a Geoguard pump with an air compressor. All pumps were cleaned prior to use according to specified cleaning procedures (see Paragraph 2.1). The well was developed until a measured total of 152 gallons of water had been evacuated and the clarity of the discharge water was approved by the company representative. The final turbidity value measured was 80 NTU's. A development form showing the exact method of development and other pertinent data is appended.

2.4.3 Installation of Dedicated Monitoring Well Pump

After the well was developed, a Geoguard Model No. 5614 dedicated monitoring well pump was installed on 2/8/90 at a depth of 12.6 feet below ground surface. These pumps are decontaminated at American Sigma and are sent prepackaged. A copy of the pump certification is kept on file at ORNL.

2.5 Hydraulic Conductivity Testing

Well number 1084 was tested for the determination of hydraulic conductivity of the aquifer in the vicinity of the well screen. This was

accomplished by instantaneously adding a known quantity of water to the monitoring well and measuring the recovery of the water level over time. The changing water levels were measured using a Druck 15 psig pressure transducer and an Omnidata Datapod II data recorder. The hydraulic conductivity value of 2.87×10^{-5} cm/second (shown as permeability on the hydraulic conductivity calculations) was calculated using the Bouwer and Rice method. A computer printout of the hydraulic conductivity calculations is included in this data package.

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1084

PRE-DRILLING CHECKLIST FOR MONITORING WELLS

PRE-DRILLING TASKS		COMPLIANCE DATE	COMPLIANCE INITIALS
1.	EXCAVATION PERMIT OBTAINED.	7-07-89	CAH
2.	ALL EQUIPMENT HAS BEEN CLEANED BEFORE DRILLING.	7-06-89	CAH
3a.	SCREEN AND CASINGS HAVE BEEN WASHED, STEAMED, RINSED WITH DE-IONIZED OR DISTILLED WATER, RINSED WITH ISOPROPYL ALCOHOL, WRAPPED WITH PROTECTIVE COVERING AND STORED OFF THE GROUND.	N/A	
3b.	PRE-PACKAGED SCREENS, CASINGS AND CENTRALIZERS WERE USED.	8-09-89	CAH
4.	WORK AREA FOR SAMPLE EXAMINATION COVERED WITH CLEAN POLYETHYLENE.	7-07-89	CAH
5.	CLEAN KNIVES, GLOVES, SAMPLE JARS AND LABELS ON-HAND.	7-07-89	CAH
6.	POLYETHYLENE COVER IN PLACE OVER HOLE.	7-07-89	CAH

ADDITIONAL NOTES/OBSERVATIONS:

OBSERVER SIGNATURE/DATE C. Allison Hodges 8-09-89

C. Allison Hodges

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1084

DECONTAMINATION CHECKLIST
DRILLING EQUIPMENT

EQUIPMENT	SCRAPE	STEAM CLEAN	STEAM RINSE	ISOPROPYL ALCOHOL RINSE	DEIONIZED WATER RINSE
RIG	X	X	X	N/A	N/A
AUGERS	X	X	X	X	X
BITS	X	X	X	X	X
RODS	X	X	X	X	X
SAMPLERS	X	X	X	X	X
PIPES	X	X	X	X	X
WORK TOOLS	X	X	X	X	X
AUGER PINS	X	X	X	X	X

OBSERVER SIGNATURE/DATE C. Allison Hodges 7-06-89
C. Allison Hodges

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1084

ORNL MONITORING WELL LOG

LOCATION: WAG 7

DRILLER: Rick Herron/Larry Ledbetter

HELPER: Freddy Dixon

DRILL: Mobile B-50/Ingersol Rand T-4

DATE: START: 7-07-89

FINISH: 8-09-89

LOGGED BY: C. Allison Hodges

HEALTH PHYSICIST: L. C. Johnson, Jerry Gray

TYPE DRILLING: Split Spoon/Auger/Air Rotary

LUBRICANT TYPE: Green Stuff

No. SAMPLES TAKEN: Two

TYPE: Soil

CONTAINMENT TYPE: Plastic, Pan. Containment Box

THICKNESS OF SOIL (REFUSAL DEPTH): 10.0'

DEPTH DRILLED IN ROCK: 5.1'

TOTAL DEPTH OF WELL: 15.1'

DRILLING FLUID SAMPLES:

TYPE: Water DATE: 8-09-89

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
0.0	.5			Gravel. (fill material)
.5	2.5	1084S01 .5-2.5	70%	Clay, light brown, with roots and gravel, also
				some shale. Moist. Firm to soft.
2.5	4.5		90%	Clay, mottled, medium bluish gray, brownish
				gray and light brown. Contains shale,
				weathered, dusky brown and dark yellowish
				orange, with mica. Hard, firm clay from 3.5
				to 4.5.
4.5	6.5		100%	Clay, mottled, medium dark, gray, brownish
				gray, and light brown. Contains shale, dusky
				brown and bluish green with mica. Moist.
6.5	8.5		100%	Clay, medium dark gray, with shale, highly
				weathered and fragmented, greenish gray to blue,
				that contains mica. Moist and hard.
8.5	9.5	1084S02 8.5-9.5		Clay, shaley, medium dark gray with silt and
				mica lenses. Contains some pebbles. Saturated.
	9.5			Split spoon refusal.
9.5	10.0			Clay, shaley, medium dark gray, with silt and
				mica lenses. Contains some pebbles. Saturated.
				Limestone (fizzes with acid) on bottom of
				augers. *Augered interval.

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1084

ORNL MONITORING WELL LOG

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
	10.0			Auger refusal.
10.0	11.5			*Hard, irregular, uneven drilling
11.5	15.10			Very hard, irregular drilling.
	15.10			Total Depth
				*Detailed lithologic logs could not be pro-
				vided due to use of containment box.

EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL No. 1084

WELL INSTALLATION/COMPLETION FORM

O.R.N.L. MONITORING WELL PROGRAM

LOGGED BY: C. Allison Hodges
PROOFED BY: Michael L. Ebers

DRILLING COMPANY: Geotek
DRILLER: Rick Herron/ Larry Ledbetter
HELPER: Freddy Dixon

LOCATION WAG 7
ORNL GRID COORDINATES
N 17,282.3522
E 27,852.1449
ELEV. GROUND 758.40
ELEV. TOP STAINLESS STEEL CASING 760.31

DRILLING DATES:
STARTED: 7-07-89
FINISHED: 8-09-89

EQUIPMENT
- ☒ 22.0 INCH AUGER 4.0 L.F.
- ☒ 6.0 INCH AUGER 6.0 L.F.
- ☒ 8.0 INCH ROTARY 9.1 L.F.

MATERIALS USED

EST. VOL.	USED VOL.	
	5.3	FEET OF 2.0 IN. S.S. SCREEN
	11.6	FEET OF 2.0 IN. S.S. CASING
2.10	3.0	SACKS OF SAND
35.0	50.0	POUNDS OF BENTONITE PELLETS
2.0	2.0	SACKS OF CEMENT
	10	POUNDS OF POWDERED BENTONITE
	15.0	GALLONS OF WATER (CEMENTING)

REASON FOR DIFFERENCES BETWEEN ESTIMATED VOLUMES AND USED VOLUMES
Irregular bore hole diameter.

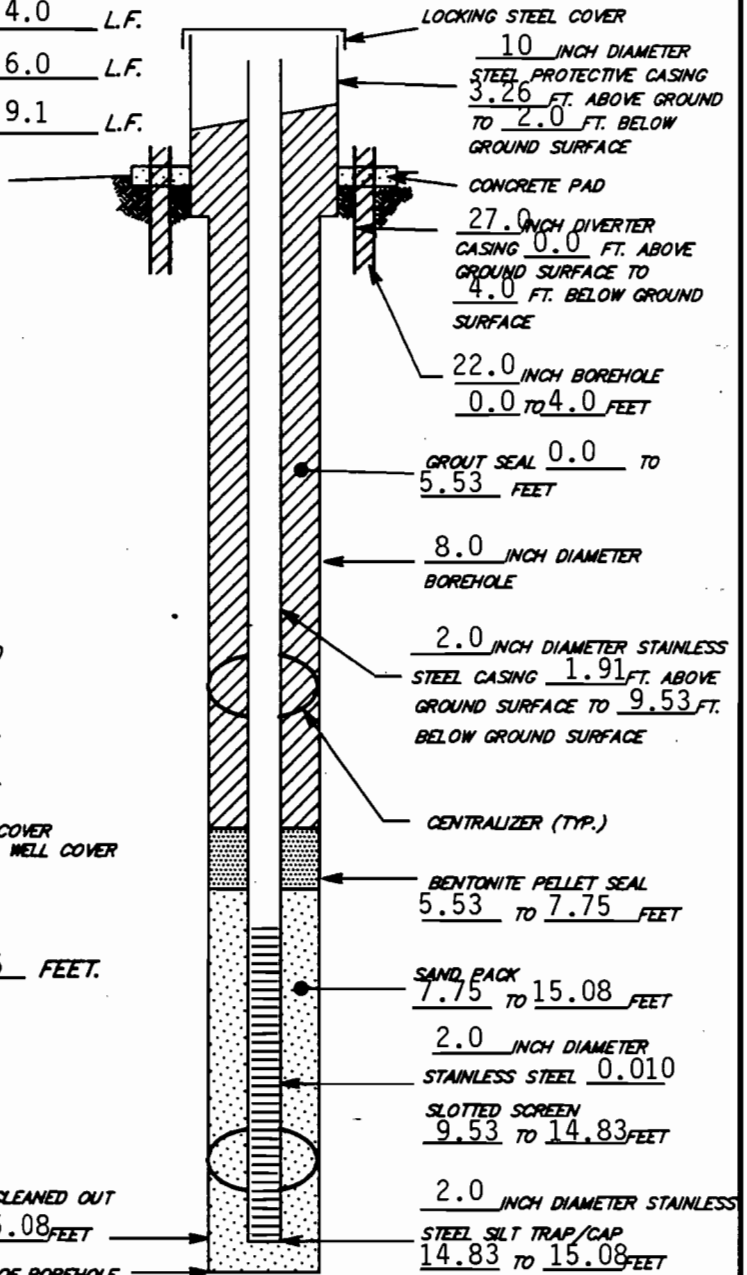
WELL COVER USED
- ☒ LOCKING STEEL COVER
- ☐ FLUSH MOUNTED WELL COVER
- ☐ OTHER

SILT TRAP USED YES ☒ NO ☐

MONITORING WELL PUMP BASE SET AT 12.6 FEET.

CENTRALIZERS AT 5.0 FEET.
14.0 FEET.
FEET.

NOTE:
ALL DEPTHS ARE MEASURED FROM GROUND SURFACE UNLESS OTHERWISE NOTED:



TYPE D WELL

NOT TO SCALE

ERC / EDGE
Environmental and Energy Services Co.

WELL No. 1084

DATE: 8-09-89

MONITORING WELL MATERIALS CERTIFICATION

ITEM/MATERIAL		DATE USED	BATCH NUMBER
SAND		8-09-89	1
BENTONITE		8-09-89	Stores
STAINLESS STEEL SCREEN	(PREPACKAGED ☒ YES ☐ NO)	8-09-89	Stores
STAINLESS STEEL CASING	(PREPACKAGED ☒ YES ☐ NO)	8-09-89	Stores
STAINLESS STEEL CENTRALIZERS	(PREPACKAGED ☒ YES ☐ NO)	8-09-89	Stores
STAINLESS STEEL CAPS	(PREPACKAGED ☒ YES ☐ NO)	8-09-89	Stores
MONITORING WELL PUMP	(PREPACKAGED ☒ YES ☐ NO)	2-08-89	4
GROUT		8-10-89	1
WELL COVERS		8-09-89	Stores
SURFACE CASING			

COMMENTS:

OBSERVER SIGNATURE/DATE C. Allison Hodges 8-10-89
C. Allison Hodges

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1084

POST-WELL COMPLETION CHECKLIST

POST-WELL COMPLETION TASKS	COMPLIANCE DATE	COMPLIANCE INITIALS
1. MUD SCRAPED FROM AUGERS, SAMPLERS, AND ALL OTHER EQUIPMENT.	7-07-89	CAH
2. ALL MUD FROM RIG AND EQUIPMENT SCRAPINGS AND CUTTINGS DISPOSED OF IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED.	7-07-89	CAH
3. WELL DEVELOPED IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED AND DETAILS OF THE DEVELOPMENT ACTIVITY RECORDED.	2-08-90	DCL
4. DRILLING SITE PROPERLY CLEANED UP AFTER COMPLETION OF WELL INSTALLATION.	8-09-89	CAH

* RELEASE SPECIFIC TECHNICAL DIRECTIONS FOR REGULATORY COMPLIANCE MONITORING WELLS PHASE I, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, W.O. K-4147, APRIL 1987.

OBSERVER SIGNATURE/DATE C. Allison Hodges 8-09-89
C. Allison Hodges

D. Charles Lytle 2-08-90
D. Charles Lytle

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1084

LOCATION: WAG 7

MONITORING WELL DEVELOPMENT FORM

DEVELOPMENT DETAILS

METHOD OF DEVELOPMENT: Surging and Pumping

DEVELOPMENT BEGAN DATE: 2-08-90 TIME:

DEVELOPMENT ENDING DATE: 2-08-90

DEVELOPMENT OBSERVED BY: D. Charles Lytle

ONE WELL VOLUME: 4.8 GALLONS

TOTAL GALLONS PUMPED: 152 TOTAL WELL VOLUMES PUMPED: 31.6

INITIAL pH: 7.3 FINAL pH: 7.4

INITIAL CONDUCTIVITY (uS): 647 FINAL CONDUCTIVITY (uS): 831

DESCRIPTION OF INITIAL TURBIDITY: Milky

DESCRIPTION OF FINAL TURBIDITY: Cloudy

FINAL MEASURED TURBIDITY: 80 NTU's

WELL APPROVED BY: R. C. Williams

ODOR OF WATER: None

WATER DISCHARGED TO:
- ☒ GROUND SURFACE
- ☐ STORM SEWERS
- ☐ DRUMS
- ☐ TANK TRUCK
- ☐ STORAGE TANKS
- ☐ OTHER

INITIAL PRE-DEVELOPMENT WATER DEPTH: 2.8 feet below ground surface.

DEVELOPMENT OBSERVATIONS

OBSERVER SIGNATURE/DATE D. Charles Lytle 2-08-90

D. Charles Lytle

ERC / EDGE Environmental and Energy Services Co.

WELL NO. 1084
LOCATION: WAG 7
DATE: 2-08-90

MONITORING WELL DEVELOPMENT PROGRESS

ONE WELL VOLUME = 4.8 GALLONS

DATE	TIME	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	MEASURED TURBIDITY (NTU'S)	pH	CONDUCTIVITY (uS)	TOTAL GALLONS PUMPED	WELL VOLUMES PUMPED	COMMENTS
2-08-90	0930	85	Milky	--	7.3	647	85	17.7	
2-08-90	1130	22	Cloudy	--	7.3	863	107	22.3	
2-08-90	1500	30	Cloudy	--	7.3	831	137	28.5	
2-08-90	1615	15	Cloudy	80	7.4	831	152	31.6	
RESULTS AT END OF DEVELOPMENT			Cloudy	80	7.4	831	152	31.6	

COMMENTS Water remained cloudy after 30 well volumes. Had to pass and move off hole.

OBSERVER SIGNATURE/DATE D. Charles Lytle 2-08-90
D Charles Lytle

MWFORM05.DWG

HYDRAULIC CONDUCTIVITY CALCULATIONS

PROGRAM SLUGT, VERSION 4.1, NOV. 1986

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:

(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3, NO.1 OF WRR ENTITLED "RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER")

(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED "A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS")

WELL NO.: 1084 DATE OF TEST: 2/13/90

PROJECT NO.: E221-002 CLIENT: MMES

SITE LOCATION: WAG 7

EDGE, INC. FIELD INVESTIGATOR: BRUCE MCMASTER

INPUT DATA ARE:

INNER CASING DIAMETER = 2.00 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 2.00 INCHES
DIAMETER OF DRILLED HOLE = 8.63 INCHES
LENGTH OF SCREEN OR INTAKE PORTION = 5.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 9.95 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 5.00 FEET
DEPTH TO STATIC WATER LEVEL BELOW REF. POINT = .98 FEET
ESTIMATED POROSITY OF GRAVEL PACK = .20
FALLING-HEAD INDEX = 1 ("1" IF FALLING,"0" IF RISING)
NUMBER OF DEPTH-TIME DATA POINTS = 32

HO WAS COMPUTED FROM INTERCEPT OF PLOT OF LOG(H) VS. TIME

SUCCESSIVE COMPUTED VALUES FOR HO (FEET)
1.1255
1.1426

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1084

HYDRAULIC CONDUCTIVITY CALCULATIONS

TIME (SEC)	DEPTH TO WATER (FEET)	HEAD (FEET)
10.00	3.440	2.460
20.00	3.080	2.100
30.00	2.820	1.840
40.00	2.600	1.620
50.00	2.480	1.500
60.00	2.370	1.390
75.00	2.200	1.220
90.00	2.130	1.150
105.00	2.040	1.060
120.00	2.000	1.020
150.00	1.900	.920
180.00	1.810	.830
240.00	1.730	.750
300.00	1.670	.690
360.00	1.630	.650
420.00	1.610	.630
480.00	1.560	.580
540.00	1.520	.540
600.00	1.510	.530
720.00	1.500	.520
840.00	1.500	.520
960.00	1.500	.520
1080.00	1.490	.510
1200.00	1.490	.510
1320.00	1.490	.510
1440.00	1.480	.500
1560.00	1.480	.500
1680.00	1.480	.500
1800.00	1.470	.490
1920.00	1.470	.490
2040.00	1.470	.490
2160.00	1.460	.480

****

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

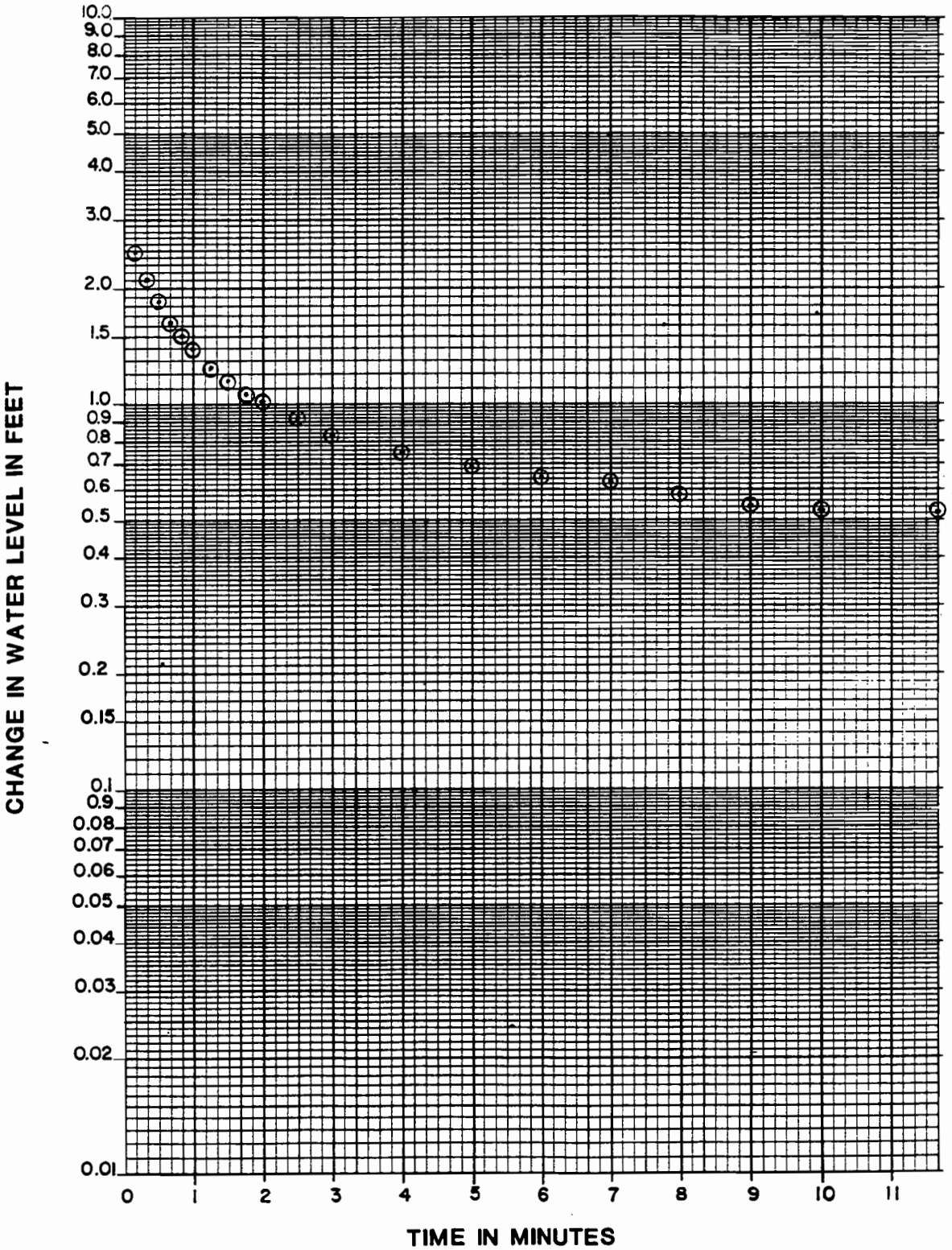
PERMEABILITY = 9.42E-07 FT/SEC = 2.87E-05 CM/SEC

TRANSMISSIVITY = 4.71E-06 FT**2/SEC

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1084

HYDRAULIC CONDUCTIVITY CALCULATIONS



EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 1084501

WELL NO.	LOCATION:	TYPE:
K84	WAG 7	Soil

SAMPLER:	SAMPLE INTERVAL:	DATE:	TIME:
C. Allison Hodge (SIGNATURE)	.5 to 2.5'	07-07-89	0913

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECEIVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
C. Allison Hodge	07-14-89	10:24	EDGE	N Owen	7/19/89	10:25	ORNL ACD CAPA

TYPE OF SAMPLE: ☒ SPLIT SPOON CORES–SOIL ☐ AUGER CUTTINGS–SOIL ☐ AUGER CUTTINGS–ROCK
☐ AIR ROTARY CUTTINGS–ROCK ☐ DRILL WATER (NO AIR IN SAMPLE) ☐ OTHER _____

ALL SAMPLES ARE IMMEDIATELY PLACED IN I–CHEM SPECIALTY CLEANED CONTAINERS AND SEALED.

REMARKS: _____

EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 1084 S2

WELL NO.	LOCATION:	TYPE:	
1084	[illegible]	Soil	
SAMPLER: C. Allison Hodge (SIGNATURE)	**SAMPLE INTERVAL:** 8.5 to 9.5'	**DATE:** 07-07-89	**TIME:**

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECEIVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
C. Allison Hodge	07-14-89	10:24	EDGE	N E Owen	7/19/89	10:25	ORNL ACD CAPA

TYPE OF SAMPLE: ☑ SPLIT SPOON CORES–SOIL ☐ AUGER CUTTINGS–SOIL ☐ AUGER CUTTINGS–ROCK
☐ AIR ROTARY CUTTINGS–ROCK ☐ DRILL WATER (NO AIR IN SAMPLE) ☐ OTHER _____

ALL SAMPLES ARE IMMEDIATELY PLACED IN I–CHEM SPECIALTY CLEANED CONTAINERS AND SEALED.

REMARKS: _____

EDGe Engineering, Design & Geosciences Group, Inc.
726 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 1084W01

WELL NO.	LOCATION:	TYPE:
1084	WAG-7	WATER

SAMPLER: (SIGNATURE)	SAMPLE INTERVAL:	DATE:	TIME:
C. Gilman Hodges		08-09-89	1750

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECEIVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
C. Gilman Hodges	8-15-89	8:37	EDGE	J.C. Price	8-15-89	0837	

TYPE OF SAMPLE: ☐ SPLIT SPOON CORES–SOIL ☐ AUGER CUTTINGS–SOIL ☐ AUGER CUTTINGS–ROCK
☐ AIR ROTARY CUTTINGS–ROCK ■ DRILL WATER (NO AIR IN SAMPLE) ☐ OTHER _____

ALL SAMPLES ARE IMMEDIATELY PLACED IN I-CHEM SPECIALTY CLEANED CONTAINERS AND SEALED.

REMARKS: _____

1.0 General Information

1.1 Well Location

Monitoring well number 1085 is located in WAG 7. It is in the southeast corner of WAG 7, approximately 300' east of chemical waste pit #7. The location is shown on ORNL drawing number C3E20004 A075. Survey coordinates for this well are N 17299.1224, E 27858.7171 (X-10 grid) or latitude 35° 54' 39.46" and longitude 84° 19' 01.03". Coordinate data were provided by Martin Marietta Energy Systems. The method used for conversion from X-10 grid to Tennessee-Lambert State Plane Coordinates came from the publication "Tennessee Valley Authority Data Services Branch and Mapping Services Branch, Oak Ridge, Tennessee, DOE Plant Control, November 6, 1985, Field Book: ESS-3115, pp. 1-20." The latitude and longitude were calculated by Adams Craft Herz Walker Engineering, Inc., using methods from the U.S. Coast and Geodetic Survey Publication 62-4, "State Plane Coordinates by Automatic Data Processing."

1.2 Drilling Information

Well number 1085 was drilled by Geotek Engineering Company. A Mobile B-50 and an Ingersol Rand T-4 rig were used to drill this boring for monitor well installation under operation of Rick Herron and Larry Ledbetter with the assistance of Steve Kirk, George Akins, Freddy Dixon and James

Shelton. Drilling commenced on 6/19/89 and was finished on 8/8/89. Paragraph 2.4.1 includes a detailed discussion of the well installation and a well schematic is included on the well installation/completion form. A synopsis of the drilling activity follows:*

6/19/89: The auger rig, augers, and tools were deconed. The rig was mobilized to the site and set up. A 22.0 inch boring was completed to 4.0' and a 15 1/4" diverter casing installed.

6/23/89: The air rotary and drilling equipment were deconed and mobilized to the site. The boring was extended to a depth of 10.5' with a 14.0" auger.

7/26/89: The air rotary rig and tools were deconed and mobilized to the site. The rig was set up and the containment box and water truck connected. A 14.0" tricone was used to extend the boring to 15.0'. A 10.0" surface casing was cut, deconed and installed to a depth of 14.60'. A bentonite seal was then installed.

7/27/89: The annulus was grouted.

8/7/89: The air rotary and tools were deconed, mobilized to the site and set up along with the containment box. An 8.0" tricone was used to drill to a total

* This information was typed directly from field notes and was edited only when necessary for clarification.

depth of 72.8 ft. Drill water and air samples were taken at 48.0'. After a 1 hour recharge period, the water level was at 9.1' below surface. An empty containment box was attached before the boring was cleaned. (The other was full). While changing the box, Freddy Dixon cut his wrist on a wire protruding from the "blooey" line. Carl Stooksbury took him to medical where his wound was cleaned. He was released back to work. The boring was cleaned and the rods removed. A 4.0" screen and stainless steel casing was installed to a depth of 72.8'. The sand was tremied to 52.6' and bentonite was poured to a level of 49.35 ft. The air sample was checked under an ultraviolet light. No hydrocarbons were detected.

8/8/89: James Lamb documented the tremie grouting of the annulus.

9/5/89: The well was checked with the "Go-NoGo" gauge and passed by R.C. Williams.

This well was logged by ERC Environmental and Energy Services Co., Inc., hydrogeologists Christopher M. Wallen and C. Allison Hodges. All well construction materials and supplies were from Martin Marietta Energy Systems approved batches. The batch origin of individual items is shown on the included Monitoring Well Materials Certification form.

2.0 Technical Information

2.1 Decontamination Procedures

The drilling rig, down hole tools, surface casing, stainless steel screen, stainless steel casing, centralizers, and stainless steel silt trap underwent the cleaning decontamination procedures outlined in the drilling specifications (Release Specific Technical Directions for Regulatory Compliance Monitoring Wells Phase 1, Oak Ridge National Laboratory, Oak Ridge, W.O., K-4147, April 1987, pgs, 2-4). A checklist of the cleaned materials is included with this data package.

2.2 Geology

WAG 7 is located in Melton Valley, which is in the Valley and Ridge Physiographic Province of East Tennessee. WAG 7 is underlain by shale, siltstone, and limestone of the Conasauga Group. The Conasauga Group in the Oak Ridge area consists of six formations. They are, in ascending order, the Pumpkin Valley Shale, Rutledge Limestone, Rogersville Shale, Maryville Limestone, Nolichucky Shale and the Maynardville Limestone. These rocks have undergone extensive deformation and contain many folds and faults resulting in varying strike and dips. The average strike and dip appears to be consistent with the regional strike of 56° northeast and dips of about 30° to the southeast.

2.3 Sample Collection

One drill water sample was collected during drilling, placed in an I-CHEM specialty cleaned glass container, sealed and submitted to Sample Receiving, Analytical Chemistry Division, Bldg. 4500S, ORNL. A chain of custody form for the sample is included with this data package. This sample (1085W01) was collected from the water pump on the drill rig on 8/7/89. Analytical results for the water sample described above can be obtained from the Remedial Action Program data base at ORNL.

2.4 Installation and Development

2.4.1 Installation

This was a type B well. A twenty two-inch diameter boring was augered from ground surface to 4.0 feet. A fifteen-inch diverter casing was installed from surface to 4.0 feet below ground surface and grouted in place. A fourteen-inch diameter boring was augered from 4.0 feet to 10.5 feet (auger refusal). The boring was then extended past the refusal depth with a 14.0 inch air rotary tricone roller bit from 10.5 feet to 15.0 feet. A ten-inch diameter string of decontaminated steel surface casing was installed from 0.0 feet to 14.60 feet, sealed with a

2.7-foot bentonite pellet layer from 11.90 feet to 14.60 feet, and tremie grouted in place. The surface casing minimizes potential cross contamination between the regolith and bedrock water bearing zones. After the surface casing was installed, the air rotary method was used to drill an eight-inch diameter boring to a total depth of 72.8 feet. A four-inch diameter stainless steel casing was installed from the top of the screen at 57.8 feet and extended 2.13 feet above ground surface. A sandpack was then tremied into the annular space from 52.6 to 72.8 feet, with a 3.25 foot bentonite pellet seal poured into the annular space above the sandpack from 49.35 to 52.60 feet. The annular space from the top of the bentonite seal to the surface was tremie grouted with a cement/bentonite slurry. A detailed schematic of the well is included on the well installation/completion form.

2.4.2 Well Development

Well number 1085 was developed to remove drill cuttings, silt, and other fines from the monitoring well. The monitoring well was developed using a Geoguard pump with an air compressor. All pumps were cleaned prior to use according to specified cleaning procedures (see Paragraph 2.1). The well was developed until a measured total of 215 gallons of water had been evacuated and the clarity of the discharge water

was approved by the company representative. The final turbidity value measured was 4.0 NTU's. A development form showing the exact method of development and other pertinent data is appended.

2.4.3 Installation of Dedicated Monitoring Well Pump

After the well was developed, a Geoguard Model No. 5614 dedicated monitoring well pump was installed on 2/8/90 at a depth of 68.1 feet below ground surface. These pumps are decontaminated at American Sigma and are sent prepackaged. A copy of the pump certification is kept on file at ORNL.

2.5 Hydraulic Conductivity Testing

Well number 1085 was tested for the determination of hydraulic conductivity of the aquifer in the vicinity of the well screen. This was accomplished by instantaneously adding a known quantity of water to the monitoring well and measuring the recovery of the water level over time. The changing water levels were measured using a Druck 15 psig pressure transducer and an Omnidata Datapod II data recorder. The hydraulic conductivity value of 6.86×10^{-5} cm/second (shown as permeability on the hydraulic conductivity calculations) was calculated using the Bouwer and Rice method. A computer printout of the hydraulic conductivity calculations is included in this data package.

ERC / EDGE
Environmental and Energy Services Co.

WELL No. 1085

PRE-DRILLING CHECKLIST FOR MONITORING WELLS

PRE-DRILLING TASKS		COMPLIANCE DATE	COMPLIANCE INITIALS
1.	EXCAVATION PERMIT OBTAINED.	6-19-89	CMW
2.	ALL EQUIPMENT HAS BEEN CLEANED BEFORE DRILLING.	6-19-89	CMW
3a.	SCREEN AND CASINGS HAVE BEEN WASHED, STEAMED, RINSED WITH DE-IONIZED OR DISTILLED WATER, RINSED WITH ISOPROPYL ALCOHOL, WRAPPED WITH PROTECTIVE COVERING AND STORED OFF THE GROUND.	N/A	CMW
3b.	PRE-PACKAGED SCREENS, CASINGS AND CENTRALIZERS WERE USED.	8-07-89	CMW
4.	WORK AREA FOR SAMPLE EXAMINATION COVERED WITH CLEAN POLYETHYLENE.	6-19-89	CMW
5.	CLEAN KNIVES, GLOVES, SAMPLE JARS AND LABELS ON-HAND.	6-19-89	CMW
6.	POLYETHYLENE COVER IN PLACE OVER HOLE.	6-19-89	CMW

ADDITIONAL NOTES/OBSERVATIONS:

OBSERVER SIGNATURE/DATE Christopher M. Wallen 6019-8
Christopher M. Wallen

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1085

DECONTAMINATION CHECKLIST
DRILLING EQUIPMENT

EQUIPMENT	SCRAPE	STEAM CLEAN	STEAM RINSE	ISOPROPYL ALCOHOL RINSE	DEIONIZED WATER RINSE
RIG	X	X	X	N/A	N/A
AUGERS	X	X	X	X	X
BITS	X	X	X	X	X
RODS	X	X	X	X	X
SAMPLERS	X	X	X	X	X
PIPES	X	X	X	X	X
WORK TOOLS	X	X	X	X	X
AUGER PINS	X	X	X	X	X

OBSERVER SIGNATURE/DATE Christopher M. Wallen 6/19/89

Christopher M. Wallen

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1085

ORNL MONITORING WELL LOG

LOCATION: X-10 WAG 7

DRILLER: Rick Herron/Larry Ledbetter

HELPER: George Akins/Steve Kirk/ Freddy Dixson

DRILL: Auger Rig, Air Rotary T-4

DATE: START: 6-19-89

FINISH: 8-08-89

LOGGED BY: Chris Wallen/ C. Allison Hodges

HEALTH PHYSICIST: Bill Shinpaugh/ Carl Stooksbury/ L. C. Johnson

TYPE DRILLING: Auger, Air Rotary

LUBRICANT TYPE: Green Stuff

No. SAMPLES TAKEN: N/A

TYPE: N/A

CONTAINMENT TYPE: Plastic, Pan, Containment Box

THICKNESS OF SOIL (REFUSAL DEPTH): 10.5

DEPTH DRILLED IN ROCK: 62.3

TOTAL DEPTH OF WELL: 72.8

DRILLING FLUID SAMPLES:

TYPE: 1 DATE: 8-07-89

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
0.0	0.8			Topsoil.
0.8	6.3			Clay, silty, light olive brown, firm, damp.
6.3	8.5			Clay, light olive gray, soft, wet.
8.5	10.5			Weathered shale and clay.
10.5	11.0			*Soft, fast, easy drilling.
11.0	12.5			Hard drilling. Fast.
12.5	18.0			Very hard, rough, irregular drilling. Slow.
				(Limestone)
18.0	22.0			Smooth, regular fast drilling.
22.0	24.0			Hard, irregular, rough drilling. Fast.
24.0	33.0			Very hard, rough, irregular drilling. Slow.
33.0	38.5			Hard, rough, fast drilling.
38.5	40.5			Very hard rough drilling. Slow. Bit locked up
				at 40.0'.
40.5	60.0			Hard, even drilling. Fast. Bit locked up at
				44.0'. Encountered soft spot at 53.5'.
60.0	65.0			Soft, smooth, regular drilling, fast.
65.0	72.8			Hard, regular drilling. Slow.
	72.8			Total Depth
			*Detailed lithologic logs could not be provided from 10.5	
			to 72.8 due to total containment.	

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1085

WELL INSTALLATION/COMPLETION FORM

O.R.N.L. MONITORING WELL PROGRAM

LOGGED BY: C. Allison Hodges
PROOFED BY: Michael L. Ebers

DRILLING COMPANY: Geotek
DRILLER: Rick Herron/ Larry Ledbetter
HELPER: James Shelton/ Freddy Dixon

DRILLING METHOD:
- ☒ 22.0 INCH AUGER 4.0 L.F.
- ☒ 14.0 INCH AUGER 11.0 L.F.
- ☒ 8.0 INCH ROTARY 61.8 L.F.
- ☐ ____ INCH ROTARY ____ L.F.

LOCATION WAG 7
ORNL GRID COORDINATES
N 17,299.1224
E 27,858.7171
ELEV. GROUND 758.80
ELEV. TOP STAINLESS STEEL CASING 760.93

DRILLING DATES:
STARTED: 6-19-89
FINISHED: 8-08-89

MATERIALS USED

EST. VOL.	USED VOL.	
	50	POUNDS OF BENTONITE PELLETS (SURFACE CASING SEAL)
	15.25	FT. OF 10.0 IN. SURFACE CASING
7.0	9.0	SACKS OF CEMENT (SURFACE CASING)
	45.0	POUNDS OF POWERED BENTONITE (SURFACE CASING)
	70.0	GALLONS OF WATER (SURFACE CASING)
	60.0	FT. OF 4.0 IN. DIA. STAINLESS STEEL CASING
	15.0	FT. OF 4.0 IN. DIA. STAINLESS STEEL SCREEN
5.1	5.0	SACKS OF SAND
60	500	POUNDS OF BENTONITE PELLETS
7.4	9.0	SACKS OF CEMENT (WELL CASING)
	45.0	POUNDS OF POWERED BENTONITE (WELL CASING)
	70.0	GALLONS OF WATER (WELL CASING)
	3.2	FT. OF 10 IN. STEEL PROTECTIVE CASING

REASON FOR DIFFERENCES BETWEEN ESTIMATED VOLUMES AND USED VOLUMES: Spillage

SURFACE CASING TREMIE GROUTED YES ☒ NO ☐

STAINLESS STEEL CASING TREMIE GROUTED YES ☒ NO ☐

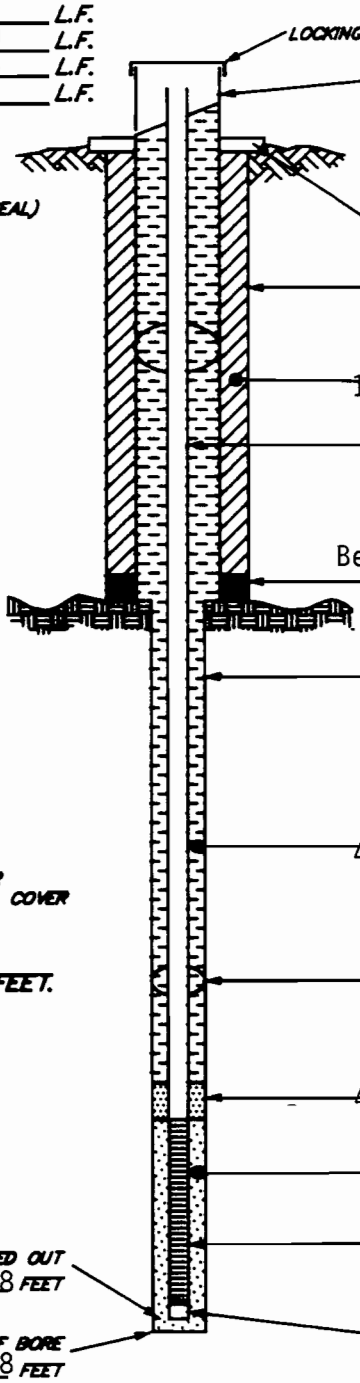
WELL COVER USED
- ☒ LOCKING STEEL COVER
- ☐ FLUSH MOUNTED WELL COVER
- ☐ OTHER

SILT TRAP USED YES ☐ NO ☒

MONITORING WELL PUMP BASE SET AT 68.1 FEET.

CENTRALIZERS AT 17.0 FEET.
37.0 FEET.
57.0 FEET.
72.0 FEET

NOTE:
ALL DEPTHS ARE MEASURED FROM GROUND SURFACE UNLESS OTHERWISE NOTED:



LOCKING CAP

10 IN. DIA. SURFACE/PROTECTIVE CASING 3.22 FEET ABOVE GROUND SURFACE TO 14.6 FEET BELOW GROUND SURFACE

CONCRETE PAD

14.0 IN. DIA. BORE HOLE 4.0 TO 15.0 FEET

GROUT SEAL 0.0 TO 11.90 FEET

4.0 IN. STAINLESS STEEL CASING 2.13 FEET ABOVE GROUND SURFACE TO 57.8 FEET BELOW GROUND SURFACE

Bentonite SEAL 11.9 TO 14.60 FEET

BEDROCK LEVEL 11.0

8.0 IN. DIA. BORE HOLE

GROUT SEAL 0.0 TO 49.35 FEET

CENTRALIZER

BENTONITE PELLET SEAL 49.35 TO 52.6 FEET

SAND PACK 52.6 TO 72.8 FEET

4.0 IN. DIA. STAINLESS STEEL SLOTTED SCREEN 57.8 TO 72.8 FEET

N/A IN. DIA. STAINLESS STEEL SILT TRAP/CAP N/A TO N/A FEET

HOLE CLEANED OUT TO 72.8 FEET

BOTTOM OF BORE HOLE 72.8 FEET

TYPE B WELL

ERC / EDGE
Environmental and Energy Services Co.

WELL No. 1085

DATE: 7-26-89

MONITORING WELL MATERIALS CERTIFICATION

ITEM/MATERIAL		DATE USED	BATCH NUMBER
SAND		8-07-89	1
BENTONITE		7-26-89	1
STAINLESS STEEL SCREEN	(PREPACKAGED ■ YES ☐ NO)	8-07-89	1
STAINLESS STEEL CASING	(PREPACKAGED ■ YES ☐ NO)	8-07-89	1
STAINLESS STEEL CENTRALIZERS	(PREPACKAGED ■ YES ☐ NO)	8-07-89	1
STAINLESS STEEL CAPS	(PREPACKAGED ■ YES ☐ NO)	8-07-89	1
MONITORING WELL PUMP	(PREPACKAGED ■ YES ☐ NO)	2-08-90	4
GROUT		7-27-89	1
		8-08-89	1
WELL COVERS		8-07-89	1
SURFACE CASING			

COMMENTS:

OBSERVER SIGNATURE/DATE C. Allison Hodges 8-08-89
C. Allison Hodges

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1085

POST-WELL COMPLETION CHECKLIST

POST-WELL COMPLETION TASKS	COMPLIANCE DATE	COMPLIANCE INITIALS
1. MUD SCRAPED FROM AUGERS, SAMPLERS, AND ALL OTHER EQUIPMENT.	8-08-89	CAH
2. ALL MUD FROM RIG AND EQUIPMENT SCRAPINGS AND CUTTINGS DISPOSED OF IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED.	8-08-89	CAH
3. WELL DEVELOPED IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED AND DETAILS OF THE DEVELOPMENT ACTIVITY RECORDED.	2-08-90	DCL
4. DRILLING SITE PROPERLY CLEANED UP AFTER COMPLETION OF WELL INSTALLATION.	8-09-89	CAH

* RELEASE SPECIFIC TECHNICAL DIRECTIONS FOR REGULATORY COMPLIANCE MONITORING WELLS PHASE I, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, W.O. K-4147, APRIL 1987.

OBSERVER SIGNATURE/DATE C. Allison Hodges 8-09-89
C. Allison Hodges

D. Charles Lytle 2-08-90
D. Charles Lytle

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1085

LOCATION: WAG 7

MONITORING WELL DEVELOPMENT FORM

DEVELOPMENT DETAILS

METHOD OF DEVELOPMENT: Surging and Pumping

DEVELOPMENT BEGAN DATE: 2-08-90 TIME:

DEVELOPMENT ENDING DATE: 2-08-90

DEVELOPMENT OBSERVED BY: D. Charles Lytle

ONE WELL VOLUME: 58.8 GALLONS

TOTAL GALLONS PUMPED: 215 TOTAL WELL VOLUMES PUMPED: 3.7

INITIAL pH: 7.2 FINAL pH: 7.6

INITIAL CONDUCTIVITY (uS): 754 FINAL CONDUCTIVITY (uS): 660

DESCRIPTION OF INITIAL TURBIDITY: Milky

DESCRIPTION OF FINAL TURBIDITY: Clear

FINAL MEASURED TURBIDITY: 4.0 NTU's

WELL APPROVED BY: R. C. Williams MMES

ODOR OF WATER: None

WATER DISCHARGED TO:
- ☒ GROUND SURFACE
- ☐ STORM SEWERS
- ☐ DRUMS
- ☐ TANK TRUCK
- ☐ STORAGE TANKS
- ☐ OTHER

INITIAL PRE-DEVELOPMENT WATER DEPTH: 3.8 feet below ground level.

DEVELOPMENT OBSERVATIONS

OBSERVER SIGNATURE/DATE D. Charles Lytle 2-08-90

D. Charles Lytle

ERC / EDGE Environmental and Energy Services Co.

WELL NO. 1085
LOCATION: WAG 7
DATE: 2-08-90

MONITORING WELL DEVELOPMENT PROGRESS

ONE WELL VOLUME = 58.8 GALLONS

DATE	TIME	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	MEASURED TURBIDITY (NTU'S)	pH	CONDUCTIVITY (µS)	TOTAL GALLONS PUMPED	WELL VOLUMES PUMPED	COMMENTS
2-08-90	0930	40	Milky	--	7.2	754	40		
2-08-90	1130	65	Slightly Cloudy	--	7.5	619	105	1.8	
2-08-90	1500	110	Clear	4.0	7.6	660	215	3.7	
RESULTS AT END OF DEVELOPMENT			Clear	4.0	7.6	660	215	3.7	

COMMENTS Nice recharger; water cleared pretty fast; passed and moved off hole.

OBSERVER SIGNATURE/DATE D. Charles Lytle 2-08-90
D. Charles Lytle

MWFORM06.DWG

HYDRAULIC CONDUCTIVITY CALCULATIONS

PROGRAM SLUGT, VERSION 4.1, NOV. 1986

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:

(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3, NO.1 OF WRR ENTITLED "RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER")

(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED "A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS")

WELL NO.: 1085 DATE OF TEST: 2/14/90

PROJECT NO.: E221-002 CLIENT: MMES

SITE LOCATION: WAG 7

EDGE, INC. FIELD INVESTIGATOR: BRUCE MCMASTER

INPUT DATA ARE:

INNER CASING DIAMETER = 4.00 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 4.00 INCHES
DIAMETER OF DRILLED HOLE = 8.63 INCHES
LENGTH OF SCREEN OR INTAKE PORTION = 15.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 66.05 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 15.00 FEET
DEPTH TO STATIC WATER LEVEL BELOW REF. POINT = .92 FEET
ESTIMATED POROSITY OF GRAVEL PACK = .20
FALLING-HEAD INDEX = 1 ("1" IF FALLING,"0" IF RISING)
NUMBER OF DEPTH-TIME DATA POINTS = 32

HO WAS COMPUTED FROM INTERCEPT OF PLOT OF LOG(H) VS. TIME

SUCCESSIVE COMPUTED
VALUES FOR HO
(FEET)

1.8483
1.8306

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1085

HYDRAULIC CONDUCTIVITY CALCULATIONS

TIME (SEC)	DEPTH TO WATER (FEET)	HEAD (FEET)
10.00	2.640	1.720
20.00	2.650	1.730
30.00	2.640	1.720
40.00	2.640	1.720
50.00	2.620	1.700
60.00	2.630	1.710
75.00	2.620	1.700
90.00	2.620	1.700
105.00	2.590	1.670
120.00	2.590	1.670
150.00	2.580	1.660
180.00	2.550	1.630
240.00	2.490	1.570
300.00	2.450	1.530
360.00	2.420	1.500
420.00	2.350	1.430
480.00	2.300	1.380
540.00	2.270	1.350
600.00	2.230	1.310
720.00	2.120	1.200
840.00	2.000	1.080
960.00	1.940	1.020
1080.00	1.840	.920
1200.00	1.790	.870
1320.00	1.700	.780
1440.00	1.650	.730
1560.00	1.640	.720
1680.00	1.520	.600
1800.00	1.460	.540
1920.00	1.410	.490
2040.00	1.330	.410
2160.00	1.260	.340

****

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

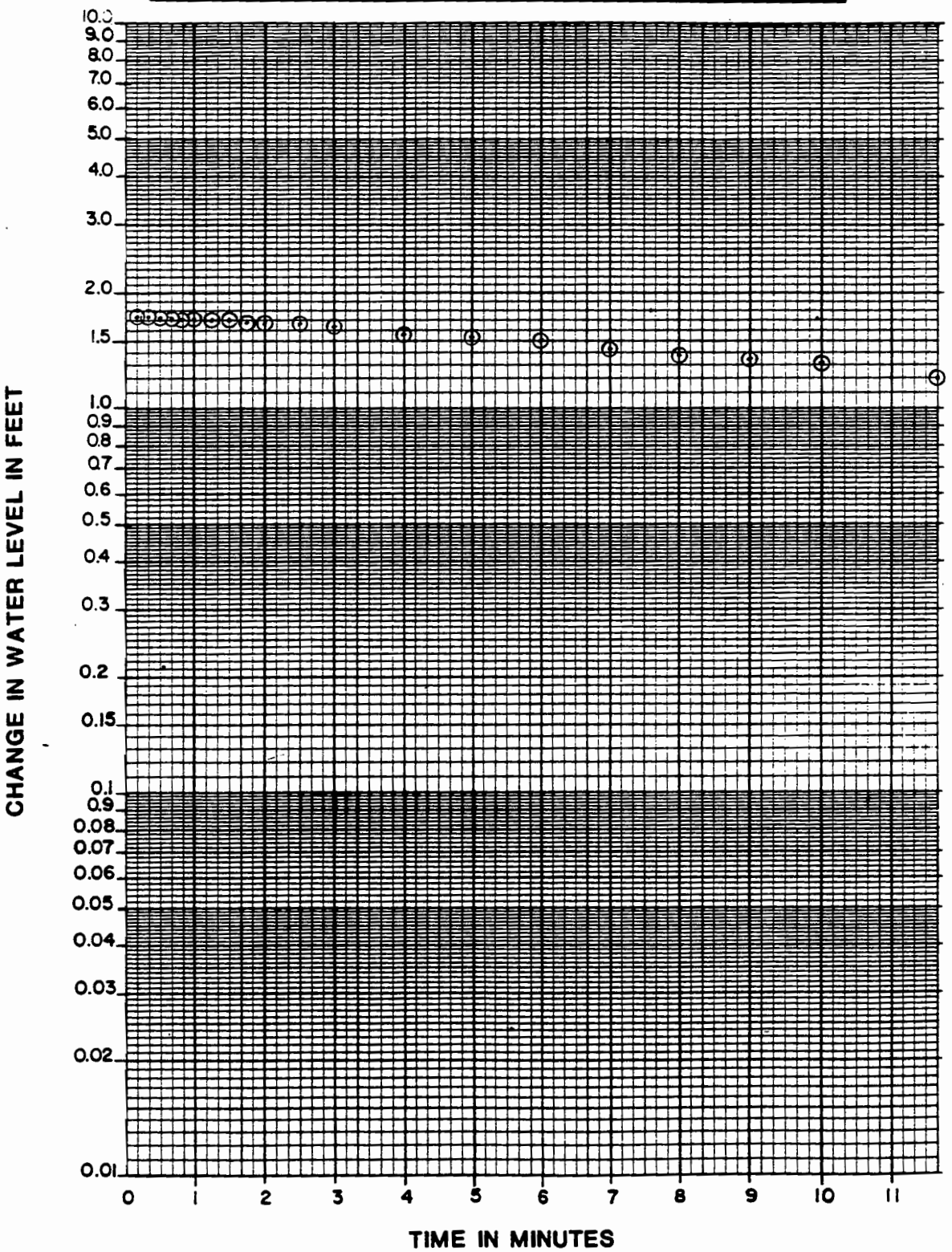
PERMEABILITY = 2.25E-06 FT/SEC = 6.86E-05 CM/SEC

TRANSMISSIVITY = 3.38E-05 FT**2/SEC

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1085

HYDRAULIC CONDUCTIVITY CALCULATIONS



EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 1085W01

WELL NO.	LOCATION:	TYPE:
1085	WAG-7	WATER

SAMPLER:	SAMPLE INTERVAL:	DATE:	TIME:
C. Allison Hodge (SIGNATURE)		08-07-89	1530

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECEIVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
C. Allison Hodge	8-15-89	8:31	EDGE	J.C. Price	8-15-89	8:37	

TYPE OF SAMPLE: ☐ SPLIT SPOON CORES–SOIL ☐ AUGER CUTTINGS–SOIL ☐ AUGER CUTTINGS–ROCK
☐ AIR ROTARY CUTTINGS–ROCK ■ DRILL WATER (NO AIR IN SAMPLE) ☐ OTHER _____

ALL SAMPLES ARE IMMEDIATELY PLACED IN I-CHEM SPECIALTY CLEANED CONTAINERS AND SEALED.

REMARKS: _____

1.0 General Information

1.1 Well Location

Monitoring well number 1086 is located in WAG 7. It is located approximately 600' northeast of chemical waste pit #7 and approximately 600' northwest of the shale fracturing batch plant. The location is shown on ORNL drawing number C3E20004 A075. Survey coordinates for this well are N 17454.7736, E 28117.0075 (X-10 grid) or latitude 35° 54' 42.16" and longitude 84° 18' 59.48". Coordinate data were provided by Martin Marietta Energy Systems. The method used for conversion from X-10 grid to Tennessee-Lambert State Plane Coordinates came from the publication "Tennessee Valley Authority Data Services Branch and Mapping Services Branch, Oak Ridge, Tennessee, DOE Plant Control, November 6, 1985, Field Book: ESS-3115, pp. 1-20." The latitude and longitude were calculated by Adams Craft Herz Walker Engineering, Inc., using methods from the U.S. Coast and Geodetic Survey Publication 62-4, "State Plane Coordinates by Automatic Data Processing."

1.2 Drilling Information

Well number 1086 was drilled by Geotek Engineering Company. A Mobile B-50 and an Ingersol Rand T-4 rig were used to drill this boring for monitor well installation under operation of Rick Herron

and Larry Ledbetter with the assistance of George Akins and Rick Herron. Drilling commenced on 6/27/89 and was finished on 7/27/89. Paragraph 2.4.1 includes a detailed discussion of the well installation and a well schematic is included on the well installation/completion form. A synopsis of the drilling activity follows:*

6/27/89: Steam cleaning auger rig, pan and tools. Mobilize to site. Lay plastic.

6/28/89: Split spoon from 2.0' to 4.3'. Auger with 6.0" auger to 5.0'. Split spoon from 5.0' to 5.4'. Auger to 6.6' or auger refusal. Bulk density taken from 2.6' to 2.9' equaled 1.94 grams/cm^3. Cannot complete well with augers. Must use air rotary method. Auger from 0.0' to 4.0' with 22.0" auger to install diverter casing (15 1/4"). Install and grouted diverter casing. Hole covered with plastic. Two split spoon samples were taken. (1086S01 and 1086SO2).

7/25/89: Steam cleaning air rotary rig and containment box. Mobilized to site and setting up. Drill with an 8.0" tricone bit. Contained all cuttings in containment box. Hard rock at 10.0'. Drilled to 15.0' and check for water. After recharge of 1 hour, water at

* This information was typed directly from field notes and was edited only when necessary for clarification.

10.0'. Drill to 20.0' as per Steve Laman. After 1 hour recharge water was at 15.0' from surface. Drilled to 25.0' as per R. Williams. Allowed well to recharge. Water level at 18.0'. Drill to 30.0' as per R. Williams, checked for water. Water level at 29.95'. Allowed well to recharge overnight. Compressed air sample and drill water sample taken. No signs of hydrocarbon from air under ultraviolet light.

7/26/89: Meeting with Bill McMaster, Mike Ebers, R. Williams, Jill Greene and Doug Connery. As per meeting 1086 borehole filled in with sand (13.0') to level of 17.0' and bentonite (2.0') to level of 15.0' to make the borehole depth only 15.0' (zone actually wanted to monitor). Borehole was filled in with 4.5 bags of sand to a level of 18.0' and 1 bucket of bentonite to a level of 15.0'. After bentonite was allowed to hydrate for 4 hours, the well was set. A 10.6' section of 2.0" stainless steel screen, cap and 10.0' section of 2.0" casing was installed to a depth of 14.75'. Centralizer was placed at 9.0'. Four bags of sand were poured into borehole to a depth of 3.75' and 1 bucket of bentonite to a depth of 3.0'.

7/27/89: The hole was grouted using 5 bags of cement and 25 lbs. of powdered bentonite.

This well was logged by ERC Environmental and Energy Services Co., Inc., hydrogeologist C. Allison Hodges. All well construction materials and supplies were from Martin Marietta Energy Systems approved batches. The batch origin of individual items is shown on the included Monitoring Well Materials Certification form.

2.0 Technical Information

2.1 Decontamination Procedures

The drilling rig, down hole tools, surface casing, stainless steel screen, stainless steel casing, centralizers, and stainless steel silt trap underwent the cleaning decontamination procedures outlined in the drilling specifications (Release Specific Technical Directions for Regulatory Compliance Monitoring Wells Phase 1, Oak Ridge National Laboratory, Oak Ridge, W.O., K-4147, April 1987, pgs, 2-4). A checklist of the cleaned materials is included with this data package.

2.2 Geology

WAG 7 is located in Melton Valley, which is in the Valley and Ridge Physiographic Province of East Tennessee. WAG 7 is underlain by shale,

siltstone, and limestone of the Conasauga Group. The Conasauga Group in the Oak Ridge area consists of six formations. They are, in ascending order, the Pumpkin Valley Shale, Rutledge Limestone, Rogersville Shale, Maryville Limestone, Nolichucky Shale and the Maynardville Limestone. These rocks have undergone extensive deformation and contain many folds and faults resulting in varying strike and dips. The average strike and dip appears to be consistent with the regional strike of 56° northeast and dips of about 30° to the southeast.

2.3 Sample Collection

Two soil samples (1086S01 and 1086S02) were collected during drilling, placed in I-CHEM specialty cleaned glass containers, sealed and submitted to Sample Receiving, Analytical Chemistry Division, Bldg. 4500S, ORNL. Chain of custody forms for these samples are included with this data package. Soil sample 1086S01 was collected in the split spoon interval from 2.1 to 2.6 on 6/28/89, and soil sample 1086S02 was collected in the augered interval from 6.0 to 6.6 on 6/28/89. Sample 1086S02 included clay (soil) as well as weathered shale (rock) and was collected directly from the auger stem. A drill water sample was collected from the water pump on the drill rig on 7/25/89. Analytical results for these samples can be obtained from the Remedial Action Program data base at ORNL.

A bulk density soil sample was collected from the split spoon sample interval from 2.6 to 2.9. The sample was measured, and weighed, and a bulk density of 1.94 grams/cm^3 was calculated.

2.4 Installation and Development

2.4.1 Installation

This was a type D well. A six-inch diameter boring was augered from ground surface to auger refusal (6.6 feet). The air rotary method was required to complete the well because the augers refused before the specified total well depth was reached. Therefore a twenty two-inch diameter boring was augered from ground surface to 4.0' and a fifteen-inch diverter casing was installed and grouted. The air rotary method was then used to drill an eight-inch diameter boring to a total depth of 30.0 feet. The boring was filled in with 4.5 bags of sand from 30.0' up to 18.0' and 50 lbs. of bentonite pellets were used to fill the boring from 18.0' up to 15.0'. A two-inch diameter stainless steel screen was installed from 14.55 feet to 4.15 feet. A two-inch diameter stainless steel casing was installed above the screen at 4.15 feet and extended 1.92 feet above ground surface. A sandpack was then poured into the annular space from 3.75 to 14.75 feet, with a .75 foot bentonite seal poured into the annular

space from the top of the bentonite seal to the surface was tremie grouted with a cement/bentonite slurry. A detailed schematic of the well is included on the well installation/completion form.

2.4.2 Well Development

Well number 1086 was developed to remove drill cuttings, silt, and other fines from the monitoring well. The monitoring well was developed using a Geoguard pump with an air compressor. All pumps were cleaned prior to use according to specified cleaning procedures (see Paragraph 2.1). The well was developed until a measured total of 207 gallons of water had been evacuated and the clarity of the discharge water was approved by the company representative. The final turbidity value measured was 20 NTU's. A development form showing the exact method of development and other pertinent data is appended.

2.4.3 Installation of Dedicated Monitoring Well Pump

After the well was developed, a Geoguard Model No. 5614 dedicated monitoring well pump was installed on 2/12/90 at a depth of 13.0 feet below ground surface. These pumps are decontaminated at American Sigma and are sent prepackaged. A copy of the pump certification is kept on file at ORNL.

2.5 Hydraulic Conductivity Testing

Well number 1086 was tested for the determination of hydraulic conductivity of the aquifer in the vicinity of the well screen. This was accomplished by instantaneously removing a known quantity of water from the monitoring well and measuring the recovery of the water level over time. The changing water levels were measured using a Druck 15 psig pressure transducer and an Omnidata Datapod II data recorder. The hydraulic conductivity value of 2.81×10^{-3} cm/second (shown as permeability on the hydraulic conductivity calculations) was calculated using the Bouwer and Rice method. A computer printout of the hydraulic conductivity calculations is included in this data package.

ERC / EDGE
Environmental and Energy Services Co.

WELL No. 1086

PRE-DRILLING CHECKLIST FOR MONITORING WELLS

PRE-DRILLING TASKS		COMPLIANCE DATE	COMPLIANCE INITIALS
1.	EXCAVATION PERMIT OBTAINED.	6-27-89	CAH
2.	ALL EQUIPMENT HAS BEEN CLEANED BEFORE DRILLING.	6-27-89	CAH
3a.	SCREEN AND CASINGS HAVE BEEN WASHED, STEAMED, RINSED WITH DE-IONIZED OR DISTILLED WATER, RINSED WITH ISOPROPYL ALCOHOL, WRAPPED WITH PROTECTIVE COVERING AND STORED OFF THE GROUND.	N/A	
3b.	PRE-PACKAGED SCREENS, CASINGS AND CENTRALIZERS WERE USED.	7-26-89	CAH
4.	WORK AREA FOR SAMPLE EXAMINATION COVERED WITH CLEAN POLYETHYLENE.	6-27-89	CAH
5.	CLEAN KNIVES, GLOVES, SAMPLE JARS AND LABELS ON-HAND.	6-27-89	CAH
6.	POLYETHYLENE COVER IN PLACE OVER HOLE.	6-28-89	CAH

ADDITIONAL NOTES/OBSERVATIONS:

OBSERVER SIGNATURE/DATE C. Allison Hodges 7-27-89

C. Allison Hodges

ERC / EDGE
Environmental and Energy Services Co.

WELL No. 1086

DECONTAMINATION CHECKLIST
DRILLING EQUIPMENT

EQUIPMENT	SCRAPE	STEAM CLEAN	STEAM RINSE	ISOPROPYL ALCOHOL RINSE	DEIONIZED WATER RINSE
RIG	X	X	X	N/A	N/A
AUGERS	X	X	X	X	X
BITS	X	X	X	X	X
RODS	X	X	X	X	X
SAMPLERS	X	X	X	X	X
PIPES	X	X	X	X	X
WORK TOOLS	X	X	X	X	X
AUGER PINS	X	X	X	X	X

OBSERVER SIGNATURE/DATE C. Allison Hodges 7-25-89
C. Allison Hodges

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1086

ORNL MONITORING WELL LOG

LOCATION: WAG 7
DRILLER: Rick Herron/Larry Ledbetter
HELPER: George Akins/Rick Herron
DRILL: B-50 Mobile Drill, Ingersol Rand T-4

DATE: START: 6-28-89
FINISH: 7-27-89
LOGGED BY: C. Allison Hodges
HEALTH PHYSICIST: W. H. Shinpaugh

TYPE DRILLING: Auger/Air Rotary
LUBRICANT TYPE: Green Stuff
No. SAMPLES TAKEN: N/A
TYPE: N/A
CONTAINMENT TYPE: Plastic, Pan, Containment Box

THICKNESS OF SOIL (REFUSAL DEPTH): 6.6'
DEPTH DRILLED IN ROCK: 23.4'
TOTAL DEPTH OF WELL: 30.0'

DRILLING FLUID SAMPLES:
TYPE: Water
DATE: 7-25-89

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
0.0	2.0			Gravel. (fill material)
2.0	3.4	1086S01 2.1-2.6	100%	Clay, mottled, light brown and dark yellowish
				orange, firm. Bulk Density @ 2.6-2.9' = 1.94
				grams/cm^3.
3.4	3.5			Shale, very brittle, dusky brown.
3.5	4.0		10%	Clay, mottled, light brown and dark yellowish
				orange, with some gravel, fill material fall in.
4.0	4.3			Shale, very brittle, dusky brown.
4.3	5.0			Shale, very brittle, dusky brown - Augered
				interval.
5.0	5.4		10%	Shale, very brittle, dusky brown and olive gray,
				with some clay, dark yellowish orange.
5.4	6.6	1086S02 6.0-6.6		Shale, hard, brittle, olive gray.
6.6	10.0			*Smooth, regular drilling.
10.0	11.0			Smooth, regular drilling encountered. Hard rock
				at 10.0' (limestone).
11.0	12.0			Rough, hard, slow drilling.
12.0	18.0			Smooth, fast drilling.
18.0	20.0			Rough, hard drilling.
20.0	25.0			Rough, hard, irregular drilling, lots of rock
				passing through containment tube.

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1086

ORNL MONITORING WELL LOG

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
25.0	30.0			Smoother drilling. Drilling still hard.
	30.0			Total Depth
				*No detailed lithologic logs could be provided
				due to use of containment box for the interval
				from 6.6' to 30.0 feet.

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1086

WELL INSTALLATION/COMPLETION FORM

O.R.N.L. MONITORING WELL PROGRAM

LOGGED BY: C. Allison Hodges
PROOFED BY: Michael L. Ebers

DRILLING COMPANY: Geotek
DRILLER: Rick Herron/ Larry Ledbetter
HELPER: George Akins/ Rick Herron

LOCATION WAG 7
ORNL GRID COORDINATES
N 17,454.7736
E 28,117.0075
ELEV. GROUND 762.37
ELEV. TOP STAINLESS STEEL CASING 764.29

DRILLING DATES:
STARTED: 6-27-89
FINISHED: 7-27-89

EQUIPMENT
☒ 22 INCH AUGER 4.0 L.F.
☒ 8 INCH AUGER 11.0 L.F.

MATERIALS USED

EST. VOL.	USED VOL.	
	10.4	FEET OF 2 IN. S.S. SCREEN
	6.1	FEET OF 2 IN. S.S. CASING
3.25	4.0	SACKS OF SAND
50.0	50.0	POUNDS OF BENTONITE PELLETS
3.0	5.0	SACKS OF CEMENT
	25.0	POUNDS OF POWDERED BENTONITE
	30.0	GALLONS OF WATER (CEMENTING)

REASON FOR DIFFERENCES BETWEEN ESTIMATED VOLUMES AND USED VOLUMES
Irregular boring diameter and spillage.

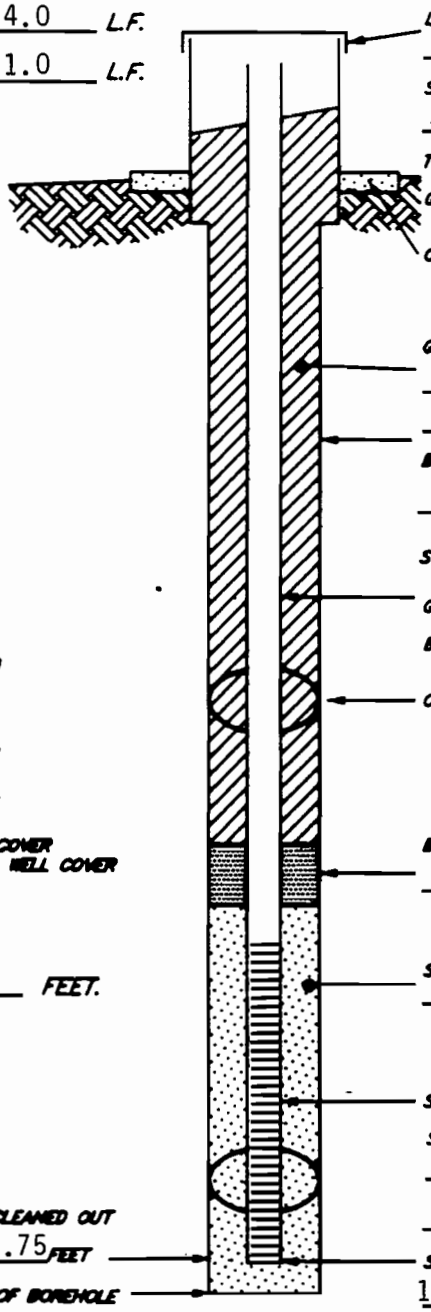
WELL COVER USED
☐ LOCKING STEEL COVER
☒ FLUSH MOUNTED WELL COVER
☐ OTHER

SILT TRAP USED YES ☒ NO ☐

MONITORING WELL PUMP BASE SET AT 13.0 FEET.

CENTRALIZERS AT 9.0 FEET.
____ FEET.
____ FEET.

NOTE:
ALL DEPTHS ARE MEASURED FROM GROUND SURFACE UNLESS OTHERWISE NOTED:



LOCKING STEEL COVER
10 INCH DIAMETER STEEL PROTECTIVE CASING
3.2 FT. ABOVE GROUND TO 2.0 FT. BELOW GROUND SURFACE
CONCRETE PAD
GROUT SEAL 0.0 TO 3.0 FEET
8.0 INCH DIAMETER BOREHOLE
2.0 INCH DIAMETER STAINLESS STEEL CASING 1.92 FT. ABOVE GROUND SURFACE TO 4.15 FT. BELOW GROUND SURFACE
CENTRALIZER (TYP.)
BENTONITE PELLET SEAL 3.0 TO 3.70 FEET
SAND PACK 3.70 TO 14.75 FEET
2 INCH DIAMETER STAINLESS STEEL .010 SLOTTED SCREEN 4.15 TO 14.55 FEET
2 INCH DIAMETER STAINLESS STEEL SILT TRAP/CAP 14.55 TO 14.75 FEET
HOLE CLEANED OUT TO 14.75 FEET
BOTTOM OF BOREHOLE 30.0 FEET - Filled with sand and bentonite from 30.0 up to 14.75'.

TYPE D WELL

NOT TO SCALE

ERC / EDGE
Environmental and Energy Services Co.

WELL No. 1086

DATE: 7/26/89

MONITORING WELL MATERIALS CERTIFICATION

ITEM/MATERIAL		DATE USED	BATCH NUMBER
SAND		7-26-89	1
BENTONITE		7-26-89	Stores
STAINLESS STEEL SCREEN	(PREPACKAGED ☐ YES ☐ NO)	7-26-89	Stores
STAINLESS STEEL CASING	(PREPACKAGED ☐ YES ☐ NO)	7-26-89	Stores
STAINLESS STEEL CENTRALIZERS	(PREPACKAGED ☐ YES ☐ NO)	7-26-89	Stores
STAINLESS STEEL CAPS	(PREPACKAGED ☐ YES ☐ NO)	7-26-89	Stores
MONITORING WELL PUMP	(PREPACKAGED ☐ YES ☐ NO)	2-12-90	4
GROUT		7-27-89	1
WELL COVERS		7-27-89	1
SURFACE CASING		7-26-89	1

COMMENTS:

OBSERVER SIGNATURE/DATE C. Allison Hodges 7-27-89
C. Allison Hodges

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1086

POST-WELL COMPLETION CHECKLIST

POST-WELL COMPLETION TASKS	COMPLIANCE DATE	COMPLIANCE INITIALS
1. MUD SCRAPED FROM AUGERS, SAMPLERS, AND ALL OTHER EQUIPMENT.	6-28-89	CAH
2. ALL MUD FROM RIG AND EQUIPMENT SCRAPINGS AND CUTTINGS DISPOSED OF IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED.	7-26-89	CAH
3. WELL DEVELOPED IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED AND DETAILS OF THE DEVELOPMENT ACTIVITY RECORDED.	2-12-90	DCL
4. DRILLING SITE PROPERLY CLEANED UP AFTER COMPLETION OF WELL INSTALLATION.	7-27-89	CAH

* RELEASE SPECIFIC TECHNICAL DIRECTIONS FOR REGULATORY COMPLIANCE MONITORING WELLS PHASE I, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, W.O. K-4147, APRIL 1987.

OBSERVER SIGNATURE/DATE C. Allison Hodges 7-27-89

C. Allison Hodges

D. Charles Lytle 2-12-90

D. Charles Lytle

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1086

LOCATION: WAG 7

MONITORING WELL DEVELOPMENT FORM

DEVELOPMENT DETAILS

METHOD OF DEVELOPMENT: Surging and Pumping

DEVELOPMENT BEGAN DATE: 2-08-90 TIME:

DEVELOPMENT ENDING DATE: 2-12-90

DEVELOPMENT OBSERVED BY: D. Charles Lytle

ONE WELL VOLUME: 6.1 GALLONS

TOTAL GALLONS PUMPED: 207 TOTAL WELL VOLUMES PUMPED: 34.0

INITIAL pH: 7.5 FINAL pH: 7.3

INITIAL CONDUCTIVITY (uS): 359 FINAL CONDUCTIVITY (uS): 221

DESCRIPTION OF INITIAL TURBIDITY: Milky

DESCRIPTION OF FINAL TURBIDITY: Slightly Cloudy

FINAL MEASURED TURBIDITY: 20 NTU's

WELL APPROVED BY: R. C. Williams MMES

ODOR OF WATER: None

WATER DISCHARGED TO:
- ☒ GROUND SURFACE
- ☐ STORM SEWERS
- ☐ DRUMS
- ☐ TANK TRUCK
- ☐ STORAGE TANKS
- ☐ OTHER

INITIAL PRE-DEVELOPMENT WATER DEPTH: 5.1 feet from ground surface.

DEVELOPMENT OBSERVATIONS

OBSERVER SIGNATURE/DATE D. Charles Lytle 2-12-90

D. Charles Lytle

ERC / EDGE Environmental and Energy Services Co.

WELL NO. 1086
LOCATION: WAG 7
DATE: 2-12-90

MONITORING WELL DEVELOPMENT PROGRESS

ONE WELL VOLUME = 6.1 GALLONS

DATE	TIME	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	MEASURED TURBIDITY (NTU'S)	pH	CONDUCTIVITY (µS)	TOTAL GALLONS PUMPED	WELL VOLUMES PUMPED	COMMENTS
2-08-90	1300	30	Milky	--	7.5	359	30	4.9	
2-08-90	1615	57	Milky	--	7.6	254	87	14.3	
2-12-90	1000	110	Cloudy	--	7.3	352	197	32.3	
2-12-90	1030	10	Slightly Cloudy	20	7.3	221	207	34.0	
RESULTS AT END OF DEVELOPMENT			Slightly Cloudy	20	7.3	221	207	34.0	

COMMENTS Water cleared up somewhat after surging but remains slightly cloudy.
We had 34.0 well volumes. Passed and moved off hole.

OBSERVER SIGNATURE/DATE D. Charles Lytle 2-12-90
D. Charles Lytle

HYDRAULIC CONDUCTIVITY CALCULATIONS

PROGRAM SLUGT, VERSION 4.1, NOV. 1986

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:

(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3, NO.1 OF WRR ENTITLED "RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER")

(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED "A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS")

WELL NO.: 1086 DATE OF TEST: 2/28/90

PROJECT NO.: E221-002 CLIENT: MMES

SITE LOCATION: WAG 7

EDGE, INC. FIELD INVESTIGATOR: BRUCE MCMASTER

INPUT DATA ARE:

INNER CASING DIAMETER = 2.00 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 2.00 INCHES
DIAMETER OF DRILLED HOLE = 8.63 INCHES
LENGTH OF SCREEN OR INTAKE PORTION = 10.40 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 7.30 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 10.40 FEET
DEPTH TO STATIC WATER LEVEL BELOW REF. POINT = 7.40 FEET
ESTIMATED POROSITY OF GRAVEL PACK = .20
FALLING-HEAD INDEX = 0 ("1" IF FALLING,"0" IF RISING)
NUMBER OF DEPTH-TIME DATA POINTS = 32

HO WAS COMPUTED FROM INTERCEPT OF PLOT OF LOG(H) VS. TIME

SUCCESSIVE COMPUTED VALUES FOR HO (FEET)
.6429
.6335

ERC / EDGE Environmental and Energy Services Co.

WELL No. 1086

HYDRAULIC CONDUCTIVITY CALCULATIONS

TIME (SEC)	DEPTH TO WATER (FEET)	HEAD (FEET)
5.00	6.150	1.250
10.00	6.530	.870
15.00	6.780	.620
20.00	6.930	.470
25.00	7.040	.360
30.00	7.100	.300
35.00	7.140	.260
40.00	7.170	.230
45.00	7.200	.200
50.00	7.220	.180
55.00	7.240	.160
60.00	7.250	.150
65.00	7.270	.130
70.00	7.270	.130
75.00	7.280	.120
80.00	7.290	.110
85.00	7.300	.100
90.00	7.310	.090
95.00	7.310	.090
100.00	7.320	.080
105.00	7.330	.070
110.00	7.330	.070
115.00	7.330	.070
120.00	7.340	.060
125.00	7.340	.060
130.00	7.350	.050
135.00	7.350	.050
140.00	7.360	.040
145.00	7.360	.040
150.00	7.360	.040
155.00	7.370	.030
160.00	7.380	.020

****

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

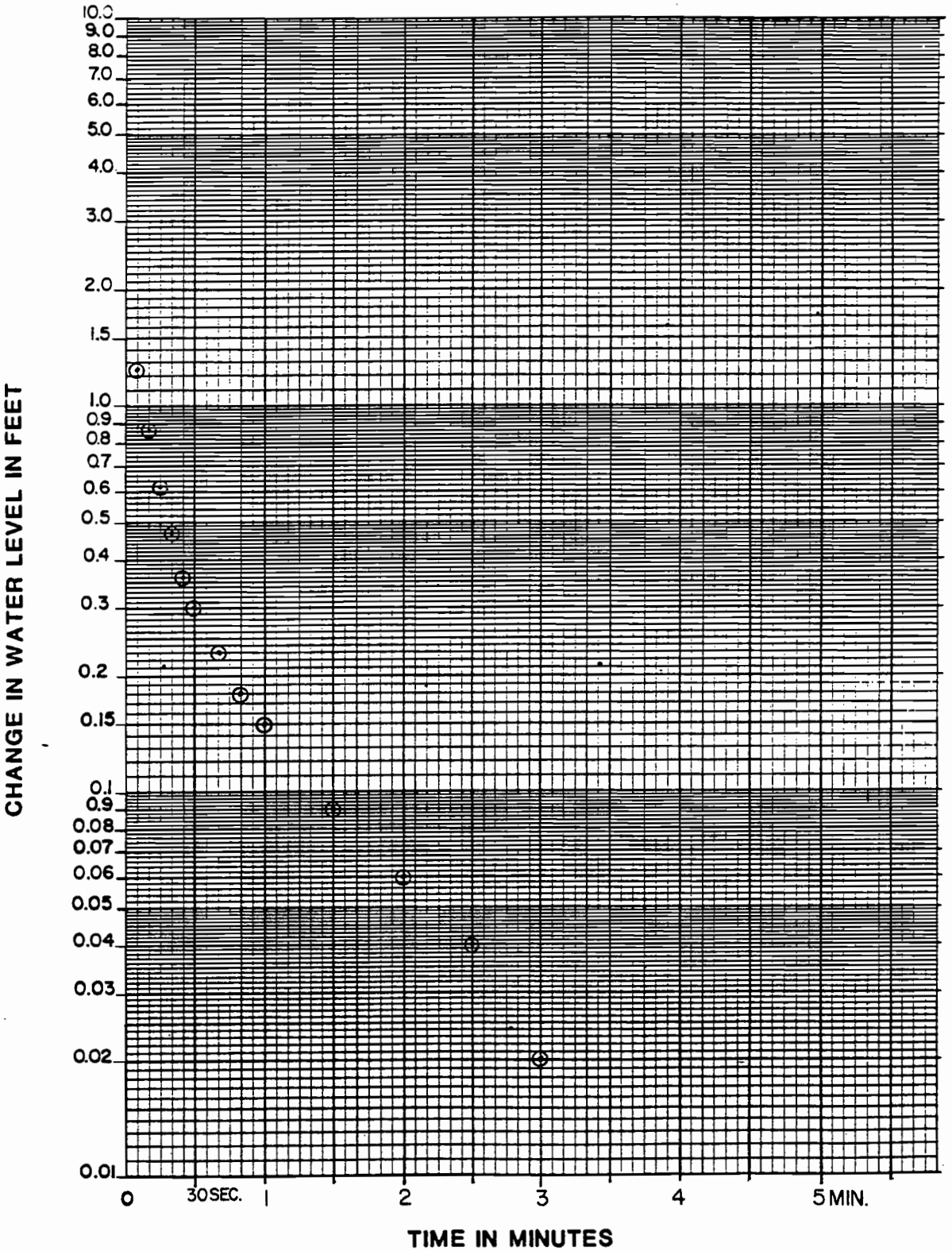
PERMEABILITY = 9.22E-05 FT/SEC = 2.81E-03 CM/SEC

TRANSMISSIVITY = 9.59E-04 FT**2/SEC

ERC / EDGE
Environmental
and Energy
Services Co.

WELL No. 1086

HYDRAULIC CONDUCTIVITY CALCULATIONS



EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 1086S01

WELL NO.	LOCATION:	TYPE:
1086	S WAG - 7	Soil

SAMPLER:	SAMPLE INTERVAL:	DATE:	TIME:
C. Allison Hodge (SIGNATURE)	2.1 - 2.4'	06-28-89	0840

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECEIVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
C. Allison Hodge	07-05-89	2:05	EDGE	Christopher M. Shelley	7/5/89	2:05	EDGe
Christopher M. Shelley	7/5/89	2:28	EDGe	M. Ferguson	7/5/89	2:28	

TYPE OF SAMPLE: ☑ SPLIT SPOON CORES–SOIL ☐ AUGER CUTTINGS–SOIL ☐ AUGER CUTTINGS–ROCK
☐ AIR ROTARY CUTTINGS–ROCK ☐ DRILL WATER (NO AIR IN SAMPLE) ☐ OTHER _____

ALL SAMPLES ARE IMMEDIATELY PLACED IN I-CHEM SPECIALTY CLEANED CONTAINERS AND SEALED.

REMARKS: _____

EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 1086 S02

WELL NO.	LOCATION:	TYPE:
1086	WAG - 7	Soil

SAMPLER:	SAMPLE INTERVAL:	DATE:	TIME:
C. Allison Hodge (SIGNATURE)	6-0-6.6	06-28-89	0853

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECEIVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
C. Allison Hodge	07-05-89	2:05	EDGE	Christopher M. Waller	7/5/89	2:05	EDGe
Christopher M. Waller	7/5/89	2:28	EDGe	M. Ferguson	7/5/89	2:28	

TYPE OF SAMPLE: ☐ SPLIT SPOON CORES–SOIL ☒ AUGER CUTTINGS–SOIL ☐ AUGER CUTTINGS–ROCK
☐ AIR ROTARY CUTTINGS–ROCK ☐ DRILL WATER (NO AIR IN SAMPLE) ☐ OTHER soil & Rock

ALL SAMPLES ARE IMMEDIATELY PLACED IN I-CHEM SPECIALTY CLEANED CONTAINERS AND SEALED.

REMARKS: Taken at Soil rock interface

EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 1086 (001)

WELL NO.	LOCATION:	TYPE:	
1086	WAG-7	WATER	
SAMPLER: C. Allison Hodges (SIGNATURE)	SAMPLE INTERVAL: N/A	DATE: 07-25-89	TIME: 1455

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECEIVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
C. Allison Hodges	07-31-89		EDGE	J. P. [illegible]	7318 9	1430	

TYPE OF SAMPLE: ☐ SPLIT SPOON CORES–SOIL ☐ AUGER CUTTINGS–SOIL ☐ AUGER CUTTINGS–ROCK
☐ AIR ROTARY CUTTINGS–ROCK ■ DRILL WATER (NO AIR IN SAMPLE) ☐ OTHER _____

ALL SAMPLES ARE IMMEDIATELY PLACED IN I-CHEM SPECIALTY CLEANED CONTAINERS AND SEALED.

REMARKS: _____

Appendix B

Operating Instructions for Handling Cuttings and Water From Well Drilling and Development of the Groundwater Quality Monitoring Wells

OPERATING INSTRUCTIONS FOR HANDLING CUTTINGS AND WATER FROM FROM WELL DRILLING AND DEVELOPMENT OF THE GROUNDWATER QUALITY MONITORING WELLS

Prepared by
J. A. Greene

PROCEDURE REVIEW AND APPROVAL Form

Environmental and Health Protection Division

Procedure Title: Operating Instructions for Handling Cuttings and Water from Well Drilling and Development of the Groundwater Quality Monitoring Wells

Procedure No. _____ Rev. No. 0 Date _____

Author _____

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Signature Mark E. Baldwin Date 8-30-89
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OPERATING INSTRUCTIONS FOR HANDLING CUTTINGS AND WATER FROM FROM WELL DRILLING AND DEVELOPMENT OF THE GROUNDWATER QUALITY MONITORING WELLS

1.0 PURPOSE

The purpose of this document is to cite the steps that are followed to handle water and soil produced during the installation and development of wells.

2.0 SCOPE

This document applies to well drilling and development associated with the Groundwater Quality Monitoring Wells Installation Program at Oak Ridge National Laboratory.

3.0 REFERENCE

Health, Safety, and Environmental Protection Procedures for Excavating Operations, ORNL/M-116/R1, Oak Ridge National Laboratory, March 3, 1988.

4.0 DEFINITIONS

Well Ratings. Ratings assigned during the excavation permit cycle by Radiation Protection (RP) and Industrial Hygiene (IH) to indicate the probability of encountering radioactive and chemical contamination, respectively. These ratings are based on historical information or from previous drilling or excavation activity. The ratings are marked on the excavation permits. (RP ratings on permits may sometimes be called ''HP'' for ''Health Physics.'' The two designations are interchangeable.) Protective measures required for the three categories are stated in Table 1, ''Excavation-classification categories,'' in ORNL/M-116/R1. The categories for soil handling are stated in Appendix B, ''Radiological Soil Handling Criteria,'' in ORNL/M-116/R1.

RP Category 1. A rating assigned by RP which indicates that the probability of encountering radioactive contamination is low and that intermittent monitoring is required by RP.

IH Category 1. A rating assigned by IH which indicates that the probability of encountering chemical contamination (i.e., organics) is low and that monitoring is not required by IH. An IH and/or Environmental Monitoring and Compliance (EM&C) representative will be called in any time chemical or hazardous contamination is suspected.

RP Category 2. A rating assigned by RP which indicates that the probability of encountering radioactive contamination is moderate and that continuous monitoring is required. The RP representative will determine the necessary level of protective clothing to be worn.

IH Category 2. A rating assigned by IH which indicates that the probability of encountering chemical contamination is moderate and that respirators must be on-site and ready for use by the workers when

indicated by the IH or RP representative on-site. Location will be checked periodically with an IH field instrument, such as a Photovac or Organic Vapor Organizer (OVA).

RP Category 3. A rating assigned by RP which indicates that there is a high probability of encountering radioactive contamination. Therefore, continuous monitoring by an RP representative is required, and protective clothing must be worn. In addition to the training listed above, workers must have successfully completed the Category 3 Driller Training course that is administered by Environmental and Health Protection Division (E&HP) personnel.

IH Category 3. A rating assigned by IH which requires the workers to wear respirators as a minimum. Additional protection deemed appropriate by IH will be designated for each location. Continuous monitoring by IH personnel is required.

Training Requirements. Training requirements for workers include the Basic Radiation Training administered by E&HP personnel and the 40 h of training required by the Superfund Amendment Reauthorization Act (SARA) through a company-approved course. There is an additional training course required for Category 3 drilling.

Air rotary containment box. A box specially designed to contain the cuttings and water that are blown from the borehole during air rotary drilling. The box is equipped with a high-efficiency particulate air (HEPA) filter to prevent particles that possibly contain contaminants from being dispersed into the air. Air rotary drilling is generally used only for drilling into bedrock.

Auger pan. A metal catch pan with a hole cut in the middle. The pan surrounds the borehole and contains soil cuttings as they are augered up.

Proper On-Site Disposal. Disposal of noncontaminated soil and water produced from work on a well at a location near the well that is not openly visible to the public and has no risk of causing erosion or direct discharge into a stream. The construction engineer (CE) will indicate to the drillers which areas are acceptable for on-site disposal. The pH will have been checked and adjusted to the 5-to-9 range before releasing. This precise definition is intended wherever this term is used in this procedure.

Proper Contaminated Waste Disposal. Generally, radioactively contaminated soil will be packaged in drums and tagged by the RP representative for disposal by ORNL Waste Operations. However, Category-2-level soil may be used on site as backfill in remote areas when covered by 1 ft of noncontaminated soil as stipulated in ORNL/M-116/R1. The CE will specify to the drillers when a well location has been approved by EM&C for on-site disposal of contaminated soil. This definition is intended wherever this term is used in this procedure.

Temporary Drilling Equipment Cleaning Facility. An outdoor area located in Melton Valley for steam cleaning of drill rigs and associated equipment, referred to as the steam cleaning area.

Containment Box Holding Pit. A lined pit at the Temporary Drilling Equipment Cleaning Facility. The contents of the pit will be sampled and tested for gross alpha, gross beta, pH, and tritium*, before being released through a silt fence. Contents that have a potential for containing hazardous materials (i.e., IH Category 2 and 3 locations) will have been checked with an IH field instrument before being released into the pit.)

Steam Cleaning Pits. Two lined pits at the Temporary Drilling Equipment Cleaning Facility that collect runoff from the steam cleaning operations. The contents of the pits will be sampled and tested for gross alpha, gross beta, pH, and tritium*, before being released through a silt fence. Contents that have a potential for containing hazardous materials (i.e., IH Category 2 and 3 locations) will have been checked with an IH field instrument before being released into the pit.)

5.0 RESPONSIBILITIES

5.1 Radiation Protection Personnel monitor and determine the presence of detectable radioactive contamination in drill cuttings during well-drilling activities. They provide guidance to ensure that exposures to the workers, public, and environment are kept as low as reasonably achievable. They also provide radiation monitoring during the precursory cleaning by the drillers.

5.2 Well-Drilling Personnel perform well drilling and completion activities. They package soil and water in appropriate containers and transport it, if necessary; perform precursory cleaning of low-level contaminated equipment; and perform cleaning of equipment between the drilling of each well.

5.3 EDGe Hydrogeologists observe all crucial well installation activities and record data for all boreholes drilled. They do a visual inspection of the cuttings produced during augering and note any unusual occurrences and obvious deleterious material encountered during the drilling process. They check the cuttings and water with a Photovac or OVA or similar instrument and check pH of water when necessary.

5.4 Construction Engineer serves as the field contact and provides guidance to the drillers during field activities.

6.0 PROCEDURE

6.1 EXPLANATION OF THE WELL RATING SYSTEM

Each well is assigned a rating by RP and IH before drilling begins. Because additional information is gained during drilling,

well ratings may be changed by RP and IH as the work progresses. A lower RP Category rating will be changed to a Category 3 rating upon encountering radioactive contamination within the Category 3 range defined in ORNL/M-116/R1. Likewise, an IH Category 3 may result if chemical contamination is detected in a well with a lower rating. The RP and/or IH representative on site will notify the on-site personnel when conditions warrant a rating change. Any additional actions or modifications in protective clothing required by the rating change will be executed at that time. The change will be documented immediately by the on-site hydrogeologist in the well data package and as soon as possible by the RP and/or IH representative by a signed written statement stating the well number, the old and new ratings, and the rationale supporting the change. The statement will be sent by the RP and/or IH representative to the Construction Engineer (CE) for filing with the original excavation permit. A copy will be sent to the RAP Well Installation Manager by the CE.

A well category also may be changed from a higher rating to a lower rating. For example, if no contamination is encountered while drilling a Category 2 or 3 well, it may be changed to a lower rating after drilling to a certain depth or for development purposes, depending on the history of the area. The documentation procedure stated above for an increase in rating must also be followed for a decrease in rating.

6.2 CATEGORY 1 WELLS (RP OR IH)

6.2.1 Category 1 Drilling

6.2.1.1 Category 1 Auger Cuttings

a. Auger cuttings will be collected in a catch pan.

b. An RP representative will scan the cuttings intermittently to check for radioactive contamination. Cuttings will be inspected for any unusual discoloration or odor by the hydrogeologist.

c. If there is no contamination detected, proper on-site disposal or disposal at the steam cleaning area will be done.

6.2.1.2 Category 1 Air Rotary Drilling

a. Cuttings will be collected in a containment box.

b. When the containment box is full, one of the following will be done to empty cuttings and/or decant water from the containment box:

(1) proper on-site disposal.

(2) disposal at the containment box holding pit.

6.2.2 Category 1 Well Development

6.2.2.1 Water removed from the well will be contained in drums.

6.2.2.2 The pH of the water will be measured and will be adjusted to be between 5 and 9 by the CE if it is above or below that range.

6.2.2.3 Drums of water will be discarded by proper on-site disposal or disposal at the steam cleaning area will be done.

6.3 CATEGORY 2 WELLS (RP AND IH)

6.3.1 Category 2 Drilling

6.3.1.1 Category 2 Auger Cuttings

a. Auger cuttings will be collected in a catch pan.

b. An RP representative will scan the cuttings continuously to check for radioactive contamination. Cuttings will be inspected for any unusual discoloration or odor and tested with a Photovac or OVA by the hydrogeologist for presence of RCRA materials.

c. If there is no contamination detected, proper on-site disposal or disposal at the steam cleaning area will be done.

d. Cuttings will be contained in drums if contamination is detected. Proper disposal will be arranged by Martin Marietta Energy Systems through Waste Operations.

6.3.1.2 Category 2 Air Rotary Drilling

a. Rock cuttings and drill water will be collected in a containment box.

b. When the containment box becomes full, the RP representative will perform a wet towel smear to detect the presence of radioactive contamination. An inspection for unusual discoloration or odor and tests with an OVA will be conducted for the presence of RCRA materials by the ~~hydro~~geologist.

c. If no contamination is detected, one of the following will be done to empty cuttings and/or decant water from the containment box:

(1) proper on-site disposal.

(2) disposal at the containment box holding pit.

d. If contamination is detected by the tests, arrangements will be made by Martin Marietta Energy Systems through Waste Operations to properly dispose of the water. Further laboratory testing of the box contents may be done.

6.3.2 Category 2 Development

6.3.2.1 Water removed from the well will be contained in drums.

6.3.2.2 When the drums are ready to be emptied, the RP representative will perform a wet towel smear to detect the presence of radioactive contamination. An inspection for unusual discoloration or odor and tests with an OVA will be conducted for presence of RCRA materials by the hydrogeologist. The pH will be adjusted if necessary.

6.3.2.3 If no contamination is detected, the water will be discarded by proper on-site disposal or disposal at the steam cleaning area will be done.

6.3.2.4 If contamination is detected by the tests, arrangements will be made by Martin Marietta Energy Systems to properly dispose of the water. Further laboratory testing may be done.

6.4 CATEGORY 3 WELLS (RP AND IH)

6.4.1 Category 3 Drilling

6.4.1.1 Category 3 Augering

a. When a well is classified as an RP Category 3 or an IH Category 3, continuous monitoring will be required by RP and IH. Wearing of respirators will be required. Cuttings will be inspected for any unusual discoloration or odor. Tests for chemical contamination (i.e., organics) will be performed with IH field instruments by an IH representative for IH Category 3 wells. Specially trained personnel will be required to do the drilling.

b. If no contamination is detected by RP or IH while augering through soil to bedrock, a rating may be changed by RP or IH to a Category 2 depending on the depth, the type of contamination expected, and the history of the area.

c. If contamination is detected during augering, cuttings will be drummed. Proper disposal of all cuttings and water will be arranged by Martin Marietta Energy Systems.

6.4.1.2 Category 3 Air Rotary Drilling

a. Rock cuttings and drill water will be collected in a containment box.

b. When the containment box becomes filled with water and/or cuttings, a sample will be collected by EM&C and will be tested by the Analytical Chemistry Division for gross alpha, gross beta, tritium*, for an RP Category 3. If it is an IH Category 3, the IH representative on-site will determine which (if any) laboratory testing is necessary for chemical contaminants.

c. Proper disposition of the containment box contents will be decided by consensus of E&HP, the IH or RP representative, EM&C, and the CE, based on the results from Analytical Chemistry Division of the above tests.

6.4.2 Category 3 Development

6.4.2.1 Water pumped from Category 3 wells will be contained in drums. Samples will be collected by EM&C and will be tested by Analytical Chemistry Division for gross alpha, gross beta, tritium*, and pH. It will be tested with IH field instruments by IH representatives for the presence of RCRA materials.

6.4.2.2 A decision based on the test results will be made between E&HP and Engineering whether to continue development.

6.5 BOREHOLE CLEANING

When sludge and water have accumulated in the bottoms of boreholes drilled in soil, the boreholes must be cleaned out prior to setting casings. A decision based on the location of the borehole and its rating will be made between the RP and/or IH representatives whether the sludge and water from the borehole must be contained in a drum. Water and sludge from a Category 2 well will be drummed, and a wet towel smear will be done by RP to

determine proper disposal of the drum contents. Laboratory testing of the drum contents for gross alpha, gross beta, tritium*, and pH will be done if recommended by the RP or IH representative. Water and sludge removed from an RP Category 3 well will be drummed, and laboratory testing will be done for gross alpha, gross beta, tritium*, and pH. EM&C will be consulted to determine proper disposal based on the test results. Further laboratory testing to determine actual contaminants will be done if recommended by EM&C.

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*Testing for tritium will be done for wells located in areas where tritium contamination is suspected. This decision will be made between RP and EM&C.

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