FIELD SAMPLING PLAN ADDENDUM 4

Depleted Uranium Impact Area Site Characterization: Monitoring Well Installation Jefferson Proving Ground, Madison, Indiana

FINAL

Prepared for:

U.S. Department of Army
Installation Support Management Activity
5183 Blackhawk Road
Aberdeen Proving Ground, Maryland 21010-5424

and

U.S. Army Corps of Engineers
Louisville District
600 Dr. Martin Luther King, Jr. Place
Louisville, Kentucky 40202-2230

Submitted by:

Science Applications International Corporation
11251 Roger Bacon Drive
Reston, Virginia 20190

Contract No. W912QR-04-D-0019
Delivery Order No. 0019

January 2007

THIS PAGE WAS INTENTIONALLY LEFT BLANK

FIELD SAMPLING PLAN ADDENDUM 4
Depleted Uranium Impact Area Site Characterization: Monitoring Well Installation
Jefferson Proving Ground, Madison, Indiana

Contract No. W912QR-04-D-0019
Delivery Order No. 19

Nuclear Regulatory Commission License SUB-1435

January 2007

Final

Heather A. Shaw for	(703) 810-8994	1/18/07
Joseph N. Skibinski Project Manager	Telephone	Date
Joseph E. Peters	(703) 318-4763	1/18/07
Joseph E. Peters Quality Assurance Officer	Telephone	Date
	(314) 770-3027	1/18/07
Randy C. Hansen Health and Safety Officer	Telephone	Date
Harry W. Anagnostopoulos	(314) 770-3059	1/18/07
Harry Anagnostopoulos Radiation Protection Manager	Telephone	Date
Seth T. Stephenson	(765) 278-3520	1/18/07
Seth T. Stephenson Field Manager	Telephone	Date

The approved Field Sampling Plan (FSP) Addendum 4 will be provided to subcontractors (i.e., drilling and UXO contractor) at the time of subcontract execution.

THIS PAGE WAS INTENTIONALLY LEFT BLANK

CERTIFICATION 4

CONTRACTOR STATEMENT OF INDEPENDENT TECHNICAL REVIEW

Science Applications International Corporation (SAIC) has prepared this Field Sampling Plan (FSP) Addendum 4 for performing site characterization at Jefferson Proving Ground's (JPG's) Depleted Uranium (DU) Impact Area, located in Madison, Indiana. Notice is hereby given that an independent technical review has been conducted that is appropriate to the level of risk and complexity inherent in the project, as defined in the Quality Control Plan (QCP). During the independent technical review, compliance with established policy principles and procedures, utilizing justified and valid assumptions, was verified. This included review of assumptions; methods, procedures, and material used in analyses; alternatives evaluated; the appropriateness of data used and level of data obtained; and reasonableness of the results, including whether the product meets the customer's needs consistent with law and existing Corps policy.

Heather A. Thom

For: Joseph N. Skibinski
Project Manager
Science Applications International Corporation

8/18/07
Date

Joseph E. Peters

Joseph E. Peters
Quality Assurance Officer
Science Applications International Corporation

8/18/07
Date

Ernest Joseph Schultheis

Joseph Schultheis
Independent Technical Review
Licensed Indiana Professional Geologist
(Registration #1641)
Science Applications International Corporation

8/18/07
Date

Significant concerns and explanation of the resolutions are documented within the project file.

As noted above, all concerns resulting from independent technical review of the project have been considered.

Lisa D. Jones-Bateman
Vice President
Science Applications International Corporation

8/18/07
Date

THIS PAGE WAS INTENTIONALLY LEFT BLANK

TABLE OF CONTENTS

Page

1. INTRODUCTION 1-1
2. MONITORING WELL INSTALLATION PLAN 2-1
   2.1 WELL LOCATIONS AND PROPOSED DEPTHS 2-2
   2.2 MONITORING WELL INSTALLATION 2-5
      2.2.1 Drilling Methods and Equipment 2-5
         2.2.1.1 Site Preparation and Construction Support 2-5
         2.2.1.2 Pre-Borings and Subsurface Anomaly Avoidance 2-6
         2.2.1.3 Bedrock Drilling and Rock Coring 2-7
         2.2.1.4 Soil Sampling 2-8
         2.2.1.5 Equipment Condition and Cleaning 2-8
      2.2.2 Materials 2-9
         2.2.2.1 Casing/Screen/Centralizers/Grout Baskets 2-9
         2.2.2.2 Filter Pack, Bentonite Seal, and Cement/Bentonite Grout 2-9
         2.2.2.3 Delivery, Storage, and Handling of Materials 2-10
      2.2.3 Surface Completion 2-10
      2.2.4 Water Source 2-11
      2.2.5 Installation 2-11
         2.2.5.1 Screen and Well Casing Placement 2-11
         2.2.5.2 Filter Pack Placement 2-11
         2.2.5.3 Bentonite Seal/Grout Basket 2-12
         2.2.5.4 Centralizers 2-12
         2.2.5.5 Cement/Bentonite Grout Placement 2-12
      2.2.6 Borehole Abandonment 2-13
      2.2.7 Protective Cover and Concrete Pad Placement 2-14
      2.2.8 Well Identification 2-14
      2.2.9 Well Development 2-15
         2.2.9.1 Pump, Surge Block, and Airlift Usage 2-15
         2.2.9.2 Development Criteria 2-15
      2.2.10 Well Survey 2-16
      2.2.11 Alignment Testing 2-16
3. INVESTIGATION-DERIVED WASTES 3-1
4. DATA USE 4-1
   4.1 LOGS, DIAGRAMS, AND FORMS 4-1
      4.1.1 Borehole Logs 4-1
      4.1.2 Well Construction Diagrams 4-2
      4.1.3 Well Development Form 4-3
   4.2 MONITORING WELL DRILLING, INSTALLATION, CONSTRUCTION, AND DEVELOPMENT REPORT 4-3
5. RADIOLOGICAL RESPONSIBILITY AND LICENSING 5-1
6. REFERENCES 6-1

APPENDICES

Appendix A. Field Forms
Appendix B. USACE Borehole Logging Guidance
Appendix C. Indiana Administrative Code – Monitoring Wells

LIST OF FIGURES

Page

Figure 2-1. Proposed Well Pair Locations 2-3

Figure 5-1. Acceptance and Remittance of Radiological Responsibility at JPG 5-2

LIST OF TABLES

Page

Table 2-1. Well Pair Location Selection Criteria 2-4

Table 4-1. Soil and Rock Parameters to Be Recorded on Borehole Logs 4-2

LIST OF ACRONYMS AND ABBREVIATIONS

ASTM	American Society for Testing and Materials
BLS	Below Land Surface
CHP	Certified Health Physicist
CSP	Certified Safety Professional
DA	U.S. Department of the Army
DGM	Digital Geophysical Mapping
DGPS	Differential Global Positioning System
DO	Delivery Order
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DU	Depleted Uranium
EI	Electrical Imaging
EOD	Explosive Ordnance Disposal
FSP	Field Sampling Plan
HASP	Health and Safety Plan
HPT	Health Physics Technician
HSA	Hollow-Stem Auger
IAC	Indiana Administrative Code
IDW	Investigation-derived Waste
ISPCS	Indiana State Plane Coordinate System
JPG	Jefferson Proving Ground
MEC	Munitions and Explosives of Concern
NGB	National Guard Bureau
NGVD	National Geodetic Vertical Datum
NRC	Nuclear Regulatory Commission
NTU	Nephelometric Turbidity Unit
PVC	Polyvinyl Chloride
QC	Quality Control
RQD	Rock Quality Determination
RSO	Radiation Safety Officer
SAIC	Science Applications International Corporation
SOW	Statement of Work
USACE	U.S. Army Corps of Engineers
USCS	Unified Soil Classification System
UXO	Unexploded Ordnance

THIS PAGE WAS INTENTIONALLY LEFT BLANK

1. INTRODUCTION

This document is Addendum 4 to the previous Field Sampling Plan (FSP) (SAIC 2005a) prepared for the Depleted Uranium (DU) Impact Area Site Characterization Project for Jefferson Proving Ground (JPG), Madison, Indiana. Science Applications International Corporation (SAIC) has prepared this Addendum in accordance with the statement of work (SOW) requirements under the U.S. Army Corps of Engineers (USACE) Contract No. W912QR-04-D-0019, Delivery Order (DO) No. 19.

This FSP Addendum documents and describes specific activities and details of the monitoring well installation task that were not addressed or have been modified from the information presented in the original FSP (SAIC 2005a). With this understanding, this Addendum follows the same format and relevant sections of the FSP are referenced. This document is to be used in conjunction with the existing FSP, not as a replacement. SAIC assumes no liability for the use of this information for any other purpose than as stated in this Addendum or the original FSP.

The information provided in this plan was developed for use by SAIC and its subcontractors to assist with the installation of 10 monitoring well pairs. The well pair locations and selection process are presented and discussed in Section 2.1 of this Addendum. Additional details concerning the scope and objectives of the monitoring well installation were presented in Section 6.2 of the FSP (SAIC 2005a) and Section 2 of this Addendum.

Section 3 provides information on investigation-derived waste (IDW), Section 4 discusses data use, Section 5 describes radiological responsibility and licensing, and the references used in preparing this Addendum are provided in Section 6. The following appendices provide supporting documentation:

- ***Appendix A. Field Forms***—This appendix contains the field forms that will be used for documenting the drilling, installation, construction, and development of the monitoring wells.
- ***Appendix B. USACE Borehole Logging Guidance***—This appendix provides a copy of the USACE borehole logging guidance that generally will be followed during the monitoring well drilling and installation.
- ***Appendix C. Indiana Administrative Code – Monitoring Wells***—This appendix provides a copy of applicable sections of the Indiana Administrative Code (IAC) related to monitoring well installation that will be followed during the field program described in this Addendum.

THIS PAGE WAS INTENTIONALLY LEFT BLANK

2. MONITORING WELL INSTALLATION PLAN

This section summarizes the monitoring well drilling, installation, construction, and development activities to be conducted at JPG starting in the spring of 2007. The timing of the monitoring well installation activities is partially dependent on weather conditions at the site; it is preferred to install the wells when the ground surface is firm and not soft from precipitation for access and when freezing of equipment is not an issue. Therefore, the well installation is tentatively planned to begin in the spring and could extend to early summer of 2007. The drilling program will be accomplished by working 10-day cycles (10 days on and 4 off). It is anticipated that all of the monitoring well installations will be completed in a one and a half month period.

The objective of this task is to install well pairs that will be used for, but not limited to, the following:

- Collection of groundwater stage data
- Collection of groundwater chemistry samples
- Collection of samples for evaluation of the potential presence of and migration of DU and corrosion products
- Confirmation of the presence of preferential groundwater flow pathways (conduits)
- Characterization of groundwater flow through the aquifer and groundwater flow pathways
- Evaluation of the connectivity between the aquifer (groundwater) and surface water.

Ten well pairs will be installed at the selected locations (Figure 2-1). Each well pair will consist of a shallow and deep well installed in the bedrock at each well pair location. In general, each well will be installed in a similar manner, but each monitoring well will be unique and construction will be adjusted to the actual site conditions, such as depth to the water table, depths and sizes of individual water bearing zones, and the orientation and/or condition of those zones.

Because the entire DU Impact Area is located north of the firing line where the potential to encounter unexploded ordnance (UXO) is likely, special UXO-related construction support procedures will be used (Section 2.2.1.1). Following the UXO construction support activities, an exclusion zone and safe work area will be established, as well as routes for ingress and egress. Down-hole UXO detection and avoidance procedures will be practiced for the first 15 feet of each borehole. Detection and avoidance will be completed by installing an initial pre-boring with a combination of hand auger (shallow, 5 to 6 feet deep) and hollow-stem auger drilling in which the UXO contractor will advance the hole at 2-foot intervals, surveying the boring before advancing to the next interval. Additional detail is provided for down-hole UXO detection and subsurface avoidance procedures in Section 2.2.1.2 of this Addendum. After down-hole UXO detection and avoidance is completed at each well location to a depth of 15 feet or auger refusal, whichever occurs first, the drilling contractor will complete the remaining borehole drilling and monitoring well installation. Each well location will be cleared to a depth of 15 feet unless it is determined during field activities that clearance to a deeper depth is necessary based on the expertise of the onsite UXO subcontractor and the senior SAIC UXO supervisor.

Equipment will be decontaminated before it is used again at the next well location. The decontamination procedures are discussed in Section 2.2.1.5 of this Addendum.

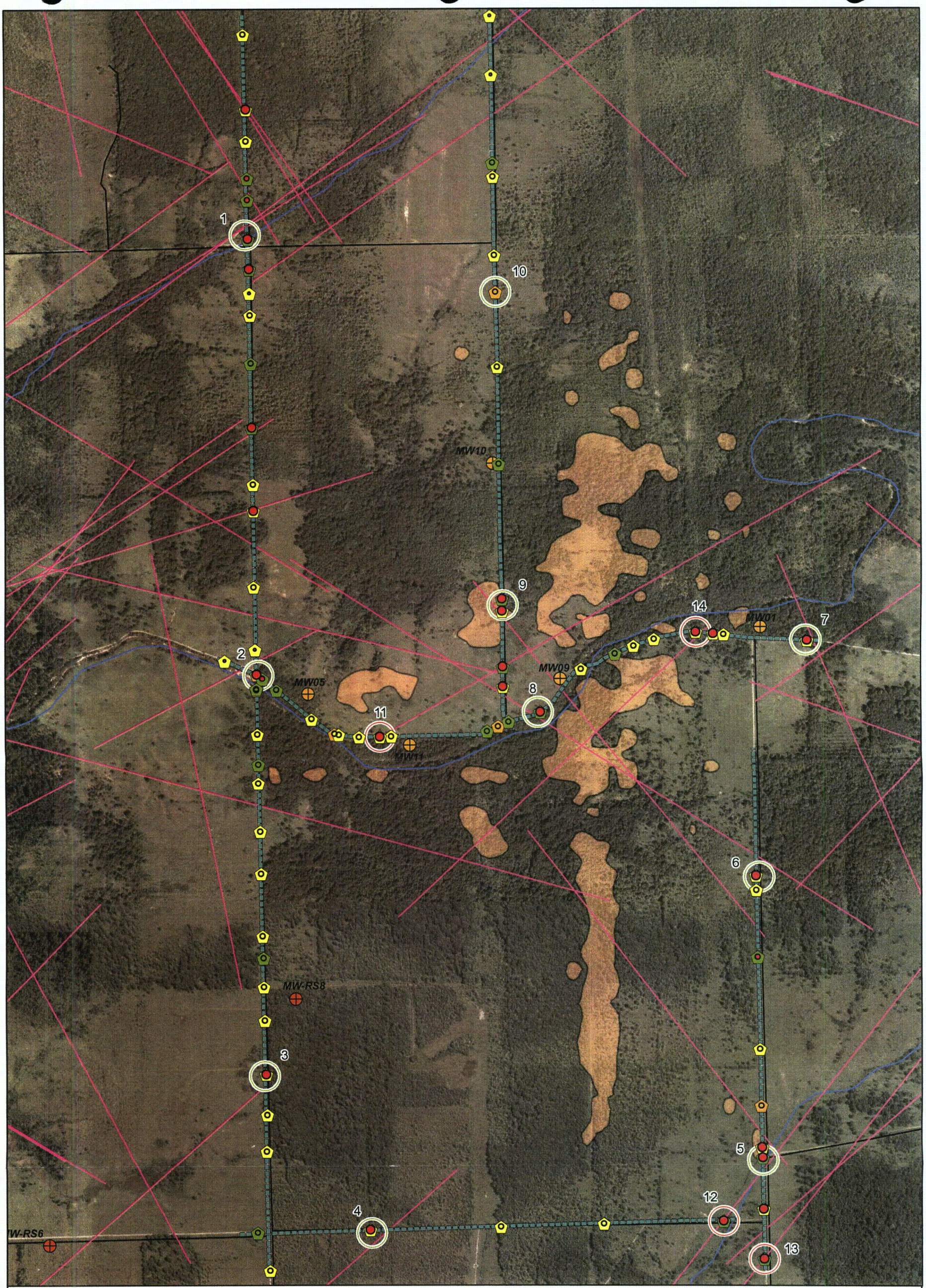
SAIC personnel, as well as subcontracted drilling and UXO personnel, are required to comply with all of the policies and procedures specified in this FSP Addendum, associated plans (SAIC 2005a, b, and c), the Health and Safety Plan (HASP) Addendum 4 that will be completed prior to the spring of 2007, and other referenced documents. The following summarizes the roles and responsibilities of the SAIC personnel conducting and overseeing the monitoring well installation.

- Mr. Joseph N. Skibinski is SAIC's JPG Project Manager. He is responsible for all activities conducted at JPG, including the monitoring well installation and all external coordination.
- Mr. Todd D. Eaby is SAIC's Hydrogeology and Multimedia Sampling and Analysis Lead for the monitoring well installation activities. He is responsible for developing the plans associated with the monitoring well installations and will be present at JPG during the first week of the monitoring well installation task. While at JPG, he will be the primary point of contact for SAIC.
- Mr. Seth T. Stephenson will serve as the Field Manager, provide anomaly avoidance and UXO construction support, and oversee UXO subcontractor personnel. He is a graduate of the Explosive Ordnance Disposal (EOD) School in Indian Head, Maryland, and has served as the UXO Team Member and UXO Supervisor on surveys and removal actions at U.S. Department of Defense (DOD) sites. When Mr. Eaby is not at JPG, Mr. Seth T. Stephenson will be the primary point of contact for SAIC and will be responsible for ensuring work activities are conducted in accordance with the procedures and policies specified in this FSP Addendum, the HASP Addendum 4 that will be completed prior to the spring of 2007, and other related project plans.
- Mr. Randy C. Hansen will serve as the Health and Safety Officer. He is a certified safety professional (CSP) and has supervised the environmental radiation protection program on remedial action projects involving radiological contamination. He has experience supporting field operations at JPG.
- Mr. Harold W. Anagnostopoulos will serve as the Radiation Safety Officer (RSO). He is a certified health physicist (CHP) in SAIC's St. Louis office who specializes in environmental compliance, occupational safety, and radiation protection.
- Mr. Joseph E. Peters will be the Quality Control (QC) Manager for all of SAIC's work at JPG. He will ensure that data collection is accomplished following the established procedures specified in the project plans and in compliance with established SAIC procedures. He is the QC Manager for USACE, National Guard Bureau (NGB), and U.S. Department of Energy (DOE) contracts and has extensive experience in working with laboratories and validating chemical and radiological data.

2.1 WELL LOCATIONS AND PROPOSED DEPTHS

Fourteen potential well pair sites (13 "fracture" sites and 1 deep overburden site) were identified following the evaluation of the fracture trace analysis and electrical imaging (EI) survey results. The evaluation of the fracture trace and EI survey and well pair site selection process is detailed in the Well Location Selection Report (SAIC 2007).

Ten well pairs were selected to be installed; the locations are shown in Figure 2-1. The well pair location selection criteria are summarized in Table 2-1, along with alternate well pair sites. Sites one though nine (Figure 2-1 and Table 2-1) have been selected to provide locations that are anticipated to provide coverage in possible flow directions from the DU Impact Area. In addition, these nine sites were selected at locations, based on the results of the fracture trace and EI survey results, to have high probabilities of intersecting preferential groundwater flow pathways or "conduits" (i.e., fractures and solution enhanced features). Four sites (numbers 11 through 14, Table 2-1) are provided as alternate well pair locations for the first nine sites in the event that a selected location cannot be used due to site conditions or the presence of unavoidable UXO that would prevent the safe operation of the drill rig and support equipment. The tenth well pair site was selected to evaluate an area identified in the EI results with a greater than average depth to bedrock. Drilling and well installation at this site will provide information for evaluating the unconsolidated materials and the zone of bedrock-soil interface in an area where deep bedrock weathering appears to have occurred.



Legend

- Excellent
- Probable
- Possible
- None
- Feature of Interest
- Probable Fracture
- Possible fracture
- EI Lines
- Fracture Traces
- Streams
- Roads
- uR/hr Exposure Rate
- Candidate Well Pair Location
- Alternate Well Pair Location
- Monitoring Well Locations
- Range Monitoring Well Locations

N W E S

0 500 1,000 2,000
Scale in Feet

JEFFERSON PROVING GROUND
Madison, Indiana

Proposed Well Pair Locations

drawn AGM	checked	approved	revisions	figure no.
date 12/14/06	date	date		2-1
job no. 01-1633-04-8527-710		file no.		

K:\GIS_Data\JPG\Projects\9.2\EI Anomalies_conduit_pair.mxd

Table 2-1. Well Pair Location Selection Criteria
Jefferson Proving Ground, Madison, Indiana

Proposed Well Pair Location	Fracture Trace		Geophysical Transect Number	Inline Distance Along Electrical Imaging Transect (Feet)	Flow Direction/Component
	Fracture Trace Number	Field Verification			
1	37-11-1009-3 and 37-11-1009-4	Good	1	11,620	Shallow migration toward northern tributary of Big Creek, deeper/general flow toward the southwest and the Ohio River
2	37-11-1009-6	Not Field Checked	1	6,890	Shallow migration toward Big Creek, deeper/general flow toward the southwest and the Ohio River
3	37-11-1011-2	Good	1	2,550	Shallow flow toward either Big Creek or Middle Fork Creek, and deeper/general flow toward the southwest and the Ohio River
4	37-11-1010-13	Good	2	1,630	Shallow flow toward Middle Fork Creek, deeper/general flow toward the southwest and/or south and the Ohio River
5	37-11-1011-1	Good	5	1,450	Shallow flow toward the Middle Fork Creek, deeper/general flow toward the south-southeast toward the West Branch of the Indiana-Kentuck Creek
6	37-11-1009-1	Good	5	4,530	Shallow flow toward Big Creek and/or Middle Fork Creek, deeper/general flow toward the south-southeast toward the West Branch of the Indiana-Kentuck Creek
7	37-11-1064-14	Good	4	7,160	Shallow flow toward Big Creek, deeper/general flow toward the east-southeast toward the West Branch of the Indiana-Kentuck Creek
8	37-11-1009-1	Good	4	3,960	Shallow flow toward Big Creek, deeper general flow direction either toward the Ohio River or toward the West Branch of the Indiana-Kentuck Creek
9	37-11-1010-10	Good	3	1,250, 1,380*	Shallow flow toward Big Creek, deeper general flow direction either toward the Ohio River or toward the West Branch of the Indiana-Kentuck Creek
10	NA	NA	3	4,650	Shallow flow toward Big Creek, deeper general flow direction either toward the Ohio River or toward the West Branch of the Indiana-Kentuck Creek
11*	37-11-1010-1	Good	4	2,180	Shallow migration toward Big Creek, deeper/general flow toward the southwest and the Ohio River
12*	37-11-1011-1	Good	2	5,460	Shallow flow toward the Middle Fork Creek, deeper/general flow toward the south-southeast toward the West Branch of the Indiana-Kentuck Creek
13*	37-11-1063-7	Good	5	350	Shallow flow toward the Middle Fork Creek, deeper/general flow toward the south-southeast toward the West Branch of the Indiana-Kentuck Creek
14*	37-11-1010-2	Good	4	5,950	Shallow flow toward Big Creek, deeper/general flow toward the east-southeast toward the West Branch of the Indiana-Kentuck Creek

*Alternate proposed well pair location.

There is some latitude regarding the location of each borehole, depending on the shape of the geophysical feature. Generally, the borehole will be located to intersect the desired portion of the geophysical feature at the target depth of the boring. If field conditions or the presence of UXO restricts the use of the desired location, the Senior Hydrogeologist will review the geophysics and fracture trace analysis data to determine the limits of the adjustment in the direction required by the field conditions. It is generally expected that moves of 15 to 25 feet can be accommodated without endangering the missing of a target feature.

If it is determined that a proposed well pair location can not be used, the project hydrogeologist, rig geologist and Army and SAIC Project Managers will discuss and decide on which alternate well pair location will be used. It is proposed that a shallow and deep well will be installed in the bedrock at each well pair location. The exception is at the tenth site, where it is anticipated that the shallow well will be installed in the overburden or at the bedrock-soil interface if sufficient permeable materials are present to provide a functional well. At all sites, if sufficiently permeable saturated materials are identified in the unconsolidated deposits, the installation of a well with a screened interval in the permeable zone will be considered. A final determination for the installation of a well in permeable unconsolidated materials will be made based on discussion between the Army and SAIC's project hydrogeologist, project manager, and rig geologist.

It is anticipated that for each conduit well pair, two boreholes will be advanced separately and will have total depths of approximately 50 and 120 feet (15.2 and 36.6 meters) below land surface (BLS). The anticipated depths will be determined partially based on targets as a result of the EI and fracture trace studies. Final depths will be determined based on the actual subsurface conditions of the aquifer observed by the rig geologist during the borehole advance and examination of the recovered unconsolidated materials and rock cores.

The goal is to target high-permeability zones, such as fractures and solution-enhanced zones, with the screened interval. If sufficient well yield to support a functional monitoring well is found to be present in the borehole, a monitoring well will be installed. The field observations will be discussed with the project hydrogeologist and appropriate well construction details will be decided. If adequate permeability is not encountered, abandonment of the borehole will be considered. A final determination for abandonment will be made based upon discussion between the Army and SAIC's project hydrogeologist, project manager, and rig geologist.

2.2 MONITORING WELL INSTALLATION

Conduit monitoring well pairs installed as part of this scope will be constructed as 2-inch (5.08 centimeters) diameter, schedule 40 polyvinyl chloride (PVC) wells with 10-foot (3.05 meters) screen lengths and standard above-grade surface completions. Specifications for drilling, installation, completion, and development of the conduit monitoring wells are described in the following subsections.

2.2.1 Drilling Methods and Equipment

SAIC will be onsite during all drilling and well installation activities to provide well installation oversight, provide health and safety oversight, catalog subsurface materials, document drilling observations and conditions, and conduct field screening for health and safety. Retrieved soils and rock cores will be logged in the field by SAIC's field geologist using USACE Forms MRK55 and MRK55-2 (Appendix A) in accordance with the USACE borehole logging guidance (Appendix B).

2.2.1.1 Site Preparation and Construction Support

As discussed above, construction support procedures will be used to mitigate worker risk during the construction of the conduit monitoring wells described in the FSP (SAIC 2005a). Construction support

will be provided by qualified UXO personnel during construction activities at potential munitions and explosives of concern (MEC) sites to ensure the safety of construction personnel from the harmful effects of UXO. During construction support, UXO teams conduct surface and subsurface UXO clearance for the known construction footprint prior to construction intrusive activities (U.S. Army 1999).

Construction support will be conducted by a qualified UXO contractor supervised by one of SAIC's qualified UXO specialists (i.e., graduate of DOD EOD School in Indian Head, Maryland). The surveyed areas will be marked. Non-UXO personnel will operate only within the designated UXO-free areas and established roadways. All other field work in areas where UXO reasonably may be exposed at the surface and within excavated areas will be subject to continuous surveillance by qualified UXO personnel. Additional procedures for work in UXO areas will be in the HASP Addendum 4, which will be completed prior to the spring of 2007.

A visual survey augmented by the use of Schonstedt® magnetic locators will be conducted to locate UXO within the top 2 feet BLS. Identified UXO will be moved to a location for consolidated demolition or disposed of by blow-in-place operations for UXO items that are unsafe to move. The survey will be conducted by two UXO technicians and SAIC's Field Manager and Senior Health Physics Technician (HPT). The demolition activities will be performed by the UXO technicians in accordance with DOD (1997), U.S. Army (2000), and U.S. Army (2004) procedures.

After the visual survey, vegetation and obstacle removal will be completed by two UXO technicians and SAIC's Field Manager and Senior HPT. Since the well locations have been selected along or in active roads, vegetation and obstacle removal is anticipated to be limited.

Digital geophysical mapping (DGM) and development of "dig sheets" will be completed by SAIC geophysicists, the Field Manager, and the Senior HPT. This provides a deeper investigation, resulting in safer work conditions for future site activities. DGM includes sophisticated measurements integrated with differential global positioning system (DGPS) technology to closely monitor the location of all measurements. Detailed mapping and advanced assessment methods are used to refine the precise locations of more deeply buried UXO for exposure and removal, as appropriate. Because of the limitations of Schonstedt® magnetic locators often employed for construction support activities in detecting subsurface UXO, an EM61-MK2 high-sensitivity metal detector will be used. The DGM will be conducted only within the 40- by 40-foot work area (i.e., based on an area that is two times the assumed length of the drill rig and includes a work area around the rig and support vehicles).

Two UXO technicians, with oversight from SAIC's Field Manager, will excavate and dispose of suspected UXO items identified in the dig sheets prior to the mobilization of drilling personnel. Since the dig sheets mentioned above will provide geo-referenced data, the UXO technicians will use a DGPS unit and Schonstedt® magnetic locators to locate and detect subsurface anomalies.

2.2.1.2 Pre-Borings and Subsurface Anomaly Avoidance

Each monitoring well (20 total) will be pre-bored for UXO avoidance purposes using a combination of both hand auger and hollow-stem auger (HSA) drilling techniques prior to drilling with diamond rock coring techniques. Prior to using the HSA, SAIC personnel will pre-screen the shallow portion of the borehole for UXO. The first 5 feet or refusal, whichever is shallowest, will be screened using a hand auger to avoid interference with UXO detection equipment from the presence of the drill rig. If the hand augured portion of the borehole is clear of suspected UXO, avoidance activities will be continued using the HSA to a depth of 15 feet BLS.

Anomaly avoidance activities will consist of advancing the borehole at 2-foot increments, as directed by the UXO specialist. Then, after withdrawing the augers and moving the rig if needed, an

instrument will be lowered into the open borehole to screen for the presence of UXO. All soil cuttings will be spread on the ground surface in the area of the borehole.

Each well location (20 total) will have either pre-boring for anomaly avoidance only or pre-boring for anomaly avoidance plus continuous split spoon collection completed. The pre-bore activities and overburden drilling are described below:

- ***Pre-Boring for Anomaly Avoidance Only***—This will be completed at 10 monitoring well locations (1 per well pair) and will be advanced to a minimum depth of 15 feet BLS or encounter with bedrock, whichever is shallowest. The anomaly avoidance process described above will be completed during the entire length of these pre-bores.
- ***Pre-Boring for Anomaly Avoidance Plus Continuous Split Spoon Collection***—This will be completed at the remaining 10 well locations (1 per well pair) and will be conducted as above with the addition of collecting 2-inch-diameter by 2-foot-long split spoons following the anomaly avoidance of each 2-foot interval. Split-spoon sample collection will be completed from the bottom of the hand-augured borehole to the total depth of the HSA borehole. If bedrock is not encountered at 15 feet BLS, then samples of unconsolidated material will be collected using a 2-inch-diameter split spoon sampler until bedrock is encountered.

Split spoon samples will be retrieved and provided to the rig geologist for visual characterization and will be recorded on the drill log form. Split spoon hammer blows per 6 inches of spoon advance will be counted and recorded by the rig geologist on the drilling log form. The retrieved soils will be evaluated for the presence of permeable materials and saturated conditions. If sufficiently permeable saturated materials are identified in the saturated unconsolidated deposits, the installation of a well with a screened interval in the permeable zone will be considered. A final determination for installing a well in permeable unconsolidated materials will be made based on discussion between the Army and SAIC's project hydrogeologist, project manager, and rig geologist.

2.2.1.3 Bedrock Drilling and Rock Coring

The conduit monitoring wells will be drilled and installed with screen intervals below top of bedrock and will require the use of a bedrock drilling method. Groundwater conduit locations (solution enhanced fractures and bedding features) within carbonate aquifers often present difficult and challenging drilling conditions. Well screens may be placed across highly fractured rock zones and/or encountered voids below the water table to intercept possible conduits or preferential groundwater flow paths.

In order to provide a stable borehole in these anticipated difficult conditions, the wells will be installed using PQ-series wire-line diamond drill coring techniques and a compatible casing advance system for advancing PWT-series outer casing or similar system. Using this drilling method and equipment, the PWT casing will be advanced simultaneously with the core barrel and rods. The simultaneous advance of the casing will "case" or isolate the borehole from the unstable portions of the formations. This will prohibit or reduce the occurrence of unstable materials collapsing or flowing into the borehole. The PQ coring system can cut and retrieve 3.35-inch (8.51-centimeter) rock cores. The outside diameter of the PWT casing is 5.5 inches (13.97 centimeters) and, therefore, results in a finished borehole of approximately 5.5 inches in diameter.

This drilling method was selected over air-rotary with a continuous casing advancement system to minimize the potential vibration and subsurface disturbance often associated with the larger air-rotary drilling rigs and methods. This was necessary for this project to reduce or eliminate potential disturbance of UXO either at the surface or blow grade.

Estimated well installation depths range from 50 to 120 feet (15.2 to 36.6 meters) and the top of bedrock is anticipated to be as shallow as 20 feet (6.1 meters) BLS, but could be at or near the ground

surface. The outer casing will be advanced simultaneously through the unconsolidated materials above the bedrock and continued into competent bedrock to prevent unconsolidated materials, weathered rock, and flowing or fluid materials from entering the borehole from the unconsolidated overburden and unstable zones within the bedrock during well installation activities. All rock cores will be placed in wooden core boxes in such a manner as to preserve their relative positions by depth. The rig geologist will label the boxes so that later determination of the depth of the rock core sequences and depth and height of voids can be completed. Intervals of lost core will be noted in the core sequence with wooden or Styrofoam™ blocks. Boxes will be marked on the cover (both inside and outside) and on the ends to provide project name, borehole number, cored interval, and box number, if there are multiple boxes. The rig geologist will construct a log from examination of the retrieved rock core and from the observation of the drill crew and drilling conditions. Following the screening and clearance by the HPT, the core boxes will be transported to a storage building as designated by the Army.

All cores collected will be documented (including photographing the core after it has been properly placed, the core surface cleaned and wetted, and labeled in the core boxes) and stored at JPG. Soil cuttings and drilling fluids from diamond coring, borehole advancement, and well construction activities will be managed in accordance with the procedures specified in Section 3.

2.2.1.4 Soil Sampling

No chemical or radiological soil sampling will be completed as part of the well installation task.

2.2.1.5 Equipment Condition and Cleaning

All drilling and support equipment used for monitoring well installation during performance of this scope will be in operable condition and free of leaks in the hydraulic, lubrication, fuel, and other fluid systems where fluid leakage would or could be detrimental to the project effort. All switches (including two functioning safety switches); gauges; and other electrical, mechanical, pneumatic, and hydraulic systems will be in safe and operable condition before arrival and during operation. The Drill Rig Operational Checklist included in Appendix A will be completed before commencement of drilling at each monitoring well pair location, typically once per week.

Prior to arrival, all drilling equipment will be cleaned with steam or pressurized hot water. After arrival, the drilling contractor will prepare a decontamination pad at a location approved by the Army. Before commencement of drilling activities, all drilling and well installation equipment will be cleaned with steam or pressurized hot water using an approved water source at the decontamination pad.

Following the completion of a borehole/well installation and prior to moving to the decontamination pad, the drill rig and associated down-hole equipment will be decontaminated by dry methods consisting of scraping and removing the loose soil and material clinging to the equipment. The HPT will survey the equipment and additional decontamination will be completed if the equipment is determined to be contaminated with DU. Additional decontamination, if warranted, may consist of a water and Alconox® wash with a water rinse. Between well and borehole locations, any drilling and well installation equipment contacting soil or groundwater will be decontaminated before it is used again at the next well location. All equipment will be surveyed by a HPT for radioactivity and will receive an unconditional release prior to allowing it to leave the site.

The temporary decontamination pad to be used for equipment cleaning will be located, to the greatest extent possible, in an area surficially cross-gradient or downgradient from the monitoring well borehole locations. Solid and liquid wastes generated from the decontamination process (IDW) will be managed in accordance with procedures specified in Section 3.

2.2.2 Materials

Generally, the riser and screen to be used for construction of conduit monitoring wells will be 2 inches (5.08 centimeters) in diameter. General details regarding the installation of the wells are presented in Section 2.2.5. Final well construction details will be determined after site-specific subsurface conditions are evaluated during drilling at each well location and reviewed by the rig geologist and the project hydrogeologist. Each well construction is anticipated to be slightly different based on the conditions observed at each borehole location in the field and will be designed such that the groundwater conduit will be screened so that monitoring for characterization of the DU Impact Area can be accomplished.

2.2.2.1 Casing/Screen/Centralizers/Grout Baskets

The casing, screen, and fitting materials will be composed of new, pre-cleaned, 2-inch (5.08 centimeters) diameter, schedule 40 PVC. Screen sections will be commercially fabricated and slotted with openings equal to 0.010 inches (0.0254 centimeters). The screens will be pre-packed or such that the filter pack will be installed in the field (i.e., U-Pack) prior to deployment down the borehole. The use of this type of screen, with the filter pack in place prior to deployment, ensures the proper placement of a continuous filter pack and aids in the proper placement of well screen and filter pack in areas where difficult drilling conditions exist as expected during this task. Screen and casing sections will be flush threaded.

A grout basket will be installed on the riser pipe for placing and supporting the bentonite seal and grout. The grout basket will be attached to the riser pipe approximately 2 to 3 feet above the top of the screen interval with stainless steel band clamps. The location of the grout basket can be adjusted to result in the installed depth being located within a relatively stable portion of the borehole above the well screen. By locating the grout basket in a stable portion of the borehole, it can perform properly by flexing outward to the borehole walls, holding the bentonite seal and grout.

Prior to placing the bentonite seal, the depth of the installed grout basket will be confirmed with a sounding tape. Clean silica well gravel will be placed down hole onto the grout basket and confirmed with a sounding tape that the grout basket is functioning properly and prohibiting materials to pass down the borehole into the open screened interval. Following confirmation that the grout basket is functioning properly, the bentonite seal will be placed by poring from the surface.

Well caps will be composed of new, pre-cleaned PVC. It is assumed that all wells will be completed with above-grade surface completions. The tops of the PVC riser pipes will be covered with expandable plugs.

The annulus between the screen assembly and the borehole will be small such that the use of centralizers will be necessary. The well pipe and screen will be installed by hanging into the borehole using the drill rig, which will aid in keeping the pipe plumb. In addition, the well screen may be placed in a void or unstable portion of the borehole and, in this situation, stable borehole sides for supporting the centralizers would not be present. The use of a grout basket also acts as a centralizer and will aid in the placement and alignment of the well riser and screen. If determined to be absolutely necessary, stainless steel well centralizers will be used for construction of the monitoring wells that are installed in open boreholes.

2.2.2.2 Filter Pack, Bentonite Seal, and Cement/Bentonite Grout

Final well construction materials selection and design will be completed following the review of additional information on the actual subsurface conditions observed during drilling. Based on the anticipated screen slot size of 0.010 inches, the granular filter pack material will consist of U.S. standard sieve size 40 × 60 (~ Morie No. 00) pack or equivalent. This filter pack size was selected based on the potential for

fine materials being present in the screened intervals. The granular filter pack will be clean, inert, siliceous, and composed of rounded grains.

Bentonite is anticipated to be used for one or more of the following purposes:

- Creation of an annular seal between the open screened interval and the upper grout seal during monitoring well installation
- Additive in grout mixture used for creation of upper grout seal during monitoring well construction (not to exceed 5 percent by weight)
- Additive in grout mixture used for abandonment of boreholes not converted into monitoring wells (not to exceed 5 percent by weight).

Bentonite material will consist of coated compressed powdered bentonite pellets or chips generally measuring ¼ or ⅜ inches (0.64 to 0.95 centimeters) in size and will be used for annular seal applications. Coated bentonite pellets and chips have a biodegradable coating that slows the hydration of the pellets to allow proper placement when the annulus between the borehole and well casing is small or when the bentonite has to drop through a large column of standing water. The coating keeps the bentonite from getting sticky by slowing the hydration. Powdered or fine granular bentonite will be used for grout additive applications.

Grout used will be composed of Type I or II Portland cement, no more than 4.7 pounds (not to exceed 5 percent) dry-weight bentonite per 94-pound (42.6 kilograms) sack of dry Portland cement, and a maximum of 6 to 7 gallons (22.7 to 26.5 liters) of approved water per sack of cement. The amount of water used to prepare grout mixtures will be minimized to the greatest extent possible.

2.2.2.3 Delivery, Storage, and Handling of Materials

All monitoring well construction materials will be supplied and delivered to the site by the subcontracted drilling company retained for the investigation. Upon delivery to the site, the Field Manager will inspect all of the materials to ensure that the required types of materials have been delivered and that the materials have not been damaged or contaminated during transport to the site. During the inspection, the Field Manager will collect and file any material certification documentation attached to or accompanying the materials. All material certification documentation will be transferred to the project file. All materials will be stored in a dry and secure location until used. It is assumed that the Army will provide a storage/staging area in a non-UXO area (or UXO-cleared area) for the well materials at JPG.

All well screens and well casings will be free of foreign matter (e.g., adhesive tape, labels, soil, and grease) and will be washed with approved water before use. However, if the materials have been packaged by the manufacturer and the packaging is intact up to the time of installation, no pre-washing will be conducted. Pipe nomenclature stamped or stenciled directly on the well screens and/or solid casings to be located below the bentonite seal will be removed by sanding, unless removable by washing with approved water washing. Washed screens will be stored in plastic sheeting until immediately before insertion into the borehole. All well screens and casings will be free of unsecured couplings, ruptures, and other physical breakage and/or defects.

All protective casings will be free of extraneous openings and devoid of any asphaltic, bituminous encrusting, and/or coating materials (with the exception of black paint or primer applied by the manufacturer).

2.2.3 Surface Completion

The well protection assembly will be composed of new iron/steel protective casing secured in place with a mortar collar and concrete. All protective casings will be equipped with locking covers and

constructed to minimize the possibility of water leakage. The surface completions will be surrounded by a minimum of three new iron/steel guard posts filled with concrete to help in location and avoidance.

2.2.4 Water Source

Water will be used for the following purposes:

- Preparation of grout mixtures used for monitoring well construction and borehole abandonment
- Preparation of concrete mixture for construction of monitoring well surface completion
- Use for lubricating and cooling drill tools and facilitating movement of soil and rock cuttings away from the cutting surface of the drill bit and out of the borehole
- Decontamination of drilling and sampling equipment.

Tap water will be used to support all drilling operations and transported to the sites in tanks.

In the event an approved water supply is already available and analytical documentation is available to document its suitability, this water source may be used without additional analysis.

The water source will be approved by the Army Project Manager before field activities commence. Field personnel will be responsible for transport and storage of the approved water in a manner to avoid the chemical contamination or degradation of the approved water once obtained.

2.2.5 Installation

A discussion of the anticipated installation process is presented below. Installation details will be documented on an as-built well construction diagram (Appendix A).

2.2.5.1 Screen and Well Casing Placement

All screens will be installed such that the bottom of each well is placed no more than 3 feet (0.91 meters) above the bottom of the drilled borehole, unless the portion of the borehole greater than 3 feet (0.91 meters) below the screen is properly abandoned (Section 2.2.6). The screen bottom will be securely fitted with a threaded PVC cap or plug. The cap/plug will be within 6 inches (15 centimeters) of the open portion of the screen. The standard length of the screen is anticipated to be 10 feet (3 meters). The riser used for the construction of above-grade well installations will be of sufficient length to allow for 2.5 feet (0.76 meters) of the riser to extend above the ground surface. The top of each installed well riser pipe will be level so that the difference in elevation between the highest and lowest points on the top of the well casing is less than or equal to 0.2 inches (0.5 centimeters).

2.2.5.2 Filter Pack Placement

The granular filter pack will be installed by the manufacturer in the case of a pre-pack screen or installed in the u-pack screen at the surface prior to deployment down the borehole. If using u-packs, the filter pack must be properly inserted into the well screen annulus and prior to closing the screen approved water must be used to wash through screen to settle and seat the filter pack. Following the successful filling of the u-pack and seating the filter pack, the unit may be closed with the factory provided cap.

In the event that sufficient permeable materials are discovered in the overburden and a well will be installed, conventional PVC well screen can be installed. If conventional well screen is used, the granular filter pack will be placed within the annular space around the monitoring well screen by slowly pouring in from the surface. The sand pack will be monitored using a sounding tape continually to ensure that the sand pack materials do not bridge and that the filter pack is placed without gaps or voids. After the sand pack is placed, a surge block will be placed inside the well and the filter pack will be surged to settle and

seat the filter pack. The filter pack levels will be checked following the surging and if settling has occurred, additional sand pack will be added. The filter pack will extend from the bottom of the borehole to 2 feet (0.61 meters) above the top of the screen. The final depth of the top of the filter pack will be measured directly with a sounding tape and recorded.

2.2.5.3 Bentonite Seal/Grout Basket

The grout basket will be attached to the riser pipe approximately 2 to 3 feet above the top of the screen interval with stainless steel band clamps. The location of the grout basket can be adjusted to result in the installed depth being located within a relatively stable portion of the borehole above the well screen. By locating the grout basket in a stable portion of the borehole, it can perform properly by flexing outward to the borehole walls, holding the bentonite seal and grout. Prior to placing the bentonite seal, the depth of the installed grout basket will be confirmed with a sounding tape and clean silica well gravel will be placed down hole onto the grout basket and confirmed with a sounding tape that the grout basket is functioning properly and prohibiting materials to pass by down the borehole into the open screened interval. Following confirmation that the grout basket is functioning properly, the bentonite seal will be placed.

The bentonite seal will be composed of commercially available coated pellets or chips. The bentonite seals will be from 2 feet (0.61 meters) thick as measured immediately after placement, without allowance for swelling. The bentonite materials will be placed in a manner to ensure that bridging does not occur. A weighted tape will be used to measure and monitor the placement of the bentonite seal. If the bentonite seal is above the depth to groundwater, approved water will be used to hydrate the pellets. The minimum hydration time for the coated bentonite pellets or chips will be 3 to 6 hours. During the hydration period if the seal is above the water table, approved water will be poured incrementally down the borehole to make sure that sufficient water is present to facilitate hydration, swelling, and sealing by the bentonite. Following the hydration period, the final depth to the top of the bentonite seal will be measured directly with a weighted tape and recorded to document proper hydration was allowed prior to grouting.

2.2.5.4 Centralizers

It is not anticipated that centralizers will be required during this well installation. If determined to be absolutely necessary, stainless steel well centralizers will be used for construction of the monitoring wells that are installed in open boreholes. They would be attached to well casings with stainless steel fasteners or strapping. The placement of centralizers would be determined in the field at the time of monitoring well installation based on total depth of well, borehole conditions, and well construction specifics. Centralizers would not be attached to the screen or any part of the well casings exposed to filter pack materials or bentonite seal. Centralizers, if used, would be oriented as best as possible to allow for unrestricted passage of tremie pipes used for placement of well materials.

2.2.5.5 Cement/Bentonite Grout Placement

All grout materials will be combined in an above-ground, rigid container or mixer and mechanically blended onsite to produce a thick, lump-free mixture throughout the mixing vessel. The grout will be placed using a tremie pipe of rigid construction for vertical control of pipe placement. The tremie pipe will be equipped with side discharge holes rather than an open end to help maintain the integrity of the underlying material onto which the grout is placed. The grout will be placed from the bottom of the interval being grouted and pumped upwards, displacing the water present in the annulus.

Before exposing any portion of the borehole above the seal by removal of any surface casing, the annulus between the surface casing and the well casing will be filled with sufficient grout to allow for planned surface casing removal. If all of the surface casing is to be removed in one operation, the grout

will be pumped through the grout pipe until undiluted grout flows from the annulus at the ground surface. During the surface casing removal, the grout pipe will be periodically re-inserted as needed for additional grouting.

If the surface casing is to be removed incrementally with intermittent grout addition, the grout will be pumped through the grout pipe until it reaches a level that will let at least 10 feet (3 meters) of grout to remain in the annulus after removing the selected length of surface casing. Using this method, the grout pipe will be re-inserted only to the base of the casing yet to be removed before repeating the process. After grouting has been completed to within approximately 10 feet (3 meters) of the ground surface, the remaining surface casing can be removed from the borehole and the remaining annulus can be grouted to 5 feet (1.5 meters) BLS. Final sealing of the annulus will be completed by placing a mortar collar from the top of the settled grout to the ground surface during protective surface casing placement.

Upon initiation of the grouting operation, the process will be conducted in one continuous operation; the process will be continued uninterrupted until all of the surface casing, if present, has been removed or pulled back to its final location; and all annular spaces are grouted to required levels, as noted. After 12 hours, the well will be checked for grout settlement and more grout will be added at that time to fill any depressions or settling. This process will be repeated until firm grout remains within 5 feet (1.5 meters) of the ground surface. A mortar collar will be placed from the top of the final grout surface to the ground surface during placement of the protective surface casing/cover. Incremental quantities of grout will be recorded on the well construction diagram.

2.2.6 Borehole Abandonment

If adequate permeability is not encountered, abandonment of the borehole will be considered. Following a discussion between the Army and SAIC's project hydrogeologist, project manager, and rig geologist resulting in a determination that the borehole will be abandoned, proper abandonment will be completed in accordance with the IAC (Appendix C). Boreholes installed during the pre-bore activities that are not completed or converted to wells due to the presence of unavoidable UXO also will be properly abandoned.

Abandonment of pre-bore boreholes, when required, will be completed by sealing with either grout or bentonite pellets or chips. If bentonite is used, it will be carefully poured from the surface and the placement will be monitored with a sounding tape to make sure that bridging does not occur. Following the placement of the bentonite to within 2 feet of the surface, the bentonite will be hydrated with water and the top 2 feet will be backfilled with surrounding soil. If grout is used for abandonment, it will be placed following the procedure described in the following paragraphs.

Boreholes with temporary casing will be abandoned with grout. All grout materials will be combined in an above-ground, rigid container or mixer and mechanically blended onsite to produce a thick, lump-free mixture throughout the mixing vessel. The grout will be placed using a tremie pipe of rigid construction for vertical control of pipe placement. The grout will be placed from the bottom of the interval being grouted and pumped upwards, displacing the water in the annulus.

Before exposing any portion of the borehole, the casing will be filled with sufficient grout to allow for planned surface casing removal. If all of the surface casing is to be removed in one operation, the grout will be pumped through the grout pipe until undiluted grout flows from the casing at the ground surface. During the surface casing removal, the grout pipe will be periodically re-inserted as needed for additional grouting.

If the surface casing is to be removed incrementally with intermittent grout addition, the grout will be pumped through the grout pipe until it reaches a level that will let at least 10 feet (3 meters) of grout to remain in the casing after removing the selected length of surface casing. Using this method, the grout

pipe will be re-inserted only to the base of the casing yet to be removed before repeating the process. After grouting has been completed to within approximately 10 feet (3 meters) of the ground surface, the remaining surface casing can be removed from the borehole and the remaining borehole can be grouted to within 2 feet of the ground surface.

Upon initiation of the grouting operation, the process will be conducted in one continuous operation; the process will be continued uninterrupted until all of the surface casing, if present, has been removed. After 12 hours, the borehole will be checked for grout settlement and more grout will be added at that time to fill any depressions or settling. This process will be repeated until firm grout remains within 2 feet of the ground surface. Following final grout placement, the remaining interval will be backfilled with the surrounding soil. Incremental quantities of grout will be recorded on the well construction diagram. A photograph will be taken of the final grout at the surface after all grout additions and settling have occurred.

2.2.7 Protective Cover and Concrete Pad Placement

Protective steel/iron casing will be installed around the uppermost portion of each monitoring well. The exterior of the protective casing will be pre-primed prior to delivery to the site. The protective casing will be set approximately 5 feet (1.5 meters) below grade and will extend approximately 3 feet (0.91 meters) above ground surface. All protective casings will be installed so that the distance between the top of the protective casing and the top of the well casing is between 2.5 and 6 inches (6 and 15 centimeters).

A mortar collar will be poured within the annulus between the protective casing and the well casing from the top of the grout surface to approximately 6 inches (15 centimeters) above the ground surface. After placement of the mortar collar, the remaining annulus formed between the outside of the protective casing and borehole or permanent casing, if present, will be filled with concrete to the ground surface and extend onto the apron around the well head to form a square-cornered concrete pad measuring approximately 30 by 30 inches (76 by 76 centimeters). The thickness of the pad will be no less than 4 inches (10 centimeters). Following the placement and curing of the pad, a drainage port approximately ¼ inch (0.64 centimeters) in diameter will be drilled into the protective casing immediately above the mortar collar. Silica sand or well gravel will be placed in the annulus between the riser pipe and the protector pipe above the mortar collar to approximately 6 inches below the top of the riser pipe.

Upon completion of the protective cover placement, a minimum of three and preferably four steel guard posts will be radially located 4 feet (1.2 meters) around each monitoring well. The guard post length will be 6 feet (1.8 meters), approximately 2 feet (0.61 meters) of which will be set in concrete below ground level and completely filled with concrete. Prior to installation, the locations of each guard post will be screened for the presence of UXO. Under the direct supervision of the UXO supervisor, the guard post hole will be advanced to 2 feet BLS. The guard post hole will be routinely screened by the UXO supervisor for the presence of UXO during the digging of the hole. All of the guard posts, as well as the protective casings including the hinges and caps/lids, will be painted orange with a paint brush and will be completely dry before sampling the well.

2.2.8 Well Identification

For each well installed as part of the investigation, the well designation number will be stenciled with white paint on the outside of the protective casing (after application and drying of the orange paint). Each pair will have a root identifier followed by an unconsolidated (O, overburden materials), intermediate (I, shallow bedrock), or deep (D, deeper bedrock) identifier. The well pairs will be identified numerically in sequential order. For example, the first intermediate/deep well pair will be identified as follows: JPG-DU-01I and JPG-DU-01D.

2.2.9 Well Development

The development of the wells will be initiated no sooner than 48 hours after nor longer than 7 days beyond the mortar collar placement or the final grouting of the wells. Development of all wells will be completed using the same development method selected. Well development details will be recorded on a well development form (Appendix A).

2.2.9.1 Pump, Surge Block, and Airlift Usage

Following the installation of the wells and acquisition of preliminary data on well yield and static water levels the development method will be selected. The selected development method will be used for all of the wells installed. Development of the wells will be accomplished using one of the following nondedicated combinations of devices: a mechanical surge block and pump or a mechanical surge block and j-tube air lift system. A j-tube air lift system uses a separate air line and eductor (water-to-surface) pipe to "air pump" water to the surface. The water is moved to the surface by forcing air with a compressor down the air line and back up into the eductor pipe. The air creates a venturi effect and draws water into the bottom of the eductor pipe and up to the surface. If air lift is used, great care will be exercised to use only the air pressure and volume required to move the water up through airlift assembly and tubing and not blow out into the well. The air discharge from the air compressor will be fitted with an oil filter to remove compressor oil from the air stream prior to injecting into the development tool.

During development, the surge block will be moved up and down the entire screened interval to force water in and out through the screen openings and through the filter pack to agitate and mobilize the particulates around the well screen during the removal of water from the well. By surging the well and therefore moving water in both directions through the filter pack, and not just in one direction as with pumping alone, proper development of the filter pack can be facilitated. Development will continue by alternating between the surge block and pumping with either a pump or air lift. Pumping periods will remove the fine particles that have been mobilized and will move them into the well bore, where they can be pumped up to the surface and out of the well. All of the groundwater pumped to the surface during development activities will be directed out of the work area and surface discharged, as discussed in Section 3.

2.2.9.2 Development Criteria

Development of each well will continue until each of the following criteria is achieved:

- A turbidity with nephelometric turbidity unit (NTU) readings that have stabilized over three successive well volumes, or the water is clear to the unaided eye
- The sediment thickness remaining in the well is less than 1.2 inches (0.03 meters)
- A minimum water removal of five times the standing water volume in the well (to include the well screen and casing plus saturated annulus, assuming 30 percent annular porosity) has been achieved
- Indicator parameters (e.g., pH, specific conductivity, and temperature) have stabilized to within 10 percent on three consecutive readings.

During the course of the development, the Army Project Manager and SAIC's project hydrogeologist will be contacted for guidance if well recharge is so slow that the required volume of water cannot be removed during 48 consecutive hours of development, if persistent water discoloration/turbidity is observed after completion of the required volume removal, or if excessive sediment remains after completion of the required volume removal.

2.2.10 Well Survey

A topographic survey of the horizontal and vertical locations of all groundwater monitoring wells will be conducted after completion of the well installations. The topographic survey will be conducted by an individual licensed in an appropriate classification within the State of Indiana for the specific work antiçipated to be conducted. This license will be current and active throughout the term of performance during the project. The horizontal coordinates of each well will be surveyed to an accuracy of at least 1 foot and will be referenced to the Indiana State Plane Coordinate System (ISPCS) NAD83 feet. Locations of the monitoring wells will be measured from the rim of the well casing (not the protective casing). The elevation of the top of each PVC well casing, protective steel outer casing, and the concrete pad will be surveyed to an accuracy of ±0.01 foot and will be referenced to the National Geodetic Vertical Datum (NGVD) of 1988.

2.2.11 Alignment Testing

Alignment tests will be conducted on each monitoring well to ensure that deformation and/or bending of the PVC well casing and screen is minimal. Testing will be conducted using a pump or bailer no less than 1.5 inches in diameter for the 2-inch-diameter wells that will be installed. A nylon rope will be attached to the device and it will be lowered to the bottom of the well and retrieved. The alignment test will be considered successful if the device can be lowered and retrieved without binding within the well. If the well fails the described test, the well will be considered for abandonment and replacement.

3. INVESTIGATION-DERIVED WASTES

Following completion of field work, in the unlikely event that any radioactive waste is generated, it shall be turned over to the U.S. Department of Army (DA) for secure storage and proper disposal. No radioactive waste is anticipated to be generated under this work scope.

IDW generated during the monitoring well installation task will consist of decontamination liquids; paper, cardboard, and plastic bagging and containers from well materials; decontamination pad materials (e.g., plastic sheeting, straw bales, and lumber); Tyvek® coveralls; disposable tubing; and disposable gloves. Soils, drilling fluids (water), sediment from circulating drilling fluids, well development fluids (groundwater), and decontamination liquids (if used) generated from equipment decontamination will be disposed of on the ground in the general area from which the materials originated. Any other wastes, if determined to be radioactive, will be turned over to the Army and will be surveyed, packaged, stored, and transported in accordance with applicable regulations, and disposed of as normal solid waste if determined not to be radioactive

Any materials such as disposable gloves, Tyvek®, paper towels, paper and plastic bagging, containers from well materials, plastic sheeting, disposable tubing, and lumber will be surveyed or placed into plastic garbage bags and later surveyed by the HPT to determine if they are radioactive, and placed into roll-off containers supplied by the drilling contractor for disposal as normal solid waste if determined to not be radioactive. If IDW disposal is determined to be necessary, the Army might handle it themselves or a change order may be requested to include the services of a qualified and experienced licensed radioactive waste broker (e.g., Duratech, Race). Radioactive wastes, if generated, will be stored temporarily in a secured location, as directed by the Army and will remain the property of the Army.

THIS PAGE WAS INTENTIONALLY LEFT BLANK

4. DATA USE

The following sections describe the logs, diagrams, and forms that will be completed during well construction activities (Section 4.1) and a report that will describe the completion of the well construction activities (Section 4.2).

4.1 LOGS, DIAGRAMS, AND FORMS

Each borehole log generated during the conduit well installation task will fully describe the subsurface materials encountered and the procedures used to gain that description. All borehole data will be generated in the field by the rig geologist on USACE Forms MRK55 and MRK55-2 (Appendix A) generally in accordance with the USACE borehole logging guidance (Appendix B). A scale of 1-inch on the log equaling 1 foot of borehole will be used during borehole log preparation. Original borehole logs and well construction diagrams will be of sufficient legibility and contrast so as to provide comparable quality in reproduction and will be recorded directly in the field without transcribing from a field book or other document.

4.1.1 Borehole Logs

All borehole logs from the conduit well installation task will routinely include the following information:

- Unique borehole/monitoring well number and location denoted.
- Depths or heights recorded in feet and decimal fractions thereof (tenths of feet).
- Field estimates of soil classification (Unified Soil Classification System [USCS]) prepared in the field at the time of the sampling by the rig geologist.
- Full description, to the greatest extent practical, of soil and rock material encountered including the parameters noted in Table 4-1.
- Visual numeric estimates of secondary soil constituents and quantitative definitions of description terms (e.g., trace, some, and several)
- Description of disturbed samples (if used to supplement subsurface description) in terms of the appropriate soil/rock parameter, to the extent practical. At a minimum, classification along with a description of drill action for corresponding depth will be recorded. Notations will be made on the log that these descriptions are based on observations of disturbed material rather than from intact samples.
- Description of drilling equipment, including such information as auger size (inner and outer diameters), bit types, core barrel length, rod lengths, rig manufacturer, and model.
- Sequence of drilling activities and use of tooling.
- Dates and times for the start and completion of the borehole along with notation by depth for drill crew shifts and individual days.
- The depth of first-encountered free water along with the method of determination and any subsequent distinct water level(s) and/or water-bearing zones encountered thereafter.
- Depths of intervals where drilling fluid loss occurred including an estimated volume of lost drilling fluids.
- Core drilling specific information for each drill run including: start and end times, lengths of run, recovery, loss and/or gain, rock quality determination (RQD), and "corrected" depth (measured depth of core hole after core barrel retrieval).
- Total depth of drilling.

- Water level approximately 24 hours following completion of installation with date and time of measurement.
- Definition of any special abbreviations used at the first occurrence of their usage.

Table 4-1. Soil and Rock Parameters to Be Recorded on Borehole Logs Jefferson Proving Ground, Madison, Indiana

Soil Parameters	Rock Parameters
USCS classification	Rock type
Depositional environment and formation, if known	Formation
ASTM D 2488 group symbol	Modifier denoting variety
Color (using Munsell Soil or GSA Rock Color Chart). Give both narrative and numerical description and note which chart was used.	Bedding/banding characteristics
Plasticity	Color (same as for soil)
Consistency (cohesive soil; very soft, soft, medium stiff, stiff, very stiff, hard)	Hardness
Density (noncohesive soil; loose, medium dense, dense, very dense)	Degree of cementation
Moisture content in relative terms: Dry-crumbly Damp-between crumbly and plastic limit Moist-between plastic limit and liquid limit Wet-greater than liquid limit Saturated-runny, all voids filled with water	Texture
Structure and orientation	Structure and orientation
Grain angularity	Degree of weathering
	Solution or void conditions
	Primary and secondary permeability, including estimates and rationale
	Lost core interval and reason for loss

4.1.2 Well Construction Diagrams

Each monitoring well installed during this well installation task will be depicted in an as-built well construction diagram (Appendix A). Each diagram will be attached to the original borehole log for that installation and will graphically denote, by depth from the ground surface, the following information:

- Location of the borehole bottom
- Borehole diameter
- Location of the well screen
- Location of granular filter pack
- Location of bentonite seal
- Location of grout
- Location of centralizers, if required
- Height of riser (stickup), without cap/plug, above the ground surface
- Height of the protective casing, without cap/cover, above the ground surface
- Depth of protective casing base below the ground surface.

Additional information to be described on each as-built well construction diagram will include the following:

- Actual quantity and composition of the grout, bentonite seal, and granular filter pack used for construction of the monitoring well
- The screen slot size in inches, slot configuration, nominal inside diameter, schedule/thickness, composition, and manufacturer
- Type of material located between the bottom of the borehole and the bottom of the screen
- The nominal inside diameter, schedule/thickness, composition, and manufacturer of the well casing(s)
- The joint design and composition
- The design and composition of centralizers, if required
- The composition and nominal inside diameter of protective casing
- Dates and times for the start and completion of the monitoring well installation
- Definition of any special abbreviations used at the first occurrence of their usage.

4.1.3 Well Development Form

For each monitoring well installed during this well installation task, development details will be recorded on a well development form (Appendix A) and will include the following information:

- Project name and location
- Well designation and location
- Date(s) and time(s) of monitoring well development
- Static water level from the top of well casing before and after completion of development
- Field readings of pH, conductivity, turbidity, and temperature measured during development
- Water quality instrument manufacturer, model and serial or identification number
- Any remarks, such as physical character of removed water (e.g., clarity, color, particulates, and odor)
- Type and size of pumping equipment used during development
- Description of surging equipment and technique used during development
- Estimated purge rate and recharge rate into the well at the time of development
- Quantity of water removed from the well during development operation and time for removal (present as both incremental and total values).

4.2 MONITORING WELL DRILLING, INSTALLATION, CONSTRUCTION, AND DEVELOPMENT REPORT

A Monitoring Well Installation Report will be prepared to document the details of the monitoring well drilling installation, construction, and development. Following the installation of the proposed well pairs, survey of well coordinates and elevations, and collection of initial groundwater stage data, an evaluation will be completed. This evaluation will assess the newly installed well pairs and the existing ERM wells and range study wells. The evaluation will determine which, if any, of the existing wells are appropriately constructed and located for inclusion in ongoing characterization activities. In addition to determining if appropriate to be included, the types of uses (e.g., chemistry sampling, stage gauging) of

the wells also will be evaluated. Following this evaluation, recommendations for any necessary rehabilitation or redevelopment also will be provided. Initial groundwater stage data will provide preliminary groundwater flow direction data that will assist in the evaluation, selection, and frequency of surface water samples and locations. Included in this evaluation will be the selection of the wells for installation of recorders for groundwater stage data collection.

The Indiana licensed well driller will prepare and submit well completion reports as required by the IAC. The report will include detailed description of all field activities and protocols, copies of daily activity logs, detailed description of any special problems encountered during drilling or well construction and their resolution, well boring and construction logs, tabulation of well construction data, well development forms, and copies of the Indiana licensed well driller well completion reports. Copies of the applicable forms are included in Appendix A.

5. RADIOLOGICAL RESPONSIBILITY AND LICENSING

The possession of radioactive materials at JPG is authorized and governed under a radioactive materials license granted by the Nuclear Regulatory Commission (NRC) to the Army. The license number is SUB-1435. The current amendment is No. 13, dated April 26, 2006. The license authorizes the possession of up to 80,000 kilograms (approximately 177,000 pounds) of DU metal, alloy, and/or other forms. The material must remain onsite, within the restricted area known as the "Depleted Uranium Impact Area."

The Army has requested that SAIC be responsible for the work that is described in this FSP Addendum, and obtain and utilize a license from NRC that authorizes the contractor to provide radiological services for the Army. SAIC has obtained and will utilize such a license.

The SAIC St. Louis office is authorized to provide certain radiological services to clients under a radioactive materials license granted by NRC to SAIC. The license number is 24-32591-01. License condition number 14 requires that SAIC enter into a written agreement with the Army so that roles, responsibilities, and lines of authority for work at the site are clearly defined. This written agreement will be issued in letter form and must be signed by authorized persons from both SAIC and the Army prior to initiating work under this FSP Addendum. Once the agreement is signed, Figure 5-1 will be used to document the true date and time that responsibilities are transferred between the Army and SAIC.

Section 1 – Acceptance by SAIC Under NRC License No. 24-32591-01

Form ID No. (MM-DD-YYYY-XX):	
Task Description and Working location (be very specific):	
Governing Work Document(s) (e.g., Field Sampling Plan, HASP Addenda):	
Client Contacted (print name):	Method of Notification:
☐ Check to confirm that the client has agreed to remit the working area(s) to SAIC	
SAIC Approval to Accept	
SAIC Name (print):	Signature:
Date Accepted:	Time Accepted:
Follow-on Client Approval to Remit	
Client Name (print):	Signature:

Section 2 – Remittance by SAIC to the Army Under NRC License No. SUB-1435

Client Contacted (print name):	Method of Notification:
☐ Check to confirm that the client has agreed to accept the working area(s) from SAIC	
SAIC Approval to Remit	
SAIC Name (print):	Signature:
Date Remitted:	Time Remitted:
Follow-on Client Approval to Accept	
Client Name (print):	Signature:

Figure 5-1. Acceptance and Remittance of Radiological Responsibility at JPG

6. REFERENCES

DOD (U.S. Department of Defense). 1997. DOD Contractor's Safety Manual for Ammunition and Explosives. DOD 4145.26M. Under Secretary of Defense for Acquisition and Technology. September 16.

SAIC (Science Applications International Corporation). 2005a. Field Sampling Plan, Site Characterization of the Depleted Uranium Impact Area. Final. May.

SAIC. 2005b. Health and Safety Plan, Site Characterization of the Depleted Uranium Impact Area. Final. May.

SAIC. 2005c. Quality Control Plan, Site Characterization of the Depleted Uranium Impact Area. Final May.

SAIC. 2007. Well Location Selection Report, Site Characterization. January

U.S. Army. 1999. Ordnance and Explosives Response, Engineer Regulation (ER) 1110-1-8153. Department of the Army, U.S. Army Corps of Engineers, Washington, DC 20314-1000. May 14.

U.S. Army. 2000. Ordnance and Explosive Response. Engineer Pamphlet 1110-1-18. U.S. Army Corps of Engineers, Washington, DC 20314-1000. April 24.

U.S. Army. 2004. Basic Safety Concepts and Considerations from Munitions and Explosives of Concern (MEC). Response Action Operations. Engineer Pamphlet 385-1-95a. U.S. Army Corps of Engineers, Washington, DC 20314-1000. August 27.

THIS PAGE WAS INTENTIONALLY LEFT BLANK

APPENDIX A

FIELD FORMS

THIS PAGE WAS INTENTIONALLY LEFT BLANK

DRILL RIG OPERATIONAL CHECKLIST

Site Name:_____

Rig
Model: _____ Manufacturer:_____

Serial Number: _____ Rig Owner: _____

Inspection Performed
by: _____
(Driller's Signature) (Date)

Checklist Reviewed and
Emergency Shutdown Observed
by: _____
(Signature) (Date)

Place an X in each appropriate ( )

1.0 GENERAL

1.1 Check all safety devices which are part of drill rig and which can be verified (see note).
Is (are all) device(s) intact and operating as designed?

Emergency Interrupt System

A.	Kill Switch 1	Yes ( ) No ( ) NA ( )
B.	Kill Switch 2	Yes ( ) No ( ) NA ( )
C.	Kill Switch 3	Yes ( ) No ( ) NA ( )
D.	Kill Switch 4	Yes ( ) No ( ) NA ( )
E.	Kill Switch 5	Yes ( ) No ( ) NA ( )
F.	Other _____	Yes ( ) No ( ) NA ( )
G.	Other _____	Yes ( ) No ( ) NA ( )
H.	Other _____	Yes ( ) No ( ) NA ( )

Note: All safety devices (not otherwise listed in this checklist) should be identified for each drill rig at the beginning of each project and subsequently checked at each inspection. Testing of all safety devices must be observed by health and safety personnel. List only safety devices which can be checked without disassembly or without rendering the device ineffective. This checklist does not cover United States Department of Transportation requirements.

1.2	Is the proper type and capacity of fire extinguisher(s) present, properly charged, and inspected?	Yes ( ) No ( ) NA ( )
1.3	Is rig properly grounded?	Yes ( ) No ( ) NA ( )
1.4	Are rig and mast a safe distance from electrical lines?	Yes ( ) No ( ) NA ( )
1.5	Can mast be raised without encountering overhead obstructions?	Yes ( ) No ( ) NA ( )

1.6 Have spill prevention materials been placed under rig (i.e., plastic sheeting)? Yes ( ) No ( ) NA ( )

1.7 Is a spill kit present? Yes ( ) No ( ) NA ( )

1.8 Is the safe operating zone/exclusion zone posted (minimum radius at least equal to height of raised drill mast)? Yes ( ) No ( ) NA ( )

1.9 Do all modifications made to the drill rig permit it to operate in a safe manner and allow the drill to operate within the manufacturer's specifications? Yes ( ) No ( ) NA ( )

1.10 Are moving parts (excluding cathead and other moving parts normally used during operations) properly guarded? Yes ( ) No ( ) NA ( )

1.11 Are all exhaust pipes, which would come in contact with personnel during normal operation properly guarded? Yes ( ) No ( ) NA ( )

1.12 Are tank(s) and lines free of leakage? Yes ( ) No ( ) NA ( )

1.13 Are all normal or manufacturer-recommended maintenance activities or schedules performed at the required frequency? Yes ( ) No ( ) NA ( )

1.14 Are walking and standing surfaces, steps, rungs, etc., free of excess grease, oil, or mud which could create a hazard? Yes ( ) No ( ) NA ( )

2.0 CONTROL MECHANISMS

Are all control mechanisms and gauges on the drill rig functional and free of oil, grease, and ice (checked while running)? Yes ( ) No ( ) NA ( )

3.0 HYDRAULICS AND PNEUMATICS

Note: The mast should be lowered during the completion of this section to allow inspection of portions of the lifting mechanisms normally out of reach during operation.

3.1 Do all hydraulic reservoirs exhibit proper fluid levels? Yes ( ) No ( ) NA ( )

3.2 Are hydraulic and/or pneumatic systems in good condition and functioning correctly (checked while running)? Yes ( ) No ( ) NA ( )

4.0 LIFTING MECHANISMS

Note: The mast should be lowered during the completion of this section to allow inspection of portions of the lifting mechanisms normally out of reach during operation.

4.1 Have all wires, ropes, cables, and lines that are kinked, worn, corroded, cracked, bent, crushed, frayed, stretched, birdcaged, or otherwise damaged been replaced and the defective equipment removed from the site? Yes ( ) No ( ) NA ( )

4.2 Have all wires, ropes, cables, and lines been wrapped around winch drums without excessive pinching or binding? Yes ( ) No ( ) NA ( )

4.3 Are all pulleys undamaged and functional? Yes ( ) No ( ) NA ( )

4.4 Are all clips, clamps, clevises, hooks, and other hardware used to rig wires, ropes, cables, or lines undamaged and attached properly? Yes ( ) No ( ) NA ( )

4.5 Do all eyes formed in wires, ropes, cables, or lines attached to the rig use a thimble to retain the shape of the eye? Yes ( ) No ( ) NA ( )

4.6 Do all hooks having functioning safety gates/latches? Yes ( ) No ( ) NA ( )

5.0 NONCONFORMING ITEMS

5.1 When did the last operation checklist inspection take place for this drill rig at this site?

Date: _____

5.2 Have any nonconforming items been carried over from the last inspection? List any such items and dates or original nonconformance.

A. _____

Date: _____

B. _____

Date: _____

C. _____

Date: _____

D. _____

Date: _____

Any nonconforming items must be documented in the following remarks section and reported to the field operations manager for the project prior to operating the drill ring. Reference all remarks to the item numbers noted above.

Remarks:

_____

_____

_____

_____

HTW DRILLING LOG

HOLE NO.	
1 COMPANY NAME	2. DRILLING SUBCONTRACTOR
SHEET 1 OF SHEETS	
3. PROJECT	4. LOCATION
5 NAME OF DRILLER	6. MANUFACTURER'S DESIGNATION OF DRILL
7 SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	8. HOLE LOCATION
	9. SURFACE ELEVATION
	10. DATE STARTED / 11. DATE COMPLETED
12 OVERBURDEN THICKNESS	15. DEPTH GROUNDWATER ENCOUNTERED
13 DEPTH DRILLED INTO ROCK	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED
14 TOTAL DEPTH OF HOLE	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)

18 GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. f	BLOW COUNTS g	REMARKS h

HTW DRILLING LOG (CONT.)

HOLE NO.

PROJECT

INSPECTOR

SHEET
OF SHEETS

ELEV. a	DEPTH. b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	ANALYTICAL SAMPLE NO. I	BLOW COUNTS g	REMARKS h

Science Applications International Corporation
An Employee-Owned Company

WELL DEVELOPMENT LOG

Project Name: _____ Well Identification: _____
Project Number: _____ Project Location: _____
Developed by: _____ & _____ Date: _____

DEVELOPMENT INFORMATION:

Time	Temp. Celsius	pH	Cond. mS/cm	Turb. NTU	D.O. mg/l	Eh mv	Sal	Purged Quantity	D.T.W.	Comments

DEVELOPMENT INFORMATION:

Time/Date Started: _____ | _____ Development Method: _____
Time Ended: _____
Purge Rate(s): _____ (gpm)
Purged Volume: _____ (gal.)
Water Quality Instrument: _____
Water Containerized/Amount? _____

ADDITIONAL INFORMATION: (i.e. weather conditions, problems encountered, maintenance required, unusual color/odor, etc.) _____

APPENDIX B

USACE BOREHOLE LOGGING GUIDANCE

THIS PAGE WAS INTENTIONALLY LEFT BLANK

Chapter 4
Borehole Logging

4-1. General

Each boring log should fully describe the subsurface environment and the procedures used to gain that description. Guidance on field logging of subsurface explorations of soil and rock may be found in ASTM Standard Guide D 5434.

4-2. Format

All borings should be recorded in the field on Engineer (ENG) Form 1836 and 1836-A, per EM 1110-1-1804 (Figure 4-1) or on ENG Form 5056-R and 5056A-R, developed for HTRW work (see Figure 4-2). This guidance applies to in-house and contracted activities. Suggested data for recording are discussed throughout this manual. Because of the large quantity of information routinely required on logs at HTRW sites, a scale of 25 mm (1 in.) on the log equaling 300 mm (1 ft) of boring is usually adequate.

4-3. Submittal

Each original boring log should be submitted directly from the field to the FA after each boring is completed. In those cases where a monitoring well or other instrument is to be inserted into the boring, both the log for that boring and the installation diagram may be submitted together.

4-4. Original Logs and Diagrams

Only the "original" boring log (and diagram) should be submitted from the field to the FA. Carbon, typed, or reproduced copies are not considered "original." The original should be of sufficient legibility and contrast to provide comparable quality in reproduction.

4-5. Time of Recording

Logs should be recorded directly in the field without transcribing from a field book or other document. This technique lessens the chance for errors of manual copying and allows the completed document to be field-reviewed closer to the time of drilling.

4-6. Routine Entries

In addition to the data desired by the FDO and uniquely required by the drilling plan, the information should include those items listed in ASTM Standard Guide D 5434, except items under section 6.1.4 in D 5434. The other exceptions would be weather conditions, and certain items concerning sample handling procedures in sections 6.1.6 and 6.1.7 in D 5434. Sample handling procedures are required to be entered in the field logbook that is described in EM 200-1-3. The following information should also be routinely entered on the boring log.

a. Each boring and well (active and abandoned) should be uniquely numbered and located on a sketch map as part of the log.

b. Depths/heights should be recorded in meters (feet) and decimal fractions thereof (millimeters or tenths of feet). English units are acceptable if typically used by the site geologist.

c. Field estimates of soil classifications shall be in accordance with ASTM Standard Practice D 2488 and shall be prepared in the field at the time of sampling by the geologist. Guidance on soil and rock classification may also be found in EM 1110-1-1906, Spigolon 1993, Murphy 1985 and U.S. Army FM 5-410.

d. Each soil sample taken should be fully described on the log. The descriptions of intact samples should include the parameters shown in Table 4-1.

e. In the field, visual numeric estimates should be made of secondary soil constituents; e.g., "silty sand with 20 percent fines" or "sandy gravel with 40 percent sand." If such terms as "trace," "some," "several," etc., are used, their quantitative meaning should be defined on each log.

f. When used to supplement other sampling techniques, disturbed samples (e.g., wash samples, cuttings, and auger flight samples) should be described in terms of the appropriate soil/rock parameters to the extent practical. "Classification" should be minimally described for these samples along with a description of drill action and water losses/gains for the corresponding depth. Notations should be made on the log that these descriptions are based on observations of disturbed material rather than intact samples.

g. Rock core should be fully described on the boring log. Typical rock core parameters are shown in Table 4-2.

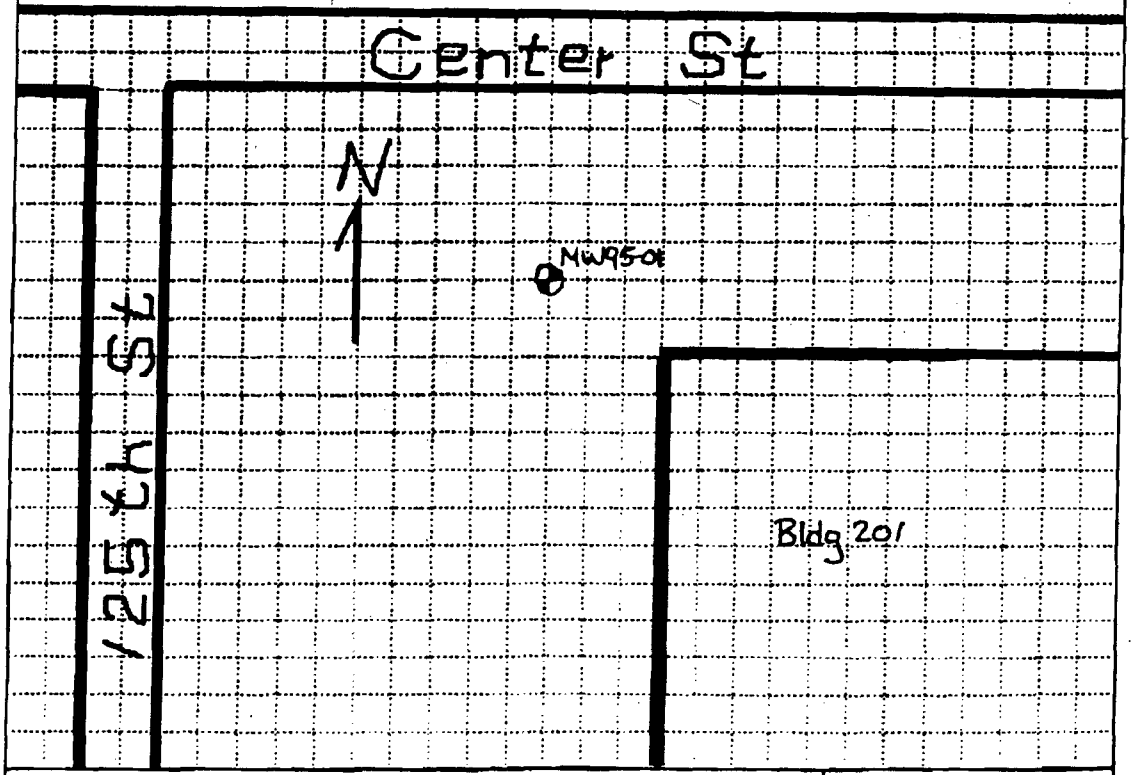
h. For rock core, a scaled graphic sketch of the core should be provided on or with the log, denoting by depth, location, orientation, and nature (natural or coring-induced) of all core breaks. Also mark the breaks purposely made to fit the core into the core boxes. If fractures are too numerous to be individually shown, their location may be drawn as a zone and described on the log. Also note, by

EM
1 N

HTRW DRILLING LOG

DISTRICT	OMAHA
HOLE NUMBER	MW95-01
1. COMPANY NAME	CONTRACTING FIRM, INC.
2. DRILL SUBCONTRACTOR	SUBCONTRACT DRILLERS, INC
SHEET / SHEETS	1 of 3
3. PROJECT	BIG SUPERFUND SITE
4. LOCATION	Site A
5. NAME OF DRILLER	JOE SUPER DRILLER
6. MANUFACTURER'S DESIGNATION OF DRILL	CME-75 Milwaukee Heavy Duty Drill Rig
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	CME-75, using 4 1/4" hollow stem augers, 3" O.D. Stainless Steel split-spoons (chemical and geotech), bullet bit (outer) drag bit (inner)
8. HOLE LOCATION	See Map Below
9. SURFACE ELEVATION	Not Yet Available
10. DATE STARTED	8-6-95
11. DATE COMPLETED	8-7-95
12. OVERBURDEN THICKNESS	12.0'
13. DEPTH DRILLED INTO ROCK	ϕ
14. TOTAL DEPTH OF HOLE	12.0'
15. DEPTH GROUNDWATER ENCOUNTERED	5.0'
16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	4.5' TOC ~72 hours (in well)
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	
18. GEOTECHNICAL SAMPLES	DISTURBED ϕ; UNDISTURBED ϕ
19. TOTAL NUMBER OF CORE BOXES	ϕ
20. SAMPLES FOR CHEMICAL ANALYSIS	VOC; METALS; OTHER (SPECIFY) BTEX 4x40z; OTHER (SPECIFY) TRPH 2x8oz; OTHER (SPECIFY) Lead 2x8oz
21. TOTAL CORE RECOVERY	ϕ %
22. DISPOSITION OF HOLE	BACKFILLED; MONITORING WELL 8-6-92; OTHER (SPECIFY)
23. SIGNATURE OF INSPECTOR	Field Geologist

LOCATION SKETCH/COMMENTS SCALE: 1" = 20'



PROJECT	BIG SUPERFUND SITE
HOLE NO.	MW95-01

ENG FORM 5056-R, AUG 94 (Proponent: CECW-EGI)

Figure 4-1. Boring log format (Sheet 1 of 3)

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NUMBER: MW95-01

PROJECT: BIG SUPERFUND SITE | INSPECTOR: Field Geologist | SHEET 2 OF 3 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO. (e)	ANALYTICAL SAMPLE NO. (f)	BLOW COUNT (g)	REMARKS (h)
	0	SC - Clayey Sand, medium dense, nonplastic, noncemented dry, medium brown, fine grained, sub-rounded, 15-20% pieces of concrete	Calibrated Hnu w/ isobutylene at 55 ppm at 190 psi BACKGROUND = 0.8 BREATH = 0.8 SCREEN = 0.9	0.0 1.3'	S-MW01-02/BT 2x4oz jar -02/T 1x8oz jar -02/L 1-8oz jar	5 10 12 12	Drilling in cow pasture - numerous manure piles - may be increasing Hnu readings N (Blow) = 22 Rec (Recovery) = 1.3' TIME - 1012
	1						
	2						
	3	SC - Clayey sand, same as above	BREATH = 0.8 SCREEN = 0.7	3.0' 4.8'		9 9 12 11	N = 21 Rec = 1.8' TIME - 1019
	4						
	5						Plug came off end of central rod. Tried driving split spoon - no recovery. Offset ~1.5' and drilled back down to 8.0'
	6						
	7						
	8	CL - Sandy Lean clay, stiff, low to medium plastic, noncemented, moist, ~15% very fine-grained sand, dark brown		8.0'		2 4 5 6	N = 9 Rec = 2.0' TIME = 1048
	9	SP - Poorly Graded Sand, loose, non-plastic, noncemented, dry to slightly moist, light brown to white, very fine to fine-grained					
	10			10.0'			

PROJECT: BIG SUPERFUND SITE | HOLE NO. MW95-01

ENG FORM 5056A-R, AUG 94 (Proponent: CECW-EG)

Figure 4-1. (Continued) (Sheet 2 of 3)

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NUMBER: MW95-01

PROJECT: BIG SUPERFUND SITE | INSPECTOR: Field Geologist | SHEET 3 OF 3 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO. (e)	ANALYTICAL SAMPLE NO. (f)	BLOW COUNT (g)	REMARKS (h)
	10	SP- Poorly Graded Sand, dense, non-plastic, patchy light cementation, moist light brown to grayish white, very fine to fine-grained, subrounded	Breath = 0.8	10.0		6	N-80
	11		Screen = 0.7			24	Rec = 2.0'
						56	Time - 1144
	12			12.0'		60	
		BOTTOM OF HOLE = 12.0'					Bailed sand from inside bottom of augers. Installed well to top of seal. 8-7-95 - Grouted to surface. Did surface completion. See attached well construction diagram.
	13						
	14						
	15						
	16						
	17						
	18						
	19						
	20						

PROJECT: BIG SUPERFUND SITE | HOLE NO. MW95-01

ENG FORM 5056A-R, AUG 94 (Proponent: CECW-EG)

Figure 4-1. (Concluded) (Sheet 3 of 3)

HTRW DRILLING LOG	DISTRICT	HOLE NUMBER
1. COMPANY NAME	2. DRILLING SUBCONTRACTOR	SHEET SHEETS OF

3. PROJECT	4. LOCATION
5. NAME OF DRILLER	6. MANUFACTURER'S DESIGNATION OF DRILL
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	8. HOLE LOCATION
	9. SURFACE ELEVATION
	10. DATE STARTED / 11. DATE COMPLETED
12. OVERBURDEN THICKNESS	15. DEPTH GROUNDWATER ENCOUNTERED
13. DEPTH DRILLED INTO ROCK	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED
14. TOTAL DEPTH OF HOLE	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %
22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR		

LOCATION SKETCH/COMMENTS SCALE:

PROJECT	HOLE NO.

Figure 4-2. HTRW Drilling Log

HTRW DRILLING LOG (CONTINUATION SHEET)							HOLE NUMBER
PROJECT		INSPECTOR					SHEET OF SHEETS
ELEV (+)	DEPTH (+)	DESCRIPTION OF MATERIALS (+)	FIELD SCREENING RESULTS (+)	SPOT/CH SAMPLE OR CORE BOX NO (+)	ANALYTICAL SAMPLE NO (+)	BLOW COUNT (+)	REMARKS (+)
PROJECT							HOLE NO

ENG FORM 5056A-R, AUG 94 (Proponent: CECW-EG)

Figure 4-2 (Concluded)

Table 4-1
SOIL PARAMETERS FOR LOGGING

PARAMETER	EXAMPLE
Classification	Sandy clay
Depositional environment and formation, if known	Glacial till, Twin Cities Formation
ASTM D 2488 Group Symbol	CL (field estimate)
Secondary components and estimated percentages	Sand: 25 percent Fine sand 5 percent Coarse sand 20 percent
Color (Soil color charts such as Munsell Soil or the Geological Society of America (GSA) Rock Color Chart are helpful for describing the color of soil samples. If a color chart is used, give both narrative and numerical description and note which chart was used. Suggested standard colors can be found in Spigolon 1993)	Gray: (Gr) (7.5 YR 5.0 (Munsell))
Plasticity	Low plasticity
Consistency (cohesive soil)	Very soft, soft, medium stiff, very stiff, hard
Density (noncohesive soil)	Loose, medium loose, dense, very dense
Moisture content Use a relative term. Avoid a percentage unless a value has been measured.	Dry, moist, wet, saturated
Structure and orientation	No apparent bedding: numerous vertical, iron-stained, tight fractures
Grain angularity	Rounded

depth, the intervals of all lost core and hydrologically significant details. This sketch should be prepared at the time of core logging, concurrent with drilling.

i. A record of the brand name and amount of any bentonite used for each boring should be made on the log, along with the reason for and start (by depth) of this use. If measured, record mud viscosities and weight.

j. The drilling equipment used should be generally described on each log. Include such information as rod size, bit type, pump type, rig manufacturer, and model.

k. Each log should record the drilling sequence; e.g.:

(1) Opened hole with 8-in. auger to 9 ft;

(2) Set 8-in. casing to 10 ft;

(3) Cleaned out and advanced hole with 8-in. roller bit to 15 ft (clean water, no water loss);

(4) Drove 1-3/8-in. ID X 2-in. outside diameter (OD) sampler to 16.5 ft;

(5) Advanced with 8-in. roller bit to 30 ft, 15-gal water loss;

(6) Drove 1-3/8-in. ID X 2-in. OD sampler to 31.5 ft;

(7) Hole heaved to 20 ft; and

(8) Mixed 25 lb of ABC bentonite in 100 gal of water for hole stabilization and advanced with 8-in. roller bit to 45 ft, etc.

l. All special problems and their resolution should be recorded on the log; e.g., hole squeezing, recurring problems at a particular depth, sudden tool drops, excessive grout takes, drilling fluid losses, unrecovered tools in hole, lost casings, etc.

m. The dates and times for the start and completion of borings should be recorded on the log along with notation by depth for drill crew shifts and individual days.

n. Each sequential boundary between the various soils and individual lithologies should be noted on the log by depth. When depths are estimated, the estimated range

Table 4-2
ROCK CORE PARAMETERS FOR LOGGING

PARAMETER	EXAMPLE
Rock type	Limestone, sandstone, granite
Formation	Anytown Formation
Modifier denoting variety	Shaly, calcareous, siliceous, micaceous
Bedding/banding characteristics	Laminated, thin bedded, massive, cross bedded, foliated
Color (Color charts such as Munsell or the GSA Rock Color Chart are helpful for describing the color of rock samples. If a color chart is used give both narrative and numerical description and note which chart was used. Suggested standard colors can be found in Spigolon 1993).	Light brown: (lBr)
Hardness	Soft, very hard
Degree of cementation	Poorly cemented, well cemented
Texture	Dense, fine-, medium-, coarse-grained, glassy, porphyritic, crystalline
Structure and orientation	Horizontal bedding, dipping beds at 30 degrees, highly fractured, open vertical joints, healed fractures, slickensides at 45 degrees, fissile
Degree of weathering	Unweathered, slightly weathered, highly weathered
Solution or void conditions	Solid, cavernous, vuggy with partial infilling by clay
Primary and secondary permeability, include estimates and rationale	Low primary; well cemented High secondary: several open joints
Lost core interval and reason for loss	50-51 ft, noncemented sandstone likely

should be noted along the boundary.

o. The depth of first encountered free water should be indicated along with the method of determination; e.g., "37.6 ft from direct measurement after drilling to 40.0 ft"; "40.1 ft from direct measurement in 60-ft hole when boring left overnight, hole dry at end of previous shift"; or "25.0 ft based on saturated soil sample while sampling 24-26 ft." Any other distinct water level(s) found below the first should also be described.

p. The interval by depth for each sample taken, classified, and/or retained should be noted on the log. Record the length of sampled interval, length of sample recovery, and the sampler type and size (diameter and length).

q. A record of the blow counts, hammer type and weight, and length of hammer fall for driven samplers should be made. For thin wall samplers, indicate whether the sampler was pushed or driven and the pressure/blow count per drive. Blow counts should be recorded in 150 mm (0.5 ft) foot increments when standard penetration (ASTM D 1586) samplers (35 mm [1-3/8 in.] ID X 50 mm [2 in.] OD) are used. For penetration less than a half foot, annotate the count with the distance over which the count was taken. Blow counts, in addition to their engineering significance, may be useful for stratigraphic correlation. (See Hsai-Wong Fang (1991) for interpretation of blow counts when 75-mm (3-in.) samplers are used).

r. When drilling fluid is used, a quantitative record should be maintained of fluid losses and/or gains and the interval over which they occur. Adjustment should be made for fluid losses due to spillage and intentional wasting (e.g., recirculation tank cleaning) to more closely estimate the amount of fluid lost to the subsurface environment.

s. Record the drilling fluid pressures typically used during all drilling operations (aqueous and pneumatic) and the driller's comments on drillability, drill speed, down pressure, rotation speed, etc.

t. Note the total depth of drilling and sampling on the log.

u. Record significant color changes in the drilling fluid return, even when intact soil samples or rock core are being obtained. Include the color change (from and to), depth at which change occurred, and a lithologic description of the cuttings before and after the change.

v. Soil gas readings, if taken, should be recorded on the log. Each notation should include interval sampled and reading. A general note on the log should indicate meter manufacturer, model, serial number, and calibration material. If several meters are used, key the individual readings to the specific meter.

w. Special abbreviations used on a log and/or well diagram should be defined in the log/diagram where used.

THIS PAGE WAS INTENTIONALLY LEFT BLANK

APPENDIX C

INDIANA ADMINISTRATIVE CODE – MONITORING WELLS

THIS PAGE WAS INTENTIONALLY LEFT BLANK

Indiana Administrative Code

ARTICLE 13. WATER WELL DRILLERS

Rule 1. Definitions

312 IAC 13-1-1 General application of definitions
Authority: IC 25-39-4-9
Affected: IC 25-39-2
Sec. 1. The definitions in this rule are in addition to those contained in IC 25-39-2 and 312 IAC 1 and apply throughout this article. *(Natural Resources Commission; 312 IAC 13-1-1; filed Nov 22, 1999, 3:34 p.m.: 23 IR 763; readopted filed Aug 4, 2005,6:00 p.m.: 28 IR 3661)*

312 IAC 13-1-2 "Abandon" defined
Authority: IC 25-39-2-5; IC 25-39-4-9
Affected: IC 25-39
Sec. 2. "Abandon" means to terminate operations of a well for water supply, monitoring, dewatering, or geothermal purposes and to restore the site of the well in a manner that will protect ground water resources from contamination. *(Natural Resources Commission; 312 IAC 13-1-2; filed Nov 22, 1999, 3:34 p.m.: 23 IR 763; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)*

312 IAC 13-1-3 "Aquifer characteristics" defined
Authority: IC 25-39-4-9
Affected: IC 25-39
Sec. 3. "Aquifer characteristics" refers to the type, thickness, transmissivity coefficient of storage, and materials of a water bearing unit. *(Natural Resources Commission; 312 IAC 13-1-3; filed Nov 22, 1999, 3:34 p.m.: 23 IR 763; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)*

312 IAC 13-1-4 "Bentonite" defined
Authority: IC 25-39-2-5; IC 25-39-4-9
Affected: IC 25-39
Sec. 4. "Bentonite" means clay material composed predominantly of sodium montmorillonite that meets American Petroleum Institute specifications Standard 13-A (1985). *(Natural Resources Commission; 312 IAC 13-1-4; filed Nov 22, 1999, 3:34 p.m.: 23 IR 763; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)*

312 IAC 13-1-5 "Bentonite slurry" defined
Authority: IC 25-39-4-9
Affected: IC 25-39
Sec. 5. "Bentonite slurry" means a mixture, made according to manufacturer specifications, of water and commercial grouting or plugging bentonite that contains high concentrations of solids. The term does not include sodium bentonite products that contain low solid concentration or are designed for drilling fluid purposes. *(Natural Resources Commission; 312 IAC 13-1-5; filed Nov 22, 1999, 3:34 p.m.: 23 IR 763; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)*

312 IAC 13-1-6 "Bridge" defined
Authority: IC 25-39-4-9
Affected: IC 25-39
Sec. 6. "Bridge" means a barrier created by any unwanted object or material that prevents the introduction of grouting materials in the borehole or well. *(Natural Resources Commission; 312 IAC 13-1-6; filed Nov 22, 1999, 3:34 p.m.: 23 IR 763; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)*

312 IAC 13-1-7 "Coarse grade crushed bentonite" defined
Authority: IC 25-39-4-9
Affected: IC 25-39
Sec. 7. "Coarse grade crushed bentonite" means natural bentonite crushed to an average size range of three-eighths (d) to three-fourths (¾) inches. *(Natural Resources Commission; 312 IAC 13-1-7; filed Nov 22, 1999, 3:34 p.m.: 23 IR 763; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)*

312 IAC 13-1-8 "Competency examination" defined
Authority: IC 25-39-4-9
Affected: IC 25-39
Sec. 8. "Competency examination" means an examination given by the department that is designed to establish the capability and skill of an individual to operate as a water well driller. *(Natural Resources Commission; 312 IAC 13-1-8; filed Nov 22, 1999, 3:34 p.m.: 23 IR 763; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)*

312 IAC 13-1-9 "Confined aquifer" defined
Authority: IC 25-39-4-9
Affected: IC 25-39
Sec. 9. "Confined aquifer" means an aquifer that contains sufficient hydrostatic head to cause ground water to rise above the upper boundary of the aquifer. *(Natural Resources Commission; 312 IAC 13-1-9; filed Nov 22, 1999, 3:34 p.m.: 23 IR 764; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)*

312 IAC 13-1-10 "Contamination" defined
Authority: IC 25-39-4-9
Affected: IC 25-39
Sec. 10. "Contamination" means the degradation of natural water quality as a result of human activities. *(Natural Resources Commission; 312 IAC 13-1-10; filed Nov 22, 1999, 3:34 p.m.: 23 IR 764; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)*

312 IAC 13-1-11 "Dewatering well" defined
Authority: IC 25-39-2-5; IC 25-39-4-9
Affected: IC 25-39
Sec. 11. "Dewatering well" means a temporary water well that:
(1) is used as part of a construction project to remove water from a surface or subsurface area; and
(2) ceases to be used upon completion of the construction project or shortly after completion of the project.
(Natural Resources Commission; 312 IAC 13-1-11; filed Nov 22, 1999, 3:34 p.m.: 23 IR 764; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)

312 IAC 13-1-12 "Disinfection" defined
Authority: IC 25-39-4-9
Affected: IC 25-39
Sec. 12. "Disinfection" means the process of destroying pathogenic micro-organisms, such as coliform bacteria. *(Natural Resources Commission; 312 IAC 13-1-12; filed Nov 22, 1999, 3:34 p.m.: 23 IR 764; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)*

312 IAC 13-1-13 "Division" defined
Authority: IC 25-39-4-9
Affected: IC 25-39
Sec. 13. "Division" means the division of water of the department. *(Natural Resources Commission; 312 IAC 13-1-13; filed Nov 22, 1999, 3:34 p.m.: 23 IR 764; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)*

312 IAC 13-1-14 "Drawdown" defined
Authority: IC 25-39-4-9
Affected: IC 25-39
Sec. 14. "Drawdown" means the amount of lowering of the water level in a well resulting from the discharge of water by pumping from the well. *(Natural Resources Commission; 312 IAC 13-1-14; filed Nov 22, 1999, 3:34 p.m.: 23 IR 764; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)*

312 IAC 13-1-15 "Grout pipe" defined
Authority: IC 25-39-4-9
Affected: IC 25-39
Sec. 15. "Grout pipe" means a length of hose or pipe positioned in the annular space of a well, between the well casing and the borehole, used for the introduction of grouting materials. *(Natural Resources Commission; 312 IAC 13-1-15; filed Nov 22, 1999, 3:34 p.m.: 23 IR 764; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)*

312 IAC 13-1-16 "High capacity water well" defined
Authority: IC 25-39-4-9
Affected: IC 25-39
Sec. 16. "High capacity water well" means a well that has the capability of withdrawing one hundred thousand (100,000) gallons of ground water or more in one (1) day. *(Natural Resources Commission; 312 IAC 13-1-16; filed Nov 22, 1999, 3:34 p.m.: 23 IR 764; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)*

312 IAC 13-1-17 "Medium grade crushed bentonite" defined
Authority: IC 25-39-2-5; IC 25-39-4-9
Affected: IC 25-39
Sec. 17. "Medium grade crushed bentonite" means natural bentonite crushed to an average size range of one-fourth (¼) to three-eighths (d) inch. *(Natural Resources Commission; 312 IAC 13-1-17; filed Nov 22, 1999, 3:34 p.m.: 23 IR 764; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)*

312 IAC 13-1-18 "Monitoring well" defined
Authority: IC 25-39-4-9
Affected: IC 25-39
Sec. 18. "Monitoring well" means a well installed to obtain hydrogeological information or to monitor the quality or quantity of ground water. *(Natural Resources Commission; 312 IAC 13-1-18; filed Nov 22, 1999, 3:34 p.m.: 23 IR 764; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)*

312 IAC 13-1-19 "Operating well drilling equipment" defined
Authority: IC 25-39-4-9
Affected: IC 25-39
Sec. 19. "Operating well drilling equipment" means to use equipment to drill a well. *(Natural Resources Commission; 312 IAC 13-1-19; filed Nov 22, 1999, 3:34 p.m.: 23 IR 764; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)*

312 IAC 13-1-20 "Public water supply well" defined
Authority: IC 25-39-4-9
Affected: IC 25-39
Sec. 20. "Public water supply well" means a well that provides a source of water to a community water system that:
(1) serves a residential population; and
(2) is defined as having fifteen (15) or more service connections or serving at least twenty-five (25) year-round residents.
(Natural Resources Commission; 312 IAC 13-1-20; filed Nov 22, 1999, 3:34 p.m.: 23 IR 764; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)

312 IAC 13-1-21 "Reference" defined
Authority: IC 25-39-4-9
Affected: IC 25-39
Sec. 21. "Reference" means a person who attests to the character and professional qualifications of an applicant for a license. *(Natural Resources Commission; 312 IAC 13-1-21; filed Nov 22, 1999, 3:34 p.m.: 23 IR 765; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)*

312 IAC 13-1-22 "Regulatory flood" defined
Authority: IC 25-39-4-9
Affected: IC 25-39
Sec. 22. "Regulatory flood" has the meaning set forth in 310 IAC 6-1-3(32). *(Natural Resources Commission; 312 IAC 13-1-22; filed Nov 22, 1999, 3:34 p.m.: 23 IR 765; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)*

312 IAC 13-1-23 "Thermoplastic pipe" defined
Authority: IC 25-39-4-9
Affected: IC 25-39
Sec. 23. "Thermoplastic pipe" means plastic well pipe made of acrylonitrile butadiene styrene, polyvinyl chloride, or rubbermodified polystyrene with standards listed in American Society of Testing Materials. *(Natural Resources Commission; 312 IAC 13-1-23; filed Nov 22, 1999, 3:34 p.m.: 23 IR 765; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)*

312 IAC 13-1-24 "Unconsolidated formation" defined
Authority: IC 25-39-4-9
Affected: IC 25-39
Sec. 24. "Unconsolidated formation" means geologic material or deposits overlying bedrock, such as sand, gravel, and clay. *(Natural Resources Commission; 312 IAC 13-1-24; filed Nov 22, 1999, 3:34 p.m.: 23 IR 765; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)*

312 IAC 13-1-25 "Well pit" defined
Authority: IC 25-39-4-9
Affected: IC 25-39
Sec. 25. "Well pit" means a subsurface excavation that contains a well. *(Natural Resources Commission; 312 IAC 13-1-25; filed Nov 22, 1999, 3:34 p.m.: 23 IR 765; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)*

Rule 2. Drilling License and Well Records

312 IAC 13-2-1 Application form
Authority: IC 25-39-3-2; IC 25-39-4-9
Affected: IC 25-39-3-3
Sec. 1. (a) An initial application for a license as a water well driller must be completed on a departmental form and must include the following:
(1) The name, current address, telephone number, and birth date of the applicant.
(2) The type of drilling equipment the applicant uses, and the number of years the applicant has operated that type of equipment.
(3) The applicable employment experience of the applicant.
(4) The signature of the applicant attesting to or affirming the accuracy of the information on the application.
(5) The license fee established under section 2 of this rule.
(6) Statements by references under IC 25-39-3-3(a)(2).
(b) Subsequent applications must provide what is required in subsection (a)(1), (a)(4), and (a)(5).
(Natural Resources Commission; 312 IAC 13-2-1; filed Nov 22, 1999, 3:34 p.m.: 23 IR 765; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)

312 IAC 13-2-2 License fee; duplicate license
Authority: IC 25-1-8-2; IC 25-39-3-2; IC 25-39-4-9
Affected: IC 25-39
Sec. 2. (a) The fee to accompany any application for a license as a water well driller is one hundred dollars ($100) for a calendar year.
(b) A person who is issued a license as a water well driller may apply to the department for a duplicate license (which is effective during the same calendar year) if the original license is lost, stolen, destroyed, or otherwise becomes unavailable to the driller. *(Natural Resources Commission; 312 IAC 13-2-2; filed Nov 22, 1999, 3:34 p.m.: 23 IR 765; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)*

312 IAC 13-2-3 License renewals and restorations
Authority: IC 25-39-4-9
Affected: IC 25-39
Sec. 3. (a) A license may be renewed for the following year, without examination, under section 1(b) of this rule.
(b) A license that has been expired in excess of one (1) year may be reinstated only upon successful completion by the applicant of a competency examination and the completion of an application and submission of the license fee.
(c) A water well driller must deliver a completed renewal application form to the division at least five (5) working days before the renewal is to become effective. *(Natural Resources Commission; 312 IAC 13-2-3; filed Nov 22, 1999, 3:34 p.m.: 23 IR 765; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)*

312 IAC 13-2-4 Competency examination
Authority: IC 25-39-4-9
Affected: IC 25-39
Sec. 4. (a) A competency examination will be given by the division at least two (2) times annually. The examination will be given on a day specified by the division during the second full week of June and during the second full week of November.
(b) The fee to take the competency examination is twenty-five dollars ($25).
(c) The competency examination is in writing, but, upon request by an applicant, an oral examination will be given.
(d) An applicant must submit a valid identification card, with a photograph of the applicant, before taking the examination. *(Natural Resources Commission; 312 IAC 13-2-4; filed Nov 22, 1999, 3:34 p.m.: 23 IR 765; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)*

312 IAC 13-2-5 Statement by a reference
Authority: IC 25-39-4-9
Affected: IC 25-39
Sec. 5. A statement by a reference shall include the following information:
(1) The state of residence of the reference.
(2) The full name, address, telephone number, and occupation of the reference.
(3) The length of time the reference has known the applicant.
(4) How the reference is familiar with the applicant's work.
(5) A general statement regarding their evaluation of the applicant's professional competency.
(6) The signature of the reference attesting to or affirming the accuracy of the information on the reference form.
(Natural Resources Commission; 312 IAC 13-2-5; filed Nov 22, 1999, 3:34 p.m.: 23 IR 766; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)

312 IAC 13-2-6 Well records
Authority: IC 25-39-4-1; IC 25-39-4-9
Affected: IC 25-39
Sec. 6. A water well driller must submit, on a departmental form or division-approved form, accurate records for each well drilled to include the following information:
(1) The method of well construction.
(2) The proposed use of the well, for example, residential, industrial, monitoring, or dewatering.
(3) Pumping information, including each of the following:
    (A) The type of pump and the depth of the pump setting (if applicable).
    (B) Whether the well was bailer, air, or pump tested.
    (C) The test rate and length of time of test pumping.
(4) Specifications for the well casing and the well screen.
(5) The inside diameter of the well.
(6) The total depth of the well.
(7) The static water level in the well.
(8) The name, address, and telephone number of the owner (and the builder, if different from the owner).
(9) The name and address of the drilling company.
(10) The name and license number of the equipment operator.
(11) The type and thickness of formations or materials encountered, including color, hardness, and a geological description.

(12) A statement of the accuracy of the information contained on the form that is signed by the water well driller or his authorized representative upon an affirmation or attestation.
(13) The type, depth, and thickness of grouting materials and method of installation.
(14) Specific roadway directions to the well, including a reference to the nearest major highway or street intersection. *(Natural Resources Commission; 312 IAC 13-2-6; filed Nov 22, 1999, 3:34 p.m.: 23 IR 766; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)*

Rule 3. Well Drilling Procedures and Well Locations

312 IAC 13-3-1 Operations at drilling site
Authority: IC 25-39-4-2; IC 25-39-4-9
Affected: IC 25-39
Sec. 1. A water well driller shall operate all equipment according to generally accepted standards in the industry. The driller is responsible for initiating, maintaining, and supervising operations and shall take appropriate precautions to prevent damage, injury, or other loss to persons and property at the drilling site. *(Natural Resources Commission; 312 IAC 13-3-1; filed Nov 22, 1999, 3:34 p.m.: 23 IR 766; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)*

312 IAC 13-3-2 Well locations
Authority: IC 25-39-4-2; IC 25-39-4-9
Affected: IC 25-39
Sec. 2. (a) A well shall be located as follows:
(1) To use every natural protection to promote the maintenance of the well and its surroundings, and to protect the quantity and quality of ground water encountered during the construction of the well.
(2) As far as practicable from any:
(A) high capacity well; and
(B) known contamination source.
(3) To protect the well against surface water ponding, drainage, or flooding. Earthen materials shall be placed around the pitless unit or finished well casing in a manner to drain surface water away from the well. The finished well casing or pitless unit shall extend at least one (1) foot above the ground level and, if located in a designated flood hazard area, must:
(A) be at least two (2) feet above the elevation of the regulatory flood; or
(B) be equipped with a watertight pitless unit cap or well seal and vented to an elevation at least two (2) feet above the elevation of the regulatory flood.
(b) This section does not apply to a monitoring well or a dewatering well. *(Natural Resources Commission; 312 IAC 13-3-2; filed Nov 22, 1999, 3:34 p.m.: 23 IR 766; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)*

312 IAC 13-3-3 Standards for wells drilled adjacent to buildings
Authority: IC 25-39-4-2; IC 25-39-4-9
Affected: IC 25-39
Sec. 3. (a) This section establishes standards for the placement of a well that is near a building.
(b) The center line of a well located outside and adjacent to a building shall, if extended vertically, clear any projection from the building by not less than five (5) feet.
(c) A well shall be reasonably accessible to equipment for proper cleaning, repair, testing, inspection, and other maintenance. *(Natural Resources Commission; 312 IAC 13-3-3; filed Nov 22, 1999, 3:34 p.m.: 23 IR 767; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)*

Rule 4. Well Equipment and Installation Specifications

312 IAC 13-4-1 Casing
Authority: IC 25-39-4-2; IC 25-39-4-9
Affected: IC 25-39
Sec. 1. (a) This section establishes minimum casing requirements.

(b) A new well shall be equipped with casing having an inside diameter of at least two (2) inches. The inside diameter of the well casing shall allow for easy installation and future removal of the permanent pumping equipment.
(c) A well must be cased to a depth of at least twenty-five (25) feet below the ground surface unless otherwise approved by the division.
(d) Casing shall be constructed of a steel or thermoplastic material or a casing specified in subsection (f). Ferrous casing shall be new, first class material that meets the American Society of Testing Materials (ASTM) standards ASTM A-120 (1984) or ASTM A-53 (1987) or American Petroleum Institute (API) standards API-5A or API-5L (1987). Thermoplastic pipe shall comply with ASTM F-480 (1981).
(e) Casing used under this section must be new. Casing that is salvaged within thirty (30) days of the installation of a well is considered new if the casing is still in new condition.
(f) Steel, thermoplastic or NSF certified fiberglass pipe, or concrete tile shall be used in bucket wells. This casing shall be new material.
(g) No finished well casing shall be cut below the ground surface except to install a pitless well adapter or as specified in 312 IAC 13-6-2(b)(1) or 312 IAC 13-6-2(c)(2). A pitless adapter must meet the requirements of section 3 of this rule.
(h) Upon installation, a well casing shall be fitted with a temporary cap that remains in place until pumping equipment or a pitless adapter is installed. The cap shall be a type that prevents vermin or other potential contaminants from entering the well.
(i) This section does not apply to a monitoring well or a dewatering well. *(Natural Resources Commission; 312 IAC 13-4-1; filed Nov 22, 1999, 3:34 p.m.: 23 IR 767; filed Oct 9, 2001, 4:32 p.m.: 25 IR 708; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)*

312 IAC 13-4-2 Well screens
Authority: IC 25-39-4-2; IC 25-39-4-9
Affected: IC 25-39
Sec. 2. (a) A well drilled in an unconsolidated formation shall be equipped with a well screen having adequate openings to provide for maximum water transmittance with respect to the size of the water bearing formation or gravel pack.
(b) Approved screen materials are stainless steel, brass, bronze, fiberglass, and polyvinyl chloride or acrylonitrile butadiene styrene plastic.
(c) This section does not apply to a monitoring well or a dewatering well. *(Natural Resources Commission; 312 IAC 13-4-2; filed Nov 22, 1999, 3:34 p.m.: 23 IR 767; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)*

312 IAC 13-4-3 Pitless units and pitless adapters
Authority: IC 25-39-4-2; IC 25-39-4-9
Affected: IC 25-39
Sec. 3. (a) A pitless unit shall do the following:
(1) Extend the upper end of the well casing at least one (1) foot above the ground level.
(2) Be affixed to the well casing in a manner that is watertight by:
(A) threading;
(B) welding (including gluing); or
(C) a mechanical connection.
(b) The cap, cover, or seal of the pitless unit shall:
(1) be self-draining and overlap the top of the casing extension with a downward flange;
(2) fit securely on the well casing; and
(3) be tamper resistant.
(c) A pitless unit shall be installed under 312 IAC 13-3-2(a)(3).
(d) A pitless adapter shall be constructed and installed to prevent the entrance of contaminants in the well through openings in the well casing to which the adapter is attached. *(Natural Resources Commission; 312 IAC 13-4-3; filed Nov 22, 1999, 3:34 p.m.: 23 IR 767; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)*

312 IAC 13-4-4 Well pits
Authority: IC 25-39-4-2; IC 25-39-4-9
Affected: IC 25-39
Sec. 4. (a) The design of a well pit that contains a well must be approved by the division before construction.
(b) This section does not apply to a monitoring well. *(Natural Resources Commission; 312 IAC 13-4-4; filed Nov 22, 1999, 3:34 p.m.: 23 IR 767; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)*

312 IAC 13-4-5 Construction water
Authority: IC 25-39-4-2; IC 25-39-4-9
Affected: IC 25-39
Sec. 5. Water used in the drilling process shall be obtained from a source that will not result in contamination of the well or water bearing zones penetrated by the well. *(Natural Resources Commission; 312 IAC 13-4-5; filed Nov 22, 1999, 3:34 p.m.: 23 IR 768; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)*

Rule 5. Grouting of Wells

312 IAC 13-5-1 Materials and installation
Authority: IC 25-39-4-2; IC 25-39-4-9
Affected: IC 25-39
Sec. 1. (a) This section governs grouting materials and the installation of grouting materials for new wells.
(b) Grouting materials shall consist of:
(1) neat cement with no more than five percent (5%) by weight of bentonite additive;
(2) bentonite slurry (which can include polymers designed to retard swelling);
(3) pelletized, granular, medium grade, or coarse grade crushed bentonite; or
(4) other materials approved by the commission.
(c) This section applies if neat cement or a bentonite slurry is used for grouting. The cement or slurry shall be pumped into place from the bottom of the annular space upward in a continuous operation with a grout pipe or the well casing using the positive displacement method.
(d) Grouting material, other than neat cement or bentonite slurry, shall be introduced in a manner to prevent bridging of the annulus between the outside of the well casing and the borehole.
(e) A borehole annulus shall be grouted upon the earlier of the following:
(1) Within twenty-four (24) hours after the installation of the well casing.
(2) Before drilling equipment is removed from the site.
(f) This section does not apply to a public water supply well. The installation of a public water supply well is governed by 327 IAC 8-3.4. *(Natural Resources Commission; 312 IAC 13-5-1; filed Nov 22, 1999, 3:34 p.m.: 23 IR 768; readopted filed Aug 4, 2005,6:00 p.m.: 28 IR 3661)*

Rule 6. Minimum Well Construction Standards

312 IAC 13-6-1 Rotary or augered wells
Authority: IC 25-39-4-2; IC 25-39-4-9
Affected: IC 25-39
Sec. 1. (a) This section governs the construction of wells by rotary or auger drilling methods.
(b) A well shall be drilled and equipped with a casing having a minimum of two (2) inches inside diameter installed in an open hole having a diameter of at least two (2) inches greater than the outside diameter of the casing.
(c) A well shall be cased to a minimum depth of twenty-five (25) feet below the ground surface unless otherwise approved by the division.
(d) A well shall have a minimum of twenty-five (25) feet of the borehole annulus pressure grouted with neat cement or a bentonite slurry unless otherwise approved by the division.
(e) A well penetrating bedrock shall have the borehole annulus pressure grouted with neat cement or a bentonite slurry from the bottom of the well casing, or the top of the formation packer to the ground surface (or to four (4) feet below the ground surface if a pitless adapter is installed).
(f) A well constructed in an unconsolidated aquifer shall have the borehole annulus pressure grouted with neat cement or a bentonite slurry from the top of the natural or introduced gravel pack to the ground surface (or to four

(4) feet below the ground surface if a pitless adapter is installed). The gravel pack shall not extend more than ten (10) feet above the top of the well screen unless otherwise approved by the division.
(g) This section does not apply to any of the following:
(1) A monitoring well.
(2) A dewatering well.
(3) A public water supply well.
The installation of a public water supply well is governed by 327 IAC 8-3.4. *(Natural Resources Commission; 312 IAC 13-6-1; filed Nov 22, 1999, 3:34 p.m.: 23 IR 768; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)*

312 IAC 13-6-2 Bucket wells
Authority: IC 25-39-4-2; IC 25-39-4-9
Affected: IC 25-39
Sec. 2. (a) This section governs the construction of wells by bucket rig drilling methods.
(b) A bucket well installed as buried slab construction shall conform with the following:
(1) The well casing shall terminate not less than ten (10) feet below the ground surface. The casing shall meet the requirements contained in 312 IAC 13-4-1 and must be firmly embedded in or connected to a pipe, a minimum of two (2) inches inside diameter, cast in a reinforced buried concrete slab, or attached to a NSF certified fiberglass cap with a watertight mechanical or glued connection. Fiberglass well casing may be slotted below the ground surface to allow for the transmittance of water into the well.
(2) The annular opening between the well casing and the well bore shall be filled with washed graded gravel from the bottom of the well to the concrete slab or the fiberglass. The annular space between the pipe and borehole shall be sealed with concrete or granular, pelletized, or coarse grade crushed bentonite at least six (6) inches thick. The remainder of the borehole shall be filled with clean earth and thoroughly tamped to minimize settling.
(c) A bucket well installed not using buried slab construction shall conform with the following:
(1) A well shall have a borehole with an inside diameter at least two (2) inches larger than the outside diameter of the lining or well casing.
(2) The well shall have a continuous watertight lining of steel or fiberglass casing or concrete extending at least five (5) feet below the ground surface. The casing shall meet the requirements contained in 312 IAC 13-4-1. Fiberglass well casing may be slotted below the ground surface to allow for the transmittance of water into the well.
(3) The annulus between the inside diameter of the borehole and the outside diameter of the well casing shall be filled with washed graded gravel from the bottom of the well to a depth at least five (5) feet below the ground surface. The remaining annulus shall be sealed with neat cement, bentonite slurry, or granular, pelletized, medium grade, or coarse grade crushed bentonite from ground level to at least five (5) feet below ground level.
(4) A reinforced cover slab at least four (4) inches thick with a diameter larger than the casing or a NSF certified fiberglass cap shall be provided. Vents or pump piping that exits through the slab shall have the pipe sleeves cast in place. Vents or pump piping that exits through the fiberglass cap or casing shall be attached with a watertight mechanical or glued connection. The top of the slab or fiberglass cap shall be sloped to drain to all sides. A watertight joint shall be made where the slab rests on the well lining using a watertight sealing compound. If a manhole is installed, the manhole shall have a metal curb cast in the concrete slab and extending four (4) inches above the slab. The manhole shall have a watertight cover with the sides to overhang the curb at least two (2) inches. A vent shall be installed in a concrete slab and shall consist of a metal pipe extending above the slab with the open end turned down and at least six (6) inches above the slab. The open end shall be covered with sixteen (16) mesh or finer screen made of durable material. A vent shall be installed in a fiberglass cap or casing and shall consist of a metal or plastic pipe extending at least six (6) inches above the cap or away from the casing with the open end turned down.
(5) A hole drilled in the concrete casing for a below ground discharge line shall be sealed on the inside and outside of the well casing with concrete or a mastic compound. Fiberglass casing equipped with a below ground discharge line shall have the discharge line attached with a watertight mechanical or glued connection.
(6) In a bucket well where casing is used with an inside diameter of less than twelve (12) inches that extends the entire depth of the borehole, the graded gravel filling the annular space between the inside of the borehole and outside of the casing shall terminate not less than ten (10) feet below ground surface. The borehole annulus shall be filled with granular, pelletized, or coarse grade crushed bentonite a minimum of six (6) inches thick and the remainder of the borehole shall be filled with clean earth and thoroughly tamped to minimize settling.
(d) This section does not apply to any of the following:
(1) A monitoring well.
(2) A dewatering well.

(3) A public water supply well.
The installation of a public water supply well is governed by 327 IAC 8-3.4. *(Natural Resources Commission; 312 IAC 13-6-2; filed Nov 22, 1999, 3:34 p.m.: 23 IR 768; filed Oct 9, 2001, 4:32 p.m.: 25 IR 709; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)*

312 IAC 13-6-3 Cable tool or jetted wells
Authority: IC 25-39-4-2; IC 25-39-4-9
Affected: IC 25-39
Sec. 3. (a) This section governs the construction of wells by cable tool or jetting methods.
(b) A well installed by cable tool or jetting shall be equipped with casing having a minimum of two (2) inches inside diameter and be cased a minimum of twenty-five (25) feet below ground surface.
(c) If well casing is driven or jetted, a borehole with an inside diameter at least two (2) inches greater than the outside diameter of the casing to be driven shall be dug at least three (3) feet, but not more than five (5) feet, below ground surface. The casing shall be centered in the larger diameter borehole. A bentonite slurry, granular bentonite, or medium grade crushed bentonite shall fill the annulus during the installation of the well casing. Notwithstanding 312 IAC 13-5-1(c), bentonite slurry may be introduced into the borehole annulus by gravity methods during the installation of the well casing.
(d) Unless otherwise approved by the division, a well must be grouted under section 1 of this rule if either of the following conditions exist:
(1) A larger diameter temporary casing is used to install a smaller diameter permanent well casing.
(2) A later diameter borehole is drilled to install a smaller diameter well casing.
(e) This section does not apply to a monitoring well, a dewatering well, or a public water supply well. The installation of a public water supply well is governed by 327 IAC 8-3.4. *(Natural Resources Commission; 312 IAC 13-6-3; filed Nov 22, 1999, 3:34 p.m.: 23 IR 769; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)*

Rule 7. Well Yield

312 IAC 13-7-1 Well yield
Authority: IC 25-39-4-9
Affected: IC 25-39
Sec. 1. (a) Every well (which is to be equipped with a pump) shall be tested for yield. The well shall be test pumped at a capacity at least equal to the pumping rate desired from the well during normal usage.
(b) A well shall be developed and tested at capacity for a minimum of one (1) hour. The yield and drawdown shall be recorded.
(c) Pumping equipment shall be installed at a depth to allow for drawdown caused by:
(1) the pumping equipment itself; and
(2) seasonal water level fluctuations.
(d) This section does not apply to a monitoring well or a dewatering well. *(Natural Resources Commission; 312 IAC 13-7-1; filed Nov 22, 1999, 3:34 p.m.: 23 IR 769; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)*

Rule 8. Other Wells and Structures

312 IAC 13-8-1 Geothermal heat pump wells
Authority: IC 14-10-2-4; IC 25-39-4-2; IC 25-39-4-9
Affected: IC 25-39
Sec. 1. (a) This section establishes standards for drilling ground water heat pump systems that are in addition to the general requirements for drilling a well under 312 IAC 12.
(b) If a return well is used with an open loop system, its design shall provide a water transmitting capacity that is at least one and one-half (1½) times the required water supply of the heat pump unit.
(c) With respect to a vertical closed loop system, boreholes shall be pressure grouted from the bottom of the borehole to the ground surface with a high solids bentonite grout that may contain sand to enhance thermal conductivity. *(Natural Resources Commission; 312 IAC 13-8-1; filed Nov 22, 1999, 3:34 p.m.: 23 IR 770; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661; filed Jul 14, 2006, 1:23 p.m.: 20060809-IR-312050341FRA)*

312 IAC 13-8-2 Radial collector wells
Authority: IC 25-39-4-2; IC 25-39-4-9
Affected: IC 25-39
Sec. 2. Plans and specifications for a radial collector well must be approved by the division before drilling begins. Factors to be considered by the division include the following:
(1) The depth of the well.
(2) Well casing materials.
(3) Well sealing procedures.
(4) Types of aquifer materials.
(5) The location of the proposed well.
(Natural Resources Commission; 312 IAC 13-8-2; filed Nov 22, 1999, 3:34 p.m.: 23 IR 770; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)

312 IAC 13-8-3 Monitoring wells
Authority: IC 14-10-2-4; IC 25-39-4-2; IC 25-39-4-9
Affected: IC 25-39
Sec. 3. (a) This section establishes standards for monitoring wells that are in addition to the general requirements for drilling a well under this article.
(b) A monitoring well shall be equipped with casing. The composition, wall thickness, and nominal diameter of the casing shall be sufficient to allow the well to be used for its intended purpose.
(c) Monitoring well casing shall be new first class material that meets the American Society of Testing Materials (ASTM) standards ASTM A-120 (1984) or ASTM A-53 (1987) or the American Petroleum Institute (API) standards API-5A or API-5L (1987). Thermoplastic pipe shall comply with ASTM F-480 (1981). Well casing shall be as follows:
(1) Clean and free of rust, grease, oil, or contaminants and composed of materials that will have minimal impact on the quality of a water sample.
(2) Centered in the borehole and free of obstructions so monitoring devices can be lowered into the well.
(d) A monitoring well screen shall be composed of materials that will not corrode or react with chemicals found in the ground water at the site. The well screen slots shall not be hand cut and shall be sized to retain at least ninety percent (90%) of the grain size of the introduced filter pack or natural formation materials if an introduced filter pack is not used. The introduced filter pack shall:
(1) be properly sized and graded; and
(2) not extend more than two (2) feet above the top of the screen or the uppermost water bearing unit to be monitored in the well annulus unless otherwise approved by the division.
(e) A filter pack seal of bentonite slurry or granular, pelletized, medium grade, or coarse grade crushed bentonite may be placed in the annulus directly above the filter pack or sand grout barrier. The filter pack seal shall:
(1) be installed to prevent bridging; and
(2) not extend more than two (2) feet above the filter pack or sand grout barrier.
(f) Except as provided in subsection (h), the finished well casing:
(1) shall extend at least two (2) feet above the ground level; and
(2) if located in a flood plain, must be:
(A) at least two (2) feet above the elevation of the regulatory flood; or
(B) equipped with a watertight cap.
The monitoring well shall be located to protect against surface water ponding, and earthen materials, neat cement, or concrete shall be placed around the well casing to drain surface water from the well.
(g) A monitoring well, located where the casing is susceptible to damage, shall be equipped with a protective outer pipe consisting of a metal casing having a diameter large enough to allow easy access to the well. The protective cover pipe shall be firmly anchored in the ground. Additional protective devices, for example, brightly colored posts around the well, are required where construction equipment or vehicular traffic could damage the well.
(h) A monitoring well must be equipped with a locking cap or cover to prevent unauthorized access. The locking cap may be placed:
(1) directly on the well casing; or
(2) if required under subsection (g), on the protective cover pipe.
(i) A monitoring well installed so that the top of the well casing is finished at an elevation below the ground surface shall be equipped with a watertight cap. The top of the well casing shall terminate at a depth no greater than one (1)

foot below the ground surface and shall be located in a flush mounted protective cover pipe. The flush mounted protective cover pipe shall include each of the following:

(1) A watertight one (1) piece or continuous welded metal casing:

(A) at least one (1) foot long; and

(B) having a nominal diameter at least four (4) inches greater than the nominal diameter of the monitoring well.

The casing shall be flanged for greater stability if installed in a location likely to be subject to vehicular traffic.

(2) A concrete ground surface seal, if an impervious surface, for example, concrete or asphalt, is not present. The ground surface seal shall be installed and extend not more than three (3) feet below the ground surface.

(3) A sealed lid that is not more than one-half (½) inch higher than the elevation of the ground surface. The sealed lid shall be as follows:

(A) Of a quality to withstand vehicular traffic if installed in a location likely to be subject to vehicular traffic.

(B) Clearly marked with the words "MONITORING WELL" or "MONITOR" and also display the words "DO NOT FILL".

(j) A monitoring well installed by the rotary or auger drilling method shall have a borehole with a diameter at least two (2) inches greater than the nominal diameter of the casing. Except as provided in subsection (e), the well shall be grouted as follows:

(1) Granular bentonite may be used to grout a monitoring well if the:

(A) diameter of the borehole is four (4) inches or larger than the nominal diameter of the well casing; and

(B) well is not more than twenty-five (25) feet deep.

(2) Except as provided in subdivision (3), the annulus of the monitoring well shall be pressure grouted with neat cement or a bentonite slurry or be grouted with pelletized, medium grade, or coarse grade crushed bentonite from the top of the filter pack or filter pack seal under subsection (e) (for a well installed in unconsolidated materials) or the bottom of the well casing (for a well penetrating bedrock) to the ground surface or to within one (1) foot of the ground surface if a flush mounted protective cover pipe is installed if the:

(A) diameter of the borehole is four (4) inches or larger than the nominal diameter of the well casing; and

(B) well is not more than one hundred (100) feet deep.

(3) The annulus of the monitoring well shall be pressure grouted with neat cement or a bentonite slurry from the top of the filter pack or filter pack seal under subsection (e) (for a well installed in unconsolidated materials) or the bottom of the well casing (for a well penetrating bedrock) to the ground surface or to within one (1) foot of the ground surface if a flush mounted protected cover pipe is installed where either the:

(A) diameter of the borehole is less than four (4) inches larger in diameter than the nominal diameter of the well casing; or

(B) well is more than one hundred (100) feet deep.

(k) A monitoring well installed by the cable tool method shall be grouted as follows:

(1) The well casing shall be centered in a borehole:

(A) with a diameter of at least two (2) inches greater than the nominal diameter of the casing to be driven;

(B) dug at least three (3) feet, but not more than five (5) feet, below the ground surface; and

(C) filled with granular bentonite or a bentonite slurry during the installation of the casing.

Notwithstanding 312 IAC 13-5-1(c), bentonite slurry may be introduced into the borehole annulus by gravity methods during the installation of the well casing.

(2) Grouting shall be performed as provided under subsection (i) if a larger diameter:

(A) temporary casing is used to install a smaller diameter permanent well casing; or

(B) borehole is drilled to install a smaller diameter well casing.

(l) A monitoring well installed by the direct push method must be constructed as follows:

(1) The well shall be equipped with a prepacked well screen.

(2) A sand grout barrier shall:

(A) be placed directly above the prepacked well screen in the annulus between the well casing (riser pipe) and the borehole wall as the probe rods are retracted;

(B) be installed to prevent bridging; and
(C) extend not more than two (2) feet above the top of the prepacked well screen.
(3) A filter pack seal may be installed under subsection (e) directly above the sand grout barrier.
(4) The remaining annulus between the well casing (riser pipe) and probe rods shall be pressure grouted with neat cement or a bentonite slurry from the top of the sand grout barrier or filter pack seal to:
(A) if a flush-mounted protective pipe is installed, within one (1) foot of the ground surface; or
(B) the ground surface.
(5) The probe rods shall be pulled during installation of the grout material.
(m) A monitoring well shall be developed following installation and before water samples are collected. This development shall be accomplished to produce water that is as free as practicable from the following:
(1) Sediment.
(2) Drill cuttings.
(3) Drilling fluids.
If a well is installed to monitor ground water quality, the well shall be adequately developed to present a representative sample of the water quality.
(n) Contaminated drill cuttings, fluids, and surge and wash waters produced in the drilling and development of a monitoring well shall be collected and contained to:
(1) prevent contamination of the area; and
(2) protect persons who might otherwise come in contact with these materials.
(o) Monitoring well construction and development equipment that comes in contact with contaminated water or contaminated geologic materials shall be cleaned with high-pressure hot water or steam, using inorganic soap or other suitable solvents, and rinsed thoroughly. Contaminated fluids or wash waters shall be collected and contained so that the result is not:
(1) contamination of the area; or
(2) a hazard to individuals who may come in contact with these materials.
(Natural Resources Commission; 312 IAC 13-8-3; filed Nov 22, 1999, 3:34 p.m.: 23 IR 770; errata filed Dec 30, 1999, 4:02 p.m.: 23 IR 1109; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661; filed Jul 14, 2006, 1:23 p.m.: 20060809-IR-312050341FRA)

312 IAC 13-8-4 Dewatering wells
Authority: IC 25-39-4-9
Affected: IC 25-39
Sec. 4. (a) This section establishes standards for dewatering wells which are in addition to the general requirements for drilling a well under this article.
(b) A dewatering well shall be equipped with casing having a nominal diameter of at least one and one-fourth (1¼) inches. The casing shall be clean and free of grease, oil, or other contaminants that would impact water quality.
(c) Upon installation, a dewatering well must be fitted with a temporary cap which remains in place until pumping equipment is installed. The cap shall be of a type that prevents vermin or other potential contaminants from entering the well.
(d) Earthen materials shall be placed around the well casing to drain surface water away from the dewatering well.
(Natural Resources Commission; 312 IAC 13-8-4; filed Nov 22, 1999, 3:34 p.m.: 23 IR 772; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)

Rule 9. Well Disinfection

312 IAC 13-9-1 Disinfection procedures for drilled wells
Authority: IC 25-39-4-2; IC 25-39-4-9
Affected: IC 25-39
Sec. 1. (a) Except as provided in subsection (d), the following procedures shall be used for the disinfection of drilled wells:
(1) The amount of water in the well shall be determined by multiplying the gallons per foot by the number of feet of water in the well according to the following table:

Diameter of Well in Inches	Gallons Per Foot
2	.16
3	.37
4	.65
5	1.00
6	1.50
8	2.60
10	4.10
12	6.00

(2) At least one hundred (100) parts per million of chlorine concentration in water are required for disinfection. For each one hundred (100) gallons of water in the well, the amount of chlorine liquid or compound shown in the following table shall be used:

Laundry Bleach (5.25% chlorine)	Hypochlorite Granules (70% chlorine)
3 cups	2 ounces

(3) The solution prepared under subdivision (2) shall be poured into the well to ensure the casing walls are wetted before the cover, cap, or seal is installed.
(4) Instead of the applications described in subdivisions (1) through (2), another application of chlorine may be substituted by a water well driller which results in a chlorine concentration of at least one hundred (100) parts per million.
(b) As used in this section, one (1) cup is equivalent to an eight (8) ounce measuring cup.
(c) As used in this section, one (1) ounce is equivalent to one (1) heaping tablespoon of granules.
(d) This section does not apply to a monitoring well or a dewatering well. *(Natural Resources Commission; 312 IAC 13-9-1; filed Nov 22, 1999, 3:34 p.m.: 23 IR 772; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)*

312 IAC 13-9-2 Disinfection procedures for bucket wells
Authority: IC 25-39-4-2; IC 25-39-4-9
Affected: IC 25-39
Sec. 2. The following procedures shall be used for the disinfection of bucket wells:
(1) The amount of disinfectant required is determined primarily by the amount of water in the well. The following table establishes the amount of chlorine to use for each foot of water in the well:

Diameter of well in feet	3	4	5	6	7	8	10
Amount of 5.25% laundry bleach to use per foot of water (in cups)	1.5	3	4.5	6	9	12	18
Amount of .70% hypochlorite (in cups)	1	2	3	4	6	8	12

(2) To determine the amount of bleach, multiply the amount of disinfectant indicated as determined by the diameter of the well times the number of feet of water in the well.
(3) The amount of bleach determined under subdivision (2) shall be added to approximately ten (10) gallons of water and splashed around the lining or wall of the well. The entire amount of disinfectant must be circulated so that the solution contacts all parts of the well.
(4) The top of the well must be sealed.
(5) Instead of the applications described in this section, another application of chlorine may be substituted which results in a chlorine concentration of one hundred (100) parts per million.
(Natural Resources Commission; 312 IAC 13-9-2; filed Nov 22, 1999, 3:34 p.m.: 23 IR 772; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)

Rule 10. Landowner Responsibility for Abandonment and Plugging of Wells

312 IAC 13-10-1 Temporary abandonment of wells
Authority: IC 25-39-4-2; IC 25-39-4-6; IC 25-39-4-9
Affected: IC 25-39
Sec. 1. A well which has not been used for more than three (3) months without being permanently abandoned must be sealed at or above the ground surface by a welded, threaded, or mechanically attached watertight cap. The well shall be maintained so that the well does not become a source or channel of ground water contamination. *(Natural Resources Commission; 312 IAC 13-10-1; filed Nov 22, 1999, 3:34 p.m.: 23 IR 772; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)*

312 IAC 13-10-2 Permanent abandonment of wells
Authority: IC 14-10-2-4; IC 25-39-4-2; IC 25-39-4-6; IC 25-39-4-9
Affected: IC 25-39
Sec. 2. (a) A well abandoned before January 1, 1988, must be sealed at or above the ground surface by a welded, threaded, or mechanically attached watertight cap. The well shall be maintained so the well does not become a source or channel of ground water contamination. A well that poses a hazard to human health must also be plugged under subsection (c). A cased or uncased bucket well or a hand dug well (other than buried slab construction) that was abandoned before January 1, 1988, shall be closed in conformance with one (1) of the following procedures:

(1) Covered with a reinforced concrete slab:
(A) at least four (4) inches thick; and
(B) having a diameter larger than the nominal diameter of the borehole or the well casing.

(2) Equipped with a properly reinforced cover:
(A) constructed of pressure treated lumber;
(B) having dimensions larger than the nominal diameter of the borehole or well casing; and
(C) protected against the water with roofing or other water repelling materials that are properly maintained to ensure the integrity of the cover.

Closure shall not be performed under this subdivision, however, if the cover is in direct contact with ground water or surface water.

(3) Closed as otherwise approved by the division.

(b) A well drilled before January 1, 1988, and abandoned before January 1, 1994, shall be as follows:

(1) Sealed at or above the ground surface by a welded, threaded, or mechanically attached watertight cap.
(2) Maintained so the well does not become a source or channel of ground water contamination.

A well that poses a hazard to human health must also be plugged under subsection (c).

(c) A well abandoned after December 31, 1987, shall be plugged with an impervious grouting material to prevent the following:

(1) Migration of materials or fluids in the well.
(2) Loss of pressure in a confined aquifer.

(d) A well drilled after December 31, 1987, and not equipped with casing must be plugged within seventy-two (72) hours after completion.

(e) This subsection applies as follows to a cased or uncased well abandoned after December 31, 1987:

(1) The plugging material must consist of one (1) or a combination of the following:
(A) Neat cement with not more than five percent (5%) by weight of bentonite additive.
(B) Bentonite slurry, which can include polymers designed to retard swelling.
(C) Pelletized, medium grade, or coarse grade crushed bentonite.
(D) Other materials approved by the commission.

(2) The following methods apply:
(A) Cement and bentonite slurries shall be pumped into place in a continuous operation with a grout pipe introducing the plugging material at the bottom of the well and moving the pipe progressively upward as the well is filled.
(B) Plugging materials other than neat cement or bentonite slurry shall be installed in a manner to prevent bridging of the well or borehole. The well or borehole shall be measured periodically throughout the plugging process to ensure that bridging does not occur.

(3) The following procedures apply:

(A) An abandoned well shall be disconnected from the water system. Any substance that may interfere with plugging shall be removed, if practicable.

(B) A well, other than:

(i) a monitoring well;

(ii) a dewatering well; or

(iii) an uncased borehole;

shall be chlorinated before abandonment as provided in 312 IAC 13-9-1.

(4) A cased well shall be plugged as follows:

(A) With neat cement, bentonite slurry, or medium grade or coarse grade crushed or pelletized bentonite from the bottom of the well to within two (2) feet below the ground surface unless otherwise provided by the department.

(B) The well casing shall be severed at least two (2) feet below the ground surface, and a cement plug larger in diameter than the borehole shall be:

(i) constructed over the borehole; and

(ii) covered with natural clay material to the ground surface.

(5) An uncased well (other than a borehole drilled by a bucket rig or a dewatering well governed by subdivision (8) or (9)) shall be filled with:

(A) natural clay materials;

(B) neat cement;

(C) bentonite slurry; or

(D) medium grade or coarse grade crushed or pelletized bentonite;

from the bottom of the borehole to a depth of not less than twenty-five (25) feet below ground surface. The borehole shall be filled with neat cement or medium grade or coarse grade crushed or pelletized bentonite from a depth not less than twenty-five (25) feet below ground surface to within two (2) feet below ground surface. The remaining borehole shall be filled with natural clay material to ground surface.

(6) A cased or uncased monitoring well shall be plugged from the bottom of the well or borehole to the ground surface with a:

(A) bentonite slurry; or

(B) pelletized or coarse grade crushed bentonite.

(7) A bucket well shall be plugged as follows:

(A) A bucket well installed as buried slab construction shall be filled with gravel from the bottom of the well to within ten (10) feet below the ground surface. Neat cement, bentonite slurry, or pelletized, medium grade, or coarse grade crushed bentonite shall be installed in the casing or well pipe from not less than ten (10) feet below the ground surface to within two (2) feet below the ground surface. The well pipe shall be:

(i) severed at least two (2) feet below the ground surface; and

(ii) covered with a cement plug larger in diameter than the well pipe.

The remaining hole shall be filled with natural clay material to the ground surface.

(B) Bucket well construction:

(i) using casing with an inside diameter of less than twelve (12) inches extending the entire length of the borehole; and

(ii) equipped with a well screen;

shall be abandoned under subdivision (4)(A).

(C) An uncased borehole drilled by a bucket rig shall be filled with natural clay material:

(i) from the bottom of the hole to the ground surface; and

(ii) thoroughly tamped to minimize settling.

(D) For other than buried slab construction, a bucket well shall be filled with gravel from the bottom of the well to at least five (5) feet below ground surface. The top section of the concrete or tile well casing shall be removed to cause the top of the well to terminate below ground surface. The well shall be filled with at least one (1) foot of:

(i) neat cement;

(ii) bentonite slurry; or

(iii) pelletized, medium grade, or coarse grade crushed bentonite;

from at least five (5) feet below ground surface to the top of the well casing. The well casing shall be covered with a cement plug larger in diameter than the borehole. The remaining hole shall be filled with natural clay material to ground surface.

(8) If a dewatering well casing is removed following use, the remaining borehole shall initially be filled with granular, pelletized, medium grade, or coarse grade crushed bentonite a minimum of one (1) foot thick. The remainder of the borehole shall be:

(A) filled with natural earth materials obtained during the drilling process to the ground surface; and

(B) thoroughly tamped to minimize settling.

(9) If a dewatering well casing is removed following use and the well site will be excavated as part of the construction project, the remaining borehole shall be:

(A) filled with natural earth materials obtained during the drilling process to the ground surface; and

(B) thoroughly tamped to minimize settling.

(f) The division shall be notified in writing of a well abandonment within thirty (30) days after plugging is completed. *(Natural Resources Commission; 312 IAC 13-10-2; filed Nov 22, 1999, 3:34 p.m.: 23 IR 773; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661; filed Jul 14, 2006, 1:23 p.m.: 20060809-IR-312050341FRA)*

Rule 11. Inspections

312 IAC 13-11-1 Inspections; compliance

Authority: IC 25-39-4-2; IC 25-39-4-9

Affected: IC 25-39

Sec. 1. A conservation officer or another representative of the department may observe the installation of a water well or pump and may inspect equipment used to drill a well. Work that does not comply with this article or IC 25-39 must be promptly corrected by the water well driller. Work that is covered contrary to the request of a department representative must, upon request, be uncovered for inspection and replaced by the water well driller. *(Natural Resources Commission; 312 IAC 13-11-1; filed Nov 22, 1999, 3:34 p.m.: 23 IR 774; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)*

312 IAC 13-11-2 Inspections by the department of records of a water well driller

Authority: IC 25-39-4-2; IC 25-39-4-6; IC 25-39-4-9

Affected: IC 25-39

Sec. 2. A conservation officer or another representative of the department may, at any reasonable time, inspect any record maintained by a water well driller that is needed to comply with IC 25-39 or this article. *(Natural Resources Commission; 312 IAC 13-11-2; filed Nov 22, 1999, 3:34 p.m.: 23 IR 774; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)*

Rule 12. Enforcement

312 IAC 13-12-1 Administrative enforcement

Authority: IC 14-10-2-4; IC 25-39-4-2; IC 25-39-4-9

Affected: IC 4-21.5; IC 25-39

Sec. 1. (a) This rule governs enforcement of IC 25-39 and this article by the department under IC 4-21.5 and 312 IAC 3-1.

(b) This rule does not limit the authority to enforce IC 25-39 and this article through any other lawful method.

(c) This rule does not establish a basis for an action against a water well driller by a person other than the department. *(Natural Resources Commission; 312 IAC 13-12-1; filed Nov 22, 1999, 3:34 p.m.: 23 IR 774; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)*

312 IAC 13-12-2 Suspension or revocation of a license as a water well driller

Authority: IC 14-10-2-4; IC 25-39-4-2; IC 25-39-4-9

Affected: IC 4-21.5-3-6; IC 4-21.5-4; IC 25-39-4

Sec. 2. (a) The division may seek to suspend or revoke the license of a water well driller who has done any of the following:

(1) Acted as a well driller without a license in violation of IC 25-39.

(2) Secured a license through error or fraud.

(3) Failed to comply with the requirements set forth in any of the following:
(A) IC 25-39-4-1, IC 25-39-4-2, IC 25-39-4-4, IC 25-39-4-5, or IC 25-39-4-6.
(B) 312 IAC 13-2 through 312 IAC 13-10.

(b) An action under this section is governed by IC 4-21.5-3-6 and shall be initiated by the division with the issuance of a written notice directed to the person who is the subject of the action. The notice shall include the following:
(1) A brief description of the order for suspension or revocation. An order for a license suspension shall not exceed a period of effectiveness that exceeds ninety (90) days.
(2) A declaration that the recipient of the order may seek:
(A) a stay of effectiveness of the suspension or revocation;
(B) review of the suspension or revocation; or
(C) both a stay of effectiveness and review of the suspension or revocation;
by making a written request within eighteen (18) days of issuance addressed to:
Director, Division of Hearings
Natural Resources Commission
Indiana Government Center-South
402 West Washington Street, Room W272
Indianapolis, Indiana 46204.

(c) An order issued by the division under subsection (b) is effective fifteen (15) days after issuance unless the recipient of the order obtains a stay of effectiveness. This subsection does not preclude the department from issuing, under IC 4-21.5-4, an emergency or other temporary order with respect to the license. *(Natural Resources Commission; 312 IAC 13-12-2; filed Nov 22, 1999, 3:34 p.m.: 23 IR 774; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)*

312 IAC 13-12-3 Denial of a new, renewal, or restoration license as a water well driller
Authority: IC 14-10-2-4; IC 25-39-4-2; IC 25-39-4-9
Affected: IC 4-21.5-3-5; IC 4-21.5-4; IC 25-39-4
Sec. 3. (a) The division may refuse to grant, renew, or restore a license to a person who has done any of the following:
(1) Acted as a well driller without a license in violation of IC 25-39.
(2) Secured a license through error or fraud.
(3) Failed to comply with the requirements set forth in any of the following:
(A) IC 25-39-4-1, IC 25-39-4-2, IC 25-39-4-4, IC 25-39-4-5, or IC 25-39-4-6.
(B) 312 IAC 13-2 through 312 IAC 13-10.

(b) An action under this section is governed by IC 4-21.5-3-5 and shall be initiated by the division with the issuance of a written notice directed to the applicant and to any person who has requested notice under IC 4-21.5-3-5(b)(4). The notice shall include the following:
(1) A brief description of the denial order and the basis for the denial.
(2) A declaration that the recipient of the order may seek administrative review by making a written request within eighteen (18) days of issuance addressed to:
Director, Division of Hearings
Natural Resources Commission
Indiana Government Center-South
402 West Washington Street, Room W272
Indianapolis, Indiana 46204.

(c) If the division orders the denial of a license renewal, and a timely and sufficient application was made for renewal of the license, the existing license does not expire until the commission has disposed of a proceeding. This subsection does not preclude the department from issuing, under IC 4-21.5-4, an emergency or other temporary order with respect to the license. *(Natural Resources Commission; 312 IAC 13-12-3; filed Nov 22, 1999, 3:34 p.m.: 23 IR 775; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)*

312 IAC 13-12-4 Administrative review of a sanction against a water well drilling license
Authority: IC 14-10-2-4; IC 25-39-4-2; IC 25-39-4-9
Affected: IC 25-39
Sec. 4. (a) The commission may consider the factors set forth in this section in conducting administrative review of an order issued by the department under section 2 or 3 of this rule.
(b) Mitigating factors are as follows:

(1) The person against whom action is taken has not previously been adjudicated by the commission or a court to have violated IC 25-39 or this article.
(2) The violation appears to have been unintentional.
(3) The violation was an isolated occurrence.
(4) Contamination is unlikely to have occurred as a result of the violation.
(5) Where a violation has occurred, the person has acted diligently to correct the violation.

(c) Aggravating factors are as follows:
(1) The person against whom action is taken has previously been adjudicated by the commission or a court to have violated IC 25-39 or this article.
(2) The violation appears to have been intentional.
(3) A pattern of violations has occurred.
(4) Significant contamination is likely to have occurred as a result of the violation.
(5) A hazard to human health is likely to have occurred as a result of the violation.

(Natural Resources Commission; 312 IAC 13-12-4; filed Nov 22, 1999, 3:34 p.m.: 23 IR 775; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)

312 IAC 13-12-5 Notice of violation

Authority: IC 14-10-2-4; IC 25-39-4-2; IC 25-39-4-9
Affected: IC 4-21.5-3-8; IC 14-10-2-6; IC 25-39-5

Sec. 5. (a) The department may issue a complaint for a notice of violation under IC 14-10-2-6 against a person who violates IC 25-39-5. The complaint shall be filed with the division of hearings of the commission and is subject to IC 4-21.5-3-8. The division of hearings shall cause the complaint to be served upon the parties named in the complaint.
(b) The department has the burden of proving any violation alleged in the complaint by a preponderance of the evidence.
(c) A separate notice of violation may be issued or a separate charge imposed for each day a violation occurs.
(d) The person who is the subject of the complaint may establish as an affirmative defense the filing by a prosecuting attorney of a misdemeanor information or infraction complaint based on the same event as that upon which the notice of violation was based. The person has the burden of proving the affirmative defense.
(e) If following a completed proceeding under IC 4-21.5 the commission finds the violation occurred, the commission shall order the person to abate the violation within a reasonable period of time. The abatement period shall not be less than fifteen (15) days. The order shall also specify that, if the violation is not abated within the specified time, the person shall pay a charge that does not exceed the maximum amount that may be assessed by a court for committing the violation as an infraction or misdemeanor.

(Natural Resources Commission; 312 IAC 13-12-5; filed Nov 22, 1999, 3:34 p.m.: 23 IR 775; readopted filed Aug 4, 2005, 6:00 p.m.: 28 IR 3661)

*

THIS PAGE WAS INTENTIONALLY LEFT BLANK