PROJECT SPECIFIC PLAN
FOR THE INSTALLATION OF THE
SOUTH FIELD PHASE II MODULE EXTRACTION/RE-INJECTION
WELLS AND ADDITIONAL SOUTH FIELD MONITORING WELLS

PROJECT NUMBER 52462-PSP-0002

JUNE 2002

Prepared by

Fluor Fernald

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1.0 INTRODUCTION

This Project Specific Plan (PSP) serves as the controlling document for the installation of South Field Phase II Module extraction and re-injection wells, and the installation of additional South Field groundwater monitoring wells to upgrade the existing groundwater monitoring well network. Specifically, this PSP covers the following:

- The installation of four new extraction wells (33262, 33264, 33265, and 33266), and one new re-injection well (33263)
- The installation of 12 Type 2 groundwater monitoring wells (23271 through 23282)
- The installation of 10 Type 6 groundwater monitoring wells (63284 through 63292)
- The installation of four Type 8 (Continuous Multi Channel Tubing [CMT]) groundwater monitoring wells (83293 through 83296)
- The collection of aquifer sediment to support the PSP for the Analysis of how Uranium is Sorbed and Partitioned on Great Miami Aquifer Matrix Sediments
- The collection of aquifer sediment to support planned *in situ* reactive zone benchscale tests as discussed below.

Figure 1-1 shows the locations of all of the wells listed above. All of the wells are located in the South Field area. Information supporting the basis and location of the extraction wells and the re-injection well was provided to the Ohio Environmental Protection Agency and U.S. Environmental Protection Agency on May 16, 2002 in the *Design for Remediation of the Great Miami Aquifer South Field Phase II Module*. In this Design Report, Extraction Wells 33262, 33264, 33265, and 33266 are identified as SF-31, SF-32, SF-33, and SF-34, respectively, and Re-Injection Well 33263 is identified as SF INJ 1. The locations and basis for the 26 groundwater monitoring wells are provided in this PSP.

A rotosonic drilling rig will be used to collect cores at the four extraction wells, the one re-injection well, and to drill the borings needed to install 22 of the 26 new monitoring wells in the South Field. The four Type 8 CMT monitoring wells will be installed using a Geoprobe 6600™ System. All drilling and sampling field activities will conform to the guidelines set forth in the Sitewide CERCLA Quality Assurance Manual (SCQ), unless otherwise specified in this PSP. Performance of the requirements specified in procedure ADM-02, *Field Project Prerequisites,* shall precede all field activities.

The installation strategy for the extraction and re-injection wells is to obtain sediment samples to design the most efficient well screens possible. These sediment samples will be obtained from the cores that will be collected using the rotosonic drilling rig. Additional sediment samples will also be collected from the core at two locations to support two other studies: 1) the analysis of how uranium is sorbed and partitioned on Great Miami Aquifer sediments (Extraction Wells 33262 and 33264), and 2) benchscale testing of *in situ* uranium precipitation from groundwater for the Fernald Environmental Management Project (FEMP) (Extraction Well 33264).

The first study that will be supported by sediment samples collected under this PSP focuses on providing information on how uranium is adsorbed or partitioned within aquifer material. It will look at the uranium fraction that is readily exchangeable or bound with carbonate minerals, metal oxides, metal hydroxides, organic matter, clay minerals, refractory minerals, and residual solids. The controlling document for this work is the *Project Specific Plan for the Analysis of how Uranium is Sorbed and Partitioned on Great Miami Aquifer Matrix Sediments* (DOE 2002).

The second study, benchscale testing, is intended to demonstrate the feasibility of using Enhanced Anaerobic Reductive Precipitation technology at the FEMP. At other sites, this technology has been shown to effectively precipitate metals and radionuclides *in situ*. This work is being conducted by ARCADIS G&M and funded by the U.S. Department of Energy's (DOE's) National Energy Technology Laboratory in Pittsburgh, Pennsylvania. If the benchscale tests provide promising results, then ARCADIS G&M would like to obtain permission to conduct a field scale test of the technology here at the FEMP. DOE considers this technology a potential tool for the enhancement of aquifer restoration at the FEMP, which should be further evaluated regarding its site-specific applicability. For instance, this technology could be deployed in recalcitrant areas of the uranium plume that are not responding well to pump-and-treat operations.

Location and Basis for Additional Monitoring Wells

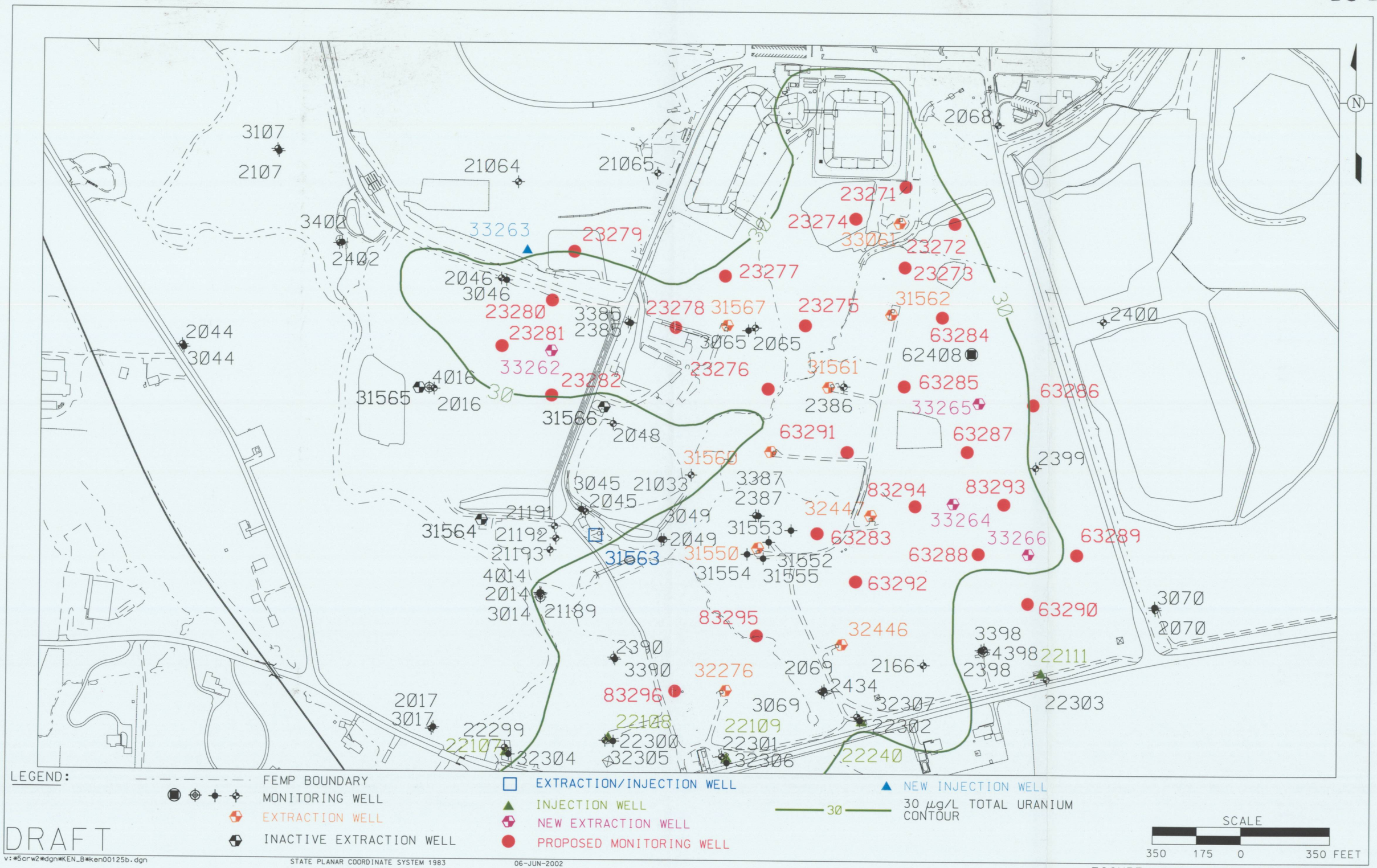
Additional groundwater monitoring wells are needed in the South Field to assist in wellfield operational decisions (e.g., well specific pumping rates), to provide a monitoring network capable of evaluating different extraction well operational strategies (e.g., pulse pumping), and for verifying that clean-up objectives within the aquifer are being achieved.

Heterogeneity within the aquifer complicates the contaminant removal process. Pulling contamination to extraction wells is complicated by the diffusion of contaminants into low-permeability sediments, hydrodynamic isolation of contaminants within the wellfield (i.e., establishment of preferential flow paths), and desorption of contaminants from sediments.

Installation of the 26 monitoring wells listed in this PSP will provide for a better monitoring network in the South Field and make it consistent with the network that was recently installed in the Pilot Plant Drainage Ditch area. The objective is to have a monitoring well located to the north, south, east, and west of each extraction well. Figure 1-2 illustrates how the network has been designed in relation to each extraction well. To construct the monitoring network shown in Figure 1-2, 12 Type 2 monitoring wells, 10 Type 6 monitoring wells, and four Type 8 monitoring wells will need to be installed. Type 2 monitoring wells are installed when the most highly contaminated plume interval is at or near the water table. Type 6 monitoring wells are installed when the most highly contaminated plume interval is below the water table but above the Type 3 well screen target depth. Type 8 monitoring wells are installed when the plume is thick enough to warrant monitoring at several different depths.

As shown in Figure 1-2, existing monitoring wells, when available, are being used to complete the network. In some cases though, existing monitoring wells are installed at depths that will no longer aid in the monitoring of the plume. For instance, Monitoring Well 2399, which is located out in front of the eastern edge of the plume, is installed too shallow to adequately monitor the uranium plume. The top of the 30 micrograms per liter (μg/L) uranium plume is below the water table and the highest uranium concentration measured in the plume is above the target screen interval for a Type 3 monitoring well. Therefore, Type 6 monitoring wells are required. Existing direct-push data were used to establish screen depths for the new monitoring wells. Figure 1-3 shows the direct-push sample locations used in relation to the monitoring network. Appendix C provides the direct-push sampling data that were used.

Uranium concentrations over time will be monitored in the surrounding network of monitoring wells to document the direction from the pumping well that is receiving the most clean-up benefit from the pumping. It is envisioned that this information will aid in the identification of hydrodynamically isolated areas within the South Field. Once hydrodynamically isolated areas are identified, pumping changes can be implemented in attempts to modify the flow patterns to enhance remediation of the formerly isolated areas.



LEGEND:

- FEMP BOUNDARY
- MONITORING WELL
- EXTRACTION WELL
- INACTIVE EXTRACTION WELL
- EXTRACTION/INJECTION WELL
- INJECTION WELL
- NEW EXTRACTION WELL
- PROPOSED MONITORING WELL
- NEW INJECTION WELL
- 30 µg/L TOTAL URANIUM CONTOUR

DRAFT

SCALE: 350 175 0 350 FEET

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FIGURE 1-1. WELL LOCATION MAP

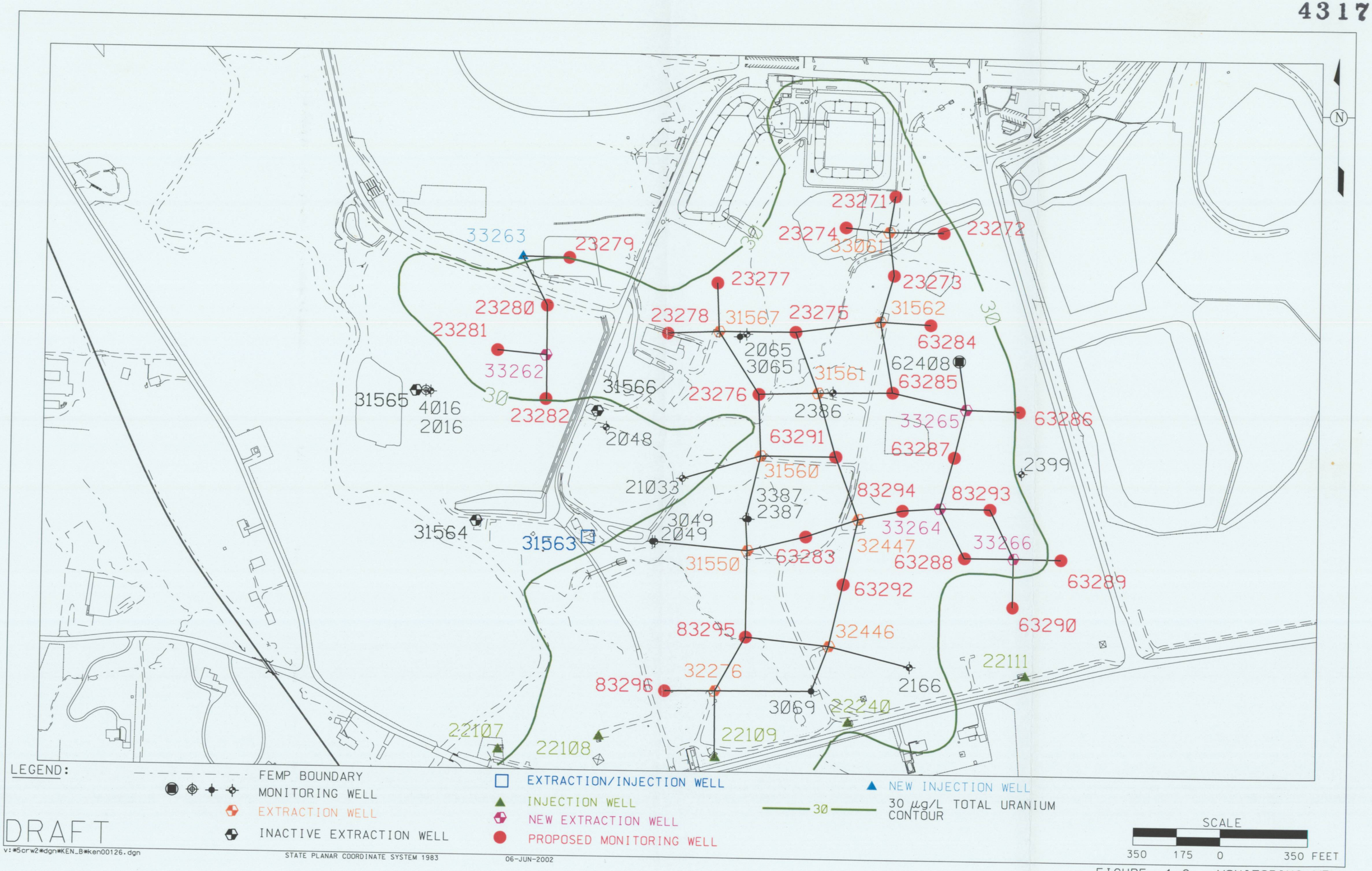
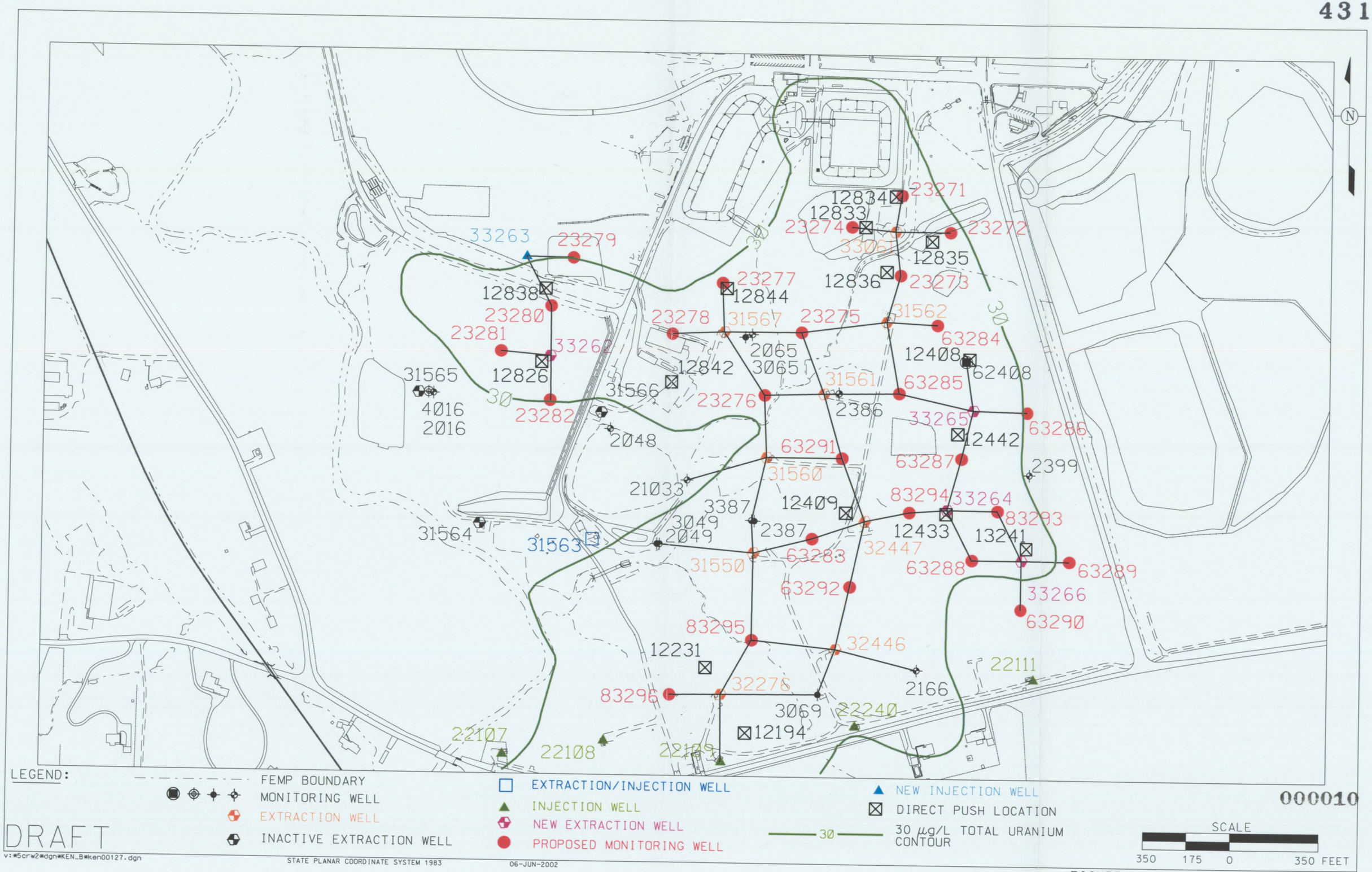


FIGURE 1-2. MONITORING WELL NETWORK DESIGN LOCATION



LEGEND:

- FEMP BOUNDARY
- MONITORING WELL
- EXTRACTION WELL
- INACTIVE EXTRACTION WELL
- EXTRACTION/INJECTION WELL
- INJECTION WELL
- NEW EXTRACTION WELL
- PROPOSED MONITORING WELL
- NEW INJECTION WELL
- DIRECT PUSH LOCATION
- 30 — 30 µg/L TOTAL URANIUM CONTOUR

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350 175 0 350 FEET

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STATE PLANAR COORDINATE SYSTEM 1983

06-JUN-2002

FIGURE 1-3. MONITORING WELL NETWORK AND DIRECT PUSH LOCATIONS

2.0 MANAGEMENT AND ORGANIZATION

A qualified subcontractor, under the direct supervision of Fluor Fernald, will conduct drilling activities. All sampling activities defined in this PSP will be performed by Fluor Fernald. Descriptions of some of the key technical responsibilities of project personnel or organizations are provided below:

The DOE Operable Unit 5 Team Leader is responsible for:

- Providing direction and oversight to the completion of PSP activities
- Acting as the point of contact within DOE and for the regulators and stakeholders for all communications concerning work carried out under this PSP.

The Fluor Fernald Aquifer Restoration/Wastewater Project (ARWWP) Manager is responsible for:

- Providing overall project management and technical guidance
- Ensuring the necessary resources are allocated to the project for the efficient and safe completion of PSP activities
- Overseeing and auditing PSP activities to ensure that the work is being performed efficiently and in accordance with all regulatory requirements and commitments, DOE Orders, site policies and procedures, and safe working practices.

The Fluor Fernald ARWWP Hydrogeology Team Coach/Project Lead is responsible for:

- The safe and prompt completion of work outlined in the PSP
- Oversight and programmatic direction of sampling activities
- Providing a technical lead for the collection and interpretation of sampling data
- Establishing and maintaining the scope, schedule, and cost baseline
- Reporting to the DOE Operable Unit 5 Team Leader and Fluor Fernald ARWWP Manager on the status of PSP activities and on the identification of any problems encountered in the accomplishment of the PSP
- Obtaining the necessary funding to complete the sampling and data analysis activities.

The Fluor Fernald ARWWP Hydrogeology Technical Lead is responsible for:

- Reporting to the Fluor Fernald ARWWP Hydrogeology Project Lead on the progress of PSP activities
- Assisting field personnel as required to complete work described in this PSP
- Assuring that data needed for screen and well design are collected
- Designing the screens for the extraction and re-injection wells
- Assuring that data needed to support an ongoing study on the analysis of how uranium is sorbed and partitioned on Great Miami Aquifer sediments are collected
- Assuring that data needed to support an off site benchscale test on *in situ* reactive zone technology are collected.

The Fluor Fernald Water Monitoring Section Team Coach is responsible for:

- Managing and overseeing the drilling and installation of the wells in the field
- Assigning a Field Geologist to oversee drilling operations
- Oversight of the subcontractor during drilling and installation
- Reporting field progress to the Fluor Fernald ARWWP Hydrogeology Project and Technical Leads.

The key project personnel are listed below:

Title	Primary	Alternate
DOE Operable Unit 5 Team Leader	Rob Janke	
Fluor Fernald ARWWP Manager	David Brettschneider	
Fluor Fernald ARWWP Hydrogeology Project Lead	Bill Hertel	
Fluor Fernald ARWWP Hydrogeology Technical Lead	Ken Broberg	Bill Hertel
Water Monitoring Section Team Coach	Karen Voisard	
Field Geologist	Jonathon Walters	Karen Voisard
Laboratory Contact	Justin Burke	
Quality Assurance Contact	Mike Hoge	Frank Thompson
Health & Safety Contact	Keith Lanning	

3.0 FIELD ACTIVITIES

Field activities will include:

- Staking and Surveying the Drilling Locations (Section 3.1)
- Installation and Development of Extraction Wells 33262, 33264, 33265, 33063, and Re-Injection Well 32363 (Section 3.2)
- Installation, Development, and Initial Sampling of 12 Type 2 Groundwater Monitoring Wells (23271 to 23282) and 10 Type 6 Groundwater Monitoring Wells (63284 to 63292) (Section 3.3)
- Installation, Development, and Initial Sampling of Four Type 8 CMT Groundwater Monitoring Wells (83293 to 83296) (Section 3.4).

3.1 STAKING AND SURVEYING THE DRILLING LOCATIONS

Exact coordinates for each well location will be surveyed prior to drilling. Estimated coordinates are provided in Table 3-1. Estimated coordinates could change to avoid field obstructions. A surveyor's stake with a highly visible ribbon tied around the top will be driven into the ground at each drilling location. The staked location will be surveyed vertically and horizontally to the nearest 0.1 foot and approved by a State of Ohio-licensed surveyor. Field crews shall conform to the requirements stated in procedure SH-0018, *Penetration Permits*, prior to penetrating the ground surface beyond six inches. The corresponding well number for the location will be written on the stake. Survey coordinates will be entered into the Site Environmental Database.

3.2 INSTALLATION AND DEVELOPMENT OF EXTRACTION WELLS 33262, 33264, 33265, 33063, AND RE-INJECTION WELL 32363

The installation strategy for the extraction and re-injection wells will be to first collect a four-inch diameter sediment core from an eight-inch boring using a rotosonic drilling rig to support design of the well screens. Samples of aquifer material taken from the core will be sieved. The grain size results will be used to select the most efficient slot size possible for the screen, and an adequate artificial filter pack sand size. Following the collection of the rotosonic core, a 24-inch diameter borehole will be drilled at each location using a cable tool drilling rig to facilitate installation of the wells.

Activities for the installation and development of the extraction and re-injection wells consist of the following:

- Collection of sediment cores
- Well installation
- Well development.

3.2.1 Collection of Sediment Cores

A rotosonic drilling rig will be used to collect a four-inch diameter sediment core at each extraction and re-injection well location prior to installing the well with a cable tool drilling rig. Soil samples will be collected in accordance with procedure DRL-02, *Solids Sampling in Drilled Boreholes*. A four-inch diameter rotosonic core will be obtained from the target sampling interval presented in Table 3-2 for each extraction and re-injection well location.

A Field Geologist shall prepare brief lithologic descriptions of the cores on a *Visual Classification of Soils Form*. The lithology of the cores will be described in approximately five feet intervals. Soil samples (500 ml) will be collected from the core and submitted to a laboratory for particle size analysis via sieves to support the selection of screen slot size, screen length, and filter pack size. The target sampling intervals presented in Table 3-2 for each extraction and re-injection well are based on previous direct-push sampling water quality results. The second to last column in Table 3-2 identifies the direct-push sample location that was used to select the target sampling intervals for the new extraction and re-injection wells. The last column on Table 3-2 identifies the cross section that contains the pertinent direct-push sample locations for each well.

Following the collection of the sediment core at each location, the rotosonic borehole will be allowed to collapse naturally up to the water table. If available, a cable tool drilling rig will be moved over the boring and drilling of the well bore will begin without abandoning the Rotosonic™ boring. If the cable tool drilling rig is not available, then the borehole above the water table will be temporarily filled with Global #4 sand or finer up to the glacial till/aquifer interface. From the glacial till/aquifer interface to the surface, the hole will be filled with bentonite chips or pellets.

Approximately 12 additional sediment samples will be collected from the sediment core obtained at Extraction Wells 33264 and 33262. Extraction Well 33264 is situated in an area of the plume with the highest dissolved uranium contamination currently noted for the South Field. Extraction Well 33262 is situated in the Southern Waste Units area, just downgradient from the area of the plume that previously had the highest dissolved uranium contamination noted for the South Field. These additional sediment samples will be used to help analyze how uranium is sorbed and partitioned on Great Miami Aquifer matrix sediments. Selecting samples from areas of the plume with the highest dissolved uranium concentrations will maximize the probability of having uranium concentrations in the sediments that are large enough to complete all of the measurements planned for the study. Two target intervals will be

selected at each well for these additional sediment samples; the zone of highest dissolved uranium contamination, and the vadose zone just above the water table that is encountered at the time of drilling. Two-liter samples will be containerized in either glass or plastic jars. The jars will be filled as much as possible to reduce headspace above the sample. The jars will be sealed and clearly labeled with a well number and depth interval. These sediment samples will be sent to Sandia National Laboratory in Carlsbad, New Mexico.

Approximately 15,000 cm^3 (approximately 0.5 ft^3) of core samples will be collected from Extraction Well 33264 to support benchscale testing of *in situ* uranium precipitation from groundwater for the FEMP. The core samples to support the benchscale testing need to be collected under controlled conditions. The laboratory that will be analyzing the samples has sent special sterilized core sleeves that will be used to collect these samples. Once collected, the samples will be shipped as soon as possible to the laboratory conducting the analyses.

3.2.2 Installation of Extraction and Re-Injection Wells

Following collection of the sediment cores and design of the well screens, a cable tool drilling rig shall be used to advance a 24-inch diameter borehole to a target drilling depth at each location. The exact drilling depth will be set once the screen has been designed and the length of the screen has been determined. The Field Geologist will document drilling, installation, and development activities on standard *Field Activity and Well Completion Logs*. Well installation shall be performed in accordance with the requirements outlined below and, unless otherwise specified, shall follow the general guidelines set forth in Appendix J of the SCQ.

The extraction wells will be constructed of 16-inch diameter 304 stainless steel. They will be capable of delivering a minimum of 300 gallons per minute (gpm) of groundwater with an average screen entrance velocity of < 0.1 feet per second (Driscoll 1986). The re-injection well will be constructed of 16-inch diameter 304 stainless steel. It will be capable of delivering a minimum of 200 gpm of groundwater with an average screen entrance velocity of < 0.05 feet per second (Driscoll 1986). Type 304 stainless steel was chosen over PVC for the re-injection well based on cost, recommendations of the site drilling contractor, and maintenance experience. Sixteen-inch diameter PVC is very expensive, making stainless steel competitive from a cost perspective. The site-drilling subcontractor recommended against the use of 16-inch diameter PVC citing difficulty in keeping the casing straight during installation. The stainless

steel casing holds up better than PVC under routine maintenance activities. All of the extraction wells and the re-injection well will be installed with a five-foot sump at the base of their screens.

The actual length and depth of the screen interval will be designed after sieve analysis results have been obtained. The Hydrogeology Technical Lead will advise the Field Geologist at what depth to place the top of the well screen. The depth selected for the screen will also consider the dynamic water level, which will be achieved during the aquifer restoration when the entire aquifer system is operating. Criteria, which will be used to determine the length and slot size of the well screen, are as follows:

- The depth and thickness of the > 30 μg/L total uranium plume in the water column
- The presence of the blue clay layer
- The lithology and grain size of the aquifer material within the > 30 μg/L total uranium plume
- Model predicted pumping water levels
- Historic measured water levels.

The extraction wells and re-injection well will be completed using an artificial filter pack. The artificial filter pack will extend to a height above the well screen a minimum of one-half the length of the well screen. A layer of "transition sand" will be installed above the artificial filter pack sand. This transition sand will have a finer grain size than the artificial filter pack sand surrounding the well screen. The transition sand will have a minimum thickness of five feet and will extend to a height of at least 10 feet above the maximum-recorded water level. A five foot thick bentonite seal (pellets) will be installed above the transition sand. The objective will be to place the bentonite plug in the aquifer sand at least 10 feet above the maximum-recorded water level or across the glacial overburden/sand interface. No bentonite pellets will be installed below the water table. A backfill of grout slurry above the bentonite seal shall extend to the ground surface. A concrete pad will be installed at a later date so as not to interfere with surface construction activities. Specific dimensions for the annular seal will be provided once the sieve results from the core have been obtained and the length of the screen has been finalized.

The well riser shall terminate approximately three feet above the ground surface. The well will be secured with a well cap. During installation of the well, the Field Geologist will be responsible for documenting that the correct thickness of annular fill material is being installed, and that the well screen is installed at the correct depth. Frequent measurements of the depth to the top of the annular fill need to be collected to verify the installation process. If installation work is interrupted, (i.e., luch carry over to the next day, etc.) the Field Geologist will verify that the depths measured prior to the interruption are the same depths measured prior to resuming installation activities after the interruption.

3.2.3 Development of Extraction and Re-Injection Wells

Well development shall be performed as outlined below. Well development shall be initiated no sooner than 48 hours following completion of well installation.

Development will be conducted with the same protocols used to develop the previously installed extraction and re-injection wells. This development strategy has proven to be very successful. Development will begin by surging the well for a maximum of 24 hours. After the well screen has been designed, the ARWWP Hydrogeology Technical Lead will determine a surging plan for the screen, based on the stroke length of the development rig being used and the length of the well screen. The stroke length of the development rig determines the length or interval of screen that is surged by the surge block during a particular event. For the purpose of this PSP, this screen length will be called the "surge interval". Each surge interval of the well screen will be surged for one hour; the sand contained in the well after one hour of surging will be measured and removed prior to raising or lowering the surge blocks to surge the next interval of screen. Surging will begin slowly and gradually increase (i.e., operate the rig slowly then gradually increase power or stroke length if possible).

Following surging, the well will be pumped for six-hours for the purpose of measuring the sand content of the pumped water and the specific capacity of the well. The goal of development will be to produce a well capable of delivering water that has a sand content of 10 parts per million (ppm) or less. If the sand content of the pumped groundwater is below 10 ppm at the conclusion of the development pumping, then development is complete. If the sand content of the pumped groundwater is above 10 ppm at the end of the development pumping, then the development cycle shall be repeated until the ARWWP Hydrogeology Technical Lead determines that development is complete.

3.2.3.1 Project-Specific Requirements for Extraction/Re-Injection Well Development

1. Measure the depth to the bottom of the well. Record the depth in the comment section of the *Well Development Form*.

2. Lower the surge block to the lower surge interval of the well screen and surge the well for one hour.

3. Remove the surge block from the well and measure the depth to the bottom of the well to record how much sediment was brought into the well as a result of the surging.

4. Bail or air lift as much sediment from the well as possible. Measure the total depth of the well to document how much sand was removed.

5. Raise the surge block to the next higher surge interval of the screen and surge for one hour.

6. Repeat Steps 3 through 5 until the top surge interval of the screen has been surged.

7. After surging the top surge interval of the screen, repeat Steps 3 through 6, but lower the surge block after each hour of surging instead of raising it. Shorter surge time intervals can be used if deemed appropriate.

8. Upon reaching the lower surge interval of the screen, repeat Steps 3 through 6 again. Follow this procedure of surging up and down the screen for a maximum of 24 hours, unless the technical lead determines that the well has reached an acceptable development state sooner than 24 hours.

3.2.3.2 Development Pumping

Development pumping will be performed as follows:

1. Measure the total depth and the static water level of the well and record the information on the *Field Activity Log.*

2. Pump the well for two hours. The Hydrogeology Technical Lead will provide the pumping rates to be used. Measure the water level of the pumping well approximately every 20 minutes. Collect a total uranium sample at the end of each two-hour pumping interval.

3. Conduct a sand content test after 15 minutes, 30 minutes, 60 minutes, 90 minutes, and 120 minutes of pumping. Steps for conducting a sand content test are provided below.

4. After two hours of pumping, increase the pumping rate as specified by the Hydrogeology Technical Lead. Pump the well for an additional two hours and repeat the measurements described in Steps 2 and 3.

5. Increase the pumping rate as specified by the Hydrogeology Technical Lead. Pump the well at this rate for an additional two hours and repeat the measurements described in Steps 2 and 3.

6. After a total of approximately six hours of pumping, stop the pumping.

7. Measure the recovery rate of the well by taking water level measurements every 30 seconds until the water level is to within one foot of the static water level recorded before the start of pumping approximately six hours earlier.

3.2.3.3 Sand Content Testing

Sand content will be measured by passing a sample of the pumped well water through a centrifugal sand sampler. The centrifugal sand sampler will be installed in the discharge line used for development, just slightly down gradient of the well head. Operation of the sand content sampler is described as follows:

1. Install the centrifugal sand content tester as directed by the manufacturer. The inlet should be located on the horizontal centerline of the discharge pipe and as close to the discharge head as possible.

2. Open the tester inlet valve wide open. Adjust the outlet valve to one-half gpm. (This will fill one quart in 30 seconds or one gallon in two minutes).

3. Close the inlet valve, remove, clean, and replace the glass tube.

4. When ready to start the sand content test, record the start time and open the inlet valve wide open.

5. After five minutes, record the amount of accumulated sand in the glass tube. Calculate the sand rate by dividing the amount of accumulated sand by five minutes (the amount of time to accumulate the sand).

6. Periodically check the flow rate through the tester during each run. If the flow rate is not one half gpm, then repeat the test.

7. Calculate the rate of sand production per unit of water according to the following calculation:

$$\frac{[\text{sand rate (ml/min)}]}{[0.5\ \text{gpm} \times 231\ \text{in}^3/\text{gallon} \times 16.387\ \text{ml/in}^3]*1E6} = \text{ppm}$$

3.2.3.4 Chlorination of Developed Well

Following development, the extraction and re-injection wells will be chlorinated using a mixture of water, sodium hypochlorite and NW-310 as outlined in the *Scope of Work for Acid and Chlorination Treatments of Re-Injection Wells, Rev 1*. The Hydrogeology Technical Lead will provide volume information for the mixture.

3.3 DRILLING AND INSTALLATION OF 12 TYPE 2 GROUNDWATER MONITORING WELLS (23271 THROUGH 23282) AND 10 TYPE 6 GROUNDWATER MONITORING WELLS (63284 THROUGH 63292)

Twelve Type 2 and 10 Type 6 monitoring wells will be installed using a rotosonic drilling rig. Table 3-3 provides elevations and depths for the water table, top of screen, and bottom of each well. Details concerning the selection of screen depths are provided in Appendix A of this PSP. In summary, the Type 2 monitoring wells will have a 15-foot long screen set such that the lower five feet of the screen are

below the elevation of the highest previously recorded dissolved uranium concentration. The Type 6 monitoring wells will have a 10-foot long screen set such that the midpoint of the screen is at the elevation of the highest previously recorded dissolved uranium concentration. These completion depths are based on water level measurements from 1988 to 2002, and the elevation of the highest previously recorded uranium plume concentration based off of monitoring well and direct push sampling results.

Well installations will be conducted in accordance with guidelines set forth in Appendix J of the SCQ. An 8-inch diameter borehole will be drilled. The wells will be composed of 4-inch diameter Type 304 stainless steel with PVC screens. The risers of the monitoring wells will be constructed of stainless steel for two reasons. First, the site has a ready supply of 4-inch diameter stainless steel risers that need to be put to use. Second, the stainless steel should be easier to plug and abandon than PVC wells. PVC wells are more prone to breakage when they are being pulled from the ground. This often results in increased plugging and abandonment costs because the rig often has to overdrill the PVC casing to get it out of the ground.

The monitoring wells will be completed with 0.010-inch slot size screens, 2-foot sumps, and an artificial filter pack. Existing monitoring wells are completed using this size screen and they yield representative groundwater samples from the aquifer. The primary filter pack will consist of Global #7 sand that is well-sorted, fine-grain, quartz sand. The individual grains of this filter pack material are well rounded and consist of less than five percent non-siliceous material. The size of the primary filter pack sand was selected so that 90 percent of the filter pack material will be held back by the 0.01 inch slot screen, and the uniformity coefficient of the filter pack material will not exceed 2.5. The primary filter pack will extend five feet above the top of the well screen. A "transition sand" of slightly smaller sized material (Global #8 sand) will extend from the top of the primary filter pack sand to a height corresponding to 2.5 feet below the base of the glacial overburden. The transition sand will have a minimum thickness of five feet. The filter pack and transition sands will be installed utilizing the gravity emplacement method (either a tremie line or hand poured). The vibration of the rotosonic casing will help to settle the sand and prevent bridging. A five-foot bentonite seal (pellets) will be installed above the transition sand and hydrated. The pellets will be allowed to expand after hydration for one hour before any grout slurry is placed on top. No bentonite will be installed below the water table. A backfill of grout slurry above the bentonite seal shall extend to three feet below ground surface. Since no above ground equipment is required for a monitoring well, as it is for an extraction or re-injection well, a three-foot thick concrete plug can be installed to complete the well installation. The riser shall terminate approximately three feet above the ground surface.

The well will be secured with a lockable well cap. A protective casing and concrete pad will be installed as outlined in the SCQ.

During installation of the well, the field geologist will be responsible for documenting that the correct thickness on annular fill material is being installed, and that the well screen is installed at the correct depth. Frequent measurements of the depth to the top of the annular fill need to be collected to verify the installation process. If installation work is interrupted, (i.e., lunch, carry over to the next day, etc.) the Field Geologist will verify that the depths measured prior to the interruption are the same depths measured prior to resuming installation activities.

Boreholes will be advanced to the "bottom of the well" depths identified in Table 3-3. The depth intervals being targeted for the well screens are based on the estimated ground surface elevations and the known depth and thickness of the 30 μg/L total uranium plume at each drilling location. These depth estimates will need to be confirmed based on actual ground surface elevation survey data, as they become available. The depth and thickness of the total uranium plume at each extraction well location have already been adequately defined by previously collected direct push groundwater samples. Details concerning the design of the monitoring wells are provided in Appendix A.

3.3.1 Development of the Type 2 and Type 6 Monitoring Wells

Type 2 and Type 6 monitoring wells will be developed according to procedure DRL-03, *Monitoring Well Development*. The goal of development is to achieve clear water (<5 Nephelometric Turbidity Units [NTU]) that contains little or no sediment. At the end of development, a groundwater sample will be collected and analyzed for total uranium at the on-site laboratory. Samples will be collected in 250 ml plastic bottles and preserved with nitric acid to a pH < 2. A duplicate sample will also be collected. Results will not be validated. No other field quality control samples are required. If the pre-sample turbidity is greater than 5 NTUs, then the sample will be filtered using a 5-micron filter. If the turbidity of the 5 micron filtered sample is still greater than 5 NTUs, then the 5 micron filtered sample will be additionally filtered using a 0.45-micron filter. Both the unfiltered and the final filtered total uranium sample will be analyzed at the on-site laboratory.

3.3.2 Sampling of the Type 2 and Type 6 Monitoring Wells

Following development of each well, groundwater samples will be initially collected and analyzed for total uranium only. Temperature, specific conductivity, turbidity, and pH will be measured per procedure EQT-02, *Horiba Water Quality Meter*. After an initial sampling, the Type 2 and Type 6 wells will be

added to the routine Integrated Environmental Monitoring Plan (IEMP) sampling program. Long-term sampling plans for these wells include only total uranium and field parameters. Dedicated sampling equipment will be installed in these wells, so that the pump intake is positioned at the depth of the highest recorded dissolved uranium concentration the aquifer. For the majority of the Type 2 wells installed under this PSP, that point is five feet from the bottom of the well screen.

3.4 DRILLING AND INSTALLATION OF FOUR TYPE 8 CMT GROUNDWATER MONITORING WELLS (83293 TO 83296)

Four Type 8 CMT wells will be installed in the South Field (83293 through 83296). Figure 1-1 illustrates the locations of the four wells. These locations are in areas of the uranium plume where the thickness of the plume ranges from 40 to 50 feet. Monitoring at several different intervals is necessary to cover the entire vertical extent of the plume in order to produce a more accurate 3-dimensional assessment of the contaminant plume. Installing CMT wells will facilitate this objective. CMT wells were installed for the first time at the FEMP last year. Monitoring to-date indicates that the wells provide representative groundwater samples. No more than four additional CMT wells will be installed at this time to limit the risk associated with potential uncertainties due to the short operational experience.

A CMT well consists of tubing that is divided into seven separate channels. Each channel will be screened at a different depth in the aquifer. The channels will be sampled using polyethylene tubing with check valves, connected to a Waterra® pump.

The CMT Multilevel System Model 403 uses 1.7 inch outside diameter polyethylene, continuous seven channel tubing. Figure 3-1 is a diagram of a CMT well. Before the system is lowered into the casing, Water Monitoring personnel will construct the CMT either on clean plastic sheeting resting on the ground surface or above ground surface resting on saw horses. The CMT will be securely covered in plastic if left out over night or in the event of rain.

The top and bottom of the screen intervals in each sampling channel are based on historical groundwater level data in the area of the plume and uranium plume thickness. Monitoring Wells 83293 and 83294 are being installed in the area of Direct-Push Sample Location 12433. The uranium plume profile measured at Direct-Push Sample Location 12433 was used to design the screen placement for these two CMT wells. Figure 3-2 presents the screen design for CMT Wells 83293 and 83294. Monitoring Wells 83295 and 83296 are being installed in the area of Direct-Push Sample Location 12231. The uranium profile measured at Direct-Push Sample Location 12231 was used to design the screen placement for these

two CMT wells. Figure 3-3 presents the screen design for CMT Wells 83295 and 83296. The location of these wells is shown in Figures 1-1 and 1-2.

The six outer channels in each well will be designated C1 through C6 identifying the sampling channels from shallowest (C1) to the deepest (C6). The center channel, designated as C7, will be open at the bottom of the well and available for water level monitoring. Table 3-4 provides a summary of screen elevations for each proposed CMT well and the basis for the selection of these elevations.

Prior to any work, the CMT will be visually inspected for damage that may have occurred during manufacturing or shipping. Each channel will be pressure tested to check for leaks after construction. Appendix B provides pressure testing protocols. Starting at the bottom, each CMT screen interval will be measured. Tables 3-5, 3-6, 3-7, and 3-8 provide the depths of each component for each of the channels in each respective well. Drill holes will be measured within each channel's monitoring zone using the CMT installation template. Three, 3/8-inch holes or 1/4 inch holes at 3/4-inch apart will be drilled in each 4-inch subinterval of the monitoring zone. The holes will be drilled with a standard drill using a drill stop to prevent drilling too deep. A 4-inch long, 0.010-inch mesh stainless steel screen will be wrapped around the drilled subsection of the CMT, one around each three holes. Individual subsections of screen are limited to 4 inches in length to avoid screen buckling during installation. The screens will be secured to the CMT by stepless, low profile stainless steel clamps.

At 2.5 feet below each individual outer channel-monitoring zone, a notch will be cut, and the individual channel will be plugged by inserting a mechanically expandable plug into the channel (Figure 3-1). If the expandable plugs are not available, then the channel will be plugged by the following method: at 2.5 feet below the monitoring zone, a 3/8-inch hole will be drilled. A foam plug will then be inserted and pushed approximately 1.5 inches towards the bottom of the well. Polyethylene hot melt will then be injected into the hole. The foam plug will serve to hold the polyethylene hot melt in place until it sets. The length of CMT between the plug and the last hole of the monitoring zone will serve as the sump for the channel. A vent hole will be drilled 1-foot below the plug of the channel so that the hole is located behind the screen mesh of the next lower monitoring zone. This will allow air to exit the channel below the monitored zone as it is being installed. A guide point will be installed at the bottom of the tubing, which has a 60-micron port for the center channel, C-7. Prior to installing the guide port, the lower 18 inches of each channel will be filled with bentonite granules and plugged from the bottom by inserting an expandable plug into the bottom of the channel. If expandable plugs are not available, then a foam rubber plug will be inserted 1.5 inches from the bottom, then polyethylene hot melt will be injected to seal the channel from the bottom.

A Geoprobe® 6600 Series with 3.25 inch outside diameter casing and expendable point at the end of the tool string will be used to drill the borehole into which the CMT will be installed. If refusal or resistance occurs, then the borehole may be augured or pre-probed through the glacial overburden and upper unsaturated portion of the aquifer. The casing will be pushed to approximately 5 feet below the desired bottom depth for each well then a sufficient quantity of de-ionized water will be added to the casing to prevent heaving sands. The prepared CMT will be lowered into the casing. As the casing is removed, the formation will be allowed to collapse. Once collapse stops, normally at the top of the water table, Global #7 or finer sand will be gravity placed to approximately 2.5 feet below the aquifer/overburden interface. There, a bentonite pellet plug of at least 5 feet in length will be placed and hydrated for approximately one hour before injecting grout slurry to 3 feet below the surface. The grout will be allowed to settle for 24 hours. Additional grout will be added if any settling occurs in the first grout placement. A 3-foot thick concrete plug will be placed in the borehole to the ground surface. A protective cover and concrete pad will be installed as specified in Appendix J of the SCQ.

3.4.1 Developing the CMT Monitoring Wells

CMT wells will be allowed to sit for at least 48 hours after installation before development begins. Development will only take place in Channels one through six. A Waterra® pump equipped with polyethylene tubing with a bottom check/valve will be used to pump each of the channels. For each channel, a minimum of five channel volumes of water will be removed. In addition, if water is added during installation, then a minimum of at least the volume of water added during drilling will be removed. The minimum volume removed will be divided evenly between all channels.

The Waterra® pump has a surge stroke of 4 inches; therefore, each CMT channel will be pumped/surged in 4-inch intervals starting at the top of the screen (for interval C1, start the surge at the top of the water table). Due to friction in deeper channels that may cause the sample tubing to kink, the screened sections of the deeper channels may be surged by hand instead of using the Waterra®. A *Monitoring, Development/Redevelopment Form* will be completed for each CMT interval.

As development of each channel in each CMT well is completed a groundwater sample and duplicate will be collected and analyzed for total uranium only from Channels one through six.

3.4.2 Sampling of the CMT Monitoring Wells

Post development sampling will be completed after three tubing volumes of groundwater are purged from each sampling channel. Each channel will be purged using the Waterra® pump equipped with a dedicated

polyethylene tube and tubing bottom check valve that will be present at the well site in a marked box. The tubing bottom check valve will be placed near the water table of each interval for purging and sample collection to ensure that the samples collected are representative. Temperature, specific conductivity, turbidity, and pH will be measured after each channel volume per procedure EQT-02, *Horiba Water Quality Meter*.

If the sample's turbidity is greater than 5 NTUs, then the sample will be filtered using a 5-micron filter. If the turbidity of the 5 micron filtered sample is still greater than 5 NTUs, then the 5 micron filtered sample will be additionally filtered using a 0.45-micron filter. Both the unfiltered and the final filtered total uranium sample will be analyzed at the on-site laboratory. Samples will be placed in a 250-mL plastic bottle treated with nitric acid per procedure SMPL-02, *Liquids and Sludge Sampling*, Data Quality Objective (DQO) GW-30.

After an initial test-sampling period, the CMT wells may be added to routine IEMP sampling. Long-term sampling plans for these wells include only total uranium and field parameters. The sampling frequency for the various intervals is expected to vary depending on uranium concentration and rate of change in that concentration, after the extraction well pumping is initiated next year. The longer term sampling plans (frequency/intervals) will be provided in the IEMP.

TABLE 3-1

ESTIMATED WELL LOCATION COORDINATES

Monitoring Well	Estimated Easting 83[a]	Estimated Northing 83[a]	Estimated Surface Elevation (Feet AMSL)[a]
33262	1348150	477800	568.9
33263	1348050	478200	577.0
33264	1349750	477200	573.3
33265	1349850	477600	576.3
33266	1350050	477000	581.0
23271	1349554	478465	576.0
23272	1349750	478318	570.8
23273	1349552	478142	574.2
23274	1349356	478335	575.0
23275	1349162	477907	574.2
23276	1349017	477652	575.6
23277	1348844	478103	573.6
23278	1348645	477896	573.6
23279	1348238	478197	577.0
23280	1348151	478001	577.0
23281	1347953	477817	568.9
23282	1348151	477622	568.9
63283	1349213	477078	573.7
63284	1349702	477942	577.7
63285	1349552	477665	576.3
63286	1350067	477594	576.3
63287	1349804	477406	576.3
63288	1349851	477000	581.0
63289	1350247	476997	581.0
63290	1350048	476802	581.0
63291	1349329	477403	573.7
63292	1349365	476886	573.7
83293	1349951	477198	581.0
83294	1349598	477189	573.3
83295	1348977	476667	565.2
83296	1348651	476444	563.0

[a]To be confirmed by survey just prior to drilling each well

TABLE 3-2

TARGET SAMPLING INTERVALS FOR THE ROTOSONIC CORE SAMPLES IN THE EXTRACTION AND RE-INJECTION WELLS

Design Report ID	Monitoring Well	Estimated[a] Surface Elevation (feet AMSL)	Estimated Depth to Water Table (feet BGS)	Top of 30 µg/L Plume (feet BWT)	Base of 30 µg/L Plume (feet BWT)	Target Sampling Interval (feet BGS)	Reference Direct-Push Location and Date Sampled	Reference Cross-Section South Field Phase II Design Report
SF 31	33262	568.9	56	0	20.0	46 to 86	12826 (Jan '01)	F-F'
SF INJ 1	33263	577	64.5	0	10.0	54.5 to 84.5	12838 (Mar '01)	B-B'
SF 32	33264	573.32	56	5	55.0	51 to 121	12433 (April '99)	I-I'
SF 33	33265	576.32	57	5	50.0	52 to 117	12442 (May '99)	Not applicable
SF 34	33266	581	65	20	35.0	75 to 110	13241 (Jan '02)	I-I'

[a]To be confirmed by survey just prior to drilling each well

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TABLE 3-3

TYPE 2 AND TYPE 6 MONITORING WELL INSTALLATION ELEVATIONS AND DEPTHS

Monitoring Well	Ground Surface[a]	Elevations (feet AMSL)[a]			Depth (feet BGS)[a]			Screen & Sump Length (feet)
		Water Table 4/1/2002	Top of Screen	Bottom of Well	Water Table	Top of Screen	Bottom of Well	
23271	576	517.6	521.5	504.5	58.4	54.5	71.5	17
23272	570.8	517.6	521.5	504.5	53.2	49.3	66.3	17
23273	574.2	517.6	521.5	504.5	56.6	52.7	69.7	17
23274	575	517.6	521.5	504.5	57.4	53.5	70.5	17
23275	574.2	517.2	522.0	505	56.7	52.2	69.2	17
23276	575.6	517.2	522.0	505	58.1	53.6	70.6	17
23277	573.59	517.2	522.0	505	56.1	51.59	68.6	17
23278	573.59	517.2	522.0	505	56.1	51.59	68.6	17
23279	577	519.59	522.0	505	57.41	55	72.0	17
23280	577	519.59	522.0	505	57.41	55	72.0	17
23281	568.9	519.59	522.0	505	49.31	46.9	63.9	17
23282	568.9	519.59	522.0	505	49.31	46.9	63.9	17
63283	573.68	518	492.7	480.18	55.68	81	93.0	12
63284	577.69	518	503.7	491.19	59.69	74	86.0	12
63285	576.32	518	504.3	491.82	58.32	72	84.0	12
63286	576.32	518	504.3	491.82	58.32	72	84.0	12
63287	576.32	518	504.3	491.82	58.32	72	84.0	12
63288	581	518	491.0	478.5	63	90	102.0	12
63289	581	518	491.0	478.5	63	90	102.0	12
63290	581	518	491.0	478.5	63	90	102.0	12
63291	573.68	518	492.7	480.18	55.68	81	93.0	12
63292	573.68	518	492.7	480.18	55.68	81	93.0	12

[a]To be confirmed by survey just prior to drilling each well

TABLE 3-4

SCREEN INTERVALS SUMMARY FOR CMT WELLS

Monitoring Well	Screen Interval (ft amsl)	Basis for Screen Intervals
83293	C1: 525 – 515 C2: 512 – 502 C3: 499 – 489 C4: 486 – 476 C5: 473 – 463 C6: 460 – 450 C7: 466.5	Direct-push sampling results from location 12433 CMT Well 82433
83294	C1: 525 – 515 C2: 512 – 502 C3: 499 – 489 C4: 486 – 476 C5: 473 – 463 C6: 460 – 450 C7: 466.5	Direct-push sampling results from location 12433 CMT Well 82433
83295	C1: 525 – 515 C2: 512 – 502 C3: 499 – 489 C4: 486 – 476 C5: 473 – 463 C6: 460 – 450 C7: 446.5	Direct-push sampling results from location 12231
83296	C1: 525 – 515 C2: 512 – 502 C3: 499 – 489 C4: 486 – 476 C5: 473 – 463 C6: 460 – 450 C7: 446.5	Direct-push sampling results from location 12231

TABLE 3-5

DEPTH TO EACH CMT WELL COMPONENT IN 83293
ELEVATION 581 AMSL
(Feet Below Ground Surface)

Channel	Screen	Blank	Plug	Vent
C1	56-66	66-69	68.5	69.5
C2	69-79	79-82	81.5	82.5
C3	82-92	92-95	94.5	95.5
C4	95-105	105-108	107.5	108.5
C5	108-118	118-121	120.5	121.5
C6	121-131	131-133.5	133	134
C7	133.5	Not applicable	Not applicable	Not applicable

TABLE 3-6

DEPTH TO EACH CMT WELL COMPONENT IN 83294
ELEVATION 573.32 AMSL
(Feet Below Ground Surface)

Channel	Screen	Blank	Plug	Vent
C1	48-58	58-61	60.5	61.5
C2	61-71	71-74	73.5	74.5
C3	74-84	84-87	86.5	87.5
C4	87-97	97-100	99.5	100.5
C5	100-110	110-113	112.5	113.5
C6	113-123	123-125.5	125	126
C7	125.5	Not applicable	Not applicable	Not applicable

TABLE 3-7

DEPTH TO EACH CMT WELL COMPONENT IN 83295
ELEVATION 565.2 AMSL
(Feet Below Ground Surface)

Channel	Screen	Blank	Plug	Vent
C1	40-50	50-53	52.5	53.5
C2	53-63	63-66	65.5	66.5
C3	66-76	76-79	78.5	79.5
C4	79-89	89-92	91.5	91
C5	92-102	102-105	104.5	104
C6	105-115	105-115	114.5	114
C7	117.5	Not applicable	Not applicable	Not applicable

TABLE 3-8

DEPTH TO EACH CMT WELL COMPONENT IN 83296
ELEVATION 565.2 AMSL
(Feet Below Ground Surface)

Channel	Screen	Blank	Plug	Vent
C1	38-48	48-51	50.5	51.5
C2	51-61	61-64	63.5	64.5
C3	64-74	74-77	76.5	77.5
C4	77-87	87-90	89.5	90.5
C5	90-100	100-103	102.5	103.5
C6	103-113	113-115.5	115	114.5
C7	115.5	Not applicable	Not applicable	Not applicable

Figure 3-1

Diagram of a CMT Well

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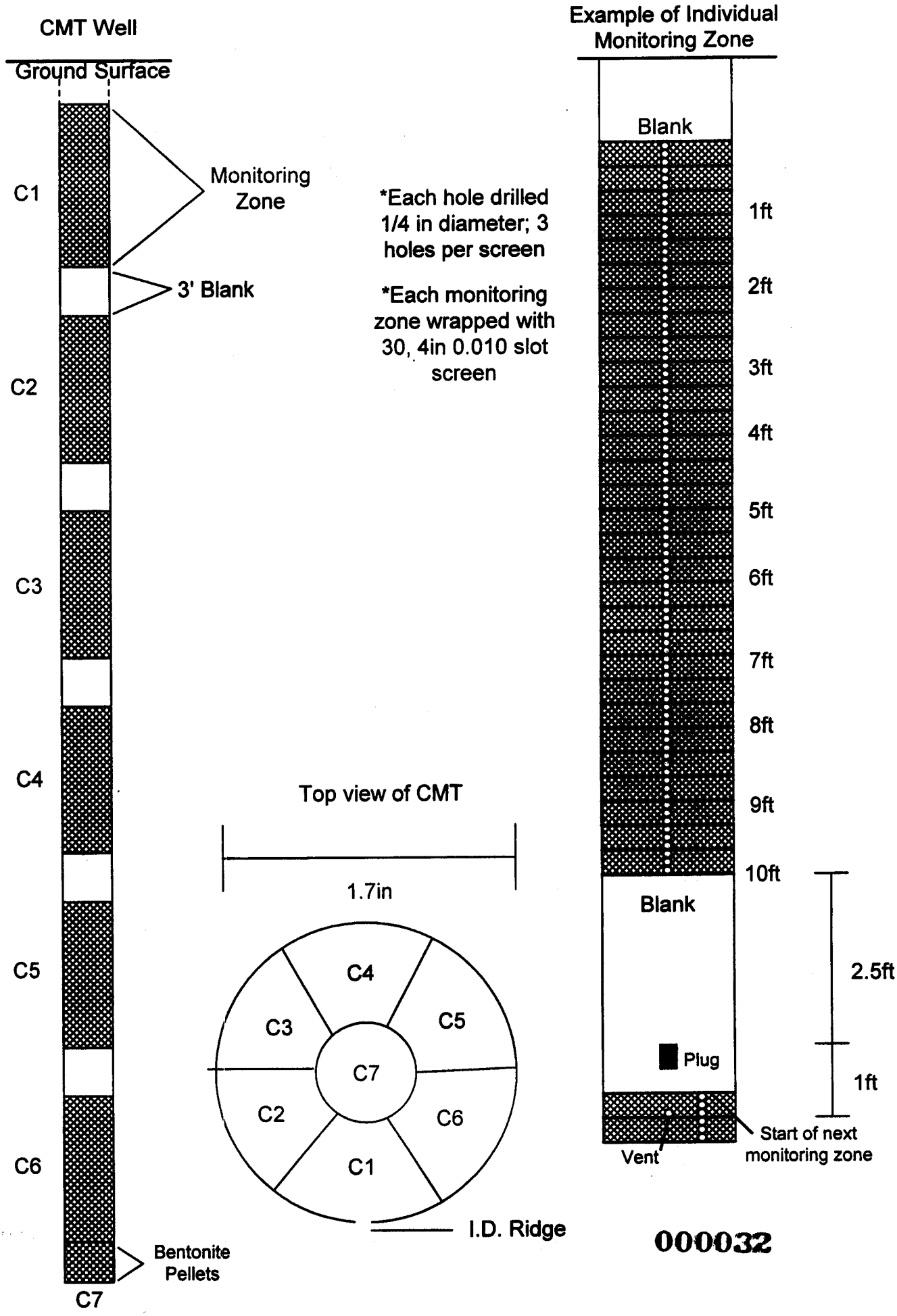


000032

Figure 3-2

Well Design Information for CMT Wells 83293 and 83294

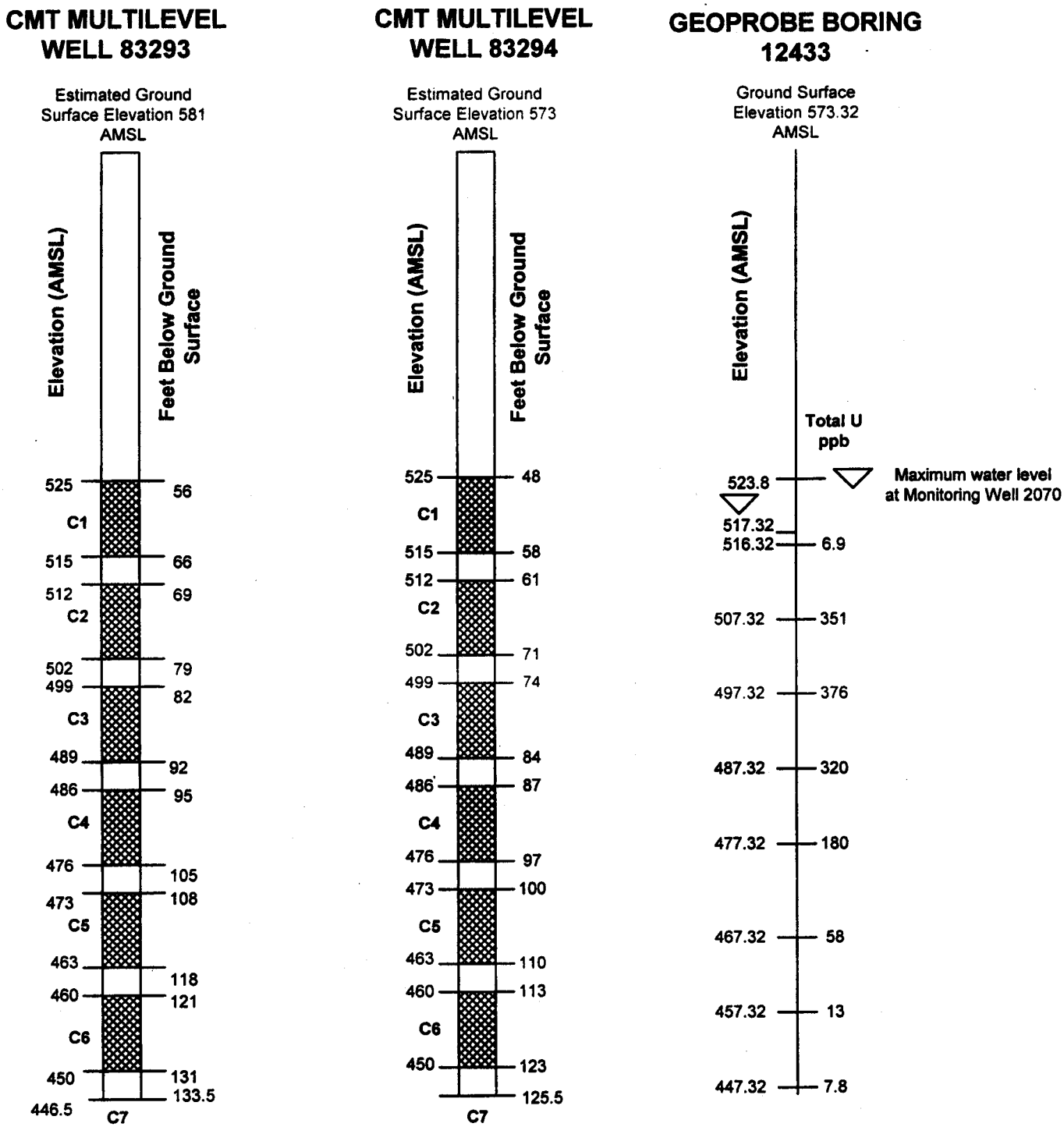
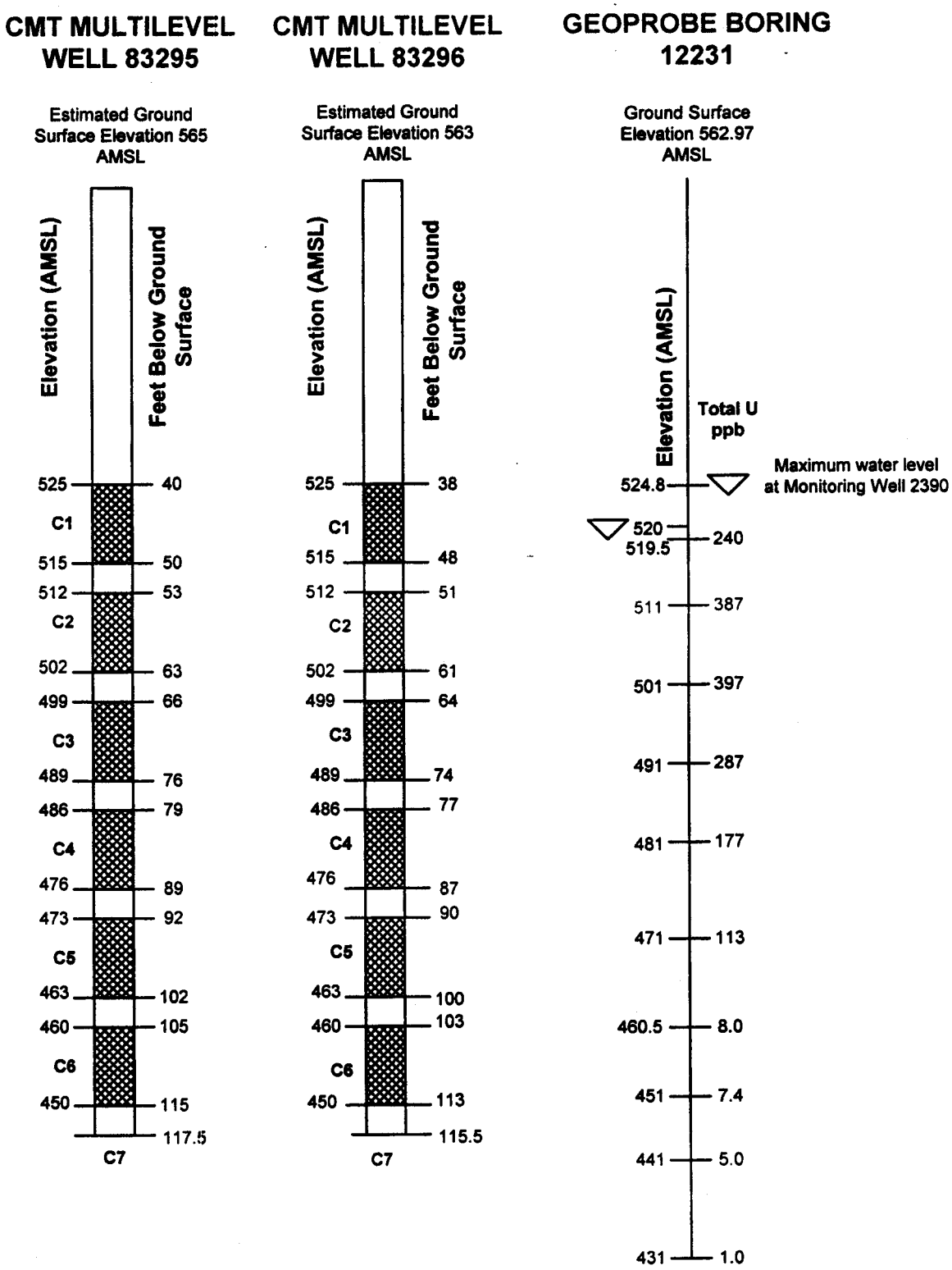


Figure 3-3

Well Design Information for CMT Wells 83295 and 83296



4.0 EQUIPMENT DECONTAMINATION

If drilling and sampling equipment are being moved from a FEMP controlled area, the equipment shall be decontaminated to Level I, using a pressure washer to remove visible materials, prior to transport to the drilling location. Decontamination of the drilling equipment will not be necessary if the equipment has been used previously in a FEMP uncontrolled area. Upon completion of drilling and sampling activities, decontamination of tools and equipment shall be performed to fulfill the Level I specification of the SCQ (reference Section K).

5.0 WASTE DISPOSAL

The disposal of drill cuttings will be coordinated with and approved by the Manager of the Waste Acceptance Organization. Options include spreading the drill cuttings out on the ground surface at the drilling site, or transporting the cuttings to a holding area for later disposal into the on-site disposal facility. Final directions for the disposal of the cuttings will be issued prior the commencement of drilling activities for the installation of the well.

Discharged pumping water (generated during well development) will be sent to the headworks of the Advanced Wastewater Treatment facility. Temporary discharge lines will be utilized to connect each drilling location to discharge flowpaths. When temporary lines are used, efforts will be made to minimize road crossings, etc., by threading the temporary lines through existing trenches, and culverts. Field personnel will work closely with Wastewater Treatment Operations personnel to assure that they are aware of the temporary lines and the schedule for the line's use.

The Field Geologist will be responsible for assuring that proper coordination with the Wastewater Treatment Operations personnel has been achieved prior to the discharge of any water into the headworks of the Advanced Wastewater Treatment facility. The Field Geologist will call the Advanced Wastewater Treatment facility Supervisor at extension 3830 a day prior to beginning development pumping. The Field Geologist will also call the Advanced Wastewater Treatment facility Supervisor just prior to pumping to assure that coordination is complete and discharge can begin at an agreed to time.

6.0 HEALTH & SAFETY

Environmental Monitoring personnel and project subcontractor personnel shall conform to precautionary surveys performed by the personnel representing the Utility Engineer, Industrial Hygiene, and Radiological Control. Concurrence with applicable safety permits (indicated by the signature of personnel assigned to this project) is expected from all project personnel in the performance of their assigned duties.

The Environmental Monitoring Field Supervisor will ensure that all Environmental Monitoring and subcontractor personnel performing project related activities have read or been briefed on the Project Health and Safety Matrix and the applicable surveys that protect worker safety and health. Signing the Project Health and Safety Matrix is an acknowledgment of reading and understanding it. It is a requirement for all personnel involved in the drilling and sampling activities associated with the well installation. A copy of applicable safety permits/surveys issued for worker safety and health shall be available for reference/review at each sample location. At the completion of the project, the completed forms shall be submitted for incorporation into the project files.

7.0 QUALITY ASSURANCE/QUALITY CONTROL REQUIREMENTS

Well installation and development work follows Quality Assurance/Quality Control (QA/QC) protocol.

7.1 PROJECT REQUIREMENTS FOR SURVEILLANCE

Self-assessment of work processes and operations may be undertaken to assure quality of performance. Self-assessments may be performed by the Hydrogeology Project Lead and Technical Lead identified in Section 2.0 of this PSP, and shall encompass technical and procedure requirements. Such self-assessment may be conducted at any point in the project.

Independent assessment may be performed by the Fluor Fernald QA organization by conducting a surveillance. At a minimum the surveillance will consist of monitoring/observing ongoing project activity and work areas to verify conformance to specified requirements. Surveillances shall be planned and documented in accordance with Section 12.3 of the SCQ.

7.2 CHANGES TO THE PROJECT SPECIFIC PLAN

Prior to the implementation of changes, the Hydrogeology Project Lead and/or Technical Lead shall be informed of the proposed field changes. Once approval has been obtained from the Project Lead and/or Technical Lead and QA representative for the changes to the PSP, the field changes may be implemented. Variances shall be processed per Section 15.3 of the SCQ.

APPENDIX A

SCREEN SPECIFICATIONS FOR TYPE 2 AND TYPE 6 MONITORING WELLS

APPENDIX A

This Appendix presents the background information that was used to determine screen depths for the Type 2 and Type 6 monitoring wells to be installed under this PSP. Type 8 monitoring wells were discussed in Section 3 of the PSP.

Type 2 Monitoring Wells

Type 2 monitoring wells will be used when the top of the 30 µg/L uranium plume is at the water table. Twelve Type 2 monitoring wells will be installed under this PSP. Four of these wells will be installed in the former Southern Waste Units area around Extraction Well 33262 and Re-Injection Well 33263. Four will be installed south of the west chamber of the Storm Water Retention Basin around Extraction Well 31567. Four will be installed southeast of the east chamber of the Storm Water Retention Basin around Extraction Well 33061. The following criteria were factored into the selection of the screen depths for the Type 2 groundwater monitoring wells:

- Water level fluctuations (seasonal and regional) in the area of the Type 2 monitoring wells.
- Water level elevations predicted by the groundwater model for the area of the Type 2 monitoring wells when the South Field Phase II Module is operational.
- The elevation recorded for the highest measured uranium concentrations near the locations of the Type 2 monitoring wells, based on direct-push sampling results from 1996 to 2002.

Each Type 2 groundwater monitoring well typically has a 15-foot long screen. In the past when a Type 2 monitoring well was installed, the upper five feet of the screen was positioned above the water table and the lower 10 feet would be positioned below the water table. The exact screen position was based on the range of water levels seen in area monitoring wells from 1988 to the time the well was installed. Recent regional water level decline coupled with anticipated pumping drawdown dictates that a different approach should be taken for these wells. Based on water level data collected since 1988, water level changes in the area where these wells are to be installed fluctuate by as much as 12.9 feet. If the screen is set too high, then the water level could fall below the base of the screen rendering the well useless for monitoring purposes.

Further exasperating the low water level situation is the increased drawdown that will be experienced when four additional extraction wells in the South Field Phase II Module become operational. Groundwater modeling that was used to design the South Field Phase II Module is presented in the Design for Remediation of the Great Miami Aquifer South Field Phase II Module. Groundwater modeling results are

shown in the design for three different conditions-- "nominal", "wet", and "dry". As would be expected, modeling under dry conditions results in the lowest predicted water levels for the South Field area, with the lowest levels occurring between the years 2001 and 2006 when most of the pumping is taking place. Figure A-1 illustrates the predicted water levels for the South Field area under dry conditions between the years of 2001 and 2006.

The standard practice of installing the Type 2 monitoring well screen so that the upper five feet is above the water table will not be followed for the 12 wells in this PSP. The screens for these wells will be positioned so that the lower five feet of the screen are below the elevation of the highest recorded uranium concentration. This will place the tops of the screens in these wells anywhere from 2.4 feet to 4.8 feet above the water table measured in April of 2002. Water levels in April tend to be higher than other times of the year due to seasonal recharge. April was selected as it is the most recent data, and should best reflect conditions that will be encountered in the field when these wells are installed in early summer.

Table A-1 summarizes specifics concerning the completion of each monitoring well. Information provided is as follows:

- Column 1 identifies the extraction well or re-injection well that is being targeted for monitoring, and the direction from the extraction well or re-injection well where the monitoring well will be located.
- Column 2 identifies the monitoring well number.
- Column 3 provides the estimated surface elevation of the monitoring well.
- Column 4 provides the estimated depth to the water table from the ground surface, based on the date given in column 10 for when direct-push data were collected.
- Column 5 provides the depth of the top of the uranium plume in reference to the water table.
- Column 6 provides the depth to the base of the uranium plume in reference to the water table.
- Column 7 provides the depth to the highest measured uranium concentration in reference to the water table, based on direct-push data noted in Column 10.
- Column 8 provides the target screen interval depth from ground surface.
- Column 9 provides the percent of the 30 μg/L uranium plume screened based on previously collected direct-push uranium concentration data.
- Column 10 provides the direct-push sampling location used to characterize the vertical profile of the plume for the area, as well as the date that the data were collected.

The rational behind the positioning of the Type 2 monitoring well screens for each of the three areas (former Southern Waste Units, south of the west chamber of the Storm Water Retention Basin, and southeast of the east chamber of the Storm Water Retention Basin) is discussed below.

Former Southern Waste Units (Monitoring Wells 23279, 23280, 23281, and 23282)

The water level in the area of the former Southern Waste Units fluctuates by approximately 11.5 feet based on water levels measured at Monitoring Well 2046 from January 1989 to April 2002. The lowest water level measured was 513.5 feet amsl. The water level in April of 2002 was 519.59 feet amsl. Modeled predicted water levels for the Southern Waste Unit area under dry-conditions places the water level at an approximate elevation of 513 feet amsl. The highest uranium concentrations from recent sampling in this area are at an elevation of approximately 512 feet amsl. The base of the 15-foot screen in these four monitoring wells will be positioned at an elevation of 507 feet amsl. This will provide five feet of screen below the highest uranium plume concentration and 10 feet of screen above the highest uranium plume concentration. Based on April 2002 water levels, the top of the screens in these wells would be positioned approximately 2.4 feet above the water table.

South of the West Chamber of the Storm Water Retention Basin (Monitoring Wells 23275, 23276, 23277, and 23278)

The water level south of the west chamber of the Storm Water Retention Basin fluctuates by approximately 12.9 feet based on water level measurements recorded at Monitoring Well 2065 from January 1988 to April 2002. The lowest water level was measured at an elevation of 512.18 feet amsl. The water level in April of 2002 was 517.2 feet amsl. Modeled predicted water levels for this area under dry-conditions places the water level at an approximate elevation of 511 feet amsl. The highest measured uranium concentrations from recent sampling in this area are at an elevation of approximately 511.2 feet amsl. The base of the 15-foot screen in these four monitoring wells will be positioned at an elevation of 507 feet amsl. This will provide five feet of screen below the highest uranium plume concentration and 10 feet above the highest uranium plume concentration. Based on April 2002 water levels, the top of the screens in these wells would be positioned approximately 4.8 feet above the water table.

South of the East Chamber of the Storm Water Retention Basin (Monitoring Wells 23271, 23272, 23273, and 23274)

The water level south of the east chamber of the Storm Water Retention Basin fluctuates by approximately 9.9 feet based on water level measurements recorded at Monitoring Well 2068 from January 1988 to April 2002. The lowest water level was measured at an elevation of 513.2 feet amsl. The water level in April of 2002 was 517.6 feet amsl. Modeled predicted water levels for this area under dry-conditions places the

water level at an approximate elevation of 511 feet amsl. The highest measured uranium concentrations from recent sampling in this area are at an approximate elevation of 511.5 feet amsl. The base of the 15-foot screen in these four monitoring wells will be positioned at an elevation of 506.5 feet amsl. This will provide five feet of screen below the highest uranium plume concentration and 10 feet above the highest uranium plume concentration. Based on April 2002 water levels, the top of the screens in these wells would be positioned approximately 3.9 feet above the water table. The uranium concentration at the water table where Monitoring Well 23271 will be installed is 91 μg/L. The concentration at 10 feet below the water table is only slightly higher at 97 μg/L. Setting the base of the screen at an elevation of 506.5 should still provide adequate plume monitoring coverage for the well.

Type 6 Groundwater Monitoring Wells

Type 6 groundwater monitoring wells will be installed when the top of the 30 μg/L uranium plume is below the water table. A shown in Figure 1-1, the 10 Type 6 monitoring wells to be installed under this PSP will be installed in the southeast portion of the uranium plume where the top of the uranium plume is positioned from five to 20 feet below the water table. The last column of Table A-1 provides the date at which the water level was recorded for each Type 6 monitoring well location. Each Type 6 monitoring well will have a 10-foot long screen. The screen will be installed so that the midpoint of the screen is positioned at the same elevation as the highest dissolved uranium concentration measured at nearby direct-push sample locations. The last column of Table A-1 identifies the direct-push sample location that was used to determine the depth at which the monitoring well screen should be installed.

TABLE A-1
SPECIFICATIONS FOR MONITORING WELL NETWORK

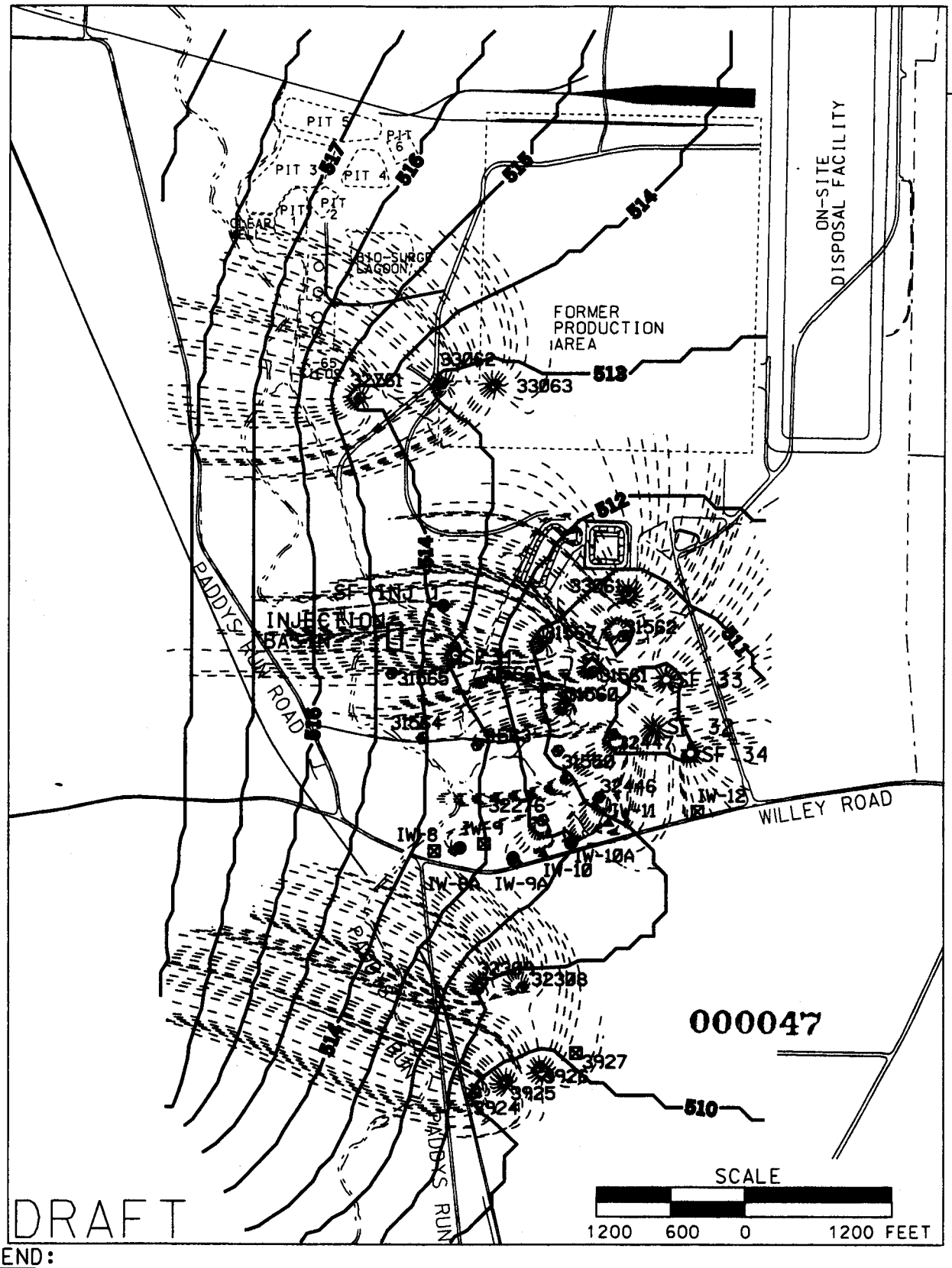
Operating Well and Monitoring Direction	Monitoring Well	Surface Elevation (Approx. feet)	Water Table (Approx. feet BGS)	Top of 30 µg/L Plume (feet BWT)	Base of 30 µg/L Plume (feet BWT)	Interval with Maximum Uranium Concentration (feet BWT)	Target Screen Interval (feet BGS)	Percent of 30 µg/L Plume Screened	Reference Location and Date
33061									
North	23271	576	63	0	25	10	58 to 73	40%	12834 (Feb '01)
East	23272	570.8	58	0	5	1	53 to 68	100%	12835 (Mar '01)
South	23273	574.2	62	0	35	1	57 to 72	29%	12836 (Mar '01)
West	23274	575	62.5	0	35	1	58 to 73	29%	12833 (Feb '01)
31562									
North	23273	574.2	62	0	35	1	57 to 72	29%	12836 (Mar '01)
East	63284	577.69	59	5	25	20	74 to 84	50%	12408 (Mar '99)
South	63285	576.32	57	5	55	20	72 to 82	20%	12442 (May '99)
West	23275	574.2	62	0	35	1	57 to 72	29%	12836 (Mar '01)
33265									
North	62408	577.52	59	5	50	20	74 to 84	22%	INSTALLED
East	63286	576.32	57	5	55	20	72 to 82	20%	12442 (May '99)
South	63287	576.32	57	5	55	20	72 to 82	20%	12442 (May '99)
West	63285	576.32	57	5	55	20	72 to 82	20%	12442 (May '99)
33264									
North	63287	576.32	57	5	55	20	72 to 82	20%	12442 (May '99)
East	83293	581	65	15	35	30	See Fig. 3-2		13241 (Jan '02)
South	63288	581	65	15	35	30	90 to 100	50%	13241 (Jan '02)
West	83294	573.32	56	5	55	20	See Fig. 3-2		12433 (Apr '99)
33266									
North	83293	581	65	20	35	30	See Fig. 3-2		13241 (Jan '02)
East	63289	581	65	15	35	30	90 to 100	50%	13241 (Jan '02)
South	63290	581	65	15	35	30	90 to 100	50%	13241 (Jan '02)
West	63288	581	65	15	35	30	90 to 100	50%	13241 (Jan '02)

TABLE A-1
SPECIFICATIONS FOR MONITORING WELL NETWORK

Operating Well and Monitoring Direction	Monitoring Well	Surface Elevation (Approx. feet)	Water Table (Approx. feet BGS)	Top of 30 µg/L Plume (feet BWT)	Base of 30 µg/L Plume (feet BWT)	Interval with Maximum Uranium Concentration (feet BWT)	Target Screen Interval (feet BGS)	Percent of 30 µg/L Plume Screened	Reference Location and Date
32447									
North	63291	573.68	56	15	60	30	81 to 91	22%	12409 (Apr '99)
East	83294	573.32	56	5	55	20	See Fig. 3-2		12433 (Apr '99)
South	63292	573.68	56	15	60	30	81 to 91	22%	12409 (Apr '99)
West	63283	573.68	56	15	60	30	81 to 91	22%	12409 (Apr '99)
32446									
North	63292	573.68	56	15	60	30	81 to 91	22%	12409 (Apr '99)
East	2166								
South	3069								
West	83295	562.97	42	0	55	20	See Fig. 3-3		12231 (Feb '97)
32276									
North	83295	562.97	42	0	55	20	See Fig. 3-3		12231 (Feb '97)
East	3069								
South	3015								
West	83296	562.97	42	0	55	20	See Fig. 3-3		12231 (Feb '97)
31560									
North	23276	575.6	62.5	0	15	3	57.5 to 72.5	100%	12842 (Mar '01)
East	63291	573.68	56	15	60	30	81 to 91	22%	12409 (Apr '99)
South	2387								
West	21033								
31550									
North	2387								
East	63283	573.68	56	15	60	30	81 to 91	22%	12409 (Apr '99)
South	83295	562.97	42	0	55	20	See Fig. 3-3		12231 (Feb '97)
West	2049								

TABLE A-1
SPECIFICATIONS FOR MONITORING WELL NETWORK

Operating Well and Monitoring Direction	Monitoring Well	Surface Elevation (Approx. feet)	Water Table (Approx. feet BGS)	Top of 30 µg/L Plume (feet BWT)	Base of 30 µg/L Plume (feet BWT)	Interval with Maximum Uranium Concentration (feet BWT)	Target Screen Interval (feet BGS)	Percent of 30 µg/L Plume Screened	Reference Location and Date
31561									
North	23275	574.2	62	0	30	1	57 to 72	33%	12836 (Mar '01)
East	63285	576.32	57	5	50	20	72 to 82	22%	12442 (May '99)
South	63291	573.68	56	15	60	30	81 to 91	22%	12409 (Apr '99)
West	23276	575.6	62.5	0	15	3	57.5 to 72.5	100%	12842 (Mar '01)
31567									
North	23277	573.59	60	0	5	1	55 to 70	100%	12844 (May '01)
East	23275	574.2	62	0	30	1	57 to 72	33%	12836 (Mar '01)
South	23276	575.6	62.5	0	15	3	57.5 to 72.5	100%	12842 (Mar '01)
West	23278	573.59	60	0	5	1	55 to 70	100%	12844 (May '01)
33262									
North	23280	577	64.5	0	5	1	59.5 to 74.5	100%	12838 (Mar '01)
East	2385								
South	23282	568.9	56	0	25	1	51 to 66	40%	12826 (Jan '01)
West	23281	568.9	56	0	25	1	51 to 66	40%	12826 (Jan '01)
33263									
North	na								
East	23279	577	64.5	0	5	1	59.5 to 74.5	100%	12838 (Mar '01)
South	23280	577	64.5	0	5	1	59.5 to 74.5	100%	12838 (Mar '01)
West	na								



LEGEND:

- FEMP BOUNDARY
- GROUNDWATER CONTOUR
- PARTICLE TRACK (6 YEARS)
- EXTRACTION WELL
- RE-INJECTION WELL
- PROPOSED RE-INJECTION WELL
- PROPOSED PLUGGING AND ABANDONMENT LOCATION
- PROPOSED EXTRACTION WELL
- PROPOSED BASIN RE-INJECTION

FIGURE A-1. PREDICTED GROUNDWATER ELEVATIONS FOR SOUTH FIELD PHASE II DESIGN YEARS 2001 THROUGH 2006 WITH DRY BOUNDARY CONDITIONS

V:/SFGP1/DGN/SOUTHFIELD/SFEXT005.DGN

STATE PLANAR COORDINATE SYSTEM 1983

05-JUN-2002

APPENDIX B

CMT WELL PRESSURE TESTING CRITERIA

APPENDIX B

Well fabrication will be verified by checking the well-specific hole layout and location (feet below grade) as indicated in Figures 3-2 and 3-3. This check will be completed for each specific channel within each multilevel well.

The addition of a redundant, un-hydrated bentonite column in each channel bottom is to be verified and documented. This column is being added to provide additional assurance that cross communication from the upper intervals to the bottom of the well or to the Channel 7 monitoring point does not occur.

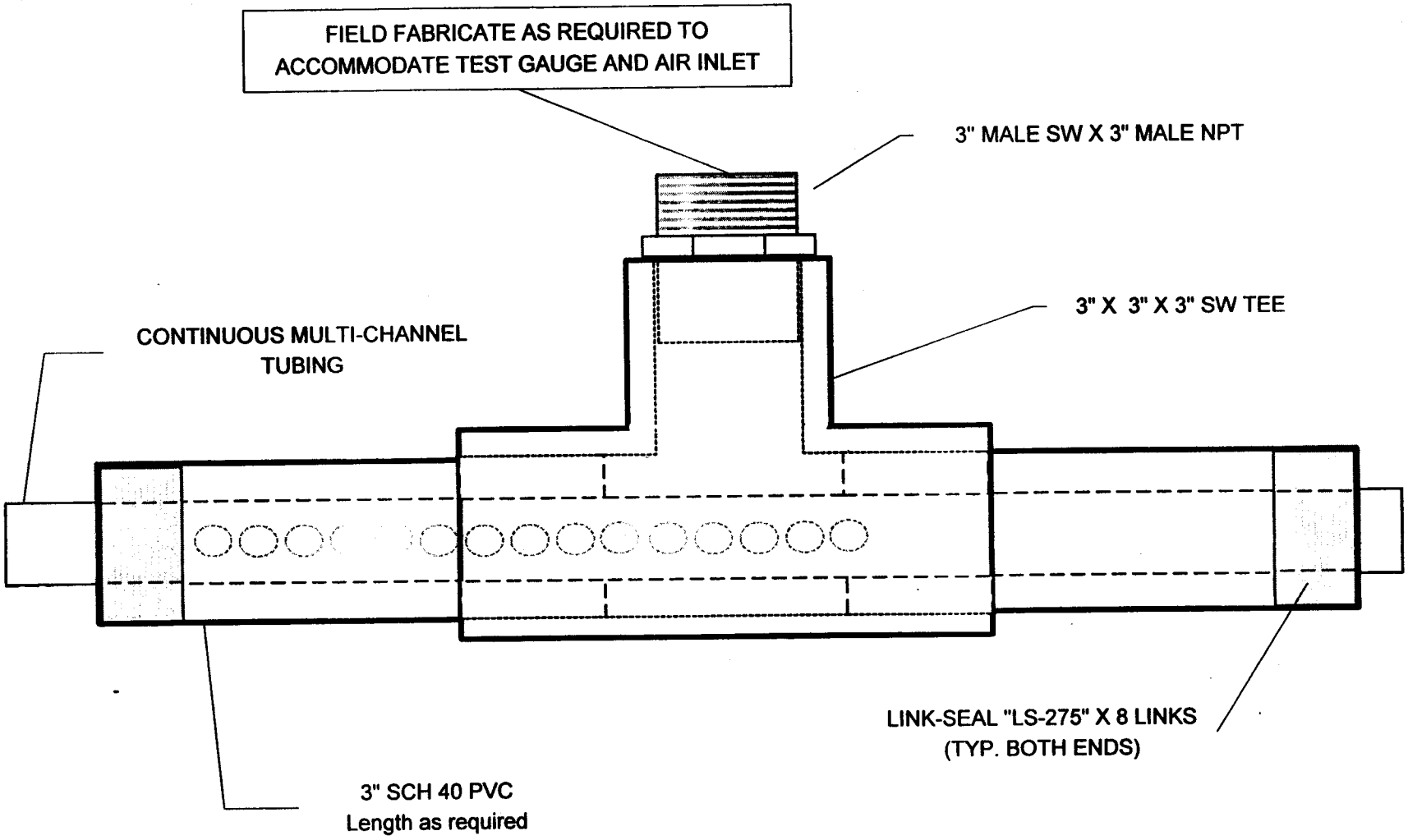
The **SHOP pre-installation pneumatic test** shall be performed by isolating a single channel within the test apparatus and mechanically blocking the adjacent zone's vent hole. The following criteria apply to these tests:

- Maintain 5 psi for a minimum of 10 minutes without a drop in pressure.
- After maintaining test pressure for the required minimum time, the test boundaries will be coated with a soap solution and visually examined for evidence of leakage as seen by bubbles.
- This test will be repeated until all channels have been tested.
- In the event the pressures drop, identify the source of the leak by the soap test, rework, and retest until results are satisfactory.

The **FIELD pre-installation pneumatic test** shall be as above for the SHOP however, the vent hole will not be will blocked, therefore, this test will include two channels at a time. This FIELD test will only be performed on the first well since it will primarily look for damage that may occur en route to the well site, during coiling, and /or as a result of the application of screen clamps. Any failure during this test will require the coil to be taken back to the shop for further evaluation to determine cause and source of failure.

Figure B-1

CMT Pressure Test Apparatus Detail



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APPENDIX C

DIRECT-PUSH SAMPLING DATA

4317

APPENDIX C

The following information is provided for each direct-push sample location used to guide screen depth selection:

- Easting survey coordinate
- Northing survey coordinate
- Reference surface elevation
- Depth (feet) to the water table
- Work duration (date sampling was conducted)
- The total uranium sampling results for each sampling depth.

TABLE C-1
GEOPROBE 12826

4317

Easting '83: 1348115.93
Northing '83: 477774.73
Reference Elevation: 568.9 feet amsl
Depth to Water Table: 56.0 feet bgs
Work Duration: 1/8/01 – 1/17/01

Sample Point	Elevation (ft amsl)	Depth Below Surface (ft)	Depth Below Water Table (@ 512.9 feet amsl)	Total Uranium Conc. (0.45 micron filtered) (µg/L)	Total Uranium Conc. (5 micron filtered) (µg/L)
1	509.9	59	3	424	424
2	502.9	66	10	47	47
3	492.9	76	20	30	31
4	492.9	76	20-D	31	31
5	482.9	86	30	15	16
6	472.9	96	40	2.0	2.1
7	462.9	106	50	2.1	2.3
8	452.9	116	60	0.8	0.8

TABLE C-2
GEOPROBE 12833

Easting '83: 1349411.68
Northing '83: 478335.75
Reference Elevation: 575.0 feet amsl
Depth to Water Table: 62.5 feet bgs
Work Duration: 2/12/01 – 2/15/01

Sample Point	Elevation (ft amsl)	Depth Below Surface (ft)	Depth Below Water Table (@ 512.5 feet amsl)	Total Uranium Conc. (0.45 micron filtered) (µg/L)	Total Uranium Conc. (5 micron filtered) (µg/L)
1	511.5	63.5	1	312	310
2	502.5	72.5	10	274	280
3	492.5	82.5	20	133	135
4	492.5	82.5	20-D	135	137
5	482.5	92.5	30	44	46
6	472.5	102.5	40	9.7	9.8
7	462.5	112.5	50	1.8	1.6
8	452.5	122.5	60	1.2	1.2

000053

TABLE C-3
GEOPROBE 12834

Easting '83: 1349531.55
Northing '83: 478460.34
Reference Elevation: 576.0 feet amsl
Depth to Water Table: 63.0 feet bgs
Work Duration: 2/20/01 – 2/26/01

Sample Point	Elevation (ft amsl)	Depth Below Surface (ft)	Depth Below Water Table (@ 513.0 feet amsl)	Total Uranium Conc. (0.45 micron filtered) (µg/L)	Total Uranium Conc. (5 micron filtered) (µg/L)
1	512	64	1	90	91
2	503	73	10	95	97
3	493	83	20	54	55
4	493	83	20-D	56	63
5	483	93	30	25	27
6	473	103	40	2.2	2.6
7	463	113	50	1.5	1.8
8	453	123	60	1.1	1.1

TABLE C-4
GEOPROBE 12835

Easting '83: 1349678.12
Northing '83: 478280.90
Reference Elevation: 570.8 feet amsl
Depth to Water Table: 58.0 feet bgs
Work Duration: 2/26/01 – 3/1/01

Sample Point	Elevation (ft amsl)	Depth Below Surface (ft)	Depth Below Water Table (@ 512.8 feet amsl)	Total Uranium Conc. (0.45 micron filtered) (µg/L)	Total Uranium Conc. (5 micron filtered) (µg/L)
1	511.8	59	1	61	64
2	502.8	68	10	6.4	6.5
3	492.8	78	20	2.5	2.4
4	492.8	78	20-D	2.4	2.3
5	482.8	88	30	1.4	1.4
6	472.8	98	40	0.8	0.8
7	462.8	108	50	0.8	0.9
8	452.8	118	60	0.4	0.4

TABLE C-5
GEOPROBE 12836

Easting '83: 1349527.37
Northing '83: 478155.77
Reference Elevation: 574.2 feet amsl
Depth to Water Table: 62.0 feet bgs
Work Duration: 3/5/01 – 3/8/01

Sample Point	Elevation (ft amsl)	Depth Below Surface (ft)	Depth Below Water Table (@ 512.2 feet amsl)	Total Uranium Conc. (0.45 micron filtered) (µg/L)	Total Uranium Conc. (5 micron filtered) (µg/L)
1	511.2	63	1	225	232
2	502.2	72	10	159	161
3	492.2	82	20	90	90
4	492.2	82	20-D	90	91
5	482.2	92	30	30	32
6	472.2	102	40	4.0	4.1
7	462.2	112	50	2.4	2.6
8	452.2	122	60	1.3	1.4

TABLE C-6
GEOPROBE 12838

Easting '83: 1348129.11
Northing '83: 478083.68
Reference Elevation: 577.0 feet amsl
Depth to Water Table: 64.5 feet bgs
Work Duration: 3/8/01 – 3/15/01

Sample Point	Elevation (ft amsl)	Depth Below Surface (ft)	Depth Below Water Table (@ 512.5 feet amsl)	Total Uranium Conc. (0.45 micron filtered) (µg/L)	Total Uranium Conc. (5 micron filtered) (µg/L)
1	511.5	65.5	1	422	439
2	502.5	74.5	10	24	25
3	492.5	84.5	20	18	19
4	492.5	84.5	20-D	19	19
5	482.5	94.5	30	12	12
6	472.5	104.5	40	4.1	4.3
7	462.5	114.5	50	4.7	5.0
8	452.5	124.5	60	1.0	1.1

TABLE C-7
GEOPROBE 12842

Easting '83: 1348644.25
Northing '83: 477701.42
Reference Elevation: 575.6 feet amsl
Depth to Water Table: 62.5 feet bgs
Work Duration: 3/22/01 – 3/29/01

Sample Point	Elevation (ft amsl)	Depth Below Surface (ft)	Depth Below Water Table (@ 513.1 feet amsl)	Total Uranium Conc. (0.45 micron filtered) (µg/L)	Total Uranium Conc. (5 micron filtered) (µg/L)
1	510.1	65.5	3	136	139
2	503.1	72.5	10	57	58
3	493.1	82.5	20	4.4	4.4
4	493.1	82.5	20-D	4.6	4.6
5	483.1	92.5	30	1.1	1.1
6	473.1	102.5	40	1.7	1.8
7	463.1	112.5	50	1.1	1.2
8	453.1	122.5	60	1.8	1.9

TABLE C-8
GEOPROBE 12844

Easting '83: 1348862.32
Northing '83: 478081.06
Reference Elevation: 573.59 feet amsl
Depth to Water Table: 60.0 feet bgs
Work Duration: 4/24/01 – 5/1/01

Sample Point	Elevation (ft amsl)	Depth Below Surface (ft)	Depth Below Water Table (@ 513.6 feet amsl)	Total Uranium Conc. (0.45 micron filtered) (µg/L)	Total Uranium Conc. (5 micron filtered) (µg/L)
1	512.6	61	1	56	55
2	503.6	70	10	11	12
3	493.6	80	20	4.3	4.5
4	493.6	80	20-D	4.2	4.2
5	483.6	90	30	2.4	2.4
6	473.6	100	40	1.4	1.5
7	463.6	110	50	0.8	0.8
8	453.6	120	60	0.5	0.5

TABLE C-9
GEOPROBE 13241

Easting '83: 1350070.84
Northing '83: 477048.77
Reference Elevation: 581.0 feet amsl
Depth to Water Table: 65.0 feet bgs
Work Duration: 1/22/02 – 1/23/02

Sample Point	Elevation (ft amsl)	Depth Below Surface (ft)	Depth Below Water Table (@ 516 feet amsl)	Total Uranium Conc. (5 micron filtered) (µg/L)
1	515	66	1	3.6
2	506	75	10	8.7
3	496	85	20	33
4	496	85	20-D	33
5	486	95	30	120
6	476	105	40	14
7	466	115	50	4.8
8	456	125	60	1.4
9	446	135	70	2.5

TABLE C-10
GEOPROBE 12408

Easting '83: 1349833.05
Northing '83: 477806.19
Reference Elevation: 577.69 feet amsl
Depth to Water Table: 59.0 feet bgs
Work Duration: 3/24/99 – 3/31/99

Sample Point	Elevation (ft amsl)	Depth Below Surface (ft)	Depth Below Water Table (@ 518.69 feet amsl)	Total Uranium Conc. (5 micron filtered) (µg/L)
1	517.69	60	1	13.7
2	508.69	69	10	76
3	498.69	79	20	184
4	488.69	89	30	27
5	478.69	99	40	4.9
6	468.69	109	50	3.8
7	458.69	119	60	4.5
8	448.69	129	70	8.0

4317

TABLE C-11
GEOPROBE 12409

Easting '83: 1349347.26
Northing '83: 477184.56
Reference Elevation: 573.68 feet amsl
Depth to Water Table: 56.0 feet bgs
Work Duration: 4/8/99 – 4/14/99

Sample Point	Elevation (ft amsl)	Depth Below Surface (ft)	Depth Below Water Table (@ 517.68 feet amsl)	Total Uranium Conc. (5 micron filtered) (µg/L)
1	516.68	57	1	5.4
2	507.68	66	10	8.9
3	497.68	76	20	334
4	487.68	86	30	485
5	477.68	96	40	318
6	467.68	106	50	79
7	457.68	116	60	29
8	447.68	126	70	7
9	437.68	136	80	6.8
10	427.68	146	90	2.3

TABLE C-12
GEOPROBE 12433

Easting '83: 1349747.26
Northing '83: 477184.56
Reference Elevation: 573.32 feet amsl
Depth to Water Table: 56.0 feet bgs
Work Duration: 4/15/99 – 4/20/99

Sample Point	Elevation (ft amsl)	Depth Below Surface (ft)	Depth Below Water Table (@ 517.32 feet amsl)	Total Uranium Conc. (5 micron filtered) (µg/L)
1	516.32	57	1	6.9
2	507.32	66	10	351
3	497.32	76	20	373
4	487.32	86	30	320
5	477.32	96	40	180
6	467.32	106	50	58
7	457.32	116	60	13
8	447.32	126	70	7.8

TABLE C-13
GEOPROBE 12442

Easting '83: 1349789.92
Northing '83: 477510.83
Reference Elevation: 576.32 feet amsl
Depth to Water Table: 57.0 feet bgs
Work Duration: 5/03/99 – 5/05/99

Sample Point	Elevation (ft amsl)	Depth Below Surface (ft)	Depth Below Water Table (@ 519.32 feet amsl)	Total Uranium Conc. (5 micron filtered) (µg/L)
1	518.32	58	1	4.5
2	509.32	67	10	81
3	499.32	77	20	254
4	489.32	87	30	180
5	479.32	97	40	154
6	469.32	107	50	33
7	459.32	117	60	9.6
8	449.32	127	70	3.9
9	439.32	137	80	3.5
10	429.32	147	90	1.6

TABLE C-14
GEOPROBE 12231

Easting '27: 1380264.8
Northing '27: 476524.9
Reference Elevation: 562.97 feet amsl
Depth to Water Table: 42.0 feet bgs
Work Duration: 1/31/97 – 2/6/97

Sample Point	Elevation (ft amsl)	Depth Below Surface (ft)	Depth Below Water Table (@ 520.97 feet amsl)	Total Uranium Conc. (5 micron filtered) (µg/L)
1	519.5	43.5	1.5	240
2	511	52	10	387
3	501	62	20	397
4	491	72	30	287
5	481	82	40	177
6	471	92	50	113
7	460.5	102.5	60.5	8.0
8	451	112	70	7.4
9	441	122	80	5.0
10	431	132	90	1.0

TABLE C-15
GEOPROBE 12194

Easting '27: 1380426.1
Northing '27: 476264.1
Reference Elevation: 565.2 feet amsl
Depth to Water Table: 45.2 feet bgs
Work Duration: 11/12/96 – 11/20/96

Sample Point	Elevation (ft amsl)	Depth Below Surface (ft)	Depth Below Water Table (@ 520.0 feet amsl)	Total Uranium Conc. (5 micron filtered) (µg/L)
1	519	46.2	1	0.7
2	510	55.2	10	295
3	500	65.2	20	497
4	490	75.2	30	341
5	480	85.2	40	199
6	470	95.2	50	106
7	460	105.2	60	9.0
8	450	115.2	70	19
9	440	125.2	80	4.8
10	430	135.2	90	2.0
11	420	145.2	100	0.7