DOE–LM/GJ684–2004

Monticello Mill Tailings Site Operable Unit III Post-Record of Decision Monitoring Plan

Draft Final

August 2004

U.S. Department of Energy

Work Performed Under DOE Contract No. DE–AC01–02GJ79491
for the U.S. Department of Energy Office of Legacy Management.
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Work Performed by S.M. Stoller Corporation under DOE Contract No. DE–AC01–02GJ79491
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Contents

Page

Tables

Figures

Appendices

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Acronyms

ASTM	American Society for Testing and Materials
BTAG	Biological Technical Assistance Group
°C	degrees centigrade
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	contaminant of concern
DO	dissolved oxygen
DOE	U.S. Department of Energy
DOI	U.S. Department of Interior
EDD	electronic data deliverable
EPA	U.S. Environmental Protection Agency
ft	feet
IRA	interim remedial action
LM	Office of Legacy Management
mg/kg	milligrams per kilogram
mL	milliliter
mL/min	milliliters per minute
MMTS	Monticello Mill Tailings Site
ORP	oxidation-reduction potential
OU	operable unit
QA	quality assurance
QAI	quality assurance instruction
QC	quality control
ROD	Record of Decision
µm	micron
µg/L	micrograms per liter
ZVI	zero valent iron

1.0 Introduction

This *Post-Record of Decision* (ROD) *Monitoring Plan* defines the administrative and environmental monitoring tasks necessary to ensure that the selected remedy for Operable Unit (OU) III, surface water and ground water, of the Monticello Mill Tailings (USDOE) Site (MMTS) meets remediation goals for surface water and ground water and remains protective of human health and the environment. MMTS is administered by the U.S. Department of Energy (DOE) Office of Legacy Management (LM) in Grand Junction, Colorado. DOE implements a significant portion of work through a technical assistance and remediation contractor.

If the results of any sampling event specified in this plan indicate that significant changes are occurring in site conditions, or as warranted by new information, then revisions to this plan or the issuance of Program Directives (STO 1; Quality Assurance Instruction [QAI] 1.6) through DOE will proceed with prior agreement between DOE and EPA, and the Utah Department of Environmental Quality.

1.1 Site Background

The MMTS is a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) National Priorities List Superfund Site (CERCLIS ID Number UT3890090035), located in and near the City of Monticello (City), San Juan County, Utah (Figure 1–1). The MMTS includes a 78-acre tract within the City limits that included a former uranium and vanadium ore mill (Millsite), and peripheral properties covering approximately 1,700 additional acres. The mill area occupied approximately 10 acres of the Millsite. Approximately one million tons of vanadium and uranium ore were processed between 1942 and 1960. Mill tailings were impounded in four piles on the site through 1999, resulting in contamination of soil, sediment, surface water, and the shallow water-table aquifer (alluvial aquifer) with radioactive and other inorganic constituents. Properties comprising the MMTS are variously owned by the City, DOE, and private parties.

OU III is one of three OUs comprising the MMTS and presents the final response action for the site. The ROD for OU I and OU II (MMTS ROD), signed in September 1990, stipulated that contaminated tailings, soil, sediment, and debris from OUs I and II would be excavated and placed in a permanent on-site repository. The MMTS ROD designated OU III to address contaminated surface water and ground water. The remedy for OU III was deferred at that time until the effects of OUs I and II remedial actions on surface water and ground water could be determined through a focused Remedial Investigation and Feasibility Study. Remedial action under OUs I and II were completed in August 2001 by the removal of approximately 2.5 million cubic yards of contaminated soil and debris from the Millsite (OU I), peripheral properties (OU II), and other vicinity properties and placement in an on-site repository for permanent storage. These actions removed the primary sources of contamination to OU III ground water and surface water.

A Remedial Investigation report for OU III was prepared and finalized in 1998 (DOE 1998) while OU I and II remedial actions were ongoing. To address further environmental change associated with continuing OU I and II activities, and to proactively mitigate potential risk until a final remedy could be selected, the Interim Remedial Action (IRA) ROD for OU III (DOE 1998) was implemented in September 1998. Its main components were (1) implementing institutional controls to restrict use of contaminated ground water; (2) extracting and treating contaminated

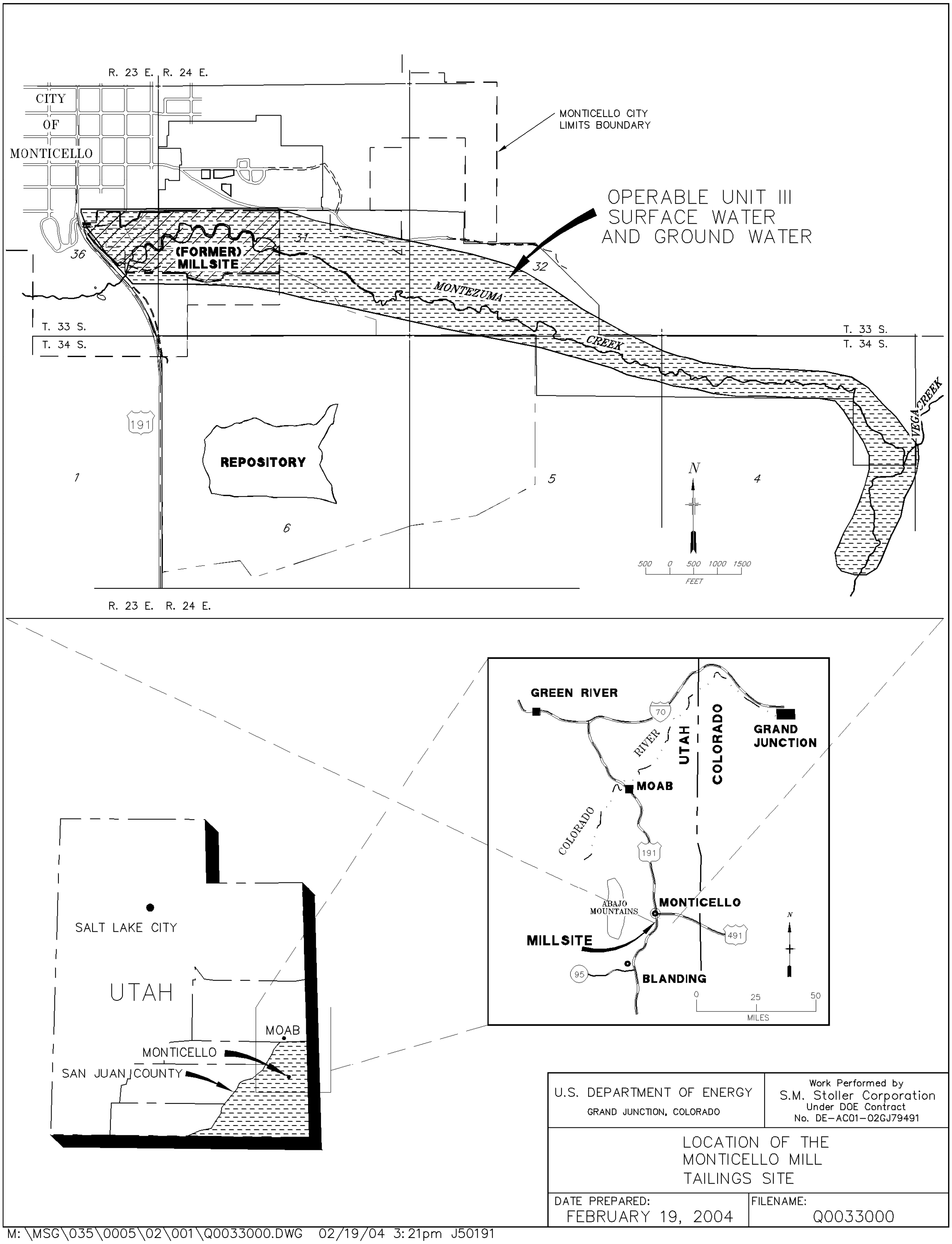

Figure 1–1. Monticello Mill Tailings Site, San Juan County, Utah

ground water from Millsite excavations; (3) comprehensive water quality and hydrogeological monitoring; (4) a treatability study of in-situ permeable reactive barrier technology; and (5) site-specific evaluation of contaminant transport characteristics and possible residual sources of contamination.

A Remedial Investigation Addendum/Focused Feasibility Study (DOE 2004a) presents the results of the IRA and an evaluation of permanent remediation alternatives for ground water and surface water based on site conditions following OU I and OU II remedial actions. As a result, the ROD for OU III (DOE 2004b), signed in June 2004, selected monitored natural attenuation with institutional controls as the final remedy.

1.2 Selected Remedy for OU III

The selected remedy for OU III consists of:

- Monitored natural attenuation of surface water and ground water, including comprehensive monitoring to evaluate its effectiveness. Specifically included as part of monitored natural attenuation is a phased approach to evaluate selenium concentration trends and the potential impacts of selenium concentrations on ecological receptors.
- Continued implementation and enforcement of the institutional controls that restrict use of the contaminated shallow alluvial aquifer, and the restrictive easement that prohibits removal of contaminated soil and sediment from the Montezuma Creek floodplain.
- Decommissioning the permeable reactive barrier when it ceases to benefit project objectives.

Monitoring activities and institutional controls will continue until the site remediation goals for surface water and ground water (Section 1.5) are met. Natural hydrological and geochemical processes identified in the OU III ground water system are expected to restore water quality to those goals by year 2045. Until that time, annual reports and CERCLA 5-year reviews will evaluate ground water and surface water restoration and the effectiveness of the institutional controls. In addition, as set forth in the ROD for OU III, if the selected remedy does not remain protective of human health and the environment, or if the monitoring results indicate that the remediation goals cannot be achieved in the allotted time (by year 2045), contingency remedies will be evaluated and will be implemented if determined necessary.

1.3 Plan Objectives and Organization

The objectives of this plan are to:

- Present the program for post-ROD surface water and ground water monitoring. The plan specifies the locations, frequency, and protocol to collect the surface water and ground water samples, submit the samples for laboratory analysis, and perform other routine monitoring tasks (Sections 2.0 and 3.0).
- Specify the analytical parameters, laboratory analytical methods, and laboratory reporting limits for the environmental samples (Sections 4.0 and 5.0).
- Present the bio-monitoring program for the post-ROD period (Section 6.0) which outlines the locations, frequency, and field protocol for abiotic and biotic monitoring required to evaluate potential ecological risk associated with selenium. In addition, the rationale,

trigger mechanisms, and schedule to implement phased selenium monitoring tasks are presented.

- Specify other details of quality assurance, data management, and schedule and funding (Sections 7.0, 8.0, and 9.0).
- Specify the method to evaluate and report the progress of surface water and ground water restoration (Appendix A).
- Identify the requirements of annual inspection and CERCLA 5-year reviews for OU III (Appendix B).
- Identify applicable or relevant and appropriate requirements and the general strategy for decommissioning the permeable reactive barrier (Appendix C) and abandoning obsolete ground water monitoring wells (Appendix D).

1.4 Site Description

The area encompassing OU III is sparsely populated and is used primarily for ranching and dry-land farming. The northwestern portion of OU III lies within the city limits of Monticello (population of about 1,900 in year 2000). The regional setting comprises the broad, nearly flat surface of the Great Sage Plain, which is about 7,000 feet (ft) in elevation. Average annual precipitation is 15 inches and occurs mainly during late summer and early fall monsoon storms.

Montezuma Creek (see Figure 1–2) is the main surface water feature in OU III, flowing west to east through the center of the study area. It is a small perennial stream with headwaters in the Abajo Mountains, which rise to nearly 11,000 ft approximately 5 miles west of Monticello. Typical base flow in the creek ranges up to about 0.5 cubic feet per second (225 gallons per minute). Montezuma Creek is used for irrigation and livestock watering. A municipal reservoir (Loyd's Lake) and water treatment plant interrupt natural flow in the creek. Montezuma Creek and its tributaries have incised a canyon network into the local bedrock formations in the east portion of the study area.

The hydrostratigraphic units associated with OU III are the shallow alluvial aquifer, the underlying Dakota Sandstone formation which locally acts as an aquitard, and the Burro Canyon sandstone aquifer. The alluvial aquifer comprises sand and gravel channel-fill deposits within the valley of Montezuma Creek. The alluvial channel is about 450 ft wide (north to south) at the eastern boundary of the Millsite and narrows to less than 200 ft about 1 mile east, where the valley becomes a steep-walled canyon (Figure 1–2). The bedrock erosional surface at the base of the alluvial aquifer is relatively flat across the width of the aquifer. Depth to bedrock is generally less than 15 ft below ground surface in the valley floor, and the typical saturated thickness of the aquifer is about 5 ft.

On the Millsite, the alluvial aquifer discharges to Montezuma Creek and to three adjoining wetlands that were constructed during site restoration. Montezuma Creek loses water to the alluvial aquifer between the eastern boundary of the Millsite and approximately 1 mile downstream. Farther east, a strong gaining stream condition results where the aquifer becomes thinner and narrower and ground water is discharged from Burro Canyon Formation. Ground water seepage from sources above the valley along the northern margin of the Millsite is an important source of recharge to the alluvial aquifer.

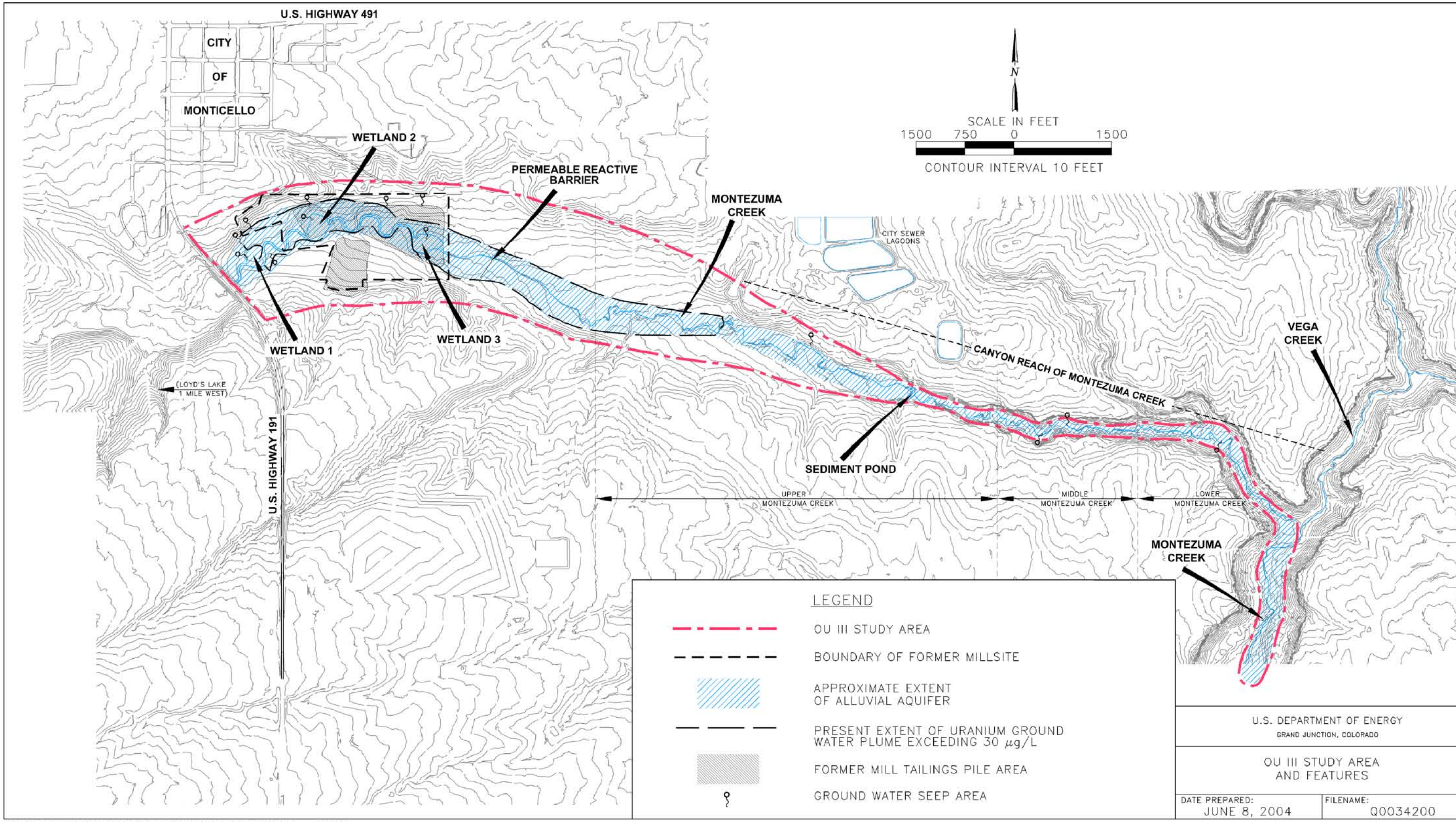

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Figure 1–2. Site Features and Approximate Extent of Ground Water Contaminant Plume

The alluvial aquifer is currently not used for drinking water, irrigation, or livestock watering. The potential to develop the alluvial aquifer as a domestic source is low because the saturated zone is very thin and generally unproductive. The city of Monticello has historically distributed Burro Canyon Formation ground water only for nondomestic purposes (municipal and residential irrigation) but it can be used to augment the culinary water supply.

1.4.1 Permeable Reactive Barrier

In June 1999, as part of the IRA ROD, a permeable reactive barrier was installed as a full-scale in situ treatability study. The permeable reactive barrier, located about 750 ft east of the Millsite (Figure 1–2), is constructed of zones containing a reactive medium (zero valent iron) that immobilizes dissolved ground water contaminants, including arsenic, molybdenum, nitrate, selenium, uranium, and vanadium. The combined reactive zones measure 103 ft long by 11–13 ft deep by 6 ft thick. Impermeable walls constructed of a soil/bentonite/water slurry extend north and south from the permeable reactive barrier to funnel ground water into the reactive zone. The north slurry wall is 97 ft long by 10–16 ft deep by 3−4 ft thick, and the south slurry wall is 240 ft long by 10–16 ft deep by 3–4 ft thick. The slurry walls and reactive zone are keyed at depth into competent bedrock of the Dakota Sandstone formation.

The effective lifespan of the permeable reactive barrier is not known at this time and is dependent on the physical and chemical mechanisms that are active in the permeable reactive barrier. The ROD for OU III does not include the permeable reactive barrier as a component of the final remedy. However, DOE will continue monitoring the effectiveness of the permeable reactive barrier of the Monticello permeable reactive barrier. When the permeable reactive barrier is no longer effective or needed, as directed by the ROD for OU III, it will be excavated and disposed in an appropriate facility as determined by the hazardous or radiological properties of the waste at that time. The effective lifespan of the permeable reactive barrier is estimated to be 10 to 20 years since its installation in 1999.

1.5 Contaminants of Concern and Remediation Goals

Contaminants of concern (COCs) for OU III surface water and ground water are arsenic, manganese, molybdenum, nitrate, selenium, uranium (and uranium isotopes), vanadium, gross alpha, and gross beta. Table 1–1 lists the ground water COCs, recent maximum concentrations detected in the alluvial aquifer, and the applicable remediation goals. Sodium and sulfate were identified in the Remedial Investigation as COCs but no benchmarks were established due to lack of toxicological data, and so these constituents are not included in Table 1–1. Also, a concentration-based remediation goal does not exist in the OU III ARARs for gross beta, nor can a risk based remediation goal be developed because gross beta is only an indicator of the type of radioactive emission, and thus, quantifiable risk factors are not available. (Risk factors are only available for specific isotopes, such as U-234 and U-238).

The approximate extent of ground water contamination by uranium, which is the most pervasive site-related constituent, is depicted on Figure 1–2. Plumes for other constituents are much less extensive; with few exceptions, only wells hydraulically upgradient of the permeable reactive barrier have COC concentrations that exceed remediation goals. Since completion of OU I and OU II removal actions and implementation of the permeable reactive barrier treatability study, decreasing concentration trends for several COCs, including uranium, are evident in the monitoring data.

Table 1–1. Contaminants with Concentrations That Exceed Applicable Ground Water Standards or Benchmarks

COC	Maximum[a]	Remediation Goal[b]
Arsenic	18.8 µg/L	10 µg/L
Manganese	14,200 µg/L	880 µg/L
Molybdenum	230 µg/L	100 µg/L
Nitrate (as N)	14.5 mg/L	10 mg/L
Selenium	237 µg/L	50 µg/L
Uranium	929 µg/L	30 µg/L
Vanadium	731 µg/L	330 µg/L
Uranium-234/-238	637[c]pCi/L	30 pCi/L
Gross alpha	68[d]pCi/L	15 pCi/L[c]

[a]Maximum concentration detected in the October 2002 sampling round.
[b]Source DOE (2004b).
[c]Calculated, assumes equilibrium.
[d]Excluding uranium.

Burro Canyon ground water is not contaminated because the Dakota Sandstone is an adequate aquitard. East of the Millsite in the canyon reach (Figure 1–2), the Dakota Sandstone has been removed by erosion and so the alluvial aquifer directly overlies the Burro Canyon aquifer. In this region, there is upward flow from the Burro Canyon aquifer to the alluvial aquifer, which prevents contaminant movement into the Burro Canyon aquifer. Additionally, discharge of ground water from the Burro Canyon aquifer has a role in preventing further downgradient movement of contamination in the alluvial aquifer.

Recent concentrations of OU III COCs in surface water (DOE 2004a), excepting nitrate, selenium, and uranium, were less than Utah surface water standards or, in their absence, ground water remediation goals that are based on human health. Uranium concentrations exceeded Safe Drinking Water Act standards in Montezuma Creek on and downstream of the Millsite. Nitrate concentrations exceeded the Utah standard at only one seep, which originates off-site and flows onto the Millsite, by as much as 10 times the standard.

Table 1–2 lists the surface water COCs for which surface water standards are available. Maximum concentrations detected during surface water sampling in October 2002 are provided for comparison. In most cases, the highest concentrations of COCs were detected in samples from seep locations on the former Millsite. The completion of surface remediation and the IRA appear to have resulted in decreased concentrations of most constituents in surface water, with the exception of selenium.

Selenium concentrations in both surface water and ground water samples increased following completion of OU I remedial action. The increases were likely due to release of naturally occurring selenium in freshly exposed bedrock during remediation of the Millsite, and from naturally occurring selenium in shallow ground water that originates off-site to the north of the Millsite. The biomonitoring tasks described in Section 6.0 of this plan were developed specifically to assess the extent to which the increased levels of selenium affect biological receptors.

Table 1–2. Contaminants of Concern and Applicable Surface Water Standards

COC	Maximum Concentration[a]	Utah Surface Water Standard
Arsenic	10 µg/L	10 µg/L
Gross alpha[b]	5 pCi/L	15 pCi/L
Nitrate (as N)	52 mg/L	4 mg/L
Selenium	112 µg/L	5 µg/L

[a]Maximum concentrations detected in the October 2002 sampling round.
[b]Excluding uranium.
µg/L = micrograms per liter; pCi/L = picocuries per liter; mg/L = milligrams per liter.

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2.0 Surface Water and Ground Water Sampling Locations and Schedule

Comprehensive surface water and ground water monitoring will be performed to obtain the data necessary to assess the performance of natural attenuation for OU III. The sampling locations and rationale for their selection are presented in the following section.

2.1 Long-Term Monitoring Network

Under this plan, 44 monitoring wells and 15 surface water locations will be sampled in October, and 31 monitoring wells and 15 surface water locations will be sampled in April. These ground water and surface water samples will be collected on the schedule specified in Table 2–1 at the locations and shown in Figure 2–1 and Figure 2–2. Water levels will be measured at each monitoring well shown in the figures during each monitoring event. Table 2–1 lists the schedule for water-quality sampling only (see also Section 3.5 and Table 3–4 for water level measurement locations).

Table 2–1. Water Sampling Locations and Schedule for Post–ROD Monitoring[a,b]

Sampling Location			Schedule	
General Location	**Description**	**Location ID**	**October**	**April**
Former Millsite	Alluvial Ground Water	MW00–01	X	X
		T00–01	X	
		T00–04	X	
		T01–01	X	X
		T01–02	X	X
		T01–04	X	X
		T01–05	X	X
		T01–07	X	X
		T01–12	X	X
		T01–13	X	
		T01–18	X	
		T01–19	X	X
		T01–20	X	
		T01–23	X	
		T01–25	X	
		T01–35	X	X
	Burro Canyon Ground Water	93–01	X	
	Montezuma Creek and Wetlands (Surface Water)	SW00–01	X	X
		SW00–02	X	X
		SW01–02	X	X
		SW01–03	X	X
		W3-03	X	X
		W3-04	X	X
	Millsite Seeps (Surface Water)	Seep 1	X	X
		Seep 2	X	X
		Seep 3	X	X
		Seep 5	X	X
		Seep 6	X	X

Table 2−1 (continued). Water Sampling Locations and Schedule for Post-ROD Monitoring[a,b]

Sampling Location			**Schedule**	
General Location	**Description**	**Location ID**	**October**	**April**
Downgradient	Alluvial Ground Water	MW00–06	X	X
		MW00–07	X	
		82–08	X	X
		88–85	X	X
		92–07	X	X
		92–08	X	X
		92–09	X	X
		92–11	X	X
		95–03	X	
		95–01	X	
		P92–06	X	X
		0200	X	X
		0201	X	X
		0202	X	X
	Burro Canyon Ground Water	92–10	X	
	Burro Canyon/Dakota Ground Water	83–70	X	
	Alluvial Ground Water (Permeable Reactive Barrier Area)	PW–17	X	X
		PW–28	X	X
	Permeable Reactive Barrier Ground Water	R1–M3	X	X
		R1–M4	X	X
		R3–M2	X	X
		R3–M3	X	X
		R4–M3	X	X
		R4–M6	X	X
		R6–M3	X	X
		R6–M4	X	X
		R10–M1	X	X
	Montezuma Creek	SW01–01	X	X
		Sorenson	X	X
		SW00–04	X	X
		SW92–08	X	X

[a]Bedrock wells 31NE93–205, 95–06, and 95–07 will be sampled on a 5-year frequency starting in October 2006.
[b]Listed locations and sample requirements are subject to change through Program Directives.

During the fall, Montezuma Creek exhibits base flow conditions, water levels in the alluvial system are generally the lowest, and contaminant levels are generally highest in both surface water and ground water. Therefore, an October sampling event is designed to be the most extensive sampling round. Selected alluvial well locations encompass the full extent of the contaminant plume. In addition, background water quality will be monitored at the west end of the Millsite. Water quality within and immediately upgradient and downgradient of the permeable reactive barrier will be monitored to allow ongoing evaluation of treatment effectiveness. During the spring, Montezuma Creek exhibits high-flow conditions, water levels in the alluvial aquifer are generally the highest, and contaminant levels are generally lowest in both surface water and ground water. An April sampling event was chosen to monitor these conditions.

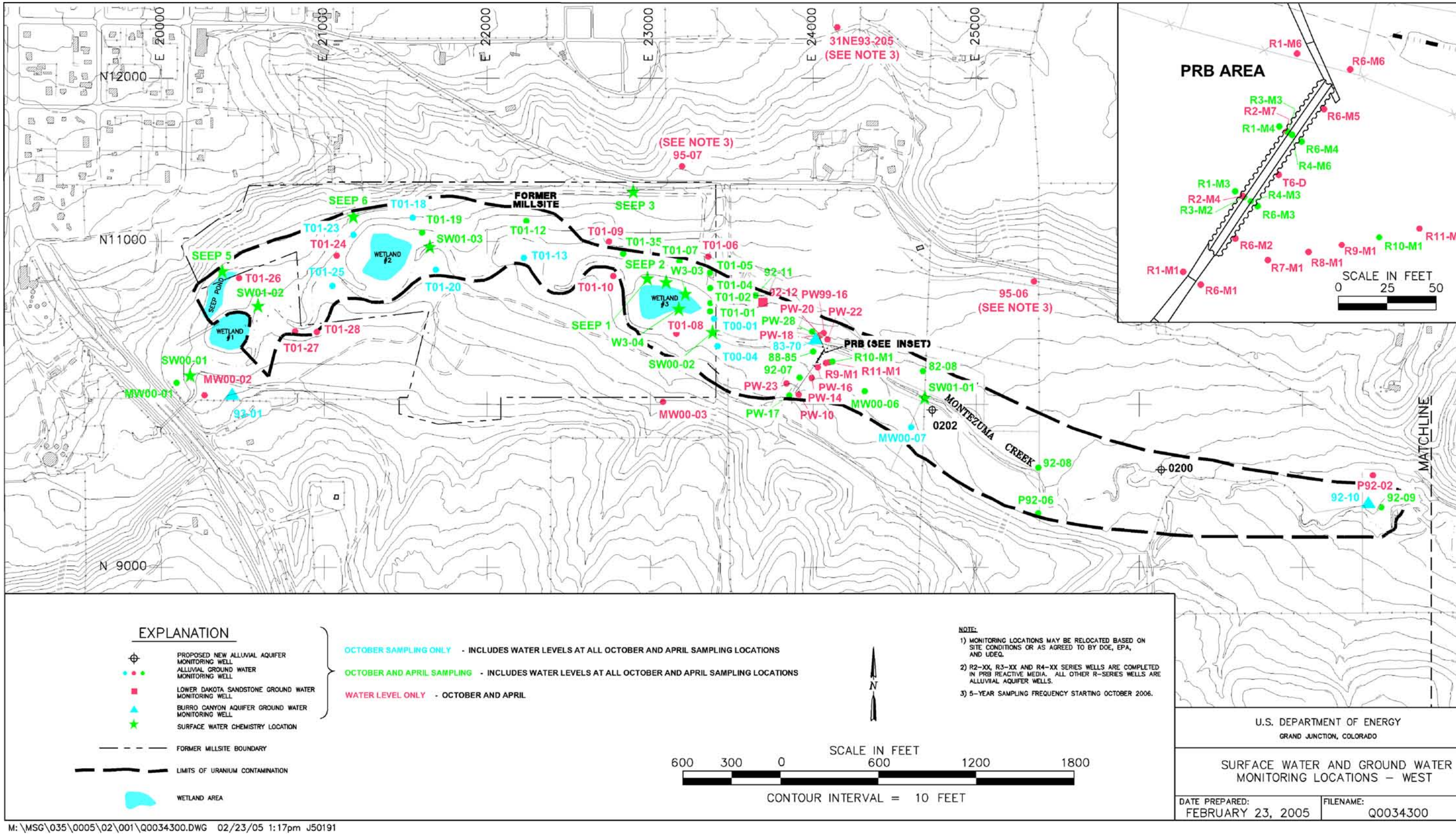

Figure 2–1. Ground Water and Surface Water Monitoring Network–West

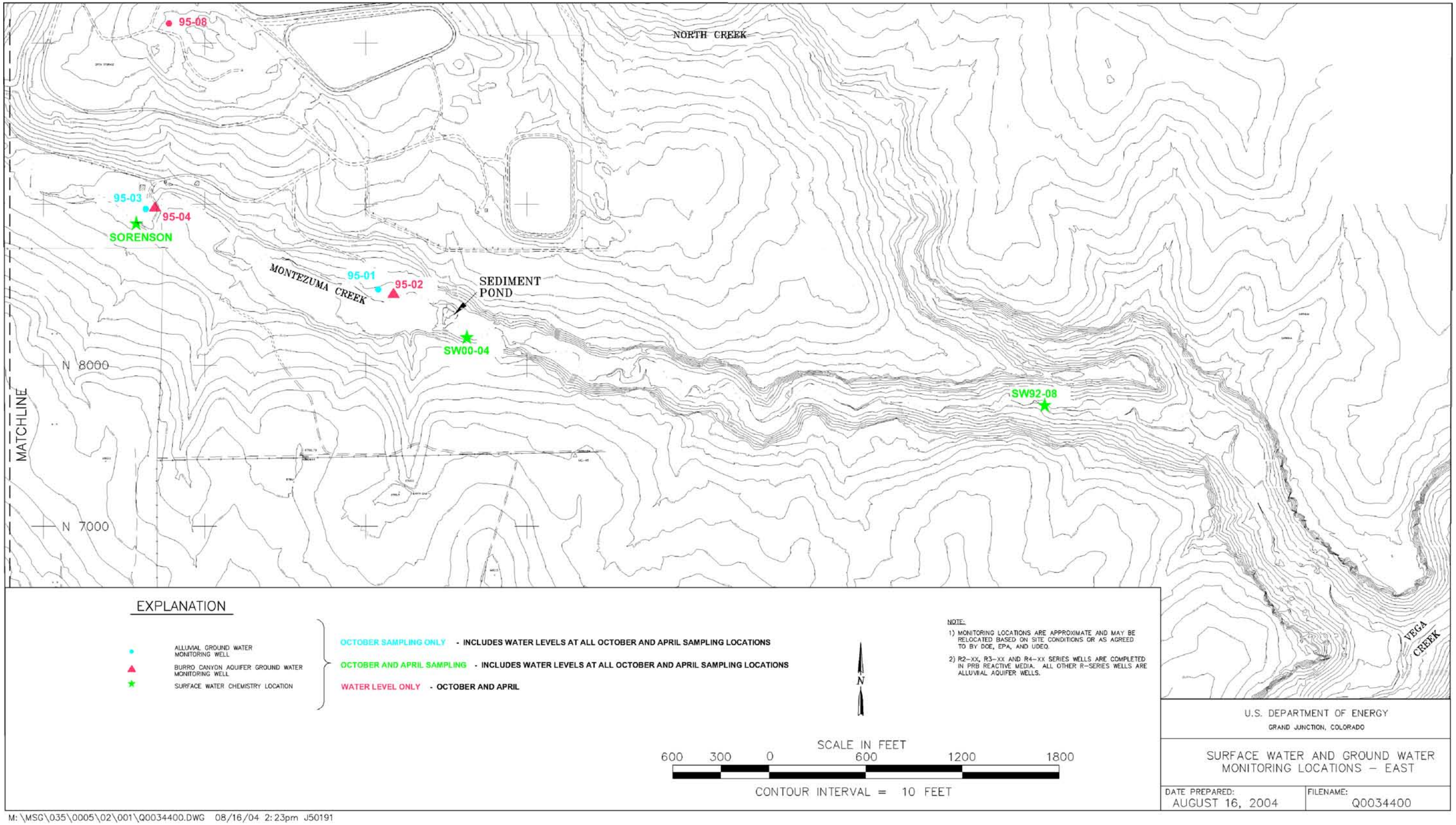

Figure 2–2. Ground Water and Surface Water Monitoring Network–East

To verify protection of water quality in the bedrock aquifer, three bedrock wells will be monitored in the October events: one location is located upgradient of the Millsite (well 93-01), and one is located beneath the main area of contamination in the alluvial aquifer (well 83-70), and the remaining location (well 92-10) is near the downgradient terminus of contamination in the alluvial aquifer. Additionally, bedrock wells 31NE93−205, 95−06, and 95−07 will be sampled on a 5-year frequency starting in October 2006 in order that additional water quality data for the bedrock formations can be evaluated in the 5-year reviews.

Eight surface water sampling locations in Montezuma Creek will be monitored, including one location upgradient of the Millsite (background location), and several locations each, on and downgradient of the former Millsite. Surface water monitoring also includes five locations of ground water seepage on the north side of the former Millsite. Surface water monitoring at the described locations enables the effect of ground water interaction on surface water quality within OU III to be assessed. Seeps 1 through 3 and open-marsh sites W3-03 and W3-04 of Wetland 3 (Figure 2–1) are particularly relevant in evaluating the contribution of selenium to ground water and surface water from natural sources (Mancos Shale and Dakota Sandstone) both on- and off-site. Surface water sites SW01−02, SW01−03, and SW00−02 are each located in Montezuma Creek downstream of the outlet of the respective wetland.

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3.0 Surface Water and Ground Water Sampling Procedures

The procedures described in this section are to guide field personnel in the collection of water quality samples, ground water levels, and stream flow measurements. All field methods employed for these tasks are consistent with standard practices as established in the contractor's *Environmental Procedures Catalog* (STO 6). These practices remain consistent with those applied in previous monitoring plans for OU III.

3.1 Work Area Practices

Work area preparation and equipment handling will be conducted to minimize the potential for cross-contamination of samples and sampling equipment. Work area preparation and practices that will minimize cross contamination includes use of tables to keep equipment, bottles, and supplies off the ground; segregation of trash and purge containers from clean areas in the sample vehicle; stowing equipment in plastic bags after decontamination; rinsing and wiping the outside of sample bottles after sample collection and before storage; and frequent changing of disposable gloves.

3.2 Well Purging

Prior to collecting a ground water sample from a monitoring well, the well will be purged using methods prescribed in this section. The goal of purging is to ensure that a representative sample of the water in the geologic formation is collected. The depth to ground water will be initially measured with an electric sounder before purging a well.

3.2.1 Well Purge Criteria

Excepting the wells completed in the permeable reactive barrier (Section 3.2.4), monitoring wells will be purged using a low-flow purging method. The low-flow purging method involves pumping at a low flow rate (< 500 milliliters per minute [mL/min]) with a dedicated pump or dedicated tubing (using a peristaltic pump) placed in the approximate middle of the screened interval. The slow pumping rate allows water to flow directly from the formation to the pump intake, while minimizing mixing of potentially stagnant water column above the pump intake, pumping-induced turbidity, and disturbance of sediment in the base of the well.

The initial pumping rate is not to exceed 500 mL/min. At the start of pumping, the water level will be monitored to determine if drawdown is occurring. If drawdown is occurring, the pump rate will be lowered until drawdown stops or a pump rate of 100 mL/min is obtained. If the water level stabilizes before 2 ft of drawdown occurs, then the well will be purged and sampled at that flow rate. Water levels and purge water measurements of temperature, specific conductance, pH, and turbidity will be taken at regular intervals from 3 to 5 minutes apart during purging. Sample collection will begin as soon as these parameters stabilize and one pump/tubing volume has been removed. Stabilization criteria for low-flow purging are specified in Section 3.2.2.

If the water level has not stabilized after 2 ft of drawdown, and the minimum flow rate of 100 mL/min has been obtained, then the well will be pumped dry. In this case it is assumed that all unrepresentative water has been removed and that sampling can proceed when sufficient water level recovery has occurred (see Section 3.3.2 for sample collection procedure at slow recovering wells).

3.2.2 Field Parameter Measurements for Monitoring Wells

For all monitoring wells, the temperature, specific conductance, pH, and turbidity will be monitored throughout the well purging process. Probes to monitor temperature, specific conductance, and pH will be immersed in a flow-through cell (STO 6; Procedure LQ–10[P]) during purging. Turbidity will be measured with a portable turbidity meter, which requires a sample to be obtained from the pump/flow cell discharge. In addition to the stabilization parameters listed above, oxidation-reduction potential (ORP) and dissolved oxygen (DO) will be measured at all permeable reactive barrier wells and selected alluvial wells, and total alkalinity will be measured in the field after well purging criteria have been met. The calibration and quality control (QC) procedures for field measurements made during ground water sampling are presented in Table 3–1.

Table 3–1. Calibration and Quality Control Checks for Field Measurement Instruments

Parameter	Quality Control Requirement	Minimum Frequency	Operational Check Criteria	Corrective Actions
pH	3 point calibration with 4, 7, and 10 buffers	Prior to start of sampling event	NA	If operational check criteria are not achieved, check meter, probe, and standard solutions used in making the measurements. Repeat operational check. If still out, recalibrate instrument. If recalibration is not possible, use a different instrument. If a new instrument is not available, flag the data and record the condition as a field variance.
	1-point operational check with 4 or 10 buffer	Twice daily	0.2 pH units	
Specific conductance	1-point calibration with 1,000 µmhos/cm standard solution	Prior to start of sampling event	NA	
	1-point operational check	Twice daily	± 10 % of standard	
Temperature	Operational check using a NIST traceable thermometer	Prior to start of sampling event	± 0.3 ºC	
Turbidity	3-point calibration with primary turbidity standards	Within 6 months of sampling event	NA	
	3-point operational check with Gelex standards	Twice daily	± 10 % of Gelex standards	
Dissolved oxygen	Calibration in water saturated air	Prior to start of sampling event	NA	
	Zero check with sodium sulfite solution (Na_2SO_4)	Twice daily	< 0.2 mg/L	
Oxidation-reduction potential	Calibration with Zobell solution	Prior to start of sampling event	NA	
	Operational check with Zobell solution	Twice daily	± 10 % of standard	

The criteria defining stability are detailed in Table 3–2. If the five nephelometric turbidity unit criteria cannot be attained and proper well construction and development have been demonstrated, sampling will commence and the results will be evaluated with consideration of sample turbidity.

Calibration of field instrumentation and field measurements of pH, specific conductance, alkalinity, temperature, turbidity, DO, and ORP will be conducted according to the manufacturer’s instructions. Any deviations from these measurements or instrument failures that cannot be corrected prior to sample collection will be documented as a field variance on the water sampling field data forms (reference Section 4.4.4, "Trip Reports, Field Variance, and Nonconformance Reporting").

Table 3–2. Purge Stability Criteria

Parameter	Criteria
pH	± 0.2 pH units over the last 3 consecutive readings
Temperature	± 10 % over the last 3 consecutive readings
Specific conductance	± 10 % over the last 3 consecutive readings
Turbidity	≤ 5 nephelometric turbidity units for the final reading
Purge volume	One pump/tubing volume
Flow rate	≤ 500 mL/min
Water Level	Essentially no drawdown over the last 3 consecutive readings

3.2.3 Purging Equipment

Well purging will be accomplished using a peristaltic pump, bladder pump, bailer, or submersible pump (STO 6; Procedure LQ-11[P], Methods A, B. and D, respectively). Dedicated bladder pumps, or downhole tubing for use with a peristaltic pump, are in-place for most OU III monitoring wells scheduled for sampling in this plan. If a non-dedicated pump is used, then a minimum of 4 hours after pump installation is required before purging and sampling can commence. Purging (and sampling) equipment is documented on the water sampling field data form for each well (STO 6; Procedure LQ–3[P]).

3.2.4 Purging and Field Parameter Monitoring at Permeable Reactive Barrier Wells

The following parameters will be measured at each permeable reactive barrier well: temperature, specific conductance, pH, ORP, DO, turbidity, and alkalinity. Calibration and operational checks of field instruments are the same as for monitoring wells (Table 3–1). Field parameter stabilization is not required during permeable reactive barrier well purging. Field measurements will be made prior to sample collection and after 1 liter has been removed from 1-inch diameter wells.

Excessive pumping of the permeable reactive barrier wells is to be avoided because of the close well spacing. The purge procedure for the permeable reactive barrier wells is as follows: 1) for wells in the zone containing gravel plus 13 percent zero valent iron (ZVI) and the zone containing 100 percent ZVI (Figure 3−1), install or lift dedicated polyethylene tubing 2 to 3 ft above the bottom of the well; 2) purge 1 liter using a peristaltic pump; 3) use a flow-through cell to measure field parameters in the next 500 milliliters (mL) of purged water; and 4) collect sample. Lifting the polyethylene tubing places the intake above the level of the bedrock sump into which the gate was constructed. The location of the permeable reactive barrier wells and zones of completion are shown in Figure 3–1.

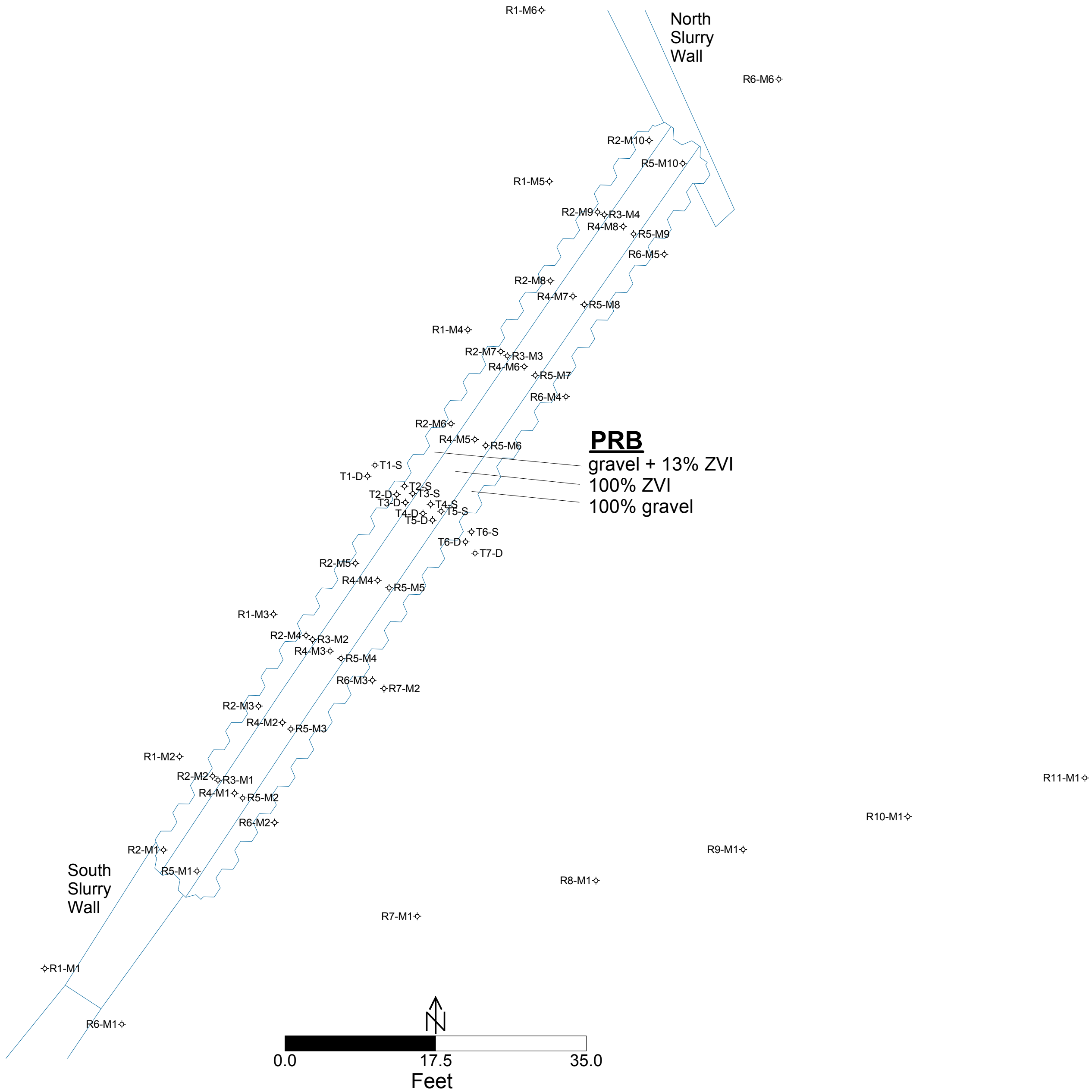

Figure 3–1. Permeable Reactive Barrier Ground Water Monitor Well Locations and Identification

3.2.5 Disposition of Purge Water

All purge water other than from wells completed in the permeable reactive barrier will be discarded on the ground in the vicinity of the sampling location in such a manner that prevents erosion, prevents muddying the work area, and prevents discharge to surface water. Purge water from the permeable reactive barrier wells will be placed in the well from which it was withdrawn after all samples from the permeable reactive barrier are collected or retained and placed in Pond 4 located near the on-site repository.

3.3 Ground Water Sample Collection Criteria and Analyte Priority

Sample fractions not requiring field filtration will be collected directly from the pump discharge line (not the flow-through cell discharge). Samples will be filtered by directly affixing the filter to the discharge line outlet. Samples will be filtered through 0.45-micron (µm) in-line disposable cartridge-type filters. Standard collection procedures are described in "Standard Practice for the Collection, Filtration, and Preservation of Liquid Samples" (STO 6; Procedure LQ–12[P]).

Water sample containers will be filled to approximately 90 percent capacity. If the container overflows when being filled with the collected sample, the exterior of the container will be rinsed with distilled water and wiped dry before being packed for shipment.

Care will be taken to slowly pump wells that have a low recharge rate. The slow pumping will minimize formation water cascading down the sides of the screen potentially resulting in changes to ground water chemistry. If the water level in a well that has been purged dry has not returned to 75 percent of the original measured water level within 2 hours, a sample will not be collected. If the water level has recovered in excess of the 75 percent, sample aliquots will be collected in order of priority until the available water is depleted or a complete sample is obtained. The well will not be revisited if a complete sample is not collected after the initial attempt.

Ground water sample aliquots should be collected according to the following priority in the event of poor well recovery and incomplete sample collection (highest to lowest priority): metals, nitrate, anions, and gross alpha and beta.

3.4 Surface Water Sample Collection Criteria

Surface water sampling locations will be approached from downstream to minimize the potential for introducing sediments into the sample from walking in the creek. Surface water field measurements of pH, temperature, and specific conductance will be taken in-situ or through a flow cell; alkalinity will also be measured in the field. Surface water sample aliquots not requiring filtration will be collected by container immersion by pointing the bottle mouth upstream (STO 6; Procedure LQ-11[P], Method G) or by a peristaltic pump. If a pump is used, entrainment of sediment into the sample will be avoided. Filtered aliquots will either be collected with a peristaltic pump (Method A) with the pump intake submerged in the stream, or excess sample volume may be collected and filtered as soon as possible at a central location. Samples will be filtered through 0.45-µm in-line disposable cartridge-type filters.

3.5 Quality Control Samples

QC samples that will be collected in conjunction with water sampling include field duplicates and field equipment blanks (Table 3–3). Sample volumes required for laboratory QC purposes will be collected as requested by the analytical laboratory.

Table 3–3. Quality Control Sample Collection and Repeat Measurement Frequencies

Matrix	Sample Type	Frequency	Analysis
Ground water	Field Duplicate	1 per 20 or fewer locations	Same as environmental sample
Surface water	Field Duplicate	1 per 20 or fewer locations	Same as environmental sample
Ground water/surface water	Equipment Blank	1 per 20 or fewer locations collected with nondedicated equipment	Same as environmental sample
Ground water–water level measurement	Repeat measurement	1 per 20 or fewer locations	Not Applicable

3.5.1 Field Duplicates

Duplicate surface water and ground water samples will be collected in the field on a frequency of one duplicate sample per 20 water samples (or less) for each media and analytical parameter. Surface water and ground water are considered separate media in the context of field duplicates. Duplicate water samples will be collected by alternately filling the original and duplicate sample container per analytical parameter. Duplicate samples will be submitted blind to the laboratory under a unique fictitious identity for the sampling event that is similar to the actual sampling locations. The fictitious identity for duplicate surface water samples will have a prefix of "SW80-" followed by a 2-digit number. The fictitious identity for a ground water sample duplicate will have a prefix of "80-" followed by a 2-digit number.

3.5.2 Equipment Blanks

Equipment blanks provide a check for cross-contamination of samples by ineffective decontamination of field equipment. At a minimum, one equipment blank sample will be prepared in the field for every 20 water samples (or less) that are collected with non-dedicated equipment. Additional equipment blanks will be collected when circumstances warrant (i.e., change in decontamination source water or assigned personnel). Equipment blanks will be prepared by collecting a sample of the final deionized rinse water (rinsate) used to decontaminate non-dedicated sampling equipment. Equipment blank samples will be submitted blind to the laboratory under a unique fictitious identity for the sampling event according to the same scheme described for field duplicates.

3.6 Ground Water Level Monitoring

Ground water levels will be measured in monitoring wells to ensure environmental conditions remain consistent with the site conceptual model of ground water flow and contaminant transport (DOE 2004a). These data are used to qualitatively evaluate the stability of the hydrologic and geochemical settings, confirm the site conceptual model, and interpret observed concentration trends. Water table maps will be developed from the water level data to evaluate ground water flow direction. The data will also be used to evaluate saturated thickness of the alluvial aquifer and flow relationships between the alluvial aquifer and the Burro Canyon aquifer.

Table 3–4, summarizes the ground water level monitoring network according to the formation in which the well is completed. The locations of the ground water level monitoring wells are shown in Figure 2–1, Figure 2–2, and Figure 3–1.

Table 3–4. Ground Water Level Measurement Network

General Location	Description	Well Number
Former Millsite	Alluvial	MW00–01, MW00–02, MW00–03, T00–01, T00–04, T01−01, T01–02, T01–04, T01–05, T01–06, T01–07, T01−08, T01–09, T01–10, T01–12, T01−13, T01–18, T01−19 T01–20, T01–23, T01–24, T01–25, T01–26, T01−27, T01–28, T01–35
	Burro Canyon	93-01
Downgradient	Alluvial and Permeable Reactive Barrier	82–08, 88–85, 92–07, 92–08, 92–09, 92–11, 95−01, 95–03, P92–02, P92–06, MW00–06, MW00–07, PW–10, PW–14, PW–16, PW–17, PW–18, PW–20, PW−22, PW–23, PW−28, PW99–16, R1–M1, R1–M3, R1−M4, R1–M6, R2−M4, R2−M7, R3–M2, R3–M3, R4−M3, R4–M6, R6–M1, R6–M2, R6–M3, T–6D, R6–M4, R6–M5, R6–M6, R7–M1, R8–M1, R9–M1, R10–M1, R11–M1, 0200, 0201, 0202
	Burro Canyon	92–10, 95–04, 95−02, 31NE93–205, 95–06, 95–07, 95–08
	Burro Canyon/Dakota Sandstone	83–70
	Dakota Sandstone	92–12

Ground water levels in the monitoring wells listed in Table 3–4 will be measured in April and October concurrent with the water quality sampling events. The water-level measurement network will be periodically reviewed and updated.

Measurements will be recorded in a bound field logbook or an appropriate field data form. Measurement of depth-to water in monitoring wells will be made to the nearest 0.01 ft with an electric sounder as described in Method A in the “Standard Test Method for the Measurement of Water Levels in Ground Water Monitoring Wells” (STO 6; Procedure LQ−2[T]).

Repeat measurements for depth to water will be taken to verify method repeatability. Water level measurements will be repeated once for every 20 (or less) measurements.

3.7 Monitoring Well Inspection

Inspection of the above-ground components of all existing monitoring wells, listed in Appendix E, will occur on an annual basis each October according to the procedures described in the “Standard Practice for the Inspection and Maintenance of Ground Water Monitoring Wells” (STO 6; Procedure LQ–18[P]). Subsurface inspection and redevelopment will be performed when indicated by decreased well yield or excessive turbidity. Well inspection information will be recorded on the water sampling field data forms. Actions taken or corrective measures required will be documented on the water sampling field data forms and documented in the trip report, which is prepared after the conclusion of the sampling event.

3.8 Surface Water Discharge Monitoring

Surface water discharge will be quantitatively measured at eight sites along Montezuma Creek. The discharge measurement sites are the same as the Montezuma Creek water quality sites identified in Table 2–1. In addition, the flow at Seeps 1, 2, 3, 5, and 6 and other known seeps will be qualitatively estimated and recorded in the field. The locations of the surface water discharge monitoring sites are shown on Figure 2–1 and Figure 2–2. Surface water discharge measurements will be taken in April and October concurrent with water quality sampling and water level measurement activities.

3.8.1 Measurement Method

Stream flow in Montezuma Creek will be determined according to the velocity-area method (STO 6; Procedure LQ–29[T] and LQ–30[T]). The velocity-area method consists of measuring the representative current velocity in each of multiple cross-sections traversing the width of the flow channel. Total discharge at a given location is the sum of the area-velocity products of the individual cross-sections.

As a general guideline, a velocity and water depth measurement will be taken per 0.5 ft of stream width. The water depth at the stream banks will also be measured. Stream width and depth measurements will be recorded to the nearest 0.1 ft and 0.025 ft, respectively. Within each partial cross-section, the velocity will be measured at a depth that is six-tenths of the total depth from the upper surface of the stream (STO 6; Procedure LQ–29[T]). For example, the velocity will be measured at 0.6 ft below the water surface or 0.4 ft above the streambed where the creek is 1 ft deep.

Stream velocity will be measured with a Swoffer Model 2100 Series Current Velocity Meter (rotating element type), or equivalent. Features of the Swoffer meter include scales for the true depth and six-tenths depth for rapid depth placement of the rotating element. Velocities should be measured over a 20-second averaging period. Unstable flow may require longer averaging periods. Calibration and operation of the current meter will proceed according to manufacturer recommendations and the general guidelines described in STO 6; Procedure LQ–29(T). The instrument calibration setting will be documented in the field.

Additional information to be recorded by field personnel includes recent and current weather conditions, crop irrigation (location, point of withdrawal, number of sprinkler heads, etc.), presence or absence of water in tributary streams, bank seepage, and other surface water withdrawals or returns.

The accuracy of stream-discharge measurements by the velocity-area method is a function of meter accuracy, area and depth measurement accuracy, and representativeness of the measured velocity. To minimize the effects of natural variation on measurement accuracy, the following factors will be considered prior to measurement:

- Straight stream reaches are preferred.
- Uniform flow within a single, well-defined, smooth channel is preferred with no overbank or underbank flow.
- Avoid overhanging brush and submerged vegetation.

- Avoid irregular, rough stream bottoms.
- Avoid eddied, turbulent, and stagnant water.
- Observe rotating elements during velocity measurement to confirm proper operation.

Field notes should record the basic measurement conditions at each location.

3.9 Equipment Decontamination Procedures

Non-dedicated water sampling equipment will be decontaminated prior to the collection of each sample. Decontamination will proceed according to Method B of the “Standard Practice for Decontamination of Field Equipment Used at Nonradioactive Waste Sites” (STO 6; Procedure GT–7[P]).

Decontamination water from ground water sampling sites will be managed with purge water, as described in Section 3.2.5. Decontamination water at surface water sites will be released at the streamside. Decontaminated equipment will be wiped dry with clean absorbent tissue and placed in clean protective containers or plastic bags until further use.

3.10 Investigation Derived Waste

Trash generated during all sampling/measurement tasks will be disposed in authorized trash receptacles.

3.11 Sampling and Measurement Equipment and Supplies

Equipment and supplies used in field sampling and measurement activities will be cleaned and inspected during preparation for the trip. Sufficient quantities of calibration solutions, spare probes, acids used for sample preservation, back-up equipment, supplies, and spare parts will be readily available to the field team. Table 3–5 shows an example of a pre-trip equipment and supply list used by team members when preparing for fieldwork. This type of list is typically included in each of the Water Sampling Data Books (standardized, bound field data forms).

Table 3–5. Water Sampling Equipment List

Pumps and Accessories
Air compressor, control box, and red airline hose
Portable bladder pump and hose whips
Grundfos submersible pump and control box, power cord
Generator for the Grundfos, pump shroud for 4" or > wells
Blue peristaltic pump and pumphead tubing
Downhole tubing for blue peristaltic
Small peristaltic pump and pumphead tubing, power cords
Reel of tubing for surface water sampling
Disposable bailers
Reel of line for bailers
12 V Whale pump, 12 V battery, socket adapter cord

Monitoring Equipment
YSI with pH, conductivity, temperature, and ORP probes
Turbidimeters
DO meters and membrane kits
Flow cell with elbows
Tubing to connect flow cells
Buckets
Alkalinity kits, with all pieces and extra supplies
Water level indicator
Stream Flow measuring equipment

Paperwork
SAP
Field Sampling Procedures
Manufacturer's Equipment Guidelines
Ticket books
Water Sampling Field Data Sheets
Labels
Logbooks
Chain-of-Custody forms
Well completion information
Custody seals

Chemicals
HNO_3
H_2SO_4
pH buffer solutions (4, 7, 10)
Conductivity calibration solutions
(100, 1,000, and 10,000 μmhos/cm)
DO zero check solution
DO probe solution
DO high/low ampules (DR/890)
Zobell solution
DI water
Organic free water
Primary turbidity calibration solutions
pH paper
Detergent
Pipetter or disposable pipettes

Miscellaneous
Well keys
Kimwipes
Disposable gloves
Filters
Trash bags
Ice chests
Calculator
Spare batteries – AA, C, D
Fuses
Bottles
Squirt Bottles
Surge blocks
Field table
Decon tube for pumps
Cell phone w/chargers
Rain/Snow gear
Tool box
Duct/Strapping tape
Misc tubing and connectors
Downrigger (fishing kit)
Broom/brush/dustpan and sponge

Vehicle
Credit card / Trip tickets
First Aid kit
Shovel
Winch kit
Jumper cables
Fire Extinguisher
MSDS sheets
Health and Safety Plan

Data Loggers
Computer
Data link(s) / Com cable kit
12V inverter
Data logger data sheets
Blank disks
Data logger manuals
Well list of data loggers

Other
Project Charge No. __________________
contractor's Laboratory Coordinator notified
Site access confirmed/arranged
Travel Authorization (TA) / Lodging
Update Initials Log (Proj. File) Yes / NA

4.0 Surface Water and Ground Water Sample Management and Analysis

The procedure described in this section will guide field personnel in the practices of preparing and managing the ground water and surface samples, once collected, through shipment to the laboratory for the required analysis.

4.1 Submitting Samples to Contract Analytical Laboratories

Samples that are submitted to analytical laboratories under the Integrated Contractor Purchasing Team, Basic Ordering Agreement as modified by the Grand Junction Site Statement of Work for Analytical Services will follow the requirements in the "Standard Practice for Sample Submittal to Contract Analytical Laboratories" (STO 6; Procedure GA-9[P]).

The contractor's Laboratory Coordinator is responsible for scheduling chemical analyses with contract laboratories. The contractor's Project Manager or designee, will notify the contractor's Laboratory Coordinator in advance (5 days or more) to arrange sample analysis. The following information, including any subsequent changes, will be provided to the contractor's Laboratory Coordinator:

- Number and types of samples
- Analytes requested
- Special requirements, regulatory methods, detection limits, etc.
- Turn-around time requested
- Reporting requirements

The contractor's Laboratory Coordinator will communicate laboratory requirements such as additional sample volume for matrix spike / matrix spike duplicate samples, shipping schedules, etc. to the contractor's Field Supervisor.

4.2 Analytical Parameters, Sample Containers, Preservation, and Holding Times

Ground water and surface water samples will be analyzed for each COC for OU III. Other noncontaminant species and properties indicative of geochemical conditions will also be measured. Table 4–1 and Table 4–2 list the analytical parameters, containers, preservation, and holding times for water samples collected under this plan.

All bottles used will be new and pre-cleaned according to EPA protocol in *Specifications and Guidance for Contaminant-Free Sample Containers* (EPA 1992). Suppliers will provide certificates of analysis as verification of bottle cleanliness. Bottles will be visually inspected for integrity and cleanliness before use. Suspect containers will not be used and will be discarded.

Table 4–1. Analytical Parameters, Containers, Preservation, and Holding Times for Samples Collected From Monitoring Wells, Millsite Wetlands, and Montezuma Creek Locations

Analytical Parameter	Container Type/Size[a,b]	Preservation	Holding Times
Metals (As, Fe, Mn, Mo, Se, U, V) Major Cations (Ca, Mg, K, and Na) (same bottles as metals)	HDPE/500 mL	Filter by 0.45-μm filter HNO_3 to pH<2	6 Months
Major Anions (Cl, F, and SO_4)	HDPE/125 mL	Filter by 0.45-μm filter; Cool to 4 °C	28 Days
Nitrate + Nitrite (NO_3 + NO_2 as N)	HDPE/125 mL	Filter by 0.45-μm filter; Cool to 4 °C; H_2SO_4 to pH<2	28 Days
Gross Alpha/Gross Beta	HDPE/1 L	**Ground water**: filter by 0.45-μm filter; **Surface water**: unfiltered HNO_3 to pH<2	6 Months
U–234 and U–238 (*Surface water* only)	HDPE/1 L	Unfiltered HNO_3 to pH<2	6 Months

[a]Sample volumes vary according to laboratory requirements
[b]HDPE = high-density polyethylene (opaque is optional for listed metals sample).

Table 4–2. Analytical Parameters, Containers, Preservation and Holding Times for Samples Collected From Millsite Seeps and Permeable Reactive Barrier Locations

Analytical Parameter	Container Type/Size[a,b]	Preservation	Holding Times
Metals (As, Fe, Mn, Mo, Se, U, V) Cations (Ca, K, Mg, and Na)	HDPE/500 mL	Filtered by 0.45 μm filter HNO_3 to pH < 2	6 months
Anions (Cl, F, SO_4)	HDPE/125 mL	Filtered by 0.45 μm filter Cool to 4° C	28 days
Nitrate + Nitrite (NO_3 + NO_2 as N)	HDPE/125 mL	Filtered by 0.45 μm filter Cool to 4° C H_2SO_4 to pH < 2	28 days

[a]Sample volumes vary according to laboratory requirements
[b]HDPE = high-density polyethylene (opaque is optional for listed metals sample).

Sample fractions that require cooling will be placed in a cooler after collection and maintained at temperatures between 0 degrees Celcius (°C) and 4 °C until laboratory analysis. The cooler will be checked for the presence of ice and replenished if necessary, following final collection and storing of samples at each site, and prior to shipment. Cooler temperatures will be measured at the laboratory upon receipt.

Preservation of some water sample fractions requires addition of specific acids to achieve a desired pH. Based on site experience, 3 mL of concentrated nitric acid (70 percent assay) or sulfuric acid (96 percent assay) per liter of sample will effectively reduce the pH to less than 2, and pH confirmation for every reserved sample container is not required. If acid is added at less than the suggested rate or if the total alkalinity is high (greater than 1,000 milligrams per liter as $CaCO_3$), then a pH confirmation is required. To check the pH, a small amount of sample will be poured from a sample container onto pH indicator paper. Indicator paper or pH probes are not to be inserted into the sample container. Acid preservation will occur as soon as possible after sample collection. Preservative may be added to bottles prior to sample collection if practical.

If chemical preservation cannot be accomplished at the sampling site, samples will be maintained at temperatures between 0 °C and 4 °C until preservation can occur. Unless prior approval is obtained, preservation will occur on the same day as sample collection and prior to sample shipment.

4.3 Sample Handling, Packaging, and Shipping

Sampling equipment, sample containers, and coolers will be kept in a clean, secure location to minimize damage, tampering, and possible contamination while on site. Filled sample containers will be securely packaged to protect the contents from damage, spilling, leaking, or breaking during transport between sampling and laboratory destinations. Void space in shipping containers should be filled with an inert material or additional ice, if appropriate, to further protect and secure the contents.

All samples will be handled, packaged, and shipped as environmental samples. Based on the results of prior sampling and analysis, surface water and ground water samples collected from the study area do not qualify as "Radioactive or Hazardous Materials," and therefore do not need to be handled, packaged, labeled, and shipped as radioactive material.

On arrival at the laboratory, the sample coordinator (recipient) must examine the shipping containers and document the receiving condition, including integrity of custody seals, when applicable. When opening the shipping container the sample coordinator will examine the contents and record the condition of the individual sample containers (e.g., bottles broken or leaking), the temperature of the water bath (when applicable), condition of samples, method of shipment, courier name(s), and other information relevant to sample receipt and log-in. The individual receiving the samples verifies that the information on the sample container(s) matches the information on the Chain of Sample Custody (Figure 4–1) form prior to signing the Custody form.

4.3.1 Sample Custody

To ensure the integrity of the sample, the contractor's Field Supervisor, or their designee, is responsible for the care, packaging, and custody of the samples until they are dispatched to the laboratory. The procedures described in "Standard Practice for Chain-of-Sample-Custody Control and Physical Security of Samples" (STO 6; Procedure GT-3[P]) will be implemented to provide security and document sample custody.

Custody seals and/or evidence tape will be placed on each ice chest or storage/shipping container that is not in direct control of a sampling team member to maintain physical security of the samples from time of collection to analysis. Samples not in direct control of a sampling team member will be stored in a secured (locked) location. Ice chests, cartons, and trays used for temporary sample storage that are not custody sealed must be in direct control of a field team member.

If samples are transported by subcontract employees or commercial carrier, the shipping container will have custody seals and/or evidence tape placed over the container opening before shipment to ensure that the integrity of the samples is not compromised during transportation. Mailed sample packages should be registered with return receipt requested. If packages are sent by common carrier, receipts are retained as part of the chain-of-custody documentation. Other commercial carrier documents shall be maintained with the chain-of-custody records.

Stoller – Grand Junction Team

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CHAIN OF CUSTODY

LAB: Paragon Analytics, Inc.
ADDRESS: 225 Commerce Dr.
Ft. Collins, CO. 80524
PHONE: 970.490.1511 *PO:* 24314

RIN 04030052 *Program/Project* LM
SITE CODE MNT01 *Site location* Monticello
Sample Matrix Water

SHIPMENT 1
Charge Code 11LMM5203
Sampler DS/FP

Ticket Number	Sample Date	Time	Sample Location	HDPE 125 ml	HDPE 500 ml	HDPE 1 L	Other	Other	REMARKS
NDX 026	04/13/2004	16:20	T00-04	2	1	1	0	0	
NDX 027	04/13/2004	17:16	T00-01	2	1	1	0	0	
NDX 028	04/14/2004	9:00	T01-25	2	1	0	0	0	insufficient water - Gross A/B not collected
NDX 029	04/14/2004	9:30	T01-20	2	1	0	0	0	insufficient water - Gross A/B not collected
NDX 030	04/14/2004	10:00	T01-08	2	1	0	0	0	insufficient water - Gross A/B not collected
NDX 031	04/14/2004	10:35	T01-01	2	1	1	0	0	
NDX 032	04/14/2004	11:15	T01-02	2	1	1	0	0	
NDX 033	04/14/2004	14:10	MW00-07	2	1	1	0	0	
NDX 034	04/14/2004	14:42	P92-06	2	1	1	0	0	
NDX 035	04/14/2004	15:20	92-08	2	1	1	0	0	
NDX 036	03/14/2004	16:00	82-08	2	1	1	0	0	
NDX 037	04/14/2004	16:40	MW00-06	2	1	1	0	0	
NDX 038	04/14/2004	18:00	PW-23	2	1	1	0	0	
NDX 039	04/14/2004	18:10	PW-17	2	1	1	0	0	
NDX 040	04/14/2004	18:30	PW-10	2	1	1	0	0	
NDX 051	04/13/2004	10:50	T01-07	2	1	1	0	0	
NDX 052	04/13/2004	11:30	T01-05	2	1	1	0	0	
NDX 053	04/13/2004	11:45	80-03	2	1	1	0	0	
NDX 054	04/13/2004	12:20	T01-04	2	1	1	0	0	
Summary for 'SITE_CODE' = MNT01 (44 detail records)			Sum	95	44	44	0	0	
Summary for 'RIN' = 04030052 (44 detail records)			Sum	95	44	44	0	0	
Grand Total				95	44	44	0	0	

Reliquished by (signature)	Date	Time	Reliquished by (signature)	Date	Time	Reliquished by (signature)	Date	Time
[signature]	4/15/04	1015						
Received by (signature)	**Date**	**Time**	**Received by (signature)**	**Date**	**Time**	**Received by (signature)**	**Date**	**Time**

Thursday, April 15, 2004

Page 2 of 2

Figure 4–1. Example Chain of Custody Form

Chain-of-custody records will be used to list all transfers in the possession of the samples and to show that the samples were in constant custody between collection and analysis. Samples that are sent or transported to an analytical laboratory by individuals other than a member of the field sampling team will be accompanied by a standardized chain of sample custody form or equivalent, with a copy retained by the originator.

4.4 Documentation and Document Control

All entries in field logbooks, data sheets, sample labels, and on forms will be made with indelible (waterproof) ink and will be legible, reproducible, accurate, complete, and traceable to the sample measurements and/or site location and in a manner consistent with the procedure described in "Standard Practice for Field Documentation Processes" (STO 6; Procedure GT−1[P]). The contractor's Project Manager is responsible for maintaining and initials/signature log for personnel authorized to record, review, and authenticate field data.

When practical, correction of errors should be made by the individual who made the entry. Errors will be corrected by drawing a line through the error, entering the correct information, then initialing and dating the entry. The erroneous material must not be obliterated. When a document requires replacement because of illegibility or inaccuracies, the document will be voided and a replacement document will be prepared. A notation will be made on the voided document that a replacement document was completed. The voided document will be retained with the field documentation.

Field data books and forms (sample ticket books, logbooks, field measurements data forms, custody forms, shipping forms, etc.) will be signed and dated upon completion and will be stored in a manner that protects them from loss or damage. The contractor's Field Supervisors will be the custodians of all records for the duration of field activities. These documents will be retained as project records in accordance with the project records log.

4.4.1 Field Books

Field data books, logbooks, and forms are intended to provide sufficient data and observations to enable participants to reconstruct events that occurred during the field sampling activities. These documents are provided to field personnel for the semi-annual monitoring events. The field data books/logbooks will be used to record the daily activities of the field team at each sample/measurement location. Any visitors to the site will be noted, as well as their arrival and departure times and general activities (auditing, observing, etc.)

Field data are collected in spiral bound books containing the forms needed to document the sampling event. These generally include water sample data form, instrument check/calibration forms, quality assurance (QA) sample lists, well inspection forms, general log sheets, and a listing of sample/measurement locations and analytes specific to the sampling event.

Bound logbooks with consecutively numbered pages will be available to field personnel. The field logbooks or log pages in the field data book will be used to record stream discharge measurements, which includes dimensions of the partial stream sections and velocity in each partial section. Logbook entries will also include the daily activities of the field team, sample locations, times, and observations of conditions that may impact data quality or interpretation.

Entries will be signed and dated by the person making the entries on that page and by an authorized reviewer.

4.4.2 Sample Ticket Books

Sample ticket books with pre-printed unique, sequential 6-digit ticket numbers will be used during each sampling event. All pertinent information recorded on each sample container label (including the project, sampler, date and time of collection, and sample location ID) also will be recorded in the sample ticket book. Information such as unusual sampling conditions or other observations also may be recorded. A self-adhesive decal, printed with the sample ticket number, will be removed from the sample ticket book and affixed to the sample container label. The sample ticket books will serve as a field sample catalog and provide traceability of analytical data to sample locations.

4.4.3 Chain of Custody Form

The custody of individual sample containers will be documented by recording each container's identification and matrix on a Chain of Sample Custody form (Figure 4–1), in accordance with the requirements specified in "Standard Practice for Chain-of-Sample-Custody Control and Physical Security of Samples" (STO 6; Procedure GT–3[P]).

These forms will be used to list all transfers of sample possession. These forms will become part of the permanent project file upon completion of fieldwork. Copies of the form received by the laboratory and the subcontracted facilities will be included in the final analytical report.

4.4.4 Trip Reports, Field Variance, and Nonconformance Reporting

At the conclusion of a field task or sampling event, satisfactory completion of the required activities will be verified through a review of the field data and will be documented in a summary trip report.

Deviations from specified field protocols and/or sampling procedures established in planning documents or Standard Operating Procedures must be fully documented by the contractor's Field Supervisor. Significant deviation resulting in modification to established protocols must be authorized by the contractor's Project Manager before the work is started. These deviations will be documented in the field data book or logbook as a field variance and in the trip report.

Field Variance

Field variance reporting applies to deviations to (1) prescribed field sampling, measurement, or survey techniques; (2) specified shipping handling or storage requirements; and (3) decontamination procedures.

Documentation must be completed on the water sampling field data sheet or in the logbook whenever an activity is performed or sample is obtained:

- That does not fall within the methods or protocols specified for sample, measurement, or survey techniques.
- That has used of an instrument that is out of calibration or has failed an operational check.

- Where there is loss of traceability of sample, measurement, or survey data to their location.
- When there was a noncompliance with established procedures.
- Where there is loss of or damage to records that cannot be duplicated.

The variance, including any corrective action taken must be fully described and reported in a timely manner for evaluation of impact to the data. Comments describing the variance will be used during sample processing and data evaluation to assess the use of associated results and validity of the data. For reference purposes, field variances from a sampling event will be complied and summarized in the trip report that is prepared after the monitoring event.

Nonconformance

Field variances that may result in a nonconformance due to unacceptable or indeterminate sample or data quality or errors that are identified after the data that has been entered into the environmental database (Section 7.0), will be reported to the contractor's QA Manager for evaluation. If corrective action is required, nonconformance reporting and corrective action will be completed in accordance with the procedures specified in Criterion 3 of the *Quality Assurance Manual* (STO 1). Proposed corrective action will be approved by the contractor's Project Manager. The contractor's QA Coordinator will assist with status tracking and verification for closure.

End of current text

5.0 Surface Water and Ground Water Analytical Program

Chemical analysis of water samples will be performed by a subcontracted laboratory. The analytical method and method detection limit for each analyte are shown in Table 5–1 and are also specified in the appropriate laboratory services procurement documents. The use of these methods will ensure required method detection limits and project reporting limits are achieved for each of the requested analytes.

Table 5–1. Laboratory Reporting Limits and Analytical Methods for OU III Water Samples

Analytical Parameter	Method Detection Limit	Analytical Method
Metals	(µg/L)	
Arsenic	0.1	EPA SW–846 6020 (ICP–MS)
Iron	50.0	EPA SW–846 6010B (Radial ICP–AES)
Manganese	5.0	EPA SW–846 6010B (Radial ICP–AES)
Molybdenum	3.0	EPA SW–846 6020 (ICP–MS)
Selenium	0.1	EPA SW–846 6020 (ICP–MS)
Uranium	1.0	EPA SW–846 6020 (ICP–MS)
Vanadium	2.0	EPA SW–846 6020 (ICP–MS)
Major Anions		
Chloride	50	EPA Method 9056
Sulfate	75	EPA Method 9056
Fluoride	20	EPA Method 9056
NO_3 + NO_2 as N	50	EPA Method 353.1
Major Cations		
Calcium	100	EPA SW–846 6010B (Radial ICP–AES)
Magnesium	50	EPA SW–846 6010B (Radial ICP–AES)
Potassium	100	EPA SW–846 6010B (Radial ICP–AES)
Sodium	600	EPA SW–846 6010B (Radial ICP–AES)
Radiological	(pCi/L)	
Gross Alpha Activity[a]	1.0	EPA SW–846 9310
Gross Beta Activity[a]	1.0	EPA SW–846 9310
U-234	3.0	Alpha-Spectrometry
U-238	1.0	Alpha-Spectrometry

[a]Limits presented actually represent minimum detected activities.

Laboratories involved in the analysis of OU III Post–ROD samples will have a written QA/QC program that provides rules and guidelines to assure reliability and validity of the work conducted at the laboratory. Subcontracted laboratories will be required to notify the contractor and obtain authorization for changes to analytical or testing procedures specified in the procurement documents. Authorization must be obtained before the subcontractor may perform the analyses affected by the proposed changes in procedures. The contractor will specify sample disposition for analytical or testing services in the procurement documents (e.g., Statement of Work). Work submitted to the laboratory may not be subcontracted by the laboratory without prior consent from the contractor.

5.1 Reports Received from Subcontractors

Laboratory or Other Data Reports

Reporting requirements and formats meeting the DOE−LM data deliverable specifications, data turnaround times, and similar requirements of the analytical laboratory are defined in procurement documents (e.g., the Statement of Work) that are issued for these types of subcontracted services.

As appropriate, the contents of the laboratory data report should include the following items:

- Reference to the location of or copies of method start-up/validation data
- The Chain of Sample Custody form
- Sample receiving documentation
- Laboratory data sheets
- QC data results and report
- Investigation sample data results by analysis
- Summary of results (e.g., case narrative)
- All raw data and supporting documentation (including calibration data)

Analytical data that do not meet specified criteria will be qualified and flagged to allow data evaluation before use. Any nonconformances or difficulties encountered during analyses will be documented in the case narrative with each data package.

The contractor's Project Manager will be contacted regarding difficulties or nonconformances associated with subcontracted analytical services. The contractor's Project Manager will work closely with the contractor's Environmental Data Services personnel, the contractor's Field Supervisor, or designated technical specialist to identify and, where possible, resolve disputes that could impact the quality of the data.

Plans and Technical Reports

The applicable procurement document will specify the criteria for technical/administrative plans and reporting requirements for technical reports received from subcontracted services. Elements to be addressed may include a deliverable schedule for draft and final documents, format, software type and version requirements, and contents of the document, including any supporting documents, data, and references.

6.0 Biomonitoring Plan

This section presents the post-ROD biomonitoring approach for OU III to determine if likely ecological receptors have the potential to be affected adversely by selenium, which displayed increasing concentrations in ground water and surface water samples during completion of OU I and OU II cleanup activities. In addition to selenium, monitoring results of additional COCs will be reviewed to determine if their inclusion in future biomonitoring analysis is warranted. This decision will be made by the Biological Technical Assistance Group (BTAG), which consists of representatives from the U.S. Fish and Wildlife Service, the U.S. Environmental Protection Agency (EPA), the Utah Department of Environmental Quality, and DOE. This biomonitoring plan follows the updated ecological risk assessment for OU III as documented in the Remedial Investigation Addendum (DOE 2004a), which was preceded by the baseline ecological risk assessment presented in DOE 1998.

The focus of biomonitoring will be to determine if selenium levels are present in environmental media at concentrations that could cause adverse effects on ecological receptors. As part of site remediation efforts, three "backwater" wetland areas were created on the former Millsite adjacent to Montezuma Creek to attract wildlife to this area. Concerns are that increasing selenium concentrations, particularly in ground water and surface water near Wetland 3 (Figure 2–1), could accumulate in sediments to levels that may ultimately be harmful to waterfowl and other wetland species.

A multi-level phased sampling approach will be undertaken whereby increasingly higher-order sampling requirements will be implemented as simpler measures dictate by exceeding established trigger levels. The baseline biomonitoring will include sediment and surface water sampling at wetland areas in fall 2004 and aquatic macroinvertebrate sampling in the wetlands and updated wildlife surveys in 2005. Annual sediment and surface water sampling of the wetlands will continue through 2006 to evaluate possible selenium accumulation trends. If the selenium concentration in surface water or sediment samples exceeds established threshold values of 5 micrograms per liter (µg/L) or 4 milligrams per kilogram (mg/kg), respectively, additional macroinvertebrate sampling may be required. If concentrations of selenium from analysis of macroinvertebrates exceed the threshold value of 7 mg/kg, the BTAG will evaluate the need to sample eggs from nesting birds. Bird eggs would be examined for evidence of embryo deformity as well as undergo analysis for selenium content.

6.1 Stratified Random Sampling

Annual collocated surface water and sediment sampling will take place in Wetlands 1, 2, and 3 and in a constructed pond downstream of the Millsite ("Sediment Pond," Figure 2–2) through 2006. A stratified sampling approach will be implemented by which up to three stratum, as the term applies to regions of distinct characteristics, will be identified at each wetland area and the sediment pond. Strata and sampling locations within each stratum will be proposed in a sediment/surface water Program Directive that will be prepared prior to the baseline sampling events. The Program Directive will be prepared as described in QAI 1.6, "Program Directives," in the *Quality Assurance Manual* (STO 1). Locations will be proposed based on results of past surface water and ground water sampling and a knowledge of how the wetlands were designed and are functioning. Representatives of the BTAG will meet in the field to observe site conditions and determine the appropriateness of the sampling approach, strata identification, numbers and locations of samples, and the analytical methods proposed in the Program Directive, prior to sample collection.

6.1.1 Co-Located Surface Water and Sediment Sampling

Surface water samples within each stratum will be collected prior to sediment sampling. Surface water sampling will take place only if water is flowing or ponded. Samples will be collected, filtered, and preserved in the field according to standard procedures (Section 2.0) and shipped to the laboratory for selenium analysis.

Sediment samples from each stratum will be collected for selenium analysis likely from the upper 3 inches of the surface, which is the most likely area of selenium accumulation from surface water and the depth to which potential receptors will most likely be exposed. However, if site-specific physical and hydrological conditions indicate otherwise, the depth of sample collection can be modified. The number of samples collected per stratum, whether composite samples are prepared for each stratum, and analytical methods will be specified in the Program Directive.

6.2 Macroinvertebrate Sampling

Macroinvertebrate sampling will be conducted in the second year of biomonitoring to establish the baseline condition. If sediment or surface water samples collected in 2005 or 2006 for a given stratum exceed threshold toxicity values for selenium (4 mg/kg for sediment [DOI 1998] and 5 µg/L for surface water [EPA 2002a]), the BTAG may require additional sampling for macroinvertebrates in that stratum. It is anticipated that three Hester-Dendy Multiple-Plate samplers (or other suitable water column sampling device or method) will be deployed in each stratum to collect macroinvertebrates inhabiting the water column. The sampling devices will be deployed in spring and retrieved after an appropriate duration. In addition, sediment grab samples will be collected at the same locations to obtain a sample of macroinvertebrates inhabiting soft sediments. Details of the sampling locations and procedures, number of samples, and analytical methods will be described in a separate Program Directive prepared during fall or winter 2004 in consultation with the BTAG and subsequent to the site visit.

If concentrations of selenium in macroinvertebrate tissue for any stratum exceed 7 mg/kg (http://sacramento.fws.gov/ec/GBP/Table1.htm), the BTAG will determine the need for and viability of sampling of avian eggs the following spring based on the results of wildlife surveys outlining the types of species present, their foraging strategies, and the number of individuals utilizing the area. If egg sampling is required, the sampling and analysis approach will be determined at that time.

6.3 Wildlife Surveys

Surface conditions in portions of OU III have changed significantly since the most recent wildlife surveys were conducted in conjunction with the OU III remedial investigation. The last wildlife surveys were completed during the 1995 and 1996 field seasons. Species that were the subject of previous surveys included spotted bat (state sensitive species), northern goshawk (state sensitive), peregrine falcon (previously endangered), and the southwestern willow flycatcher (endangered). No sensitive or endangered species were identified at the site during previous surveys, though potential habitat does exist in the area. Because of the changed nature of the site, and the disruption and restoration activities that have occurred, DOE will conduct a new survey of the site vicinity in 2005. The wildlife surveys conducted at that time will focus on the wetland areas and their uses. The same sensitive and endangered species identified in previous surveys will also be targeted in particular, but other wildlife using the area will be noted to enable selection of the most appropriate ecological receptors and media for estimation of potential site risks. A Program Directive identifying the objectives, scope, and methodology of the wildlife survey scheduled for 2005 will be prepared during winter 2004.

6.4 Biomonitoring Duration

If no consistent increases in selenium are observed in water or sediment and if biota concentrations remain below trigger levels (if biota sampling is required) for 3 consecutive years, biomonitoring can be discontinued. If, however, biota sampling results indicate that selenium is present at concentrations that are having a negative impact on ecological receptors, some type of corrective action may be necessary (e.g., dredging wetlands, relocating wetlands, etc.). The appropriate type of corrective action will be determined in consultation with the BTAG.

6.5 Schedule

Table 6−1 contains a schedule of biomonitoring activities. Additional schedule information is included in Section 9.0 of this plan.

Table 6–1. Schedule of Biomonitoring Activities

Biomonitoring Task	Fiscal Year 2004	Fiscal Year 2005	Fiscal Year 2006	Out Years
Soil/sediment/surface water sampling	X	X	X	T
Wildlife survey		X		
Macroinvertebrate sampling		X	T	T
Other media (TBD)			T	T

TBD=to be determined by the Biological Technical Assistance Group.
T= only if trigger level exceeded.

End of current text

7.0 Data Management

Field measurement data and laboratory analytical data received from the subcontracted laboratory in electronic format, will be entered into the environmental database, as administered by the contractor’s Environmental Data Services personnel at the DOE Grand Junction. Validation of the data received from the laboratory will be conducted according to EPA guidelines (EPA 2002b).

Technical data, including field data and results of laboratory analyses, will be routinely verified and validated to assure the data are of sufficient quality and quantity to meet the project's intended data needs. Results of data validation efforts will be documented and summarized in a report to the contractor’s Project Manager. Procedures for validating field measurements and laboratory data are described below.

7.1 Field Data

The objective of field data verification is to ensure that data are collected in a consistent manner and in accordance with the sampling plan. Field data verification includes reviewing raw data and supporting documentation generated from field investigations. The data are reviewed for completeness, transcription errors, and accuracy of calculations.

Field data will be reviewed prior to signing the data sheet and verification completed during the preparation of the trip report. As appropriate, parameters that do not meet specified criteria will be documented as a field variance and inappropriate or suspect data will not be included for database entry. Following distribution of the trip report, field data such as water level measurements and field parameter measurements will be entered into the environmental database.

7.2 Laboratory Data

Analytical data will be documented by the laboratory performing the analyses in accordance with standard procedures inherent in the analytical methods and as approved under the State certification program. Data will be appropriately flagged to identify its use or limitations in accordance with standard laboratory protocols and consistent with the requirements of the procurement documents. Once received from the analytical laboratory, laboratory records and data package requirements will be checked to assess the completeness of the data package. Validation of the data received from the laboratory will then be conducted by the contractor according to the guidelines in *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (EPA 540-R-01-008).

End of current text

8.0 Quality Assurance

The contractor employs a management system that applies to all programs and projects funded through DOE Office of Legacy Management Task Orders. The management system incorporates the philosophy, policies, and requirements of Health and Safety, Environmental Compliance, and QA in all aspects of project planning and implementation. Health and Safety requirements are documented in the *Health and Safety Manual* (STO 2), the *Site Radiological Control Manual* (STO 3), and the *Integrated Safety Management System Description* (STO 10). Environmental Compliance policy and requirements are documented in the *Environmental Compliance Manual* (STO 11). The QA Program is documented in the *Quality Assurance Manual* (STO 1).

8.1 General Description of the Quality Assurance Program

Work performed by or for the contractor must comply with the applicable requirements of the QA Program documented in the *Quality Assurance Manual* (STO 1). The QA Program is designed to implement the requirements and philosophy of DOE Order 414.1A, *Quality Assurance* with Change 1. The QA manual also includes the requirements of other standards that are regularly imposed by customers, regulators, or other DOE Orders. “QA Program Implementation” (STO 1; QAI 1.1), provides comparison matrices to other QA standards.

8.1.1 Purpose and Scope

The work performed by the contractor for the long term surveillance and maintenance of the MMTS OU III Project must comply with the requirements established through the listed elements of the QA Program and other relevant project documents and procedures. The quality assurance plan outline provided in Table 8–1 identifies and documents the “Standard Requirements” of the QA Program that apply to the MMTS OU III Post-ROD Monitoring activities. Table 8–2 lists the company manuals that provide guidance or implementing procedures for elements of the quality management system.

Additional QA/QC requirements that apply to project management, field, and laboratory activities are specified within the text or by reference to procedures or other project documents in the appropriate sections of this Plan.

QA requirements have been established to assure that the administrative and technical work will be of sufficient quality to satisfy project objectives. These activities include project management, work performance and assessment as applicable to the execution of the work scope established in the DOE Office of Legacy Management Task Orders. QA requirements will be applied to subcontractors through the appropriate procurement documents.

Table 8–1. MMTS OU III Quality Assurance Plan Outline

Applicable QA Program Criteria and Quality Assurance Instructions (QAI's)	
Management	
Criterion 1	Quality Assurance Program
QAI 1.1	QA Program Implementation
QAI 1.2	Development and Approval of QA Program Plans
QAI 1.3	Administrative and Technical Planning
QAI 1.4	QA Review of Documents that Implement the QA Program
QAI 1.6	Program Directives
Criterion 2	Personnel Training and Qualification
QAI 2.1	Certification of Personnel
Criterion 3	Quality Improvement
QAI 3.1	Lessons Learned
QAI 3.2	NCR Reporting, Disposition, and Closure
Criterion 4	Documents and Records
Performance	
Criterion 5	Work Processes
QAI 5.1	Instructions and Procedures
Criterion 6	Design
QAI 6.1	QA Review of Design Input and Output Documents
QAI 6.3	Design of Data Collection Programs
Criterion 7	Procurement
QAI 7.2	Supplier Selection
Criterion 8	Inspection and Acceptance Testing
Assessment	
Criterion 9	Management Review and Assessment
QAI 9.1	Management Assessments
Criterion 10	Independent Assessment
QAI 10.1	Internal Independent Assessments
QAI 10.2	Surveillances
QAI 10.3	External Assessment Tracking and Response

Table 8–2. List of Contractor Manuals that Implement Portions of the Quality Assurance Management System

Manual	Title
STO 1	*Quality Assurance Manual*
STO 2	*Health and Safety Manual*
STO 3	*Site Radiological Control Manual*
STO 4	*Training Manual*
STO 6	*Environmental Procedures Catalog*
STO 9	*Records Management Manual*
STO 10	*Integrated Safety Management System Description*
STO 11	*Environmental Compliance Manual*
STO 12	*Project Management Control System Manual*
STO 14	*Drilling Health and Safety Requirements*
STO 18	*Procurement Manual*
STO-100	*General Administrative Procedures Manual*
STO 204	*Engineering Procedures and Guidelines*
STO 206	*Quality Assurance Desk Instructions*

End of current text

9.0 Schedule and Funding

Scheduled tasks implementing post ROD monitoring are identified in Table 9–1.

Table 9–1. Schedule

Task	Date
Draft-Final RD/RA Work Plan submitted to EPA/UDEQ	August 20, 2004
Draft-Final Post ROD Monitoring Plan submitted to EPA/UDEQ	August 27, 2004
Well Installation and Development Complete	August 31, 2004
EPA and UDEQ Accept Post-Rod Monitoring Plan	September 1, 2004
Annual Inspection[1]	September 15, 2004
Post-ROD Monitoring begins	October 2004
Surface and Ground Water Sampling[2]	
Obtain Surface and Ground Water Samples	October 2004
Obtain Surface and Ground Water Samples	April 2005
Sediment and Surface Water Sampling[3]	
Program Directive for Sediment and Surface Water Samples	September 15, 2004
Obtain Sediment and Surface Water Samples	October 2004
Obtain Sediment and Surface Water Samples	April 2005
Macroinvertebrate Sampling[4]	
BTAG Field Meeting to establish probable locations for placement of macroinvertebrate sampling devices	October 5, 2004
Program Directive for macroinvertebrate sampling	February 1, 2005
Place macroinvertebrate samplers (timing dependent upon BTAG recommendations)	Spring, 2005
Collect macroinvertebrate samples (timing dependent upon BTAG recommendations)	Summer, 2005
Wildlife Survey	
Program Directive for Wildlife Survey	January 15, 2005
Obtain Subcontractor for Wildlife Survey	February 15, 2005
Complete Wildlife Survey (timing dependent upon program directive)	Summer, 2005
Complete Wildlife Survey Report	November 1, 2005
Decommission Unnecessary Wells	Summer, 2006
CERCLA 5-year review[5]	June 2007
Decommission Permeable Reactive Barrier	2014

[1]Annual inspections are scheduled for September of each year in perpetuity.
[2]Sampling scheduled for April and October of each year until remediation goals are met.
[3]Sampling will be conducted in April and October through October 2006. Sampling beyond 2006 will be conducted if trigger levels identified in this *Post-Rod Monitoring Plan* are exceeded.
[4]Sampling beyond 2005 will be conducted if trigger levels identified in this *Post-Rod Monitoring Plan* are exceeded.
[5]CERCLA 5-year reviews are scheduled in June every five years in perpetuity.

DOE’s budget for Fiscal Year (FY) 2004 for the Monticello project is $1,084,712. The FY 2005 budget has not been negotiated but it is based on DOE’s Life-cycle Baseline Estimate. The Life-cycle Estimate includes indirect costs, escalation, and contingency. The 2004 Life-cycle Baseline for the Monticello project for FY2005 through FY2009 is as follows:

FY2005	$1,095,349
FY2006	$ 995,266
FY2007	$1,052,993
FY2008	$1,047,692
FY2009	$1,074,932

10.0 References

ASTM, 1999. *ASTM Standards on Biological Effects and Environmental Fate*, 2nd edition, ASTM stock number ENVFATE2.

National Academy of Sciences (NAS) 2003. *Bioavailability of Contaminants in Soils and Sediments: Processes, Tool, and Applications*, Water Science and Technology Board, National Academies Press, http://www.nap.edu/books/0309086256/html

STO 1. *Quality Assurance Manual*, S.M. Stoller Corporation under contract to U.S. Department of Energy, Grand Junction, Colorado, continuously updated.

STO 2. *Health and Safety Manual*, S.M. Stoller Corporation under contract to U.S. Department of Energy, Grand Junction, Colorado, continuously updated.

STO 3. *Site Radiological Control Manual*, S.M. Stoller Corporation under contract to U.S. Department of Energy, Grand Junction, Colorado, continuously updated.

STO 4. *Training Manual*, S.M. Stoller Corporation under contract to U.S. Department of Energy, Grand Junction, Colorado, continuously updated.

STO 6. *Environmental Procedures Catalog*, S.M. Stoller Corporation under contract to U.S. Department of Energy, Grand Junction, Colorado, continuously updated.

STO 9. *Records Management Manual*, S.M. Stoller Corporation under contract to U.S. Department of Energy, Grand Junction, Colorado, continuously updated.

STO 10. *Integrated Safety Management System Description*, S.M. Stoller Corporation under contract to U.S. Department of Energy, Grand Junction, Colorado, continuously updated.

STO 11. *Environmental Compliance Manual*, S.M. Stoller Corporation under contract to U.S. Department of Energy, Grand Junction, Colorado, continuously updated.

STO 12. *Project Management Control System Manual*, S.M. Stoller Corporation under contract to U.S. Department of Energy, Grand Junction, Colorado, continuously updated.

STO 14. *Drilling Health and Safety Requirements*, S.M. Stoller Corporation under contract to U.S. Department of Energy, Grand Junction, Colorado, continuously updated.

STO 18. *Procurement Manual*, S.M. Stoller Corporation under contract to U.S. Department of Energy, Grand Junction, Colorado, continuously updated.

STO 100. *General Administrative Procedures Manual*, S.M. Stoller Corporation under contract to U.S. Department of Energy, Grand Junction, Colorado, continuously updated.

STO 204. *Engineering Procedures and Guidelines*, S.M. Stoller Corporation under contract to U.S. Department of Energy, Grand Junction, Colorado, continuously updated.

STO 206. *Quality Assurance Desk Instructions*, S.M. Stoller Corporation under contract to U.S. Department of Energy, Grand Junction, Colorado, continuously updated.

U.S. Department of Energy (DOE), 2004a. *Monticello Mill Tailings Site, Operable Unit III–Final Remedial Investigation Addendum and Focused Feasibility Study*, GJO–2003–413–TAC, prepared for the U.S. Department of Energy, Grand Junction, Colorado, January.

———, 2004b. *Record of Decision for the Monticello Mill Tailings Site, Operable Unit III—Surface Water and Ground Water, Monticello, Utah,* prepared for the U.S. Department of Energy, Grand Junction, Colorado, May

U.S. Department of Interior (DOI), 1998. *Guidelines for Interpretation of the Biological Effects of Selected Constituents in Biota, Water, and Sediment*, National Irrigation Water Quality Program Information Report No. 3, November.

U.S. Environmental Protection Agency (EPA), 1992. *Specifications and Guidance for Contaminant-Free Sample Containers*, OSWER Directive 9240.0–05A, December.

———, 2002a. *National Recommended Water Quality Criteria: 2002*, EPA-822-R-02-047, November.

———, 2002b. *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review,* EPA 540-R-01-008, July.

Appendix A

Performance Evaluation Plan for Monitored Natural Attenuation at Monticello Mill Tailings Site Operable Unit III

Contents

Figures

Tables

End of current text

1.0 Plan Objective

This plan specifies the method, criteria, and reporting requirements for evaluating the progress of aquifer restoration within Operable Unit (OU) III of the Monticello Mill Tailings Site (MMTS) under the selected remedy of monitored natural attenuation.

2.0 Monitored Natural Attenuation Performance Evaluation Method

The progress of aquifer restoration will be evaluated primarily by comparing temporal trends of uranium concentration in ground water, as determined by semiannual monitoring data, to concentrations predicted by numerical modeling (DOE 2004c). Uranium is the primary ground water contaminant at the site because it is the most widespread in extent and is the single greatest contributor to potential human health risk. Uranium trend analysis will be performed for separate regions of the aquifer using concentration averaging for samples from multiple wells for both the observed and model-predicted data sets. Specific criteria in this plan define whether the observed restoration rate for uranium meets expectations. Attenuation rates of contaminants of concern (COCs) other than uranium will also be evaluated.

2.1 Aquifer Regions

Five aquifer regions, shown on Figure 1, represent distinct areas of contamination, hydrogeology, and geographic position relative to the permeable reactive barrier and former millsite. Aquifer restoration will be evaluated separately for each region.

Region 1 encompasses the north margin of the former millsite and former source areas. Ground water restoration occurs by underflow from the west and inflows from recharge sources to the north. Significant quantities of ground water in this area is displaced to Montezuma Creek. Uranium concentrations are moderately low (see Table 1) in this region, and except for manganese anomalies, the remaining COCs are below the respective remediation goals).

Table 1. Monitor Wells for Trend Analysis

Region	Monitor Wells for Trend Analysis	Representative Uranium Concentrations[a] (micrograms per liter [μg/L])
1	T01-07, T01-12, T01-19, T01-35	100 to 220
2	T01-01, T01-02, T01-04, T01-05	175 to 400
3	88-85, 92-11, 92-07, PW-17, PW-28	200 to 950
4	MW00-06, MW00-07, R10-M1, 82-08	<30 to 300
5	P92-06, 92-08, 92-09	100 to 400

[a]October 1999 through October 2003; single-point extreme values excluded.

Region 2 encompasses the general area from Wetland 3 to the eastern boundary of the former millsite. Most or all of the ground water that flows from the former millsite passes through or originates in this area. Leakage from Wetland 3 may significantly influence ground water flow in this region. Uranium concentrations are moderately high (Table 1) and the remediation goal for each COC except nitrate is exceeded in this region.

Region 3 is the area between the former millsite and the permeable reactive barrier; Region 3 encompasses the area of highest contamination downgradient of the former millsite. The remediation goal for each COC except manganese is exceeded in this region. Minor leakage from Montezuma Creek may locally affect ground water quality.

Region 4 extends from the permeable reactive barrier to monitor well 82-08, approximately 750 feet east of the permeable reactive barrier. Ground water quality is affected by localized irrigation returns, uncontaminated effluent from the permeable reactive barrier, possible leakage from Montezuma Creek, and flow of contaminated ground water around the south end of the permeable reactive barrier system. As a result, the uranium concentration varies widely in this region. The ground water model used to predict uranium concentration did not simulate treatment by the permeable reactive barrier. Remediation goals are exceeded only by uranium and selenium in this region.

Region 5 extends east of monitor well 82-08 to nearly the terminus of the uranium plume. One location of selenium contamination occurs within this region; otherwise, uranium is the only COC that exceeds its remediation goal. The uranium plume extends slightly east of the most downgradient monitor well in Region 5 (well 92-09). Significant advancement of the uranium plume beyond well 92-09 is prevented by ground water discharge from the bedrock aquifer that causes dilution and displacement of contaminated alluvial ground water to Montezuma Creek through this area.

2.2 Performance Evaluation Wells and Data Analysis

Table 1 lists the monitor wells that are used for analyzing COC trends in each region of the aquifer and representative uranium concentrations. Wells that exhibit erratic concentrations in recent years, are spatially correlated, or pose sampling problems were generally avoided in compiling this list. Each well listed in Table 1 has been used in characterizing aquifer conditions in the period following remediation of the former millsite and installation of the permeable reactive barrier. Many of the locations have been monitored since 1992. All wells listed in Table 1 will be sampled semiannually in April and October. Ground water monitoring at numerous existing OU III wells not listed in Table 1 or shown on Figure 1 will also occur during the post- Record of Decision (ROD) period (see DOE 2004b). Several new monitor wells will be installed in the alluvial aquifer during 2004 to complement or replace selected wells listed in Table 1 (see Section 2.2.3).

For each sampling event, the arithmetic mean of the uranium concentration, computed for each region using the wells listed in Table 1, is plotted as a point on a graph of concentration in relation to time for that region. On the same graph, a second trend line represents the average of the model-predicted uranium concentration for the same wells, starting from October 2002. Figure 2 illustrates example concentration trends for Regions 1, 2, and 3 based on recent monitoring results for wells listed in Table 1. Because some wells were not sampled during each event indicated in the figure, conclusions regarding restoration progress are not implied on Figure 2. The above method will be applied to the data beginning in October 2004.

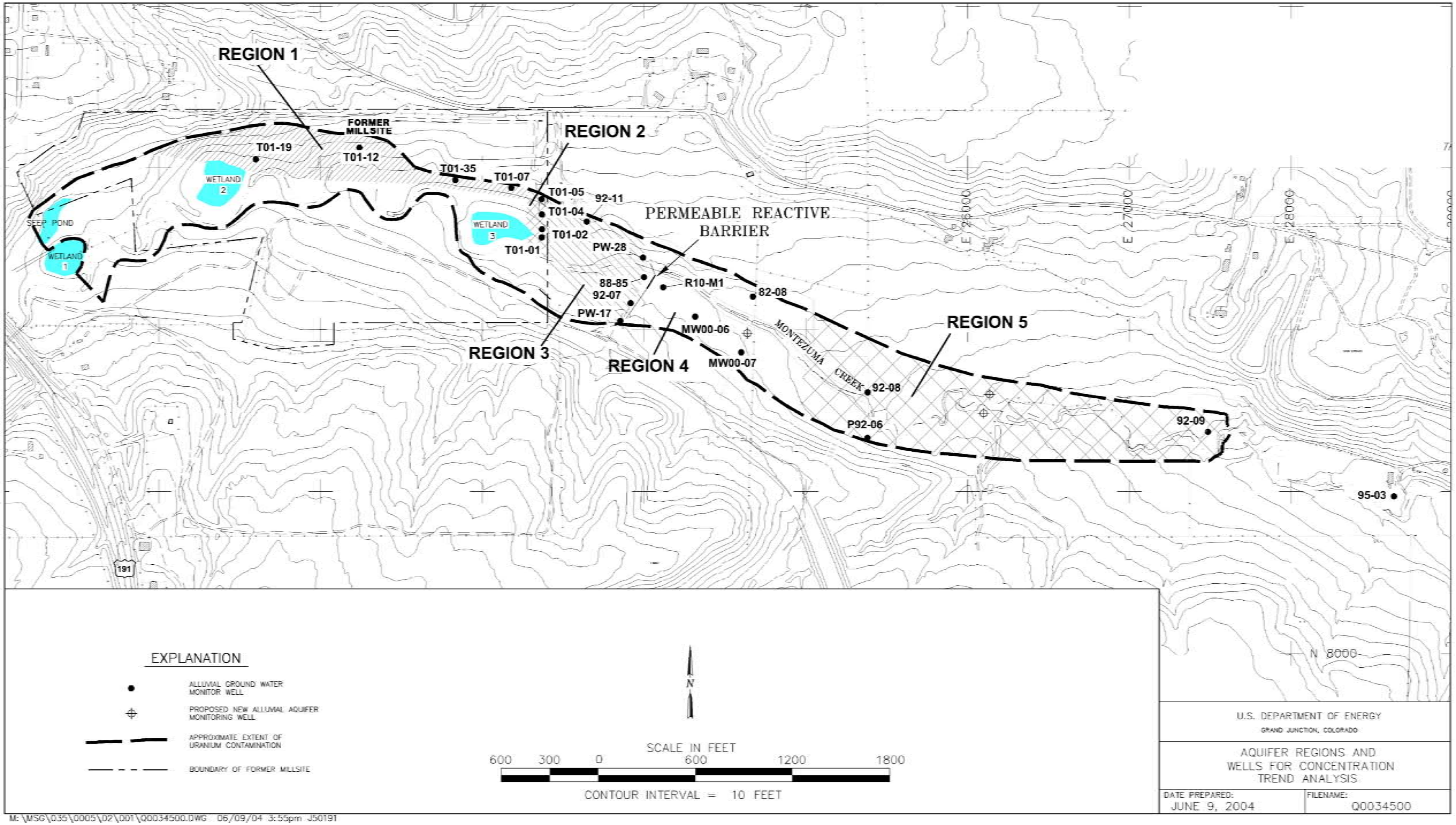

Figure 1. Aquifer Regions and Wells for Concentration Trend Analysis

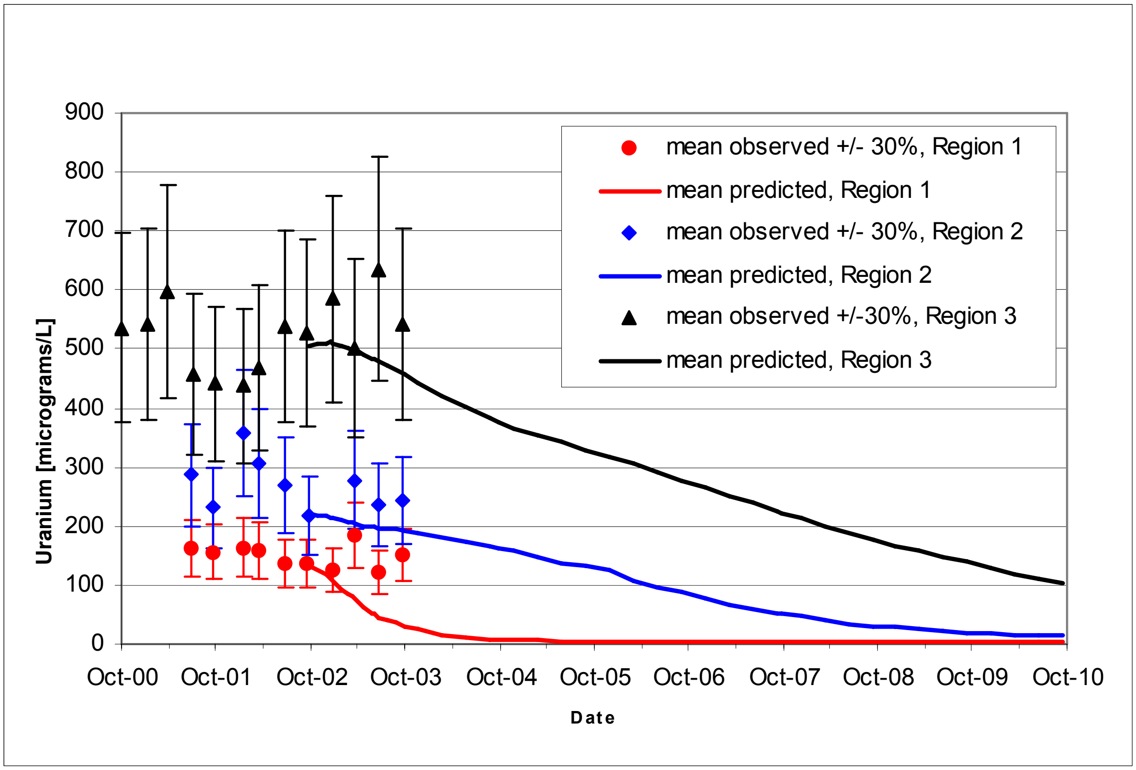

Figure 2. Example Trend Analysis Graph

2.2.1 Concentration Data Uncertainty Range

The uncertainty range displayed on Figure 2 (± 30 percent) accounts for the cumulative effects of natural variation in ground water flow and geochemistry, sample collection bias, and laboratory analytical uncertainty on measured uranium concentrations. This range was determined by analyzing the measured concentration of uranium over time at selected OU III monitor wells, including most of those listed in Table 1 and others in uncontaminated regions of the aquifer. Within the plume area, the variation in uranium was evaluated for the period of April 2000 through October 2003. At background locations, uranium concentrations dating to 1992 were evaluated.

For a given well, concentration residuals were calculated as the difference between the best-fit value, as determined by linear regression, and the observed concentration. Concentration residuals were calculated separately for background wells and wells within the uranium plume. For both of these data sets, the maximum and minimum percent differences of the concentration residuals computed for each well were averaged. The resulting overall range of the average concentration residuals was minus 20 to plus 30 percent. Observed concentrations for individual wells varied from the residual value by as much as 77 percent. Tables 2 through 8 (at the end of this appendix) provide computational summaries of this uncertainty analysis.

2.2.2 Model-Predicted Concentrations

Tables 9 through 13 (at the end of this appendix) provide the uranium concentrations predicted by the ground water model (DOE 2004c) in 1-year increments for 50 years of simulated time, starting October 2002, for the monitor wells listed in Table 1. Average uranium concentrations per well group (aquifer region) are also provided in the tables. Figures 3 through 7 illustrate model-predicted uranium concentration trends at individual wells and as the group average within the respective aquifer region. The time scales for Figures 2 through 7 do not extend through the full 50 years of simulation in order to show more clearly changes in the initial years.

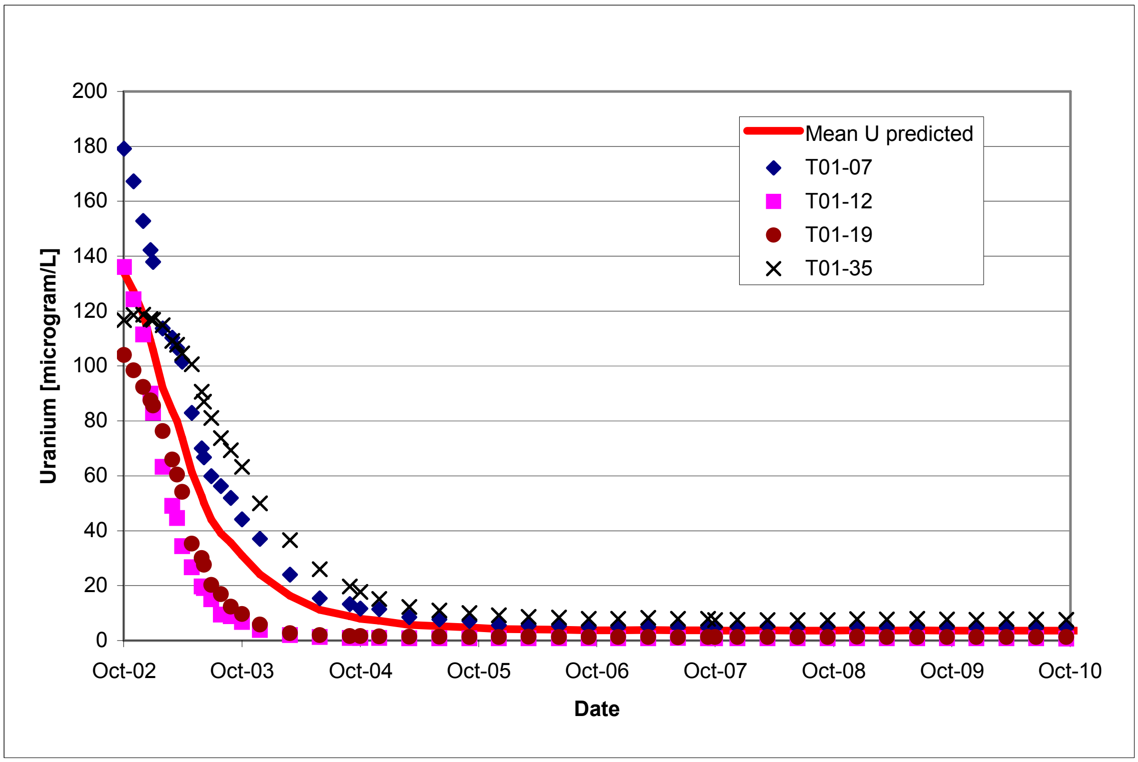

Figure 3. Model-Predicted Uranium Concentrations, Region 1

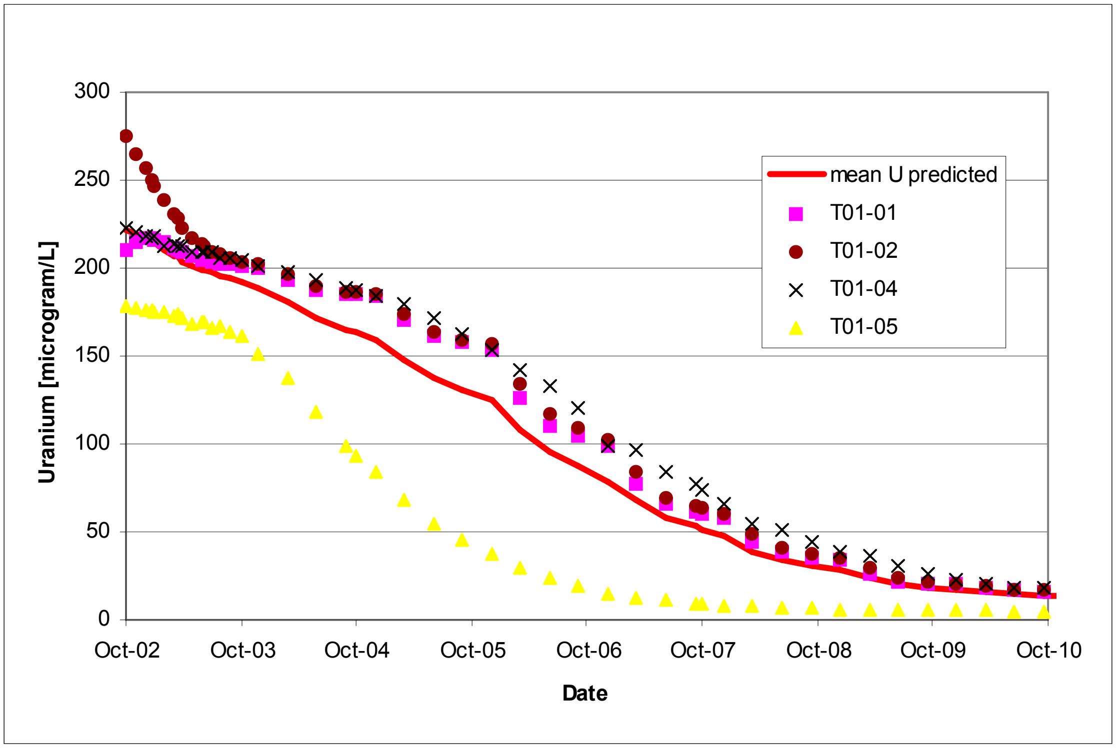

Figure 4. Model-Predicted Uranium Concentrations, Region 2

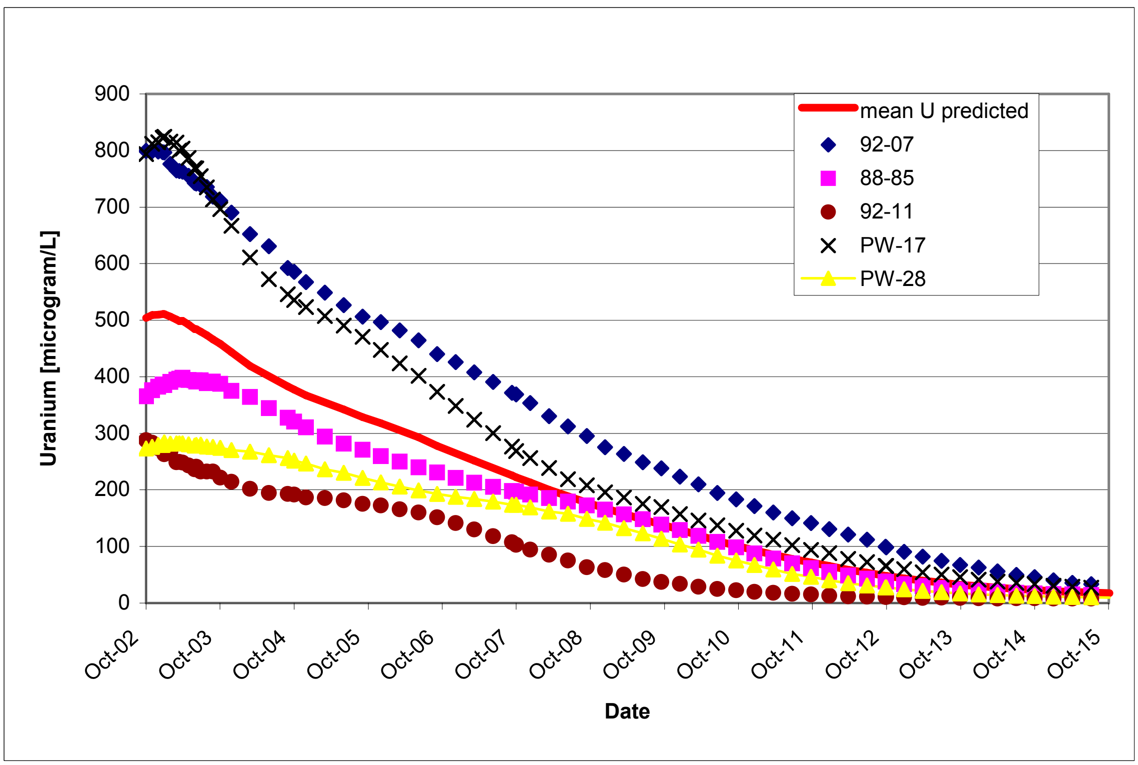

Figure 5. Model-Predicted Uranium Concentrations, Region 3

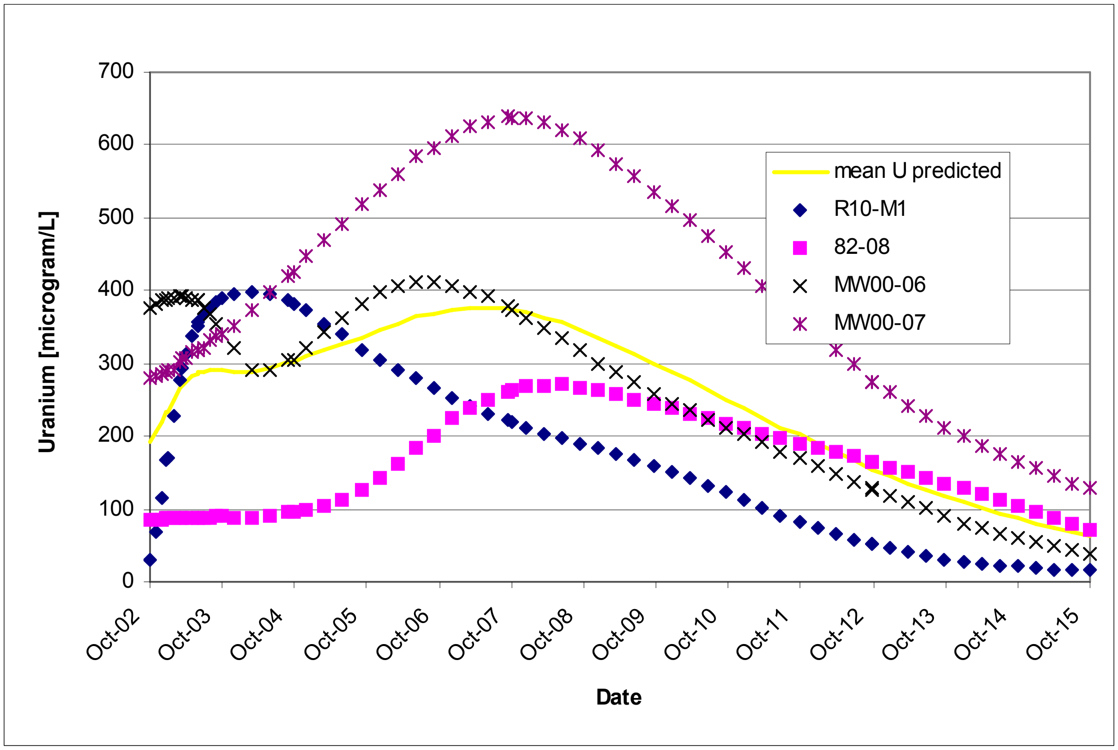

Figure 6. Model-Predicted Uranium Concentrations, Region 4

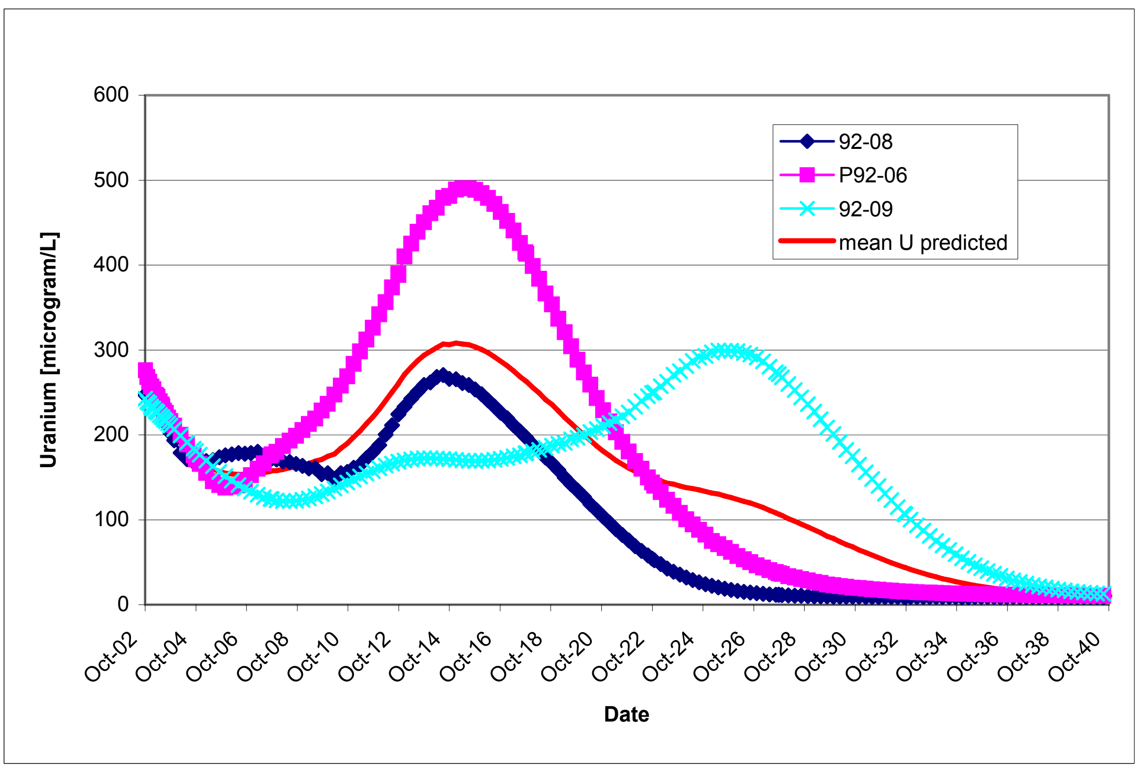

Figure 7. Model-Predicted Uranium Concentrations, Region 5

2.2.3 Addition of New Monitoring Wells

Three new wells will be installed into the alluvial aquifer in 2004 to complement the existing monitoring network. Proposed locations of the new wells are shown on Figure 1. The new well proposed in Region 4 (see Figure 1) will ultimately replace wells MW00-07 and 82-08 as a trend analysis well in that region. The limited saturated thickness (about 1 foot [ft]) and low yield of well MW00-07 pose sampling difficulties. Crop irrigation north of this well biases the monitoring results for samples from that location. The new well will be adjacent to and deeper than existing well 82-07 (well 82-07 is not shown on Figure 1) where recent low water levels are periodically below the screen. The two proposed wells in Region 5 will improve monitoring resolution in that region of the aquifer which is expected to be last in reaching remediation goals.

The new wells will be sampled semiannually to establish a seasonal water quality profile, and their concentration trends will be evaluated qualitatively to expected rates of ground water restoration. As predicted by numerical modeling, quantitative performance criteria (Section 3.1) cannot be immediately applied to the new wells because the ground water model was not based on concentration input from those locations. In 2007 (during the 5-year review), a decision will be made whether quantitative performance measures will subsequently be applied to the new wells.

3.0 Performance Criteria

3.1 Quantitative Evaluation of Uranium Attenuation

The progress of monitored natural attenuation for uranium is expected to closely approximate the model-predicted concentration trends. As long as the lower limit of the uncertainty range (minus 30 percent) associated with the observed concentration average for uranium does not exceed the model-predicted value for three consecutive sampling events, the progress of monitored natural attenuation is considered to be consistent with the model trend. This method allows possible deviatory behavior to be interpreted during successive water years and provides a minimum number of data points to constitute a concentration "trend." Concentration trends at wells not listed in Table 1 will be analyzed to assist in the general interpretation of monitored natural attenuation progress. The method described in Section 2.2 will be applied to the data beginning in October 2004.

3.1.1 Aquifer Region 4

The previously defined quantitative performance criteria do not immediately apply to Region 4 because of the general complexity of this region (see Section 2.1). A decision will be made in 2007 (during the 5-year review) whether those criteria will be subsequently applied to Region 4. The decision will consider the general progress of ground water restoration in this portion of the aquifer and the status of the permeable reactive barrier based on concentration trends and other indicators of flow dynamics (e.g., creek flow and ground water levels).

3.2 Plume Expansion

Assessment of plume expansion uses a sentinel well located a short distance beyond the terminus of the uranium plume (well 95-03; Figure 1). The ground water model predicts slight increases in uranium concentrations east of the current extent of the uranium plume but predicts that the concentrations will never exceed the remediation goal at the location of well 95-03. Unexpected plume expansion will be indicated by concentrations in ground water sample results that exceed the uranium remediation goal at well 95-03.

Ground water discharge from the Burro Canyon sandstone aquifer represents a significant local process that limits plume migration beyond its current extent in the eastern portion of OU III. Hydraulic heads at the alluvial and Burro Canyon aquifer wells in the area of concern, measured semiannually to determine vertical flow potentials, will complement water quality data in evaluating plume expansion criteria.

3.3 Permeable Reactive Barrier Performance

The permeable reactive barrier will be monitored to ensure that no adverse impact to ground water quality or land use occurs. Permeable reactive barrier failure is indicated by loss of treatment effectiveness whereby COC concentrations in the permeable reactive barrier equal or exceed concentrations in the influent ground water, or when ground water mounding reaches the top of the permeable reactive media.

Concentration trend analysis will consider possible effects associated with the eventual decommissioning of the permeable reactive barrier. Such effects will depend on contaminant concentrations in ground water hydraulically upgradient of the permeable reactive barrier and whether the disturbance to the subsurface mobilizes contaminants to ground water or flow directions change following the removal of the permeable reactive barrier and replacement with clean fill.

3.4 Other Contaminants of Concern

The progress of aquifer restoration for the remaining COCs (arsenic, manganese, molybdenum, nitrate, selenium, and vanadium) will be evaluated using concentration trends determined from semiannual monitoring. The rate at which these trends (at an individual well or averaged for a region of the aquifer) approach the respective remediation goal will be compared to the remediation time frame as a qualitative measure of restoration progress. These COCs are expected to attenuate to safe levels within the remediation time frame because they generally do not greatly exceed the respective remediation goals and are present only in the small area between the former millsite and permeable reactive barrier. Selenium mobilization from natural sources provides an exception (see Sections 5.3.1 and 7.2 of the ROD), as does manganese, which occurs in excess of its remediation goal only in ground water samples from locations on the former millsite.

3.5 Surface Water Restoration

The selected remedy for OU III assumes that remediation goals for surface water will be achieved through aquifer restoration because of the strong interaction between surface water and ground water at the site and, with the exception of selenium, because the remediation goals for surface water and ground water are equal for the respective COCs. Therefore, ground water and surface water interaction cannot in itself cause remediation goals to be exceeded for COCs other than selenium. However, sufficient discharge of ground water that contains selenium at 50 µg/L (ground water remediation goal for selenium) may result in surface water concentrations that exceed the surface water remediation goal for selenium of 5 µg/L.

Attainment of surface water remediation goals will be tracked by continued water-quality monitoring during the post-ROD period at multiple locations on Montezuma Creek, in the constructed wetlands, and at ground water seeps. Figure 8 illustrates the locations of the post-ROD surface water monitoring sites as identified in DOE 2004b. Specific criterion by which selenium concentration trends in surface water will initiate response actions pertaining to ecological risk are described in Appendix C of this ROD.

4.0 Reporting Requirements and Response Action

Annual reports will document monitoring results and monitored natural attenuation performance for the period encompassing the previous two sampling events. Annual reports will be completed within 5 months after the second sampling event for the reporting period. Annual reports will include

- Water quality sample results and summary.
- Hydrogeologic data summary.
- Concentration trend analysis and comparison to performance criteria.
- Interpretation of any deviation from expected concentration trends.

Discussion of potential response actions under CERCLA will be initiated among U.S. Department of Energy (DOE), U.S. Environmental Protection Agency (EPA), and the Utah Department of Environmental Quality (UDEQ) if, for any region of the aquifer, the lower limit of the uncertainty range (minus 30 percent) of the observed concentration average exceeds the model-predicted value for three consecutive sampling events. Example parameters that will be discussed include temporary climate changes (e.g., drought) from the assumed baseline conditions, changes in land use, identification of unremediated source material, and evaluation of discharge from the Burro Canyon aquifer. The sensitivity of the ground water model to the flow-and-transport variables (e.g., hydraulic conductivity, uranium partitioning coefficient) used to predict future concentrations will also be considered.

If the data are consistently above model predictions, a second assessment of the data will be performed during the 5-year review using additional statistical methods. In this evaluation, data for the region in question will be evaluated for the most recent 5-year period to determine if the observed trend for that period, assuming a 70-percent confidence interval, can meet the remediation goal in the established time frame. This second type of trend analysis accounts for linearly decreasing concentrations over time, as distinct from the highly nonlinear response predicted by the model. If the linear trend indicates an unacceptable remediation time, DOE, EPA, and UDEQ will determine the need to implement a contingency remedy. If the linear trend indicates that clean-up levels will be met in an acceptable time, then the selected remedy will be continued.

For the remaining COCs, if significant increases in the concentrations occur unexpectedly, or if average concentrations for the aquifer regions persist above the remediation goal, the need for response action will be evaluated. Failure of the permeable reactive barrier will initiate a separate response in which a strategy for its decommissioning will be developed by DOE, EPA, and UDEQ.

4.1 Plan Modification

This monitored natural attenuation performance evaluation plan may require modification during the post-ROD monitoring period. Plan modification may include reducing the scope of ground water monitoring as remediation goals are attained in regions of the aquifer, using wells other than those listed in Table 1 for quantitative trend analysis, or redefining quantitative performance criteria. DOE, EPA, or UDEQ may formally propose such changes. Any approval or proposal will be done in consultation between these parties pursuant to the then current agreement (currently 1989 Federal Facilities Agreement).

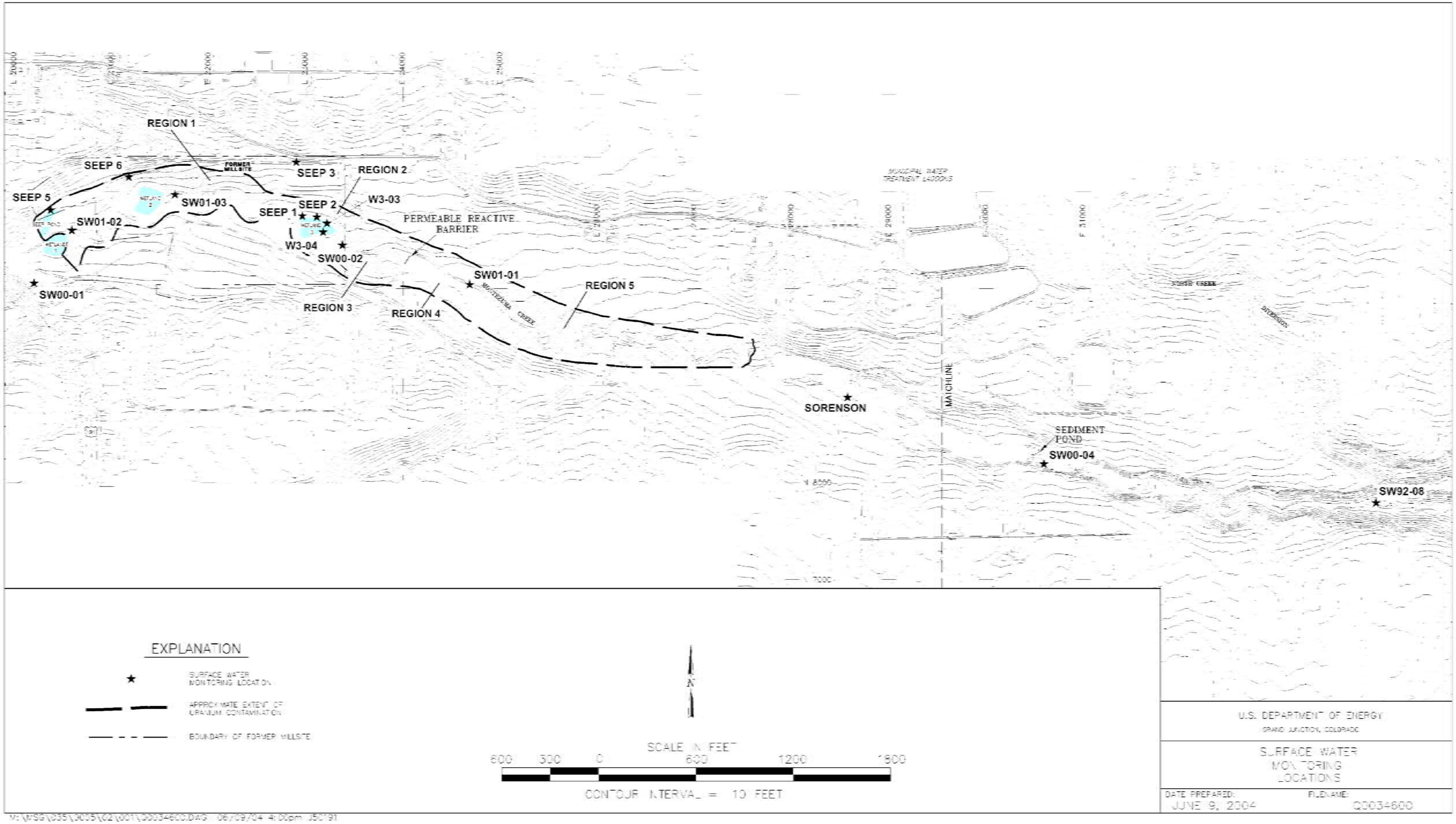

Figure 8. Locations of the Post-ROD Surface Water Monitoring Sites

Table 2. Residuals Analysis Summary

Well	Uranium Variation in Aquifer Regions 1, 2, 3, 5.				
	Maximum Percent Difference		Minimum Percent Difference		
T01-07		5.0435		-5.2708	
T01-12		54.3744		-28.3703	
T01-19		12.5641		-7.5272	
T01-35		18.6413		-15.5926	
T01-01		77.4739		-38.2691	
T01-02		17.3254		-15.2688	
T01-04		22.2202		-15.6268	
T01-05		14.0194		-16.4590	
88-85		19.6685		-17.1713	
92-07		59.6514		-22.0929	
92-11		30.9175		-22.1384	
PW-17		20.0616		-14.8996	
PW-28		24.2677		-24.7583	
92-08		57.9051		-29.4098	
92-09		10.6220		-8.8181	
P92-02		3.6398		-3.2010	
P92-06		72.8809		-23.4040	
	Mean	30.6633	Mean	-18.1340	
Well	Uranium Variation at Background Locations				
	Maximum Percent Difference		Minimum Percent Difference		
92-01		14.16706		-16.968	
92-03		13.68651		-22.9633	
92-05		21.20232		-36.1803	
MW00-01		48.30178		-25.3276	
MW00-02		44.33328		-23.0294	
	Mean	28.33819	Mean	-24.8937	

Table 3. Linear Regression Residuals Analysis: Uranium, Region 1 Wells

Observations								
Loc T01-07	Loc T01-07	Loc T01-12	Loc T01-12	Loc T01-19	Loc T01-19	Loc T01-35	Loc T01-35	
sample date	uran µg/l	sample date	uran µg/l	sample date	uran µg/l	sample date	uran µg/l	
07/11/2001	214	07/11/2001	164	07/11/2001	109	10/09/2001	159	
10/09/2001	201	10/09/2001	153	10/09/2001	111	01/31/2002	166	
01/31/2002	199	01/31/2002	161	01/31/2002	130	04/03/2002	155	
04/03/2002	203	04/03/2002	155	04/03/2002	128	07/09/2002	125	
07/09/2002	191	07/09/2002	119	07/09/2002	110	10/07/2002	115	
10/07/2002	183	10/07/2002	141	10/07/2002	105	01/13/2003	126	
04/08/2003	197	04/08/2003	282	04/08/2003	109	04/08/2003	148	
		07/07/2003	144	07/07/2003	109	07/07/2003	117	
Computational Summary								
Loc T01-07					**Loc T01-12**			
SUMMARY OUTPUT					SUMMARY OUTPUT			
Regression Statistics					*Regression Statistics*			
Multiple R	0.69				Multiple R	0.31163594		
R Square	0.48				R Square	0.097116959		
Adjusted R Square	0.37				Adjusted R Square	-0.053363547		
Standard Error	7.69				Standard Error	50.70147618		
Observations	7				Observations	8		
Loc T01-07					**Loc T01-12**			
RESIDUAL OUTPUT					RESIDUAL OUTPUT			
Observation	*Predicted Loc T01-07*	*Residuals*	*% difference*		*Observation*	*Predicted Loc T01-12*	*Residuals*	*% difference*
1	207.15	6.85	3.31		1	144.1387431	19.86125693	13.77926331
2	204.37	-3.37	-1.65		2	149.5916667	3.408333269	2.278424556
3	200.86	-1.86	-0.92		3	156.4987034	4.501296628	2.876251708
4	198.95	4.05	2.04		4	160.2551619	-5.255161896	-3.279246568
5	195.96	-4.96	-2.53		5	166.1322018	-47.13220184	-28.37029867
6	193.18	-10.18	-5.27		6	171.5851255	-30.58512551	-17.82504481
7	187.54	9.46	5.04		7	182.672737	99.32726304	54.37443195
		max % diff	**5.04**		8	188.1256606	-44.12566062	-23.4554183
		min % diff	**-5.27**				**max % diff**	**54.37**
							min % diff	**-28.37**
Loc T01-19					**Loc T01-35**			
SUMMARY OUTPUT					SUMMARY OUTPUT			
Regression Statistics					*Regression Statistics*			
Multiple R	0.312126766				Multiple R	0.681832728		
R Square	0.097423118				R Square	0.464895869		
Adjusted R Square	-0.053006362				Adjusted R Square	0.375711847		
Standard Error	9.757205407				Standard Error	16.05676988		
Observations	8				Observations	8		
Loc T01-19					**Loc T01-35**			
RESIDUAL OUTPUT					RESIDUAL OUTPUT			
Observation	*Predicted Loc T01-19*	*Residuals*	*% difference*		*Observation*	*Predicted Loc T01-35*	*Residuals*	*% difference*
1	117.8725355	-8.872535494	-7.527228847		1	159.0517341	-0.051734134	-0.032526608
2	116.8213209	-5.821320901	-4.983097996		2	151.8889542	14.11104575	9.290369944
3	115.4897824	14.51021758	12.56407041		3	147.9934073	7.006592709	4.734395158
4	114.7656124	13.23438764	11.53166647		4	141.8987612	-16.89876125	-11.90902662
5	113.6326366	-3.632636635	-3.196825087		5	136.243935	-21.24393502	-15.592573
6	112.581422	-7.581422042	-6.734167951		6	130.0864576	-4.086457573	-3.141339728
7	110.4439524	-1.44395237	-1.307407367		7	124.7457884	23.25421164	18.64127996
8	109.3927378	-0.392737777	-0.359016316		8	119.0909621	-2.090962132	-1.755768947
		max % diff	**12.56**				**max % diff**	**18.64**
		min % diff	**-7.53**				**min % diff**	**-15.59**

Table 4. Linear Regression Residuals Analysis: Uranium, Region 2 Wells

Observations								
Loc T01-01	Loc T01-01	Loc T01-02	Loc T01-02	Loc T01-04	Loc T01-04	Loc T01-05	Loc T01-05	
sample date	uran µg/l	sample date	uran µg/l	sample date	uran µg/l	sample date	uran µg/l	
07/18/2001	326	07/18/2001	311	07/18/2001	221	10/09/2001	180	
10/09/2001	321	01/31/2002	301	10/09/2001	192	01/31/2002	230	
01/31/2002	651	04/03/2002	373	01/31/2002	251	04/03/2002	235	
04/03/2002	331	07/10/2002	323	04/03/2002	282	07/10/2002	201	
07/10/2002	326	10/08/2002	278	07/10/2002	226	10/08/2002	188	
10/08/2002	193	04/09/2003	391	10/08/2002	213	04/09/2003	194	
04/09/2003	291	07/07/2003	305	04/09/2003	233	07/07/2003	168	
Computational Summary								
Loc T01-01					**Loc T01-02**			
SUMMARY OUTPUT					SUMMARY OUTPUT			
Regression Statistics					*Regression Statistics*			
Multiple R	0.329993297				Multiple R	0.172405518		
R Square	0.108895576				R Square	0.029723663		
Adjusted R Square	-0.069325309				Adjusted R Square	-0.164331605		
Standard Error	146.8904189				Standard Error	44.13532343		
Observations	7				Observations	7		
Loc T01-01					**Loc T01-02**			
RESIDUAL OUTPUT					RESIDUAL OUTPUT			
Observation	*Predicted Loc T01-01*	*Residuals*	*% difference*		*Observation*	*Predicted Loc T01-02*	*Residuals*	*% difference*
1	409.4980731	-83.49807308	-20.39034578		1	315.4811466	-4.481146618	-1.420416613
2	391.514606	-70.51460604	-18.01072168		2	321.0409392	-20.04093919	-6.242487092
3	366.8144224	284.1855776	77.47393784		3	322.7907216	50.20927838	15.55474647
4	353.3809892	-22.3809892	-6.33338801		4	325.5565068	-2.556506757	-0.785272819
5	332.147498	-6.147498003	-1.850833753		5	328.0965135	-50.09651351	-15.26883446
6	312.647353	-119.647353	-38.26910795		6	333.2611939	57.73880608	17.32539135
7	272.9970582	18.00294176	6.594555222		7	335.7729784	-30.77297838	-9.164816815
		max % diff	**77.47**				**max % diff**	**17.33**
		min % diff	**-38.27**				**min % diff**	**-15.27**
Loc T01-04					**Loc T01-05**			
SUMMARY OUTPUT					SUMMARY OUTPUT			
Regression Statistics					*Regression Statistics*			
Multiple R	0.135351376				Multiple R	0.491576988		
R Square	0.018319995				R Square	0.241647935		
Adjusted R Square	-0.178016006				Adjusted R Square	0.089977522		
Standard Error	31.25289678				Standard Error	23.77780404		
Observations	7				Observations	7		
Loc T01-04					**Loc T01-05**			
RESIDUAL OUTPUT					RESIDUAL OUTPUT			
Observation	*Predicted Loc T01-04*	*Residuals*	*% difference*		*Observation*	*Predicted Loc T01-05*	*Residuals*	*% difference*
1	226.065262	-5.065262001	-2.240619349		1	215.4631868	-35.46318679	-16.45904682
2	227.560489	-35.56048895	-15.62682921		2	209.4017832	20.59821684	9.836696006
3	229.6141742	21.38582583	9.313809094		3	206.1052303	28.89476969	14.01942573
4	230.7310907	51.26890932	22.22019978		4	200.89455	0.10545	0.052490224
5	232.4965394	-6.496539375	-2.794252075		5	196.1092313	-8.109231347	-4.135058453
6	234.1178698	-21.11786981	-9.020187064		6	186.3790834	7.62091658	4.088933393
7	237.414575	-4.414575014	-1.859437237		7	181.646935	-13.64693497	-7.512890309
		max % diff	**22.22**				**max % diff**	**14.02**
		min % diff	**-15.63**				**min % diff**	**-16.46**

Table 5. Linear Regression Residuals Analysis: Uranium, Region 3 Wells

Observations

	Loc 88-85	Loc 92-07	Loc 92-11	Loc PW-17	Loc PW-28	Loc PW-28
date_sampled	uran µg/l	uran µg/l	uran µg/l	uran µg/l	date_sampled	uran µg/l
10/18/2000	402	709	270	973	10/18/2000	324
01/29/2001	442	647	423	833	01/29/2001	370
04/12/2001	419	1170	370	727	04/12/2001	304
07/19/2001	393	576	307	761	07/19/2001	247
10/16/2001	366	620	254	759	10/16/2001	206
01/29/2002	350	645	292	686	01/29/2002	216
04/02/2002	374	664	321	753	04/02/2002	233
07/10/2002	417	771	362	881	07/10/2002	263
10/01/2002	417	806	317	836	10/01/2002	256
01/14/2003	397	838	303	803	04/08/2003	270
04/08/2003	329	759	360	792		
07/09/2003	475	845	355	866		

Computational Summary

Loc 88-85
SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.024160903
R Square	0.000583749
Adjusted R Square	-0.099357876
Standard Error	42.09817703
Observations	12

Loc 92-07
SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.135859654
R Square	0.018457846
Adjusted R Square	-0.07969637
Standard Error	164.1459361
Observations	12

Loc 88-85
RESIDUAL OUTPUT

Observation	*Predicted Loc 88-85*	*Residuals*	*% difference*
1	399.9075892	2.092410787	0.523223576
2	399.5990192	42.40098083	10.61088211
3	399.3803239	19.61967609	4.912529466
4	399.086733	-6.086732995	-1.525165457
5	398.8201045	-32.82010452	-8.229300415
6	398.5055428	-48.50554283	-12.17186152
7	398.3168058	-24.31680581	-6.104890745
8	398.0202191	18.97978092	4.768546926
9	397.7715656	19.22843445	4.834039462
10	397.4570039	-0.457003862	-0.114981962
11	397.2053545	-68.20535451	-17.17130792
12	396.9297386	78.07026145	19.66853422
		max % diff	**19.67**
		min % diff	**-17.17**

Loc 92-07
RESIDUAL OUTPUT

Observation	*Predicted Loc 92-07*	*Residuals*	*% difference*
1	721.1815515	-12.18155148	-1.689110247
2	728.0083436	-81.00834357	-11.12739219
3	732.8467496	437.1532504	59.65138695
4	739.342144	-163.342144	-22.09290318
5	745.2410226	-125.2410226	-16.80543862
6	752.2003738	-107.2003738	-14.25157146
7	756.3759845	-92.3759845	-12.21297164
8	762.9376584	8.062341553	1.056749718
9	768.4388598	37.56114016	4.887980309
10	775.398211	62.601789	8.073501861
11	780.9656919	-21.96569193	-2.812632124
12	787.0634091	57.93659086	7.361108418
		max % diff	**59.65**
		min % diff	**-22.09**

Loc 92-11
SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.081275103
R Square	0.006605642
Adjusted R Square	-0.092733793
Standard Error	49.9039732
Observations	12

Loc PW-28
SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.519495225
R Square	0.269875288
Adjusted R Square	0.178609699
Standard Error	46.02957224
Observations	10

Loc 92-11
RESIDUAL OUTPUT

Observation	*Predicted Loc 92-11*	*Residuals*	*% difference*
1	321.8700746	-51.87007463	-16.11522124
2	323.1042655	99.89573452	30.91749172
3	323.9789833	46.02101673	14.20493893
4	325.1532619	-18.15326194	-5.582986261
5	326.2196987	-72.21969869	-22.13836227
6	327.4778544	-35.47785442	-10.83366522
7	328.2327478	-7.232747848	-2.203542424
8	329.419009	32.58099104	9.89044049
9	330.4135511	-13.4135511	-4.059624992
10	331.6717068	-28.67170682	-8.644604357
11	332.6782314	27.32176861	8.212670992
12	333.7806155	21.21938455	6.357284864
		max % diff	**30.92**
		min % diff	**-22.14**

Loc PW-28
RESIDUAL OUTPUT

Observation	*Predicted Loc PW-28*	*Residuals*	*% difference*
1	307.2362974	16.76370261	5.456289753
2	297.7443776	72.2556224	24.2676698
3	291.0170946	12.98290535	4.461217431
4	281.9859477	-34.98594767	-12.40698267
5	273.7841917	-67.78419173	-24.75825624
6	264.1079628	-48.10796283	-18.21526406
7	258.3022255	-25.30222548	-9.795589424
8	249.1789239	13.82107606	5.546647301
9	241.5300954	14.46990463	5.990932353
10	224.1128833	45.88711666	20.47500169
		max % diff	**24.27**
		min % diff	**-24.76**

Loc PW-17
SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.038321931
R Square	0.00146857
Adjusted R Square	-0.098384573
Standard Error	81.56826183
Observations	12

Loc PW-17
RESIDUAL OUTPUT

Observation	*Predicted Loc PW-17*	*Residuals*	*% difference*
1	810.4172801	162.5827199	20.06160578
2	809.4685597	23.53144027	2.907023379
3	808.7961657	-81.79616566	-10.11332263
4	807.8934996	-46.89349964	-5.804416011
5	807.0737315	-48.07373153	-5.956547667
6	806.1065894	-120.1065894	-14.89959156
7	805.5263041	-52.52630408	-6.520743495
8	804.6144272	76.38557281	9.493438128
9	803.8499243	32.15007566	3.999512184
10	802.8827822	0.117217818	0.014599618
11	802.1090685	-10.10906846	-1.260310954
12	801.2616677	64.73833229	8.079549403
		max % diff	**20.06**
		min % diff	**-14.90**

Table 6. Linear Regression Residuals Analysis: Uranium, Region 5 Wells

Observations

Loc 92-08 date_sampled	Loc 92-08 uran µg/l	Loc 92-09 date_sampled	Loc 92-09 uran µg/l	Loc P92-02 date_sampled	Loc P92-02 uran µg/l	Loc P92-06 date_sampled	Loc P92-06 uran µg/l
10-Jan-00	467	12-Apr-00	271	12-Apr-00	66	10-Jan-00	1080
12-Apr-00	337	02-Nov-00	283	02-Nov-00	62	12-Apr-00	895
26-Jul-00	227	10-Apr-01	281	10-Apr-01	59	26-Jul-00	697
02-Nov-00	276	16-Oct-01	265	16-Oct-01	54	02-Nov-00	546
29-Jan-01	363	02-Apr-02	272	02-Apr-02	54	10-Apr-01	550
10-Apr-01	316	07-Oct-02	260	07-Oct-02	52	19-Jul-01	604
19-Jul-01	281	09-Apr-03	319	09-Apr-03	46	16-Oct-01	492
16-Oct-01	292	07-Oct-03	285			02-Apr-02	414
02-Apr-02	257					11-Jul-02	364
11-Jul-02	241					07-Oct-02	306
07-Oct-02	261					09-Apr-03	352
09-Apr-03	488					09-Jul-03	439
07-Oct-03	311					07-Oct-03	903

Computational Summary

Loc 92-08
SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.06
R Square	0.00
Adjusted R Square	-0.10
Standard Error	88.44
Observations	12.00

Loc 92-08
RESIDUAL OUTPUT

Observation	*Predicted Y*	*Residuals*	*% difference*
1	324.09	142.91	44.10
2	322.89	14.11	4.37
3	321.57	-94.57	-29.41
4	320.32	-44.32	-13.84
5	319.20	43.80	13.72
6	318.30	-2.30	-0.72
7	317.03	-36.03	-11.36
8	315.90	-23.90	-7.57
9	313.77	-56.77	-18.09
10	312.50	-71.50	-22.88
11	311.38	-50.38	-16.18
12	309.05	178.95	57.91
		max % diff	**57.91**
		min % diff	**-29.41**

Loc 92-09
SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.35
R Square	0.13
Adjusted R Square	-0.05
Standard Error	20.01
Observations	7.00

Loc 92-09
RESIDUAL OUTPUT

Observation	*Predicted Y*	*Residuals*	*% difference*
1	268.95	2.05	0.76
2	272.55	10.45	3.84
3	275.42	5.58	2.03
4	278.78	-13.78	-4.94
5	281.79	-9.79	-3.48
6	285.14	-25.14	-8.82
7	288.37	30.63	10.62
		max % diff	**10.62**
		min % diff	**-8.82**

Loc P92-02
SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.98
R Square	0.96
Adjusted R Square	0.96
Standard Error	1.37
Observations	7.00

Loc P92-02
RESIDUAL OUTPUT

Observation	*Predicted Y*	*Residuals*	*% difference*
1	65.27	0.63	0.97
2	61.92	0.18	0.29
3	59.25	-0.75	-1.26
4	56.10	-1.80	-3.20
5	53.31	0.89	1.67
6	50.17	1.83	3.64
7	47.19	-0.99	-2.09
		max % diff	**3.64**
		min % diff	**-3.20**

Loc P92-06
SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.86
R Square	0.74
Adjusted R Square	0.71
Standard Error	123.71
Observations	12.00

Loc P92-06
RESIDUAL OUTPUT

Observation	*Predicted Y*	*Residuals*	*% difference*
1	851.11	228.89	26.89
2	807.99	87.01	10.77
3	759.24	-62.24	-8.20
4	712.83	-166.83	-23.40
5	638.30	-88.30	-13.83
6	591.43	12.57	2.13
7	549.71	-57.71	-10.50
8	470.96	-56.96	-12.09
9	424.09	-60.09	-14.17
10	382.84	-76.84	-20.07
11	296.59	55.41	18.68
12	253.93	185.07	72.88
		max % diff	**72.88**
		min % diff	**-23.40**

Table 7. Uranium Concentration Variation: Background Locations

Well 92-01

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.105522584
R Square	0.011135016
Adjusted R Square	-0.153675815
Standard Error	0.69475875
Observations	8

RESIDUAL OUTPUT

Observation	*Predicted Y*	*Residuals*	*% difference*
1	5.595656162	0.204343838	3.651829782
2	5.569847159	-0.669847159	-12.02631131
3	5.559835046	0.640164954	11.51409977
4	5.540033311	-0.940033311	-16.96800828
5	5.518229154	0.781770846	14.1670602
6	5.47640077	-0.17640077	-3.221107755
7	5.441914602	0.558085398	10.2553134
8	5.398083796	-0.398083796	-7.374539024

Well 92-03

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.819116647
R Square	0.670952082
Adjusted R Square	0.506428123
Standard Error	0.717607129
Observations	4

RESIDUAL OUTPUT

Observation	*Predicted Y*	*Residuals*	*% difference*
1	4.381528144	0.418471856	9.550819758
2	3.634633285	-0.834633285	-22.96334236
3	2.902719124	0.397280876	13.68650768
4	2.481119447	0.018880553	0.76096913

Well 92-05

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.153477295
R Square	0.02355528
Adjusted R Square	-0.074089192
Standard Error	0.915663985
Observations	12

RESIDUAL OUTPUT

Observation	*Predicted Y*	*Residuals*	*% difference*
1	4.857432909	-1.757432909	-36.18028169
2	4.868343225	0.431656775	8.866605235
3	4.889709259	0.810290741	16.57134807
4	4.907438522	0.892561478	18.1879299
5	4.9296001	-1.0296001	-20.88607755
6	5.032907149	1.067092851	21.20231547
7	5.073479885	0.126520115	2.493754154
8	5.115871006	0.184128994	3.599171945
9	5.159398619	0.740601381	14.35441291
10	5.177923425	-0.277923425	-5.367468813
11	5.189288337	-0.789288337	-15.20995338
12	5.198607565	-0.398607565	-7.667583285

MW00-01

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.124976429
R Square	0.015619108
Adjusted R Square	-0.107428504
Standard Error	1.15283878
Observations	10

RESIDUAL OUTPUT

Observation	*Predicted Y*	*Residuals*	*% difference*
1	5.236685903	-0.636685903	-12.15818391
2	5.26978024	-1.06978024	-20.30028182
3	5.326975889	2.573024111	48.30177882
4	5.360429947	0.139570053	2.603710043
5	5.392445121	0.007554879	0.140101168
6	5.456115749	0.243884251	4.469924436
7	5.490648971	-1.390648971	-25.32758838
8	5.523383587	-0.023383587	-0.423356202
9	5.58885282	-0.38885282	-6.957650028
10	5.654681774	0.545318226	9.643658975

MW00-02

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.259558486
R Square	0.067370608
Adjusted R Square	-0.065862163
Standard Error	1.568932583
Observations	9

RESIDUAL OUTPUT

Observation	*Predicted Y*	*Residuals*	*% difference*
1	7.037214156	-1.537214156	-21.84407241
2	6.928409028	3.071590972	44.33327997
3	6.738298969	-0.338298969	-5.020539617
4	6.625906859	-1.525906859	-23.029404
5	6.517101731	-0.017101731	-0.262413139
6	6.309056761	0.290943239	4.611517215
7	6.193077669	-1.193077669	-19.26469734
8	6.08307688	1.21692312	20.00505901
9	5.867857946	0.032142054	0.547764693

Table 8. Uranium Concentration Variation: Background Locations

Observations					
Date Sampled	Loc 92-01	Loc 92-03	Loc 92-05	Loc MW00-01	Loc MW00-02
	Uranium (mg/L)	Uranium (mg/L)	Uranium (mg/L)	Uranium (mg/L)	Uranium (mg/L)
11/12/1992	0.0058	0.0048			
03/08/1993	0.0049				
04/22/1993	0.0062				
07/20/1993	0.0046				
07/22/1993			0.0031		
10/26/1993	0.0063		0.0053		
10/27/1993		0.0028			
05/02/1994	0.0053		0.0057		
10/04/1994	0.006	0.0033			
10/05/1994			0.0058		
04/18/1995			0.0039		
04/19/1995	0.005	0.0025			
04/08/1996					
07/23/1996					
10/13/1997			0.0061		
10/14/1997					
04/21/1998					
10/05/1998			0.0052		
10/06/1998					
04/13/1999					
10/13/1999			0.0053		
10/25/1999					
04/10/2000					
08/01/2000				0.0046	
08/02/2000					0.0055
10/30/2000			0.0059		
11/01/2000				0.0042	0.01
04/09/2001				0.0079	0.0064
04/10/2001					
04/11/2001			0.0049		
07/11/2001				0.0055	
07/12/2001					0.0051
07/20/2001			0.0044		
10/08/2001				0.0054	
10/10/2001			0.0048		
10/11/2001					0.0065
10/17/2001					
04/03/2002				0.0057	0.0066
07/08/2002				0.0041	
07/09/2002					0.005
10/07/2002				0.0055	
10/08/2002					
10/09/2002					0.0073
04/07/2003				0.0052	0.0059
10/07/2003				0.0062	

Table 9. Model-Predicted Uranium Concentrations at Selected Region 1 Wells

Model Time Day	Model Time Yr	Normalized Time Calendar	T01-07 U (µg/L)	T01-12 U (µg/L)	T01-19 U (µg/L)	T01-35 U (µg/L)	Mean U Predicted U (µg/L)
0	0.0	15-Oct-02	179.1	136.1	104.0	116.7	134.0
365	1.0	15-Oct-03	44.2	6.8	9.7	63.3	31.0
730	2.0	14-Oct-04	11.7	0.9	1.6	17.7	8.0
1067	2.9	16-Sep-05	7.1	0.8	1.3	10.1	4.8
1436	3.9	19-Sep-06	4.9	0.8	1.3	8.0	3.7
1825	5.0	14-Oct-07	4.9	0.8	1.2	7.5	3.6
2173	6.0	26-Sep-08	5.1	0.8	1.3	7.4	3.7
2264	6.2	26-Dec-08	4.9	0.8	1.4	7.8	3.7
2542	7.0	29-Sep-09	4.8	0.8	1.3	7.7	3.7
2911	8.0	03-Oct-10	4.7	0.8	1.3	7.5	3.6
3279	9.0	07-Oct-11	4.8	0.8	1.3	7.8	3.7
3650	10.0	12-Oct-12	4.9	0.8	1.3	7.5	3.6
4015	11.0	12-Oct-13	4.6	0.8	1.3	7.8	3.6
4384	12.0	15-Oct-14	4.8	0.8	1.3	7.9	3.7
4752	13.0	19-Oct-15	4.7	0.8	1.3	7.4	3.6
5121	14.0	22-Oct-16	5.0	0.8	1.3	7.7	3.7
5475	15.0	11-Oct-17	4.9	0.8	1.3	7.7	3.7
5490	15.0	25-Oct-17	4.5	0.8	1.3	7.7	3.6
5859	16.1	29-Oct-18	5.0	0.8	1.3	7.7	3.7
6227	17.1	02-Nov-19	4.8	0.8	1.4	7.9	3.7
6596	18.1	04-Nov-20	4.9	0.8	1.3	7.6	3.6
6965	19.1	08-Nov-21	4.7	0.8	1.3	7.9	3.7
7300	20.0	10-Oct-22	4.7	0.8	1.3	7.6	3.6
7611	20.9	17-Aug-23	4.6	0.8	1.3	7.5	3.5
7980	21.9	19-Aug-24	4.9	0.8	1.3	7.5	3.6
8439	23.1	22-Nov-25	4.8	0.8	1.3	7.8	3.7
8808	24.1	26-Nov-26	4.8	0.8	1.3	7.6	3.6
9125	25.0	09-Oct-27	5.0	0.8	1.2	7.5	3.6
9544	26.1	30-Nov-28	4.9	0.8	1.3	7.6	3.6
9821	26.9	04-Sep-29	4.8	0.8	1.3	7.8	3.7
10191	27.9	09-Sep-30	4.7	0.8	1.3	7.9	3.7
10562	28.9	15-Sep-31	4.8	0.8	1.3	7.5	3.6
10654	29.2	16-Dec-31	4.8	0.8	1.2	7.6	3.6
10747	29.4	18-Mar-32	4.6	0.8	1.2	7.9	3.6
10950	30.0	07-Oct-32	4.7	0.8	1.3	7.8	3.7
11302	31.0	24-Sep-33	4.7	0.8	1.3	7.8	3.6
11672	32.0	29-Sep-34	5.0	0.8	1.2	7.6	3.7
12042	33.0	04-Oct-35	5.1	0.8	1.2	8.0	3.8
12413	34.0	09-Oct-36	4.8	0.8	1.3	8.0	3.7
12782	35.0	13-Oct-37	4.8	0.8	1.3	8.0	3.7
13153	36.0	19-Oct-38	5.1	0.8	1.3	7.8	3.8
13523	37.0	24-Oct-39	5.0	0.8	1.2	7.8	3.7
13893	38.1	28-Oct-40	4.8	0.8	1.3	7.9	3.7
14262	39.1	01-Nov-41	4.6	0.8	1.4	7.8	3.6
14600	40.0	05-Oct-42	4.8	0.8	1.3	8.0	3.7

Table 9 (continued). Model-Predicted Uranium Concentrations at Selected Region 1 Wells

Model Time Day	Model Time Yr	Normalized Time Calendar	T01-07 U (µg/L)	T01-12 U (µg/L)	T01-19 U (µg/L)	T01-35 U (µg/L)	Mean U Predicted U (µg/L)
14997	41.1	06-Nov-43	5.0	0.8	1.2	8.0	3.8
15330	42.0	04-Oct-44	4.9	0.8	1.2	7.9	3.7
15695	43.0	04-Oct-45	5.0	0.8	1.3	7.8	3.7
16060	44.0	04-Oct-46	4.9	0.8	1.3	7.8	3.7
16425	45.0	04-Oct-47	4.9	0.8	1.4	7.7	3.7
16836	46.1	18-Nov-48	4.8	0.8	1.3	7.9	3.7
17206	47.1	23-Nov-49	5.1	0.8	1.3	7.9	3.8
17573	48.1	25-Nov-50	4.7	0.8	1.3	7.9	3.7
17851	48.9	30-Aug-51	4.7	0.8	1.3	7.7	3.6
18250	50.0	02-Oct-52	5.0	0.8	1.3	7.6	3.7

Table 10. Model-Predicted Uranium Concentrations at Selected Region 2 Wells

Model Time Day	Model Time Yr	Normalized Time Calendar	T01-01 U (µg/L)	T01-02 U (µg/L)	T01-04 U (µg/L)	T01-05 U (µg/L)	Mean U Predicted U (µg/L)
0	0.0	15-Oct-02	209.8	274.6	223.2	178.0	221.4
365	1.0	15-Oct-03	201.2	203.7	204.4	160.9	192.6
730	2.0	14-Oct-04	185.3	186.2	187.7	93.5	163.2
1067	2.9	16-Sep-05	157.6	159.1	162.6	45.0	131.1
1436	3.9	19-Sep-06	104.0	109.1	120.0	18.8	88.0
1825	5.0	14-Oct-07	60.4	63.5	73.4	9.1	51.6
2173	6.0	26-Sep-08	35.4	37.9	44.3	6.4	31.0
2264	6.2	26-Dec-08	33.5	35.7	38.7	5.9	28.5
2542	7.0	29-Sep-09	21.0	22.1	25.7	5.5	18.6
2911	8.0	03-Oct-10	16.3	16.7	17.8	5.1	14.0
3279	9.0	07-Oct-11	14.1	14.3	13.3	4.7	11.6
3650	10.0	12-Oct-12	13.0	13.1	11.8	4.8	10.7
4015	11.0	12-Oct-13	12.0	12.1	10.8	4.7	9.9
4384	12.0	15-Oct-14	11.8	11.8	10.4	4.7	9.7
4752	13.0	19-Oct-15	11.4	11.4	10.2	4.7	9.4
5121	14.0	22-Oct-16	11.4	11.3	10.3	4.5	9.4
5475	15.0	11-Oct-17	11.4	11.3	10.3	4.9	9.5
5490	15.0	25-Oct-17	11.4	11.3	10.2	4.8	9.4
5859	16.1	29-Oct-18	11.4	11.3	10.2	4.7	9.4
6227	17.1	02-Nov-19	11.4	11.3	10.2	4.7	9.4
6596	18.1	04-Nov-20	11.4	11.3	10.2	4.5	9.3
6965	19.1	08-Nov-21	11.4	11.3	10.2	4.7	9.4
7300	20.0	10-Oct-22	11.4	11.3	10.3	5.0	9.5
7611	20.9	17-Aug-23	11.4	11.3	10.2	4.8	9.4
7980	21.9	19-Aug-24	11.4	11.3	10.4	4.8	9.5
8439	23.1	22-Nov-25	11.4	11.3	10.2	4.6	9.4
8808	24.1	26-Nov-26	11.4	11.3	10.2	4.9	9.4
9125	25.0	09-Oct-27	11.4	11.3	10.2	4.8	9.4
9544	26.1	30-Nov-28	11.4	11.3	10.3	4.7	9.4
9821	26.9	04-Sep-29	11.4	11.3	10.3	4.8	9.4
10191	27.9	09-Sep-30	11.4	11.3	10.3	4.8	9.4
10562	28.9	15-Sep-31	11.4	11.3	10.2	4.8	9.4
10654	29.2	16-Dec-31	11.4	11.3	10.4	4.9	9.5
10747	29.4	18-Mar-32	11.4	11.3	10.3	4.9	9.5
10950	30.0	07-Oct-32	11.4	11.3	10.2	4.7	9.4
11302	31.0	24-Sep-33	11.4	11.3	10.2	4.9	9.4
11672	32.0	29-Sep-34	11.4	11.3	10.3	4.7	9.4
12042	33.0	04-Oct-35	11.4	11.3	10.1	4.4	9.3
12413	34.0	09-Oct-36	11.4	11.3	10.3	4.8	9.5
12782	35.0	13-Oct-37	11.4	11.3	10.2	5.0	9.5
13153	36.0	19-Oct-38	11.4	11.3	10.1	4.8	9.4
13523	37.0	24-Oct-39	11.4	11.3	10.4	4.7	9.4
13893	38.1	28-Oct-40	11.4	11.3	10.3	4.7	9.4
14262	39.1	01-Nov-41	11.4	11.3	10.5	4.9	9.5
14600	40.0	05-Oct-42	11.4	11.3	10.4	4.6	9.4

Table 10 (continued). Model-Predicted Uranium Concentrations at Selected Region 2 Wells

Model Time Day	Model Time Yr	Normalized Time Calendar	T01-01 U (µg/L)	T01-02 U (µg/L)	T01-04 U (µg/L)	T01-05 U (µg/L)	Mean U Predicted U (µg/L)
14997	41.1	06-Nov-43	11.4	11.3	10.6	4.9	9.5
15330	42.0	04-Oct-44	11.4	11.3	10.4	4.4	9.4
15695	43.0	04-Oct-45	11.4	11.3	10.3	4.9	9.5
16060	44.0	04-Oct-46	11.4	11.3	10.3	4.6	9.4
16425	45.0	04-Oct-47	11.4	11.3	10.3	5.0	9.5
16836	46.1	18-Nov-48	11.4	11.3	10.4	4.7	9.5
17206	47.1	23-Nov-49	11.4	11.3	10.4	4.6	9.4
17573	48.1	25-Nov-50	11.4	11.3	10.3	4.8	9.5
17851	48.9	30-Aug-51	11.4	11.3	10.2	4.8	9.4
18250	50.0	02-Oct-52	11.4	11.3	10.4	4.9	9.5

Table 11. Model-Predicted Uranium Concentrations at Selected Region 3 Wells

Model Time Day	Model Time Yr	Normalized Time Calendar	92-07 U (µg/L)	88-85 U (µg/L)	92-11 U (µg/L)	PW-17 U (µg/L)	PW-28 U (µg/L)	Mean U Predicted U (µg/L)
0	0.0	15-Oct-02	799.5	365.6	288.0	793.6	273.2	504
365	1.0	15-Oct-03	711.1	387.7	221.8	696.3	274.4	458
730	2.0	14-Oct-04	585.7	320.7	191.9	535.6	251.9	377
1067	2.9	16-Sep-05	506.2	270.8	175.4	470.7	221.0	329
1436	3.9	19-Sep-06	440.2	230.7	151.7	373.1	192.7	278
1825	5.0	14-Oct-07	368.8	196.9	103.0	268.5	173.9	222
2173	6.0	26-Sep-08	295.3	172.3	63.1	208.3	148.8	178
2264	6.2	26-Dec-08	275.2	165.4	58.0	195.6	142.0	167
2542	7.0	29-Sep-09	237.9	138.7	37.1	169.4	113.7	139
2911	8.0	03-Oct-10	183.4	98.2	22.6	127.9	75.3	101
3279	9.0	07-Oct-11	141.4	61.6	15.2	93.9	46.5	72
3650	10.0	12-Oct-12	98.7	37.9	10.5	65.5	27.6	48
4015	11.0	12-Oct-13	67.4	23.7	8.8	45.7	16.8	32
4384	12.0	15-Oct-14	45.7	16.9	8.6	33.1	12.2	23
4752	13.0	19-Oct-15	30.3	13.7	7.5	25.5	9.8	17
5121	14.0	22-Oct-16	21.6	12.2	7.6	21.2	8.8	14
5475	15.0	11-Oct-17	17.3	11.4	7.2	18.3	8.1	12
5490	15.0	25-Oct-17	17.2	11.3	7.3	18.5	8.1	12
5859	16.1	29-Oct-18	15.0	10.9	7.3	16.7	7.8	12
6227	17.1	02-Nov-19	13.1	10.6	7.3	15.4	7.7	11
6596	18.1	04-Nov-20	12.1	10.6	7.1	14.5	7.6	10
6965	19.1	08-Nov-21	11.5	10.6	7.2	13.7	7.7	10
7300	20.0	10-Oct-22	11.3	10.5	7.4	13.7	7.5	10
7611	20.9	17-Aug-23	11.1	10.5	7.2	13.2	7.6	10
7980	21.9	19-Aug-24	11.0	10.5	7.2	12.8	7.7	10
8439	23.1	22-Nov-25	10.9	10.5	7.3	12.6	7.7	10
8808	24.1	26-Nov-26	10.9	10.5	7.0	12.5	7.7	10
9125	25.0	09-Oct-27	10.9	10.5	7.1	12.1	7.6	10
9544	26.1	30-Nov-28	10.9	10.5	7.4	12.1	7.6	10
9821	26.9	04-Sep-29	10.9	10.5	7.4	12.0	7.6	10
10191	27.9	09-Sep-30	10.8	10.5	7.1	11.8	7.6	10
10562	28.9	15-Sep-31	10.8	10.5	7.3	11.9	7.6	10
10654	29.2	16-Dec-31	10.8	10.5	7.4	11.9	7.7	10
10747	29.4	18-Mar-32	10.8	10.5	7.6	11.9	7.7	10
10950	30.0	07-Oct-32	10.8	10.5	7.3	11.8	7.7	10
11302	31.0	24-Sep-33	10.8	10.5	7.3	11.6	7.7	10
11672	32.0	29-Sep-34	10.8	10.5	7.3	11.4	7.6	10
12042	33.0	04-Oct-35	10.8	10.5	7.4	11.3	7.6	10
12413	34.0	09-Oct-36	10.8	10.5	7.1	11.3	7.7	9
12782	35.0	13-Oct-37	10.8	10.5	7.4	11.3	7.5	9
13153	36.0	19-Oct-38	10.8	10.5	7.3	11.2	7.7	9
13523	37.0	24-Oct-39	10.8	10.5	7.2	11.1	7.7	9
13893	38.1	28-Oct-40	10.8	10.5	7.1	11.1	7.6	9
14262	39.1	01-Nov-41	10.8	10.5	7.3	11.0	7.6	9
14600	40.0	05-Oct-42	10.8	10.5	7.3	10.9	7.7	9

Table 11 (continued). Model-Predicted Uranium Concentrations at Selected Region 3 Wells

Model Time Day	Model Time Yr	Normalized Time Calendar	92-07 U (µg/L)	88-85 U (µg/L)	92-11 U (µg/L)	PW-17 U (µg/L)	PW-28 U (µg/L)	Mean U Predicted U (µg/L)
14997	41.1	06-Nov-43	10.8	10.5	7.4	10.8	7.7	9
15330	42.0	04-Oct-44	10.8	10.6	7.3	10.8	7.6	9
15695	43.0	04-Oct-45	10.8	10.5	7.5	10.9	7.7	9
16060	44.0	04-Oct-46	10.8	10.5	7.3	10.8	7.6	9
16425	45.0	04-Oct-47	10.8	10.6	7.5	10.7	7.5	9
16836	46.1	18-Nov-48	10.8	10.6	7.4	10.7	7.7	9
17206	47.1	23-Nov-49	10.8	10.5	7.2	10.6	7.7	9
17573	48.1	25-Nov-50	10.8	10.5	7.4	10.6	7.7	9
17851	48.9	30-Aug-51	10.8	10.5	7.3	10.5	7.8	9
18250	50.0	02-Oct-52	10.8	10.5	7.3	10.3	7.9	9

Table 12. Model-Predicted Uranium Concentrations at Selected Region 4 Wells

Model Time Day	Model Time Yr	Normalized Time Calendar	MW00-07 U (µg/L)	MW00-06 U (µg/L)	R10-M1 U (µg/L)	82-08 U (µg/L)	Mean U Predicted U (µg/L)
0	0.0	15-Oct-02	279.3	374.9	30.3	84.8	192.3
365	1.0	15-Oct-03	341.5	339.8	391.0	89.4	290.4
730	2.0	14-Oct-04	426.4	305.8	380.8	95.8	302.2
1067	2.9	16-Sep-05	519.0	381.6	317.8	125.5	336.0
1436	3.9	19-Sep-06	596.5	411.1	265.3	201.0	368.5
1825	5.0	14-Oct-07	638.2	373.5	218.4	263.3	373.3
2173	6.0	26-Sep-08	608.4	319.4	189.2	267.4	346.1
2264	6.2	26-Dec-08	592.5	300.4	183.0	264.5	335.1
2542	7.0	29-Sep-09	535.0	259.0	160.1	245.5	299.9
2911	8.0	03-Oct-10	452.4	212.3	122.2	216.0	250.7
3279	9.0	07-Oct-11	366.7	170.9	82.6	188.9	202.3
3650	10.0	12-Oct-12	275.5	127.4	51.0	164.0	154.5
4015	11.0	12-Oct-13	211.9	90.3	31.3	135.6	117.3
4384	12.0	15-Oct-14	163.5	61.3	20.8	103.5	87.3
4752	13.0	19-Oct-15	128.2	39.5	15.6	72.0	63.8
5121	14.0	22-Oct-16	97.4	27.8	13.2	46.4	46.2
5475	15.0	11-Oct-17	73.1	20.3	11.9	30.2	33.9
5490	15.0	25-Oct-17	72.2	20.6	11.9	29.3	33.5
5859	16.1	29-Oct-18	53.8	16.0	11.2	19.0	25.0
6227	17.1	02-Nov-19	40.8	14.1	10.9	13.8	19.9
6596	18.1	04-Nov-20	31.8	12.7	10.7	11.0	16.6
6965	19.1	08-Nov-21	26.1	11.9	10.6	9.7	14.6
7300	20.0	10-Oct-22	22.6	11.5	10.6	9.0	13.4
7611	20.9	17-Aug-23	20.0	11.3	10.6	8.6	12.6
7980	21.9	19-Aug-24	17.8	11.1	10.6	8.5	12.0
8439	23.1	22-Nov-25	16.1	11.0	10.6	8.3	11.5
8808	24.1	26-Nov-26	14.9	10.9	10.6	8.3	11.2
9125	25.0	09-Oct-27	14.2	10.9	10.6	8.3	11.0
9544	26.1	30-Nov-28	13.5	10.8	10.6	8.3	10.8
9821	26.9	04-Sep-29	13.2	10.8	10.6	8.3	10.7
10191	27.9	09-Sep-30	12.8	10.8	10.6	8.4	10.6
10562	28.9	15-Sep-31	12.4	10.7	10.6	8.3	10.5
10654	29.2	16-Dec-31	12.4	10.7	10.6	8.3	10.5
10747	29.4	18-Mar-32	12.3	10.7	10.6	8.2	10.5
10950	30.0	07-Oct-32	12.2	10.7	10.6	8.3	10.5
11302	31.0	24-Sep-33	11.9	10.7	10.6	8.3	10.4
11672	32.0	29-Sep-34	11.7	10.7	10.6	8.4	10.4
12042	33.0	04-Oct-35	11.5	10.7	10.6	8.3	10.3
12413	34.0	09-Oct-36	11.4	10.7	10.6	8.3	10.2
12782	35.0	13-Oct-37	11.3	10.7	10.6	8.3	10.2
13153	36.0	19-Oct-38	11.0	10.7	10.6	8.3	10.2
13523	37.0	24-Oct-39	10.8	10.7	10.6	8.2	10.1
13893	38.1	28-Oct-40	10.7	10.7	10.6	8.3	10.1
14262	39.1	01-Nov-41	10.5	10.7	10.6	8.4	10.0
14600	40.0	05-Oct-42	10.5	10.6	10.6	8.3	10.0

Table 12 (continued). Model-Predicted Uranium Concentrations at Selected Region 4 Wells

Model Time Day	Model Time Yr	Normalized Time Calendar	MW00-07 U (µg/L)	MW00-06 U (µg/L)	R10-M1 U (µg/L)	82-08 U (µg/L)	Mean U Predicted U (µg/L)
14997	41.1	06-Nov-43	10.4	10.6	10.6	8.3	10.0
15330	42.0	04-Oct-44	10.3	10.6	10.6	8.2	9.9
15695	43.0	04-Oct-45	10.2	10.6	10.6	8.2	9.9
16060	44.0	04-Oct-46	10.1	10.6	10.6	8.3	9.9
16425	45.0	04-Oct-47	9.9	10.6	10.6	8.2	9.8
16836	46.1	18-Nov-48	9.8	10.6	10.6	8.3	9.8
17206	47.1	23-Nov-49	9.8	10.6	10.6	8.3	9.8
17573	48.1	25-Nov-50	9.8	10.6	10.6	8.3	9.8
17851	48.9	30-Aug-51	9.7	10.6	10.6	8.3	9.8
18250	50.0	02-Oct-52	9.7	10.6	10.6	8.4	9.8

Table 13. Model-Predicted Uranium Concentrations at Selected Region 5 Wells

Model Time Day	Model Time Yr	Normalized Time Calendar	P92-06 U (µg/L)	P92-02 U (µg/L)	92-09 U (µg/L)	92-08 U (µg/L)	Mean U Predicted U (µg/L)
0	0.0	15-Oct-02	276.1	52.0	242.7	247.0	204.5
365	1.0	15-Oct-03	216.4	63.1	211.0	202.2	173.2
730	2.0	14-Oct-04	171.1	77.0	181.0	167.6	149.1
1067	2.9	16-Sep-05	140.7	75.9	156.4	173.7	136.7
1436	3.9	19-Sep-06	146.7	79.7	136.6	177.8	135.2
1825	5.0	14-Oct-07	177.1	87.7	124.2	172.0	140.3
2173	6.0	26-Sep-08	198.9	97.7	122.3	165.8	146.2
2264	6.2	26-Dec-08	205.5	99.9	123.4	163.4	148.1
2542	7.0	29-Sep-09	228.7	108.4	130.4	153.5	155.3
2911	8.0	03-Oct-10	268.9	121.2	144.0	156.3	172.6
3279	9.0	07-Oct-11	326.2	134.1	157.6	179.5	199.4
3650	10.0	12-Oct-12	389.7	144.4	168.2	224.4	231.7
4015	11.0	12-Oct-13	450.3	148.9	172.6	258.8	257.6
4384	12.0	15-Oct-14	481.3	145.5	171.2	266.1	266.0
4752	13.0	19-Oct-15	488.5	138.5	169.3	253.4	262.4
5121	14.0	22-Oct-16	462.4	130.9	171.9	226.2	247.8
5475	15.0	11-Oct-17	415.1	125.5	178.3	197.6	229.1
5490	15.0	25-Oct-17	413.1	124.9	178.7	196.5	228.3
5859	16.1	29-Oct-18	353.8	121.8	187.2	166.3	207.3
6227	17.1	02-Nov-19	288.5	118.8	196.6	134.6	184.6
6596	18.1	04-Nov-20	229.0	117.6	210.0	103.7	165.0
6965	19.1	08-Nov-21	180.6	123.8	226.3	75.7	151.6
7300	20.0	10-Oct-22	143.9	134.1	249.3	54.2	145.4
7611	20.9	17-Aug-23	116.3	150.8	270.8	38.8	144.2
7980	21.9	19-Aug-24	88.3	170.9	291.3	26.5	144.3
8439	23.1	22-Nov-25	62.2	188.3	299.0	17.4	141.7
8808	24.1	26-Nov-26	46.3	192.4	291.1	13.5	135.8
9125	25.0	09-Oct-27	37.0	189.2	271.7	11.6	127.4
9544	26.1	30-Nov-28	28.4	175.8	236.3	10.1	112.7
9821	26.9	04-Sep-29	23.9	161.3	208.7	9.7	100.9
10191	27.9	09-Sep-30	20.1	140.0	174.6	9.3	86.0
10562	28.9	15-Sep-31	17.5	116.0	139.7	9.1	70.6
10654	29.2	16-Dec-31	17.0	111.9	130.9	9.0	67.2
10747	29.4	18-Mar-32	16.4	103.7	123.2	9.0	63.1
10950	30.0	07-Oct-32	15.5	91.4	106.2	9.0	55.5
11302	31.0	24-Sep-33	14.2	73.0	80.8	8.9	44.2
11672	32.0	29-Sep-34	13.1	54.4	59.4	9.0	34.0
12042	33.0	04-Oct-35	12.4	39.3	42.8	8.9	25.8
12413	34.0	09-Oct-36	11.8	27.3	31.0	8.9	19.8
12782	35.0	13-Oct-37	11.4	19.9	23.0	8.9	15.8
13153	36.0	19-Oct-38	11.0	14.8	17.7	8.9	13.1
13523	37.0	24-Oct-39	10.8	11.2	14.5	8.9	11.3
13893	38.1	28-Oct-40	10.5	9.3	12.4	8.9	10.3
14262	39.1	01-Nov-41	10.3	8.2	11.1	8.9	9.6
14600	40.0	05-Oct-42	10.2	7.6	10.4	8.9	9.3
14997	41.1	06-Nov-43	10.0	7.2	9.8	8.9	9.0

Table 13 (continued). Model-Predicted Uranium Concentrations at Selected Region 5 Wells

Model Time Day	Model Time Yr	Normalized Time Calendar	P92-06 U (µg/L)	P92-02 U (µg/L)	92-09 U (µg/L)	92-08 U (µg/L)	Mean U Predicted U (µg/L)
15330	42.0	04-Oct-44	9.9	7.0	9.6	8.9	8.8
15695	43.0	04-Oct-45	9.7	6.9	9.3	8.9	8.7
16060	44.0	04-Oct-46	9.6	6.8	9.2	8.9	8.6
16425	45.0	04-Oct-47	9.4	6.8	9.1	8.9	8.5
16836	46.1	18-Nov-48	9.3	6.8	8.9	8.9	8.5
17206	47.1	23-Nov-49	9.2	6.8	8.9	8.8	8.4
17573	48.1	25-Nov-50	9.1	6.8	8.8	8.9	8.4
17851	48.9	30-Aug-51	9.1	6.7	8.8	8.8	8.4
18250	50.0	02-Oct-52	9.0	6.7	8.8	8.8	8.3

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Appendix B

MMTS OU III Post-ROD Annual Inspection and CERCLA 5-Year Review Procedure

Contents

Figures

1.0 Introduction

Institutional controls have been applied at Operable Unit (OU) III to prevent use of contaminated alluvial ground water and to restrict land use within the floodplain of Montezuma Creek where contaminated sediments were left in place and supplemental standards were applied. The former millsite which was transferred to the City of Monticello through the National Park Service also limits the use of the property in perpetuity as a public park.

The Utah State Engineers' office issued the *Ground Water Management Policy for the Monticello Mill Tailings Site and Adjacent Areas,* which became effective May 21, 1999. The policy states that new applications to appropriate water for domestic use from the shallow alluvial aquifer within the boundaries of the Monticello Ground Water Restricted Area will not be approved; existing water rights are not affected. The policy states that applications to drill wells into the deeper Burro Canyon Formation would be approved if it could be demonstrated that the well construction would not allow the shallow alluvial water to flow to the deeper formation. The Monticello Ground Water Restricted Area (institutional control area) is shown on Figure B−1.

Because radioactively contaminated soil and sediment exceeding radium-226 standards in Title 40 CFR Part 192.12 remained in the Montezuma Creek floodplain following hot-spot remediation, restrictive easements were placed on private properties to which supplemental standards were applied. The restrictive easements generally apply to the floodplain of Montezuma Creek and extend about 50 feet from the centerline of the creek. The restrictive easement prohibits the building of a habitable structure on and the removal of soils from within the easement area. Property owners were compensated for restrictive easements on their properties. The quitclaim deed transferring ownership of the millsite to the City of Monticello also prohibits construction of habitable structures, camping, and removal of soils from areas where supplemental standards were applied.

As part of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process, the U.S. Department of Energy (DOE) will continue to monitor the sites, with oversight provided by the U.S. Environmental Protection Agency (EPA) and the Utah Department of Environmental Quality. DOE has implemented this monitoring program through the *Monticello Long-Term Surveillance and Maintenance Administrative Manual* (DOE 2002a), which describes long-term surveillance and maintenance activities that are conducted at the Monticello CERCLA sites. The document references operating procedures that define the work conducted by permanent employees located in Monticello, Utah. The work includes monitoring compliance with institutional controls (i.e., prohibitions on installation of wells into contaminated water, prohibitions on removal of contaminated soils, prohibitions on construction of habitable buildings in areas in which supplemental standards have been applied), monitoring the condition of the repository and associated facilities (i.e., evaporation pond, leachate collection and removal systems, leak detection systems, and temporary storage facility for contaminated materials), and monitoring contaminated soils left in place at areas in which supplemental standards have been applied. The operating procedures also identify how annual inspections and CERCLA 5-year reviews will be conducted.

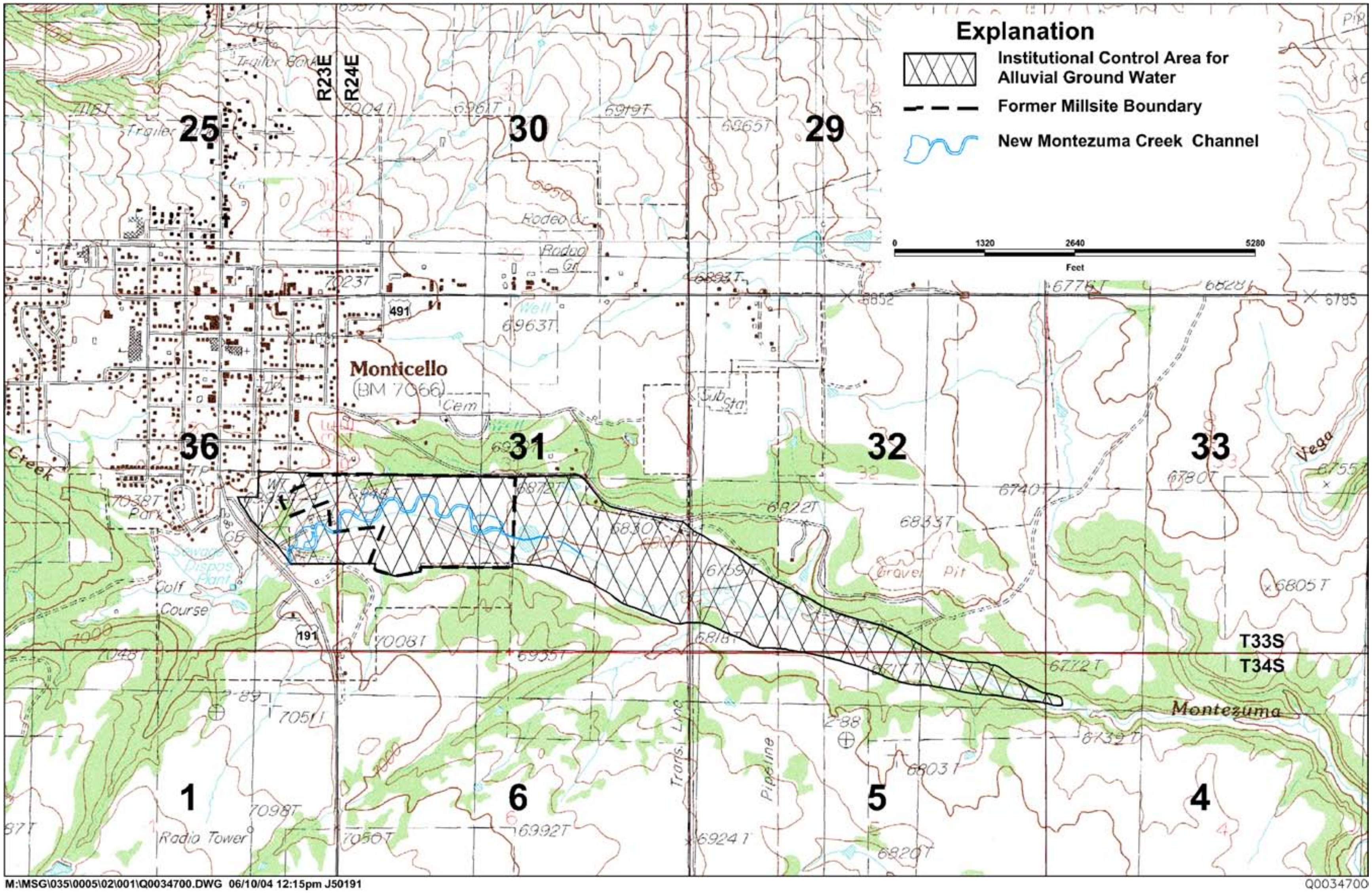

Figure B–1. Monticello Ground Water Restricted Area

Procedures for conducting annual inspections (including identification of a lead inspector) are provided in the *Monticello Long-Term Surveillance and Maintenance Operation Procedures for Annual Inspections and CERCLA Five Year-Reviews* (DOE 2002b). Because OU III requirements were not fully identified when that document was written, the following procedures describe additional inspection requirements for annual inspections and CERCLA 5-Year Reviews.

2.0 Procedure Specific to OU III for Annual Inspections

During annual inspections, the lead inspector will determine if water wells have been placed in the shallow alluvial aquifer by:

- Physically inspecting the Monticello Ground Water Restricted Area (see Figure B−1) to see if there is evidence of new well installation or evidence of existing wells having been retrofitted for human consumption (i.e., wells have been piped to a habitable structure). Existing wells are indicated on Figure 2−1 and 2−2 of this plan. The wells will be inspected to ensure that they are locked and the above ground piping remains in good condition.

- Interviewing the permanent on-site employees to determine if drilling rigs were present in the Monticello Ground Water Restricted area (see Figure B−1) during the previous year. If drilling activity occurred, the lead inspector will make a determination if the wells were installed in compliance with the *Ground Water Management Policy for the Monticello Mill Tailings Site and Adjacent Areas*.

Appendix E of this document contains a list of all monitoring wells installed for OU III. Locations of these wells are identified on Plate 1. The lead inspector shall inspect all wells (except those scheduled to be decommissioned) for damage of the casing caused by humans (accidental or vandalism) or by natural causes (flooding, freeze/thaw cycle, etc.) All wells shall be inspected to ensure they are locked.

The lead inspector will determine if wells scheduled for abandonment have actually been abandoned. A list of wells abandoned since the last annual inspection shall be included in the annual inspection report.

Several OU III properties (MP−00951−VL, MP−00990−CS, MP−01084−VL, MG−01026−VL, MG−01027−VL, MP−01029−VL, MG−01030−VL, and MG−01033−VL) are privately owned. The Monticello Long-Term Surveillance and Maintenance Representative is required on an annual basis to determine if ownership of these properties has changed. The lead inspector shall interview the Monticello Long-Term Surveillance and Maintenance Representative to determine if ownership has changed in the previous year. Changes of ownership shall be documented in the annual inspection report.

The lead inspector will also review the annual inspection report from the previous year to ensure that previously identified corrective actions have been completed.

The lead inspector will include a summary of the activity listed above in the annual inspection report. The lead inspector will also specify in the annual inspection report all necessary corrective action, such as enforcement action concerning institutional controls or required maintenance.

Results of the physical inspection, interviews, and progress in completing previously identified corrective action will be included in the annual inspection report.

3.0 Procedure Specific to OU III for CERCLA 5-Year Reviews

CERCLA 5-year reviews are conducted once every 5 years. The next 5-year review is scheduled for 2007. In addition to the requirements listed in *Monticello Long-Term Surveillance and Maintenance Operation Procedures for Annual Inspections and CERCLA Five Year-Reviews*, the lead inspector will:

- Conduct the activities listed above for an annual inspection,
- Obtain all annual inspection reports for the 5-year review period and ensure that all necessary corrective action has been complete, and
- Review the annual ground and surface water monitoring reports for the 5-year review period.

The lead inspector will include a summary of the above activities in the CERCLA 5-Year Review report and use the information obtained to make a protectiveness statement in accordance with the most recent EPA Comprehensive Five-Year Review Guidance (currently OSWER Directive 9355.7-03B-P published in 2001).

4.0 References

U.S. Department of Energy, 2002a. *Monticello Long-Term Surveillance and Maintenance Administrative Manual,* GJO−2001−224−TAR, U.S. Department of Energy Grand Junction Office, Grand Junction, Colorado, April.

———, 2002b. *Monticello Long-Term Surveillance and Maintenance Operating Procedures for Annual Inspections and CERCLA Five-Year Reviews*, GJO−2001−222−TAR, U.S. Department of Energy Grand Junction Office, Grand Junction, Colorado, April.

Appendix C

Monticello Permeable Reactive Barrier Decommissioning Strategy

Monticello Permeable Reactive Barrier Decommissioning Strategy

In June 1999, a permeable reactive barrier was installed as a full-scale in situ treatability study. The permeable reactive barrier is designed to capture and treat ground water flowing downgradient through the alluvial aquifer from the Monticello Millsite the adjacent property to the west (see Figure 2−1 of this plan). The permeable reactive barrier is constructed of a zone of reactive medium (zero valent iron) that immobilizes dissolved ground water contaminants, including arsenic, molybdenum, nitrate, selenium, uranium, and vanadium (DOE 1998d, 1998e). The reactive zone measures 103 feet (ft) long by 11–13 ft deep by 8 ft thick (DOE 1999a, 1999b). Impermeable walls constructed of a soil/bentonite/water slurry extend north and south from the permeable reactive barrier to funnel ground water into the reactive zone. The north slurry wall is 97 ft long by 10–16 ft deep by 3–4 ft thick, and the south slurry wall is 240 ft long by 10–16 ft deep by 3−4 ft thick. The slurry walls and reactive zone are keyed at depth in competent bedrock of the Dakota Sandstone aquitard.

The effective lifespan of the permeable reactive barrier is not known at this time and is dependent on the physical and chemical mechanisms that are active in the permeable reactive barrier. Preliminary estimates place its lifespan at 10 to 20 years. The ROD for OU III does not include the permeable reactive barrier as a component of the final remedy. However, DOE will continue monitoring the effectiveness of the permeable reactive barrier. When the permeable reactive barrier is no longer effective or needed, as directed by the ROD for OU III, it will be excavated, and radioactive components will be disposed of in a facility permitted for disposal of residual radioactive material. The excavation will be backfilled with permeable gravel to near ground surface and then overlain with fine textured soil. The slurry walls will not be removed. On the basis of the estimated lifespan, removal of the permeable reactive barrier can be expected to occur between 2009 and 2019. The cost to remove and dispose the reactive barrier in year 2014 has been estimated to be between 100- and 600-thousand dollars, depending on whether the reactive media classifies as hazardous waste.

The reactive media in the permeable reactive barrier will be tested by the accepted method at the time of decommissioning to determine if it is a characteristic hazardous waste. The radioactivity of the zero valent iron will also be tested upon decommissioning. Results of these tests will determine worker health and safety requirements during decommissioning, and the waste transport and disposal requirements. A plan to decommission the permeable reactive barrier will be developed in advance to specify the details of the construction activities, health and safety, mitigating potential release of contaminants to ground water during excavation, waste characterization and disposal, site restoration, and compliance with applicable or relevant and appropriate requirements.

End of current text

Appendix D

MMTS OU III Monitoring Well Decommissioning Strategy

MMTS OU III Monitoring Well Decommissioning Strategy

Ground water monitoring wells associated with Operable Unit III will require eventual decommissioning (abandonment). Approximately 43 wells currently not in use will be abandoned by the U.S. Department of Energy (DOE) in 2005. The wells to be abandoned in 2005 comprise two categories: those that are located on private land west of the Millsite where continued monitoring provides no benefit; and, those that are located either on or east of the Millsite that are outside of the alluvial aquifer channel and are not useful in monitoring plume movement. In general, the wells not identified as active for water level measurement or water quality sampling in Section 2.0 of this post-ROD monitoring plan will be abandoned in 2005. The many wells at the permeable reactive barrier that are not currently monitored are not identified for abandonment at this time. Wells tentatively identified for abandonment in 2005 are indicated as such in Appendix E of this plan.

Other wells will become eligible for abandonment as aquifer restoration proceeds. When remediation goals are sustained at a given well, and contaminated ground water is not likely to arrive at the well from an upgradient area, the well will be removed from active monitoring status and considered for abandonment, in agreement between DOE, EPA, and UDEQ. Well abandonment will proceed in phases as sufficient wells become eligible. Well abandonment will conform to the substantive requirements of the Utah Well Drilling Standards. Past abandonments of Monticello project wells have employed rotary or hollow-stem auger overdrilling methods followed by grout placement. Steel conductor casing, if present, was perforated and then pressure grouted. The cost to abandon the wells indicated in 2005 has been estimated to be about 70,000 dollars. Program Directives will be prepared to guide well abandonment activities. Well abandonments will be documented in annual performance evaluation reports for OU III or in the CERCLA 5-year review reports.

End of current text

Appendix E

MMTS OU III Post-ROD Ground Water Monitoring Well Completion Information

Table 1. MMTS OU III Post-ROD Ground Water Monitoring Well Completion Information

Well	Zone of Completion	Elevation TOC, Ft	Ground Elevation, Ft	Stickup, Ft	Well Depth, Ft BTOC	Screen Length, Ft	Top of Screen, Ft BTOC	Bottom of Screen, Ft BTOC	Sump Length, Ft	Borehole Diameter, In	Well Diameter, In	Easting	Northing
31NE93-205	KB	6940.62	6938.4	2.2	241.7	30.0	208.9	238.9	2.8	8	4	24151.6	12299.5
82-08	QA	6787.40	6785.3	2.1	22.1	5.0	14.1	19.1	3	no data	2	24677.0	10204.9
83-70	KD/KB	6800.91	6799.6	1.3	171.7	120.0	51.7	171.7	0	8	4	24018.3	10398.6
88-85	QA	6797.09	6797.1	0.0	12.1	5.0	7.1	12.1	0	8	2	23982.6	10336.1
92-07	QA	6804.02	6804.1	-0.1	21.1	5.0	15.7	20.7	0.4	8	2	23918.2	10162.3
92-08	QA	6775.68	6773.1	2.6	20.8	5.0	15.5	20.5	0.35	8	2	25382.0	9612.4
92-09	QA	6733.29	6730.8	2.5	18.8	5.1	13.4	18.5	0.3	8	2	27449.7	9367.0
92-10	KB	6733.80	6731.5	2.3	67.3	30.0	36.7	66.7	0.6	8	4	27424.8	9365.0
92-11	QA	6813.73	6813.0	0.7	14.9	4.4	10.2	14.6	0.28	8	2	23652.3	10618.1
92-12	KD	6815.05	6813.4	1.7	61.4	10.0	50.9	60.9	0.6	8	4	23670.9	10622.4
93-01	KB	6889.98	6889.6	0.4	179.5	60.0	119.4	179.4	0.1	7	4	20454.7	10067.2
95-01	QA	6675.83	6673.4	2.4	11.3	5.0	5.9	10.9	0.33	8	2	30162.7	8453.4
95-02	KB	6678.99	6676.5	2.5	32.0	10.0	21.7	31.7	0.3	8	4	30170.2	8452.2
95-03	QA	6704.78	6702.6	2.2	13.1	5.0	7.7	12.7	0.34	8	2	28639.5	8976.6
95-04	KB	6706.24	6704.1	2.1	36.5	10.0	26.1	36.1	0.33	8	4	28635.7	8969.7
95-06	KB	6824.91	6824.0	0.9	106.4	15.0	91.0	106.0	0.38	8	4	25350.0	10750.2
95-07	KD	6883.34	6880.4	2.9	113.1	30.0	82.8	112.8	0.3	8	2	23200.7	11462.7
95-08	KB	6841.51	6838.5	3.0	158.0	30.0	127.6	157.6	0.4	8	4	28770.2	10126.0
MW00-01	QA	6882.77	6882.7	0.0	13.8	6.0	7.4	13.4	0.35	4	2	20100.9	10137.3
MW00-02	QA	6883.26	6880.9	2.4	16.0	5.0	10.3	15.4	0.59	4	2	20267.9	10050.6
MW00-03	QA	6853.15	6850.7	2.4	11.6	5.0	6.2	11.2	0.35	4	2	23081.6	10016.0
MW00-06	QA	6793.14	6793.4	-0.3	19.2	5.0	13.8	18.9	0.35	4	2	24316.7	10081.4
MW00-07	QA	6790.85	6791.1	-0.3	22.3	5.0	16.9	22.0	0.3	4	2	24601.5	9860.3
P92-02	QA	6737.02	6734.8	2.2	22.5	2.5	19.6	22.1	0.35	8	2	27431.1	9563.8
P92-06	QA	6774.73	6772.2	2.5	17.0	2.5	14.2	16.7	0.3	8	2	25380.5	9331.3
PW-10	QA	6813.94	6813.9	0.0	33.3	5.0	27.9	32.9	0.4	2.2	1	23911.4	10061.5
PW-14	QA	6800.44	6800.5	-0.1	19.2	5.0	13.8	18.8	0.4	2.5	1	23991.3	10177.1
PW-16	QA	6796.72	6796.8	-0.1	15.0	5.0	9.6	14.6	0.4	2.2	1	24029.5	10227.7
PW-17	QA	6817.56	6817.6	0.0	35.8	5.0	30.4	35.4	0.4	2.2	1	23854.1	10054.5
PW-18	QA	6799.73	6799.8	-0.1	11.9	5.0	6.8	11.8	0.4	2.2	1	24030.2	10416.8
PW-20	QA	6799.57	6800.1	-0.5	15.9	5.0	10.5	15.5	0.4	2.2	1	24041.7	10419.5
PW-22	QA	6797.45	6797.7	-0.3	16.9	5.0	11.5	16.5	0.4	2.2	1	24088.9	10398.4
PW-23	QA	6809.15	6809.1	0.0	24.4	5.0	19.0	24.0	0.4	2.2	1	23836.2	10129.0
PW-28	QA	6799.93	6800.4	-0.5	14.6	5.0	9.2	14.2	0.4	2.2	1	23993.8	10445.9
PW99-16	QA	6799.76	6799.8	0.0	16.7	5.0	11.4	16.4	0.3	2.2	0.5	24064.7	10438.0
R10-M1	QA	6795.11	6795.1	0.0	15.7	5.0	10.3	15.3	0.4	2.2	1	24097.9	10258.2
R11-M1	QA	6794.79	6794.8	0.0	14.5	5.0	9.1	14.1	0.4	2.2	1	24118.5	10262.7
R1-M1	QA	6797.77	6797.9	-0.1	13.4	5.0	8.0	13.0	0.4	2.2	1	23997.7	10240.5
R1-M2	QA	6796.60	6796.6	0.0	15.5	5.0	10.1	15.1	0.4	2.2	1	24013.4	10265.1
R1-M3	QA	6795.91	6795.9	0.0	13.9	5.0	8.5	13.5	0.4	2.2	1	24024.3	10281.7
R1-M4	QA	6795.85	6795.9	0.0	13.8	5.0	8.4	13.4	0.4	2.2	1	24046.9	10314.8
R1-M5	QA	6795.61	6795.8	-0.2	11.8	5.0	6.4	11.4	0.4	2.2	1	24056.3	10332.1
R1-M6	QA	6798.16	6798.3	-0.1	15.4	5.0	10.1	15.1	0.4	2.2	1	24055.9	10352.0
R2-M1	RM	6796.94	6796.9	0.0	15.4	5.0	10.0	15.0	0.4	2.2	1	24011.5	10254.3
R2-M10	RM	6795.56	6795.8	-0.2	15.6	5.0	10.2	15.2	0.4	2.2	1	24067.9	10336.8
R2-M2	RM	6796.43	6796.4	0.0	16.6	5.0	11.2	16.2	0.4	2.2	1	24017.2	10262.9

Table 1 (continued). MMTS OU III Post-ROD Ground Water Monitoring Well Completion Information

Well	Zone of Completion	Elevation TOC, Ft	Ground Elevation, Ft	Stickup, Ft	Well Depth, Ft BTOC	Screen Length, Ft	Top of Screen, Ft BTOC	Bottom of Screen, Ft BTOC	Sump Length, Ft	Borehole Diameter, In	Well Diameter, In	Easting	Northing
R2-M3	RM	6796.03	6796.1	-0.1	14.9	5.0	9.6	14.6	0.4	2.2	1	24022.6	10271.0
R2-M4	RM	6795.84	6795.8	0.0	14.4	5.0	9.0	14.0	0.4	2.2	1	24028.1	10279.2
R2-M5	RM	6795.71	6795.8	-0.1	14.8	5.0	9.4	14.4	0.4	2.2	1	24033.8	10287.6
R2-M6	RM	6795.71	6795.8	-0.1	14.6	5.0	9.2	14.2	0.4	2.2	1	24044.9	10303.9
R2-M7	RM	6795.80	6795.8	0.0	13.7	5.0	8.3	13.3	0.4	2.2	1	24050.7	10312.3
R2-M8	RM	6795.76	6795.8	0.0	13.0	5.0	7.6	12.6	0.4	2.2	1	24056.4	10320.5
R2-M9	RM	6795.58	6795.7	-0.1	14.9	5.0	9.5	14.5	0.4	2.2	1	24061.9	10328.5
R3-M1	RM	6796.42	6796.4	0.0	16.3	5.0	10.9	15.9	0.4	2.2	1	24017.8	10262.4
R3-M2	RM	6795.80	6795.9	-0.1	14.5	5.0	9.1	14.1	0.4	2.2	1	24028.8	10278.7
R3-M3	RM	6795.76	6795.8	0.0	13.8	5.0	8.4	13.4	0.4	2.2	1	24051.4	10311.8
R3-M4	RM	6795.55	6795.7	-0.1	14.8	5.0	9.4	14.4	0.4	2.2	1	24062.7	10328.2
R4-M1	RM	6796.41	6796.4	0.0	16.7	5.0	11.3	16.3	0.4	2.2	1	24019.8	10260.9
R4-M2	RM	6795.97	6796.0	0.0	14.8	5.0	9.4	14.4	0.4	2.2	1	24025.3	10269.1
R4-M3	RM	6795.76	6795.8	0.0	14.4	5.0	9.0	14.0	0.4	2.2	1	24030.9	10277.4
R4-M4	RM	6795.66	6795.7	0.0	14.7	5.0	9.3	14.3	0.4	2.2	1	24036.4	10285.6
R4-M5	RM	6795.72	6795.8	-0.1	14.4	5.0	9.1	14.1	0.4	2.2	1	24047.7	10302.0
R4-M6	RM	6795.71	6795.8	-0.1	13.8	5.0	8.4	13.4	0.4	2.2	1	24053.4	10310.5
R4-M7	RM	6795.58	6795.7	-0.1	13.1	5.0	7.7	12.7	0.4	2.2	1	24059.1	10318.7
R4-M8	RM	6795.67	6795.7	0.0	14.7	5.0	9.3	14.3	0.4	2.2	1	24064.9	10326.8
R5-M1	RM	6796.84	6796.9	-0.1	15.8	5.0	10.4	15.4	0.4	2.2	1	24015.4	10251.8
R5-M10	RM	6795.63	6795.6	0.0	16.8	5.0	11.4	16.4	0.4	2.2	1	24071.8	10334.2
R5-M2	RM	6796.39	6796.4	0.0	16.4	5.0	11.0	16.0	0.4	2.2	1	24020.7	10260.3
R5-M3	RM	6795.98	6795.9	0.1	14.8	5.0	9.4	14.4	0.4	2.2	1	24026.3	10268.3
R5-M4	RM	6795.76	6795.8	0.0	14.4	5.0	8.9	13.9	0.4	2.2	1	24032.1	10276.6
R5-M5	RM	6795.63	6795.7	-0.1	14.5	5.0	9.1	14.1	0.4	2.2	1	24037.7	10284.8
R5-M6	RM	6795.70	6795.8	-0.1	14.5	5.0	9.1	14.1	0.4	2.2	1	24048.9	10301.3
R5-M7	RM	6795.70	6795.7	0.0	13.5	5.0	8.1	13.1	0.4	2.2	1	24054.7	10309.5
R5-M8	RM	6795.52	6795.7	-0.2	13.1	5.0	7.7	12.7	0.4	2.2	1	24060.4	10317.7
R5-M9	RM	6795.66	6795.7	0.0	15.0	5.0	9.6	14.6	0.4	2.2	1	24066.1	10325.9
R6-M1	QA	6797.41	6797.5	-0.1	15.0	5.0	9.6	14.6	0.4	2.2	1	24006.7	10234.0
R6-M2	QA	6796.18	6796.1	0.1	14.5	5.0	9.1	14.1	0.4	2.2	1	24024.4	10257.5
R6-M3	QA	6795.71	6795.8	-0.1	13.0	5.0	7.6	12.6	0.4	2.2	1	24035.8	10274.0
R6-M4	QA	6795.53	6795.6	-0.1	13.3	5.0	7.9	12.9	0.4	2.2	1	24058.2	10307.0
R6-M5	QA	6795.54	6795.6	-0.1	12.3	5.0	6.9	11.9	0.4	2.2	1	24069.7	10323.6
R6-M6	QA	6797.22	6797.5	-0.3	12.4	5.0	7.1	12.1	0.4	2.2	1	24083.0	10344.0
R7-M1	QA	6796.00	6796.0	0.0	13.8	5.0	8.4	13.4	0.4	2.2	1	24041.0	10246.6
R7-M2	QA	6795.78	6795.8	0.0	13.3	5.0	7.9	12.9	0.4	2.2	1	24037.1	10273.1
R8-M1	QA	6795.60	6795.6	0.0	13.4	5.0	8.0	13.0	0.4	2.2	1	24061.7	10250.7
R9-M1	QA	6795.21	6795.3	-0.1	14.5	5.0	9.1	14.1	0.4	2.2	1	24078.8	10254.3
T00-01	QA	6806.52	6806.6	-0.1	12.2	5.0	7.1	12.1	0.4	2.2	1	23399.5	10522.8
T00-02	QA	6806.77	6804.5	2.3	10.3	5.0	5.1	10.1	0.4	2.2	1	23400.5	10476.5
T00-03	QA	6805.27	6803.3	2.0	9.0	5.0	3.8	8.8	0.4	2.2	1	23400.3	10396.9
T00-04	QA	6804.31	6804.4	-0.1	7.9	5.0	2.6	7.6	0.4	2.2	1	23400.7	10354.0
T00-05	QA	6809.45	6807.5	1.9	12.8	5.0	7.4	12.4	0.4	2.2	1	23400.7	10313.6
T00-06	QA	6820.77	6818.9	1.9	14.6	5.0	9.4	14.4	0.4	2.2	1	23398.6	10246.2
T00-07	QA	6823.09	6821.2	1.9	13.9	5.0	8.7	13.7	0.4	2.2	1	23399.6	10190.1

Table 1 (continued). MMTS OU III Post-ROD Ground Water Monitoring Well Completion Information

Well	Zone of Completion	Elevation TOC, Ft	Ground Elevation, Ft	Stickup, Ft	Well Depth, Ft BTOC	Screen Length, Ft	Top of Screen, Ft BTOC	Bottom of Screen, Ft BTOC	Sump Length, Ft	Borehole Diameter, In	Well Diameter, In	Easting	Northing
T01-01	QA	6806.09	6805.5	0.6	10.9	5.0	5.6	10.6	0.4	2	1	23367.9	10570.6
T01-02	QA	6807.66	6807.2	0.5	12.2	5.0	6.9	11.9	0.4	2	1	23369.8	10621.3
T01-03	QA	6810.65	6810.4	0.3	14.2	5.0	8.9	13.9	0.4	2	1	23369.4	10668.9
T01-04	QA	6814.15	6813.8	0.3	17.3	5.0	12.1	17.1	0.4	2	1	23369.2	10713.3
T01-05	QA	6822.21	6821.7	0.5	24.3	5.0	19.1	24.1	0.4	2	1	23366.6	10807.0
T01-06	QA	6828.41	6828.0	0.4	23.9	5.0	18.6	23.6	0.4	2	1	23356.9	10906.5
T01-07	QA	6823.29	6822.8	0.5	23.0	5.0	17.7	22.7	0.4	2.5	1	23178.8	10877.6
T01-08	QA	6808.11	6807.7	0.4	7.9	4.9	2.6	7.5	0.4	2	1	23161.5	10433.2
T01-09	QA	6832.80	6832.3	0.5	19.4	4.9	14.2	19.1	0.4	2.5	1	22749.0	10999.0
T01-10	QA	6817.45	6816.8	0.6	9.3	4.9	4.2	9.1	0.4	2	1	22773.9	10787.5
T01-12	QA	6844.34	6844.0	0.3	24.0	4.9	18.8	23.7	0.4	2.5	1	22240.7	11125.1
T01-13	QA	6829.67	6829.2	0.4	11.6	4.9	6.5	11.4	0.4	2	1	22225.5	10898.8
T01-18	QA	6860.49	6860.2	0.3	21.8	4.9	16.6	21.5	0.4	2.5	1	21542.9	11145.5
T01-19	QA	6848.64	6848.2	0.5	12.7	4.9	7.5	12.4	0.4	2.5	1	21599.7	11054.4
T01-20	QA	6845.40	6845.0	0.4	16.4	4.9	11.2	16.1	0.4	2	1	21685.8	10825.2
T01-23	QA	6858.89	6858.3	0.6	14.3	4.9	9.0	13.9	0.4	2	1	21180.5	11037.0
T01-24	QA	6858.83	6858.5	0.3	9.7	4.9	4.4	9.3	0.4	2	1	21077.5	10910.1
T01-25	QA	6856.33	6855.9	0.4	14.3	4.9	9.2	14.1	0.4	2	1	21052.8	10723.5
T01-26	QA	6878.24	6877.9	0.4	21.1	4.9	15.9	20.8	0.4	2	1	20479.2	10774.4
T01-27	QA	6864.71	6864.2	0.5	7.1	4.9	2.0	6.8	0.4	2	1	20822.9	10447.8
T01-28	QA	6869.20	6868.8	0.4	5.1	1.6	3.3	4.9	0.4	2	1	20955.3	10442.7
T01-35	QA	6824.26	6823.9	0.4	15.3	5.0	9.9	14.9	0.4	2	1	22805.7	10927.7
T1-D	QA	6795.82	6795.9	-0.1	13.5	5.0	8.1	13.1	0.4	2.2	1	24035.2	10297.8
T1-S	QA	6795.84	6795.8	0.0	10.1	5.0	4.7	9.7	0.4	2.2	1	24036.1	10299.0
T2-D	RM	6795.75	6795.8	-0.1	14.7	5.0	9.3	14.3	0.4	2.2	1	24038.6	10295.6
T2-S	RM	6795.71	6795.8	-0.1	9.7	5.0	4.3	9.3	0.4	2.2	1	24039.5	10296.6
T3-D	RM	6795.73	6795.8	-0.1	14.4	5.0	9.0	14.0	0.4	2.2	1	24039.6	10294.7
T3-S	RM	6795.77	6795.7	0.1	10.3	5.0	4.9	9.9	0.4	2.2	1	24040.5	10295.7
T4-D	RM	6795.73	6795.7	0.0	15.0	5.0	9.6	14.6	0.4	2.2	1	24041.6	10293.4
T4-S	RM	6795.57	6795.8	-0.2	10.3	5.0	4.9	9.9	0.4	2.2	1	24042.5	10294.5
T5-D	RM	6795.71	6795.7	0.0	15.2	5.0	9.8	14.8	0.4	2.2	1	24042.7	10292.6
T5-S	RM	6795.70	6795.7	0.0	10.5	5.0	5.1	10.1	0.4	2.2	1	24043.7	10293.7
T6-D	QA	6795.66	6795.7	0.0	13.5	5.0	8.1	13.1	0.4	2.2	1	24046.6	10290.1
T6-S	QA	6795.64	6795.7	-0.1	10.6	5.0	5.2	10.2	0.4	2.2	1	24047.3	10291.3
T7-D	QA	6795.73	6795.8	-0.1	13.8	5.0	8.4	13.4	0.4	2.2	1	24047.7	10288.8
TW-01	QA	6796.54	6796.9	-0.4	13.4	5.0	8.0	13.0	0.35	4	2	24010.0	10260.1
TW-02	QA	6795.82	6796.2	-0.4	12.3	5.0	6.9	12.0	0.35	4	2	24019.1	10273.1
TW-03	QA	6795.61	6795.9	-0.3	13.0	5.0	7.6	12.7	0.35	4	2	24029.6	10290.4
TW-04	QA	6795.53	6795.8	-0.3	13.3	5.0	8.0	13.0	0.35	4	2	24040.6	10306.4
TW-05	QA	6795.29	6795.7	-0.4	12.4	5.0	7.0	12.0	0.35	4	2	24052.3	10321.8
TW-06	QA	6795.45	6795.8	-0.4	12.4	5.0	7.0	12.0	0.35	4	2	24064.0	10338.6
TW-07	QA	6795.46	6795.8	-0.3	12.1	5.0	6.7	11.8	0.35	4	2	24042.9	10259.9
TW-08	QA	6795.20	6795.6	-0.4	13.1	5.0	7.7	12.8	0.35	4	2	24059.6	10283.3
TW-09	QA/KD	6795.24	6795.6	-0.4	19.2	5.0	13.8	18.8	0.35	4	2	24061.4	10285.9
TW-10	QA	6794.94	6795.3	-0.4	12.3	5.0	6.9	11.9	0.35	4	2	24077.3	10307.8
TW-11	RM	6796.20	6796.3	-0.1	15.0	5.0	7.1	12.1	0.35	2.2	2	24022.5	10265.0

Table 1 (continued). MMTS OU III Post-ROD Ground Water Monitoring Well Completion Information

	Well	Zone of Completion	Elevation TOC, Ft	Ground Elevation, Ft	Stickup, Ft	Well Depth, Ft BTOC	Screen Length, Ft	Top of Screen, Ft BTOC	Bottom of Screen, Ft BTOC	Sump Length, Ft	Borehole Diameter, In	Well Diameter, In	Easting	Northing
	TW-12	RM	6795.68	6795.8	-0.1	14.2	5.0	6.3	11.3	0.35	2.2	2	24033.7	10281.6
	TW-13	RM	6795.61	6795.8	-0.2	13.8	5.0	6.0	11.0	0.35	2.2	2	24050.6	10306.2
	TW-14	RM	6795.50	6795.7	-0.2	12.6	5.0	4.8	9.8	0.35	2.2	2	24058.3	10316.7
*	31SW93-197-2	KB	6912.04	6909.8	2.2	210.1	10.3	197.1	207.4	2.7	8	4	23345.4	9691.6
*	31SW93-197-3	KD	6911.85	6909.3	2.6	161.6	9.7	151.4	161.1	0.45	8	4	23351.9	9713.9
*	31SW93-197-4	KM	6911.41	6909.0	2.4	71.4	10.0	61.3	71.3	0.15	8	2	23368.4	9671.3
*	31SW93-197-5	KM	6909.24	6906.7	2.5	46.8	10.1	36.4	46.5	0.3	8	2	23395.3	9731.8
*	31SW93-200-1	KB	6883.88	** no data	approx 2.5	158.2	10.0	145.4	155.4	2.85	8	4	20865.4	10218.9
*	31SW93-200-2	KD	6883.38	** no data	approx 2.5	110.5	10.0	100.1	110.1	0.4	8	4	20881.2	10243.3
*	31SW93-200-3	KM/KD	6883.99	** no data	approx 2.5	23.9	10.0	13.6	23.6	0.35	8	2	20855.2	10234.9
*	31SW93-200-4	KM	6883.19	** no data	approx 2.5	12.5	9.1	2.2	11.3	1.15	8	2	20889.5	10228.3
*	82-07	QA	6785.70	6784.5	1.2	14.2	3.0	10.7	13.7	0.5	no data	2	24669.3	10006.0
*	82-20	QA	6889.70	6888.0	1.7	22.7	4.0	17.1	21.1	1.6	no data	2	20418.6	10089.6
*	92-01 ***	QA	6981.51	6979.3	2.2	26.5	2.5	23.6	26.1	0.35	8	2	16615.2	9169.0
*	92-02 ***	KB	6985.38	6982.9	2.5	218.5	30.0	187.9	217.9	0.6	8	4	16596.2	9156.2
*	92-03 ***	QA	6965.96	6963.2	2.8	15.5	2.5	12.7	15.2	0.35	8	2	17873.7	10437.7
*	92-04 ***	KB	6965.01	6962.3	2.7	207.7	30.0	177.1	207.1	0.6	8	4	17891.9	10440.7
*	92-05	QA	6894.78	6891.9	2.9	19.7	4.9	14.4	19.3	0.43	8	2	19863.1	9818.8
*	92-06	KB	6894.95	6892.6	2.3	162.3	30.0	131.8	161.8	0.6	8	4	19859.8	9847.7
*	92-13	KD	6894.71	6892.3	2.4	116.7	10.0	106.1	116.1	0.6	8	4	19864.8	9853.2
*	MW00-04	QA	6807.15	6804.8	2.3	11.0	5.0	5.6	10.7	0.35	4	2	23397.2	10341.5
*	MW00-08	QA	6809.06	6806.5	2.6	15.2	5.0	9.8	14.8	0.35	4	2	23398.7	10520.0
*	P92-01	QA	6748.56	6746.1	2.5	14.0	2.5	11.2	13.7	0.3	8	2	27438.7	8900.9
*	P92-03	QA	6739.49	6737.4	2.1	15.3	2.5	12.5	15.0	0.35	8	2	27116.4	9559.2
*	P92-04	QA	6815.90	6813.6	2.3	24.9	2.5	22.1	24.6	0.33	8	2	25380.5	10617.3
*	P92-05	QA	6789.38	6787.0	2.4	9.6	2.5	6.8	9.3	0.35	8	2	25382.0	10112.4
*	P92-07	QA	6817.08	6817.2	-0.1	13.7	2.6	10.9	13.5	0.26	8	2	24654.5	10616.8
*	P92-09	QA	6835.19	6835.3	-0.1	15.2	2.5	12.5	15.0	0.23	8	2	23691.6	10924.5
*	T00-08	QA	6913.96	6910.0	4.0	10.5	5.0	5.2	10.2	0.4	2.2	1	19845.9	10359.7
*	T00-09	QA	6906.08	6901.4	4.7	27.7	5.0	22.4	27.4	0.4	2.2	1	19894.7	10319.1
*	T00-10	QA	6900.97	6897.1	3.9	25.1	5.0	19.9	24.9	0.4	2.2	1	19934.4	10279.4
*	T00-11	QA	6894.21	6891.3	3.0	23.0	5.0	17.7	22.7	0.4	2.2	1	19980.2	10242.3
*	T00-12	QA	6890.94	6886.9	4.0	21.2	5.0	15.9	20.9	0.4	2.2	1	20026.9	10196.5
*	T00-13	QA	6886.74	6884.4	2.3	16.8	5.0	11.6	16.6	0.4	2.2	1	20070.8	10157.7
*	T00-14	QA	6885.79	6883.7	2.1	11.9	4.8	6.9	11.7	0.4	2.2	1	20109.1	10115.7
*	T00-15	QA	6884.44	6881.5	2.9	13.2	5.0	7.9	12.9	0.4	2.2	1	20154.4	10069.1
*	T01-11	QA	6839.50	6839.1	0.4	8.0	2.5	5.3	7.8	0.4	2	1	22751.1	10309.7
*	T01-15	QA	6870.60	6870.1	0.6	13.3	4.9	8.2	13.1	0.4	2	1	22196.0	10171.8
*	T01-16	QA	6867.04	6866.6	0.4	16.1	4.9	11.0	15.9	0.4	2	1	22423.7	10165.7
*	T01-17	QA	6855.14	6854.8	0.4	11.4	4.9	6.1	11.0	0.4	2	1	22749.7	10106.4
*	T01-22	QA	6868.90	6868.5	0.4	8.3	2.5	5.6	8.1	0.4	2	1	21754.9	10305.9
*	T99-03	QA	6820.52	6818.1	2.4	25.3	5.0	19.9	24.9	0.4	2.2	1	24484.9	9597.8
*	T99-05	QA	6713.06	6711.1	1.9	13.2	5.0	7.8	12.8	0.4	2.2	1	28506.8	8838.3
*	T99-06	QA	6732.88	6731.8	1.1	10.3	5.0	4.9	9.9	0.4	2.2	1	27448.1	9173.9
*	T99-07	QA	6741.92	6739.5	2.4	12.9	5.0	7.5	12.5	0.4	2.2	1	27444.3	9039.0
*	T99-10	QA	6745.66	6742.9	2.8	10.3	5.0	4.9	9.9	0.4	2.2	1	27441.6	9660.0

Table 1 (continued). MMTS OU III Post-ROD Ground Water Monitoring Well Completion Information

TOC = top of casing
BTOC = below top of casing
PM = reactive media; well is completed in the permeable reactive barrier
QA = Quaternary alluvium; well is completed in the alluvial aquifer
KM = Mancos shale formation
KD = Dakota formation
KB = Burro Canyon formation
* Well is not currently monitored and is tentatively identified for abandonment in yr 2005
** Ground surface and TOC lowered approx 14 ft during restoration; TOC elev re-surveyed, new ground surface not re-surveyed. All depths corrected to new TOC.
*** Ground surface and TOC altered during construction of golf course and not re-surveyed. Posted values correspond to original installations. Actual ground and TOC elevations may vary +/- several feet.

No data for new wells 200, 0201, and 0202; installation scheduled for August 2004.

End of current text