GJO-99-104-TAR
GJO-MSG-2.2.5

Monticello Mill Tailings Site Operable Unit III

Interim Remedial Action Annual Status Report

August 1999

U.S. Department of Energy

GRAND JUNCTION OFFICE

Work Performed Under DOE Contract No. DE-AC13-96GJ87335 for the U.S. Department of Energy
Approved for public release; distribution is unlimited.

This page intentionally left blank

Monticello Mill Tailings Site
Operable Unit III

Interim Remedial Action Annual Status Report

August 1999

Prepared for
U.S. Department of Energy
Albuquerque Operations Office
Grand Junction Office

Project Number MSG-035-0011-00-000
Document Number Q0017700

Work Performed Under DOE Contract Number DE-AC13-96GJ87335
Task Order Number MAC99-03

This page intentionally blank

Contents

Page

ACRONYMS V

1.0 INTRODUCTION 1-1

2.0 INSTITUTIONAL CONTROLS 2-1

3.0 MILLSITE DEWATERING AND TREATMENT 3-1

4.0 MONITORING AND ADDITIONAL DATA COLLECTION 4-1

4.1 Surface Water and Ground Water Monitoring 4-1
4.2 Data Collection 4-2
4.2.1 Vadose Zone Data Collection 4-2
4.2.2 Surface Water and Ground Water Data Collection 4-12

5.0 PERT WALL TREATABILITY STUDY 5-1

5.1 Treatability Studies 5-1
5.2 Site Characterization 5-1
5.3 Design 5-2
5.4 Installation 5-2

6.0 REFERENCES 6-1

Tables

Table 4.2.1–1. Subsurface Sampling Locations for Metals Characterization 4-7
Table 4.2.2–1. Millsite Temporary Wells 4-12
Table 4.2.2–2. Monticello Interim Remedial Action Temporary Well Data Summary 4-15

Figures

Figure 1–1. Monticello Mill Tailings Site, San Juan County, Utah 1-2
Figure 4.1–1. Ground-Water and Surface-Water Monitoring Network—West 4-3
Figure 4.1–2. Ground-Water and Surface-Water Monitoring Network—East 4-5
Figure 4.2.1–1. Uranium Desorption From RVZ Soil (Synthetic Irrigation Water Scenario) 4-8
Figure 4.2.1–2. Arsenic Desorption From RVZ Soil (Synthetic Irrigation Water Scenario) 4-9
Figure 4.2.1–3. Vanadium Desorption From RVZ Soil (Synthetic Irrigation Water Scenario) 4-10
Figure 4.2.1–4. Uranium Desorption From RVZ Soil (Comparison of Rising Water Table and Synthetic Irrigation Water Scenario) 4-11
Figure 4.2.2–1. OU III Interim Remedial Action Borehole and Temporary Wells 4-13
Figure 5.3–1. PeRT Wall "As Built" Location Map 5-33

Appendices

Appendix A Ground-Water Management Policy for the Monticello Mill Tailings Site and Adjacent Areas

Appendix B Draft Example of a Surface-Water Analytical Data

Acronyms

DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
FS	feasibility study
IRA	Interim Remedial Action
Kd	distribution coefficient
mL/g	milliliters per gram
MMTS	Monticello Mill Tailings Site
OU	operable unit
PeRT	permeable reactive treatment
RA	remedial action
RD	remedial design
RI	remedial investigation
ROD	Record of Decision
UDEQ	Utah State Department of Environmental Quality
WWTP	Wastewater Treatment Plant
ZVI	zero valent iron

This page intentionally blank

1.0 Introduction

In September 1998, the Record of Decision for an Interim Remedial Action at the Monticello Mill Tailings Site, Operable Unit III – Surface Water and Ground Water, Monticello, Utah, (DOE 1998a) was signed by the U. S. Environmental Protection Agency (EPA) and the Utah Department of Environmental Quality (UDEQ). The Monticello Mill Tailings Site (MMTS) is located in southeast Utah, in and near the city of Monticello in San Juan County (Figure 1–1). Operable Unit (OU) III encompasses contaminated ground water and surface water at and downgradient of the former Monticello Millsite. The Millsite is a 110-acre tract of land owned by the U.S. Department of Energy (DOE). Mill tailings and associated contaminated material remained on the Millsite as a result of historical vanadium and uranium milling operations; these materials were the primary source of contamination in ground water and surface water. Pursuant to the Record of Decision (ROD) (DOE 1990) for the MMTS, contaminated materials from OU I (the Millsite) and OU II (peripheral properties) are currently being excavated and placed in an on-site repository designed for their permanent storage. The ROD for MMTS also stipulated that a ROD for OU III would be produced when sufficient data were gathered through a focused remedial investigation/feasibility study (RI/FS).

Previously, OU III also encompassed contaminated soil and sediment deposited downstream of the Millsite in and adjacent to Montezuma Creek. However, during the spring of 1999 subsequent to remediation of the contaminated properties, a decision was made to address the remedy selection for the OU III soil and sediment area along Montezuma Creek under OU II (peripheral properties) of the MMTS.

The RI for OU III began with site characterization activities in the fall of 1992; data collection for the purposes of completing the RI report (DOE 1998b) and preparing a draft FS report (DOE 1998c) continued through June 1996. During review of the draft FS report in the summer of 1997, DOE, EPA, and UDEQ mutually agreed that it was not possible at that time to definitively predict the effects that Millsite remediation would have on the ground water and surface water systems. A decision was made to conduct an interim remedial action (IRA) and revise the draft FS after post-Millsite remediation conditions in ground water and surface water had stabilized. The draft final FS is scheduled to be submitted to EPA and UDEQ in May 2004.

The IRA was designed to

- prevent the use of contaminated ground water by implementing institutional controls,
- remove contaminants from the ground water and, in turn, the surface water, by treating extracted ground water through dewatering activities,
- continue to monitor the changing conditions in the alluvial aquifer and in surface water and collect data to characterize post-remediation conditions at the site, and
- evaluate the feasibility of a Permeable Reactive Treatment (PeRT) wall for in-situ treatment by conducting a pilot-scale treatability study.

The *Monticello Mill Tailings Site, Operable Unit III, Interim Remedial Design/Remedial Action (RD/RA) Work Plan for Operable Unit III – Surface Water and Ground Water* (DOE 1999a) was prepared to give an overview of the management, work elements or tasks, and schedules for completion of the IRA. A draft *Monticello Mill Tailings Site, Operable Unit III, Interim*

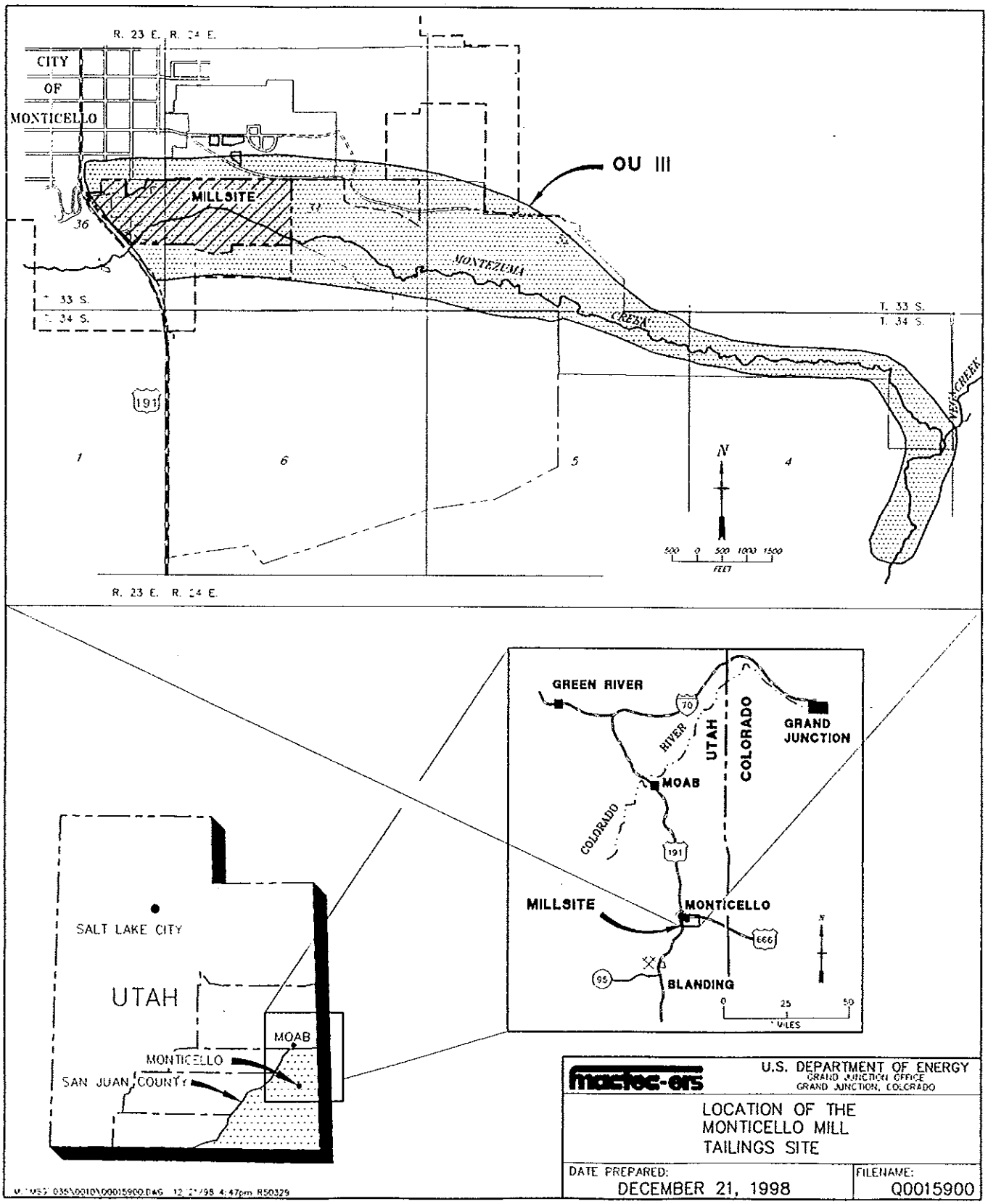


Figure 1–1. Monticello Mill Tailings Site, San Juan County, Utah

Remedial Action Work Plan (DOE 1999b) was prepared to identify the data collection and PeRT wall treatability study activities that will be undertaken as part of the IRA. A decision was made in August 1999 to revise the IRA Work Plan to 1) include information from the RD/RA Work Plan; 2) expand the activities discussed to include all activities necessary to get to the final ROD; and 3) include a commitment to perform an annual analysis of the applicable or relevant and appropriate requirements (ARARs).

This status report has been prepared to summarize the progress made in performing the four IRA activities outlined in the previous paragraph through June 1999 and since the signing of the ROD for the IRA in September 1998. Status reports will be prepared annually; the report prepared in August 2000 will also summarize any progress made in other activities necessary to get to the final ROD and an update to the ARARs analysis presented in the RI (DOE 1998b).

This page intentionally blank

2.0 Institutional Controls

The Utah State Engineer's Office informally approved DOE's request for institutional controls for the shallow alluvial aquifer on October 21, 1998. At that time the State Engineer's office assumed responsibility for preparation of a ground-water management policy, for fulfilling the public participation requirements associated with the implementation of institutional controls, and for implementing the institutional controls. On March 18, 1999, the State Engineer issued notice of a public meeting regarding the proposal to prohibit drilling of shallow alluvial wells in the contaminated areas along Montezuma Creek. Property owners that would be affected by the institutional control received personal invitations to the meeting. The meeting was held on April 7, 1999 at the San Juan County Courthouse and a draft ground-water management policy was made available. Only one person (an affected property owner) attended the meeting. The property owner questioned whether his potential use of a well completed in the deeper Burro Canyon aquifer would be affected by the institutional control. The property owner was told that because the Burro Canyon aquifer has not been contaminated by the overlying shallow aquifer, his use of the well would not be affected by the institutional control.

The State Engineer's office did not receive comments during the 30-day public comment period. At the close of the public comment period the Ground-Water Management Policy for the Monticello Mill Tailings Site and Adjacent Areas (a copy is provided in Appendix A) was issued and 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. Also, change applications proposing to divert and use water from the shallow aquifer for domestic purposes will not be approved. 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. A map of the Monticello Ground-Water Restricted Area was attached to the Ground-Water Management Policy.

The State Engineer's office conducted a search of their database for existing water rights appropriating water for domestic use. Only one such water right, Water Right 09–0130, exists within the Monticello Ground-Water Restricted Area. The water right is to 0.01 cubic foot per second of flow from a surface diversion of an unnamed spring. A field visit to the location of the water right was made on April 7, 1999. Water appears to have been taken from a very shallow well or pumped from a sump to supply what is now an abandoned, dilapidated house nearby. The property owner was contacted about relinquishing the existing water right or agreeing not to exercise the water right until it is determined that the risk to human health is acceptable; negotiations between DOE and the property owner are currently under way.

DOE accepts responsibility for ensuring that the institutional controls are working. DOE will conduct annual inspections of the properties to look for any evidence of well installations or ground water use. The first inspection will occur during October 1999. The results of this inspection will be reported in the next annual IRA status report.

This page intentionally blank

3.0 Millsite Dewatering and Treatment

Ground water removal at the Millsite was initiated during March 1998 with construction of a dewatering trench along the western side of the Carbonate Pile. Up to 100 gallons per minute entered the trench and flowed to Pond 3. In May 1998, an "L" shaped trench was constructed along the west and south sides of the Carbonate Pile. Water was pumped from this trench to allow remediation of the Carbonate Pile. On occasion, dewatering was halted due to insufficient capacity at Pond 3. As excavation in the East Pile progressed, very little ground water was encountered. Pumping in the Carbonate Pile area contributed to the dry conditions in the East Pile.

Some of the water recovered was used for dust control; the rest was treated at the waste water treatment plant (WWTP) before discharge to Montezuma Creek or use for dust control. Prior to 1998, approximately 4 million gallons of water were treated at the site. In March 1998, a reverse osmosis system was added to the treatment process. The WWTP operated from April 1998 through winter. In May 1999, the WWTP was dismantled. Since April 1998, the plant processed over 50 million gallons.

Data on the volumes and concentrations of water removed from the subsurface has been recorded and is currently being processed for the purpose of estimating the reduction in mass of contaminants from the alluvial system. The calculations will be finalized after use of contaminated water for dust suppression is discontinued. An estimate of the mass of contaminants removed during Millsite remediation and the calculations and assumptions used for the estimation will be presented in the next annual IRA status report.

This page intentionally blank

4.0 Monitoring and Additional Data Collection

The monitoring and additional data collection component of the IRA consists of two primary tasks: surface-water and ground-water monitoring and characterization of post-Millsite remediation conditions.

4.1 Surface Water and Ground Water Monitoring

Quarterly surface water and ground water monitoring is ongoing at the site. Monitoring in October 1998 was according to the *Monticello Mill Tailings Site, Operable Unit III, Annual Monitoring Program* (DOE 1997a). Monitoring in 1999 was according to the *Monticello Mill Tailings Site, Operable Unit III, Interim Remedial Action, Surface Water and Ground Water Monitoring Plan* (DOE 1999c).

Water quality samples were collected from specified locations according to a variable schedule (Figures 4.1–1 and 4.1–2). Because during the fall, Montezuma Creek exhibits base flow conditions, water levels in the alluvial system are generally the lowest, and contaminant levels are generally the highest in both surface water and ground water, the October sampling round was designed to be the most extensive. During October 1998, 27 ground water samples and 6 surface water samples were collected. Water levels were measured at all existing wells and stream flow discharge was measured at all surface water locations sampled.

During January 1999, 10 ground water samples and 6 surface water samples were collected. Water levels were measured at all existing wells; stream flow discharge measurements were not made. Three of the six surface water sampling locations were new locations on the Millsite; these locations were selected after considering previous source areas and observing field conditions.

Five temporary wells were installed on the Millsite and sampled during February 1999. These wells will be sampled quarterly during 1999 and the sampling results will be used to determine if permanent well installations are warranted in those areas. Installation of these wells is further discussed in Section 4.2.2.

The April sampling event was designed to compliment the October sampling event. 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. Data from the April sampling event is expected to show the low end of the range of concentrations at each location. During April 1999, 20 ground water samples and 11 surface water samples were collected. One of the surface water sampling locations (SW99–04) was a new sampling location and was selected downstream of where significant soil and sediment remediation was performed during 1998. Water levels were measured at all existing wells and stream flow discharge was measured at all surface water locations sampled.

The *Monticello Mill Tailings Site, Operable Unit III, Data Summary Report, October 1996 – April 1998* (DOE 1998d) was prepared in November 1998 to summarize data that had been collected since preparation of the RI (DOE 1998b). The report contains analytical data tables, plume maps and time concentration plots for key contaminants, and water level and discharge data. The Data Summary Report will be updated in November 1999 to report data collected from

October 1998 through July 1999. Analytical data tables will be reformatted in the November 1999 data report to make them more readable. A draft example of a reformatted surface-water data table is provided in Appendix B.

4.2 Data Collection

Activities were undertaken, per the *Monticello Mill Tailings Site, Operable Unit III, Interim Remedial Action Work Plan* (DOE 1999b) to characterize post Millsite remediation conditions in the vadose zone and in the surface water and ground water systems. Progress was made in Tasks 1 and 2 of the vadose zone data collection.

4.2.1 Vadose Zone Data Collection

Task 1 of vadose zone data collection is to characterize the distribution of metals in the vadose zone soil. Surface soil samples have been collected in accordance with the OU I verification plan (DOE 1997b). Of the 330 planned sample locations, 282 samples have been collected as of August 27, 1999. Subsurface sample collection has occurred at the locations specified in the IRA Work Plan and show in Table 4.2.1–1. Soil samples were submitted to the Grand Junction Office Analytical Chemistry Laboratory for analysis of the OU III contaminant of concern metals and radionuclides. Surface and subsurface sample collection to characterize the distribution of metals in the vadose zone is expected to be completed during fall 1999.

Task 2 of vadose zone data collection is to evaluate contaminant mobility in the vadose zone by performing column tests. Six column tests of the 10 planned tests have been completed using six different sub-pile vadose soil samples. A synthetic fluid was used in the tests to simulate contaminant leaching under ambient conditions following Millsite remediation (baseline desorption tests). Contaminant concentrations in the soil samples spanned the observed range for soil that will remain on the site. A minimum of 10 and a maximum of 28 pore volumes were passed through the columns (approximately 90 and 260 hour duration, respectively). The flow rate through the columns was about 0.8 milliliters per minute, resulting in a residence time of about 10 hours per pore volume. Under these conditions, 10 pore volumes are estimated to be equivalent to 100 years of sub-pile leaching at the site.

One effluent sample per pore volume was collected and analyzed for arsenic and vanadium. Uranium concentrations were analyzed more frequently. The desorption profiles from the column tests are displayed in Figures 4.2.1–1 through 4.2.1–3. Fluid flow was discontinued toward the end of 3 tests and then resumed after 96 hours (2 tests) and 48 hours (third test) to evaluate if desorption is rapid and reversible. The results indicated that desorption is rapid and reversible. At the end of each test, a solution of sodium bromide (1,000 milligrams per liter) was substituted and bromide breakthrough was then monitored. The bromide results are used to estimate dispersivity in the column.

and flow velocity

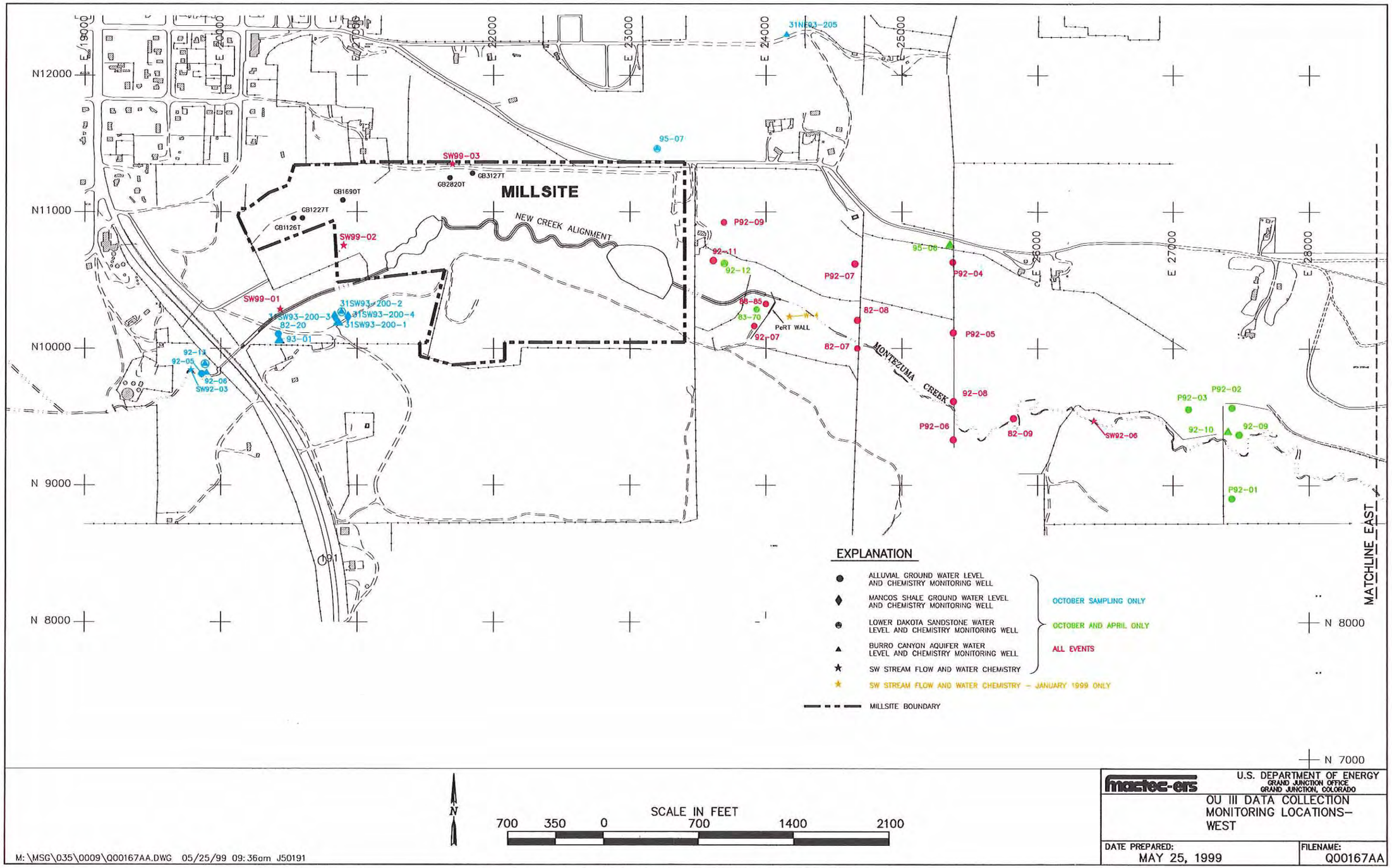


Figure 4.1–1. Ground-Water and Surface-Water Monitoring Network—West

This page intentionally left blank

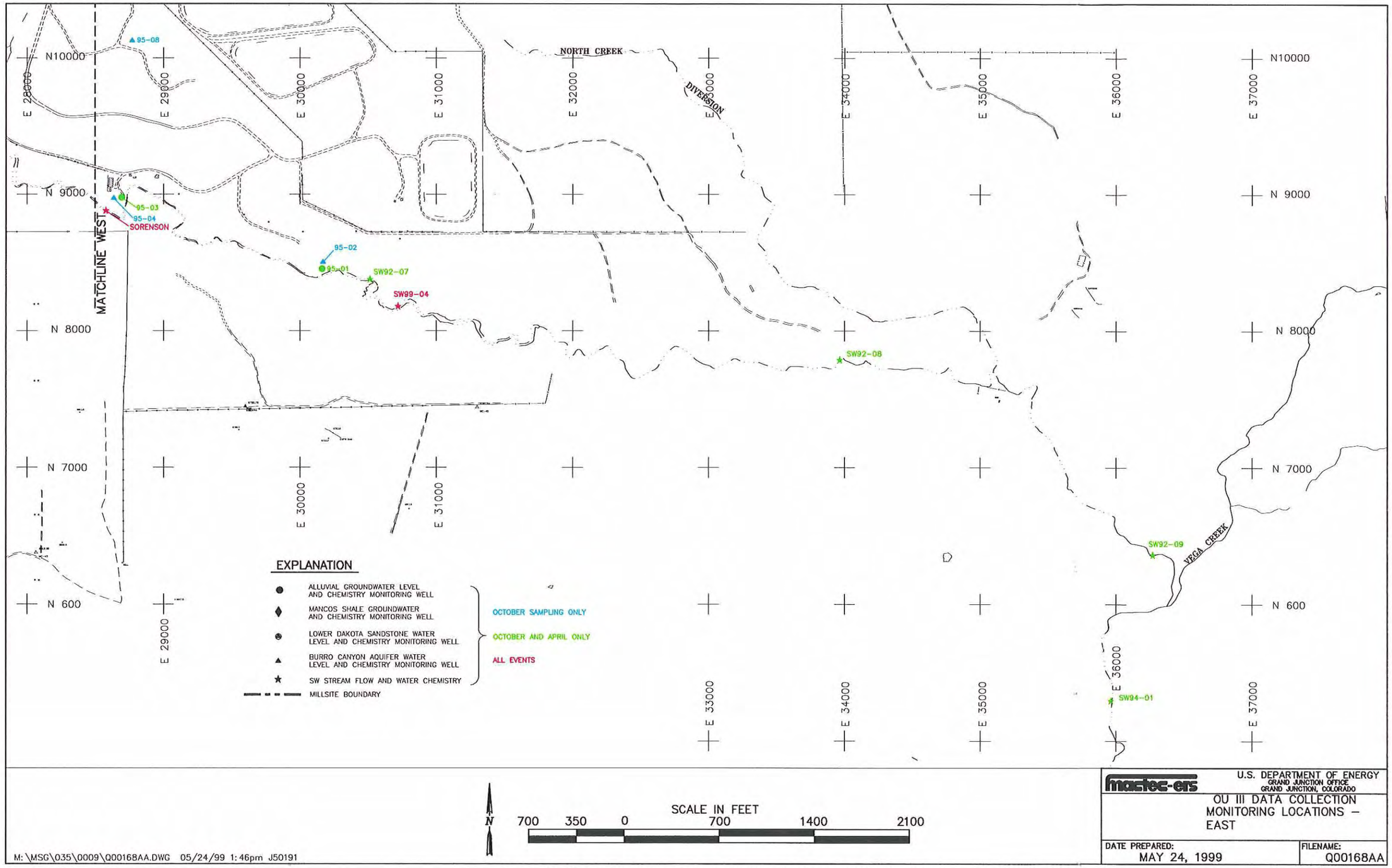


Figure 4.1–2. Ground-Water and Surface-Water Monitoring Network—East

This page intentionally left blank

Table 4.2.1–1. Subsurface Sampling Locations for Metals Characterization

Grid	Sample Collected as of 06/30/99		Former Pile Area	Grid	Sample Collected as of 06/30/99		Former Pile Area	Grid	Sample Collected as of 06/30/99		Former Pile Area
	Yes	No			Yes	No			Yes	No	
Grid Blocks Designated for 2-3 ft Depth Samples											
1223	X		Off-Pile	3291		X	Acid	4220		X	East
1447	X		Carbonate	3309		X	East	4458	X		East
1845	X		Carbonate	3417	X		Vanadium	4466	X		East
2037	X		Carbonate	3584		X	Acid	4719		X	Off-Pile
2067	X		Carbonate	3588		X	Acid	4847	X		East
2337		X	Carbonate	3710		X	East	4851		X	East
2799	X		Vanadium	3636		X	East	5056		X	East
2805		X	Vanadium	3947		X	East	5058		X	East
2951		X	Acid	3964		X	Off-Pile	5193	X		East
2994		X	Acid	3668		X	Off-Pile	5359		X	East
3069		X	Acid	4062		X	Off-Pile	5317		X	East
3084		X	Acid	4122		X	East	5400	X		East
3146	X		Vanadium	4148	X		East	5507	X		Off-Pile
3197		X	Acid								
Grid Blocks Designated for 2-3, 4-5, and 6-7 ft Depth Samples											
1514		X	Carbonate	2919	X		Vanadium	3441		X	East
1668		X	Carbonate	3022	X		Vanadium	3653		X	Acid
1853		X	Carbonate	3051	X		Vanadium	3923	X		Off-Pile
1880		X	Carbonate	3104		X	Acid	4644		X	East
1975	X		Carbonate	3238	X		Vanadium	4359	X		East
2041		X	Carbonate	3254		X	Acid	4775		X	East
2153	X		Carbonate	3287		X	Acid	4384		X	Off-Pile
2409		X	Carbonate	3339	X		Vanadium	4951		X	East
2618	X		Vanadium	3395		X	Acid	5262		X	East
2627		X	Carbonate								

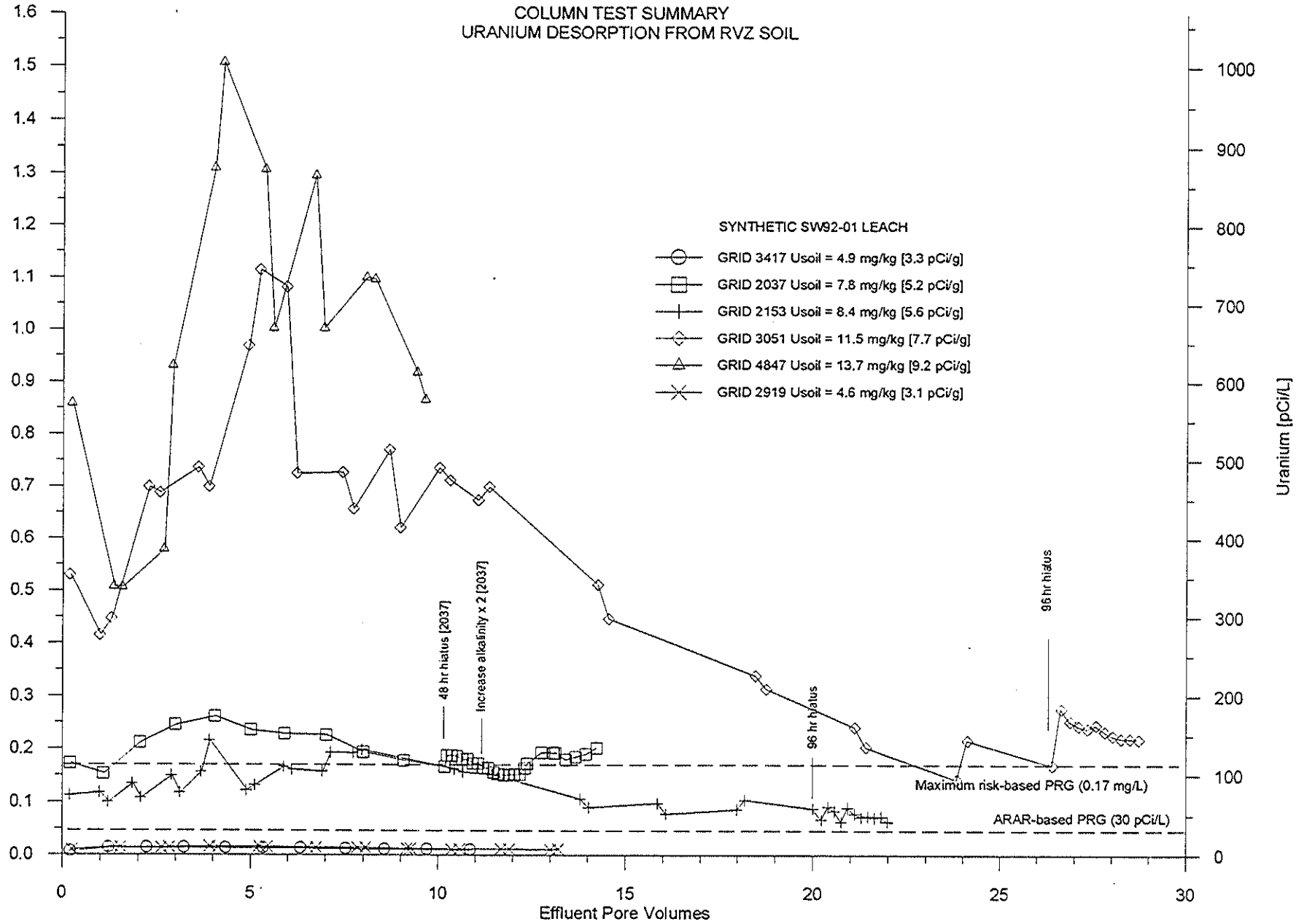


Figure 4.2.1–1. Uranium Desorption From RVZ Soil (Synthetic Irrigation Water Scenario)

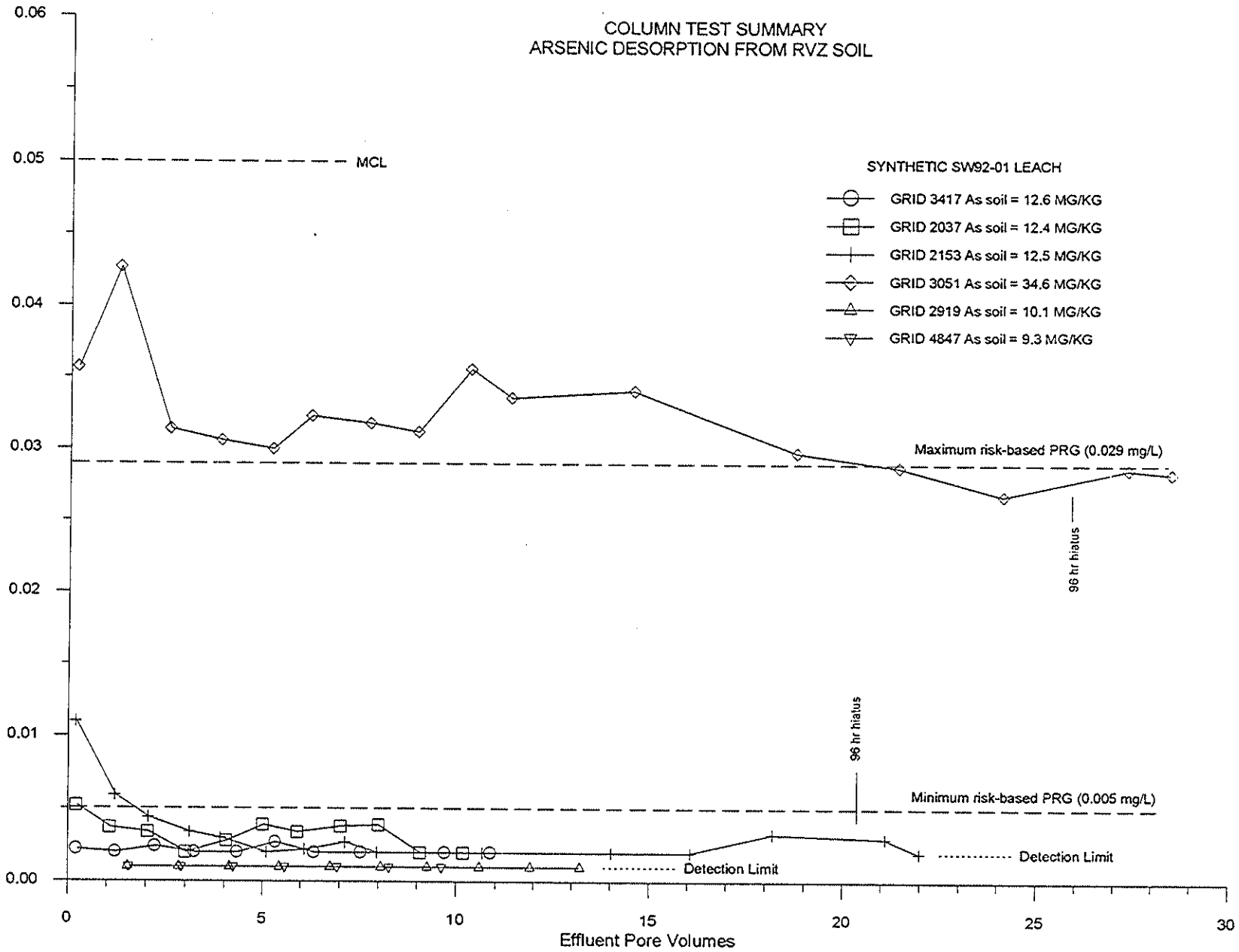


Figure 4.2.1–2. Arsenic Desorption From RVZ Soil (Synthetic Irrigation Water Scenario)

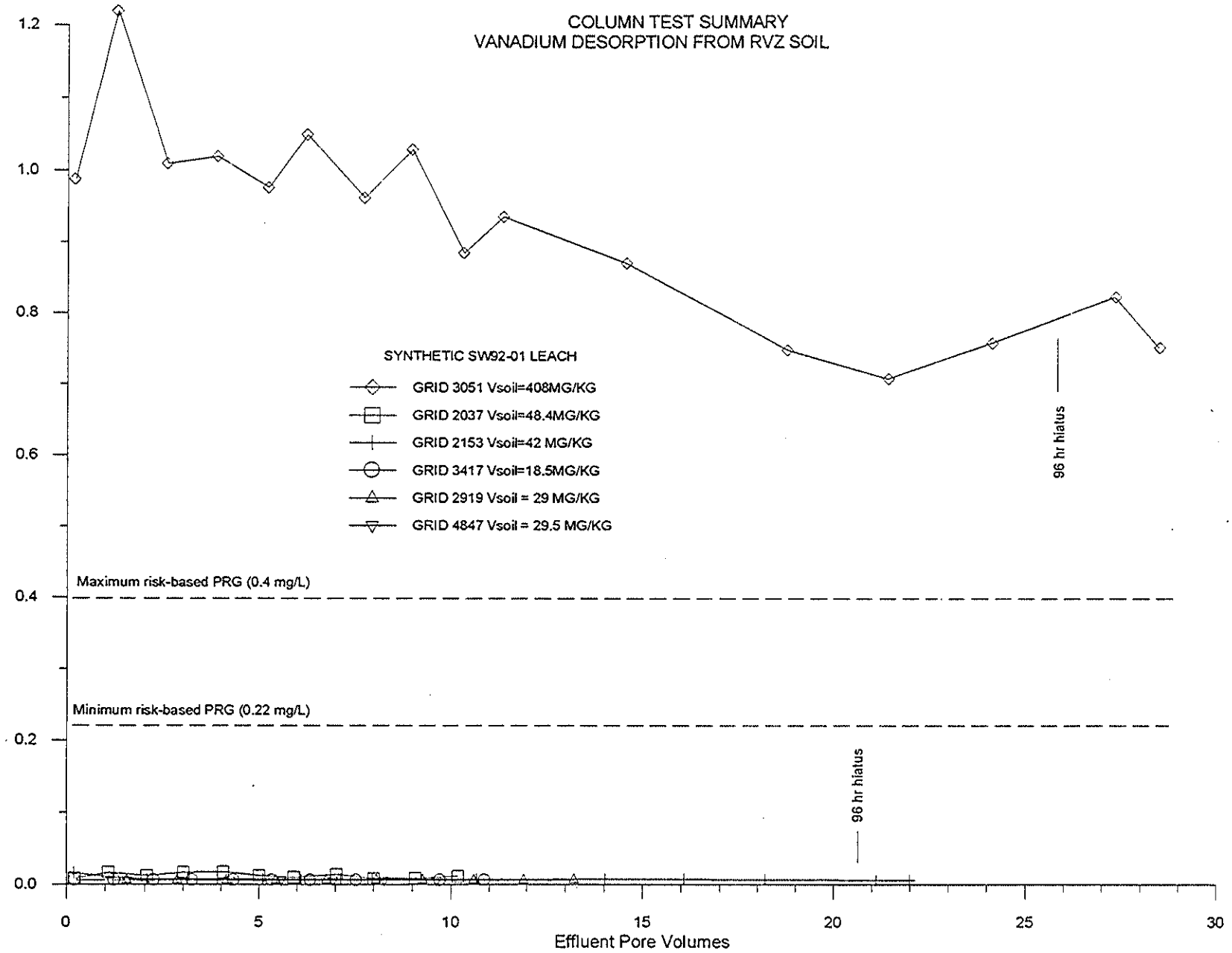


Figure 4.2.1–3. Vanadium Desorption From RVZ Soil (Synthetic Irrigation Water Scenario)

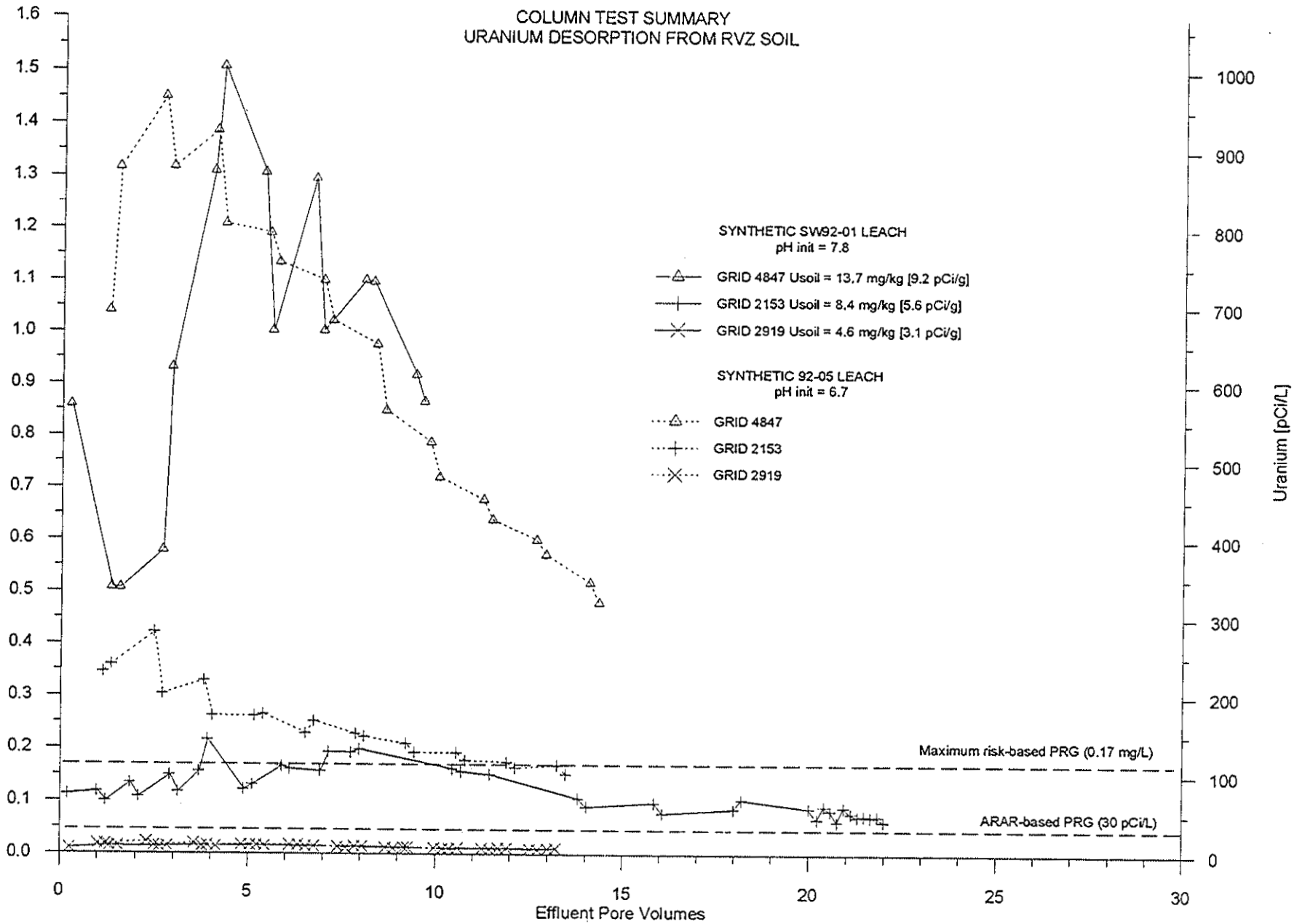


Figure 4.2.1–4. Uranium Desorption From RVZ Soil (Comparison of Rising Water Table and Synthetic Irrigation Water Scenario)

Preliminary calculations using the retardation equation results in Kd values for uranium of about 6 to 6.5 milliliters per gram (mL/g). A numerical model was used to simulate the uranium desorption profile for one column test (sample 3051). The best fits to the observed data resulted with Kd values of between 6 and 7 mL/g.

Three column tests of the six tests planned were completed for the RVZ rising water table scenario described in the IRA Work Plan. The uranium desorption results for these tests (mildly acidic test fluid) are very similar to the baseline tests (basic test fluid) for the respective soil samples (Figure 4.2.1–4). Arsenic and vanadium results are pending. Three tests are currently being set up using a dilute solution of lawn fertilizer to evaluate the RVZ golf course scenario.

4.2.2 Surface Water and Ground Water Data Collection

Surface water and ground water data collection activities during the past year include installing temporary monitoring wells for short-term monitoring on the Millsite and east of the PeRT wall and selecting new locations for surface water sampling.

During the week of February 1, 1999, the Geoprobe rig was used to drill six boreholes and install five temporary wells in the northwestern and central northern areas of the Millsite. Three of the locations (borehole GB1033 and wells GB1126T, and GB1227T) were selected in the general vicinity of the former well 36SE93–201–2 which during RI monitoring contained some of the highest concentrations of contaminants measured in the ground water at the Millsite. Two of the well locations (wells GB2820T, and GB3127T) were selected in an area downgradient of the drainage on Property MP–00845 north of the Millsite where some areas of significant contamination were found during remediation. The fifth well (GB1690T) was located between those two sets of locations as shown in Figure 4.2.2–1.

At borehole GB1033, the Geoprobe drilled to 39 ft without encountering bedrock or ground water. Drilling was terminated because there was not additional drill rod available to go further. Bedrock depths for the temporary wells and whether or not the boreholes contained water at the time of drilling are shown in Table 4.2.2–1.

Table 4.2.2–1. Millsite Temporary Wells

Well Identification	Depth to bedrock	Water present at drilling
GB1126T	32.5 ft	yes
GB1227T	12.3 ft	no
GB1690T	19 ft	yes
GB2820T	22.2 ft	yes
GB3127T	7 ft	no

During the week of June 21, 1999, subsurface conditions were investigated using a Geoprobe rig at 10 locations in the Montezuma Creek valley east of the PeRT wall. A temporary monitoring well was installed at seven of the locations. The borings were completed along three north-south transects, primarily on the south side of Montezuma Creek, in alignment with other OU III monitoring wells (Figure 4.2.2–1). Soil samples were collected and examined in the field for lithology and water content. Saturated alluvium was encountered at 4 locations, the remaining holes, including the upper bedrock, were dry. Borehole, well completion, and water level information is summarized in Table 4.2.2–2. Ground water sample collection at the temporary

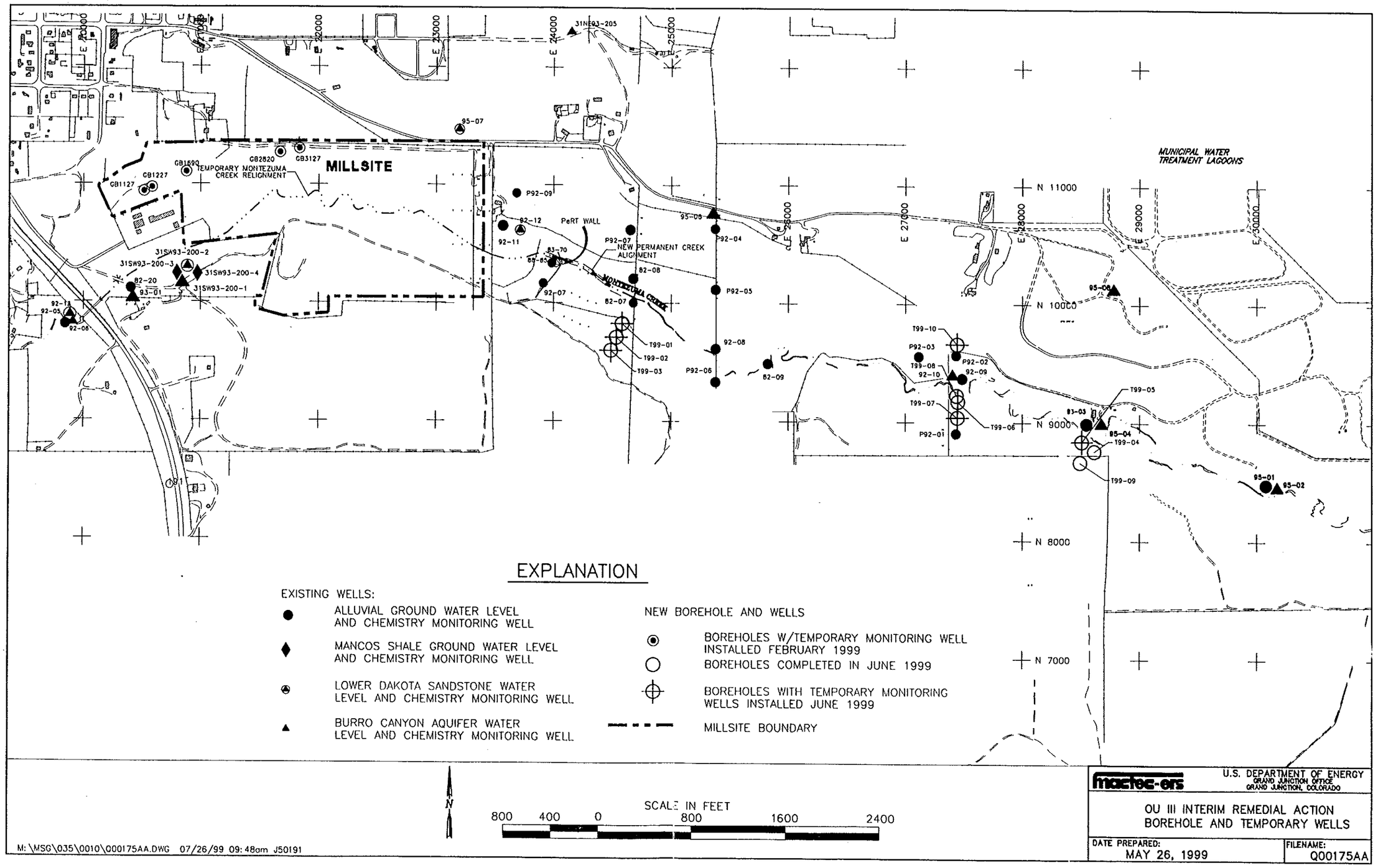


Figure 4.2.2–1. OU III Interim Remedial Action Borehole and Temporary Wells

This page intentionally left blank

Table 4.2.2–2. Monticello Interim Remedial Action Temporary Well Data Summary

Location	Northing	Easting	Elev Ground Surface [ft]	Elev Top of PVC [ft]	Stickup [ft]	Depth Drilled [ft]	Bottom of Screen [ft bgs]	Depth to Bedrock [ft bgs]	Elev Bedrock [ft]	Depth to Water [ft btoc]	Elev Water [ft]	Saturated Thickness [ft]
T99-01	9824.8	24580.0	6794.90	6796.18	1.28	30	28.8	29	6765.9	27.71	6768.47	2.6
T99-02	9708.6	24530.3	6807.32	6810.85	3.53	31.8	31.6	31	6776.3	DRY	NA	0.0
T99-03	9597.8	24484.9	6818.08	6820.52	2.44	24.5	22.8	22.25	6795.8	21.33	6799.19	3.4
T99-04	8757.4	28615.2	6713.82	NA	NA	13	NA	[13]	[6700.8]	[DRY]	NA	0.0
T99-05	8838.3	28506.8	6711.13	6713.06	1.93	11.5	11	10.7	6700.4	11.51	6701.55	1.1
T99-06	9173.9	27448.1	6731.77	6732.88	1.11	10.5	8.4	8.7	6723.1	DRY	NA	0.0
T99-07	9039.0	27444.3	6739.48	6741.92	2.44	10.5	10.2	10.25	6729.2	DRY	NA	0.0
T99-08	9224.6	27436.6	6727.44	NA	NA	6.5	NA	5.25	6722.2	4.75 bgs	[6733]	0.8
T99-09	8663.5	28492.3	6722.56	NA	NA	9	NA	[9]	[6713.6]	[DRY]	NA	0.0
T99-10	9660.0	27441.6	6742.85	6745.66	2.81	7.5	7.3	7.2	6735.7	DRY	NA	0.0

Northings and Eastings per Monticello Projects Coordinate System
bgs = below ground surface
NA = not applicable
btoc = below top of casing
Water level data per 6/25/99 measurements.
Brackets denote infererred depths and elevations.

wells will occur concurrently with the quarterly surface water and ground water sampling events; the first sampling event was completed on August 5, 1999. Water levels were also measured at that time.

Each boring extended into bedrock except possibly T99–04 and T99–09, where the hard white sandstone recovered at refusal depth (13 and 9 feet below ground surface, respectively) could be bedrock or cobbles. The refusal depths are consistent with bedrock depth at T99–05 (10.5 feet below ground surface) and outcrops 200 feet south of T99–09. Bedrock consists of friable gray siltstone at T99–01, friable tan sandstone at T99–02, and light gray mudstone at T99–03, each within the middle section of the Dakota Formation. At the remaining locations, the upper bedrock was sandstone of the Burro Canyon Formation, commonly light gray/green and very friable to decomposed. The low point of the bedrock valley in the western transect, which includes existing wells 82–08 and 82–09, occurs at T99–01, which is south of the creek. This was also observed farther west in the PeRT wall area. At the other 2 transects, the axis of the bedrock valley is not on the south side of the creek.

In the western transect, seven feet of basal fluvial sand, gravel, and cobbles, typical of materials comprising the alluvial aquifer, were encountered at T99–01, of which about 2.5 ft was saturated. At T99–02, several feet of this material were present above bedrock but were not saturated. The borehole data does not suggest a bedrock high in this area. Farther south at T99–03, coarse alluvium was not present but about 3 feet of interbedded sand seams and sandy silt above the bedrock were saturated. An underground irrigation line parallels the transect within 10 feet of the wells on the opposite side of a fence. Coarse river alluvium apparently thins and pinches out south of T99–01 to T99–03. The remainder of the unconsolidated deposits consists of about 10 to 15 feet of fine sandy silt (loess) that is interbedded at depth with intervals of imbricated shale clasts, and poorly sorted sand with some gravel and occasional cobbles. These colluvial deposits total about 10 to 15 feet thick, and are derived from sheet erosion off the upper slopes and ravines bordering the valley.

About 1 foot of saturated river alluvium was encountered at T99–08, located on the lowest depositional terrace about 10 feet from the creek in the middle transect. The depth to bedrock (approximately 5 feet) is probably 2 to 3 feet below the bottom of the stream bed at that location. A well was not set at T99–08. At T99–06 and T99–07, coarse alluvium (sand, gravel, and cobbles) was 3.5 and 2 ft thick, respectively, and dry. The alluvium was overlain by dry, fine sandy silt (5 and 8 ft thick, respectively). North of the creek at T99–10, bedrock was overlain by about 3 ft of dry cobbles and sand and 4.5 ft of dry sandy silt (bottom to top).

Four to 5 ft of cobbles were present in the eastern transect at T99–04 and T99–09. The cobbles were overlain by about 8 and 4.5 ft, respectively, of fine sandy silt. As discussed above, the depth to bedrock at T99–04 and T99–09 is uncertain, but is probably at or just below the depth of refusal. Ground water was not encountered at these locations. Approximately 1 ft of saturated sand, gravel, and cobbles is present at T99–05, which is nearest the creek along the transect. The coarse alluvium is overlain by about 10 ft of dry red silt with fine sand.

As discussed in Section 4.1, three surface water monitoring locations were added to the monitoring network in January 1999 and one location was added in April 1999. All four of these locations will be sampled quarterly. Additional surface water monitoring locations will be proposed during the coming year as the final alignment of Montezuma Creek is established.

5.0 PeRT Wall Treatability Study

PeRT wall treatability study activities accomplished during the year were completion of laboratory and field treatability studies and site characterization, and design and installation of the PeRT wall. Installation of wells associated with monitoring the performance of the slurry wall and permeable gate began the week of July 26, 1999.

5.1 Treatability Studies

Both laboratory and field treatability studies were done for this project. The purpose of the laboratory treatability study was to evaluate a variety of reactive materials for their ability to remove contaminants from ground water. Eighteen materials (mostly sorbents) were evaluated by using batch tests and twelve zero valent iron (ZVI) products were evaluated by using column tests. None of the tested sorbents were satisfactory for use as the PeRT wall reactive media because they were not able to meet performance requirements for all contaminants of concern. The ZVI products were found to be very effective and six types were selected to be further evaluated in the field treatability study. Results of the laboratory treatability study are reported in *Permeable Reactive Treatment (PeRT) Wall, Results of Laboratory Treatability Testing for the Monticello, Utah, PeRT Wall* (DOE 1998e).

The purpose of the field treatability study was to provide supplemental data that could be used to better predict the effects of emplacing the PeRT wall. Experiments were conducted in four-foot high, 4-inch (inside) diameter clear acrylic columns in a field trailer using ground water from the site. Six types of ZVI supplied by four manufacturers were used in the study. The following specific objectives were evaluated in this study (1) removal of contaminants, (2) chemical transport in the alluvial aquifer by effluent from a ZVI-containing column, (3) iron and manganese mobilization from ZVI, (4) changes in hydraulic conductivity, (5) concentrations of priority pollutant metals, (6) rates of contaminant uptake and mineral precipitation, and (7) geochemical modeling. The results showed that all the products were effective in removing the contaminants of concern, but some products released lower amounts of iron and manganese and showed better hydraulic conductivity. Results of the field treatability studies are reported in *Permeable Reactive Treatment (PeRT) Wall, Results of Field Treatability Studies for the Monticello, Utah, PeRT Wall* (DOE 1998f).

5.2 Site Characterization

Sixteen temporary monitoring wells were also installed in January 1999 in the immediate area of the PeRT wall prior to its construction. Core samples were collected to determine subsurface lithology and depth to bedrock at each location. Water levels were measured on two occasions in the temporary wells and other nearby wells to evaluate ground water flow directions. A ground water sample was collected from each temporary well during January 28 to February 2, 1999, for laboratory analysis of uranium. Two other previously existing wells in the area were also sampled. A letter report was prepared to summarize the results of that investigation (Letter to Vernon Cromwell: "Field Characterization Summary, March 1999—Monticello PeRT Wall Project," Dated March 4, 1999).

5.3 Design

The PeRT wall consists of permeable and impermeable sections. The southern and northern impermeable walls were constructed using a slurry wall keyed into the underlying bedrock aquitard. The northern impermeable wall is approximately 90 linear feet, while the southern wall is approximately 290 linear feet. The PeRT wall (permeable section) was constructed by driving steel sheet piling down to bedrock forming a rectangular box. The soil inside the box was excavated and replaced with the reactive media (ZVI) and gravel packs on the upstream and downstream side of the iron. The upstream gravel pack is approximately 2-feet wide composed of 13 percent (by volume) coarse ZVI (-4 to +20 mesh). The middle 4 feet are composed of 100 percent -8 to +20 mesh ZVI. The downstream gravel pack is approximately 2-feet wide composed solely of 3/8-inch washed pea gravel. A 2-inch inside diameter schedule PVC pipe with 3/16-inch holes was placed at the bottom (1 foot above bedrock) of the downstream gravel pack. This is connected to a vertical pipe that runs to the ground surface. This will be used as an air sparging system if the monitoring results show elevated levels of iron or manganese. Three schedule 2-inch inside diameter air sparging vents connected to a perforated pipe two feet below the top of the wall will be used for pressure relief if the air sparging system is used. Design details were summarized in *the Design Specifications for the Monticello Millsite PeRT Wall Groundwater Treatment System* (DOE 1999d).

5.4 Installation

The construction of the PeRT wall took approximately 6 weeks; it was completed on June 30, 1999. After the site was leveled and equipment was mobilized, the first activity was to construct the northern and southern slurry (impermeable) walls. This was accomplished by using a trackhoe to excavate a trench approximately 1-3 feet into bedrock and using a bentonite slurry to hold the trench open. The trench was then filled with a 5 percent bentonite/soil mix. Laboratory tests on the material used in the slurry wall indicate an average hydraulic conductivity of $1\text{-}2 \times 10^{-8}$ cm/sec at 20 degrees Celsius. The next step was to construct the permeable or reactive portion of the PeRT wall. The first activity was to drive 3/8-inch interlocking sheet piles into bedrock (until refusal occurred) to form a rectangular box approximately 103-feet long by 8-feet wide. The sheet piles were driven using a 140-ton vibratory hammer hoisted on a crane. After the sheet pile box was in place and the sheetpiles were cut near the ground surface, the upper portion of the native material inside the box was excavated using a trackhoe. Steel bracing was added to the top of the box for additional support. The remaining native material was then removed to bedrock. A trackhoe was used to scrape and remove any loose bedrock material from the excavation. Workers also entered the excavation to more completely clean loose material and remove soils that had adhered to the sheet piles. The final step was to fill the excavation with the ZVI and gravel. Specially designed sheet pile boxes were used to keep the materials separated as the box was filled. After the reactive gate was filled to final grade, a geotextile material was placed on top before the native soils were replaced. Figure 5.3–1 is an "as built" location map of the PeRT wall. A summary report containing details of the PeRT wall installation is in preparation.

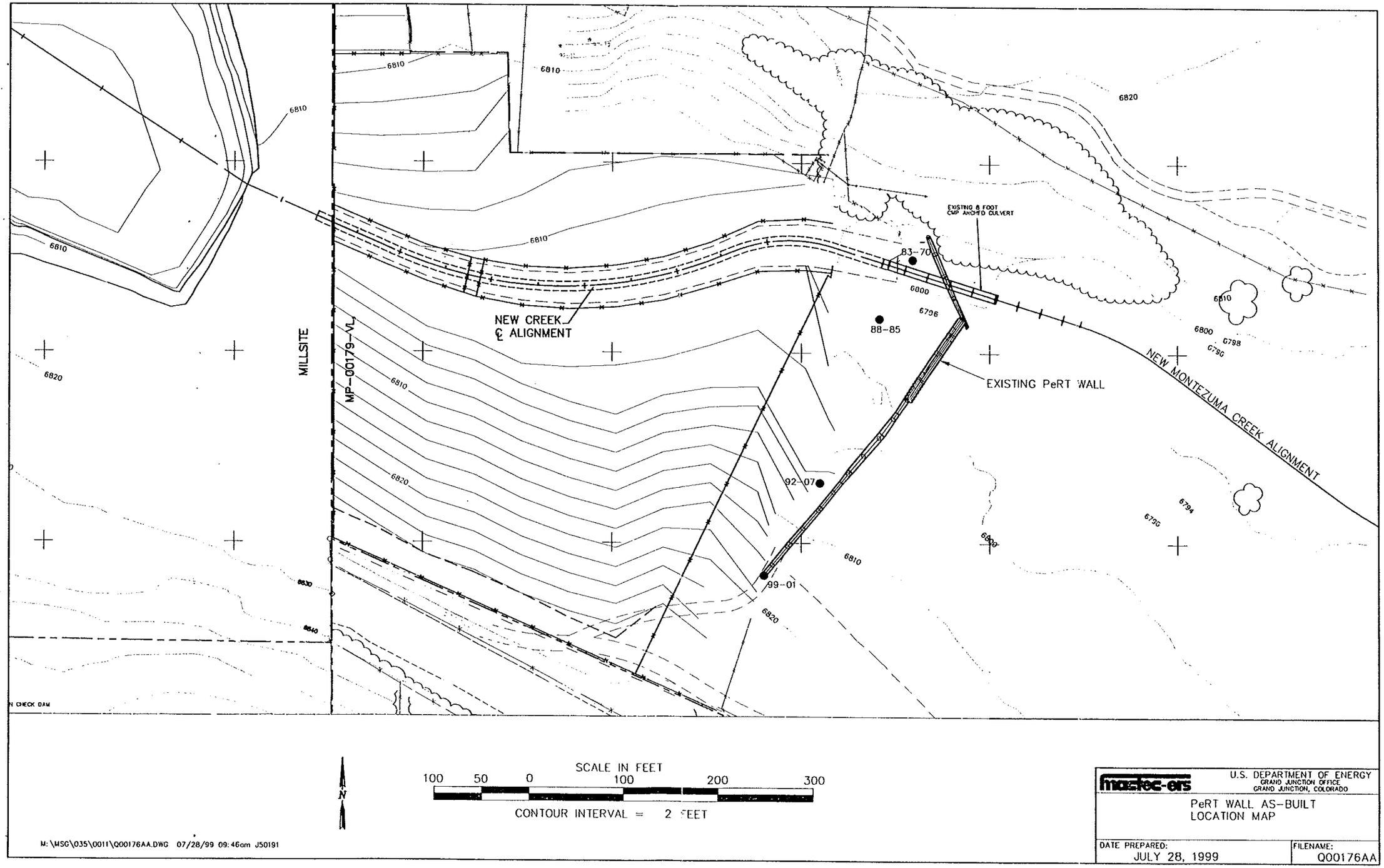


Figure 5.3–2. PeRT Wall "As Built" Location Map

This page intentionally left blank

6.0 References

Cromwell, 1999. Letter to Vernon Cromwell: "Field Characterization Summary, March 1999—Monticello PeRT Wall Project," Dated March 4, 1999.

U.S. Department of Energy, 1990. *Monticello Mill Tailings Site: Declaration for the Record of Decision and Record of Decision Summary*, DOE/ID/12584–50, prepared for the U.S. Department of Energy Grand Junction Office, Grand Junction, Colorado, August.

———, 1997a. *Monticello Mill Tailings Site, Operable Unit III, Annual Monitoring Program*, MAC–MSGRAP 1.3.5, prepared by MACTEC for the U.S. Department of Energy Grand Junction Office, Grand Junction, Colorado, September.

———, 1997b. *Monticello Remedial Action Project Radiological Sampling and Verification Plan for Operable Unit I*, MAC–MRAP 1.3.12, prepared by MACTEC for the U.S. Department of Energy Grand Junction Office, Grand Junction, Colorado, May.

———, 1998a. *Record of Decision for and Interim Remedial Action at the Monticello Mill Tailings Site, Operable Unit III—Surface Water and Ground Water*, GJO–98–51–TAR, prepared by MACTEC for the U.S. Department of Energy Grand Junction Office, Grand Junction, Colorado, April.

———, 1998b. *Monticello Mill Tailings Site, Operable Unit III, Remedial Investigation*, GJO–97–6–TAR, prepared by MACTEC for the U.S. Department of Energy Grand Junction Office, Grand Junction, Colorado, January.

———, 1998c. *Monticello Mill Tailings Site, Operable Unit III, Feasibility Study of Surface Water and Groundwater*, GJO–97–21–TAR, prepared by MACTEC for the U.S. Department of Energy Grand Junction Office, Grand Junction, Colorado, March.

———, 1998d. *Monticello Mill Tailings Site, Operable Unit III, Data Summary Report October 1996 - April 1998*, GJO–98–72–TAR, prepared by MACTEC for the U.S. Department of Energy Grand Junction Office, Grand Junction, Colorado, November.

———, 1998e. *Permeable Reactive Treatment (PeRT) Wall Results of Laboratory Treatability Testing for the Monticello PeRT Wall*, GJO–98–52–TAR, prepared by MACTEC for the U.S. Department of Energy Grand Junction Office, Grand Junction, Colorado, May.

———, 1998f. *Permeable Reactive Treatment (PeRT) Wall Results of Field Treatability Studies for the Monticello, Utah, PeRT Wall*, GJO–98–69–TAR, prepared by MACTEC for the U.S. Department of Energy Grand Junction Office, Grand Junction, Colorado, November.

———, 1999a. *Monticello Mill Tailings Site, Operable Unit III, Interim Remedial Design/Remedial Action (RD/RA) Work Plan for Operable Unit III—Surface Water and Ground Water*, Draft Final, MAC–MSG 2.2.1, prepared by MACTEC for the U.S. Department of Energy Grand Junction Office, Grand Junction, Colorado, March.

U.S. Department of Energy, 1999b. *Monticello Mill Tailings Site, Operable Unit III, Interim Remedial Action Work Plan*, MAC–MSG 2.2.4, prepared by MACTEC for the U.S. Department of Energy Grand Junction Office, Grand Junction, Colorado, May.

———, 1999c. *Monticello Mill Tailings Site, Operable Unit III, Interim Remedial Action, Surface Water and Ground Water Monitoring Plan*, MAC–MSGRAP 1.3.5-1, prepared by MACTEC for the U.S. Department of Energy Grand Junction Office, Grand Junction, Colorado, July.

———, 1999d. *Permeable Reactive Treatment (PeRT) Wall Design Specifications for the Monticello Millsite PeRT Wall Groundwater Treatment System*, MAC–PTW 1.8-2, prepared by MACTEC for the U.S. Department of Energy Grand Junction Office, Grand Junction, Colorado, May.

Appendix A

Ground-Water Management Policy
for the
Monticello Mill Tailings Site and Adjacent Areas

This page intentionally blank

State of Utah
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WATER RIGHTS

Michael O. Leavitt
Governor
Ted Stewart
Executive Director
Robert L. Morgan
State Engineer

1594 West North Temple, Suite 220
Box 146300
Salt Lake City, Utah 84114-6300
801-538-7240
801-538-7467 (Fax)

Ground-Water Management Policy for the Monticello Mill Tailings Site and Adjacent Areas

---

The Monticello Mill Tailings Site is on the southeast portion of the town of Monticello in Section 36, T33S, R23E and Section 31, T33S, R24E, SLB&M. The mill site was used from 1942 to 1960 in the processing of uranium and vanadium. The U.S. Department of Energy (DOE) is currently cleaning up the site. The site is in the small canyon that forms the drainage for South Creek. The general direction of water flow, of both surface streams and the shallow ground water system is in a southeasterly direction. The geology of the site consists of about ten to 30 feet of alluvial fill material underlaid by Mancos Shale or Dakota Sandstone. The former mill site area was heavily contaminated and there has been some movement of the metals and radionuclides down gradient.

The U.S. Department of Energy, with oversight from the Environmental Protection Agency and Utah Department of Environmental Quality, has conducted extensive sampling and testing of the site and adjacent areas. They have determined that at the present level of contamination it could pose a significant human health risk if they ingest the water. DOE submitted a request to the State Engineer to apply institutional controls for the site to restrict the development and use of the shallow ground water for domestic purposes.

The State Engineer has reviewed the data and information related to the Monticello Mill Tailings Site and believes there are potential human health concerns. The area of concern is the shallow alluvial fill aquifer at and immediately east of the Monticello Mill Tailings Site. Therefore, the State Engineer adopts the following ground-water management policy.

1. The area covered by this ground-water management policy is shown on attachment number 1, and hereafter referred to as the Monticello Ground-Water Restricted Area.

2. New applications to appropriate water will not be approved which propose to divert and use water for domestic purposes from the shallow alluvial fill aquifer within the boundaries of the Monticello Ground-Water Restricted Area. In addition, change applications will not be approved which propose to divert and use water from the shallow alluvial fill aquifer for domestic purposes

3. Several existing water rights divert and use surface or ground water within the restricted area. This management policy, and any restrictions or limitations it may impose, does not affect these existing water rights as they now exist. If actions are necessary to curtail water use under existing water rights they will be handled under individual agreements between the parties.

4. If a water user requests permission to drill a well into the deeper bedrock formations within the restricted area, they will be required to demonstrate that they can seal out the shallow contaminated ground water and not allow the flow of water between the shallow alluvial aquifer and the deeper bedrock aquifers/formations.

5. The above controls will remain in effect until it is determined that the risk to human health is eliminated or reduced to acceptable limits.

6. The effective date of this policy is May 21, 1999.

Robert L. Morgan

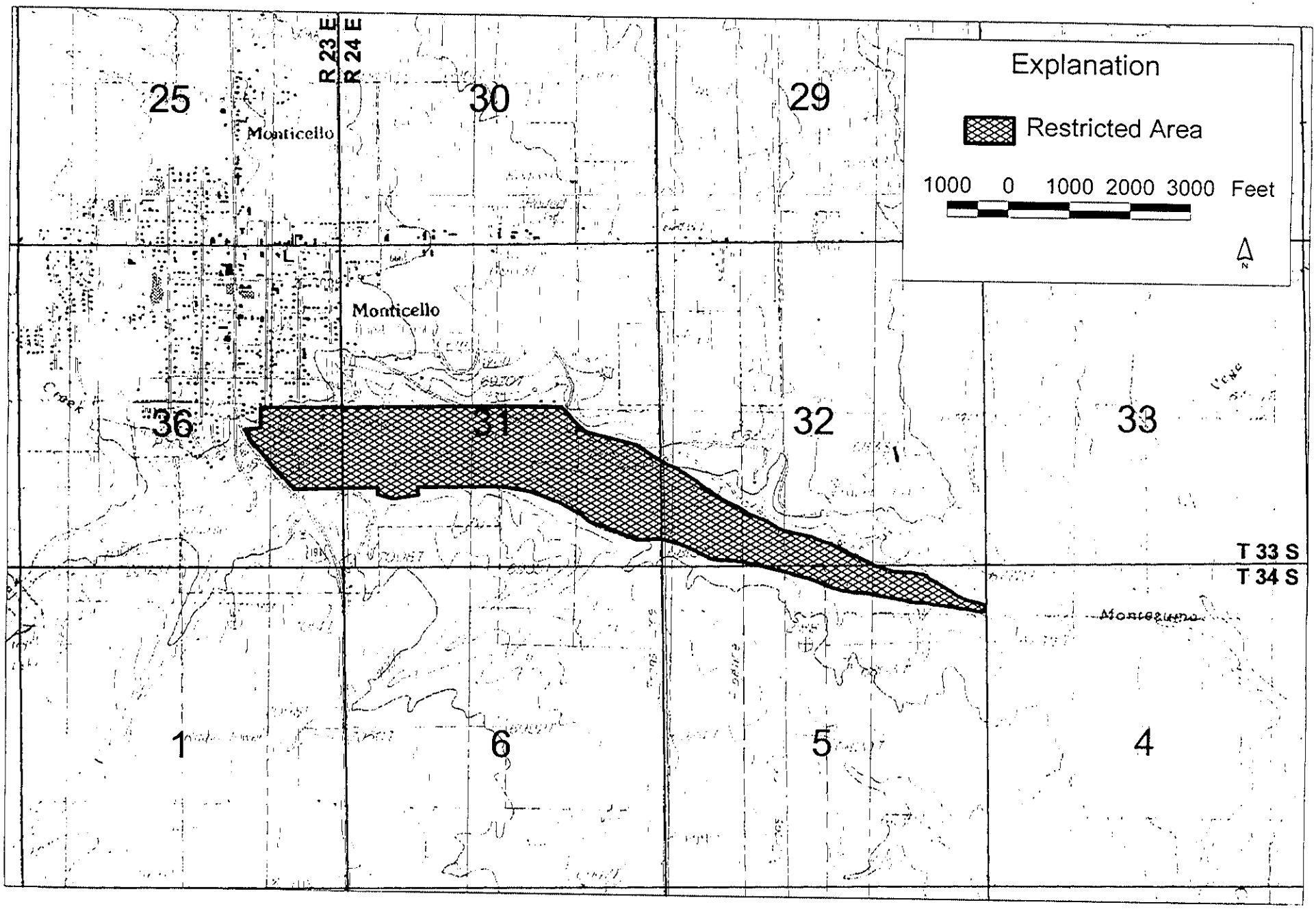
Robert L. Morgan, P.E.
State Engineer

If you have questions about this policy, contact a Division of Water Rights office listed below:

Division of Water Rights
453 South Carbon Avenue
P.O. Box 718
Price, Utah 84501-0718
Phone: 435-637-1303
Fax: 435-637-7937

Division of Water Rights
1594 West North Temple
Box 146300
Salt Lake City, Utah 84114-6300
801-538-7240
801-538-7467

Attachment 1 - Monticello Ground-Water Restricted Area



This page intentionally blank

Appendix B

Draft Example of Surface-Water Analytical Data

This page intentionally blank

Down-Gradient - Upper Canyon Sorenson [a]

Analyte	Unit	Minimum	Maximum	Average	Median	FOD	10/16/1997	10/16/1997	04/21/1998	10/12/1998	01/25/1999	01/25/1999	04/12/1999	04/12/1999
Creek Flow	cfs						0.84	0.84	2.2					
Field Measurements														
Alky	ppm	167	2182	432.09	270	11/11	259	259	191	161	198	--	177	--
CDT	umhos/cm	999	2170	1647.58	1706.5	12/12	1224	1224	1240	1319	1832	--	1660	--
Eh	mV						--	--	--	--	--	--	054	--
pH		7.46	8.41	7.94	7.91	12/12	7.91	7.91	8.31	8.30	7.65	--	7.82	--
Temp	deg C	1.6	20.8	8.85	8.4	12/12	5.8	5.8	10.0	15.0	5.1	--	16.3	--
Turb	NTU						--	--	--	--	41.0	--	8.65	--
Common Ions														
Ca [b]	mg/L	137	332	255.86	266	14/14	306	--	197	148	--	--	--	--
Ca [c]	mg/L	228	329	292.5	319	6/6	312	308	191	136	269	265	240	238
Cl [c]	mg/L	21.6	66.5	38.47	35.2	14/14	32.8	32.5	21.9	81.2	44.5	45.1	31.7	31.9
F [c]	ug/L	66.8	224	144.04	155.5	14/14	194B	190B	170B	241J	285	319	169J	167J
Hardness	mg/L	443	1080	840.36	884.5	14/14	974	--	627	494	--	--	--	--
K [b]	mg/L	1.53	8.2	4.47	4.51	14/14	4.07	--	2.49J	8.3	--	--	--	--
K [c]	mg/L	2.07	5.34	3.89	4.22	6/6	4.14	4.08	2.41J	7.73	4.26J	4.19J	3.86J	3.82J
Mg [b]	mg/L	24.6	60.8	49.14	56.2	14/14	50.9	--	32.9	30.3	--	--	--	--
Mg [c]	mg/L	41.6	58.5	52.28	56.9	6/6	51.8	51.5	33.1	28.7	49.1	48.2	50	49.6
Na [b]	mg/L	44.6	165	84.94	79.5	14/14	76	--	51.6	107	--	--	--	--
Na [c]	mg/L	68.4	101	76.57	70.65	6/6	77.6	76.3	51.7	100	92.2	90.7	81	81.1
NH4 [c]	ug/L	13.3	92	49.99	42.1	13/13	--	--	--	--	--	--	--	--
NO2 [c]	ug/L	25.3	63.4	39.8	35.25	4/4	--	--	--	--	--	--	--	--
NO3 [c]	ug/L	128	3620	2312	2750	4/4	--	--	--	--	--	--	--	--
NO3+NO2-N [c]	ug/L	223	913	452.8	395	10/10	433	427	281	267	788J	853J	121	97.4J
SO4 [c]	mg/L	291	895	686.93	745	14/14	742	740	499	380	779	789	708	705
TDS [b]	mg/L	710	1700	1379.08	1580	13/13	1520	1520	1020	923	1410	1430	1350	1360
Metals														
As [b]	ug/L	.22	5	1.65	1.2	4/14	2.2UJ	--	1.1U	2.5J	--	--	--	--
As [c]	ug/L	.22	3.2	.98	.5	2/7	2.2UJ	2.2UJ	1.0U	1.8J	0.39J	0.53J	1.0U	1.0U
Cu [b]	ug/L	.5	3.3	1.76	1.65	1/14	2.2U	--	17.0J	2.7J	--	--	--	--
Cu [c]	ug/L	1.4	2	1.63	1.5	1/7	2.2U	2.2U	2.0U	2.2J	1.7J	1.9J	1.0U	1.0U
Mn [b]	ug/L	81.6	439	213.97	194	14/14	181	--	130	94.8	--	--	--	--
Mn [c]	ug/L	99.5	460	226.36	183	7/7	181	177	118	81.4	161J	163J	125	123
Mo [b]	ug/L	7.8	54.9	21.91	14.2	11/14	15.7	--	9.2J	11.3	--	--	--	--
Mo [c]	ug/L	13.5	45.9	21.81	15.4	7/7	15.9	16.1	8.7J	11.0	17.0J	17.2J	10.9	10.9
Pb [b]	ug/L	.22	2.3	.6	.5	1/13	1.1U	--	1.1U	1.1U	--	--	--	--
Pb [c]	ug/L	.2	.5	.4	.5	0/6	1.1U	1.1U	1.0U	1.0U	1.0U	1.0U	1.0U	1.0U
Se [b]	ug/L	1	7.8	3.18	2.6	11/14	2.2U	--	1.3J	1.5J	--	--	--	--
Se [c]	ug/L	1.4	6.5	3.29	2.8	7/7	2.2U	2.2U	1.5J	1.5J	3.3J	3.2J	2.9J	2.9J
U [b]	ug/L	78.6	456	197.13	151.5	12/12	159	--	88.8	87.2	--	--	--	--
U [c]	ug/L	138	291	190.67	143	3/3	163	161	87.0	87.6	100	98.0	107	106
V [b]	ug/L	2.8	119	37.44	12.65	12/14	6.1J	--	9.6J	10.8J	--	--	--	--
V [c]	ug/L	2.4	74.7	16.19	3	4/7	4.1J	4.1J	6.3J	9.4J	4.8J	4.6J	3.0J	3.3J
Zn [b]	ug/L	1	24.4	8.64	5.95	9/14	2U	--	11.4J	19.6J	--	--	--	--
Zn [c]	ug/L	1	12.9	3.36	1.5	2/7	17.2	20.6	6.1J	4.0U	7.5J	6.0U	9.0U	9.0U
Radiological														
Alpha [c,d]	pCi/L	55	290	139.82	123.5	14/14	43.3	64.0	55.2	35.5	50.8	42.5	59.0J	69.4J
Alpha [c,e]	pCi/L						65.7J	--	41.2J	33.8	--	--	--	--
Alpha-U [f]	pCi/L	0	53.6	16.26	10.5	14/14	0 [i]	0 [i]	0 [i]	0 [i]	0 [i]	0 [i]	0 [i]	0 [i]
Alpha-U [g]	pCi/L						0 [i]	--	0 [i]	0 [i]	--	--	--	--
Beta [c]	pCi/L	16.5	118	42.82	36.35	11/14	40.0	49.5	12.1	26.2	37.8	28.5	31.5	27.3
Beta [c,h]	pCi/L						71.1J	--	33.0J	75.8	--	--	--	--
Pb210 [c]	pCi/L	.6	6.6	1.55	1	3/13	0.89U	0.87U	0.30U	0.29U	0.28J	0.30J	0.25U	0.25U
Ra226 [c]	pCi/L	.33	.84	.61	.615	14/14	0.33U	0.36U	0.27U	1.8	0.16U	0.11U	0.15U	0.94
Rn222 [b]	pCi/L	67	194	134.79	140.5	14/14	96	120	53	49	156	127	144	147
Th230 [c]	pCi/L	.025	.49	.22	.15	1/14	--	--	0.80U	1.6U	0.80U	0.80U	1.2U	1.2U
U [b]	ug/L	78.6	456	197.13	151.5	12/12	159	--	88.8	87.2	--	--	--	--
U [c]	ug/L	138	291	190.67	143	3/3	163	161	87.0	87.6	100	98.0	107	106
U234 [c]	pCi/L	16.5	177	69.98	56	14/14	--	--	29.8	--	--	--	--	--
U235 [c]	pCi/L	.485	3.9	2.14	2.05	9/12	--	--	1.7	--	--	--	--	--
U238 [c]	pCi/L	16.5	174	68.66	57.45	14/14	--	--	33.8	--	--	--	--	--

[a] Definition of Qualifiers: -- - No Data. R - Data unusable. J - Estimated quantity. J- - Estimated quantity (underestimate). U - Not detected; value is sample detection limit. UJ - Not detected, associated value is estimated. UJ- - Not detected; associated value is estimated (underestimate).
[b] Sample was unfiltered.
[c] Sample was filtered in the field.
[d] Toal gross alpha excluding radon which is lost during analysis.
[e] Toal gross alpha, using EPA Preperation Method 00-02-01, excluding radon which is lost during analysis.
[f] Gross alpha minus uranium activity. Result rounded as appropriate.
[g] Gross alpha, using EPA Preperation Method 00-02-01, minus uranium activity. Result rounded as appropriate.
[h] Gross beta, using EPA Preperation Method 00-02-01.
[i] Uranium activity greater than gross alpha.

Draft

work on
1) significant figures
2) add ~~surface~~ WWTP discharge
3) spread columns apart to improve readability

This page intentionally left blank