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Monticello Mill Tailings Site
Operable Unit III

Interim Remedial Action Progress Report

July 1999 – July 2000

September 2000

GRAND JUNCTION OFFICE

Work Performed Under DOE Contract No. DE--AC13--96GJ87335 for the U.S. Department of Energy
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Operable Unit III

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

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Task Order Number MAC00–03

Signature Page

Interim Remedial Action Work Plan
for
Operable Unit III—Surface Water and Ground Water

Monticello Mill Tailings Site

September 2000

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Acronyms

COC	contaminant of concern
COE	U.S. Army Corps of Engineers
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
ESL	Environmental Sciences Laboratory
FS	feasibility study
IRA	Interim Remedial Action
Kd	distribution coefficient
kg	kilograms
µg/L	micrograms per liter
mL/g	milliliters per gram
MMTS	Monticello Mill Tailings Site
OU	operable unit
pCi/g	picocuries per gram
PeRT	permeable reactive treatment
ppb	parts per billion
ppb	parts per million
RA	remedial action
RD	remedial design
RI	remedial investigation
ROD	Record of Decision
RVZ	residual vadose zone
UDEQ	Utah State Department of Environmental Quality
UPDES	Utah Pollutant Discharge Elimination System
WWTP	Wastewater Treatment Plant
ZVI	zero valent iron

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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 former Millsite is a 110-acre tract of land owned by the city of Monticello. 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) were 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 August 2004. A generalized schedule showing major OU III activities up to and including the ROD is shown in Figure 1–2.

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.

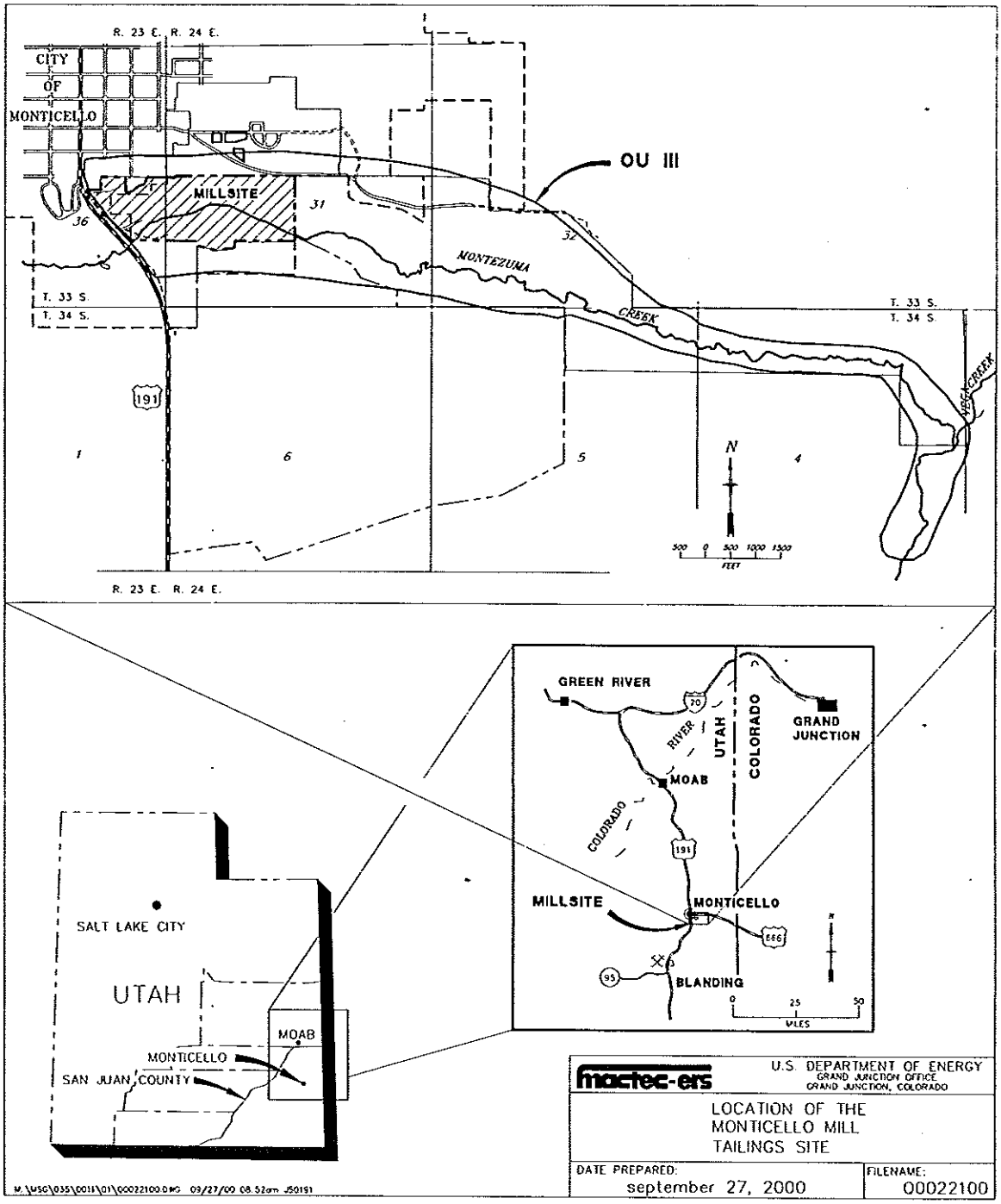

Figure 1–1. Monticello Mill Tailings Site, San Juan County, Utah

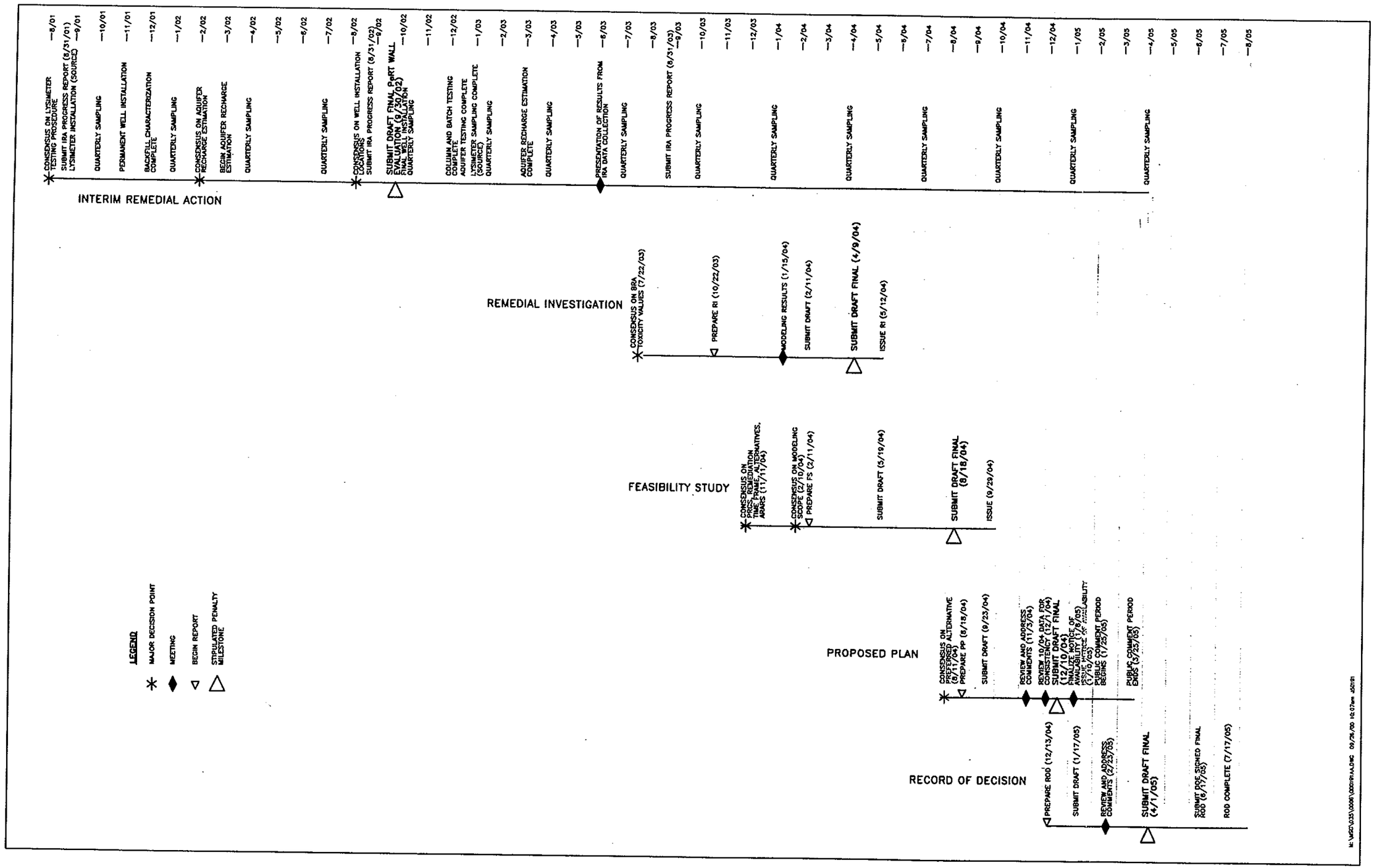

Figure 1–2. Monticello Mill Tailings Site, Operable Unit III, Schedule

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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 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). The IRA Work Plan is anticipated to be finalized in October 2000.

This progress report has been prepared to summarize the progress made in performing the four IRA activities outlined in the previous paragraph since the signing of the ROD for the IRA in September 1998 through June 2000. Progress reports are prepared annually and will include an update to the ARARs analysis presented in the draft FS (DOE 1998c), any finalized Program Directives that may be prepared during the previous year that cover investigative activities, and they will also summarize any progress made in other activities necessary to get to the final ROD.

End of current text

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.

DOE made the decision to pursue obtaining the water right along with purchasing restrictive easements from property owners who own property along Montezuma Creek on which supplemental standards were applied. The restrictive easement would prohibit the building of a habitable structure and the removal of soils from within the easement area. One of the property owners is also the owner of the water right. The U.S. Army Corps of Engineers (COE) obtained appraisals in order to determine fair market value of the easement and water right. Offers were mailed to the property owners by the COE via letter dated June 21, 2000.

A meeting was held on August 1, 2000, with the affected property owners, COE, DOE, and DOE's contractor to discuss the offers. The three property owners at the meeting were unwilling to accept the offers presented. The owners concerns were:

- Offers presented for the easement do not represent fair market value
- There appeared to be a discrepancy in the average valuation price (dollars per acre) of the easement from one property to the next
- The highest and best use identified in the appraisal was not correct and the easement would impact the owners future development plans of the property. Potential development plans mentioned by the property owners included a gravel extraction operation, subdivision for housing development, and fishing cabins.
- As stated, the restrictive easement would also prohibit plowing, discing, or other disturbance activities. The owners were concerned that activities such as placing a culvert in the stream would not be permitted. The owners were informed that the language prohibiting plowing, discing and other disturbance activities would be removed from the easement. Language clarifying that disturbed soils will be placed back in the easement area would be added.

Purchase of the water right was not discussed at the August 2000 meeting but is currently tied to resolution of problems discussed above associated with purchase of the restrictive easements.

The COE will follow-up with the property owners to explain the Government position on the appraisals and the fair market value determination. DOE requested that the San Juan County Commission consider putting in place a requirement that would allow DOE to scan future house footprints. This would eliminate the need for the restrictive easement. The proposal was presented to the San Juan County Commission on August 21, 2000. The commissioners were not in favor of using the county permitting process to effect a use restriction. The COE and DOE will continue to work with the landowners to resolve their concerns.

With regard to the institutional controls on ground water, DOE accepts responsibility for ensuring that the Ground-Water Management Policy is working. DOE will conduct annual inspections of the properties to look for any evidence of well installations or ground water use. The first inspection occurred during October 1999; no new private wells have been installed and there is no evidence of domestic use of the alluvial ground water in the OU III area. The next inspection is scheduled for October 2000. The results of the October 2000 inspection will be reported in the next annual IRA progress report.

3.0 Millsite Dewatering and Treatment

The primary objective of Millsite dewatering and treatment was to facilitate excavation and removal of mill tailings and contaminated soil that extended below the water table. It was also realized that in treating contaminated ground water, contaminants would be permanently removed from the ground water system, thereby, positively affecting ground water and surface-water quality.

Ground-water removal at the Millsite was initiated in 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. The trenches extended to bedrock and thus intercepted all alluvial ground water. Water was pumped from the trenches to allow remediation of the Carbonate Pile. On occasion, dewatering was halted due to insufficient capacity at Pond 3. The Carbonate Pile excavation eventually extended to bedrock. Uncontaminated ground water that discharged to the excavation from the west was then routed to Montezuma Creek to reduce the inflow to Pond 3 and reduce treatment volumes. As excavation progressed eastward to include the East Pile, very little ground water was encountered. Intercepting ground water from the west and 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) to Utah Pollutant Discharge Elimination System (UPDES) standards 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 the winter and in May 1999, the WWTP was dismantled. Since April 1998, the plant processed over 50 million gallons.

OU III involvement in dewatering and treatment activities was limited to acquisition of data on volumes and concentrations of water being removed from the surface-water and ground-water systems. Using this data, it is estimated that between about 50 and 100 kilograms (kg) of uranium were removed from (and as source to) the alluvial aquifer during dewatering and treatment plant operation. This assumes a total treatment volume of 54 million gallons of water with uranium concentrations averaging between 0.5 and 1 mg/L (see Appendix B–1 for calculation methods). Since shutdown of the WWTP, it is estimated that 4,080,000 gallons of contaminated water from Pond 4 were used for dust suppression which represents between 7.5 and 15 kg of additional uranium removed from the alluvial system (Appendix B–1). This combined mass can be compared to a mass of 1,800 kg uranium (dissolved and sorbed) that was estimated to be present in the alluvial aquifer prior to Millsite remediation (see Appendix B–2, Calculation Q00076AA). The uranium removed from the alluvial system during approximately one year of continuous ground-water treatment is therefore approximately 3 to 6 percent of the total inventory. This excludes the mass of sorbed uranium that was excavated and removed from the system during surface remediation. As the estimates in Appendix B–2 indicate (Calculation Q00076AA), the contribution of the sorbed phase to the total mass inventory is much greater than the solute phase, even if the distribution coefficient (*Kd*) is only 1 mL/g (uranium example).

End of current text

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 1999 was according to the *Monticello Mill Tailings Site, Operable Unit III, Interim Remedial Action, Surface Water and Ground Water Monitoring Plan* (DOE 1999c). Monitoring in 2000 was according to the *Monticello Mill Tailings Site, Operable Unit III, Interim Remedial Action, Surface Water and Ground Water Monitoring Plan* (DOE 1999d). Changes to the scheduled activities were documented in Program Directives; Program Directives issued during the year are presented in Appendix C. Monitoring associated with the PeRT treatability study is discussed in Section 5.0.

Water quality samples were collected from specified locations according to a variable schedule (Figures 4.1–1 and 4.1–2). Field measurement data, common ion and metals concentrations, and radioactivity data organized by sampling location are presented in Appendix D. Metals data presented in Appendix D are limited to the contaminants of concern (COCs) established for OU III in the RI, except for cobalt, copper, lead, and zinc, which were deleted as COCs per the recommendations presented in the *Monticello Mill Tailings Site, Operable Unit III, Surface Water and Ground Water Data Summary Report—October 1998–July 1999* (DOE 1999e). Time-concentration plots for arsenic, manganese, molybdenum, selenium, uranium, and vanadium at selected surface-water and ground-water locations are presented in Appendix E. Surface-water and ground-water sampling locations nearest to the eastern boundary of the Millsite were favored for representation because those are the locations where changes in water quality due to Millsite activities are expected to be seen first. Contaminants were chosen for illustration on time-concentration plots and plume maps on the basis of their distribution above detection limits. Stream discharge measurements, ground-water levels, and water level hydrographs are presented in Appendix F.

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 1999, 35 ground water samples and 10 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 2000, 15 ground water samples and four surface-water samples were collected. Water levels were measured at all existing wells; stream flow discharge measurements were not made.

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 2000, 23 ground water samples and 10 surface-water samples were collected. Four of the surface-water sampling locations (SW00–01 through SW00–04) were new sampling locations and were selected by DOE, EPA and UDEQ as permanent sampling locations. Location SW00–01 replaces SW99–01, SW00–03 replaces SW92–06, and SW00–04 replaces SW99–04. SW00–02 is a new site at the eastern boundary of the former Millsite. Two of the surface-water samples were collected from seeps (seeps 4307 and 5215) in the southeastern part of the Millsite. Water levels were measured at all existing wells and stream flow discharge was measured at all surface-water locations sampled.

During July 2000, five surface-water samples, one seep sample, and 24 ground water samples were collected. Five of the ground water locations were additions to the routine sampling locations and were added as part of an investigation to determine the source of contamination at seeps 4307 and 5215. These five ground water samples were collected at 31SW93–197–2 through 31SW93–197–5, and AEC–6 (Figure 4.1–1). Water levels were measured at all existing wells and stream flow discharge was measured at all surface-water locations sampled.

4.1.1 Surface Water Results

In surface-water, concentrations of arsenic, manganese, molybdenum, selenium, uranium, and vanadium at SW00–01 near the western end of the Millsite were comparable to background concentrations measured at location SW92–03 (see Figure 4.1.1–1).

Downstream of the Millsite, arsenic is generally not present in Montezuma Creek surface-water samples at detectable concentrations (see Figure 4.1.1–1). Arsenic was occasionally detected at concentrations less than 2 micrograms per liter (µg/L). The most stringent Utah surface-water standard for arsenic is 50 µg/L based on domestic use.

Manganese concentrations downstream of the Millsite are approximately two to three times background concentrations. East of the Sorenson site, concentrations of manganese tend to increase to approximately one-half the Burro Canyon ground water concentrations and remain at these levels throughout the eastern portion of the surface-water monitoring network. Discharge of Burro Canyon ground water to the alluvial ground water and to surface water is believed to be the cause of the increase in manganese concentrations. Manganese concentrations fluctuate widely in surface water east of the Millsite and have not shown any significant decreasing trends since either Millsite seep discharge to surface water was eliminated after the October 1994 sampling event or due to excavation activities.

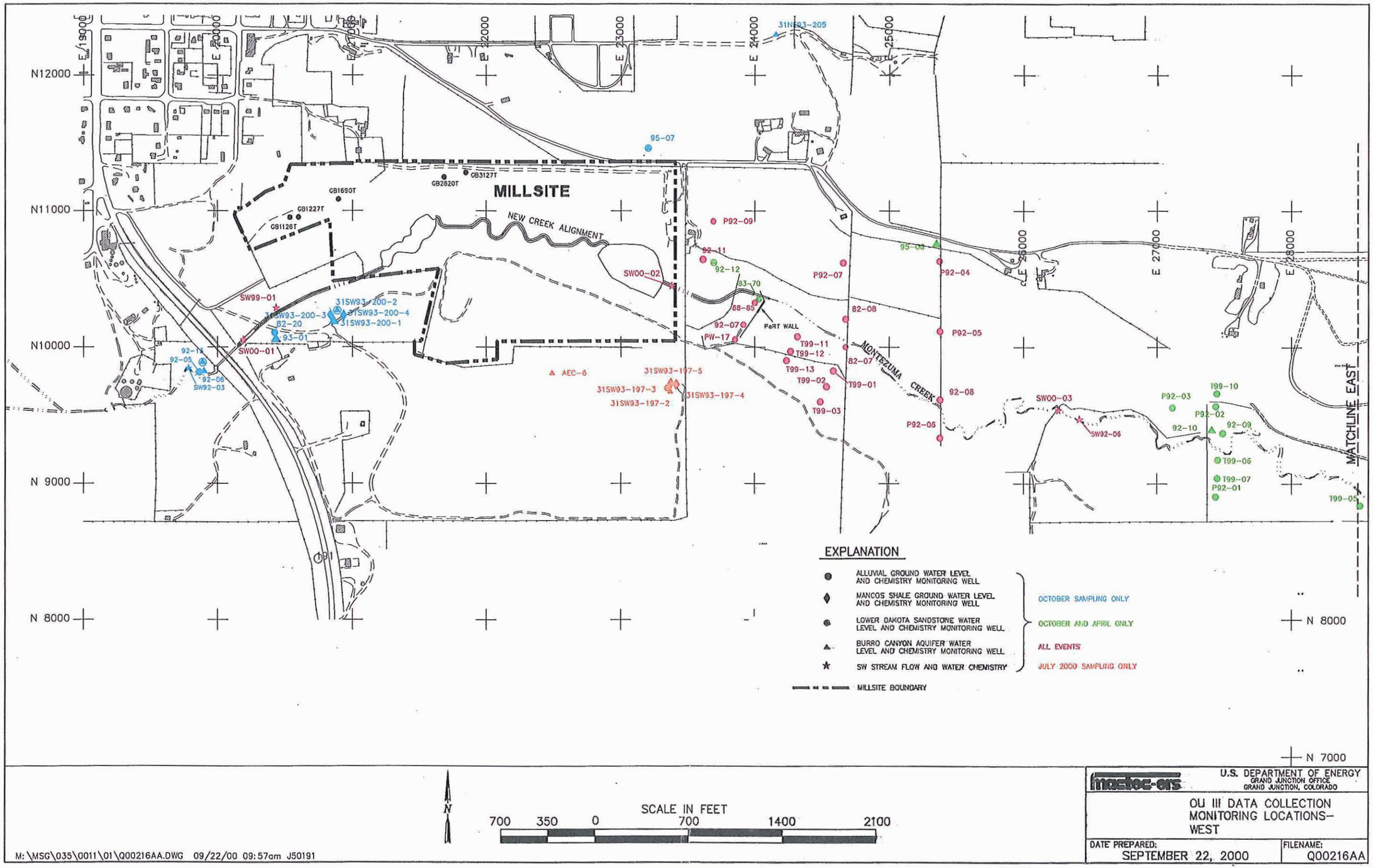

Figure 4.1–1. Ground Water and Surface Water Monitoring Network–West

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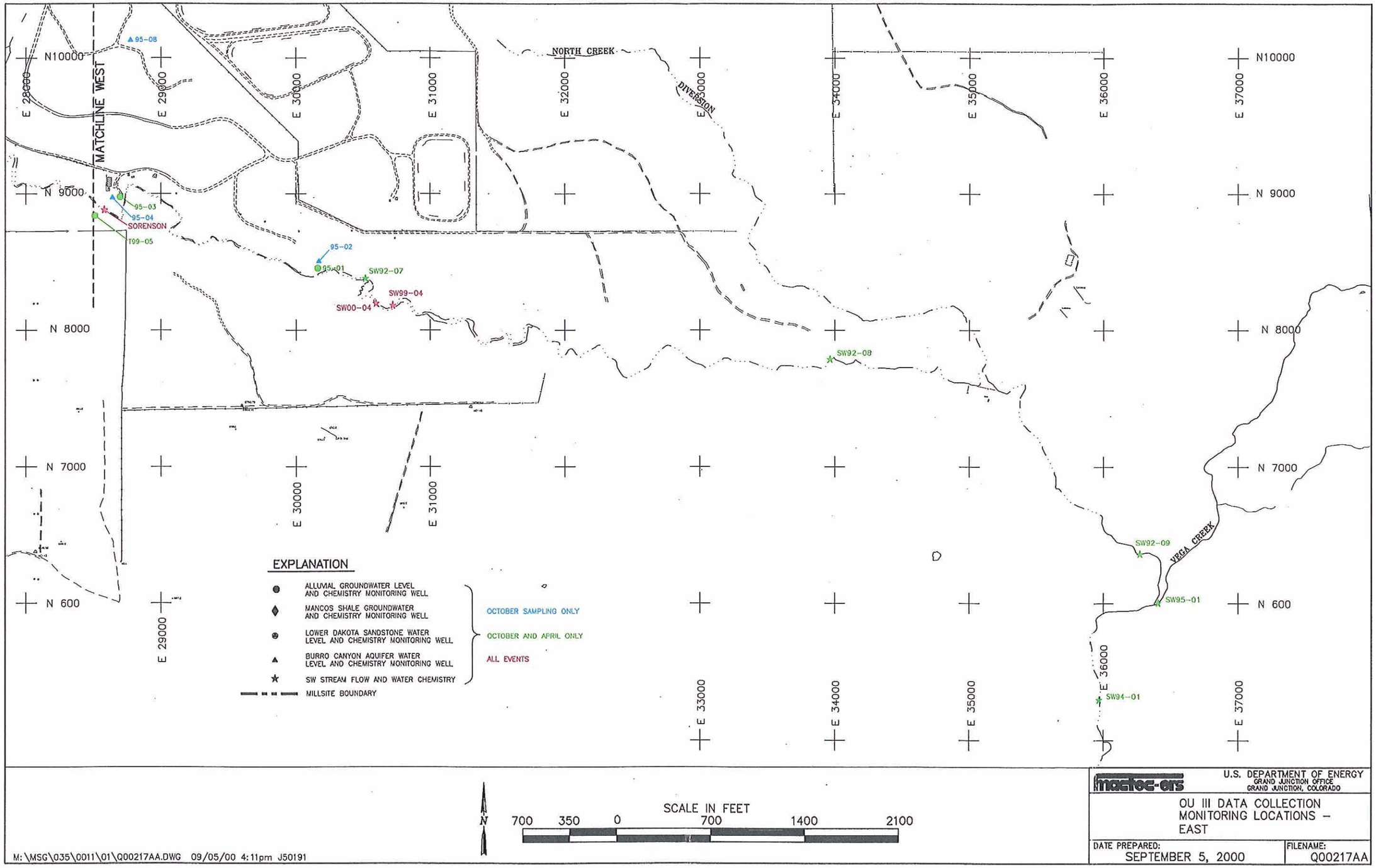

Figure 4.1–2. Ground Water and Surface Water Monitoring Network–East

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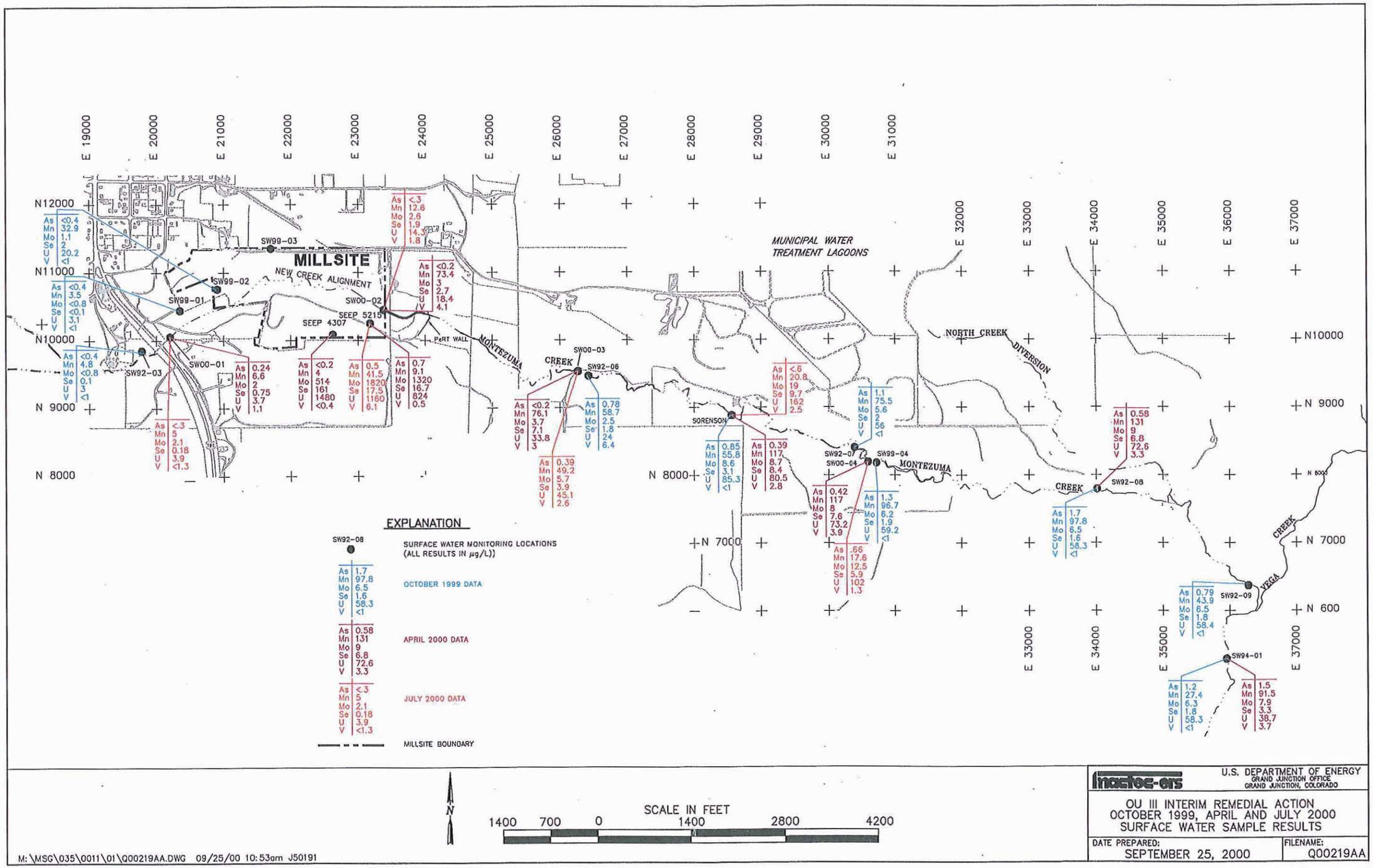

Figure 4.1.1–1. Surface Water Sample Results

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Molybdenum concentrations downstream of the Millsite are approximately equivalent to background concentrations at SW00–02 and SW00–03 sampling locations located nearest the Millsite. East of SW00–03, concentrations of molybdenum increase to approximately two to three times background and remain at this level throughout the eastern portion of the surface-water monitoring network (see Figure 4.1.1–1). Discharge of contaminated alluvial ground water to surface water is believed to be the cause of the increase in molybdenum concentrations. Overall, molybdenum concentrations have continued to decrease in surface water east of the Millsite since Millsite seep discharge to surface water was eliminated after the October 1994 sampling event; the decrease in molybdenum is also attributed to the positive effect of source removal at the Millsite and downstream along Montezuma creek.

Selenium concentrations ranged from non-detect to 9.7 µg/L at locations downstream of the Millsite. In April 2000, selenium concentrations at seeps 4307 and 5215 were 161 µg/L and 16.7 µg/L, respectively. Selenium has shown a tendency of increasing concentrations in surface water during the last year, which may be due to leaching of exposed bedrock on the Millsite. At the Sorenson site, selenium concentrations have doubled during the last year and were 8.4 µg/L and 9.7 µg/L in April and July 2000, respectively. In upstream (background) surface-water samples, selenium is generally not detected. The Utah criterion for protection of aquatic wildlife based on a four-day average sample is 5 µg/L.

As shown by the April 2000 data, uranium concentrations progressively increase from background levels at SW00–01 on the western edge of the Millsite to an approximate maximum concentration of 162 µg/L at the Sorenson site east of the Millsite as measured in July 2000 (Figure 4.1.1–1). East of this location, uranium concentrations either remain the same or decrease slightly at all other locations in the monitoring network. Uranium concentrations have continued to decrease in surface-water east of the Millsite since seep discharge to surface water was eliminated after the October 1994 sampling event. Changes during the last year are probably also due to the positive effects of Millsite remediation. The highest uranium concentrations were measured at seeps 4307 and 5215 (see Section 4.2.7, Figure 4.2.7–1) on the Millsite in April 2000 (1,480 µg/L and 824 µg/L, respectively). The high concentration of uranium was confirmed at seep 5215 in July 2000 (1,160 µg/L). The investigation of the source of uranium for seeps 4307 and 5215 has been referred to as the "Deer Draw" investigation because of the proximity of Deer Draw to the seeps. The status of the Deer Draw investigation is discussed in Section 4.2.7.

Vanadium is generally not detected in surface-water samples collected east of and on the Millsite. The maximum vanadium concentration of 6.4 µg/L was measured at SW92–06 in April 2000. Overall, vanadium concentrations have decreased substantially in surface water east of the Millsite since seep discharge to surface water was eliminated after the October 1994 sampling event. Recent declines in the vanadium concentration may be due to source removal activities on and off the Millsite.

4.1.2 Ground Water Results

Since tailings removal began in about April 1997 ground-water monitoring on the Millsite has been reduced to a few temporary wells along its northern margin and in the southwest corner. During the period reported in this progress report (July 1999 to July 2000), much of the alluvial aquifer on the Millsite remains dewatered and excavated to bedrock. The aquifer has yet to be reconstructed. Sample results from the temporary wells along the northern margin indicate that concentrations of some contaminants exceed background levels. The extent of contaminated ground water in this area is thought to be small. Alluvial ground water in the southwest corner of the Millsite (well 82–20) is not contaminated. Figures 4.1.2–1 through 4.1.2–7 illustrate the ground-water sampling locations and results for arsenic, manganese, molybdenum, nitrate, selenium, uranium, and vanadium from October 1999, April 2000, and July 2000. Alluvial and bedrock ground-water quality data is presented in Appendix D.

New downgradient wells continue to be added to the sampling network to improve the definition of the downgradient contaminant plume. Installation of new monitoring wells is summarized in Sections 4.2.3 and 4.2.4. In general, contaminant concentrations in the alluvial aquifer are about the same as before the Millsite was remediated. However, for some wells close to the Millsite (92–11, 92–07, and 88–85 for some contaminants) there is a trend towards decreasing concentrations during the last year. Selenium is the only COC identified in the RI that has shown a trend of increasing concentrations. The trend is most notable at wells 92–11 and 88–85 closest to the Millsite. Plots of concentration versus time for several wells are included in Appendix E.

Since October 1998, ground water samples collected from wells just east of the Millsite have shown large increases in nitrate, from about 5,000 µg/L or less to between 15,000 and 35,000 µg/L (reported as equivalent nitrogen [N]). The MCL for nitrate (as N) is 10,000 µg/L. No such impact has occurred in surface water. Nitrate results since November 1992 for the effected wells (92–11, 92–07, and 88–85) are shown in Figure 4.1.2–8. Farther downgradient, the increases have been much smaller and the MCL has not been exceeded (Figure 4.1.2–8).

Among the July 2000 sample results, the maximum nitrate concentration (55,100 µg/L) occurred in the sample collected from well MW00–08A, located on the eastern boundary of the Millsite (see Section 4.2.3, Figure 4.2.3–1). However, the levels of COCs in the same sample were low relative to typical concentrations from wells in that area prior to tailings removal. Samples collected from the two wells at the western edge of the Millsite (MW00–01 and MW00–02; see Section 4.2.3, Figure 4.2.3–1) contained about 900 and 400 µg/L nitrate as N, consistent with historical values at 92–05 located west of the highway. Nitrate in ground water beneath the eastern portion of the Millsite prior to surface remediation was typically about 2,000 to 7,000 µg/L. The data indicate a nitrate source on or along the north and south margins of the Millsite that was absent or isolated prior to tailings removal. The nitrate pulse appears not to be an effect of contaminant mobilization during tailings excavation, or any activity or land use east of the Millsite.

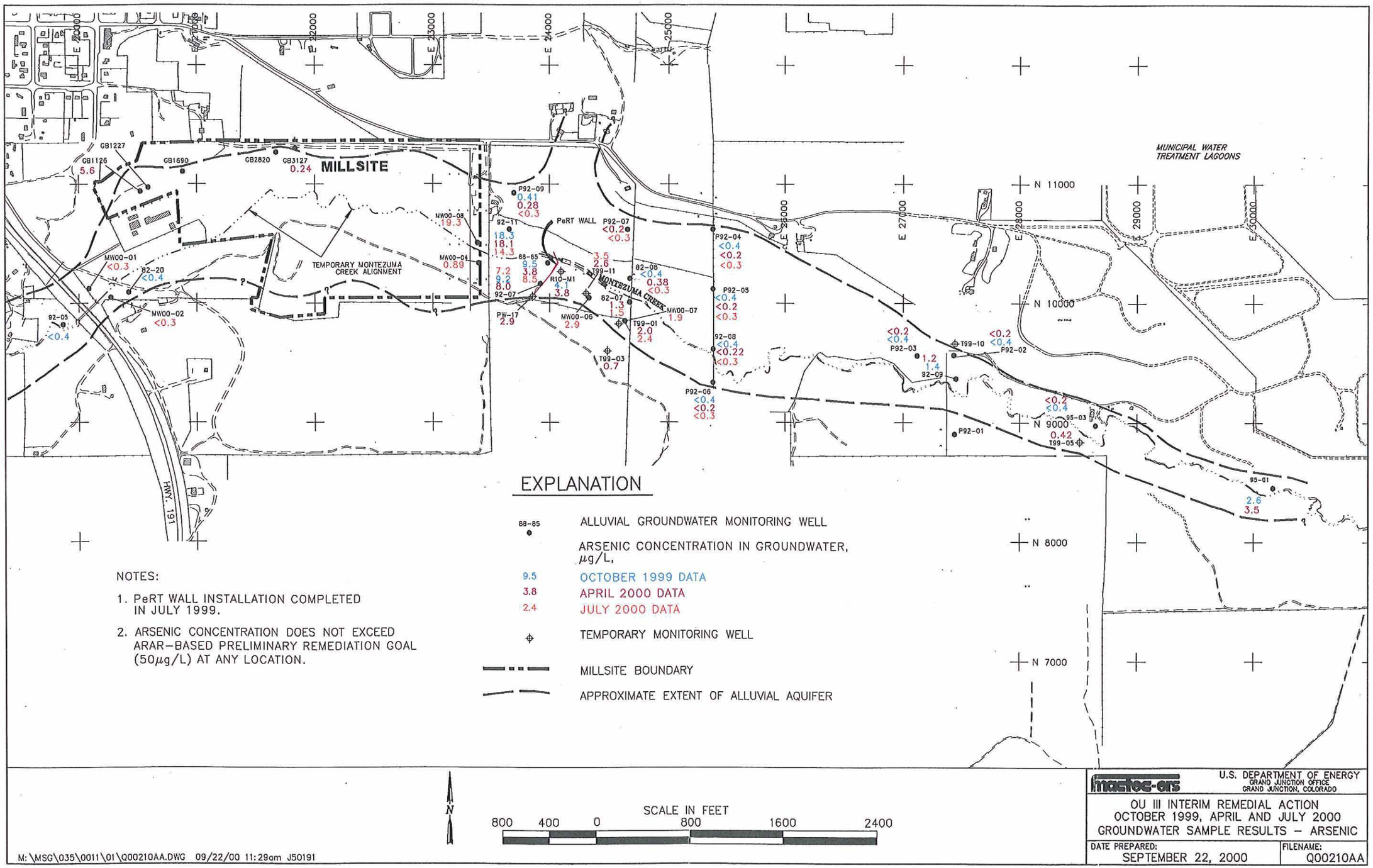

Figure 4.1.2–1. Ground Water Sample Results–Arsenic

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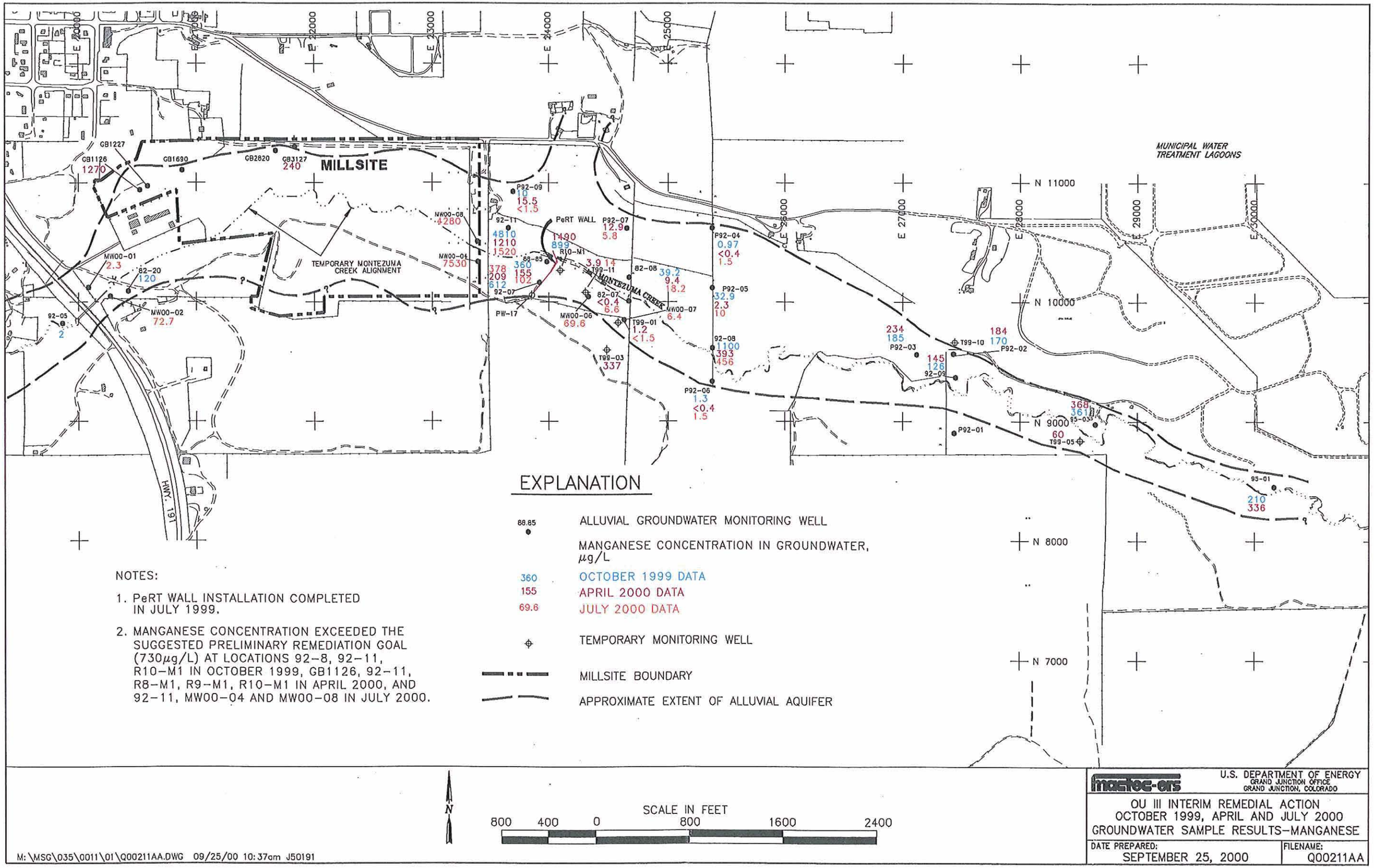

Figure 4.1.2-2. Ground Water Sample Results–Manganese

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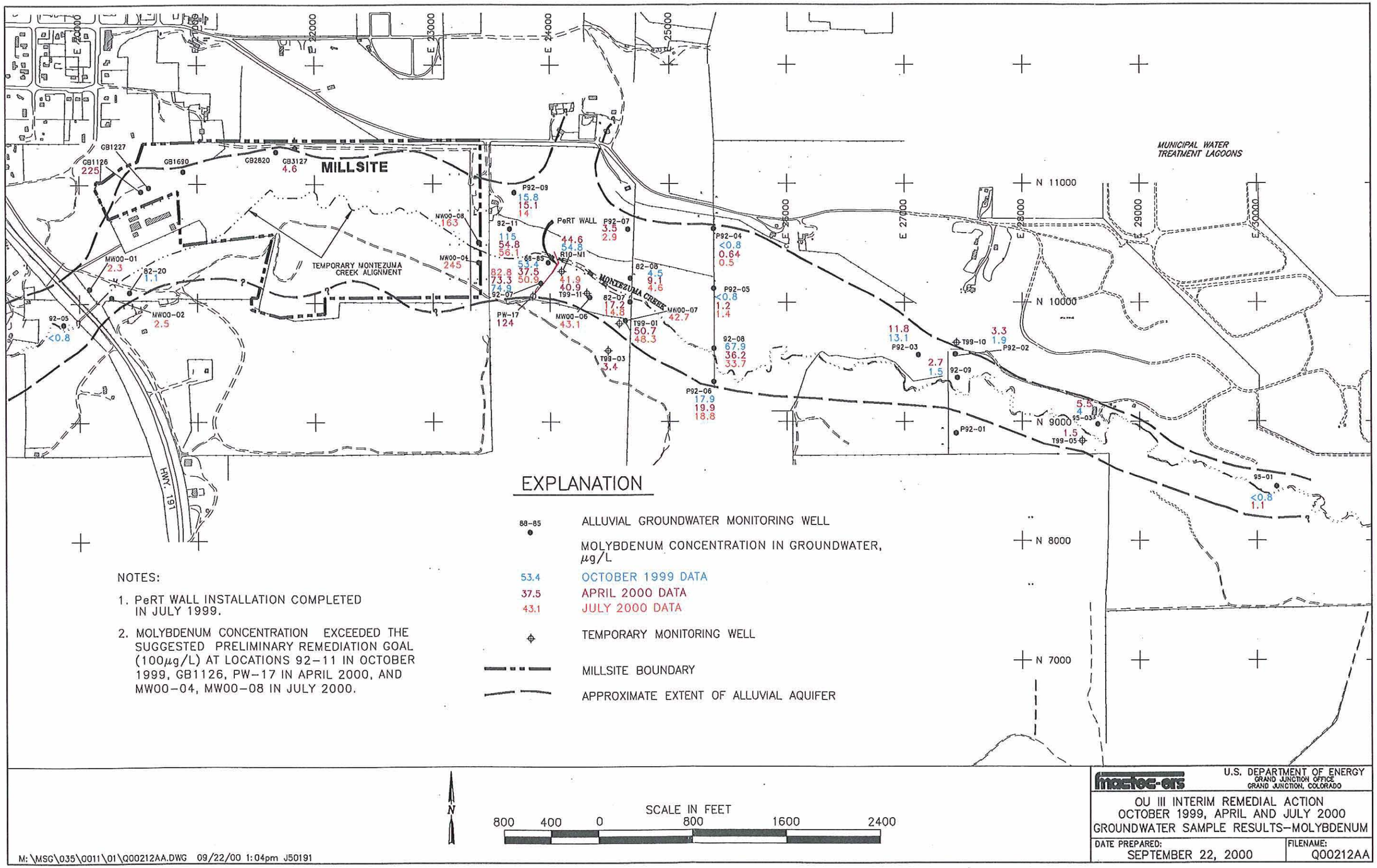

EXPLANATION

68-85 ●	ALLUVIAL GROUNDWATER MONITORING WELL
	MOLYBDENUM CONCENTRATION IN GROUNDWATER, µg/L
53.4	OCTOBER 1999 DATA
37.5	APRIL 2000 DATA
43.1	JULY 2000 DATA
⊕	TEMPORARY MONITORING WELL
	MILLSITE BOUNDARY
	APPROXIMATE EXTENT OF ALLUVIAL AQUIFER

NOTES:

1. PeRT WALL INSTALLATION COMPLETED IN JULY 1999.
2. MOLYBDENUM CONCENTRATION EXCEEDED THE SUGGESTED PRELIMINARY REMEDIATION GOAL (100µg/L) AT LOCATIONS 92-11 IN OCTOBER 1999, GB1126, PW-17 IN APRIL 2000, AND MW00-04, MW00-08 IN JULY 2000.

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U.S. DEPARTMENT OF ENERGY
GRAND JUNCTION OFFICE
GRAND JUNCTION, COLORADO

OU III INTERIM REMEDIAL ACTION
OCTOBER 1999, APRIL AND JULY 2000
GROUNDWATER SAMPLE RESULTS–MOLYBDENUM

DATE PREPARED: SEPTEMBER 22, 2000

FILENAME: Q00212AA

Figure 4.1.2–3. Ground Water Sample Results–Molybdenum

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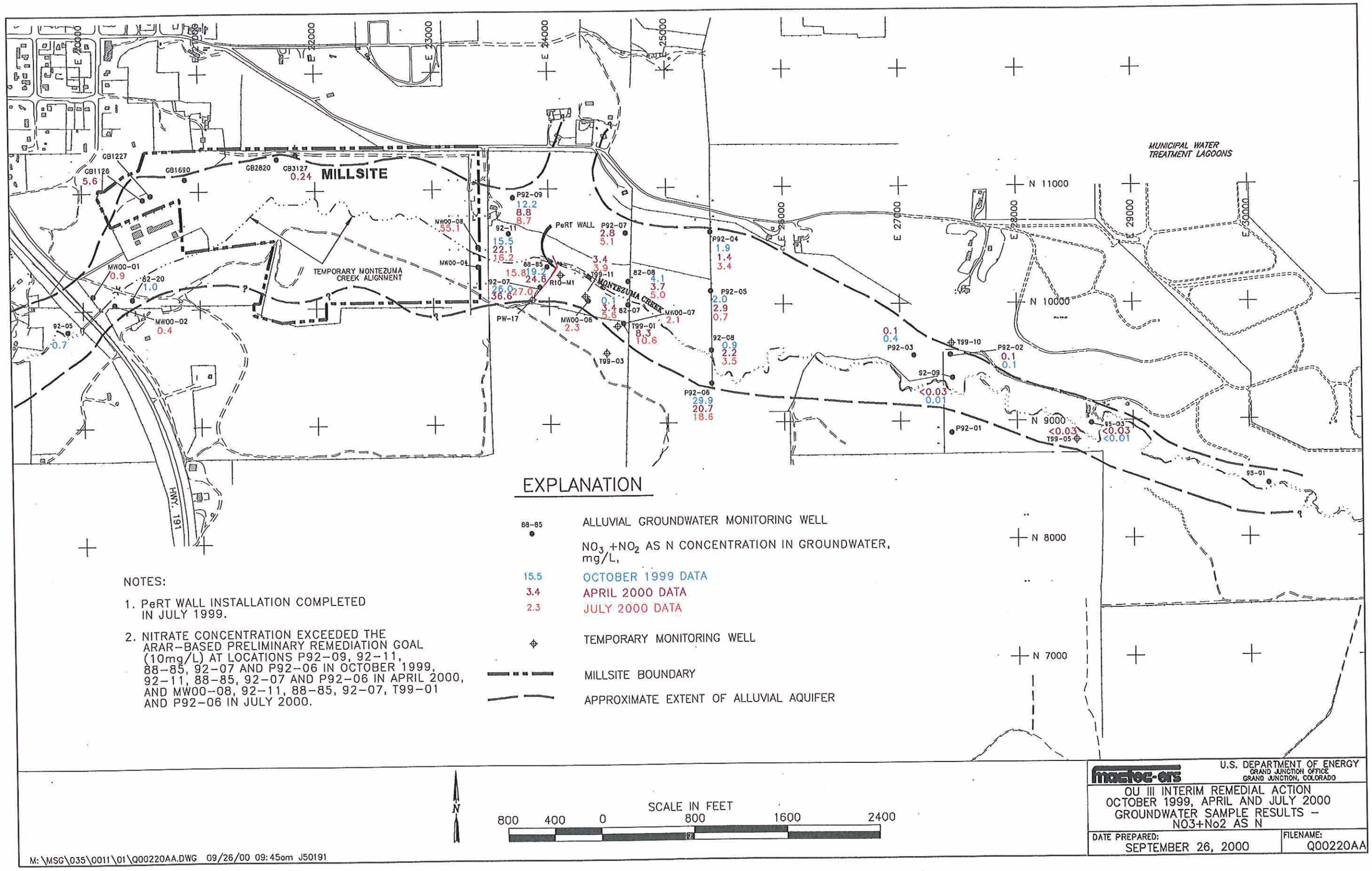

EXPLANATION

88-85 — ALLUVIAL GROUNDWATER MONITORING WELL

NO_3+NO_2 AS N CONCENTRATION IN GROUNDWATER, mg/L,

15.5 — OCTOBER 1999 DATA

3.4 — APRIL 2000 DATA

2.3 — JULY 2000 DATA

TEMPORARY MONITORING WELL

MILLSITE BOUNDARY

APPROXIMATE EXTENT OF ALLUVIAL AQUIFER

NOTES:

1. PeRT WALL INSTALLATION COMPLETED IN JULY 1999.
2. NITRATE CONCENTRATION EXCEEDED THE ARAR–BASED PRELIMINARY REMEDIATION GOAL (10mg/L) AT LOCATIONS P92–09, 92–11, 88–85, 92–07 AND P92–06 IN OCTOBER 1999, 92–11, 88–85, 92–07 AND P92–06 IN APRIL 2000, AND MW00–08, 92–11, 88–85, 92–07, T99–01 AND P92–06 IN JULY 2000.

N

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macTec-ers

U.S. DEPARTMENT OF ENERGY
GRAND JUNCTION OFFICE
GRAND JUNCTION, COLORADO

OU III INTERIM REMEDIAL ACTION
OCTOBER 1999, APRIL AND JULY 2000
GROUNDWATER SAMPLE RESULTS –
NO3+No2 AS N

DATE PREPARED: SEPTEMBER 26, 2000

FILENAME: Q00220AA

Figure 4.1.2–4. Ground Water Sample Results–Nitrate

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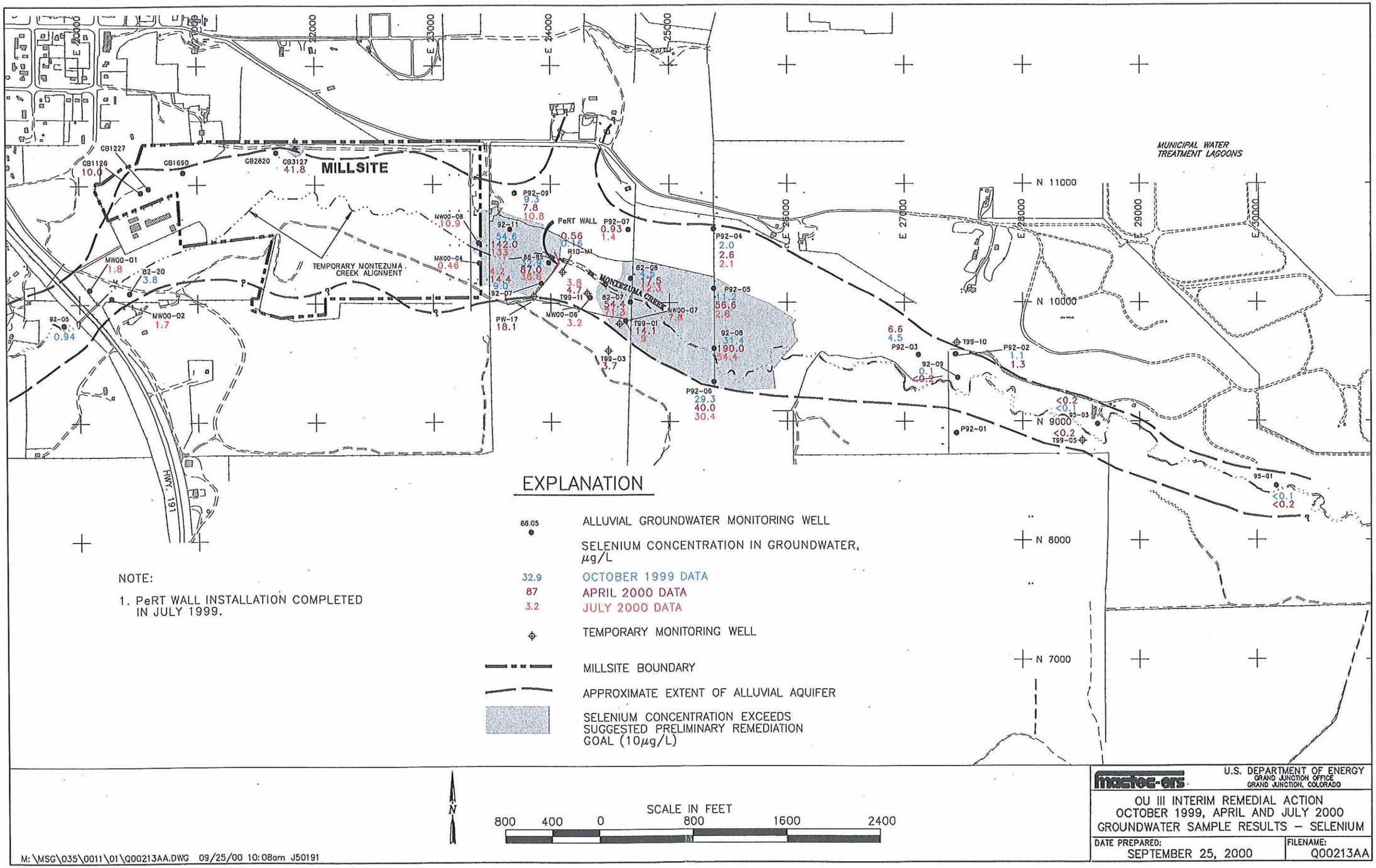

Figure 4.1.2–5. Ground Water Sample Results–Selenium

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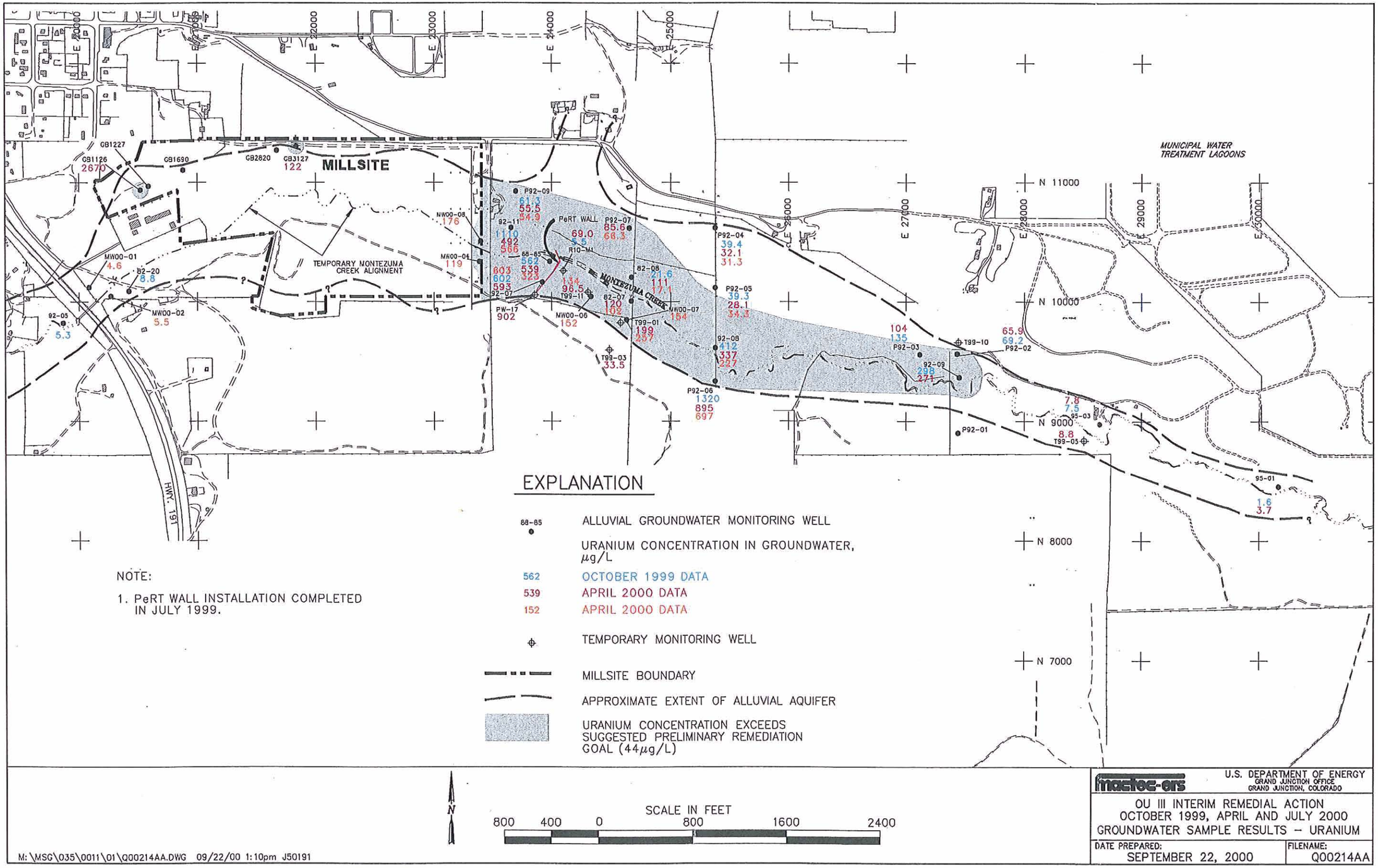

EXPLANATION

68-65 ●	ALLUVIAL GROUNDWATER MONITORING WELL
	URANIUM CONCENTRATION IN GROUNDWATER, µg/L
562	OCTOBER 1999 DATA
539	APRIL 2000 DATA
152	APRIL 2000 DATA
⊕	TEMPORARY MONITORING WELL
	MILLSITE BOUNDARY
	APPROXIMATE EXTENT OF ALLUVIAL AQUIFER
	URANIUM CONCENTRATION EXCEEDS SUGGESTED PRELIMINARY REMEDIATION GOAL (44µg/L)

NOTE:

1. PeRT WALL INSTALLATION COMPLETED IN JULY 1999.

N

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U.S. DEPARTMENT OF ENERGY
GRAND JUNCTION OFFICE
GRAND JUNCTION, COLORADO

OU III INTERIM REMEDIAL ACTION
OCTOBER 1999, APRIL AND JULY 2000
GROUNDWATER SAMPLE RESULTS – URANIUM

DATE PREPARED: SEPTEMBER 22, 2000

FILENAME: Q00214AA

Figure 4.1.2–6. Ground Water Sample Results–Uranium

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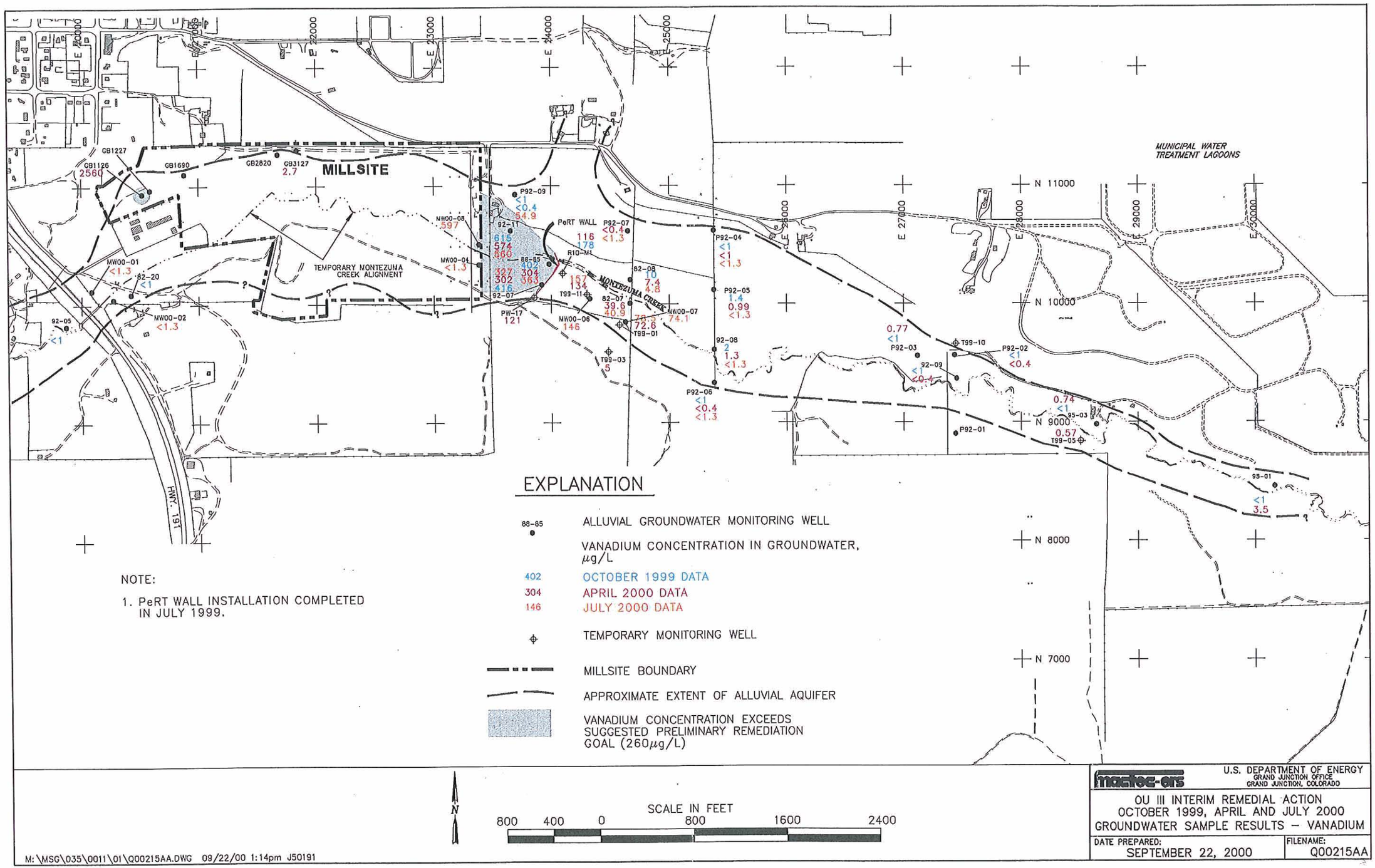

Figure 4.1.2–7. Ground Water Sample Results–Vanadium

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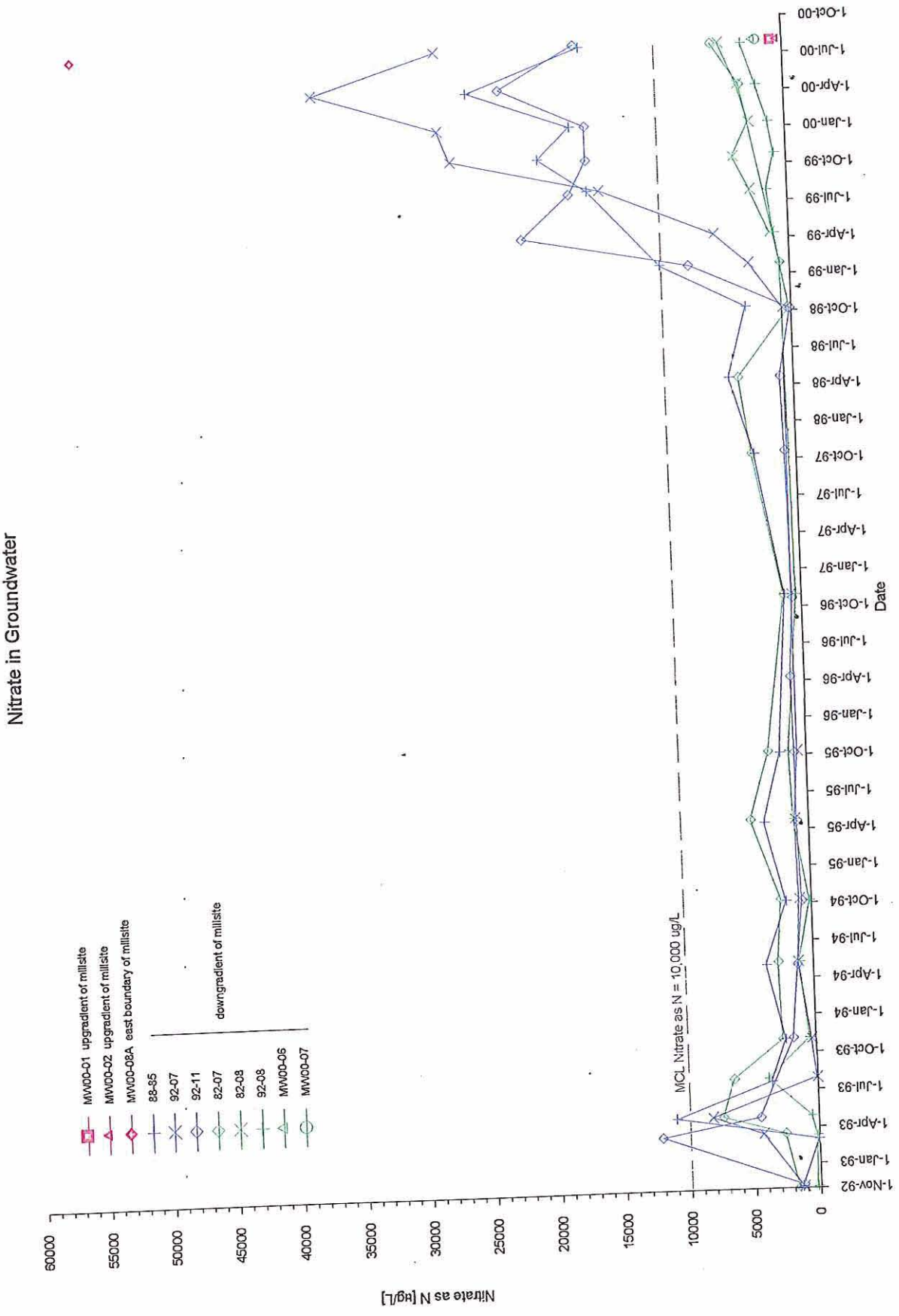

Figure 4.2.1–8. Ground Water Sample Results–Nitrate

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4.2. Data Collection

This section reports the status of data collection tasks to characterize conditions on the former Millsite that affect surface water, and ground water. The task status updates information presented in the August 1999 status report (DOE 1999f). Additional data interpretation is also provided.

4.2.1 Distribution of Metal COCs in Vadose Zone Soil

Soil samples were collected at 238 locations to characterize the distribution of COC metals in the upper six inches of the remediated surface on the Millsite. Another 64 samples were collected from the upper six-inch interval in areas that were remediated to bedrock. At 125 other locations, surface samples (115 soil and 10 rock) were collected for analysis of uranium and thorium to satisfy OU I verification objectives. Those uranium results are included in the discussions that follow. Surface soil sampling was completed in fall 1999.

As remediation of the Millsite proceeded, data from surface and subsurface soil samples and column leach tests (Section 4.2.2) was used to guide soil removal beyond the depth of radiological contamination. The additional soil removed has been loosely referred to as "residual vadose zone" (RVZ), although in many areas of the Millsite the soil would be saturated if the alluvial aquifer was restored. This resulted in the removal of a 2-ft layer beneath areas of each pile and a 4-ft layer along the toe of the Vanadium Pile. Soil samples from those intervals are not included in the final characterization results presented in this report. The new surface was not re-sampled in some areas after the additional soil was removed.

At 56 of the surface locations, a sample was also collected from the 2 – 3 ft depth interval; additional depth sampling up to 7 ft below the remediated surface was completed at 20 of those 56 locations. The depth samples did not include bedrock material. Depth intervals presented in this report have been adjusted to account for soil removal after sample collection. For example, samples collected 2 – 3 ft below the original verified surface, prior to removing an additional 2-ft layer, are presented as surface samples. Subsurface sampling was completed in winter 1999.

Surface Sample Results

Sample locations and results for the final remediated surface (0 – 6-inch depth interval) are shown in Plates 1 to 3 for arsenic, uranium, and vanadium, respectively. These elements are the primary components of risk due to consumption of ground water in OU III. Also shown are areas where soil was removed below the depth of radiological contamination ("RVZ" removal areas) and areas where soil removal extended to bedrock. The actual area of exposed bedrock is greater than appears in Plates 1 to 3. The maps will be updated after field mapping is completed during fall 2000. Laboratory results for the surface soil samples are tabulated in Appendix G–1. Summary statistics and frequency distributions for arsenic, uranium, and vanadium results are shown in Table 4.2.1–1 and Figures 4.2.1–1 to 4.2.1–3.

Table 4.2.1–1. Summary of Surface Sample Results

	Arsenic (mg/kg)			Uranium (pCi/g)			Vanadium (mg/kg)		
	All	*Soil*	*Bedrock*	*All*	*Soil*	*Bedrock*	*All*	*Soil*	*Bedrock*
Mean	10.3	10.6	9.2	8.5	7.0	15.5	37.6	38.5	33.9
Number of Samples	301	237	64	427	353	74	302	238	64
Minimum Concentration	1.6	1.6	2.9	1	1.36	1	3.2	3.2	4.4
Maximum Concentration	25.7	25.7	22.1	231.7	53.5	231.7	410	410	159
Standard Deviation	3.5	3.3	4.1	15.0	4.7	33.7	32.2	33.0	29.2

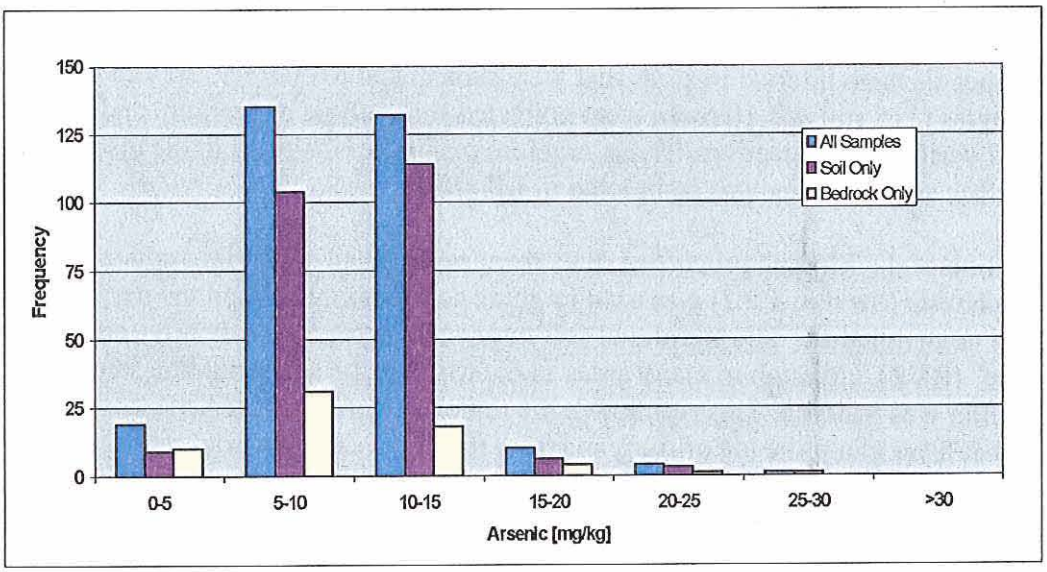

Figure 4.2.1–1. Arsenic Concentrations in Surface Soils

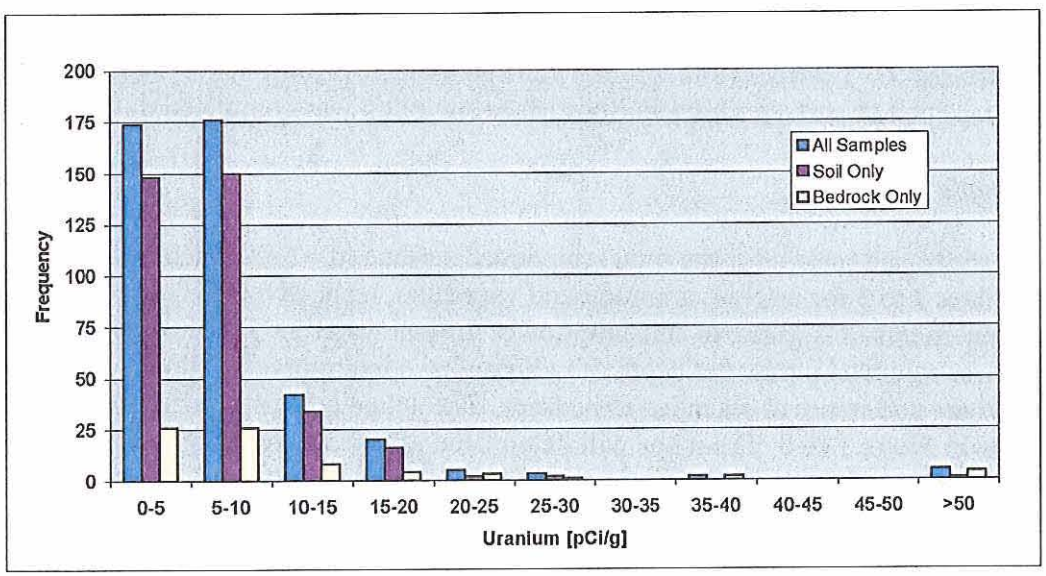

Figure 4.2.1–2. Uranium Concentrations in Surface Soils

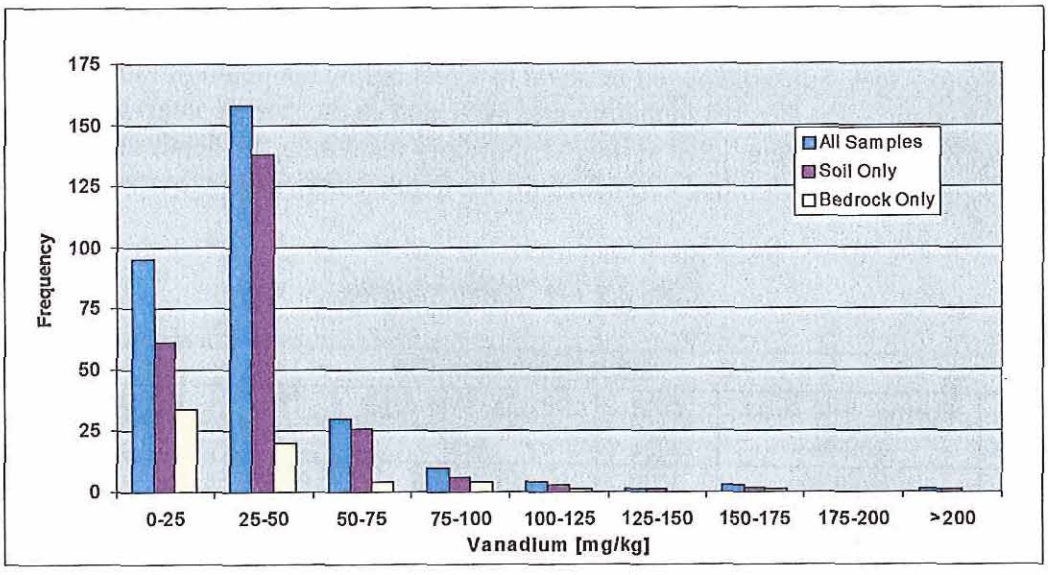

Figure 4.2.1–3. Vanadium Concentrations in Surface Soils

Arsenic concentrations in the upper six inches of soil and bedrock are narrowly distributed about a mean of about 10 mg/kg. Mean concentrations and deviation from the mean among bedrock and soil sample groups are very similar. Arsenic concentrations in about 50 percent of both soil and bedrock samples are ≤10 mg/kg, and 95 percent of the samples are ≤15 mg/kg. In map view, arsenic concentrations beneath the former Acid Pile appear to be slightly less than beneath the Carbonate, Vanadium, and East Piles (Plate 1).

The average concentration of uranium in bedrock samples is greater than in the soil samples. The bedrock results also exhibit a wider positive deviation from the bedrock mean (15.5 pCi/g). These probably result from the greater frequency of outlier values among the bedrock samples. In map view, the higher concentrations are associated with two bedrock areas northwest of the former Carbonate Pile, and in the bedrock area of the East Pile (Plate 2). The soil sample data indicate a narrow distribution about the mean of 7 pCi/g. Uranium concentrations in about 95 percent of the soil samples are ≤15 pCi/g.

Average concentrations of vanadium are similar between soil and bedrock sample groups. Bedrock and soil samples also display a similarly narrow distribution about the respective means. About 90 to 95 percent of all samples contain less than 75 mg/kg vanadium. The higher outlier samples tend to be associated with the central and southern portions of the Carbonate and Vanadium Piles (Plate 3).

Depth Sample Results

Depth-sample location information is summarized in Table 4.2.1–2. All depths are relative to the final remediated surface. Some depth samples were collected prior to the removal of soil below the depth of radiological contamination. Samples collected from the removed intervals are not included in the table or in the characterization results presented in this report. Deeper samples

have been adjusted up accordingly. For example, the grid 3051 sample was originally collected at a depth of 6 to 7 feet. Subsequent soil removal to 4 feet below the depth of radiological contamination occurred in the area including grid 3051 and so the sample interval is reported as 2 to 3 feet below the final remediated surface. Laboratory results for the depth samples are included in Appendix G–2. Summary statistics for the depth samples are provided in Table 4.2.1–3.

Table 4.2.1–2. Depth Samples

2-3 ft Depth Samples					
Grid	**Former Pile Area**	**Grid**	**Former Pile Area**	**Grid**	**Former Pile Area**
1223	Off-Pile	3291	Acid	4122	East
1845	Carbonate	3339	Vanadium	4148	East
2037	Carbonate	3417	Vanadium	4458	East
2067	Carbonate	3584	Acid	4719	Off-Pile
2337	Carbonate	3593	Acid	4775	East
2618	Vanadium	3635	East	4849	East
2805	Vanadium	3653	Acid	4851	East
2951	Acid	3668	Off-Pile	5056	East
3051	Vanadium	3710	East	5058	East
3104	Acid	3915	East	5193	East
3146	Vanadium	3964	Off-Pile	5400	East
3164	Acid	4062	Off-Pile	5507	Off-Pile
2-3, 4-5, and 6-7 ft Depth Samples					
1513	Carbonate	2153	Carbonate	3923	Off-Pile
1668	Carbonate	2409	Carbonate	4359	East
1670	Carbonate	2919	Vanadium	4384	Off-Pile
1853	Carbonate	3022	Vanadium	4644	East
1880	Carbonate	3238	Vanadium	4951	East
1975	Carbonate	3287	Acid	5300	East
2041	Carbonate	3395	Acid		

Sample means for arsenic (Table 4.2.1–3) suggest a slight increase in concentration with depth. Figure 4.2.1–4 reveals however, that the averages are biased by one or two outliers, and that concentrations may not vary or decrease with depth. Each point on the plot (and on Figures 4.2.1–5 and 4.2.1–6) represents a sample from the respective depth interval. Grid 2409 had the maximum arsenic concentrations for each interval below 12 inches. Except for those points, arsenic concentrations appear to be narrowly distributed about the means. On average, uranium concentrations in the depth samples are less than surface samples. The concentrations also exhibit less variability with depth (Figure 4.2.1–5). The results suggest that less uranium is present at depth, relative to the surface soil. Vanadium concentrations range widely in the zero to 12 and 24 to 36-inch depth intervals, where the means are 39 and 52 mg/kg, respectively. In the lower depths, vanadium concentrations are less variable about means of 45 and 33 mg/kg. Vanadium results are plotted against sample depth interval in Figure 4.2.1–6.

Table 4.2.1–3. Summary Statistics for Depth Soil Samples

	Arsenic mg/kg				Uranium pCi/g				Vanadium mg/kg			
Depth [in]	0-12 in**	24-36 in	48-60 in	72-84 in	0-12 in**	24-36 in	48-60 in	72-84 in	0-12 in**	24-36 in	48-60 in	72-84 in
Mean	10.6	13.0	15.4	15.4	7.0	5.7	5.2	5.2	38.5	51.8	45.3	33.4
Number of Samples	237	56	20	18	353	56	19	18	238	56	20	18
Minimum Concentration	1.6	5.1	5.2	7.8	1.36	2	3.1	2.8	3.2	9.8	17	20.6
Maximum Concentration	25.7	95.9	96.3	85.7	53.5	22.7	10.7	11.3	410	516	371	117
Standard Deviation	3.3	12.1	19.3	17.7	4.7	4.0	2.5	2.5	33.0	80.3	77.2	22.1

**Statistics calculated from all surface soil samples.

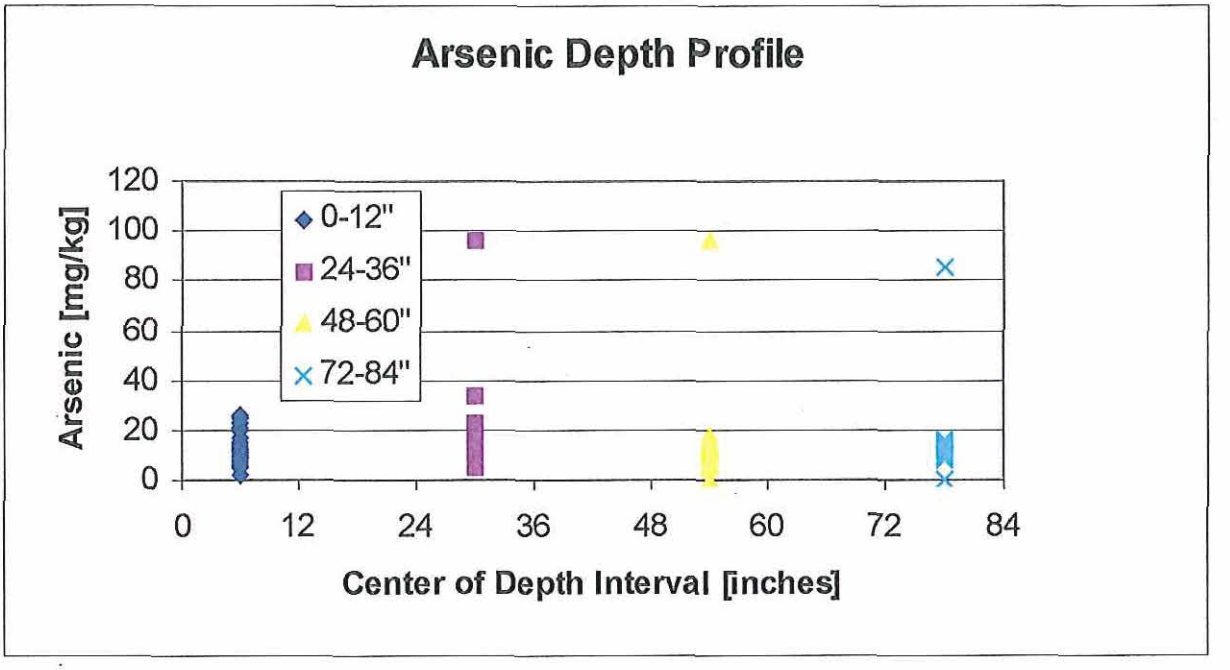

Figure 4.2.1–4. Arsenic Depth Profile

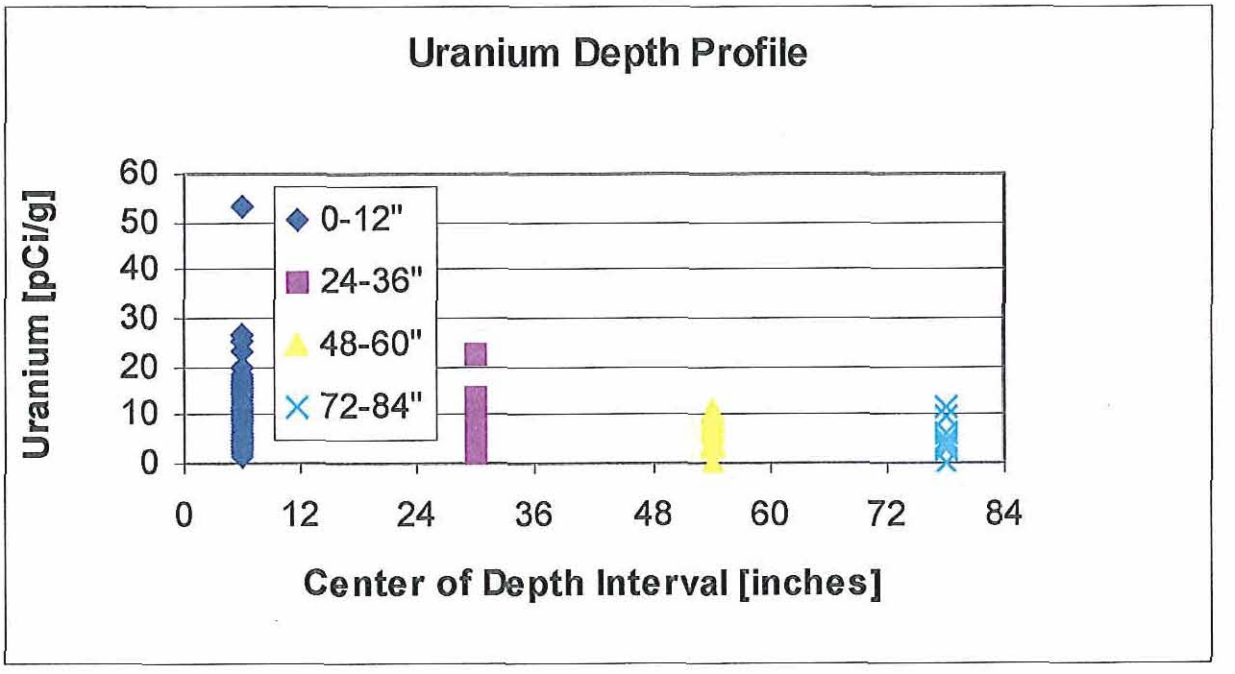

Figure 4.2.1–5. Uranium Depth Profile

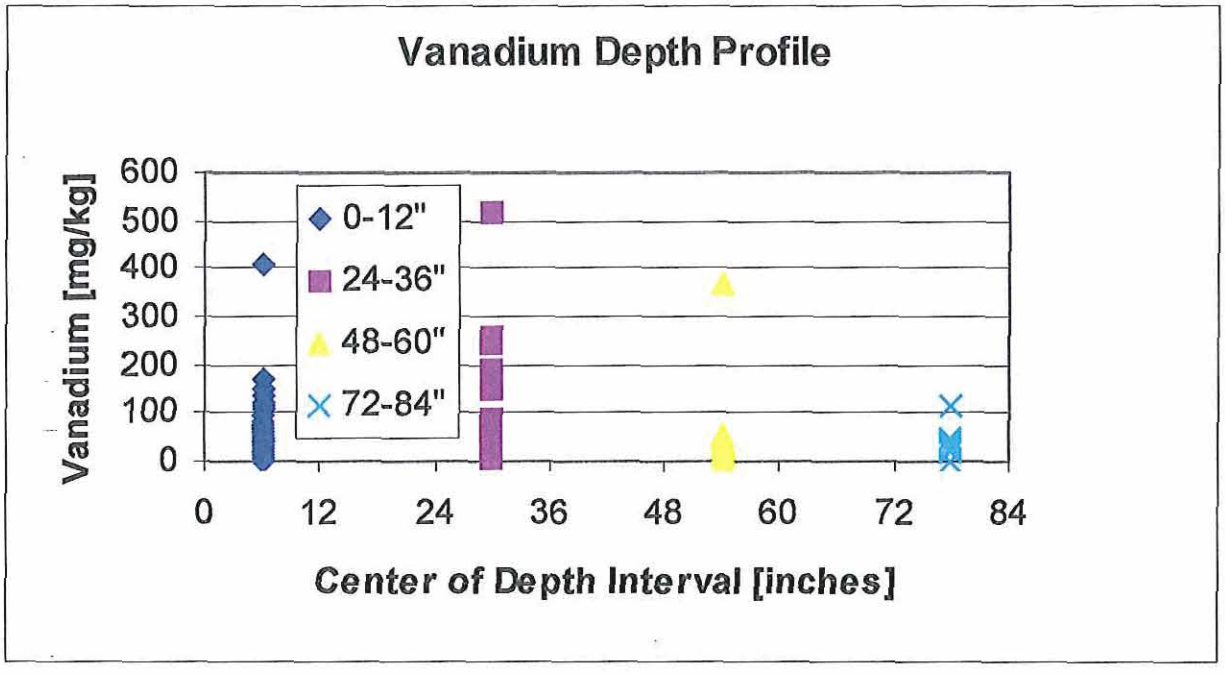

Figure 4.2.1–6. Vanadium Depth Profile

4.2.2 Characterize Mobility of COCs in Vadose Zone

Column leach testing was performed to determine if post-remediation soil was a potential source of ground water contamination. Soil samples used in the column tests were collected from sub-pile areas that had been remediated to a radiological standard (Ra-226). Leaching of arsenic, uranium, and vanadium was evaluated. The column testing was completed in May 2000.

Summary of Vadose Zone Column Tests

Twenty-two column experiments were performed at the Environmental Sciences Laboratory (ESL) at the DOE Grand Junction Office. Columns were run with three fluid compositions (synthetic) to simulate different waters that might leach unsaturated zone soil in future scenarios, which are: infiltration of precipitation (12 complete tests, 1 partial test), a rising ground water table (5 complete tests, 1 partial test), and infiltration of irrigation water containing components of fertilizer (3 complete tests). Six tests were originally planned to evaluate the effect of fertilizer on leaching, however three tests were omitted after it was learned that the former Millsite would not be restored as a golf course. Conditions of each column test are summarized in Table 4.2.2-1. Pertinent details regarding the objectives, scope, and design of the study are presented in the Interim Remedial Action Work Plan for Operable Unit III (DOE 1999g). The ESL has prepared a report that further describes the methods used and results of the leaching studies (DOE 2000).

Table 4.2.2–1 Vadose Zone Column Conditions

Sample Number	Influent Composition	Sample Depth (ft)	Sediment Weight (g)	Pore Volume (mL)	Total[a] Pore Volume	Total[a] Volume (mL)	Total[a] Run Time (hrs)
1845	Loyd's Lake	2 – 3	1000	563	15.1	8486	170
2037	Loyd's Lake	0 – 0.5	1031	540	10.2	5495	130
2153	Loyd's Lake	2 – 3	1277	565	22.0	12425	257
2618	Loyd's Lake	0 – 0.5	997	611	12.1	7420	168
2919	Loyd's Lake	4 – 5	1232	440	13.3	5864	132
3051	Loyd's Lake	0 – 0.5	1210	430	29.0	12465	266
3164	Loyd's Lake	2 – 3	1419	380	15.0	5700	120
3287	Loyd's Lake	2 – 3	1312	428	27.7	11861	236
3417	Loyd's Lake	2 – 3	1150	515	10.9	5607	130
3710	Loyd's Lake	2 – 3	1364	403	4.1	1641	58
3710–II	Loyd's Lake	2 – 3	1299	427	13.2	5646	120
4847	Loyd's Lake	2 – 3	1214	445	9.6	4288	96
4849	Loyd's Lake	2 – 3	1157	468	21.3	9956	214
2153	Ground water	2 – 3	1099	424	13.5	5708	130
2618	Ground water	0 – 0.5	1227	539	12.7	6828	141
2919	Ground water	4 – 5	1086	433	12.7	5516	120
3287	Ground water	2 – 3	1283	423	19.8	8376	167
4847	Ground water	2 – 3	1111	400	14.3	5733	121
4849	Ground water	2 – 3	1108	203[b]	4.1	822	45
2037	golf course	0 – 0.5	854	488	10.4	5051	107
3051	golf course	0 – 0.5	878	430	11.4	4907	108
3417	golf course	2 – 3	968	476	10.8	5122	109

[a]Not including bromide tracer experiments.
[b]Suspect measurement, leaky column with flow blockage: test aborted.

The soil samples and column tests are identified by their respective grid block within the OU I verification grid (Figure 4.2.2–1) and fluid composition. Some samples were composites of several locations within a grid block. Discrete depth intervals up to 5 ft below the remediated surface were sampled. Most samples consisted of fine sandy silt, with some clay and occasional gravel. The samples from grids 3287 and 3164 were composed of sand and gravel with few fines.

At the ESL, the samples were dried then manually disaggregated. The occasional gravel in the fine-grained samples was handpicked and removed. Coarse gravel (>0.75 in.) and cobbles were removed in the field for samples 3287 and 3164, which accounted for about 25 percent of the original volume. Soils used in the tests were first analyzed at the GJO Analytical Chemistry Laboratory (ACL) for arsenic, uranium, and vanadium. Analytical results for the soils are shown in Table 4.2.2–2.

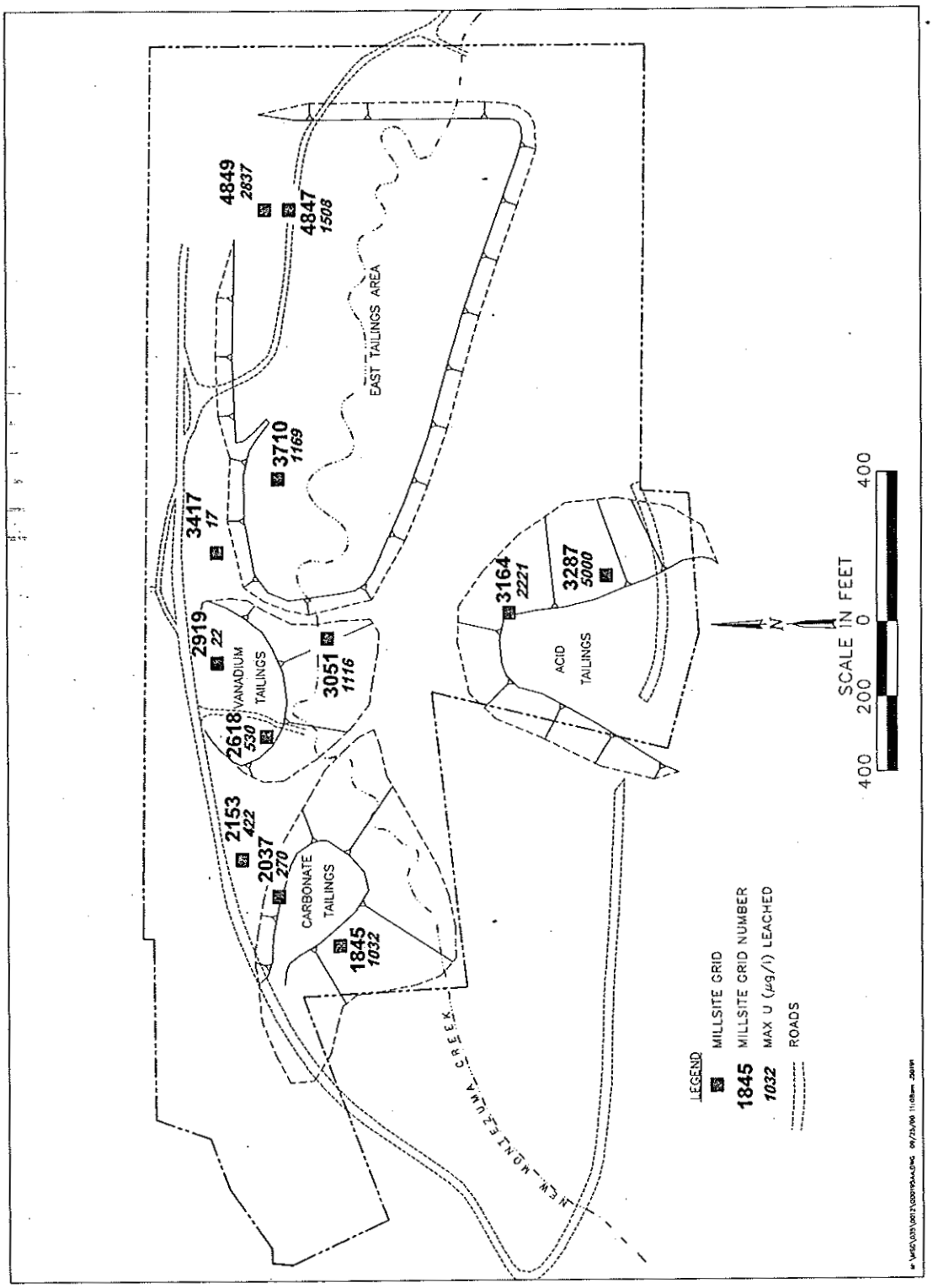

Figure 4.2.2–1. Locations of Soil Samples Used in Column Testing

Table 4.2.2–2 Concentrations of Arsenic, Uranium and Vanadium in Soils Before Column Testing

Sample	Arsenic (mg/kg)	Uranium (pCi/g)	Vanadium (mg/kg)
1845	10.4	12.9	31.9
2037	12.4	5.2	48.4
2153	12.5	5.6	42
2618	14–27	7	53–121
2919	10.1	3.1	29
3051	34.6	7.7	408
3164	10.7	6.4	42.9
3287	10.6	10	35.1
3417	12.6	3.3	18.5
3710	13.5	12.1	58
4847	9.3	9.2	29.5
4849	10.8	22.7	25.7

During the leaching portion of the experiments, concentrations of uranium, pH, electrical conductivity, oxidation-reduction potential, and alkalinity were measured in the ESL soon after sample collection. Samples were collected at a minimum frequency of one per pore volume (about every 12 hours). The columns were run for at least 10 pore volumes. To observe longer-term concentration levels, some columns were run for up to 29 pore volumes. Effluent samples were collected and submitted to the GJO ACL for analysis of arsenic, uranium, vanadium, and major inorganic ions.

Flow to the columns was interrupted in six tests for prolonged periods to determine if a rate-limiting step was evident in the leaching process. In addition, bromide tracer experiments were conducted to estimate dispersivity coefficients in the columns. The results of the leaching tests will be used along with geohydrologic modeling to estimate the impact these soils may have on contamination to the underlying aquifer. Some of the early results of the ESL column experiments were used to identify areas in which additional (nonradiologic) soils were removed to help meet ground-water quality standards.

Vadose Zone Column Test Results—Uranium

The results of 13 baseline mobility tests for uranium are illustrated in Figure 4.2.2–2. The influent, called "Loyd's Lake" water, was simulated from the composition of samples collected from OU III location SW92–01, on South Creek near the outflow from Loyd's Lake. The composition is intended to represent irrigation water or precipitation that contacts the subpile soil.

The graphs clearly show that leachable uranium is present in soil with uranium concentrations greater than about 5 pCi/g. Columns 3417 and 2919 did not leach uranium. The concentration of uranium in those samples was about 3 pCi/g, which is consistent with background levels in OU II reference area soil samples. The column test results show good agreement between initial soil concentration and effluent concentration. Uranium concentrations in about 60 percent of subpile surface samples were greater than 5 pCi/g. About 30 to 35 percent of the depth samples exceeded 5pCi/g uranium. These results suggest that leachable uranium is present throughout the depth intervals sampled; however, the amount apparently decreases with depth.

Maximum uranium concentrations in the effluent ranged from about 0.5 to 3.5 parts per million (ppm) (500 to 3,500 µg/L or parts per billion [ppb]). Peak concentrations typically occurred after several pore volumes had passed. The cause of this is not known but may be related to preferential flow in the early stages of the experiments. A period of relatively rapid flushing through several or more pore volumes then occurs until levels reach between about 0.25 and 0.5 ppm. In the later stages of the experiments effluent concentrations decrease much more gradually. Persistent tails appear to converge to levels on the order of 100 to several hundred ppb. Complete leaching of uranium did not occur in any test. Normalizing the column test conditions to a 1-meter thick subpile layer, the flushing period is about 6 years per pore volume assuming 25 percent porosity and 4 cm recharge annually (equivalent to 10 percent of annual precipitation). Under these assumptions, the 5 to 10 column test pore volumes required to flush most of the uranium from the soil is equivalent to 30 to 60 calendar years.

Flow to five columns was temporarily interrupted for periods ranging between 55 and 97 hours. This was done to determine if concentrations would rebound to a higher level after flow was resumed. Significant rebounding would be a qualitative indication of a rate limiting step in the leaching process. The periods of flow interruption are shown in Figure 4.2.2–2. A rebound is seen in each instance. Except in column 4849 however, the effect is mild relative to the concentrations during the early part of the tests. This would indicate that to some degree the effluent (or soil water) concentration could be a function of the flow rate through the medium. In the vadose zone, where flow rates are expected to be much lower, concentrations may therefore persist at the higher levels observed in the columns.

Uranium leaching was not observed to be very sensitive to fluid composition. In Table 4.2.2–1 and Figure 4.2.2–3, the fluid called "Ground water" was simulated from OU III sample results at well 92–05, which is upgradient of the former Millsite. The solution is slightly acidic (pH = 6.7) but is otherwise similar to the composition of Loyd's Lake water (pH = 7.8). For a given sample, the curves shown in Figure 4.2.2–3 essentially overlap. The results of the "Golf Course" leach (Table 4.2.2–1 and Figure 4.2.2–4) suggests that the fertilizer components either have no effect or reduce uranium mobility.

In summary, the results indicate that uranium is readily mobilized under the column test conditions. By extrapolation, the sub-pile vadose zone represents a source of contamination to ground water for a relatively long period if leached by ground water, irrigation water, or precipitation. However, the impact on ground-water quality depends on the infiltration rate, thickness and area of the subpile layer, and volumetric flux of the ground water beneath the source, in addition to source concentration and contaminant mobility.

Vadose Zone Column Test Results—Arsenic

Arsenic desorption curves using Loyd's Lake water are shown in Figure 4.2.2–5. The most significant leaching occurred in column 3051, where the initial soil concentration (35 mg/kg) was about triple that in the other columns. The peak concentration in the column 3051 test was 43 ppb. Arsenic concentrations in many of the effluent samples of the remaining tests were less than or only slightly above the limits of detection. The peak concentration among those tests was 14 ppb (column 2618). In the columns with leachable arsenic (i.e., columns 3051, 2618, and 2153), early peaks are followed by relatively flat tails at about one-half the concentration of the peak value. Neither rapid nor complete leaching of these samples occurred.

With the exception of sample 3287, arsenic concentrations were consistently greater in the effluent of the acidic leach (Figure 4.2.2–6, "Ground Water" leach) than in the Loyd's Lake effluent. Arsenic concentrations in the effluent of both 3287 tests were near or below detection limits. Although arsenic mobility appears to be favored by mildly acidic conditions, the resulting concentrations remained relatively low. The results of the "Golf Course" leach (Figure 4.2.2–7) suggests that fertilizer components may reduce the mobility of arsenic. The effect of interrupting flow was very subtle or absent.

Arsenic concentrations in about 90 to 95 percent of surface and depth samples were ≤15 mg/kg. Averages for surface samples and in discrete depth intervals are about 10 to 12 mg/kg, excluding several anomalous depth samples. The column soils, except 3051, contained arsenic between 9.3 and 13.6 mg/kg. Arsenic leaching from those columns was minor or absent. The subpile soil is not likely an important source of arsenic contamination to ground water

Vadose Zone Column Test Results—Vanadium

Vanadium desorption curves for the Loyd's Lake fluid are shown in Figures 4.2.2–8 and 4.2.2–9. The most significant leaching occurred from sample 3051, which also had the highest initial soil concentration (408 mg/kg). The graphs show that leachable vanadium is present when soil concentrations exceed about 60 mg/kg. Desorption was not rapid or complete in these tests (columns 3071, 2618, and 3051). The vanadium concentration in 90 to 95 percent of subpile samples (surface and depth) was less than 60 mg/kg. The maximum effluent concentration for column samples with less than 60 mg/kg was 18 ppb vanadium. Most results were near or less than the limits of detection. Similar to the arsenic results, the mobility of vanadium may be slightly greater in the acidic leach test and possibly less mobile in the Golf Course leach (Figures 4.2.2–10 and 4.2.2–11). The data is not sufficient to evaluate the effect of interrupting flow. Subpile soil is not likely to be a significant source of vanadium to the ground water.

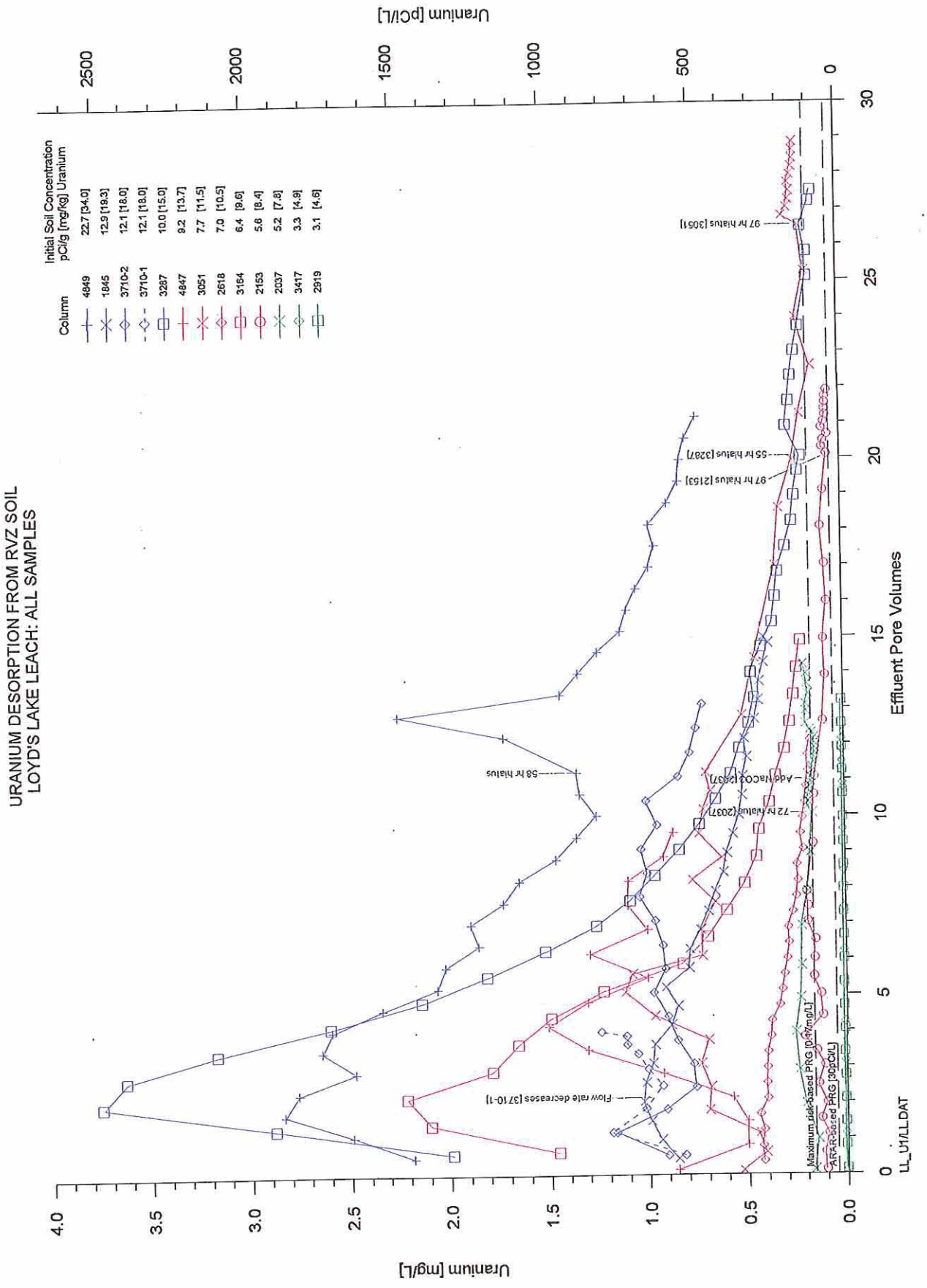

Figure 4.2.2–2. Uranium Desorption From RVZ Soil–Loyd's Lake Leach All Soils

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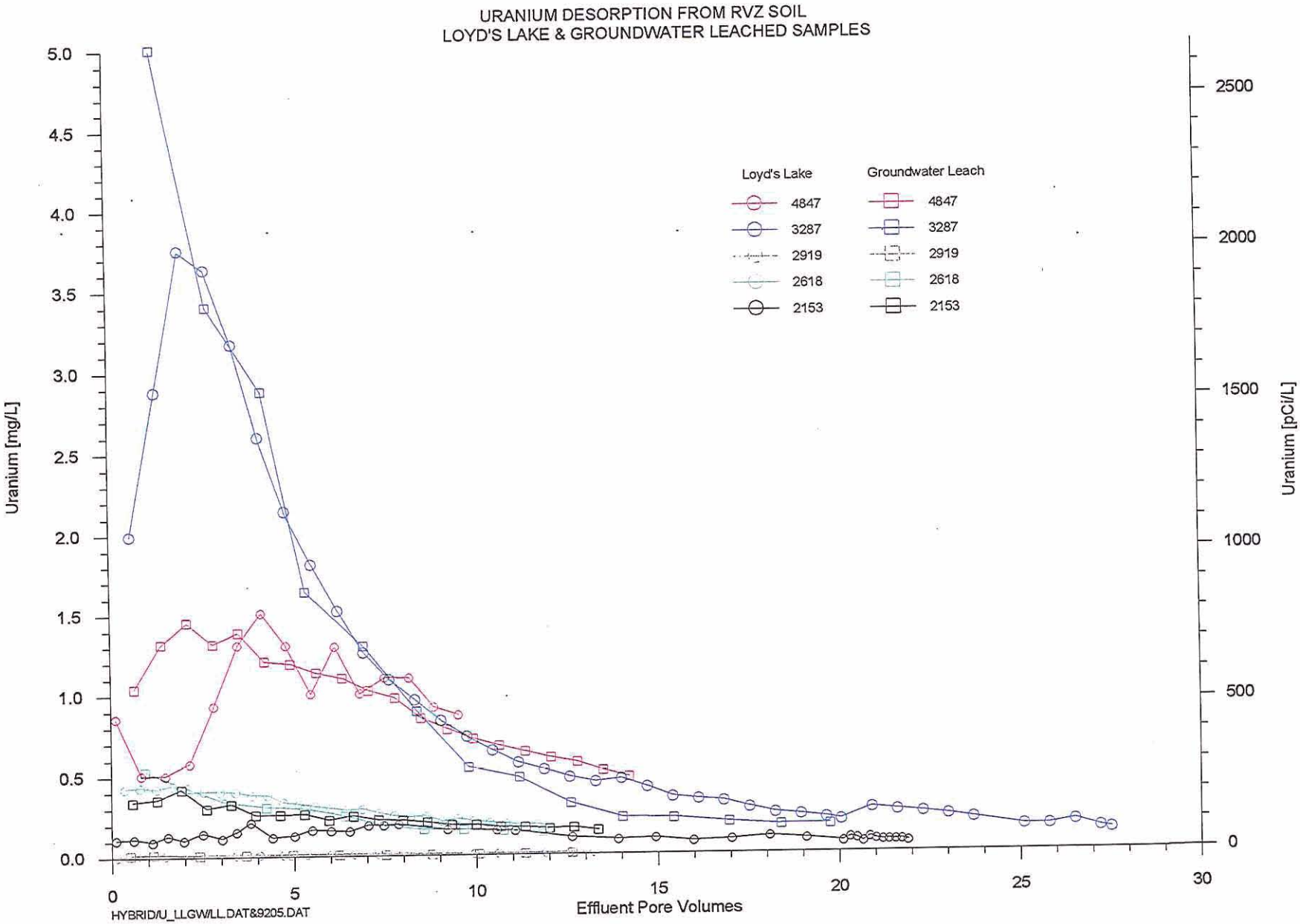

Figure 4.2.2–3. Uranium Desorption From RVZ Soil–Loyd's Lake and Ground Water Leached Samples

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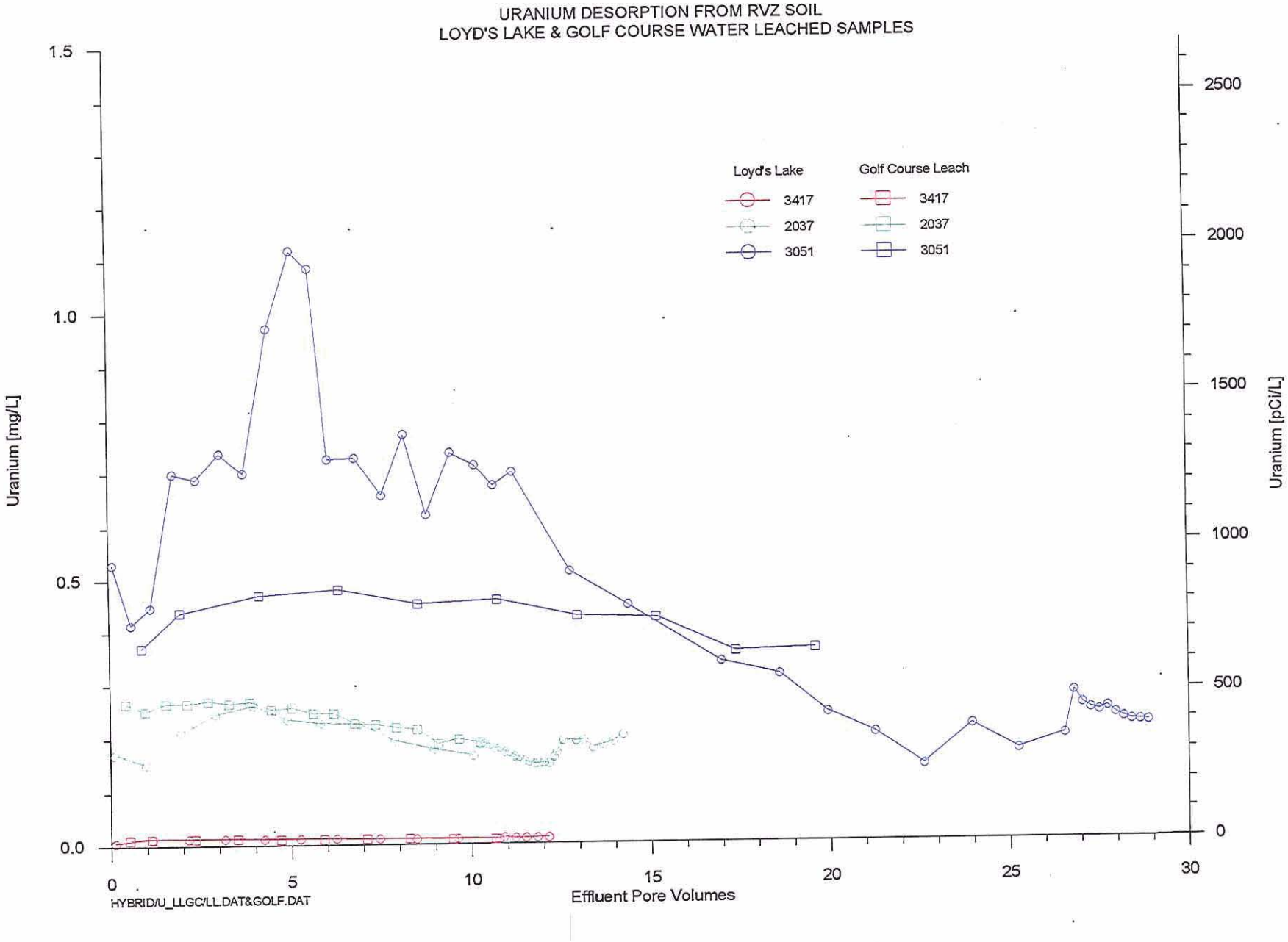

Figure 4.2.2–4. Uranium Desorption From RVZ Soil–Loyd's Lake and Golf Course Water Leached Samples

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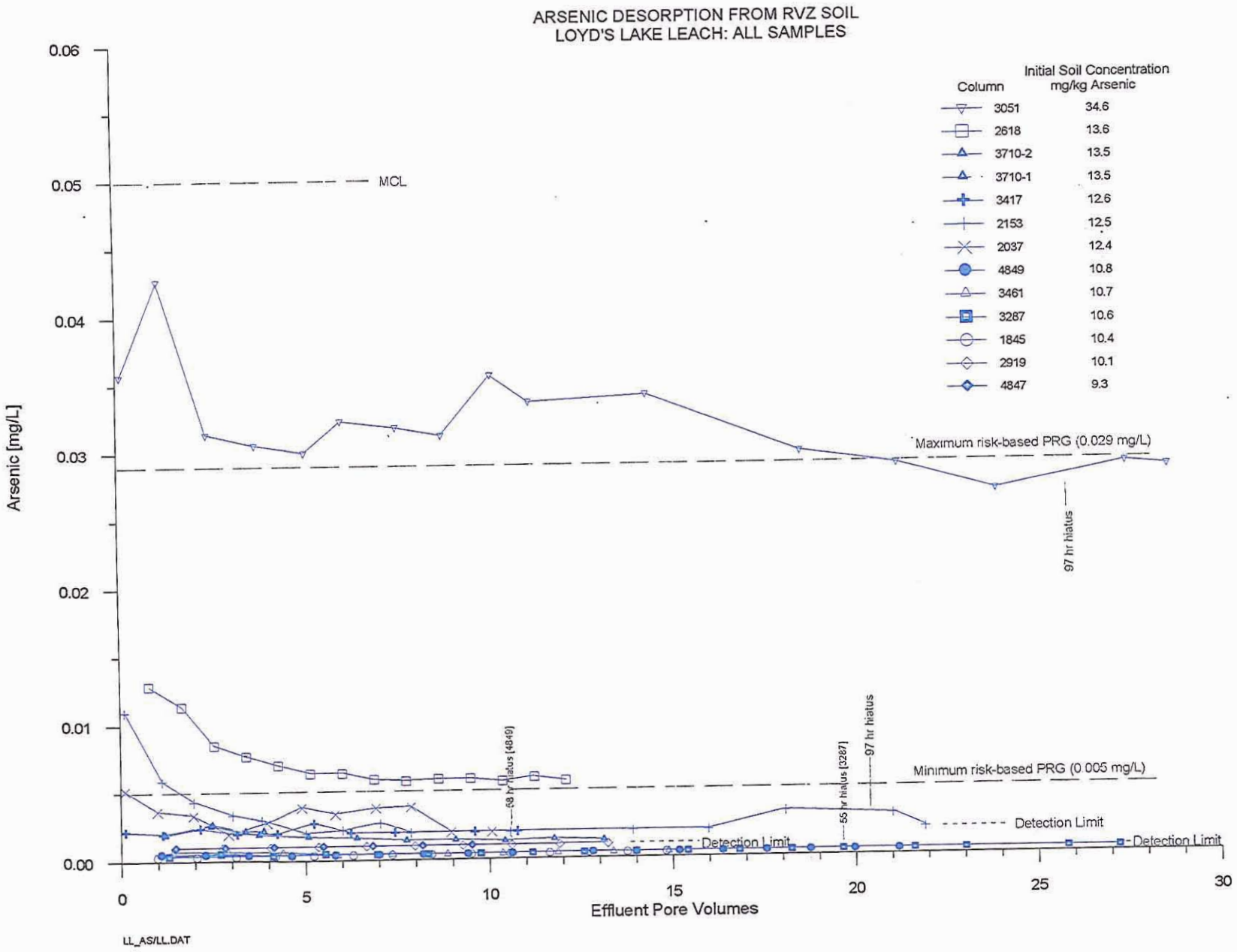

Figure 4.2.2–5. Arsenic Desorption From RVZ Soil–Loyd's Lake Leach All Samples

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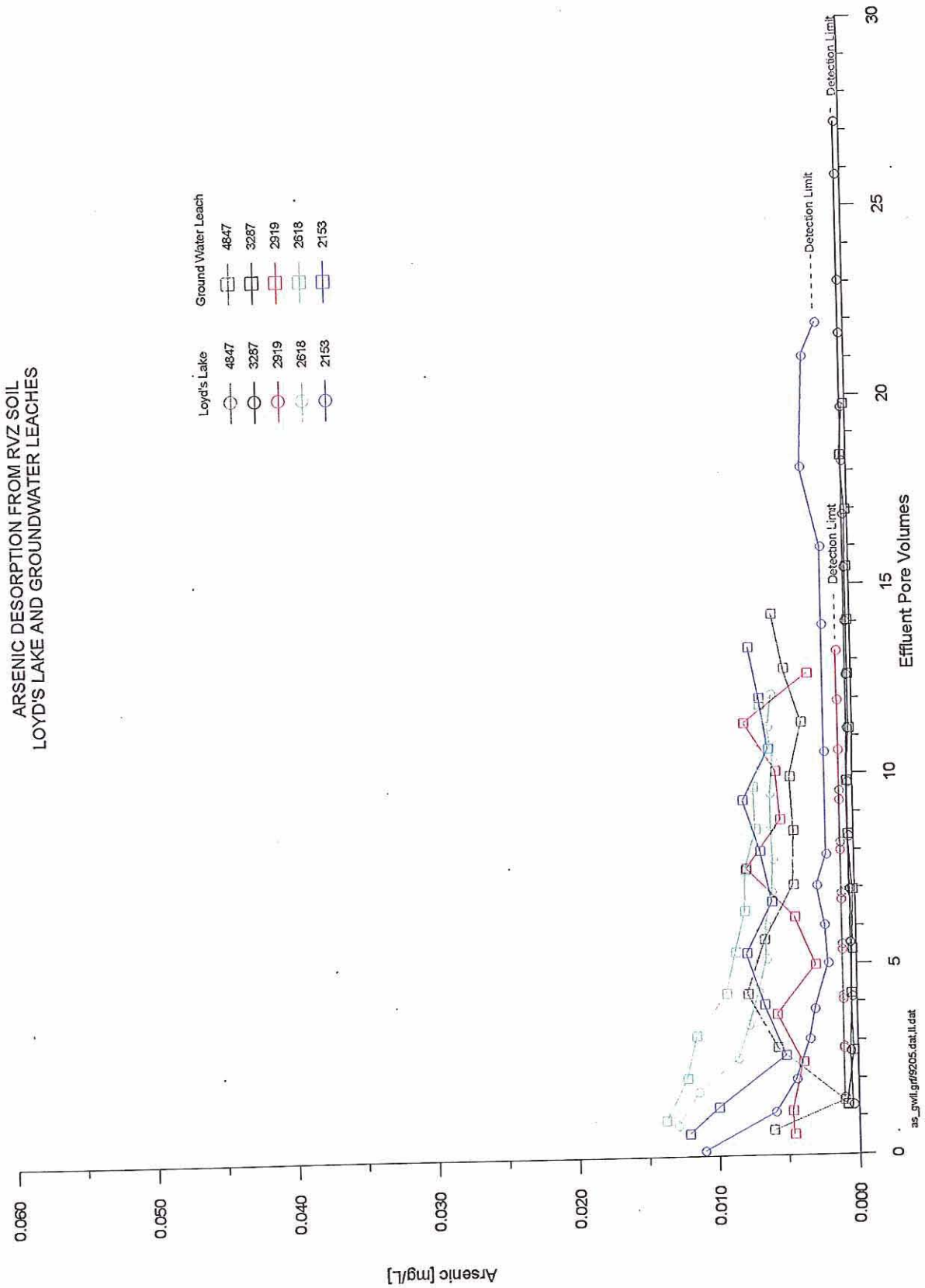

Figure 4.2.2–6. Arsenic Desorption From RVZ Soil–Loyd's Lake and Ground Water Leaches

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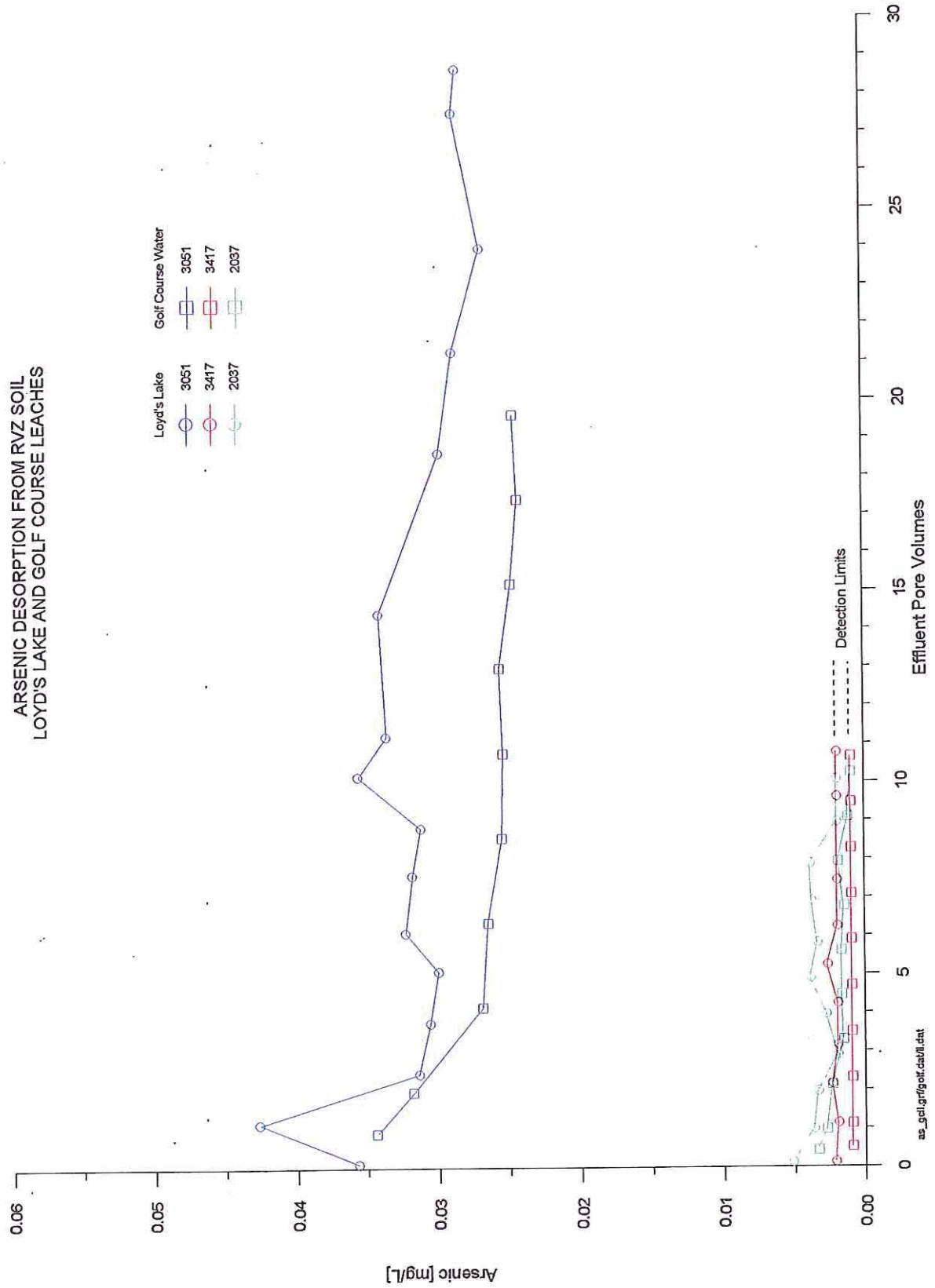

Figure 4.2.2–7. Arsenic Desorption From RVZ Soil–Loyd's Lake and Golf Course Leaches

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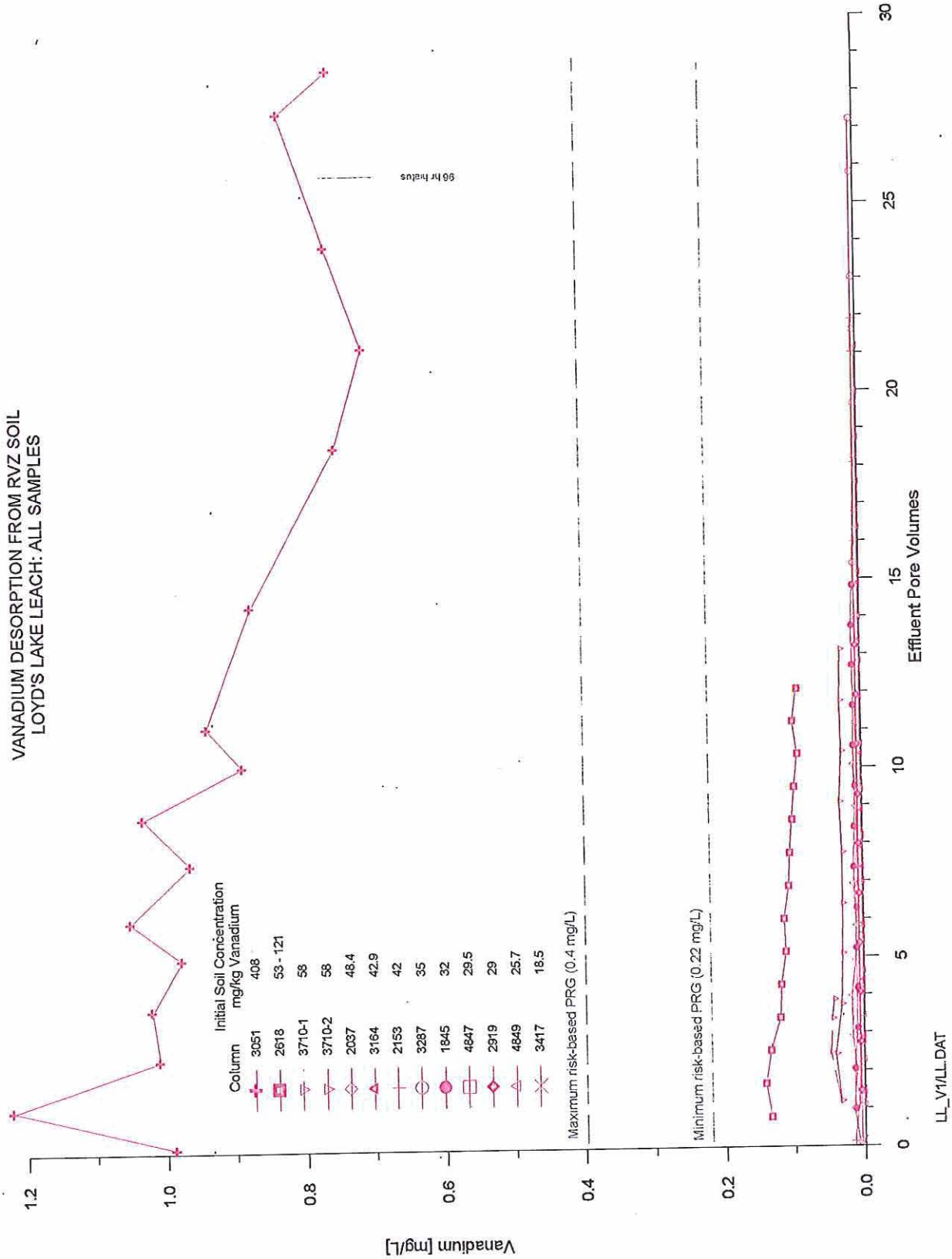

Figure 4.2.2–8. Vanadium Desorption From RVZ Soil–Loyd's Lake Leach All Samples

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Figure 4.2.2–9. Vanadium Desorption From RVZ Soil–Loyd's Lake Leach All Samples Except 3051

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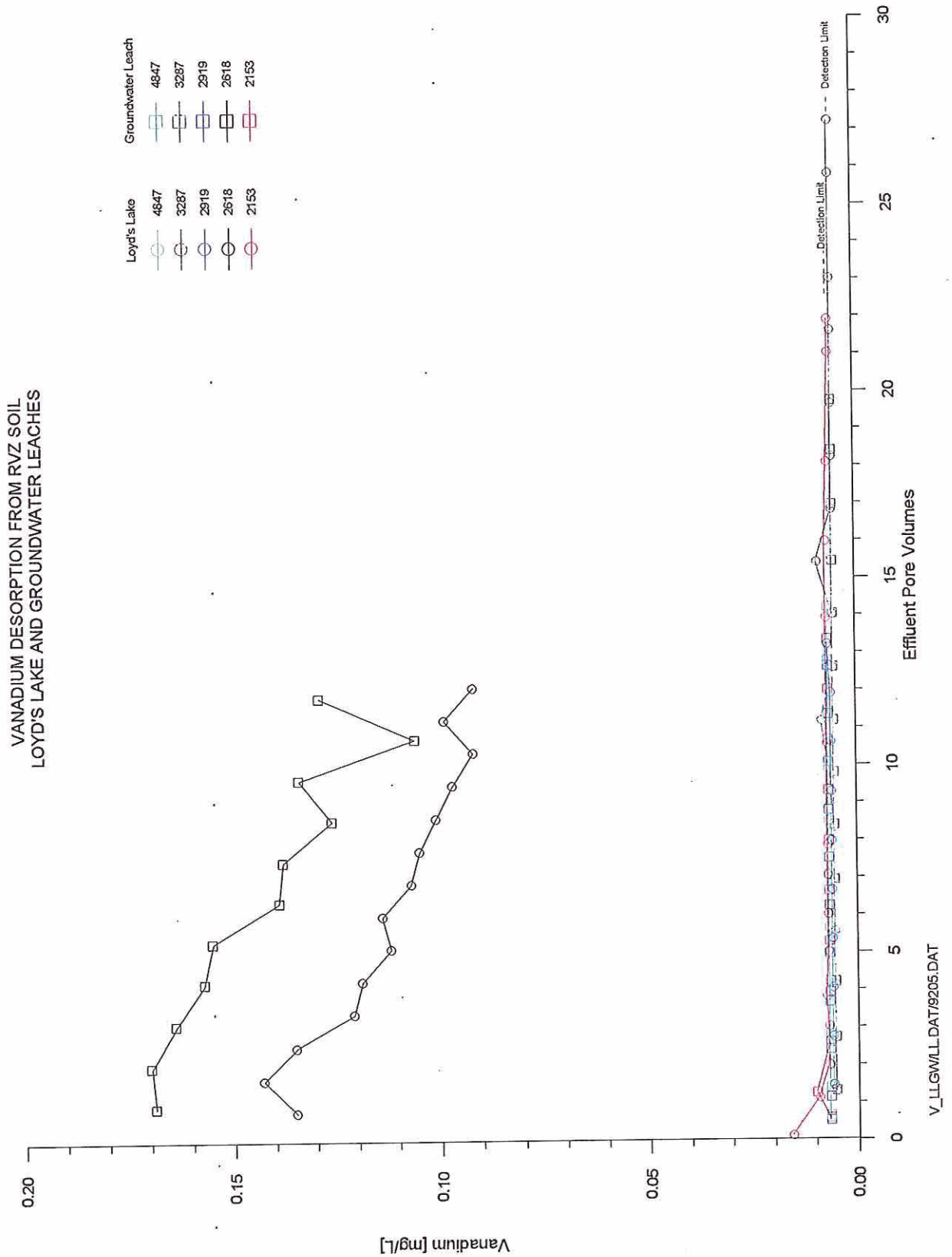

Figure 4.2.2–10. Vanadium Desorption From RVZ Soil–Loyd's Lake and Ground Water Leaches

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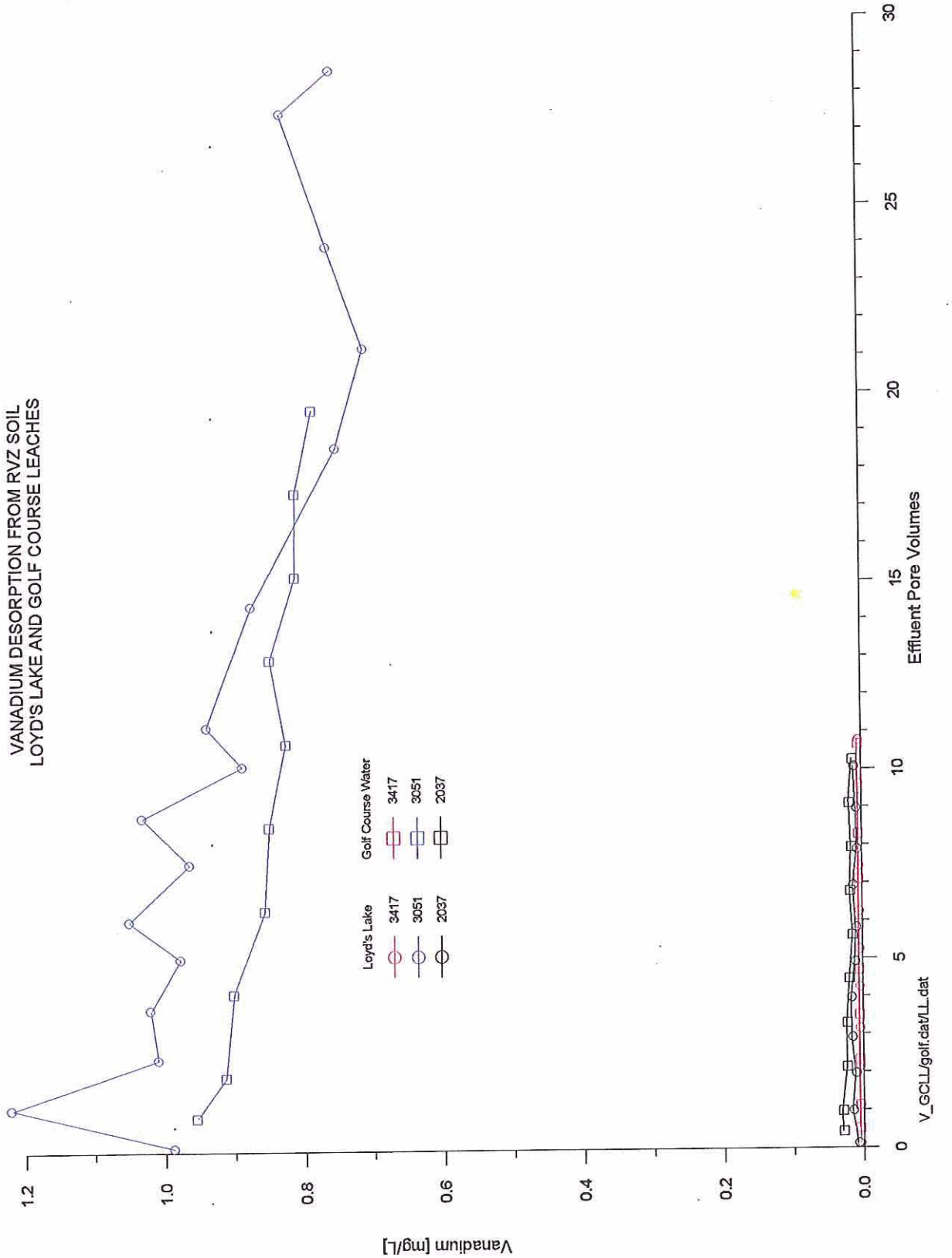

Figure 4.2.2–11. Vanadium Desorption From RVZ Soil–Loyd's Lake and Golf Course Leaches

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4.2.3 Installation and Monitoring of Temporary Wells

Since the inception of the IRA, temporary wells for OU III plume monitoring have been installed on four occasions: February, June, and October 1999, and April/May 2000. Temporary wells installed as part of the Deer Draw investigation are discussed in Section 4.2.7. Borehole and well data has been used to determine aquifer boundaries, to determine the extent of ground water contamination in areas not previously characterized, and to guide placement of permanent wells for long-term monitoring. Depth to bedrock, water level, and lithologic information has also been obtained. Temporary wells were installed along the upgradient and downgradient ends of the Millsite, on the Millsite, and in several north-south transects east of the Millsite and PeRT wall (Figures 4.2.3–1 and 4.2.3–2). The majority of temporary wells planned for the Millsite could not be installed because the site has not been sufficiently restored. Much of the area of interest remains exposed to bedrock, and ground water capture and diversion remains in effect.

In February 1999, five temporary wells (GB1126T, GB1227T, GB1690T, GB2820T, and GB3127T) were completed in the northwestern and central northern areas of the Millsite. Rationale for well placement and additional installation information is provided in the August 1999 Status Report (DOE 1999f). These wells have been monitored quarterly since February 1999. Only well GB1126T has routinely yielded enough water for sample collection although only partial samples have been collected because of limited water and very slow recovery. Wells GB1227T and GB1690T have always been dry. Partial samples have been collected periodically at GB2820T and GB3127T. To facilitate Millsite restoration, and because of the poor well performance, these wells were abandoned in August 2000. The data obtained from monitoring these wells will be used to site permanent well installations following restoration.

Seven temporary wells were set in the Montezuma Creek valley east of the PeRT wall in June 1999. The wells were completed along three north-south transects, primarily on the south side of Montezuma Creek, in alignment with other OU III monitoring wells. The wells have been monitored quarterly since July 1999. Saturated alluvium was not encountered at locations T99-06, T99–07, and T99–10 during drilling and the wells, which are screened to bedrock, have since remained dry. Well T99–02 is typically dry or has very little water (also screened to bedrock).

Well T99–03 contains enough water to collect a sample but it is very slow to recover. Wells T99–01 and T99–05 routinely yield sufficient water for sample collection. Refer to the August 1999 IRA Status Report (DOE 1999f) for additional information regarding these wells.

Temporary wells T99–11, T99–12, and T99–13 were installed in October 1999. These wells were installed primarily to optimize the location for a permanent well closer to the PeRT wall than currently exists. Quarterly monitoring of these wells began in January 2000. Wells T99–12 and T99–13 have been dry since installation.

Two lines of temporary wells were installed in April/May 2000: 8 along the western boundary of the Millsite, and seven along the eastern boundary of the Millsite (Figures 4.2.3–1 and 4.2.3–3). These were installed to investigate bedrock topography and the extent of the aquifer toward the valley margins, and to select permanent well locations. The eastern line of temporary wells remains incomplete north of the creek until the area is re-contoured to allow rig access. These wells will only be monitored for water levels. Ground water pinches out to the north between wells T00–12 and T00–11. Four to 5 feet of saturated alluvium are present in the center of the valley at wells T00–14 and T00–15. Along the east boundary, 1 to 2 feet of ground water occurs in the central part of the valley between wells T00–01 and T00–05. This area may be underlain by fill that was placed after soil remediation. The extent of the aquifer farther north is not known. Granular deposits (alluvium?) are present above bedrock south of T00–05, however they are presently unsaturated. Ground-water levels in this area may be effected by continued ground-water diversion to the west. These wells are scheduled to be surveyed during October 2000; following survey, lithology and well completion diagrams will be prepared.

PeRT Performance Monitoring Wells

Temporary wells were installed in phases since September 1999 to monitor the hydraulic performance of the PeRT wall. A large majority of those wells were completed in September and October 1999. Surface remediation and site restorations precluded installing several wells until January and February 2000. The final PeRT performance monitoring well was completed August 2, 2000. Figure 4.2.3–3 shows the locations of the PeRT performance monitoring wells, excluding those within the reactive media, which are shown in Figure 4.2.3–4. The PeRT wells shown in these figures have been monitored concurrent with OU III quarterly events since installation. The monitoring data is being used to evaluate the hydraulic performance of the gate and slurry walls and the effectiveness of the reactive media in reducing contaminant concentrations. Water quality monitoring is conducted at each well in and immediately surrounding the gate. Water levels are measured at each well. In addition, the creek stage at several locations in the PeRT area has been measured during recent quarterly monitoring events.

Under the Monticello PeRT Wall Project, data collection activities were also implemented in June and July for gate performance monitoring. Although these efforts are separate from OU III IRA tasks, they are relevant to OU III objectives and so are briefly described. In June, the Geoprobe rig was used to place four 2-inch wells in the ZVI section of the gate. Six 2-inch wells on the upgradient side of the gate and four 2-inch wells about 15 to 20 feet east (downgradient) of the gate were installed by sonic drilling in July. Well TW–09 is completed in bedrock and is paired with alluvial well TW–08. Depth to bedrock at TW–08/TW–09 is 12.5 ft below ground surface.

Well TW–09 is screened from 14.2 to 19.2 ft below ground surface. The bedrock was dry to the cored depth of 35 ft. After the new wells were developed, gas-displacement slug tests were conducted in triplicate at ten alluvial wells and seven ZVI wells. A multi-species tracer test through the gate was completed in July. Data analysis is in progress. Prior to the tracer tests, flow conditions were evaluated at several wells using a downhole instrument, the colloidal borescope, that tracks movement of suspended colloids (see Section 5.2 for more information). Additional borescope tests are for the planned for the fall.

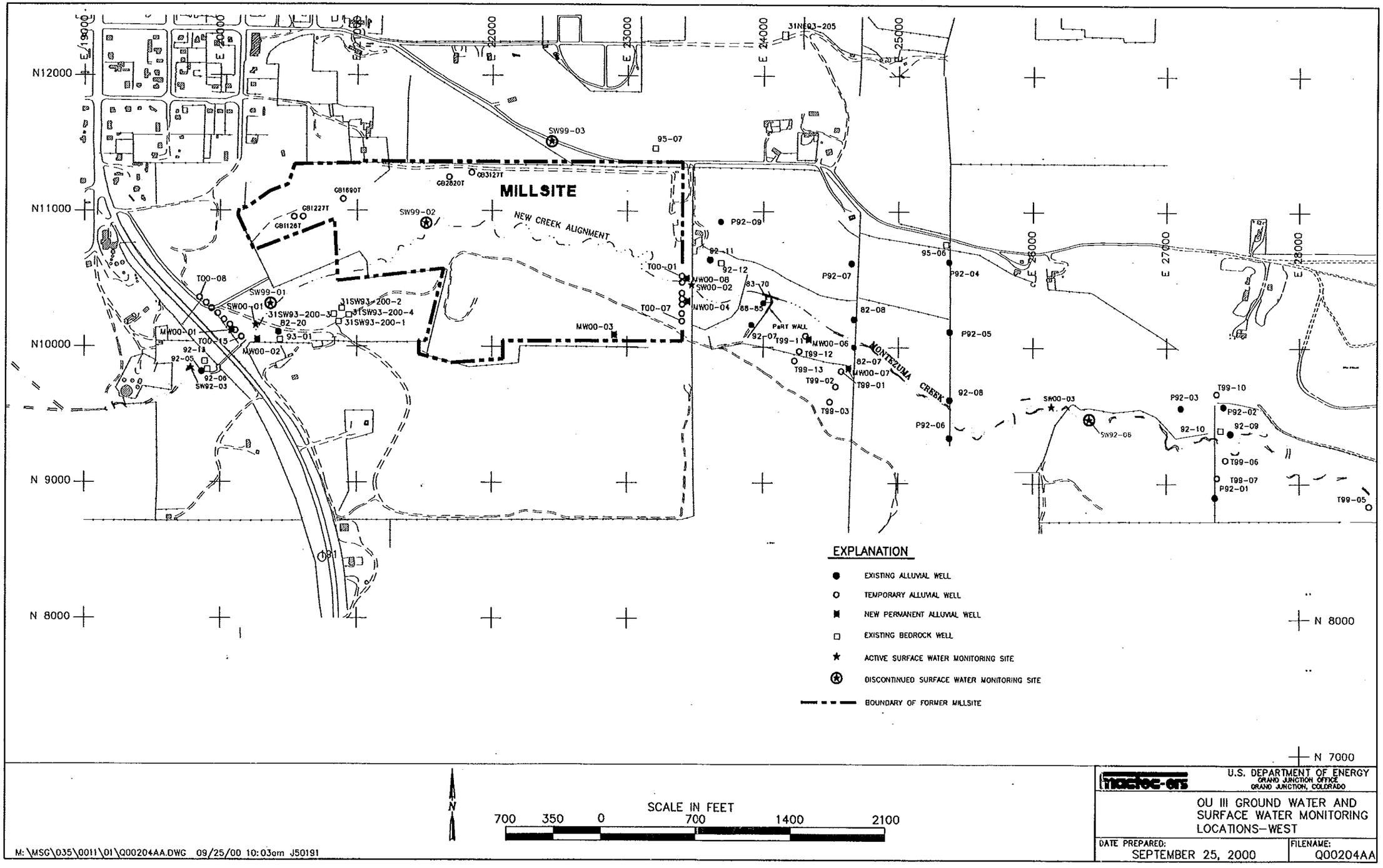

Figure 4.2.3–1. Locations of Temporary Monitoring Wells–West

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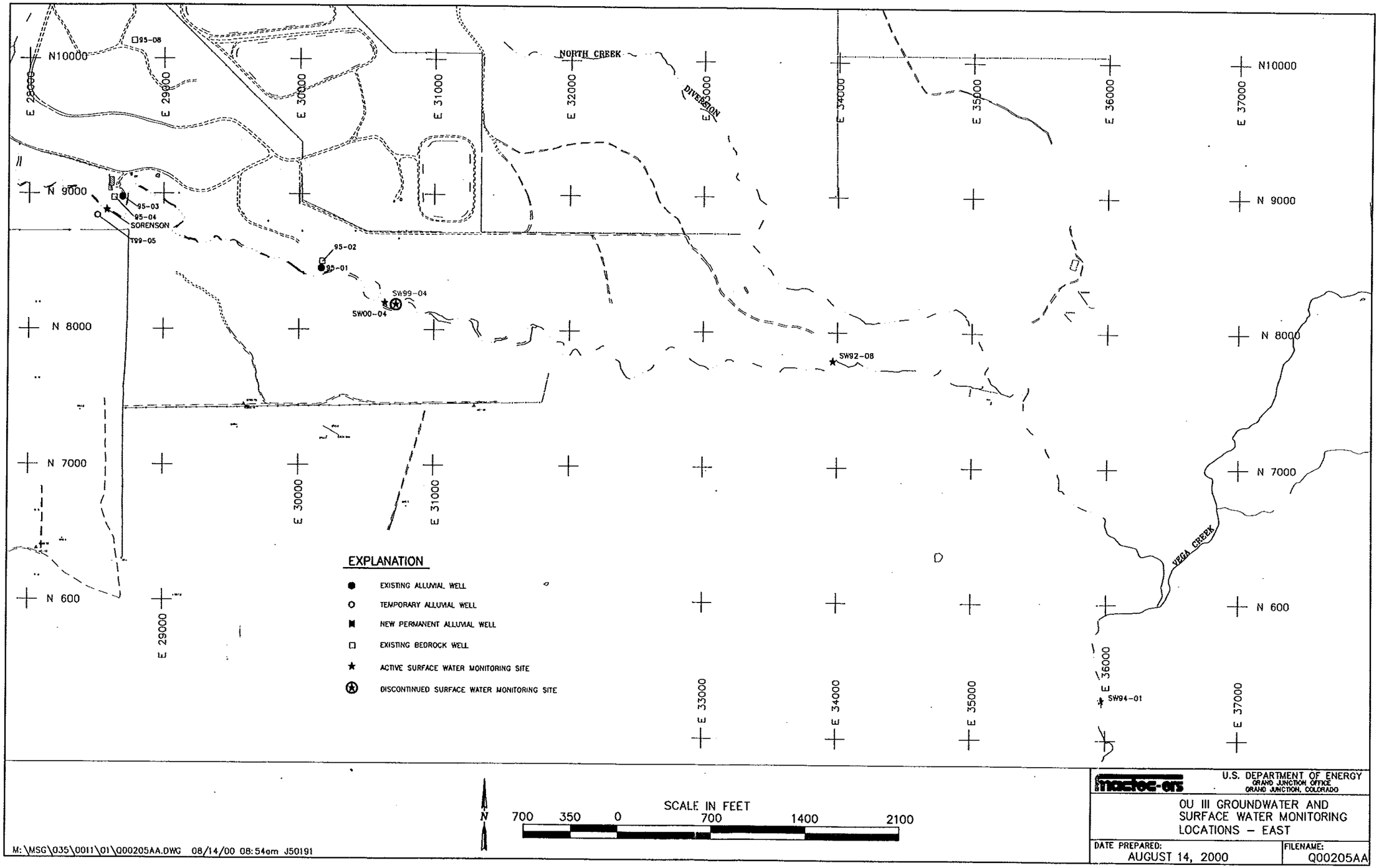

Figure 4.2.3–2. Locations of Temporary Monitoring Wells–East

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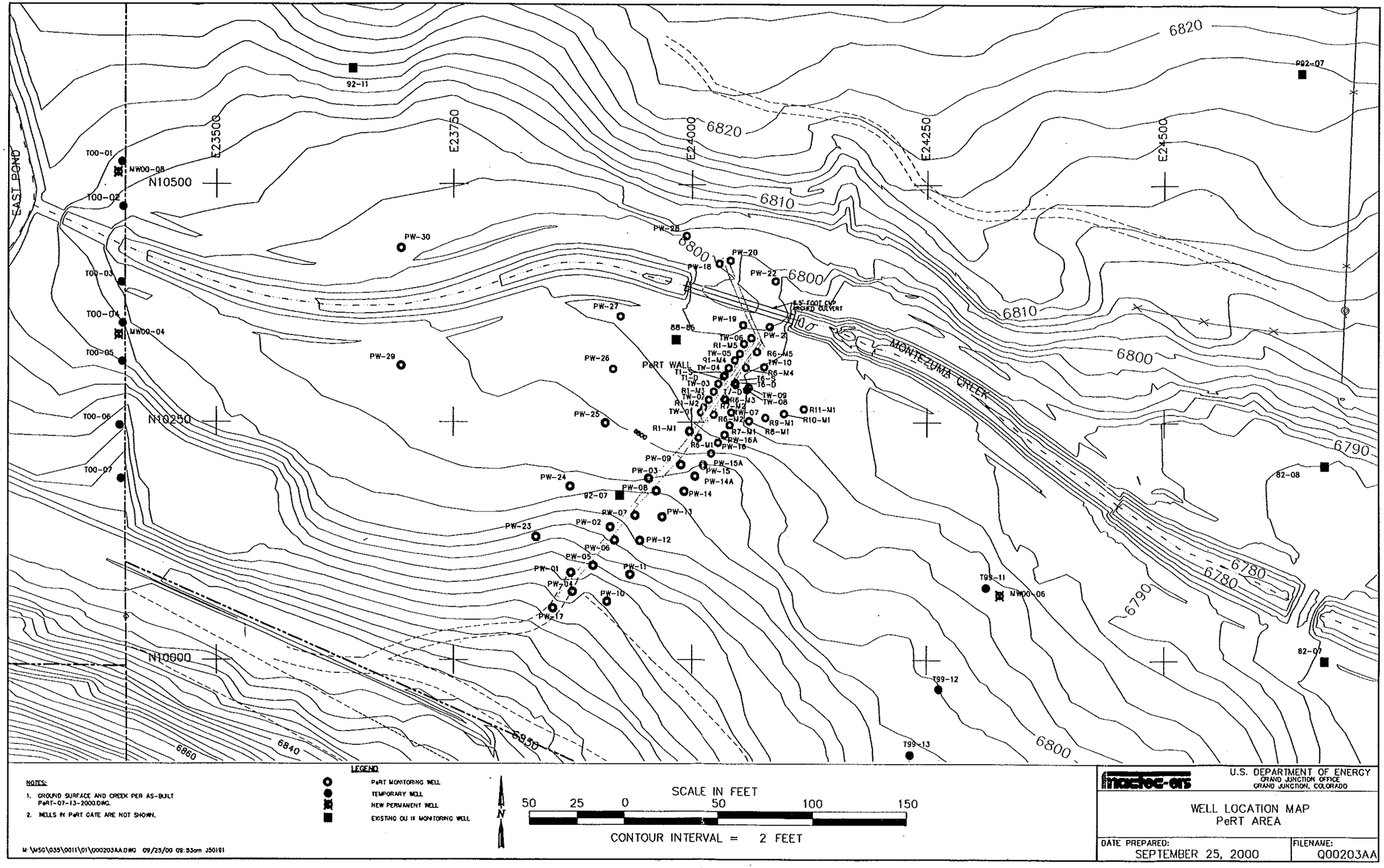

Figure 4.2.3–3. Well Location Map PeRT Area

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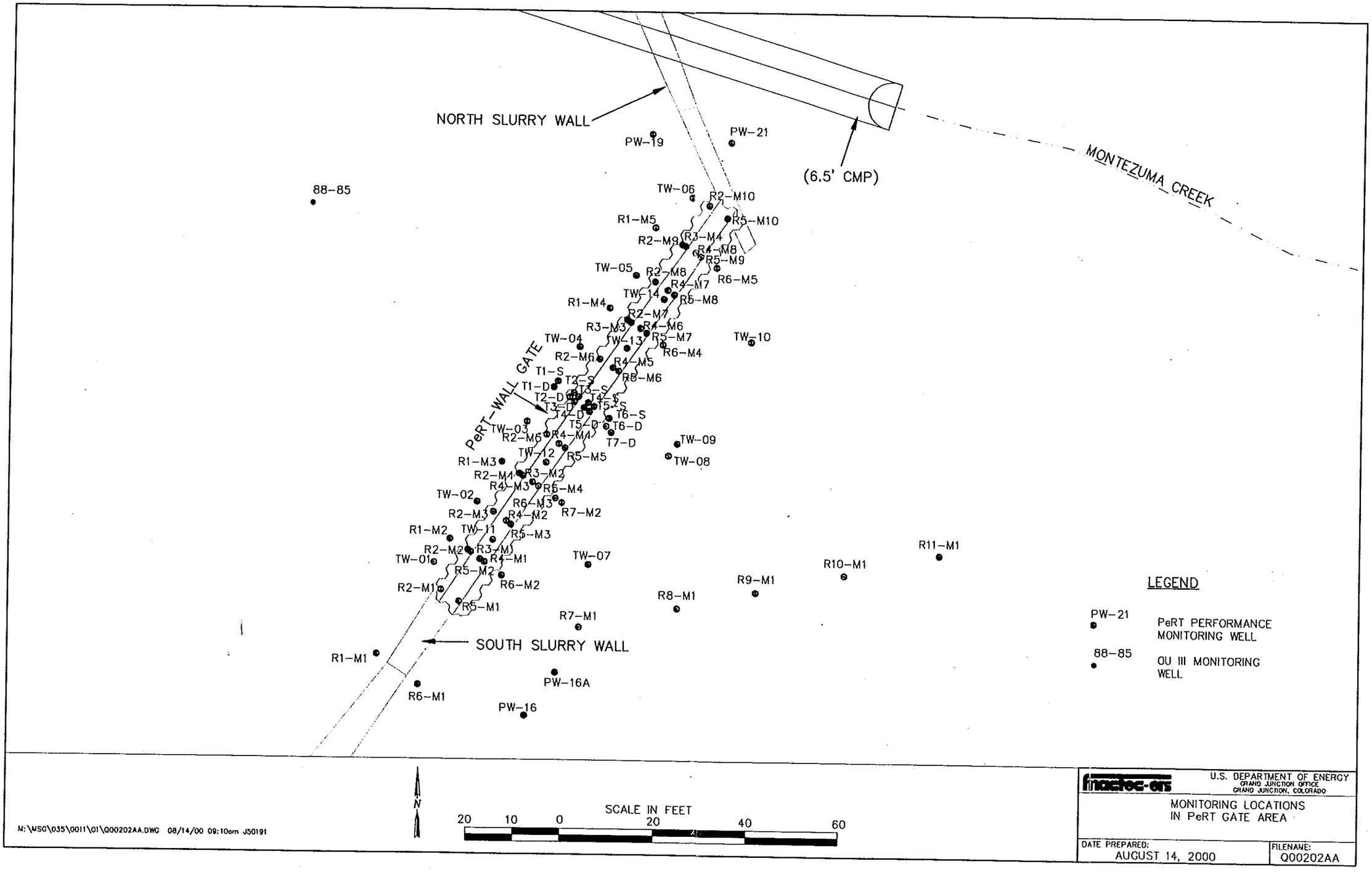

Figure 4.2.3–4. Monitoring Locations in PeRT Gate Area

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4.2.4 Installation and Monitoring of Permanent Wells

Seven monitoring wells were installed in June 2000 for long-term use. Subcontracted drilling services were provided by Boart Longyear. Drilling was accomplished with a Sonic-150 drill rig. All wells were 2-inch schedule 40 PVC. Well screens were 0.010-inch machine slotted PVC, 5 feet in length. The bottoms of the screens were set at or just below the bedrock surface. New permanent well locations are shown in Figure 4.2.3–1.

Wells MW00–01 and MW00–02 will be used to monitor alluvial ground water entering the former Millsite from the west. These locations will eventually replace background well 92–05 if ground-water quality is shown to be similar. Well MW00–3 was placed at the downgradient terminus of Deer Draw. This area recently became of interest when elevated uranium was detected in nearby seep samples. Wells MW00–04 and MW00–08 were installed in the axis of the alluvial valley and will be used for monitoring ground water as it exits the former Millsite. These wells were likely installed in backfill and presently do not produce enough water to develop or sample. Wells MW00–06 and MW00–07 will be used to monitor the main body of the contaminant of the contaminant plume downgradient of the PeRT wall. Quarterly monitoring at each new well began in July 2000.

4.2.5 Evaluate Contaminant Mobility in Alluvial Aquifer

Column leach tests will be performed to evaluate leaching of contaminants from aquifer substrate. The column tests will use material collected below the water table and within current or former plume areas. Samples of alluvium were collected when each new permanent well was drilled in June 2000. Additional samples were collected at existing wells 88–85 and 92–07 in August 2000. Five tests will be run using materials collected from the plume downgradient of the Millsite. Five tests will also be run using alluvium from Millsite locations. These samples will be collected from basal deposits exposed in the excavations of the former pile areas. The aquifer leach tests were started in August 2000.

4.2.6 Select New Locations for Long-Term Surface Water Monitoring

Four surface-water sites were added to the network in 1999 and monitored quarterly through January 2000 (refer to Figures 4.2.3–1 and 4.2.3–2). Two were located on Montezuma Creek on the Millsite (SW99–01 and SW99–02), one was at the pond near base of Steele's Draw (SW99–03), and the fourth was on the creek below the recently constructed sediment retention pond (SW99–04). Rationale for monitoring at those locations and the results through July 1999 are included in the August 1999 status report (DOE 1999f) and November 1999 data summary report (DOE 1999e).

In April 2000, four new surface-water locations were selected for long term monitoring (SW00-01 to SW00–04, Figures 4.2.3–1 and 4.2.3–2). SW00–01 is located on Montezuma Creek at the west boundary of the former Millsite. This location will eventually replace SW92–03 as the background monitoring location on the creek if water quality is shown to be similar. At present, SW92–03 is monitored annually in October. Quarterly monitoring at SW00–01 (and SW00–02, SW00–03, and SW00–04) began in April 2000. Site SW00–02 will be used to monitor water quality as the creek exits the former Millsite. SW00–03 will replace SW92–06,

which became inaccessible during and after surface remediation; additionally, site SW92–06 was within a shallow, muddy, slow moving reach, resulting in a poor working environment and poor conditions to measure stream flow. Site SW00–04 replaces SW99–04 below the downstream end of the sediment retention pond. Extensive soil remediation occurred in the canyon upstream of the pond. The pond was constructed to retain sediments entrained in the creek during remediation. Results of water quality monitoring are discussed in Section 4.1 and presented in Appendix D.

4.2.7 South Millsite Source Investigation

During a site visit on April 4-5, 2000, DOE, EPA, and UDEQ decided to add two surface water/seep sample locations to the quarterly sampling round that was scheduled for mid-April. The surface water that is of concern is located in the southeastern part of the Millsite, downstream/downgradient of the Deer Draw drainage, in the vicinity of verification grid blocks 4307 and 5215 (Figure 4.2.7–1). The samples that were collected on April 14, 2000 were given the names seep 4307 and seep 5215; total uranium results were 824 µg/L and 1,480 µg/L, respectively. The results also showed a ratio of U-234 to U-238 of 1:1; a 1:1 ratio is typically seen in water samples collected from contaminated areas on and downgradient of the Millsite.

The surface water analytical results were reviewed with the regulatory agencies. The decision was made to conduct soil sampling in the vicinity of the seeps to determine if perhaps there was tailings source material that had been missed during remediation. The additional sampling that was triggered by the seep results was initially referred to as the "Deer Draw" investigation because of the proximity of Deer Draw to the seep areas. Results of the soil samples that were collected near the seeps indicated that the area in question did meet the verification standards established for the Millsite. Uranium concentrations in the samples were generally below 12 mg/kg.

Additional soil samples were also collected on property MP–00391–VL Phase III southwest of the seeps to investigate the possibility that supplemental standard areas on that property were contributing to the high uranium results. Samples were collected from both verified and supplemental standard areas. Uranium concentrations from areas not remediated were consistently higher at the surface than those from areas that were remediated. The concentrations of uranium in the soil samples are within the range of concentrations tested in the vadose zone column tests summarized in Section 4.2.2 and the column effluent concentrations are within the range seen at the seeps. This indicates that if the soil on property MP–00391–VL has the same leaching characteristics as vadose zone material collected from the Millsite, leaching of the soils on property MP–00391–VL may produce an effluent with a similar uranium concentrations as seen in the seeps.

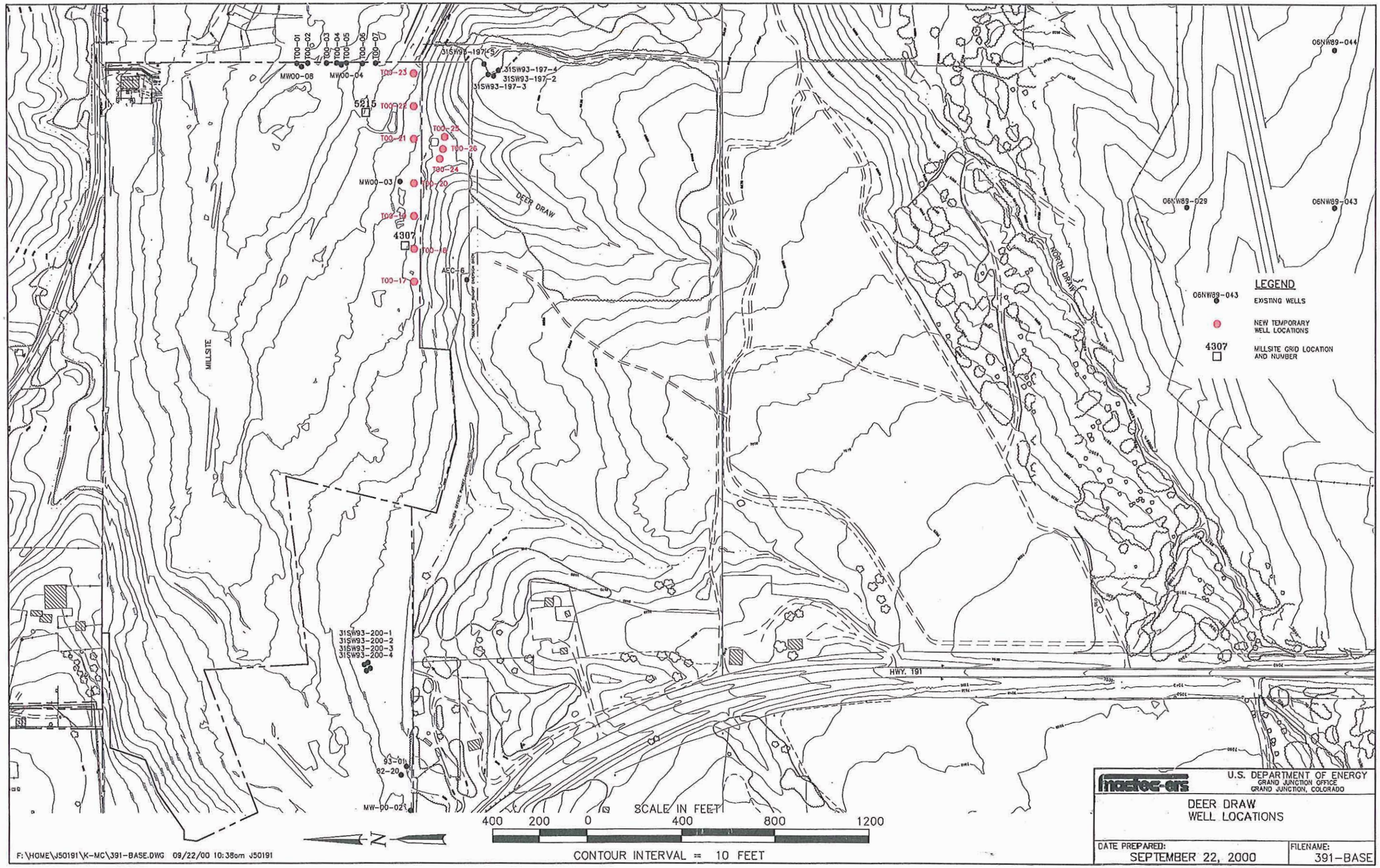

Figure 4.2.7–1. Temporary Wells Near Seeps 4307 and 5215

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Historical analytical data from wells completed in uncontaminated areas south of the Millsite was reviewed. The ground water samples were collected in wells completed in the alluvium and Mancos and Dakota Sandstone Formations. Uranium data indicated that there was a 2:1 to 3:1 enrichment of U-234 over U-238 (U-234 enrichment is typically seen in background wells) and concentrations ranged from 3.73 pCi/L to 25.5 pCi/L. A surface water sample was collected from Deer Draw in July 2000; the uranium results for this sample was 17.9 µg/L. These results are much lower than what has been detected at the seeps indicating that the surface water that intermittently flows down Deer Draw is not the source of the contamination at the seeps. Similarly, background ground water in the Mancos and Dakota Formations contains detectable concentrations of uranium, but at levels one to two orders of magnitude less than at the seeps.

Seven temporary wells along the Millsite southeastern boundary and three temporary wells in Deer Draw were installed during August 2000 to investigate the extent of alluvial ground water and contamination in this area (Figure 4.2.7–1). All wells were dry except for wells T00–17, T00-18, and T00–19. Uranium results from these wells ranged from 638 µg/L to 1,110 µg/L. The dry condition found in the wells T00–24, T00–25, and T00–26 located in Deer Draw indicates that the draw does not funnel significant ground water into the Millsite alluvium.

The investigation as to the source of water and uranium that feeds seeps 4307 and 5215 is ongoing. Currently, the former ore storage areas south of the Millsite are being considered as possible source areas. DOE, EPA, and UDEQ will likely identify additional field activities near the former ore storage areas during a site visit on September 26, 2000.

End of current text

5.0 PeRT Wall Treatability Study

PeRT wall treatability study activities accomplished during the year were ground water monitoring to provide data on the treatment performance of the wall and a tracer study on the reactive gate.

5.1. Performance Monitoring

The performance of the PeRT wall as a treatment technology is being evaluated by measuring water levels and collecting ground water samples at 61 wells, including seven upgradient of the wall, 40 within the reactive media, and 14 downgradient of the wall. Six locations have a shallow and deep well pair in a transect through the center of the reactive media parallel to ground-water flow. One well pair is located upgradient of the PeRT wall, four within the wall, and one downgradient of the PeRT wall. The time frame of water sampling of the 61 wells covered by this report occurred in September, October, and November 1999 and January and April 2000. Sampling is now conducted quarterly, concurrent with annual monitoring. The location of the wells sampled to evaluate the PeRT wall as a treatment technology are shown in Figure 5.1–1.

During each sampling event, samples were collected from all monitoring wells that yielded sufficient water for metals analysis. Samples were also collected during each sampling event from some of these monitoring wells for anion, cation, iron, and manganese analyses. Sample results are presented in Appendix C.

Analytical results for the COCs (arsenic, manganese, molybdenum, selenium, uranium, and vanadium) at each of the wells along the four major well transects through the reactive media are summarized in Table 5.1–1. Information in the table is presented by row and by the upgradient well number corresponding to the transect. Row 1 wells are located upgradient of the reactive media. Row 2 and 3 wells are located in the pretreatment zone that is composed of zero valent iron (ZVI) mixed with gravel. Row 4 and 5 wells are located in 100 percent ZVI, and Row 6 is located downgradient of the reactive media (refer to Figure 5.1–1).

Arsenic concentrations are generally reduced to non detect levels within the pretreatment and ZVI zones (Table 5.1–1). In samples collected downgradient of the reactive media, arsenic concentrations ranged from non detect to 8.5 µg/l except at well R6–M4 which had concentrations as high as 26.2 µg/L. Well R6–M4 is a very slow producing well and the high concentrations of arsenic are thought to be due to residual source in this area that has not yet been sufficiently flushed. The most recent sample form this well (April 2000) had a concentration of 0.73 µg/L.

Manganese concentrations increase as ground water moves through the pretreatment and ZVI zones (Table 5.1–1). An increase in manganese concentration was anticipated because manganese is a component of the reactive media. There has been no increase in manganese at permanent wells 82–07 and 82–08 located approximately 700 ft downgradient of the reactive media.

Molybdenum, selenium, and uranium concentrations are generally reduced in the pretreatment zone as compared to upgradient concentrations and are further reduced in the ZVI zone (Table 5.1–1). Downgradient of the reactive media, molybdenum concentrations rebound to levels less than or equal to upgradient concentrations. Concentrations of selenium and uranium downgradient of the reactive media remain at relatively low levels as compared to upgradient concentrations.

Vanadium concentrations are generally reduced to non detect levels within the pretreatment and ZVI zones (Table 5.1–1). In samples collected downgradient of the reactive media, vanadium concentrations ranged from non detect to 95.5 µg/L.

Table 5.1–1. Ground Water Transect Concentrations Through Gate Transects

Contaminant	Row	Transect			
		R1–M2	R1–M3	R1–M4	R1–M5
Arsenic	*Upgradient*				
	1	8.6 – 13.3	7.6 – 12.3	5.6 – 7.9	5.0 – 7.2
	Pretreatment				
	2	<0.4 – 0.45	<0.2 – 0.4	<0.4 – 0.86	<0.2 – <0.4
	3	<0.2 – <0.4	<0.4 – 0.25	<0.4 – 0.36	<0.2 – <0.4
	100 Percent ZVI				
	4	<0.2 – 0.47	<0.2 – <0.4	<0.2 – 0.4	<0.2 – <0.4
	5	<0.2 – 0.4	<0.2 – <0.4	<0.4 – 0.2	<0.2 – <0.4
	Downgradient				
	6	0.41 – 3.7	<0.4 – 1.2	7.1 – 26.2	2.4 – 8.5
Manganese	*Upgradient*				
	1	596 – 845	376 – 608	—	8.6
	Pretreatment				
	2	315 – 879	148 – 667	—	483
	3	347 – 1,550	249 – 881	—	606
	100 Percent ZVI				
	4	223 – 1,050	306 – 1,070	—	573
	5	290 – 800	287 – 515	615 – 3,400	324
	Downgradient				
	6	306 – 1,470	3,420 – 5,590	615 – 3,400	2,710 – 6,090
Molybdenum	*Upgradient*				
	1	73.2 – 91.7	54.9 – 73.2	24.8 – 43	26.7 – 49.1
	Pretreatment				
	2	16.6 – 41.2	18.8 – 24.3	22.2 – 49.5	5.4 – 16.9
	3	9.9 – 44.5	16.1 – 24.8	32.3 – 45.8	2.4 – 15.1
	100 Percent ZVI				
	4	1.9 – 10.8	<0.8 – 10.6	<0.8 – 3.5	<0.8 – 6.8
	5	<0.8 – 9.3	<0.8 – 7.4	<0.8 – 4.1	<0.8 – 6.8
	Downgradient				
	6	5.2 – 10.0	34.2 – 121	14.3 – 31.3	20.5 – 53.5

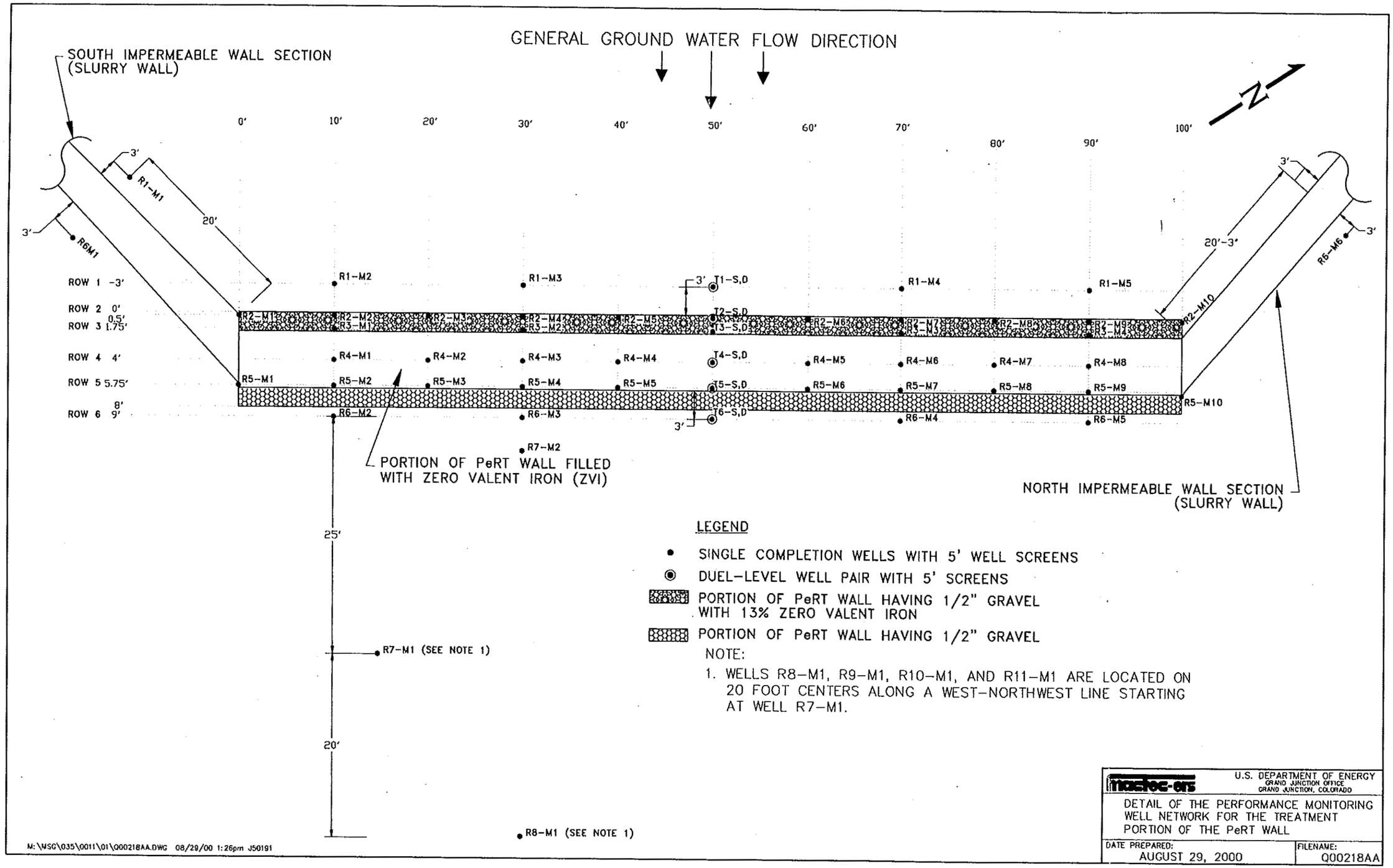

Figure 5.1–1. PeRT Wall Locations With Water Quality Results During This Reporting Period

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Table 5.1–1. Ground Water Transect Concentrations Through Gate Transects (continued)

Contaminant	Row	Transect			
		R1–M2	R1–M3	R1–M4	R1–M5
Selenium	*Upgradient*				
	1	3.8 – 30.4	6.1 – 49.6	24.3 – 96.7	19.6 – 80.6
	Pretreatment				
	2	2.0 – 29.4	0.48 – 27.6	13.2 – 83	0.13 – 56.6
	3	0.21 – 31.5	<0.1 – 33.2	17.5 – 82.4	<0.1 – 54
	100 Percent ZVI				
	4	<0.1 – 3.8	<0.1 – 0.49	<0.1 – <0.2	<0.1 – <0.1
	5	<0.1 – 1.6	<0.1 – 0.17	<0.1 – <0.2	<0.1 – <0.2
	Downgradient				
	6	<0.1 – <0.2	0.77 – 2.4	<0.1 – 15.1	<0.1 – 0.92
Uranium	*Upgradient*				
	1	289 – 680	246 – 722	370 – 584	384 – 566
	Pretreatment				
	2	1.8 – 161	0.56 – 136	173 – 654	0.31 – 96.6
	3	<0.2 – 157	<0.2 98.2	273 – 594	<0.2 – 36.5
	100 Percent ZVI				
	4	<0.2 – 0.41	<0.1 – 0.49	<0.2 – 0.42	<0.1 – 0.28
	5	<0.1 – 0.4	<0.1 – 0.4	<0.1 – 0.41	<0.1 – 0.3
	Downgradient				
	6	<0.1 – 1	169 – 368	2.4 – 50	3.4 – 14.7
Vanadium	*Upgradient*				
	1	293 – 440	248 – 387	208 – 355	214 – 346
	Pretreatment				
	2	<0.4 – <1.0	<0.4 – <1.0	<1.0 – 355	<1.0 – 0.64
	3	<1 – 3	<0.4 – <1.0	<1.0 – 53	<0.4 – <1.0
	100 Percent ZVI				
	4	<0.4 – 1.4	<0.4 – <1.0	<0.4 – 1.5	<0.4 – 1.0
	5	<0.4 – <1.0	<0.4 – 1.1	<0.4 – 1.2	<1.0 – 0.41
	Downgradient				
	6	<0.4 – 3.0	25.1 – 45.5	3.9 – 95.5	2.3 – 23.5

These data indicate that the reactive media is effective in reducing the concentrations of the COCs in ground water and that downgradient of the wall, several pore volumes of clean water will need to pass through the aquifer matrix to achieve non detectable levels. Upgradient of the reactive media, alkalinity of the ground water ranges from 220 to 440 mg/L. Within the ZVI zone, the alkalinity drops to less than 100 mg/L. A drop in the alkalinity can be used as an indication that ground water that has passed through the reactive media as arrived at and changed the water quality at a location. Using this information, ground water at well T99–01 located about 700 ft downgradient of the PeRT wall shows the chemical signature of water that has passed through the reactive media.

A PeRT Wall Treatability Study Report will be prepared during the spring of 2002 to evaluate the first two years of ground-water monitoring and water level data. This document will be submitted as a primary document with a draft final stipulated penalty milestone date of September 30,2002. The PeRT wall will also be evaluated as a remedial alternative in the post-Millsite remediation FS.

5.2. Flow Evaluation

Two of the objectives of the PeRT wall treatability study are to determine the ground-water residence time and flow patterns within the PeRT wall and to determine the tendency for the PeRT wall to clog. Changes in subsurface flow conditions and the degree of clogging will ultimately impact the longevity of the PeRT wall system. A colloidal borescope in conjunction with tracer testing was used to evaluate flow within the reactive media and to provide a baseline data against which future observations can be compared.

The colloidal borescope is an instrument used to measure the movement of natural colloids in a borehole to determine the rate and direction of ground-water flow. The measurements are considered representative only when steady direction flow is observed. Flow velocity up to 3 cm/s can be measured. Measurements were made during the week of July 26, 2000, prior to the tracer test, at wells upgradient of, downgradient of, and within the reactive media. Flow direction and velocities are currently being evaluated to determine the capture zone, residence time, whether there are preferential flow paths, and whether flow is directly through the reactive media.

The reactive media tracer test began on July 17, 2000 and was terminated on July 26, 2000. The colloidal borescope was during the tracer test to aid in the interpretation of the tracer test results. Tracers used during the test were the inert gases argon and helium and anions bromide and chloride. Preliminary analysis of the data indicates that the gases were not detected downgradient of the injection wells and the anion tracers moved quickly and relatively directly through the wall. Results of the borescope and tracer test are currently being evaluated and will be submitted in a report to the regulatory agencies for review during the first quarter of fiscal year 2001. The report will contain a description of the testing procedures, the data, and a discussion of the results.

Figure 5.2–1 illustrates the water table surface and saturated thickness in the general area of the PeRT wall based on April 10, 2000, water level data. The surface was created using SURFER. Water level data was interpolated by triangulation; grid cells were 1-ft square. Creek elevations were included in the analysis from which the contours in Figure 5.2–1 were created because the creek and aquifer are assumed to be hydraulically connected. Creek elevations were higher than adjacent ground-water levels, implying a losing stream condition, and therefore, water level contours across the point in the downstream direction. Surface plots generated without creek stage data also exhibited similarly shaped contours near the creek.

A ground-water divide is apparent south of the creek and west of the PeRT wall. Flow is directed east to the permeable gate and to the south and southeast, where bypass around the southern end of the wall is implied. Most wells below the south slurry wall have remained dry after the wall was installed. Volumetric flow through the gate will be estimated using recently obtained tracer tests and slug tests, in addition to hydraulic data that will be collected during fall 2000. The amount of wall bypass can then be estimated with an analytical or numerical model, or by water balance.

The water table at the reactive gate is shown in Figure 5.2–2, which is identical to the previous figure except that contour intervals and map scale differ. a steep gradient is observed along the upgradient edge of the gate, with about 2 feet of head loss over a distance of several feet. The gradient is very shallow across the reactive media and is again relatively steep as water exits the gate. Ground water then spreads laterally to re-occupy the region below the gate and wall, and the resulting level of saturation is thin. Geochemical data (e.g., alkalinity) and tracer test data demonstrate unequivocally that ground water is flowing through the gate.

End of current text

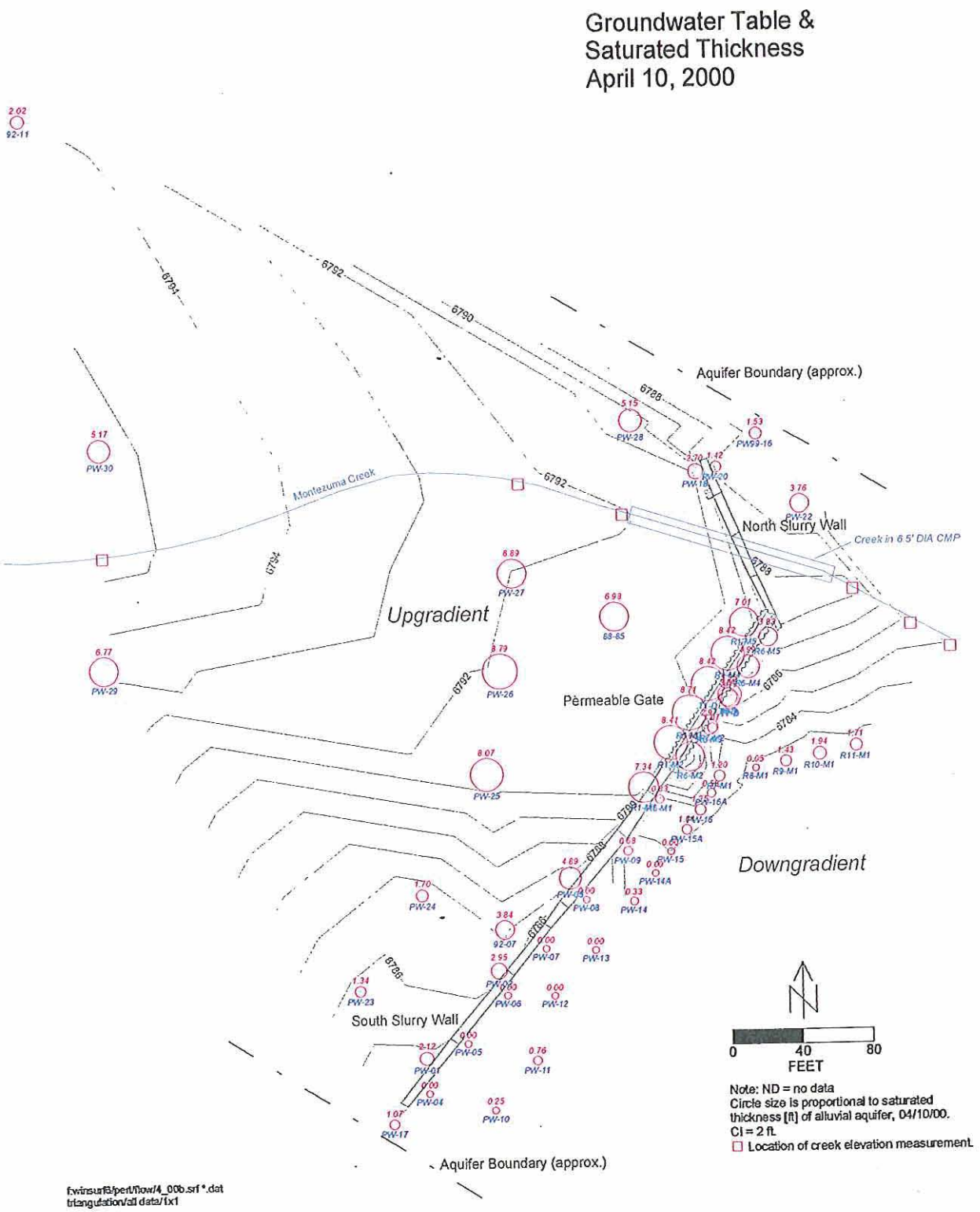

Figure 5.2–1. PeRT Wall Table Surface and Saturated Thickness

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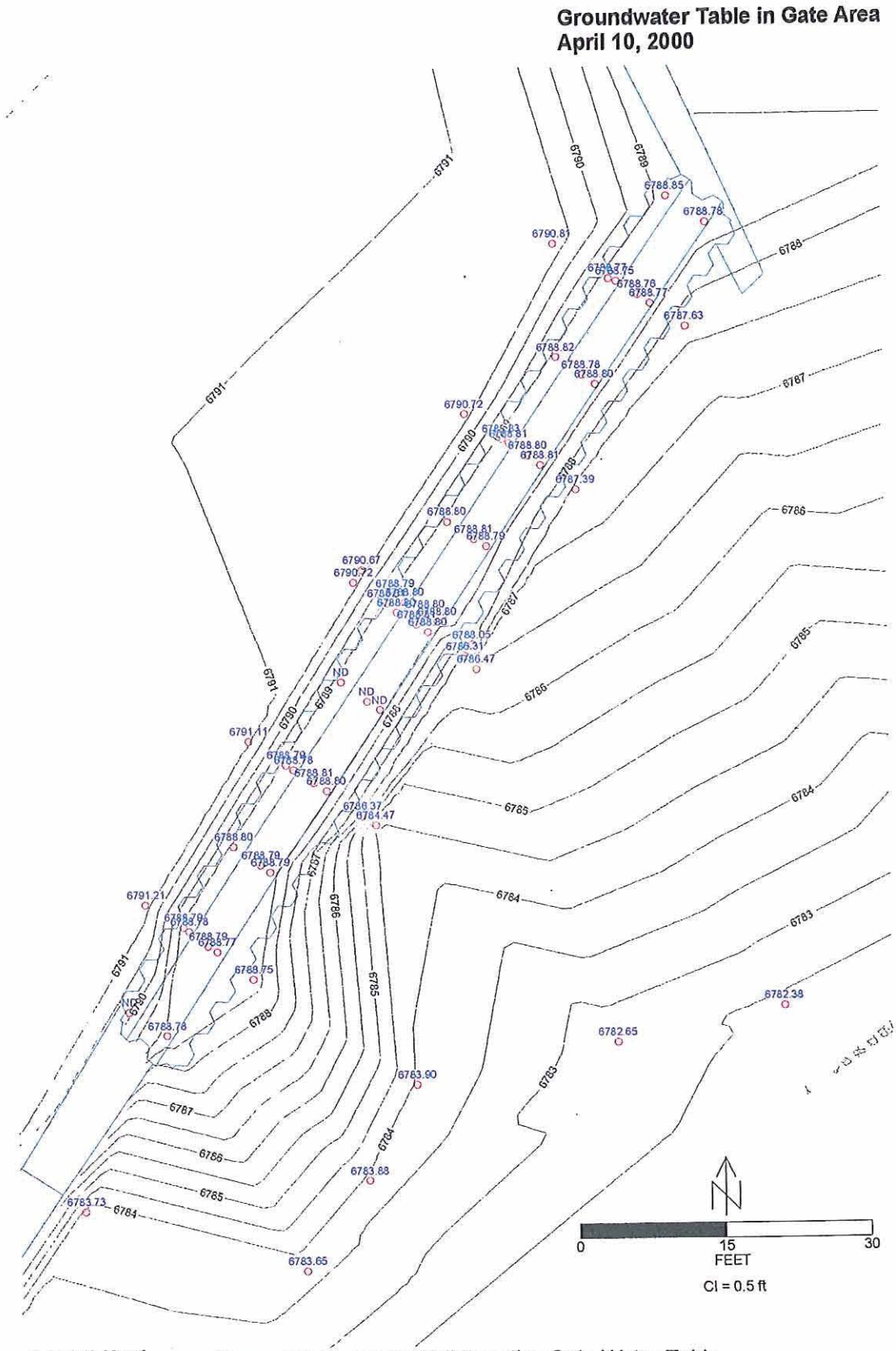

Figure 5.2–2. PeRT Wall Reactive Gate Water Table

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6.0 Remedial Investigation

Since drafting the last IRA Status Report in August 1999 (DOE 1999f) discussion has occurred between DOE, EPA, and UDEQ with regards to the schedule and content of the addendum to the RI. Previously, it had been agreed that two years worth of surface-water and ground-water monitoring data following Millsite restoration would probably be sufficient to begin preparation of the addendum to the RI and the FS. Based on the schedule for Millsite restoration this data would have been collected by January 2003. However, due to the slow progress on Millsite restoration, final creek alignment, and aquifer restoration, it was decided to include surface-water and ground-water data through October 2003 in the addendum to the RI.

The content of the RI addendum was discussed during technical meetings April 4-5, 2000 and July 26, 2000 between DOE, EPA, and UDEQ. It had previously been agreed that the RI addendum would include a summary of the IRA data collection activities and data, an updated baseline ground-water flow and transport model, and a review/update to the human health and ecological risk assessments. It was agreed during the technical meeting that MODFLOW/MT3D would be used as the primary code for the ground-water modeling effort.

At the July 26, 2000 meeting, the risk assessments were discussed in detail. There is no plan to change the human health exposure scenarios that were presented in the RI finalized in September 1998 (DOE 1998b). IRIS will be consulted prior to the update to ensure that the most current toxicity information is used. A commitment has been made to reach consensus on the toxicity values by July 22, 2003. The baseline risk of ground water ingestion (primary exposure) will be determined using post-Millsite remediation ground water concentrations. Future ground water concentrations will be predicted using ground-water flow and transport modeling. For exposure scenarios that were found to be insignificant in the 1998 RI, only a screening level evaluation will be performed.

EPA reviewed the 1998 ecological risk assessment prior to the July 26, 2000, meeting. EPA indicated that the exposure pathways and exposure parameters do not require updating and that while toxicity reference values have been updated, the interpretations from the hazard indices would not change. It was agreed by DOE, EPA, and UDEQ, that the updated ecological risk assessment to be prepared in 2004 will use post-Millsite remediation surface-water concentrations, but that dose from other media would not be updated. EPA recommended possible future sampling for benthic macroinvertebrates. Benthic macroinvertebrate sampling will be discussed further at future OU III technical meetings and the scope of this possible sampling effort will be determined prior to October 2002 when it is thought that such an effort might take place.

The submittal of the draft final addendum to the RI is scheduled for April 9, 2004.

End of current text

7.0 Feasibility Study

A number of issues have been identified that require resolution either prior to or during preparation of the final FS. These issues are: 1) selection of the ground-water modeling code; 2) identification of preliminary remediation goals (PRGs) for each of the contaminants of concern; 3) identification of locations for "point-of-compliance" monitoring; 4) concurrence on the remediation time frame; and 5) concurrence on the remedial alternatives to be evaluated. Following is a brief summary of the progress made on resolving each of these issues to date. The draft final FS is scheduled to be submitted to the EPA and UDEQ in August 2004.

7.1. Ground Water Modeling Status

The ground-water flow and solute transport models presented in the RI (DOE 1998b) will be updated to reflect changes to the ground water system and contaminant distributions resulting from surface remediation. The models will also incorporate new information obtained during the IRA that was not available during the RI. Modeling for the RI was conducted using the codes MODFLOW and MT3D96, which are generally recognized as industry standards. The RI ground water models will be used only as templates for constructing new models; however, the conceptual model of flow and contaminant transport for the site will remain essentially the same.

Model selection was discussed in a meeting on April 5, 2000, between DOE, EPA and UDEQ. It was mutually agreed that DOE would use MODFLOW and MT3D as the primary codes for future OU III ground water modeling. The OU III models will be assembled and run in Visual MODFLOW or Ground Water Vistas. Ground Water Vistas supports both stochastic and deterministic simulations of flow and transport. Visual MODFLOW is currently limited to deterministic models but is being revised to support stochastic analysis and calibration to solute concentration. The IRA Work Plan states that the primary flow and transport models will be run deterministically. Discussions during the April 2000 meeting led to no changes to the basic modeling approach for OU III as outlined in the *Monticello Mill Tailings Site, Operable Unit III, Interim Remedial Action Work Plan*, November (DOE 1999g).

Over the past year, initial data development was begun for the ground water model. Flow in Montezuma Creek and discharge of ground water to the excavation on the Millsite has been measured about 6 times for water budget analysis. These measurements have consistently indicated that the ground-water flux across the central portion of the former Millsite is about 100 gallons per minute. This provides an important calibration target for the ground-water flow model. Ground-water flux will also be calculated from data obtained from the borescope/tracer tests conducted in the PeRT wall gate during July 2000 (Section 5.2). This will provide a second flux target for model calibration.

7.2. Preliminary Remediation Goals

Preliminary remediation goals were developed and presented in the draft FS (DOE 1998c) for surface water and ground water.

7.2.1 Surface Water

Achieving acceptable risk levels and compliance with applicable or relevant and appropriate requirements (ARARs) are the two primary goals of remedial action. As shown in the RI, contamination associated with OU III surface water does not cause excess risk to human health or the environment. Therefore, the remedial action objective for surface water is simply to prevent concentrations of COCs from exceeding State surface-water standards in "Standards of Quality for Waters of the State," R317–2, UAC.

The current PRGs for surface water are those that were presented in the draft FS and are presented in Table 7.2.1–1. PRGs for copper, lead, and zinc are not listed because these metals were subsequently eliminated as COCs (see *Monticello Mill Tailing Site, Operable Unit III Surface Water and Ground Water Data Summary Report* December 1999e).

Table 7.2.1–1. Surface-Water Preliminary Remediation Goals

COC	Utah Surface Water Standard			PRG
	Domestic	Agricultural	Aquatic Wildlife	
Arsenic	50 µg/L	100 µg/L	190 µg/L	50 µg/L
Selenium	10 µg/L	50 µg/L	5.0 µg/L	5.0 µg/L
Ra–226	5 pCi/L	–	–	5.0 pCi/L
Gross Alpha[a]	15 pCi/L	15 pCi/L	–	15 pCi/L

[a]The standard for gross alpha does not exclude Rn–222 or uranium.

7.2.2 Ground Water

As shown in the RI, under current conditions there is no unacceptable risk to human health because ground water is not being used as a drinking water source. However, risks exceed the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) established risk range for carcinogens and hazard index for noncarcinogens under the future-use residential scenario because daily consumption of ground water was assumed. No unacceptable risk to ecological receptors was identified. The remedial action objectives for ground water are to protect human health on the basis of risk, and achieve maximum contaminant levels specified in the Federal Safe Drinking Water Act (SDWA), or the State standard specified in "Administrative Rules for Ground Water Quality Protection," R317–6, UAC.

Because remedial action at OU III is undertaken under the Federal Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), the substantive standards of the Utah Ground Water Quality Protection Rules are considered to be met unless otherwise determined by the Utah Executive Secretary. Therefore, DOE does not need to submit a Corrective Action Plan, however the corrective action (remedial action) undertaken must meet the requirements of the Ground Water Quality Protection Rule. With regard to remedial goals, a summary of the substantive standards of the Ground Water Quality Protection Rule applicable to OU III for a Corrective Action follow:

- For contaminants with specified levels, ground-water quality standards shall be met or, where applicable, alternate corrective action concentration limits (ACACLs). ACACLs can be higher or lower than the standards specified in Table 1 of the Ground Water Quality

Protection Rules. Higher ACACLs shall be protective of human health and the environment, and shall utilize best available technology.

- For contaminants for which no ground-water quality standard has been established, Corrective Action Concentration Limits (CACLs) shall be proposed. These levels shall consider EPA MCL goals, health advisories, risk-based contaminant levels or standards established by other regulatory agencies and other relevant information.

The ARAR-based preliminary goals proposed in the draft FS are presented in Table 7.2.2–1. A risk-based PRG for lead-210 was proposed in the draft FS as 2 to 8 pCi/L. The lower concentration presented in the range is based on the reasonable maximum exposure (RME) risk and the higher concentration is based on the central tendency (CT) risk.

Table 7.2.2–1. Ground Water Preliminary Remediation Goals

COC	Regulatory Standards			ARAR-Based Preliminary Remediation Goals
	Federal SDWA	Utah Ground Water Standards, Table 1	UMTRCA	
Carcinogenic Nonradionuclides				
Arsenic	50 µg/L	50 µg/L	50 µg/L	50 µg/L
Carcinogenic Radionuclides				
Pb-210	—	—	—	2 to 8 pCi/L[b]
Ra-226	5.0 pCi/L	5.0 pCi/L	5.0 pCi/L	5 pCi/L
U-234/238	—	—	30 pCi/L	30 pCi/L
Gross Alpha[a]	15 pCi/L	15 pCi/L	15 pCi/L	15 pCi/L
Gross Beta	4 mrem	4 mrem	—	4 mrem
Noncarcinogens				
Arsenic	50 µg/L	50 µg/L	50 µg/L	50 µg/L
Manganese	—	—	—	730 µg/L[b]
Molybdenum	—	—	100 µg/L	100 µg/L
Nitrate (as N)	10 mg/L	10 mg/L	10 mg/L	10 mg/L
Selenium	50 µg/L	50 µg/L	10 µg/L	10 µg/L
Uranium	—	—	44 µg/L	44 µg/L
Vanadium	—	—	—	260 µg/L[b]

[a] The standards for gross alpha include Ra-226 but exclude radon and uranium.
[b] UDEQ stated during the February 2000 FFA that arriving at a PRG using 125 percent of the ground water protection standard as was done in the FS is not appropriate because the aquifer is already contaminated. Therefore, values proposed in the FS are not reprinted. In this table, the PRG's for lead-210, manganese, and vanadium are based on risk.

Key: COC = contaminant of concern; SDWA = Safe Drinking Water Act; UMTRCA = Uranium Mill Tailings Radiation Control Act; µg/L = micrograms per liter; Pb-210 = lead-210; Ra-226 = radium-226; U-234/-238 = uranium-234 and uranium-238; pCi/L = picocuries per liter; N = nitrogen

At the February 2000 Federal Facilities Agreement (FFA), UDEQ informed DOE that they are developing CACLs for vanadium and manganese that may be used as PRGs. Also at the February 2000 FFA, DOE committed to reviewing and possibly revising the PRGs presented in the draft FS and preparing a discussion paper proposing PRGs after the radionuclide MCLs are finalized by EPA in November 2000.

UDEQ presented the EPA Region III risk-based screening concentrations at the July 26, 2000 OU III technical meeting and proposed that they be used as PRGs. They are 0.73 mg/L for manganese and 0.26 mg/L for vanadium.

7.3. Point of Compliance and Area of Attainment

The point-of-compliance for surface-water monitoring to determine compliance with ARARs was discussed during the February 2000 FFA and the April 2000 OU III technical meeting. UDEQ stated during the FFA meeting that DOE will be required to meet in-stream water quality standards at least at the eastern boundary of the Millsite. At the OU III technical meeting it was proposed that other "natural" points of compliance are the outlet at Sutherland's Pond (which corresponds to the eastern most area of significant Montezuma Creek remediation) and downstream of the Vega Creek confluence above the rugged canyon area (beyond which accessibility is severely restricted). UDEQ is currently considering these locations.

For ground water, the area of attainment can be defined by the NCP, which states that

> "... remediation levels should generally be attained throughout the contaminated plume, or at and beyond the edge of the waste management area when waste is left in place." (55 Federal Register 8713)

On this basis, the point of compliance for OU III ground water was defined in the draft FS as that portion of the alluvial aquifer within the boundary of the Millsite and downgradient of the Millsite where concentrations of COCs exceed PRGs. At the February 2000 FFA and during the April 2000 OU III technical meeting, EPA reiterated this position by stating that cleanup standards must be met in ground water, not at the pump or point of distribution. Therefore, with regards to ground water, there are currently no unresolved issues about point-of-compliance.

7.4. Remediation Time Frame

In accordance with EPA guidance (Guidance for Remedial Actions for Contaminated Ground Water at Superfund Sites, [EPA 1988]), "remediation time frame" is defined as the period of time required to achieve remedial action objectives in ground water at all locations within the area of attainment. DOE discussed the 40 CFR 192 (UMTRA) ground-water provisions for a 100-year remediation time frame in the draft FS; during review of the draft FS, EPA and UDEQ both suggested that a 100-year time-frame was unacceptable.

At the February 2000 FFA, DOE questioned why the 100-year natural attenuation time frame in 40 CFR 192 is not relevant and appropriate given that 40 CFR 192 has been identified as a relevant and appropriate regulation. EPA indicated that when a regulation is relevant and appropriate not all parts of the regulation need to be relevant and appropriate.

Currently, there are no action items related to further discussions on remediation time frame. It is anticipated that this topic will have been revisited with the regulatory agencies by no later than preparation of the post-remediation FS.

7.5. Remedial Alternatives

Remedial alternatives to be considered in the post-Millsite remediation FS were discussed during the April 2000 OU III technical meeting. It was agreed that due to the extensive excavation of subpile soils during Millsite remediation, the remedial alternatives that may be considered in the final FS are limited. Remedial alternatives currently identified are the no action alternative, monitored natural attenuation, enhanced monitored natural attenuation, hot-spot pump and treatment modifications to the current PeRT wall or installation of another PeRT wall, and a combination of pump and treat with enhanced attenuation. A preliminary screening of a passive alternative using wetlands as reducing environment to precipitate out contaminants may be considered. These alternatives are briefly described below.

Summary of Feasibility Study Alternatives

1. **No Action Alternative**—The no action alternative only includes monitoring contaminant concentration levels. It does not include any activity to reduce contaminant concentrations or to reduce human or ecological exposure to contaminated media and assumes that no reduction in contaminant concentrations will be achieved.

2. **Monitored Natural Attenuation**—The monitored natural attenuation alternative assumes processes in the ground water and subsurface will reduce the concentrations of contaminants over time. Monitoring the contaminant concentrations and periodic reevaluation of the length of time until concentrations reach acceptable levels is the major activity involved in this alternative. The alternative also includes institutional controls, such as deed restrictions, to control human exposure to contaminated ground water.

3. **Enhanced Attenuation with Monitoring**—This alternative involves pumping Burro Canyon ground water and then infiltrating that ground water into the alluvial aquifer. This will increase the hydraulic gradient of the alluvial ground water, causing the ground water to flow faster and thereby, speeding or "enhancing" the natural attenuation process. As with the monitored natural attenuation alternative, monitoring, reevaluation, and institutional controls are part of this alternative.

4. **Hot Spot Extraction and Treatment**—The hot spot extraction and treatment alternative involves extracting ground water from the most contaminated areas of the plume and then treating the extracted ground water. Ground water would be extracted using wells located in areas with high concentrations of contaminants. Two to four "hot spot" areas would be addressed, however, this number may change with additional information. The alternative does not address contaminated ground water outside the "hot spot" areas. Several treatment options are available for the extracted ground water. Two options considered are to treat the ground water in Pond 4 using evaporation or to use an active treatment process similar to what was used during remediation of the Millsite. The alternative also makes use of monitoring and institutional controls.

5. **Hot Spot Extraction and Treatment with Enhanced Attenuation**—This alternative involves all the components of Alternative 4, Hot Spot Extraction and Treatment, plus uses the components of Alternative 3, Enhanced Attenuation with Monitoring. A major aspect of this alternative is that Burro Canyon ground water would be infiltrated into the alluvial

aquifer in areas not addressed by the "hot spot" extraction. This enhances natural attenuation in areas that are not being remediated by ground-water extraction. This alternative has a shorter remediation time than Alternatives 3 or 4 but has higher costs than either of those alternatives.

6. **Permeable Reactive Treatment (PeRT) Wall**—The PeRT wall alternative makes use of the existing PeRT wall at the site. The existing PeRT wall was installed as a technology demonstration project but has worked well at reducing contaminant concentrations in the ground water. The alternative includes modification of the existing PeRT wall to enhance its performance and may include an additional PeRT wall to treat contaminants in areas that are not being addressed by the existing PeRT wall. Monitoring and institutional controls are also included in this alternative.

Passive Treatment with a Wetlands Reducing Zone—This alternative makes use of an innovative treatment process that has theoretical feasibility but which has not been demonstrated. The alternative involves creating a wetlands area that intercepts the ground water. The plants in the wetlands area create a reducing environment in the water that causes dissolved metals to precipitate out of solution. As with all the other alternatives, this alternative also makes use of monitoring and institutional controls.

8.0 Applicable or Relevant and Appropriate Requirements

This section presents an updated evaluation of ARARs for the surface water and ground water in OU III. The CERCLA response action for OU III must comply with chemical-, location-, and action-specific ARARs and attain a degree of cleanup that ensures protection of human health and the environment. ARARs compliance must be met during the response as well as at its completion. Remedial actions that leave any hazardous substance, pollutant, or contaminant on site must meet a level or standard of control that at least attains standards, requirements, limitations, or criteria that are identified as applicable or relevant and appropriate for the site. Only substantive requirements must be met for on-site CERCLA activities; both substantive and administrative requirements must be met for off-site activities.

Chemical-specific ARARs set health- or risk-based concentration limits for particular hazardous substances or contaminants in air, soil, water, and other media. The principal COCs at OU III are radioactive and nonradioactive substances associated with uranium and vanadium mill tailings. Location-specific ARARs establish additional requirements on the basis of unique characteristics of a site that could be affected as a result of remedial action. These ARARs may be used to restrict or preclude certain activities or remedial actions on the basis of location or characteristics of a site. Action-specific ARARs are performance, design, and other requirements that control remedial activities or actions. These requirements are not concerned with contaminants present or with site characteristics at the location but address how a selected remedial action alternative must be achieved. Action-specific requirements may specify particular performance levels, actions, or technologies, as well as specific levels (or a method for setting specific levels) for discharged or residual contaminants.

Section 3.1 addresses Federal ARARs for OU III surface water and ground water. Section 3.2 addresses State ARARs for OU III surface water and ground water.

8.1. Federal ARARs

This section addresses Federal requirements and identifies how each pertains to OU III surface water and ground water. A list of applicable or relevant and appropriate Federal requirements for OU III surface water and ground water is presented in Table 8.1–1.

8.1.1 Safe Drinking Water Act

The requirements of this act and its corresponding regulations address public water systems. The requirements are implemented by the State of Utah through the federally approved program under the Safe Drinking Water Act (SDWA). See the discussion in Section 3.2.1, "Drinking Water" for an ARARs determination.

Table 8.1–1. Federal ARARs for OU III Surface Water and Ground Water

Standard, Requirement, Criterion, or Limitation	Citation	Description	Status	Comment
Safe Drinking Water Act National Primary and Secondary Drinking Water Standards	42 USC 300(g) 40 CFR Part 141 40 CFR Part 143	Establishes health-based standards for public water systems (maximum contaminant levels [MCLs]).	Relevant and appropriate through the State of Utah standards as a chemical-specific requirement.	Because the quality of the alluvial aquifer could allow it to be used as a drinking water aquifer, the MCLs may apply as cleanup standards.
Clean Water Act Water Quality Criteria	33 USC 1251–1376 40 CFR Part 131 "Quality Criteria for Water:	Criteria for states to set water quality standards on the basis of toxicity to aquatic organisms and human health.	Applicable through the State of Utah standards as a chemical-, location-, and action-specific requirement.	Addresses Montezuma Creek contamination.
National Pollutant Discharge Elimination System	40 CFR Parts 122 through 125	Establishes standards for discharges of pollutants into waterways and through the use of underground injection wells.	Applicable through the State.	A point source effluent discharge into Montezuma Creek may be used depending on the selected water-treatment technology. Potential storm-water discharges into Montezuma Creek must be controlled. Aquifer reinjection may be used as part of a treatment remedy.
Dredge or Fill Requirements (Section 404)	40 CFR Parts 230 and 231 33 CFR Part 323 40 CFR Part 404	Regulates the discharge of dredged or fill material into navigable waters and manages wetland areas.	Applicable as location- and action-specific requirement.	Dredged or fill material requirements applicable through the State of Utah standards. EPA has jurisdiction over wetlands at CERCLA sites in the state.
Clean Air Act National Primary and Secondary Ambient Air Quality Standards	42 USC 7401–7462 40 CFR Part 50	Establishes standards for ambient air quality to protect public health and welfare.	Applicable through the State of Utah standards as a chemical-, location-, and action-specific requirement.	Seeks to protect and enhance the quality of the nation's air resources.

Table 8.1–1. Federal ARARs for OU III Surface Water and Ground Water (continued)

Standard, Requirement, Criterion, or Limitation	Citation	Description	Status	Comment
Resource Conservation and Recovery Act (RCRA)	42 USC 6901 40 CFR Parts 260–279	Regulates the generation, treatment, storage, and disposal of hazardous waste.	Applicable through the State of Utah Standards as a chemical-, location-, and action-specific requirement.	Hazardous waste is not known to exist within OU III. However, these regulations will apply if hazardous waste is generated during the OU III treatment process.
Uranium Mill Tailings Radiation Control Act (UMTRCA)	42 USC 2022, 42 USC 7901–7942	Establishes health-based groundwater remediation standards for inactive uranium processing sites.	Relevant and appropriate chemical- and action-specific requirement.	Although the cleanup standards apply only to certain specifically designated sites where uranium was processed, the groundwater cleanup standards are relevant and appropriate to the OU III selected remedy because uranium and vanadium were processed at this site.
National Historic Preservation Act	16 USC 470 40 CFR 6.301(b)	Requires Federal agencies to take into account the effect of any federally assisted undertaking or licensing on a structure or object that is included on or eligible for the National Register of Historic Places.	Applicable location- and action-specific requirement for the OU III selected remedy.	Applies to any district, site, building, structure, or object listed on or eligible for the National Register of Historic Places.
Archeological and Historic Preservation Act	16 USC 469 40 CFR 6.301(c)	Establishes procedures to provide for preservation of historical and archeological data that might be destroyed through alteration of terrain as a result of a Federal construction project or a federally licensed activity or program.	Applicable as a location- and action-specific requirement.	Applies if OU III activities affect the historical or archeological sites that have been identified near OU III.

Table 8.1–1. Federal ARARs for OU III Surface Water and Ground Water (continued)

Standard, Requirement, Criterion, or Limitation	Citation	Description	Status	Comment
Fish and Wildlife Coordination Act	16 USC 661-666 40 CFR 6.302(g)	Requires consultation when a Federal department or agency proposes or authorizes any modification of any stream or other water body; requires adequate provisions for protection of fish and wildlife resources.	Relevant and appropriate as a location- and action-specific requirement.	The Montezuma Creek channel may be modified during OU III activities, which may result in temporary habitat loss for wildlife species.
Endangered Species Act	16 USC 1531–1543 50 CFR Parts 17 and 402 40 CFR 6.302(h)	Requires that Federal agencies ensure that any action authorized, funded, or carried out by such agencies is not likely to jeopardize the continued existence of any threatened or endangered species or destroy or adversely modify critical habitat.	Applicable as a location- and action-specific requirement.	Currently threatened or endangered species or critical habitat have not been identified in OU III. Applies if remedial action will cause depletions in Montezuma Creek flow to the San Juan River greater than 100 acre-feet per year.
Floodplain/Wetlands Environmental Review	40 CFR Part 6, Appendix M	Establishes agency policy and guidance for carrying out the provisions of Executive Orders 11988, "Floodplain Management," and 11990, "Protection of Wetlands."	Applicable as a location- and action-specific requirement.	Remediation actions could affect site floodplains and wetlands.
National Environmental Policy Act (NEPA)	40 CFR 1500 10 CFR 1021	Requires that all federally undertaken actions be assessed for potential environmental impacts. All potential environmental impacts must be properly mitigated.	Relevant and appropriate as a location- and action-specific requirement.	NEPA values have been and will be incorporated in the CERCLA documentation.

Federal Water Pollution Control Act, as Amended by the Clean Water Act

Water Quality Criteria

The water quality criteria of this act and its corresponding regulations set water quality standards on the basis of toxicity to aquatic organisms and human health, and manage storm-water runoff discharges. The requirements are implemented by the State of Utah through federally approved programs under the Clean Water Act. See the corresponding discussions in Section 8.2 (Water Quality Rules, Standards of Quality for Waters of the State, Ground Water Quality Protection, Underground Injection Control Program, and Utah Pollutant Discharge Elimination System) for ARARs determinations.

Dredge or Fill Requirements (Section 404)

The provisions of 40 CFR 230 and 231 and 33 CFR 323 regulate activities associated with discharging dredged or fill material into waters of the U.S. Navigable waters and isolated wetlands are protected under the jurisdiction of the U.S. Army Corps of Engineers; a general permit (GP–40) was issued by the Corps of Engineers to the State authorizing the State Engineer to regulate the discharge of dredged or fill material into Utah streams. See the discussion in Section 8.2 for an ARARs determination.

The discharge of dredged or fill materials into waters of the U.S. (including wetland areas) is regulated by EPA rather than the Corps of Engineers for CERCLA sites. Wetland areas have been identified and delineated throughout OU III. Guidelines of the *Monticello Wetlands Master Plan* (DOE 1996b), which was developed to adhere to these applicable location- and action-specific requirements, and which has been approved by EPA, will be followed for any wetland area disturbance, remediation, and restoration activities that occur in association with the selected OU III surface-water and ground-water remedy.

Clean Air Act

The requirements of this act and its corresponding regulations seek to protect and enhance the quality of the nation's air resources in order to promote public health and welfare and the productive capacity of the nation's population. The requirements are implemented by the State of Utah through the federally approved program under the Clean Air Act. See the discussion in Section 8.2.2 (Air Quality) for an ARARs determination.

Resource Conservation and Recovery Act (RCRA)

The requirements of this act and its corresponding regulations address the generation and management of hazardous waste (RCRA Subpart C), and the management of underground storage tanks containing regulated substances (RCRA Subpart I). The requirements are implemented by the State of Utah through the federally approved program under RCRA, as amended. See the discussion in Section 8.2 for an ARARs determination.

Uranium Mill Tailings Radiation Control Act

The requirements of this act and its corresponding regulations, promulgated at 40 CFR Part 192, are not applicable because the site does not meet the statutory or jurisdictional prerequisites that are applicable only to 24 specifically identified inactive uranium mills and mill tailings sites. However, these requirements are relevant and appropriate for the selected OU III surface-water and ground-water remedy because mill tailing contaminants have been dispersed into the environment. Included in these requirements are the cleanup standards for remedial actions at inactive uranium processing sites with ground-water contamination and the process for determining and implementing alternate concentration limits (alternate cleanup standards). Therefore, these Federal requirements are relevant and appropriate chemical- and action-specific requirements for the selected OU III surface-water and ground-water remedy.

National Historic Preservation Act

The regulations implementing this act and its corresponding regulations at 40 CFR 6.301(b) require Federal agencies to take into account the effect of any federally assisted undertaking or licensing on a structure or object that is included on or eligible to the National Register of Historic Places. Because structures or objects exist near OU III for which a determination of eligibility has not been made, these Federal requirements are applicable location- and action-specific requirements for the selected OU III surface-water and ground-water remedy.

Archaeological and Historical Preservation Act

This act and its corresponding regulations establish procedures to provide for the preservation of historical and archaeological resources that may be destroyed through alteration of terrain as a result of a Federal construction project or a federally licensed activity or program. On the basis of recent archaeological survey results, which identify regulated resources near OU III, these Federal regulations are considered applicable action- and location-specific requirements for remedial activities associated with the selected OU III surface-water and ground-water remedy.

Fish and Wildlife Coordination Act

This act and its corresponding regulations require consultation with the U.S. Fish and Wildlife Service whenever a Federal department or agency proposes or authorizes modification of any stream or other body of water and requires adequate provisions for the protection of fish and wildlife resources. Recent flora and fauna surveys identified no fish in Montezuma Creek within OU III but showed that a short-term loss of habitat for wildlife may result if the Montezuma Creek channel is modified. Because the Montezuma Creek channel may be temporarily disturbed, these Federal requirements are relevant and appropriate location- and action-specific requirements for the selected OU III surface-water and ground-water remedy.

Endangered Species Act

This act and its corresponding regulations require that Federal agencies ensure that any action authorized, funded, or carried out by such agencies is not likely to jeopardize the continued existence of any threatened or endangered species or destroy or adversely modify critical habitat

required for the continued existence of that species. DOE currently is conducting surveys to determine if threatened or endangered species are present in Montezuma Creek. To date, no threatened or endangered species were identified at or near MMTS or within OU III; however, these requirements are applicable location- and action-specific Federal requirements if threatened or endangered species are identified. DOE is also calculating potential depletions in flow to the San Juan River (of which Montezuma Creek is a tributary) that could result from re-routing Montezuma Creek or interrupting ground water recharges to the creek during implementation of the OU III selected remedy. Flows to the San Juan River are protected under this act because endangered fish reside in the river. DOE is committed to designing its response action to ensure minimal (less than 100 acre-feet per year) depletion of flow to the San Juan River.

Bald and Golden Eagle Protection Act

This act and its corresponding regulations, which are administered by the U. S. Fish and Wildlife Service, provide for the preservation of bald and golden eagles through the protection of the individual raptor and its progeny. On the basis of survey information, neither bald nor golden eagles reside at or near the MMTS. Therefore, these Federal requirements are not applicable nor relevant and appropriate to the OU III selected remedy.

Executive Orders 11988—Floodplain Management, and 11990—Protection of Wetlands

These presidential orders and their corresponding regulations require Federal agencies to evaluate actions they may take to avoid, to the extent possible, adverse effects associated with direct and indirect development of a floodplain or wetland. The 10 CFR 1022 "Compliance with Floodplain/Wetlands Environmental Review Requirements" were issued to implement the requirements of Executive Orders 11988 and 11990. Activities associated with the OU III remedy may affect site floodplains and wetlands. Therefore, these orders and their corresponding regulations are applicable Federal location- and action-specific requirements.

Farmland Protection Policy Act

The purpose of this act and its corresponding regulations is to minimize the extent to which Federal programs contribute to the unnecessary and irreversible conversion of prime, unique, or important farmlands to nonagricultural uses. This requirement is administered through the U.S. National Resource Conservation Service. Because prime, unique, or important farmlands are not located within OU III, these Federal requirements are not applicable or relevant and appropriate to the selected OU III surface-water and ground-water remedy.

National Environmental Policy Act

The National Environmental Policy Act (NEPA) and its corresponding regulations are relevant and appropriate location- and action-specific Federal requirements for all federally funded projects and programs, including any activities associated with the selected OU III surface-water and ground-water remedy. Additional guidance that would be considered under NEPA includes the Council on Environmental Quality regulations, 40 CFR Part 1500; DOE NEPA regulations,

10 CFR 1021; DOE Order 451.1, *Implementation of NEPA*; and *Secretarial Policy Statement on the National Environmental Policy Act* (issued June 1994). NEPA values have been and will be incorporated into the CERCLA documentation.

8.2. State of Utah ARARs

Because MMTS is in Utah, compliance with all State-specific environmental rules, regulations, standards, criteria, or limitations that are applicable or relevant and appropriate to the selected OU III surface-water and ground-water remedy is mandatory. This section addresses State of Utah requirements and identifies how each may pertain to OU III surface-water and ground water. The authorization process for allowing a state to implement a Federal program is generally a phased process. Because of this, the State of Utah may not have adopted a specific rule or portion of a regulatory program. In such instances, if a nonadopted rule or regulation in a state-implemented program is an ARAR, the Federal standards will apply. A list of applicable or relevant and appropriate State of Utah requirements for OU III surface-water and ground water is presented in Table 8.2–1.

8.2.1 Drinking Water

Drinking Water Rules—These rules represent the State's implemented version of the Federal Safe Drinking Water Act's National Primary and Secondary Drinking Water Regulations, which contain criteria and procedures to ensure a supply of drinking water that dependably complies with maximum contaminant levels. They include quality control and testing procedures that ensure proper operation and maintenance of a potable public water supply system, specify the minimum quality of water that may be taken into the system, and provide siting requirements for new facilities for public water systems. They also establish maximum contaminant levels that may be considered when establishing cleanup standards. EPA is in the process of revising existing MCLs for radionuclides; new radionuclide standards will also be promulgated. The ultimate effect will be to limit the amount of radionuclides found in drinking water. It is anticipated that these rules will become effective in November 2003, and that the State of Utah will become authorized to implement the new rules.

Because the alluvial aquifer is not used as a public water supply system, these requirements are not applicable. However, because the alluvial aquifer is of a quality that would allow it to be used as a drinking water source, the Utah Drinking Water Rules are relevant and appropriate chemical-specific requirements for the selected OU III surface-water and ground-water remedy.

Water Quality

This is the State-implemented version of the Federal Clean Water Act program.

Water Quality Rules

The definitions for water pollution and the general requirements are applicable chemical-, location-, and action-specific requirements for the selected OU III surface-water and ground-water remedy.

Table 8.2–1. State ARARs for OU III Surface Water and Ground Water

Department/Division	Subject	Statute	Rule	Comments
Department of Environmental Quality, Division of Drinking Water	Safe Drinking Water Rules	Title 19, Chapter 4, Utah Code Annotated (U.C.A.)	R309, Utah Administrative Code (U.A.C.)	This is the State-implemented Safe Drinking Water Act program. The quality of the alluvial aquifer could allow it to be used as a drinking-water aquifer. Relevant and appropriate chemical-specific requirement.
Department of Environmental Quality, Division of Water Quality	Definitions and General Requirements	Title 19, Chapter 5, U.C.A.	R317–1, U.A.C.	Applicable chemical-, location-, and action-specific requirement.
	Standards for Quality for Waters of the State	Title 19, Chapter 5, U.C.A.	R317–2, U.A.C.	These rules are specific to Utah waters, though they are derived in part by using Federal criteria. See particularly the nondegradation policy in R317–2–3. Applicable chemical-, location-, and action-specific requirement.
	Groundwater Quality Protection	Title 19, Chapter 5, U.C.A.	R317–6, U.A.C.	There is no corresponding Federal program. Applicable chemical- and action-specific requirement.
	Utah Underground Injection Control	Title 19, Chapter 5, U.C.A.	R317–7, U.A.C.	Applicable chemical- and action-specific requirement if Class V injection wells are used in association with a water treatment technology.
	Utah Pollutant Discharge Elimination System	Title 19, Chapter 5, U.C.A.	R317–8, U.A.C.	Applicable chemical-, location-, and action-specific requirement if a point-source effluent discharge into Montezuma Creek is used in association with a water treatment technology. Applicable location- and action-specific requirement; potential storm-water runoff into Montezuma Creek needs to be controlled.

Table 8.2–1. State ARARs for OU III Surface Water and Ground Water (continued)

Department/Division	Subject	Statute	Rule	Comments
Department of Environmental Quality, Division of Air Quality	Utah Air Conservation Rules	Title 19, Chapter 2, U.C.A.	R307–1 and R307–12, U.A.C.	This is the State-implemented National Primary and Secondary Ambient Air Quality Standards program. These rules are applicable through the State of Utah standards as a chemical-, location-, and action-specific requirement. This provision is applicable in association with controlling point-source air emissions from OU III treatment technologies. R317–1–3, in particular, specifies general air pollution requirements that must be met at all facilities. Also applicable is the provision associated with controlling fugitive dust emissions from OU III.
Department of Environmental Quality, Division of Radiation Control	Radioactive Material Management	Title 19, Chapter 3, U.C.A.	R313–12, R313–15–301, R313–19 through R313–22, and R313–25–18 through R313–25–22, U.A.C.	These provisions address the safe management, including disposal, of radioactive material. They also address standards for protection against radiation and licensing requirements. These State requirements are applicable chemical- and action-specific requirements.
Department of Environmental Quality, Division of Solid and Hazardous Waste	Hazardous Waste Management Rules (RCRA Subpart C)	Title 19, Chapter 6, Part 1, U.C.A.	R315, U.A.C.	These rules are applicable chemical-, location-, and action-specific requirements through the State of Utah standards; hazardous waste is not known to exist within OU III. Hazardous waste may be generated or managed in association with implementing the selected OU III remedy (e.g., water treatment process wastes).

Table 8.2–1. State ARARs for OU III Surface Water and Ground Water (continued)

Department/Division	Subject	Statute	Rule	Comments
Department of Environmental Quality, Division of Environmental Response and Remediation	Corrective Action Cleanup Standards Policy for CERCLA and Underground Storage Tank Sites	Title 19, Chapter 6, Part 1, U.C.A.	R311–211, U.A.C.	Remediation strategy must achieve compliance with this policy that sets forth criteria for establishing cleanup standards and requires source control or removal, and prevention of further degradation. This rule is an applicable chemical-, location-, and action-specific State requirement.
State Engineer	Dredge or fill requirements including stream channel alteration.			Applicable as a chemical-, location-, and action-specific requirement.
Department of Natural Resources, Division of Water Rights	Well-drilling standards (standards for drilling and abandonment of wells)	73–3–25(2)(b), U.C.A.	R655–4, U.A.C.	Includes such requirements as performance standards for casing joints and requirements for abandoning a well. Also included are water right issues associated with consumptive use. This law is applicable to all drilling anticipated for any of the alternatives and for any planned water use. Applicable action- and location-specific requirement.
Department of Administrative Services, Division of State History	Protection of archaeological, anthropological resources.	9–8–501 to 9–8–506, U.C.A.	R212, U.A.C.	Section 63–18–18, U.C.A., states legislative interest in preservation of archaeological, anthropological, and paleontological resources. Section 63–18–25, U.C.A., addresses historical resources on State lands, and Section 63–18–37, U.C.A. addresses projects by State agencies. Applicable location- and action-specific requirement.

Standards of Quality for Waters of the State

The Clean Water Act provides criteria for states to set water quality standards on the basis of toxicity to aquatic organisms and human health. These rules are specific to Utah waters and are applicable chemical-, location-, and action-specific requirements for the selected OU III surface-water and ground-water remedy.

Utah Pollutant Discharge Elimination System

The UPDES rules address point-source discharges of pollutants and storm-water runoff discharges into Utah waterways. They also address the use of injection wells (i.e., underground discharges of water) through the Underground Injection Control Program. These rules are applicable chemical-, location-, and action-specific State of Utah requirements if a point-source discharge into Montezuma Creek is used in association with a water treatment technology. These rules are also applicable location- and action-specific State of Utah requirements for controlling storm-water runoff associated with construction activities. Additionally, the rules associated with the Underground Injection Control Program are applicable chemical- and action-specific State of Utah requirements for the use of Class V injection wells if aquifer reinjection is included in the selected OU III surface-water and ground-water remedy.

Ground Water Quality Protection

Utah-specific ground-water protection standards are addressed by this rule. An equivalent Federal program does not exist. These ground water rules are applicable chemical-, location-, and action-specific State of Utah requirements for the selected OU III surface-water and ground-water remedy.

Dredge or Fill Requirements (Section 404)

These rules, which are implemented by the State Engineer, are applicable location- and action-specific requirements for any dredge or fill activities in Montezuma Creek, including stream channel alterations, associated with the selected OU III surface-water and ground-water remedy.

8.2.2 Air Quality

The Utah Air Conservation Rules address the prevention and control of air pollution sources in Utah and establish air quality emission standards and monitoring requirements. Because air emissions may occur as part of OU III water treatment technologies, and fugitive dust could be generated through the clearing of land, use of construction equipment, and construction and use of haul roads, the state-implemented version of the Federal National Primary and Secondary Ambient Air Quality Standards program, which establish standards for ambient air quality, and the National Emission Standards for Hazardous Air Pollutants program, which establishes standards for new stationary sources, are applicable chemical-, location-, and action-specific State of Utah requirements for the selected OU III surface-water and ground-water remedy.

Utah Hazardous Waste and Underground Storage Tank Management

Subpart C of RCRA addresses the generation, treatment, storage, disposal, and transportation of hazardous waste. Part 261.4 (a)(4) of 40 CFR excludes mill tailings (source, special nuclear, or by-product material, as defined by the Atomic Energy Act of 1954) from meeting the definition of a hazardous waste. Subpart I of RCRA regulates underground storage tanks (USTs) that are used to store regulated substances. On the basis of historical land-use knowledge and field investigations, it is unlikely that hazardous waste or USTs are present within OU III. However, hazardous waste may be generated during the implementation of the selected OU III surface-water and ground-water remedy (e.g., waste-treatment process wastes). Therefore, the hazardous waste rules are applicable chemical-, location-, and action-specific State of Utah requirements if hazardous waste is discovered or generated. To the extent possible, hazardous waste will be managed in accordance with the *Monticello Remedial Action Project, Special Waste Management Plan for the Monticello Mill Tailings Site and Vicinity Properties* (DOE 1997e). The State of Utah UST requirements are not applicable or relevant and appropriate to the selected OU III surface-water and ground-water remedy.

Corrective Action Cleanup Standards Policy for CERCLA and Underground Storage Tank Sites

This policy is a Utah-specific requirement that establishes a cleanup standards policy for CERCLA and UST sites. The policy sets forth criteria for establishing cleanup standards and requires source control or removal, and prevention of further degradation. This policy is an applicable chemical-, location-, and action-specific State of Utah requirement for the selected OU III surface-water and ground-water remedy.

Radiation Control

These State rules address the management, including disposal and transportation, of radioactive materials. They also address licensing requirements and standards for protection against radiation. These rules are applicable chemical- and action-specific State of Utah requirements for the selected OU III surface-water and ground-water remedy.

Utah State History

These requirements address the protection of archaeological, anthropological, and paleontological resources on State lands and lands associated with projects conducted or approved by State agencies. These location- and action-specific State of Utah requirements are applicable to activities associated with the selected OU III surface-water and ground-water remedy.

Water Rights

These requirements, which include well-drilling and abandonment standards, and consumptive use of water not already permitted to OU I, are applicable action- and location-specific State of Utah requirements for the selected OU III surface-water and ground-water remedy.

8.3. To-Be-Considered

This section discusses guidance, advisories, or criteria that are not promulgated, and therefore cannot be considered ARARs, but which may be used to establish protective CERCLA remedies for the OU III surface-water and ground water.

Implementation Guidance for Radionuclides:

EPA addresses radionuclide monitoring of drinking water in the draft document *Implementation Guidance for Radionuclides* (EPA 2000). This guidance discusses circumstances that could require that monitoring of radionuclides occur at the point of entry to the distribution system instead of at the tap. Thus, the quality criteria would apply to the raw water (within the ground water system) instead of the water potentially treated by the public drinking water treatment system.

9.0 References

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