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Environmental Assessment of Ground Water Compliance at the Slick Rock, Colorado, UMTRA Project Sites

Final

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Acronyms and Abbreviations

ACL	alternate concentration limit
CDPHE	Colorado Department of Public Health and Environment
CFR	Code of Federal Regulations
COPC	contaminant of potential concern
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
ft	foot (feet)
MCL	maximum concentration limit (listed in 40 CFR 192, Table 1 to Subpart A)
µg/L	micrograms per liter
mg/L	milligrams per liter
NEPA	National Environmental Policy Act
PEIS	Programmatic Environmental Impact Statement (for the UMTRA Ground Water Project)
SOWP	Site Observational Work Plan
UMTRA	Uranium Mill Tailings Remedial Action (Project)
UMTRCA	Uranium Mill Tailings Radiation Control Act
USFWS	U.S. Fish and Wildlife Service

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Executive Summary

This environmental assessment addresses the environmental effects of a proposed action and the no action alternative to comply with U.S. Environmental Protection Agency (EPA) ground water standards at the Slick Rock, Colorado, Uranium Mill Tailings Remedial Action Project sites. The sites consist of two areas designated as the North Continent (NC) site and the Union Carbide (UC) site. In 1996, the U.S. Department of Energy (DOE) completed surface cleanup at both sites and encapsulated the tailings in a disposal cell 5 miles east of the original sites.

Maximum concentration limits (MCLs) referred to in this environmental assessment are the standards established in Title 40 *Code of Federal Regulations* Part 192 (40 CFR 192) unless noted otherwise.

Ground water contaminants of potential concern at the NC site are uranium and selenium. Uranium is more prevalent, and concentrations in the majority of alluvial wells at the NC site exceed the MCL of 0.044 milligram per liter (mg/L). Selenium contamination is less prevalent; samples from only one well had concentrations exceeding the MCL of 0.01 mg/L. To achieve compliance with Subpart B of 40 CFR 192 at the NC site, DOE is proposing the strategy of natural flushing in conjunction with institutional controls and continued monitoring. Ground water flow and transport modeling has predicted that concentrations of uranium and selenium in the alluvial aquifer will decrease to levels below their respective MCLs within 50 years.

Ground water contaminants of potential concern at the UC site are manganese, molybdenum, nitrate, selenium, radium-226, radium-228, uranium, benzene, and toluene. Molybdenum, nitrate, and selenium are major contaminants; elevated concentrations are one to two orders of magnitude above the respective MCLs and are widely distributed in the alluvial aquifer. Minor contaminants include manganese, radium-226, radium-228, uranium, benzene, and toluene, which are present in concentrations only slightly above their respective standards (background for manganese) or have been detected in only a small portion of the alluvial aquifer. To achieve compliance with Subpart B of 40 CFR 192 at the UC site, DOE proposes the strategy of natural flushing for all contaminants in conjunction with institutional controls and continued monitoring until cleanup goals are achieved. Ground water flow and transport modeling predicts that concentrations of molybdenum, nitrate, and uranium will decrease to levels below their respective MCLs and that concentrations of manganese will decrease to levels below background in the alluvial aquifer within 100 years. For benzene and toluene, it is anticipated that natural biological degradation will reduce these contaminants to levels below the State of Colorado drinking water standards (Regulation 41) within 100 years. Radium concentrations slightly exceed the MCL at only one location at the UC site. Concentrations at that location are expected to decrease to levels below the MCL within 100 years.

Ground water flow and transport modeling predicts that concentrations of selenium in the alluvial aquifer at the UC site will not decrease below the 0.01 mg/L MCL within 100 years; therefore, DOE proposes an alternate concentration limit at the risk-based human health drinking water benchmark of 0.18 mg/L. The flow and transport modeling predicts that selenium concentrations in the alluvial aquifer will be below this benchmark value within 50 years, with a

14 percent probability that the maximum average selenium concentration will be above the benchmark after 100 years of natural flushing.

The compliance strategies for both the NC and UC sites would result in compliance with EPA standards in 40 CFR 192 and the proposed alternate concentration limit for selenium.

The proposed monitoring program would begin upon regulatory concurrence with the Ground Water Compliance Action Plan (DOE 2002a). In about 2005, DOE would compare the actual monitoring results to the modeling predictions. If actual ground water conditions are reasonably comparable to predicted conditions, in 2006 the sites may be turned over to the Long-Term Surveillance and Maintenance Program for long-term management. If monitoring results indicate that natural flushing is not proceeding as predicted, DOE would reevaluate conditions in the alluvial aquifer to determine if changes to the compliance strategy are needed.

DOE received one set of comments on the Draft Environmental Assessment during the public comment period concerning the potential for the plume to migrate off site at the UC site. Changes and clarifications were made in this Final Environmental Assessment to address the comments. Appendix A provides the full text of the comments and DOE's response.

1.0 Introduction

The U.S. Department of Energy (DOE) is proposing ground water compliance strategies for two former uranium-ore processing sites at Slick Rock, Colorado (Figure 1). The proposed strategies are in compliance with U.S. Environmental Protection Agency (EPA) regulations in Title 40 *Code of Federal Regulations* Part 192 (40 CFR 192). The standards were established to minimize risk to human health and the environment that result from milling-related constituents in ground water.

1.1 Site Description

The Slick Rock sites consist of two former uranium-ore processing sites designated as the North Continent (NC) site and the Union Carbide (UC) site. These sites are located along the Dolores River at an elevation of approximately 5,500 feet (ft) above mean sea level. The UC site is about 1 mile downstream of the NC site. Both sites are currently owned by UMETCO Minerals Corporation. Steep hillsides and cliffs of the Dolores River Canyon surround the sites and rise to an elevation of about 6,500 ft above mean sea level. After removal of surface contamination in 1996, the sites were regraded with on-site material and reseeded. Figure 2 is an April 2001 aerial photograph of the region.

The Slick Rock sites are located in a remote portion of San Miguel County in southwest Colorado (Figure 1). The region has an arid to semiarid climate with high evaporation, low precipitation, low humidity, and large temperature variations. The average annual precipitation in the area is about 13 inches (DOE 2002b).

The fine-grained units of the Jurassic Summerville and Morrison Formations underlie the Quaternary Dolores River alluvium at the NC site. These formations form an aquitard that inhibits downward migration of alluvial ground water. Three hydrostratigraphic units underlie the UC site. These units are, in descending order, the Dolores River alluvium, the Jurassic Entrada Sandstone, and the Jurassic Navajo Sandstone. At both the NC and UC sites, the uppermost aquifer is in the Dolores River alluvium.

The Dolores River alluvium ranges in thickness from 18 to 26 ft and consists of unconsolidated clayey sands, sandy gravels, and cobbles. Ground water in the alluvium is unconfined and generally flows to the north and toward the river; depth to the water table ranges from 5 to 15 ft below ground surface. The Dolores River alluvium is laterally restricted by bedrock that forms the terraces and canyon walls adjacent to the Dolores River. The Dolores River floodplain is discontinuous and pinches out in areas where the river meets the canyon wall. Alluvial material also covers the terraces adjacent to the river and is topographically and hydrologically isolated from the river alluvium. The terrace alluvial deposits are typically unsaturated.

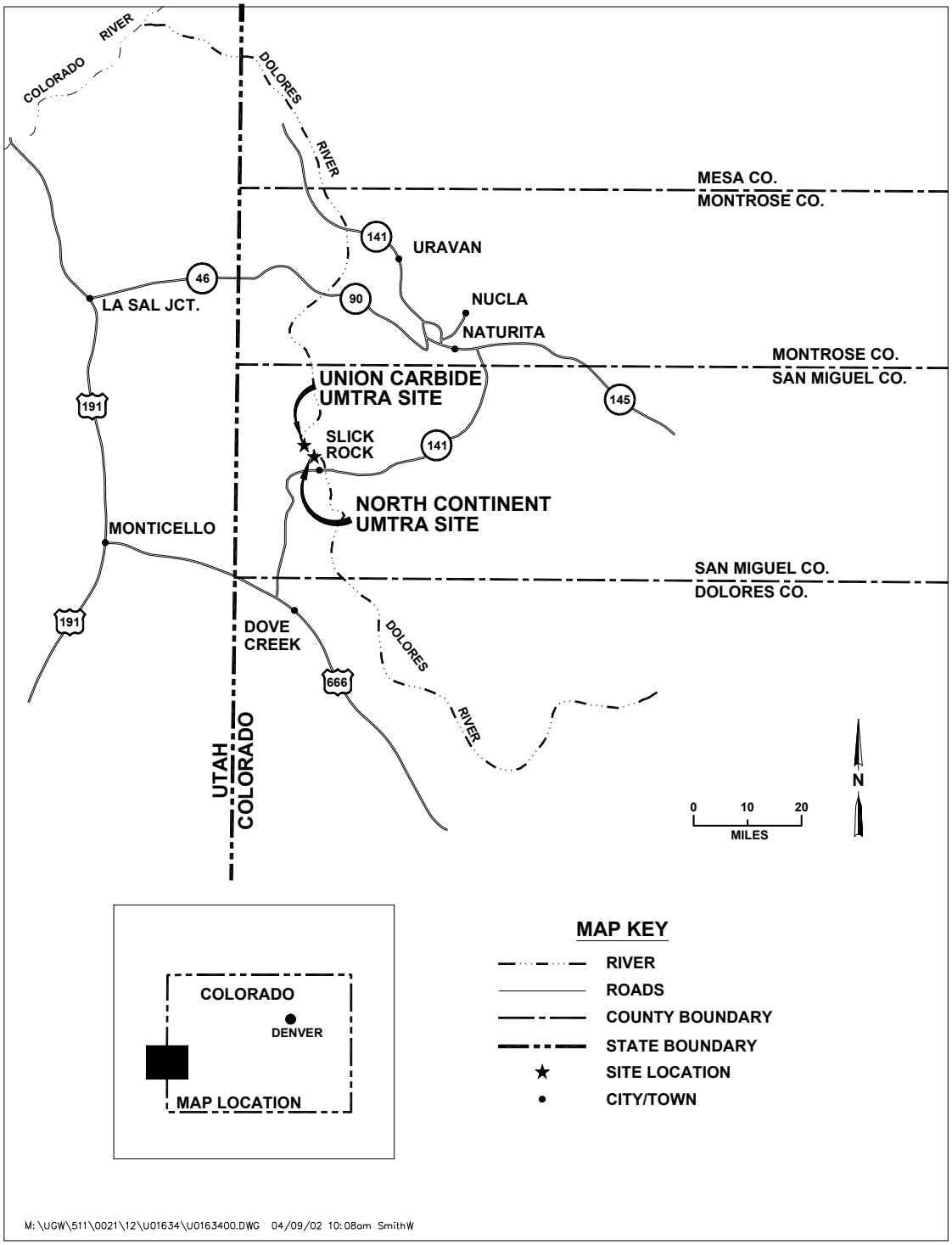

Figure 1. Location of the Slick Rock UMTRA Project Sites

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Figure 2. April 2001 Aerial Photograph of the Slick Rock Area

1.2 Site History

The Shattuck Chemical Company built the NC mill in 1931. In 1934, North Continent Mines, Inc., acquired the site. The mill was designed to extract vanadium and radium salts from locally mined ores. In 1945, the federal government acquired control of the site through the Union Mines Development Corporation with the specific purpose of supplying uranium for the Manhattan Project. Union Carbide became the owner of the site in 1957, and the NC mill closed in the early 1960s (DOE 1995b). The NC site is currently owned by UMETCO Minerals Corporation, which has been acquired from Union Carbide by DOW Chemical.

From 1931 to 1942, vanadium was extracted from ore using a sulfuric acid leaching process. In 1942, the extraction techniques included an initial salt roast circuit with an acid leach process to recover vanadium, uranium, and radium concentrates (Merritt 1971).

The UC mill began operation in 1957 using a uranium-vanadium upgrading technique to process ore mined from the surrounding area. The milling process at the UC site included an initial step to dry-grind the coarse-grained sandstone, separating the fines from the coarser ore.

The coarse ore fraction was combined with a recirculated sulfuric acid solution. Following this step, a sand-slime separation process obtained a second uranium product. The sand product was further acid-leached, washed, and discharged to the tailings pile. A third uranium product resulted from an ammonia neutralization step on part of the pregnant solution. The upgraded material, which was composed of all three products, was shipped to the Union Carbide mill at Rifle, Colorado, for further processing. Because the finer fraction was shipped off site, the tailings pile at the UC site was composed of fine-grained sand with virtually no slimes. The UC mill closed in December 1961 (Merritt 1971), and the site is currently owned by UMETCO.

Surface remediation at the Slick Rock sites began in 1995 and was completed in 1996. The purpose of the surface remediation program was to clean up surface and subsurface soils that had been contaminated with residual radioactive materials from the milling process. The Uranium Mill Tailings Remedial Action (UMTRA) Surface Project is described in the Surface Environmental Assessment (Surface EA) (DOE 1995b). Tailings and other contaminated surface materials were placed in a disposal cell approximately 5 miles east of the sites.

1.3 Overview of Contamination

Historical processing of uranium and vanadium ores at the sites has resulted in contaminated ground water. A review of existing data indicated that additional evaluation of ground water, surface water, subpile soils, and geology was needed. In 2001, DOE conducted the field investigations to address data gaps. Section 4.0 of the Site Observational Work Plan (SOWP, DOE 2002b) describes the results. Uranium and selenium are the contaminants of potential concern (COPCs) at the NC site. Molybdenum, manganese, nitrate, selenium, uranium, radium-226, radium-228, benzene, and toluene are the COPCs at the UC site.

Maximum concentration limits (MCLs) discussed in this environmental assessment refer to the standards established in 40 CFR 192 unless noted otherwise.

1.4 Summary of Current Risk

Present conditions at the Slick Rock sites present no unacceptable risks to human health because there is currently no use of ground water from the uppermost aquifer. Under the proposed action (Section 3.0), future risks would remain acceptable because institutional controls (explained in Section 3.1.3.2) would restrict access to contaminated ground water.

Contaminant concentrations in the Dolores River have historically been below State of Colorado surface water standards (Water Quality Control Commission Regulation 35, "Classifications and Numeric Standards for Gunnison and Lower Dolores River Basins") and present no unacceptable risks to human health or ecological receptors. Concentrations are anticipated to remain below the standards in the future.

1.5 National Environmental Policy Act Process

The National Environmental Policy Act (NEPA) of 1969 requires federal agencies to analyze the environmental impacts of proposed and alternative actions. In 1996, DOE completed the *Final Programmatic Environmental Impact Statement for the Uranium Mill Tailings Remedial Action Ground Water Project* (PEIS) (DOE 1996). In that document, DOE analyzed the potential effects of implementing four alternatives for achieving ground water compliance at the UMTRA Project sites. A Record of Decision was issued in April 1997 in which DOE selected the Proposed Action Alternative for conducting the UMTRA Ground Water Project. Under the Proposed Action Alternative, DOE was given the option of implementing active remediation, natural flushing, no further ground water remediation[1], or any combination of these three strategies. The PEIS then recommended that DOE prepare site-specific NEPA documents, such as this environmental assessment, to convey the strategy that was selected for each of the sites. The issues discussed and the environmental impacts analyzed in this environmental assessment are tiered to the PEIS as allowed by NEPA regulations in 10 CFR 1021.210(c).

2.0 Purpose and Need for Action

The purpose of the UMTRA Ground Water Project is to protect human health and the environment at abandoned uranium-ore processing sites by complying with the EPA ground water standards in 40 CFR 192 Subpart B. DOE proposes to implement the compliance strategy outlined in the SOWP (DOE 2002b), which uses the framework established in the PEIS (DOE 1996).

[1] "No further remediation" is not the same as the "no action" alternative discussed in this environmental assessment. The "no further remediation" sites require activities such as site characterization to show that no further remediation is warranted.

3.0 Proposed Action and No Action Alternatives

The PEIS provides several alternatives for complying with UMTRA ground water standards and assesses in general terms the effects associated with each alternative. DOE followed the step-by-step decision process described in the PEIS to select the compliance strategy proposed in this environmental assessment. Section 3.1 describes the proposed actions for the NC and UC sites and briefly describes the other alternatives DOE considered but later eliminated. Section 3.2 describes the no action alternative, which is required to be evaluated in DOE's environmental assessments.

3.1 Proposed Action Alternative

3.1.1 NC Site

3.1.1.1 Decision Process for the Proposed Action for the NC Site

DOE's proposed strategy at the NC site is natural flushing with institutional controls and continued monitoring. Figure 3 shows the steps that were followed in selecting this compliance strategy, and Table 1 explains the decision process in the figure.

Table 1. Explanation of the Compliance Strategy Selection Process for the NC Site

Box (Figure 3)	Action or Question	Response
1	Characterize plume and hydrologic conditions.	Review historical data and identify data gaps; conduct additional field investigation to address the data gaps. Move to Box 2.
2	Is ground water contamination present in excess of MCLs or background?	Selenium and uranium concentrations exceed the respective MCLs. Move to Box 4.
4	Does contaminated ground water qualify for supplemental standards due to its classification as limited use ground water?	The ground water does not qualify for limited use because the background dissolved solids concentration is less than 10,000 mg/L, the aquifer will yield more than 150 gallons per day, and background selenium and uranium concentrations are low. Move to Box 6.
6	Does contaminated ground water qualify for alternate concentration limits (ACLs) based on acceptable human health and environmental risks and other factors?	Current concentrations would result in unacceptable human health and environment risk. Ground water flow and transport modeling indicates that natural flushing will be effective for both constituents. Move to Box 8.
8	Does contaminated ground water qualify for supplemental standards due to excessive environmental harm from remediation?	Although the applicability has not been formally addressed, it is unlikely that remedial action would cause excessive harm to the environment. Move to Box 10.
10	Will natural flushing result in compliance with MCLs, background, or ACLs within 100 years?	Ground water flow and transport modeling predicts that selenium and uranium concentrations will be less than the standards within 100 years. Move to Box 11.
11	Can institutional controls be maintained during the flushing period, and is the compliance strategy protective of human health and the environment?	An environmental covenant will be used to prevent use of ground water during the natural flushing period. Ground water can be used without restriction after the natural flushing period and will be protective of human health and the environment at that time. Move to Box 12—implement the natural flushing strategy.

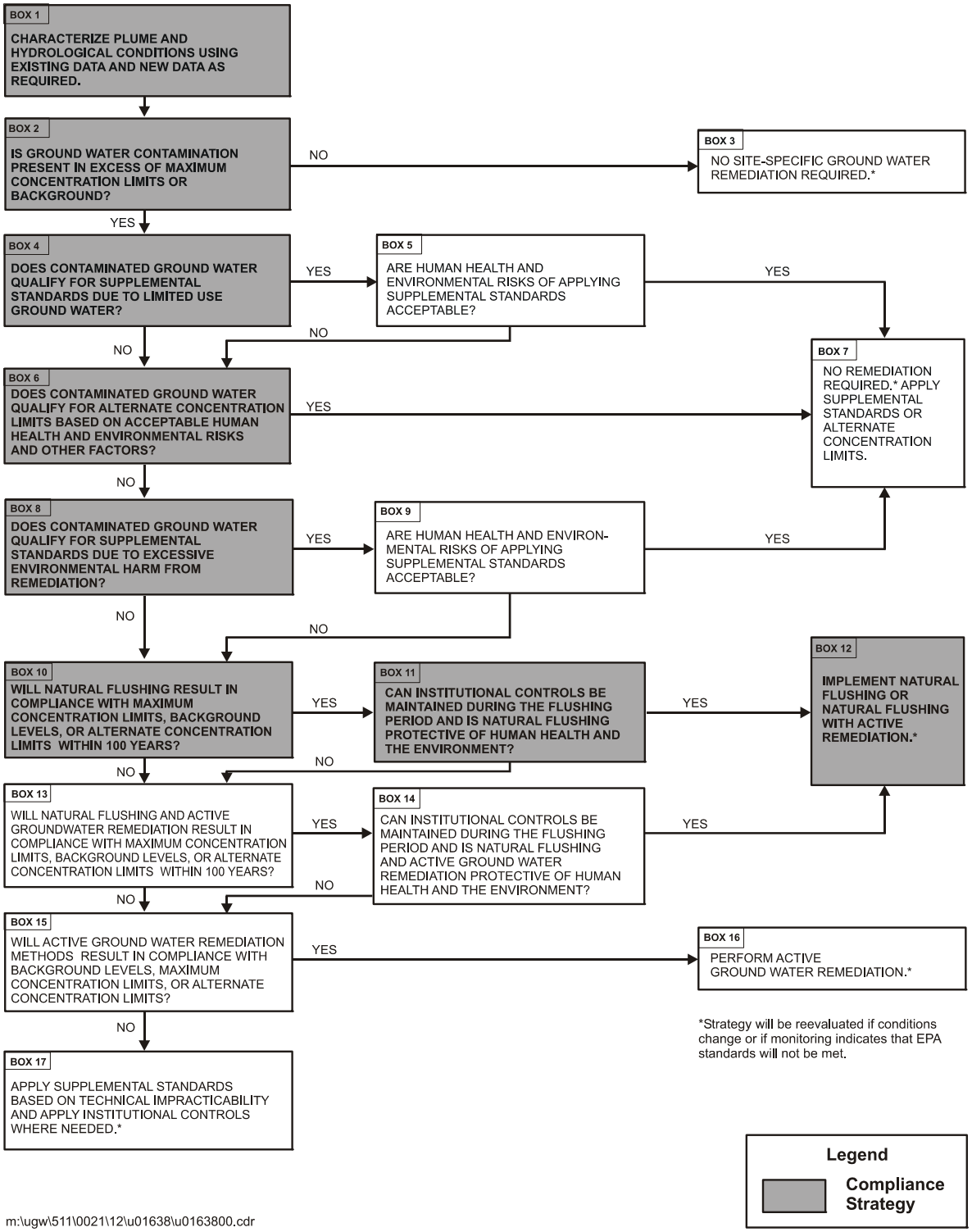

Figure 3. Compliance Selection Framework for the Slick Rock Sites

3.1.1.2 Alternatives Considered but Eliminated

The two other possible alternatives—active remediation and no further remediation—were eliminated from further consideration at the NC site. Active remediation was eliminated because flow and transport modeling conducted for the SOWP (DOE 2002b) predicted that site-related concentrations of selenium and uranium in ground water in the uppermost aquifer beneath the NC site will decrease to levels below their MCLs within 100 years, as allowed in 40 CFR 192. Although ground water discharges to the Dolores River, contaminants rapidly mix with river water, and concentrations decrease to levels that are below all applicable standards and benchmarks. The no further remediation alternative was eliminated because DOE was required to address the ground water constituents with concentrations that exceed MCLs. Natural flushing was the best alternative for addressing those constituents.

3.1.1.3 Explanation of the Proposed Action for the NC Site

Natural flushing is a process in which natural geochemical and biological processes and ground water movement decrease contaminant concentrations in the aquifer through time.

The following conditions are requirements of the natural flushing compliance strategy (40 CFR 192.12[c][2]):

- Natural flushing must decrease concentrations of residual radioactive materials to background levels, MCLs, or alternate concentration limits (ACLs) within 100 years.

- Institutional controls must be implemented that will effectively protect public health and the environment during the natural flushing period.

Contaminant flow and transport modeling predicts that natural ground water movement and geochemical processes will reduce contaminant concentrations in the uppermost (alluvial) aquifer to meet the regulatory requirements at the NC site. Application and success of the natural flushing alternative would be verified through a monitoring program as required by 40 CFR 192.12(c)(3). Figure 4 shows the point-of-compliance wells along with surface water locations. Table 2 identifies the rationale for monitoring those locations under the proposed action alternative.

Table 2. Proposed Monitoring Program at the NC Site

Location	Matrix	Location	Rationale	Analytes
0696	Surface water	Upstream	Background for NC site.	Uranium
0692	Surface water	Adjacent to site	Predicted location where the center of the uranium plume intersects the river.	
0303	Ground water	On site	Hot spot for uranium.	
0305	Ground water	On site	Hot spot for uranium; selenium above the MCL.	Uranium, Selenium
0307	Ground water	On site	Downgradient of hot spots; monitor plume migration.	
0309	Ground water	On site	Farthest downgradient well on site.	Uranium
0311	Ground water	Downgradient	Off site across the river. Monitor migration of the uranium plume between sites.	

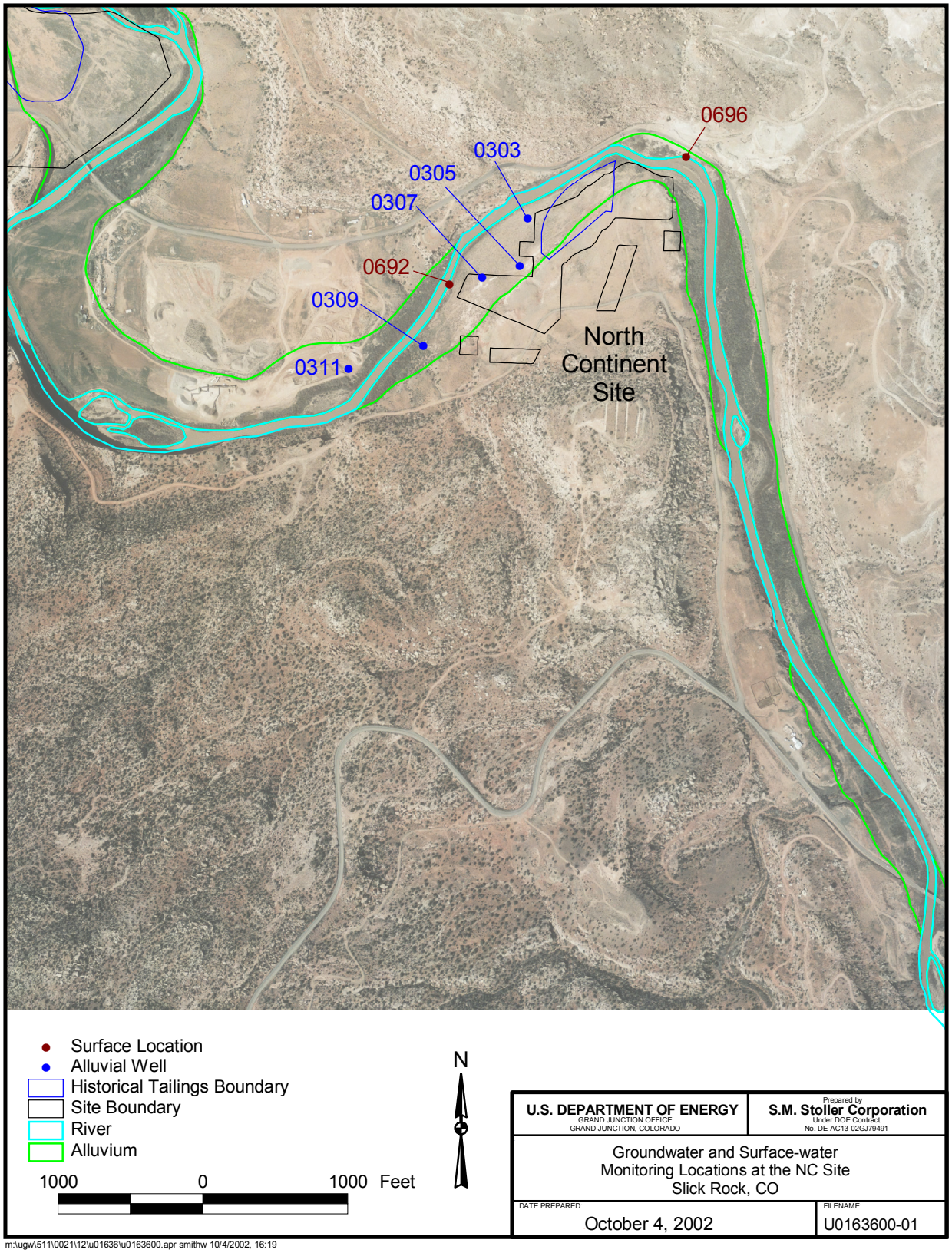

Figure 4. Monitoring Locations at the Slick Rock NC Site

Ground water and surface water would be monitored during the period of natural flushing to verify that concentrations of uranium and selenium are decreasing as predicted. If monitoring results indicate that natural flushing is not proceeding as predicted, DOE would reevaluate conditions in the alluvial aquifer to determine if changes to the compliance strategy are needed.

Compliance monitoring would take place on an annual basis for the first 10 years; after 10 years, sampling frequency would be reduced to once every 5 years. Natural flushing would be considered complete when, for three consecutive sampling events, uranium concentrations are below the MCL in all wells in the monitoring network, and selenium concentrations are below the MCL in wells 0305 and 0307.

3.1.2 UC Site

3.1.2.1 Decision Process for the Proposed Action for the UC Site

Using the compliance selection framework shown in Figure 3, DOE determined that natural flushing in conjunction with continued monitoring and institutional controls would be protective of human health and the environment at the UC site. A natural flushing ACL of 0.18 milligram per liter (mg/L) is proposed for selenium. Table 3 shows the decision process that arrived at the natural flushing strategy.

Table 3. Explanation of the Decision Path for the UC Site Compliance Strategy

Box (Figure 3)	Action or Question	Response
1	Characterize plume and hydrologic conditions.	Review historical data and identify data gaps in the Summary of Site Conditions and Work Plan. Conduct additional field investigation to address the data gaps. Move to Box 2.
2	Is ground water contamination present in excess of MCLs or background?	Molybdenum, nitrate, radium-226+228, selenium, and uranium concentrations exceed the respective MCLs; benzene and toluene levels exceed State of Colorado standards, and manganese concentration exceeds the maximum background concentration. Move to Box 4.
4	Does contaminated ground water qualify for supplemental standards on the basis of limited use?	The ground water does not qualify for limited use designation because the background dissolved solids concentration is less than 10,000 mg/L, the aquifer will yield more than 150 gallons per day, and background COPC concentrations are generally low. Move to Box 6.
6	Does contaminated ground water qualify for ACLs based on acceptable human health and environmental risks and other factors?	Current concentrations would result in unacceptable human health and environmental risks. Ground water flow and transport modeling indicates that natural flushing will be effective. Move to Box 8.
8	Does contaminated ground water qualify for supplemental standards due to excessive environmental harm from remediation?	Although the applicability has not been formally addressed, it is unlikely that remedial action would cause excessive harm to the environment. Move to Box 10.
10	Will natural flushing result in compliance with MCLs, background, or ACLs within 100 years?	Ground water flow and transport modeling predicts that molybdenum, nitrate, and uranium concentrations will be less than their MCLs, manganese concentration will be within the range of background, and selenium levels will be below the ACL within 100 years. Other COPCs are expected to attain acceptable concentrations through flushing and biological/chemical processes. Move to Box 11.
11	Can institutional controls be maintained during the flushing period and is the compliance strategy protective of human health and the environment?	The COPC plumes are within the site boundary, which will facilitate maintaining institutional controls to prevent use of ground water. Ground water can be used after 100 years and will be protective of human health and the environment at that time. Move to Box 12; implement natural flushing.

3.1.2.2 Alternatives Considered but Eliminated

As at the NC site, the other two possible alternatives—active remediation and no further remediation—were also eliminated from further consideration at the UC site. Active remediation was not required because natural flushing would result in compliance with the standards in 40 CFR 192. The no further remediation alternative was eliminated because DOE is required to address the ground water constituents with concentrations that exceed MCLs.

3.1.2.3 Explanation of the Proposed Action for the UC Site

Figures 9, 10, and 11 in the discussion of ground water (Section 4.1) show the distribution of molybdenum, nitrate, and selenium, respectively, in alluvial wells at the UC site.

Because modeling has predicted that selenium concentrations in the uppermost aquifer will not flush naturally to a level below the MCL within 100 years, the compliance strategy for selenium at the UC site is natural flushing to a risk-based ACL of 0.18 mg/L. This human health risk-based number is derived from standard EPA exposure assumptions for a residential drinking water scenario (EPA 1989) and the use of the reference dose for selenium from EPA's Integrated Risk Information System database. The 0.18 mg/L selenium concentration is also in agreement with the Drinking Water Equivalent Level of 0.20 mg/L that was established with the drinking water standards (EPA 2000). The Drinking Water Equivalent Level represents a lifetime exposure concentration protective of adverse noncancer health effects that assumes all of the exposure to a contaminant is from drinking water.

Contaminant flow and transport modeling predicts that natural ground water movement and geochemical processes will reduce contaminant concentrations in the uppermost aquifer (alluvial aquifer) to meet the regulatory requirements. Modeling of the uppermost aquifer has predicted that site-related manganese concentrations will decrease to levels below background; molybdenum, nitrate, and uranium concentrations will be below their MCLs; and selenium will flush to levels below the proposed ACL within 100 years. Radium-226 and radium-228 were not included in the ground water flow and transport model because radium movement in ground water is typically controlled by its limited solubility rather than ground water transport. Well 0319 is the only location where radium concentration exceeds the standard. Because the average radium-226+228 concentration in well 0319 (6.2 picocuries per liter [pCi/L]) is close to the 5 pCi/L standard in 40 CFR 192, radium concentrations are expected to fall below the standard within 100 years (DOE 2002a).

Benzene and toluene were also not included in the ground water flow and transport model because biodegradation, rather than ground water transport, is anticipated to be the dominant process that reduces the concentrations of these constituents. Published degradation rates (Mackay et al. 1992) indicate that these organics should degrade to acceptable levels within the 100-year time frame. Alluvial ground water contaminated with benzene and toluene appears to be limited to an area of about 100 ft by 250 ft near well 0319. State of Colorado drinking water standards for benzene and toluene are 5 micrograms per liter (µg/L) and 1,000 µg/L, respectively. It is likely that both compounds are remnants from spilled gasoline.

Microorganisms in the aquifer matrix under oxidizing conditions can use these compounds as a sole carbon source (primary food). It is not uncommon for an old fuel spill to consist primarily of aromatic organic compounds such as benzene and toluene. The highest benzene concentration detected was 19,800 µg/L in a sample from well 0319 in May 2001. Concentrations decreased through three subsequent rounds of sampling, and benzene concentration in the September 2002 sample from well 0319 was 1,050 µg/L. Likewise, toluene concentration in well 0319 has decreased from a maximum of 13,700 µg/L in May 2001 to 425 µg/L in the September 2002 sample. Thus, although continued monitoring is required, it is likely that the benzene and toluene contaminant plume is not growing and will be consumed by microorganisms over time.

The Entrada Sandstone Formation underlies the alluvium at the UC site. Molybdenum, nitrate, and selenium have been detected in Entrada Sandstone wells in concentrations above their respective MCLs; however, these elevated concentrations are believed to be a result of drilling through the contaminated alluvial aquifer to install the bedrock wells. Hydrologic data indicate that a slight upward hydraulic gradient exists between the Entrada and alluvial aquifers and that the hydraulic conductivity in the alluvial aquifer is two orders of magnitude greater than that in the Entrada aquifer. These hydrologic conditions inhibit alluvial ground water from flowing downward into the Entrada aquifer. The contamination is considered to be isolated in the vicinity of the wells and not indicative of widespread aquifer contamination resulting from former milling activities. Because these contaminants are considered to be a result of well drilling and installation, the use of a predictive ground water model is not required. These wells will be monitored to verify compliance. Currently, only molybdenum concentration in one well is above the standard.

Application and success of the natural flushing alternative would be verified through a monitoring program as required by 40 CFR 192.12(c)(3). Figure 5 shows the 12 compliance monitoring locations, and Table 4 identifies the rationale for monitoring those locations under the proposed action alternative. All ground water monitoring locations will be treated as point-of-compliance wells. Ground water and surface water would be monitored during the period of natural flushing to verify that concentrations of COPCs are decreasing as predicted. If monitoring results indicate that natural flushing is not reducing COPC concentrations as predicted, DOE would reevaluate aquifer conditions to determine if changes in the compliance strategy are needed.

Monitoring would take place on an annual basis for the first 10 years; after 10 years, sampling frequency would be reduced to once every 5 years. Natural flushing would be considered complete when COPCs in all wells in the sampling network have concentrations less than the MCLs, ACL (selenium only), or background (manganese only) for three consecutive sampling events. Entrada Sandstone wells 0317 and 0324 would be monitored until COPC concentrations are below applicable standards for three consecutive sampling events. Well 0684 will be monitored for the same constituents and with the same frequency as well 0320.

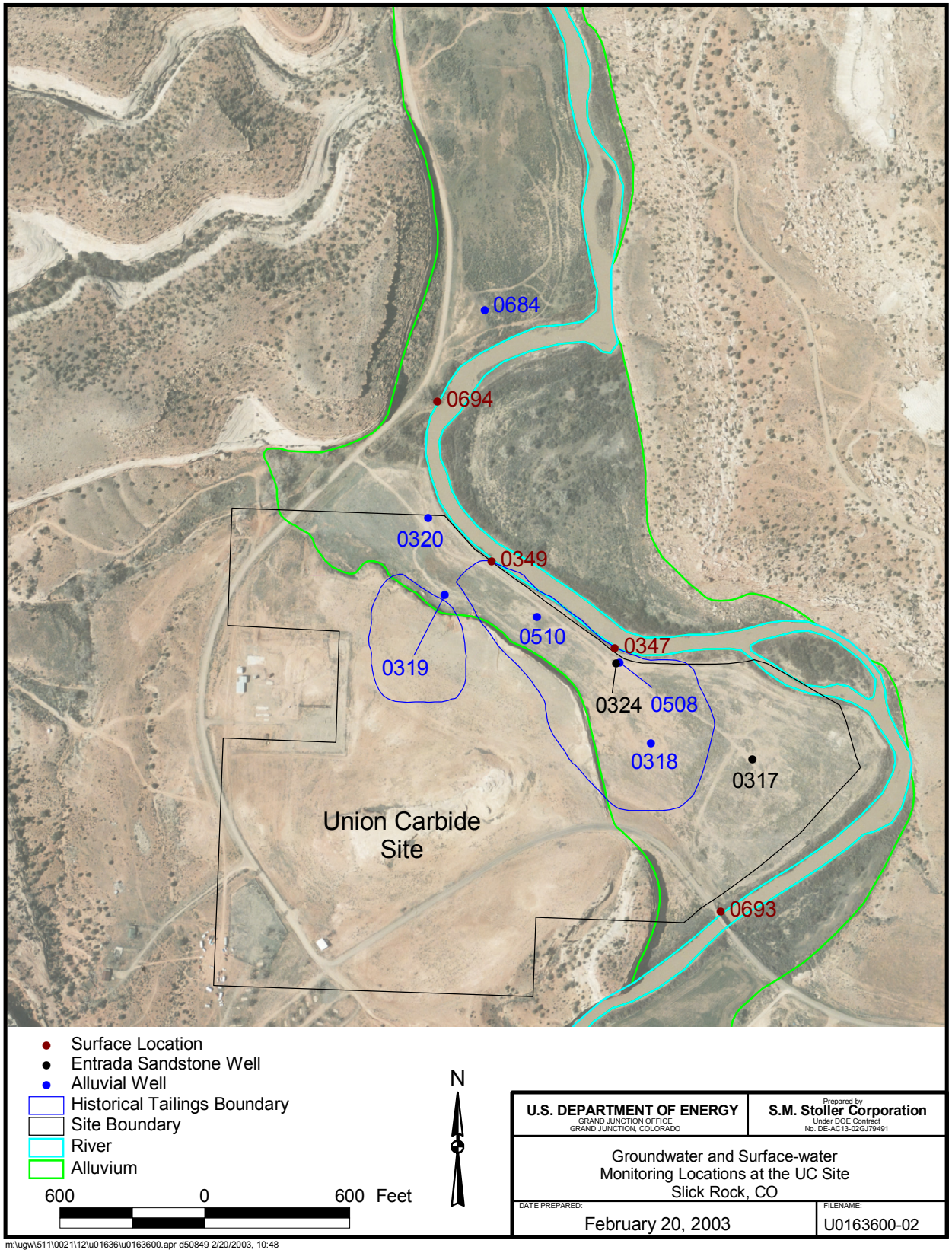

Figure 5. Monitoring Locations at the Slick Rock UC Site

Table 4. Proposed Monitoring Program at the UC Site

ID	Matrix	Location	Rationale	Analytes
0693	Surface water	Upstream	Background for UC site.	Manganese, molybdenum, nitrate, selenium, and uranium
0347	Surface water	Adjacent to site	Predicted location where the center of the selenium plume intersects the river. Point of exposure for selenium.	
0349	Surface water	Adjacent to site	Predicted location where contaminant plumes intersect the river.	
0694	Surface water	Downstream	Potential for contaminant plumes to discharge to the river at this location.	
0318	Ground water	On site	Hot spot for several COPCs.	
0508	Ground water	On site	High selenium, nitrate, molybdenum; point of compliance for selenium.	
0510	Ground water	On site	Edge of former tailings pile, high COPC concentrations.	
0317	Ground water	On site	Entrada Sandstone well, exceeds molybdenum standard.	Molybdenum
0324	Ground water	On site	Entrada Sandstone well, exceeds nitrate and selenium standards.	Nitrate and selenium
0319	Ground water	On site	Hot spot for benzene, toluene, and radium-226/radium-228.	Benzene, toluene, radium-226, and radium-228
0320	Ground water	On site	Farthest downgradient well on site; monitor plume movement.	Manganese, molybdenum, nitrate, selenium, and uranium
0684	Ground water	Off site	Verify that contaminants are not migrating off site.	Manganese, molybdenum, nitrate, selenium, and uranium

3.1.3 Long-Term Stewardship

Once the proposed action has been made final, DOE has the responsibility to ensure that the selected strategy continues to be protective of human health and the environment. Upon regulatory concurrence with the Ground Water Compliance Action Plan (DOE 2002a), the verification-monitoring period will begin. This phase should continue through 2005. At that time, ground water monitoring results will be compared to modeling predictions. If ground water conditions at both sites are reasonably comparable to the predicted conditions, the sites may be turned over to the Long-Term Surveillance and Maintenance (LTSM) Program administered by the DOE Grand Junction Office in Grand Junction, Colorado. The LTSM Program will manage the sites according to a long-term surveillance plan to be prepared specifically for the Slick Rock sites. DOE will maintain authority and responsibility for long-term monitoring.

DOE created the LTSM Program in 1988 to provide long-term care for low-level radioactive materials disposal sites. LTSM Program personnel inspect each disposal site at least annually and prepare, distribute, and archive an annual site condition report. The purpose of the annual inspection is to confirm the integrity of visible features at the site, identify changes or new conditions that may affect the site's features, and determine the need, if any, for maintenance, follow-up inspections, or additional monitoring. At the Slick Rock sites, LTSM inspectors would periodically verify that ground water is not being used for any purpose and would ensure that the

institutional controls are being enforced. Inspectors would look for indications of unauthorized use of ground water such as drilling, building, and excavating.

3.1.3.1 Land Status

Both the NC and UC sites are currently owned by UMETCO Minerals Corporation. The NC site is not fenced and is currently used for livestock grazing. Most of the UC site is enclosed within a barbed wire fence. Land between the two sites is privately owned. Land use between the two sites includes irrigated alfalfa fields, livestock grazing, and gravel mining. Water used to irrigate the alfalfa is pumped from the Dolores River.

3.1.3.2 Institutional Controls

An institutional control is a restriction that limits access to a contaminated medium such as alluvial ground water. If natural flushing is to be protective of human health and the environment, an institutional control must be maintained during the flushing period to prevent unauthorized access to the ground water.

Separate institutional controls are being developed for the UC and NC sites to prevent future use of contaminated ground water. Institutional controls are required for the 100-year time frame allowed by regulations for the constituents to flush to acceptable levels. The institutional control for each property would consist of a State of Colorado environmental covenant to cover the portion of the property affected by contaminated ground water. Currently, there are no residents or users of the ground water in the area of contamination. Figure 6 shows the proposed institutional controls boundaries.

The State of Colorado passed into law Senate Bill 01-145 in July 2001 “to provide an effective and enforceable means of ensuring the conduct of any required maintenance, monitoring, or operation, and of restricting future uses of the land, including placing restrictions on drilling for or pumping groundwater for as long as any residual contamination remains hazardous.” These covenants are executed between the State of Colorado and the property owner. DOE believes these covenants would satisfy the requirements of an institutional control for permanence, enforceability, and ability to be maintained and verified.

3.2 No Action Alternative

By law, DOE is required to evaluate a no action alternative in environmental assessments (10 CFR 1021.321[c]). Evaluation of a no action alternative provides a baseline for comparing the effects of the proposed action. Under the no action alternative for the Slick Rock sites, DOE would conduct no further activities at either the NC or UC site and would conduct no monitoring of ground water or surface water quality (DOE 1996, Section 2.2). Although the natural flushing process would continue at both sites, DOE would not document compliance with ground water standards. No institutional controls would be implemented to prohibit unauthorized access to and use of contaminated ground water.

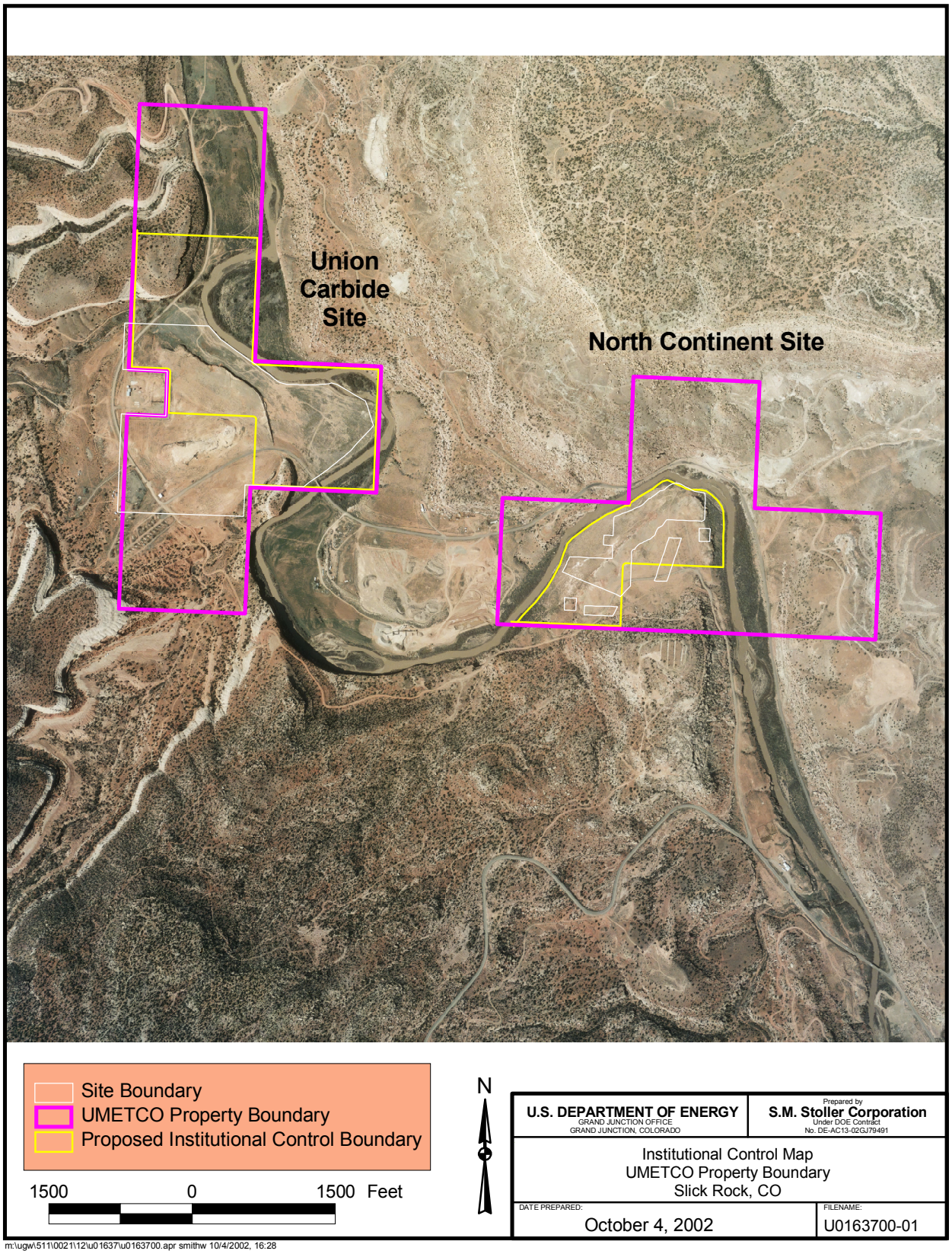

Figure 6. Institutional Control Boundaries at the Slick Rock Sites

4.0 Affected Environment and Environmental Consequences

NEPA and DOE's NEPA guidance (DOE 1993) direct that only the environmental issues or resources affected by the proposed action and no action alternatives be described in an environmental assessment. The following issues and resources are not affected and are therefore not addressed in this environmental assessment:

Resource or Issue	Rationale
Air quality	No air emissions would result from the proposed action.
Cultural and historical resources	A Class III cultural resource survey of about 260 acres near the NC and UC sites identified a lithic scatter site, a petroglyph panel, and two isolated finds (DOE 1995b). The proposed action would involve no surface-disturbing activities and would have no effect on these resources.
Soils	No soils would be disturbed during the proposed action.
Transportation	No increase in traffic would occur. The only transportation-related activity would be annual sampling at the monitoring locations.
Vegetation	No surface-disturbing activities would take place under the proposed action. Ground water beneath the sites presents no risk to wetland plants or deep-rooted plants.
Visual resources	No surface-disturbing activities would take place to affect visual resources.
Wild and scenic rivers	No proposed or designated wild and scenic rivers are near the sites.

The remainder of Section 4 presents discussions of environmentally sensitive issues that are related to the sites and other issues that the proposed action may directly or indirectly affect. These issues and resources are ground water, surface water, land and water use, human health, ecological risk, floodplains, wetlands, wildlife, socioeconomics, and environmental justice.

4.1 Ground Water

Ground water is unconfined in the alluvial aquifer underlying the Slick Rock sites; the canyon and terrace walls of the Dolores River valley control the flow direction. Table 5 provides a summary of alluvial ground water quality at the NC and UC sites, and Figure 7 shows the alluvial ground water surface contours generated from the March 2002 water level measurements.

Table 5. Summary of Alluvial Ground Water Quality at the NC and UC Sites

Contaminant	Frequency of Detection	Range (mg/L)	Mean (mg/L)	Cleanup Goal (mg/L)
NC Site				
Selenium				0.18
Background	5/6	<0.0001–0.0012	0.00034	
Current plume	19/21	<0.0001–0.0367	0.005	
Uranium				0.044
Background	6/6	0.0019–0.0139	0.00695	
Current plume	21/21	0.131–1.31	0.551	
UC Site				
Manganese				Background range
Background	6/6	0.215–3.53	1.88	
Current plume	25/25	0.104–12.8	2.56	
Molybdenum				0.1
Background	6/6	0.0026–0.0046	0.0035	
Current plume	25/25	0.0055–1.83	0.47	
Nitrate				44 as $N0_3$
Background	5/6	<0.0314–0.756	0.325	
Current plume	24/25	<0.0314–3,510	620	
Selenium				0.01
Background	5/6	<0.0001–0.0012	0.00034	
Current plume	24/25	<0.0001–2.52	0.416	
Uranium				0.044
Background	6/6	0.0019–0.0139	0.00695	
Current plume	25/25	0.00033–0.1	0.039	
Radium-226+228				5 pCi/L
Background	1/6	<0.12–0.19	Not applicable	
Current plume	14/25	<0.12–3.22	0.4899	
Benzene				5 µg/L
Background	Not applicable	Not applicable	Not applicable	
Current plume	10/19	<5–17,400 µg/L	3,750 µg/L	
Toluene				1,000 µg/L
Background	Not applicable	Not applicable	Not applicable	
Current plume	7/19	<5–13,600 µg/L	3,240 µg/L	

NC Site Notes
Current plume wells: 0302–0309, 0327; background wells: 0300 and 0301
Current plume and background data collected September 2000 through March 2001
Source of cleanup goals: Selenium—alternate concentration limit as allowed in 40 CFR 192; uranium—40 CFR 192

UC Site Notes
Current plume wells for inorganic constituents: 0313–0316, 0318–0320, 0332–0338, 0508–0510
Wells for organic constituents: 0319, 0320, 0332–0338; background wells: 0300 and 0301
Current plume and background data collected September 2000 through March 2001
Source of cleanup goals: Manganese—background range; nitrate, selenium, radium, uranium—40 CFR 192;
benzene and toluene—Colorado Ground Water Classifications and Standards (Reg. 41)

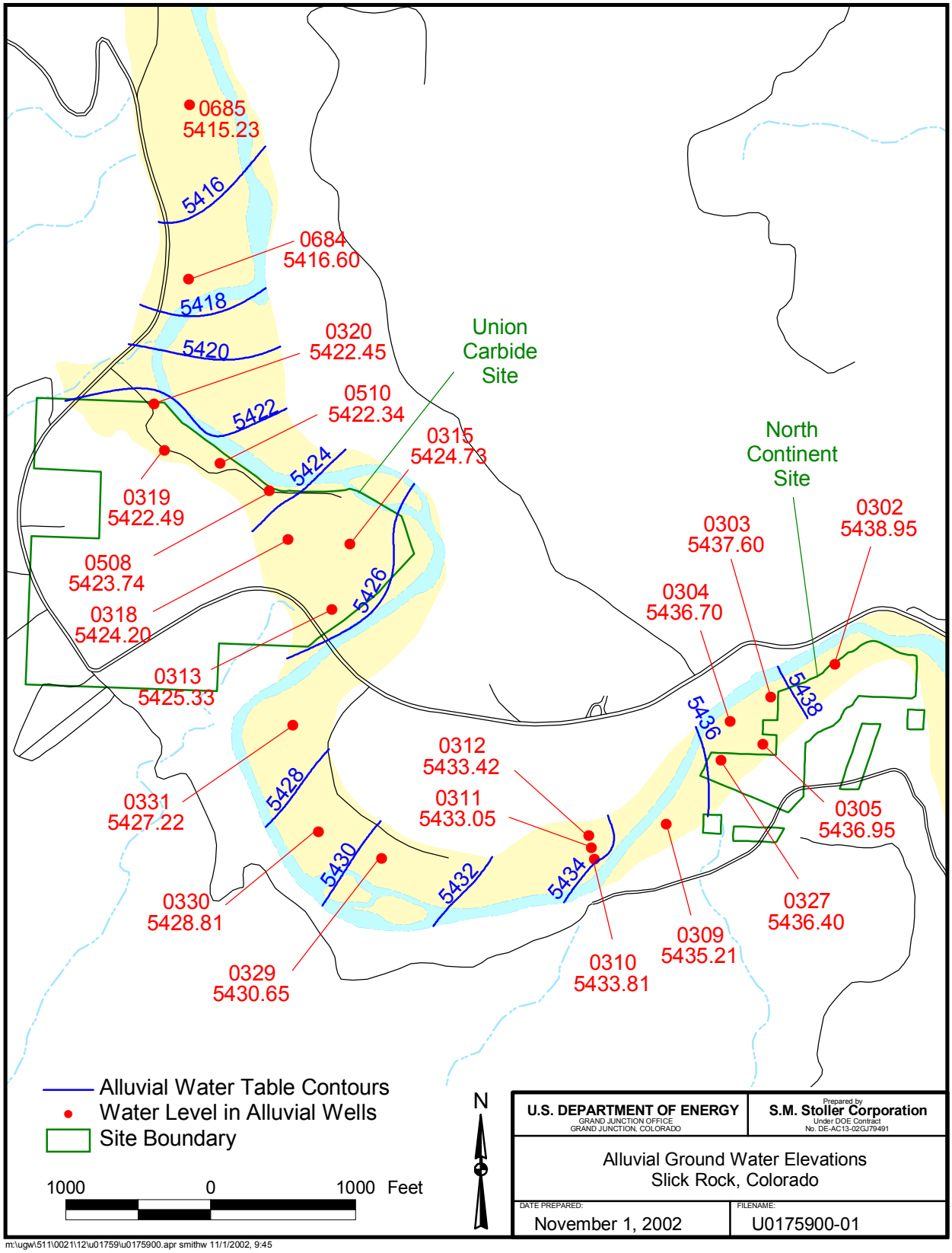

Figure 7. Alluvial Water Table Contours (March 2002 water level measurements)

4.1.1 Affected Environment

NC Site

Uranium is the primary COPC in alluvial ground water; concentrations are up to 1.3 mg/L beneath the middle of the site. In the farthest downgradient portion of the site, concentrations are an order of magnitude greater than the uranium MCL of 0.044 mg/L. Downgradient and across the river from the site, uranium concentrations in samples from alluvial well 0311 average 0.042 mg/L, which is near the MCL. Although this appears to be isolated, DOE has included this location in its compliance monitoring. Figure 8 shows the distribution of uranium concentrations at the NC site based on February 2001 sampling results. Ground water contamination downgradient of the NC site is not extensive. With the exception of well 0311, uranium concentrations throughout the alluvial aquifer across the river and downgradient are at or slightly above background concentrations. Wells 0310 and 0312, which are adjacent to 0311, have average uranium concentrations of 0.015 mg/L and 0.026 mg/L, respectively, and uranium concentrations in the remaining downgradient wells (0328, 0329, 0330, and 0331) typically range from 0.01 mg/L to 0.03 mg/L.

Although selenium is also a COPC at the NC site, selenium contamination is limited to one on-site well, where concentrations are slightly above the MCL of 0.01 mg/L.

The fine-grained units of the Summerville and Morrison Formations that underlie the alluvial aquifer at the NC site form an aquitard that inhibits downward migration of ground water.

UC Site

COPCs in alluvial ground water at the UC site are manganese, molybdenum, nitrate, selenium, uranium, radium-226, radium-228, benzene, and toluene. Sampling data from 2000 and 2001 indicated that all except manganese were present in concentrations greater than the their respective standards; manganese has no MCL, but concentrations exceeded maximum average background. Sampling data from 2002 indicate that concentrations have decreased since the 2000–2001 sampling.

None of the contaminant plumes in the alluvial aquifer have migrated off site; the radium-226/228 contamination is isolated to one well (0319), and the benzene and toluene contamination is limited to an area of about 100 × 250 ft in ground water in the vicinity of well 0319. Manganese concentrations are elevated in several wells, but concentrations are near background levels. The primary contaminants in the alluvial aquifer are molybdenum, nitrate, and selenium. Molybdenum concentrations range up to an order of magnitude greater than its MCL, and nitrate and selenium concentrations are up to two orders of magnitude greater than the respective MCLs. Figures 9, 10, and 11, respectively, show the distributions of molybdenum, nitrate, and selenium concentrations in the alluvial aquifer at the UC site based on February 2001 sampling results.

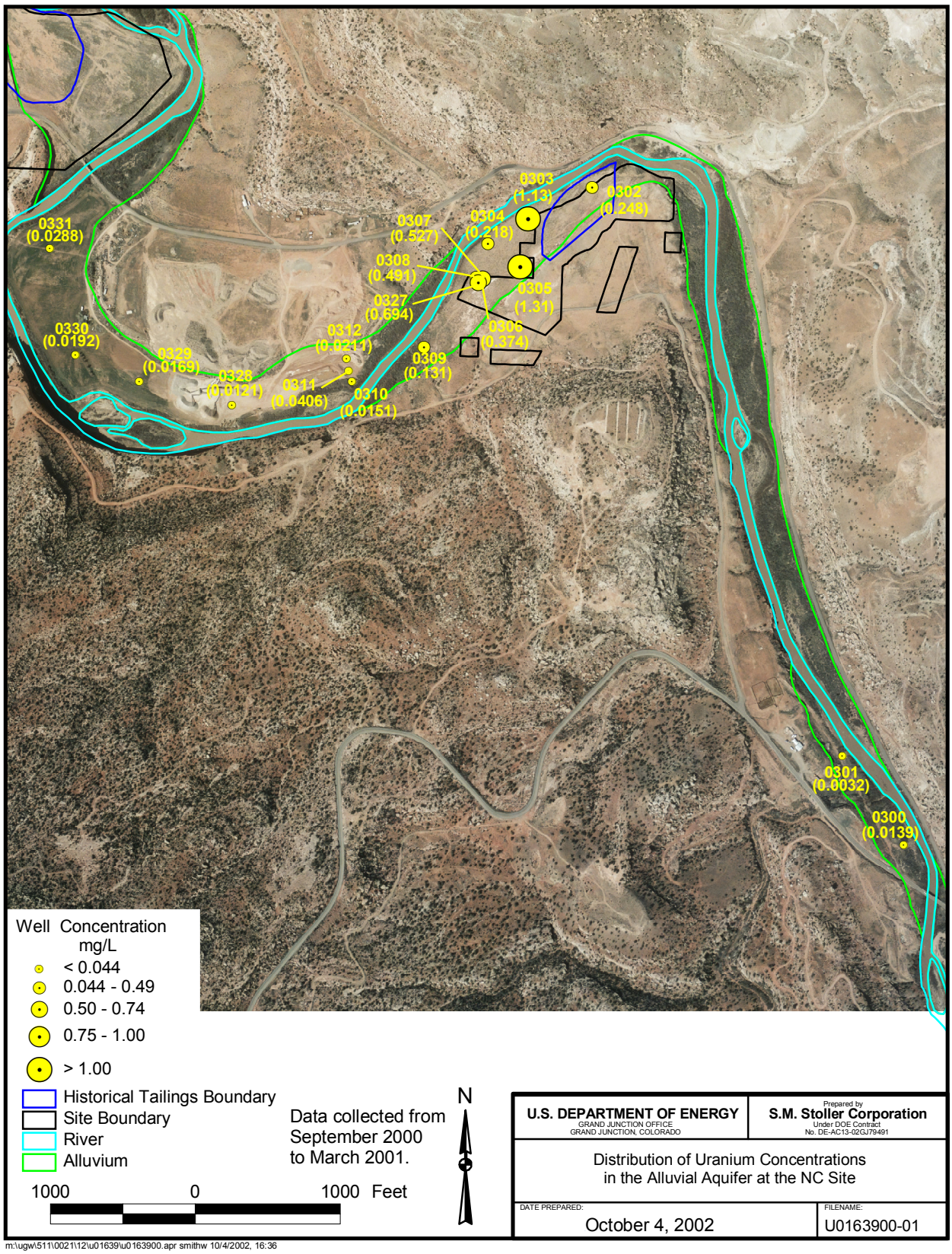

Figure 8. Distribution of Uranium in Alluvial Ground Water at the NC Site

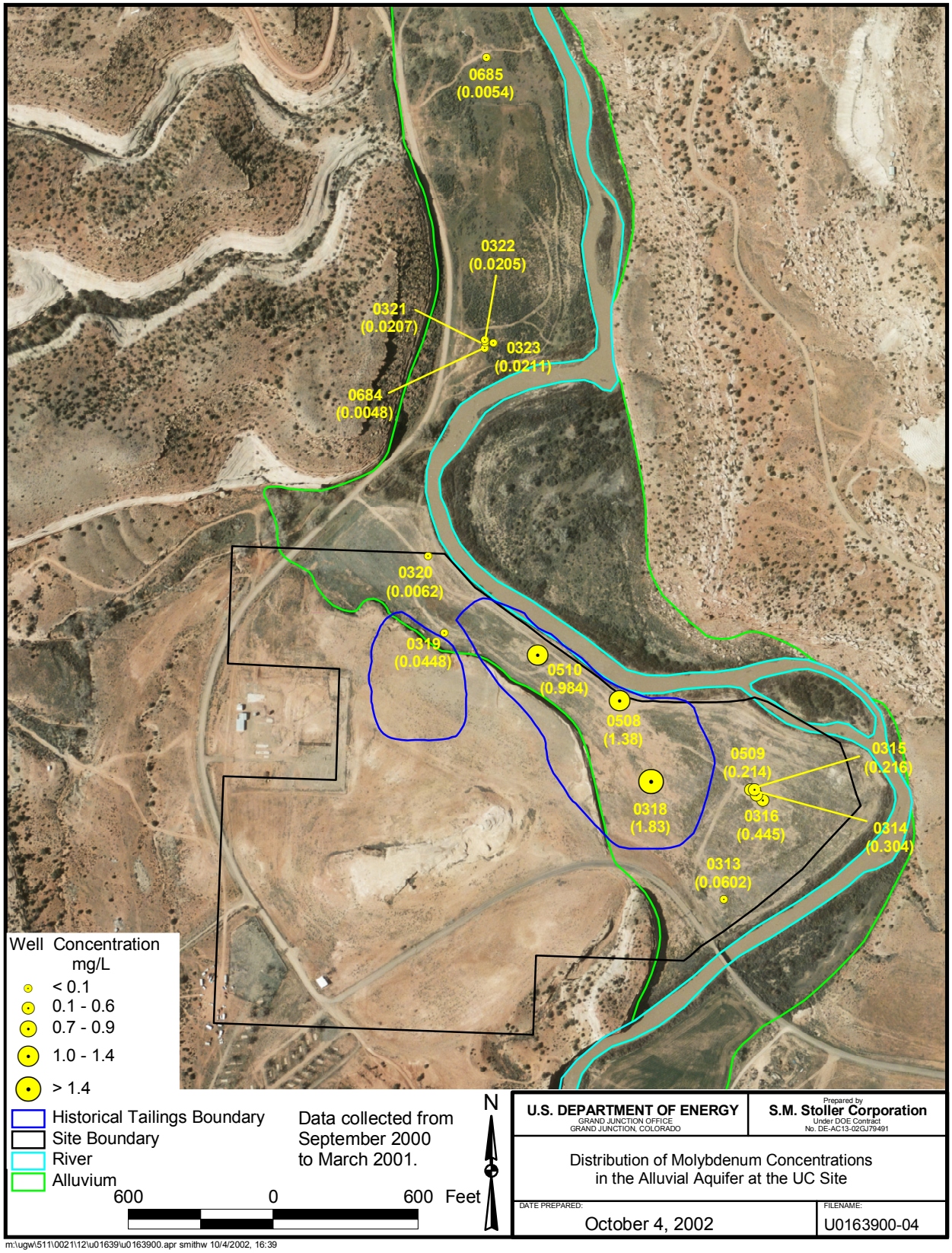

Figure 9. Distribution of Molybdenum in Alluvial Ground Water at the UC Site

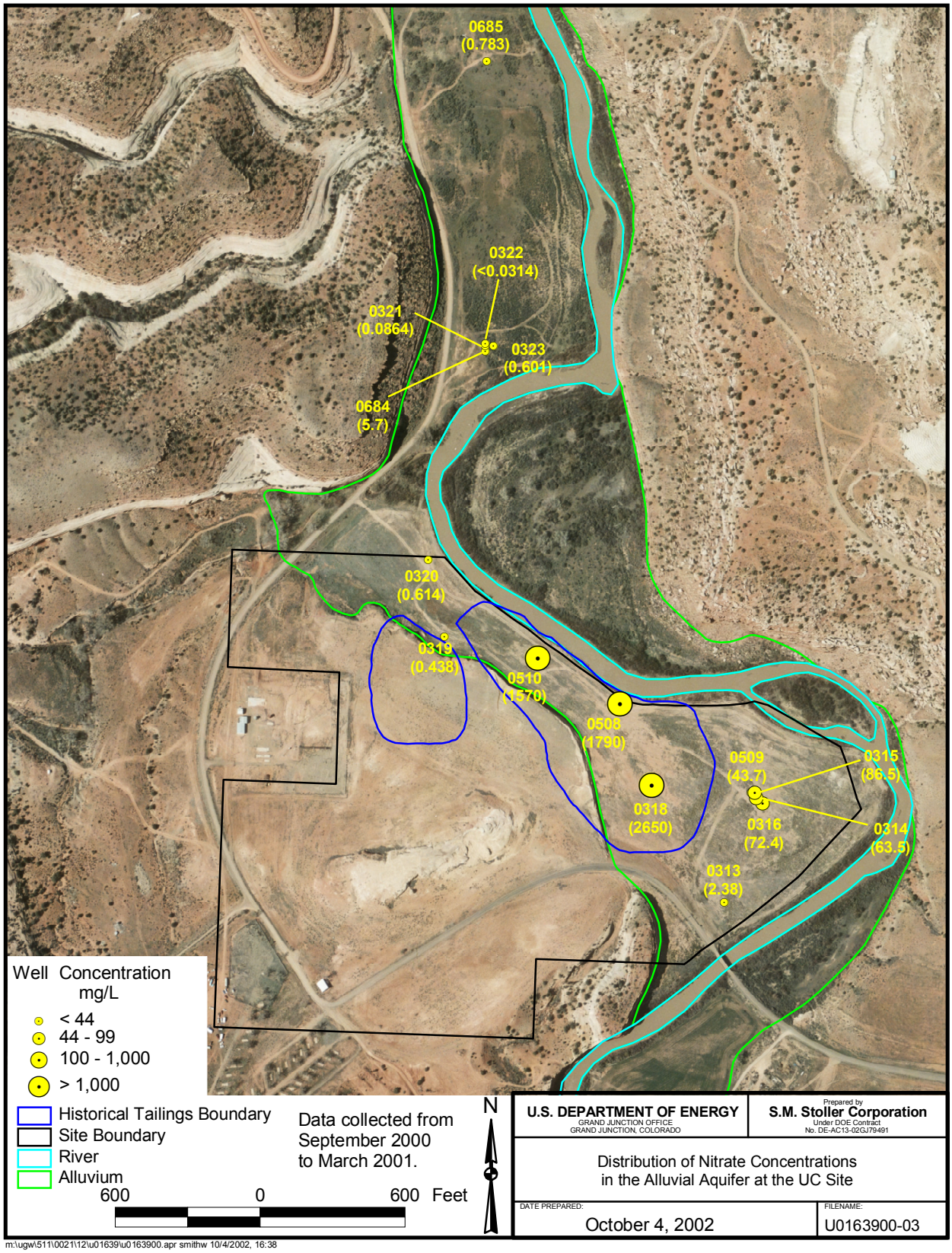

Figure 10. Distribution of Nitrate in Alluvial Ground Water at the UC Site

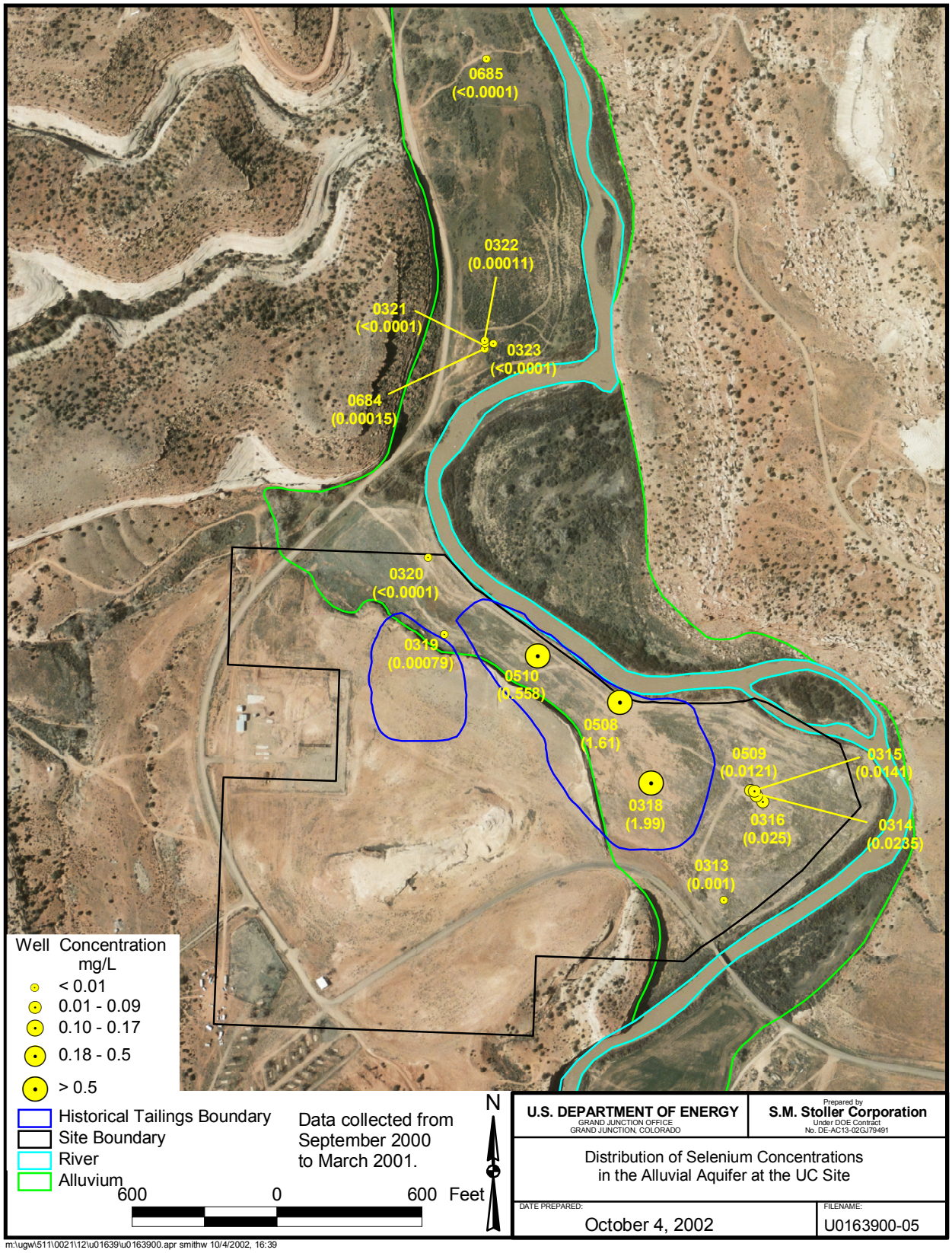

Figure 11. Distribution of Selenium in Alluvial Ground Water at the UC Site

4.1.2 Environmental Consequences

Proposed Action Alternative

At the NC site, ground water flow and transport modeling has predicted that site-related concentrations of selenium and uranium in alluvial ground water will decrease to levels below their respective MCLs within 100 years. At the UC site, modeling has predicted that concentrations of molybdenum, nitrate, and uranium in alluvial ground water will decrease to levels below the MCLs; manganese concentrations will decrease to background levels; and selenium concentrations will decrease to levels below the proposed ACL within 100 years. Benzene, toluene, radium-226, and radium-228 were not included in the ground water flow and transport model because biological and geochemical processes, rather than ground water transport, will be the primary factors in reducing the concentration of these COPCs. Until contaminant concentrations are within acceptable levels, enforceable institutional controls would be in place to ensure protection of human health and the environment.

No Action Alternative

Under the no action alternative, ground water quality would change as the contaminant plume migrates through the aquifer. Generally, contaminant concentrations will decrease, though the centers of the plumes will shift as the plumes migrate downgradient. As with the proposed action alternative, contamination would eventually flush through the aquifer. However, under the no action alternative, institutional controls would not be in place, and private wells could be installed in contaminated portions of the alluvial aquifer. No monitoring would take place to evaluate ground water quality.

4.2 Surface Water

4.2.1 Affected Environment

The Dolores River is the only perennial surface water feature in the vicinity of the Slick Rock sites. The river receives discharge from the contaminated alluvial aquifer at both sites (Figure 7); however, the surface water monitoring program has demonstrated that effects on surface water quality are negligible due to the much larger volume of water in the river.

The estimated combined inflow to the Dolores River from the alluvial aquifer at the NC and UC sites ranges from 93,534 to 211,827 cubic feet per day. The mean flow in the Dolores River, based on the data collected from February 2000 through February 2001, is 195 cubic feet per second, or more than 16 million cubic feet per day.

Five rounds of samples were collected quarterly from the Dolores River at the UC site between February 2001 and February 2002. Figure 5 shows the sampling locations. Concentrations of ammonium, manganese, and nitrate have been generally higher in samples from adjacent locations 0347 and 0349 than in samples from upstream location 0693. In samples from location 0347, manganese concentration was below the upstream concentration in three of five samples; ammonium concentration was lower in two of five samples, and nitrate concentration was lower

in one of five samples. Of the samples from location 0349, ammonium and nitrate concentrations were higher than upstream concentrations in all five samples, and manganese concentration was higher than the upstream concentration in three of five samples. Concentrations of all constituents were below Colorado Department of Health and Environment (CDPHE) surface water standards in all Dolores River samples (Table 6). The river near the Slick Rock sites is used for irrigation, livestock watering, and recreation.

Table 6. Comparison of Maximum Dolores River Contaminant Concentrations at the UC Site to Surface Water Standards

Analyte[a]	Standard[b]	Upstream (0693)	Adjacent (0346, 0347, 0349)	Downstream (0694)
Ammonium[c]	NA	0.0388	0.0906	0.0827
Ammonia as N[d]		0.0301	0.0703	0.0642
pH		8.69	8.08	8.05
Temperature		5.3	3.5	7.7
Percent un-ionized ammonia[e]		6.48	1.79	2.45
Un-ionized ammonia as N[f]	0.02	0.002	0.0013	0.0016
Manganese	0.05	0.0122	0.0234	0.02
Nitrate as N	10	0.766	2.23	3.7

[a]Units are in mg/L, except for pH (standard units) and temperature (°C).
[b]Values listed in CDPHE Water Quality Control Commission, Regulation No. 35, "Classifications and Numerical Standards for Gunnison and Lower Dolores River Basins." The ammonia standard is based on chronic exposure.
[c]Conversion of ammonium values to un-ionized ammonia as N is required in order to compare to the standard.
[d]Ammonia as N was derived by multiplying ammonium value by the conversion factor of 0.776 (atomic weight ratio of N/NH_4).
[e]The percentage un-ionized ammonia was derived using temperature and pH values (measured when the sample was taken) in conjunction with Table 1 from *Aqueous Ammonia Equilibrium Calculations: Effect of pH and Temperature* (Emerson et al. 1975).
[f]Un-ionized ammonia as N was derived by multiplying the ammonia as N value by the percent un-ionized.

4.2.2 Environmental Consequences

Proposed Action Alternative

Surface water monitoring has demonstrated that the natural flushing strategy would be protective of water quality in the Dolores River. Analyte concentrations at locations adjacent to and downstream of the NC and UC sites have not exceeded CDPHE standards, even though concentrations of contaminants in the alluvial aquifer are up to three orders of magnitude greater than the surface water standards in wells adjacent to the river. This scenario of insignificant impact to the river is not expected to change as natural flushing progresses. Monitoring of the Dolores River will verify that the natural flushing strategy is protective of the environment.

No Action Alternative

The Dolores River would not be adversely affected under the no action alternative. As with the proposed action alternative, concentrations of ground water contaminants that flow into the river will decrease over time, and monitoring has shown that the volume of water in the river naturally decreases concentrations that reach the river. However, there would be no monitoring, and it would not be possible to track the progress of natural flushing.

4.3 Land and Water Use

4.3.1 Affected Environment

Land Use

Both the NC and UC sites are currently owned by UMETCO Minerals Corporation. The NC site is not fenced and is currently used for livestock grazing. Most of the UC site is enclosed within a barbed wire fence. Land between the two sites is privately owned. Land use between the two sites includes irrigated alfalfa fields, livestock grazing, and gravel mining.

Ground Water Use

There is no current use of alluvial ground water at the Slick Rock sites. Historically, a hand-dug alluvial well located between the two sites (0675) was used as a source of domestic water, but the well is no longer used. Recent water level measurements show that the well is dry.

Ground water use from the Entrada Sandstone is limited to watering livestock through a "collector system." The collector system consists of a plastic pipe installed into the cliff face in the Entrada Sandstone. Water discharges from the pipe into a stock tank at a rate of approximately 1 liter per minute. The collector system is located northwest and upgradient of the UC site and represents background water quality.

Ground water used at the Slick Rock sites comes primarily from the Navajo Sandstone aquifer. Currently, a domestic well completed in the Navajo Sandstone provides water to two nearby residents and their livestock. Historically, wells completed in the Navajo Sandstone provided water for the milling operations, the former post office/café, and the Slick Rock community at the millsite.

Surface Water Use

Water used to irrigate the alfalfa fields between the NC and UC sites is pumped from the Dolores River. Also, during spring runoff when sufficient flow is released from McPhee Reservoir, the Dolores River near the Slick Rock sites is used extensively for rafting and kayaking.

4.3.2 Environmental Consequences

Proposed Action Alternative

Land and ground water use within the institutional controls boundary (Figure 6) would be restricted by the proposed environmental covenants. Site-related contaminants have had a negligible effect on water quality in the Dolores River, and use of the river for irrigation and recreation would be unaffected by the proposed action. DOE would continue to monitor ground water and surface water to track the progress of natural flushing and verify that the proposed strategy is protective of human health and the environment.

No Action Alternative

Under the no action alternative, DOE would not implement institutional controls to prohibit use of contaminated ground water and would not monitor contaminant concentrations in ground water and surface water to evaluate the progress of natural flushing.

4.4 Human Health

4.4.1 Affected Environment

NC Site

Alluvial ground water at the NC site does not currently pose a health risk to humans because it is not being used for any purpose. The only potentially complete exposure pathway to contaminated ground water is where it discharges to the Dolores River. This section of the river is popular for rafting and kayaking during brief periods in the spring when sufficient water is released from McPhee Reservoir.

UC Site

As with the NC site, alluvial ground water at the UC site does not currently pose a health risk to humans because it is not being used for any purpose. The only potentially complete exposure pathway to contaminated ground water is where it discharges to the Dolores River. The section of the river at the UC site is also used for recreation. A residential property is located more than one-half mile downgradient from on-site well 0320. Concentrations of COPCs in samples collected from alluvial well 0320 have been significantly below their respective water quality benchmarks.

4.4.2 Environmental Consequences

Proposed Action Alternative

NC Site

Under the proposed action, institutional controls would ensure that contaminated ground water is not used for any purpose. DOE would continue to monitor ground water at selected locations for uranium and selenium.

Surface water in the Dolores River would also be monitored. Wells not needed for the monitoring network would be decommissioned in accordance with UMTRA Project procedures and applicable State of Colorado regulations. Standard procedures are in place to ensure that activities associated with decommissioning and monitoring activities are protective of workers.

The only complete exposure pathway to ground water contamination is by contact where contaminated water discharges to the Dolores River. However, ground water mixes with river water, and contaminant concentrations decrease significantly and are protective for any likely

human exposures to surface water. Monitoring of surface water quality would verify protectiveness of human health for probable uses.

UC Site

Under the proposed action, institutional controls would ensure that contaminated ground water is not used for any purpose. DOE would continue to monitor ground water at selected locations for manganese, molybdenum, nitrate, selenium, and uranium. Well 0319 would be monitored for benzene, toluene, radium-226, and radium-228. Surface water in the Dolores River would also be monitored. An application for an ACL for selenium would be submitted to the U.S. Nuclear Regulatory Commission. Wells not needed for the monitoring network would be decommissioned in accordance with UMTRA Project procedures and applicable State of Colorado regulations.

The only complete exposure pathway to ground water contamination is through contact where contaminated water discharges to the Dolores River. However, as at the NC site, when ground water mixes with river water, contaminant concentrations decrease significantly and are protective for any likely human exposures to surface water. Monitoring of surface water quality would verify protectiveness of human health for probable uses.

Flow and transport modeling predicts that site-related COPCs will not migrate north of the property boundary in concentrations that would present an unacceptable risk to human health (based on the established benchmarks). Therefore, future use of alluvial ground water at the private property one-half mile downgradient from well 0320 should present no site-related risk to human health.

No Action Alternative

Under the no action alternative, no further activities would take place at either site, institutional controls would not be applied, and monitoring would be discontinued. Natural flushing would continue, but its effectiveness would not be evaluated. Because of the lack of institutional controls, contaminated water could be used for unsuitable purposes and could present unacceptable risks.

4.5 Floodplains and Wetlands

A floodplain/wetlands assessment was developed in 1995 and included as Attachment 2 in the Surface EA (DOE 1995b). The Surface EA provides a detailed description of the floodplains and wetlands associated with the NC and UC sites.

4.5.1 Affected Environment

Floodplain

Portions of the UC and NC sites are located within the 100-year floodplain of the Dolores River. At both sites, the floodplain is a terrace within meander loops of the river, bounded by canyon

walls. Surface remediation in 1996 lowered the elevation of the floodplain in some areas, and this elevation was maintained after remediation to encourage the development of riparian habitat. However, this activity did little to affect the original boundary of the floodplain.

There are approximately 18 acres of floodplain area at the NC site and 22 acres at the UC site. The floodplain soil consists of unsaturated alluvial deposits of fine silty sand and silty sandy gravel. Vegetation on the floodplain terrace consists of shrub and herbaceous cover dominated by rabbitbrush (*Chrysothamnus sp.*), four-wing saltbush (*Atriplex canescens*), and various grass and mustard species. Riparian vegetation grows adjacent to the river. Cattle grazing is allowed during the winter at the NC site but is excluded by fencing at the UC site because of thinner vegetation cover there.

Determination of a 100-year flood event was made using U.S. Army Corps of Engineers HEC computer models (DOE 1995b). The resulting flow is 15,900 cubic feet per second (USGS 1984), and the boundary of the 100-year floodplain was determined using this flow. Because excavation of contaminated soils deepened the existing floodplain in some areas, the flood level would be lower at these sites than before remediation.

Wetlands

A strip of riparian vegetation varying from 2 to 20 ft wide along the Dolores River at both the UC and NC sites is U.S. Army Corps of Engineers jurisdictional wetland. This strip is dominated by sandbar willow (*Salix exigua*) and has herbaceous wetland species at the waterline. Portions of the wetland were disturbed by surface remediation and required Corps of Engineers and San Miguel County permits. The disturbed areas were revegetated and restored as specified in the permits, and annual monitoring requirements were fulfilled in 2001.

4.5.2 Environmental Consequences

Proposed Action Alternative

Ground water contamination has had no apparent effect on the floodplains or wetlands. The proposed action would have no direct effect on the floodplains and wetlands in the area. Seasonal water table variation may affect mobilization of contaminants at the sites and most likely will have no long-term adverse effects on the floodplains or wetlands. No surface-disturbing activities other than routine ground water and surface water sampling would take place.

No Action Alternative

The no action alternative would also have no effect on the floodplains and wetlands at the NC and UC sites.

4.6 Ecological Risk

4.6.1 Affected Environment

A baseline inventory of wildlife species likely to inhabit the site area was documented in the Surface EA (DOE 1995b). The Surface EA assessed the effects of surface remediation and included a Biological Assessment. Agencies consulted concerning both nonsensitive and threatened or endangered species included the U.S. Fish and Wildlife Service (USFWS), Bureau of Land Management, Colorado Division of Wildlife, and U.S. Army Corps of Engineers. The USFWS (Grand Junction office) was consulted again informally on June 28, 2000 (letter from DOE to USFWS), to update the list of sensitive species that may occur in the project area. The NC and UC sites have similar wildlife habitats. Both are surrounded by steep, rocky, side slopes vegetated with piñon and juniper that are characteristic of southwest desert-shrub communities. The relatively narrow valleys are characterized as dry rangeland shrubs and grasses. The Dolores River at both sites supports riparian plant communities.

Nonsensitive Species

Terrestrial and avian wildlife common to both areas include mammals, birds, and reptiles. Approximately 32 species of mammals, including beaver, mule deer, elk, bear, and bighorn sheep, have been observed or may occur near the sites. The 66 species of riparian and upland (desert-shrub habitat) birds include the yellow warbler, blue grosbeak, and birds of prey, such as the red-tailed hawk. Several species of reptiles, including the sagebrush lizard and whiptail have been observed or have the potential to occur in the area.

Aquatic and amphibious species that inhabit or could inhabit the site areas include twelve fish species, such as the bluehead sucker and mottled sculpin, and a few species of amphibians, such as the leopard frog.

Sensitive Species

A meeting between DOE and USFWS was held on April 19, 2002, to begin informal consultation concerning sensitive species that may occur in the area of the proposed action. As a result of the meeting, the western yellow-billed cuckoo was added to the list as a candidate species. The species list varies from that documented in the Surface EA, primarily because of changes in the status of some species. For example, since 1994 the peregrine falcon (*Falco peregrinus*) has been delisted (64 *Federal Register* [FR] 46541, 1999), and the southwestern willow flycatcher (*Empidomax traillii extimus*) has been listed (60 FR 10693, 1995). Table 7 provides information on the status of the species that may occur in the Slick Rock area.

Table 7. Listed and Candidate Threatened or Endangered Species Likely To Occur at the Slick Rock Sites

Species	Federal Status[a]	Critical Habitat[b]	State Status[a]	Comments
Birds				
Bald eagle *(Haliaeetus leucocephalus)*	T	N	T	Marginal potential for nesting sites.
Southwestern willow flycatcher *(Empidomax traillii extimus)*	E	N	E	Potentially suitable habitat exists in the general vicinity of the sites.
Western yellow-billed cuckoo *(Coccyzus americanus occidentalis)*	C	N	NL	Possible that this species could inhabit the project area.
Fish				
Colorado pikeminnow *(Ptychocheilus lucius)*	E	N	T	Marginal potential to occur in the project area.
Razorback sucker (*Xyrauchen texanus)*	E	N	E	Marginal potential to occur in the project area.
Humpback chub (*Gila cypha*)	E	N	T	Marginal potential to occur in the project area.
Bonytail chub (*Gila elegans*)	E	N	E	Marginal potential to occur in the project area.

[a] Endangered Species Act listed; T = threatened, E = endangered, C = candidate, NL = Not Listed
[b] Designated critical habitat; Y = Yes, N = No

The bald eagle is not known to nest along the Dolores River but its presence has been documented during winter months.

Southwestern willow flycatcher surveys were conducted by Jacobs Engineering, DOE's Technical Assistance Contractor, in 1990 and 1991 along an 8-mile stretch of the Dolores River. No flycatchers were heard or observed. Additional surveys were planned (DOE 1995a); however, the results have not been located.

The Biological Assessment attached to the Surface EA stated that the four endangered fish species identified in Table 7 do not occur in the vicinity of the Slick Rock sites. Fish studies conducted in the early 1980s (Valdez et al. 1982) resulted in no observations of any of the listed fish species. The Colorado pikeminnow was found approximately 120 miles downriver from the sites in a study conducted in 1991 (DOE 1995a). Principal limiting factors affecting the survivability of this species include low river flows caused by irrigation, nonnative fish species, and elevated levels of copper and iron (Valdez et al. 1992). USFWS issued a "may affect" determination in their Biological Opinion due to water depletion caused by surface remedial actions described in the Surface EA.

4.6.2 Environmental Consequences

Proposed Action Alternative

Ecological COPCs in ground water and surface water are addressed in Section 6.2 and Appendix I of the SOWP (DOE 2002b). Because contaminated soils were removed during surface remediation, the soil and air media are not considered further in this assessment.

DOE collected samples of ground water, surface water, and sediments to determine if contaminants were present in those media that may pose a risk to wildlife. In order for a risk to be present, a medium must have contaminant concentrations that exceed background concentrations, a complete exposure pathway to a receptor must exist, and the contaminant concentrations present must have reasonable potential to present an adverse effect as measured by established benchmarks or standards.

To evaluate potential risk, hypotheses were developed for the Slick Rock sites where complete exposure pathways to ecological receptors may exist based on the current site conditions. Section 6.2 and Appendix I of the SOWP (DOE 2002b) discuss the risk hypotheses in detail. Because institutional controls would restrict access to ground water, contaminated ground water would not be brought to the surface, where it could provide a potentially complete exposure pathway to wildlife.

As discussed in Section 6.2 of the SOWP, ground water at the NC site presents a low potential risk, and ground water at the UC site does not appear to present significant risk to deep-rooted plants or terrestrial wildlife. Although concentrations of some constituents are elevated at the UC site, the potential for a complete exposure pathway is low. Section 6.3 of the SOWP concludes that at both sites there are no unacceptable risks to ecological receptors due to site-related contaminants, and on the basis of anticipated future use of ground water, no ecological risks are expected.

No Action Alternative

Wildlife species would not be affected by human activities at the sites because none would occur. However, DOE would not implement institutional controls to prohibit access to contaminated ground water, which could conceivably be pumped to the surface and stored in a tank or pond where it could be consumed by livestock and wildlife.

4.7 Socioeconomics and Environmental Justice

4.7.1 Affected environment

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, states that federal programs and actions shall not disproportionately affect minority or low-income populations.

The Slick Rock sites are in a remote, sparsely populated portion of San Miguel County in southwestern Colorado. About 10 people live within 10 miles of the NC and UC sites (DOE 1995b).

4.7.2 Environmental Consequences

Proposed Action

Ground water at the sites is not a current or potential source of drinking water, and institutional controls would prevent unauthorized access to the contaminated ground water. Therefore, no adverse effects to any populations would be expected.

No Action Alternative

Because no populations live near the NC and UC sites, the no action alternative would produce no disproportionately high or adverse effects to minority or low-income populations. However, DOE would not implement institutional controls, and future residents could have access to contaminated ground water.

4.8 Cumulative Impacts

The Council on Environmental Quality defines "cumulative impact" as the "impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions" (40 CFR 1508.7). Institutional controls would prohibit activities that potentially entailed use of or exposure to contaminated ground water. Therefore, no cumulative impacts are anticipated as a result of the proposed action. The no action alternative would not prohibit access to contaminated ground water, which could conceivably be pumped to the surface and consumed by humans or wildlife.

5.0 Persons and Agencies Consulted

San Miguel County Officials, Dove Creek, Colorado

U.S. Army Corps of Engineers, Grand Junction, Colorado

U.S. Fish and Wildlife Service, Grand Junction Office, Grand Junction, Colorado

6.0 References

10 CFR 1021.210(c). U.S. Department of Energy, "National Environmental Policy Act Implementing Procedure," *Code of Federal Regulations,* January 1, 2002.

40 CFR 192. U.S. Environmental Protection Agency, "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings," *Code of Federal Regulations,* July 1, 2001.

Colorado Department of Public Health and Environment (CDPHE), 1998. *Classifications and Numeric Standards for Gunnison and Lower Dolores River Basins*, Regulation No. 35, Water Quality Commission, Denver.

Emerson, K., R.C. Russo, R.E. Lund, and R.V. Thurston, 1975. *Aqueous Ammonia Equilibrium Calculations: Effect of pH and Temperature*, Department of Chemistry, Fisheries Bioassay Laboratory, Montana State University, Bozeman, Montana.

Mackay, D., W.Y. Shiu, and K.C. Ma, 1992. *Illustrated Handbook of Physical-Chemical Properties and Environmental Fate for Organic Chemicals,* Lewis Publishers, Chelsea, Michigan.

Merritt, R.C., 1971. *The Extractive Metallurgy of Uranium,* Colorado School of Mines Research Institute, Golden, Colorado.

U.S. Department of Energy (DOE), 1993. *Recommendations for the Preparation of Environmental Assessments and Environmental Impact Statements,* Office of NEPA Oversight, May.

———, 1995a. *Baseline Risk Assessment of Groundwater Contamination at the Uranium Mill Tailings Site Near Slick Rock, Colorado,* DOE/AL/62350-147, Rev. 1, prepared for the U.S. Department of Energy Environmental Restoration Division, UMTRA Project Team, Albuquerque, New Mexico.

———, 1995b. *Environmental Assessment of Remedial Action at the Slick Rock Uranium Mill Tailings Sites, Slick Rock Colorado*, DOE/EA-0339, U.S. Department of Energy UMTRA Project Office, Albuquerque, New Mexico, January.

———, 1996. *Final Programmatic Environmental Impact Statement for the Uranium Mill Tailings Remedial Action Ground Water Project,* DOE/EIS-0198, U.S. Department of Energy UMTRA Project Office, Albuquerque Operations Office, Albuquerque, New Mexico, October.

———, 2002a. *Draft Ground Water Compliance Action Plan for the Slick Rock, Colorado, UMTRA Project Site,* MAC-GWSKR 1.9, U.S. Department of Energy Grand Junction Office, Grand Junction, Colorado, April.

———, 2002b. *Site Observational Work Plan for the Slick Rock, Colorado, UMTRA Project Site*, MAC-GWSKR 1.1, GJO-2001-257-TAR, U.S. Department of Energy Grand Junction Office, Grand Junction, Colorado, April.

U. S. Environmental Protection Agency (EPA), 1989. *Risk Assessment Guidance for Superfund,* Vol. 1, *Human Health Evaluation Manual*, EPA/540/1-89/002, Office of Emergency and Remedial Response, Washington, D.C.

———, 2000. *Drinking Water Standards and Health Advisories*, EPA 822-B-00-001, Office of Water 4302, Washington, D.C.

U.S. Geological Survey, 1984. *Summary of Basin and Stream Flow Characteristics for Selected Basins in Western Colorado and Adjacent States,* USGS open file report 84-137.

Valdez, R., P. Mangan, M. McInerny, and R.P. Smith, 1982. *Colorado River Fishery Project Final Report, Field Investigations Report No. 4, Tributary Report, Fishery Investigations of the Gunnison and Dolores River,* FWS, Grand Junction, Colorado.

Valdez, R., W.J. Masslich, and A. Wasowicz, 1992. *Dolores River Native Fish Suitability Study,* Final Report, prepared for Utah Division of Wildlife Resources, Salt Lake City, Utah.

Appendix A

Comments Received on the Draft Environmental Assessment and Responses to Comments

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January 18, 2003

Mr. Donald R. Metzler, Program Manager
U.S. Department of Energy
Grand Junction Office
2597 B 3/4 Road
Grand Junction, CO 81503

Subject: Draft *Environmental Assessment of Ground Water Compliance at the Slick Rock Uranium Mill Tailings Sites*

Dear Mr. Metzler:

Thank you for providing a copy of the referenced draft document to us for review and comment. We purchased 280 acres in the Dolores River Canyon in 1995 and 1996. Our property begins at the southern edge of Section 24 -- 0.5 mile north of the former UC tailings pile -- and extends along the canyon bottom to 1.7 air-miles north (down river) of the former UC tailings pile. As land owners we obviously have an interest in the quality of the ground water at this locale in the Dolores River Canyon. We plan to develop a well for household water that will utilize water from the alluvial aquifer.

We have followed the progress of the remediation of the UC and NC sites since 1995. In fact, Cole spoke with you about our concerns regarding ground water contamination on January 10, 1995, before we bought our property. At that time, you observed that the uranium mill tailings did not get into the aquifer north of the UC site, and that they migrated immediately to the river. Your comment, along with the January 1995 *EA of Remedial Action at the Slick Rock Uranium Mill Tailing Sites,* made us feel comfortable about buying the property. In fact, page 4-8 of the 1995 EA states: "Three private wells are downgradient of the UC site and are expected to be beyond the reach of the contaminant plume, as evidenced by the water quality in downgradient alluvial DOE monitor wells." Since those three private wells were upgradient from the land that we were planning to purchase, we concluded that no plume would ever reach our land. We suspect that conclusion remains warranted, though we have a few questions after reading the new draft EA.

Please excuse us if we have misread the draft EA. We only heard about the EA just over a week ago from the San Miguel County Director for Environmental Health. Cole immediately left a message on your machine, but of course the document only arrived two days ago given the Postal System. We are therefor rushing to beat the comment deadline.

General Comments on the Draft Environmental Assessment Document

We are pleased that further ground water compliance strategies will be implemented, but we are somewhat concerned that the primary emphasis is on natural flushing of the contaminated sites. The sandstone formations at the sites form an aquitard, and the movement of water in the alluvial aquifer is toward the north. It therefor appears that the Contaminants Of Potential Concern (COPCs) might possibly contaminate the alluvial aquifer under our property at some time in the future, perhaps during our lives if we live long enough, or during our children's or grandchildren's lives. The currently contaminated sites will eventually be cleansed, but will the ground waters north of the sites end up with the pollutants?

The draft EA mentions that the flow in the alluvium is north and toward the river. Is the implication that the COPCs will eventually discharge into the river[1] and so spare the alluvial aquifer toward the north? Or will the COPCs travel in the alluvial aquifer even beneath the river and so eventually reach the aquifer under our property? Do the Navajo Sandstone or Entrada Sandstone layers below the UC and NC sites contain cracks that might transport COPCs from the UC or NC sites to the aquifers beneath our property during the next fifty years (our own lifetimes)? How about slow transport to arrive under our property during the lifetimes of our descendents? Might the plumes rise to the surface of our property? Or would the COPCs be so dispersed by the time they eventually reached the aquifer(s) under our property that they would no longer exceed EPA's maximum contaminant levels (MCLs)?

We expect that the answers to the above questions will confirm the future heath of the aquifers under our property, because your experts have not proposed any institutional control on wells in the alluvial aquifer within 0.25 mile of even the southern boundary of our property (EA Figure 6). Also, your excellent documentation on aerial photos of the drastic reduction (to far below MCLs) of COPC's in wells only a short distance north of the UC site support your EA's analyses and proposed action. These aspects of the EA make us feel good about the situation with respect to our property.

The proposed actions rely on the natural flushing compliance strategy and its requirement of decreased concentrations to accepted levels within 100 years. This time frame may be reasonable from the geological and chemical time perspective, but not from the human-use perspective within the area of proposed institutional controls.

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[1] That is what the March 3, 1994, Slick Rock Remedial Action Selection Report, Section 5.0 on Water Resources Protection, stated on its page 5-8: "Ground water discharges from the alluvium into the Dolores River downgradient of the UC site." In addition, the new draft EA, page 26, states: "The estimated combined inflow to the Dolores River from the alluvial aquifer at the NC and UC sites ranges from 93,534 to 211,827 cubic feet per day."

Page-Specific Comments on the Draft EA

Page 10. Table 3 contains the statement that "the COPC plumes are within the site boundary." How were the plume patterns determined? Obviously, a very careful "mapping" of the COPC plumes is vital to determining the specific areas at risk of groundwater contamination.

Page 14. Although the number and placement of the 11 monitoring locations within the UC site is commendable, the addition of two additional ground-water wells north of the UC site would provide improved monitoring of plume movement.

Page 25. It is encouraging that the sampling data at the UC Site indicates a decrease in concentrations of COPCs between the 2000-2001 sampling and the 2002 sampling. It is also encouraging that "none of the contaminant plumes in the alluvial aquifer have migrated off site." We hope that these trends continue.

Page 39. The estimate of the 100-year flood being 84,200 cubic feet per second (cfs) is far above reality. That much flow was the amount being passed through Glen Canyon Dam during spring 1984, when the flow was so great that it began ripping out structures in the overflow tunnels and some people became worried about losing the dam that retains Lake Powell. Even before any dam existed on the Colorado River, the highest flow ever recorded through the Grand Canyon was less than 300,000 cfs, and the Dolores River makes up only a tiny portion of the Colorado River watershed. In addition, the maximum flow ever recorded since 1918 at Bedrock was only 8,000 cfs, an order of magnitude below the bad estimate. Finally, the 1990 *Dolores River Instream Flow Assessment* by the US DI BLM modelled the 100-year peak flood at Bedrock to be only 16,000 cfs. We would like the unrealistic estimate of 84,200 cfs for the 100-year flood corrected. In 1996 the same bad estimate in the 1995 EA for the Slick Rock UMTRA project contributed to stopping a project on our land, wherein we had hoped to provide high quality soil to top the Burro Canyon disposal site of the UMTRA cleanup.

Thank you for the opportunity to comment on this document. We look forward to your response.

Sincerely,

By E-mail

/s/ Cole Crocker-Bedford
/s/ Kara-Lynn Crocker-Bedford

DOE Response to comments received January 18, 2003

Response to comment concerning off-site migration of COPCs: The EA states that none of the contaminant plumes have migrated off the Union Carbide site to date. This statement is based on monitoring results from alluvial monitor well 0320, which is located on site and immediately downgradient of the contaminant plumes. Concentrations of COPCs in samples collected from well 0320 have been significantly below their respective water quality benchmarks. Ground water monitoring results from well 0320 will reflect future plume migration because there is no ground water flow scenario where the plumes could bypass this well. Monitor well 0320 is scheduled for long-term monitoring to track contaminant plume movement.

Extensive plume migration in the future is not expected because ground water modeling conducted to support the natural flushing strategy predicts that most contaminant plumes will not migrate off the Union Carbide site. The contaminant plumes are not expected to migrate extensively to the north (downgradient) because the contaminated ground water is expected to slowly discharge into the Dolores River over time. Ground water discharge to the river, however, is not of sufficient volume to adversely affect the river water quality. Only the nitrate plume (nitrate is the most mobile COPC) is projected to migrate beyond the site boundary. The nitrate plume is projected to extend just beyond the site boundary and to be within the institutional control boundary. To minimize concerns with plume migration, DOE will amend the EA to include a point-of-compliance well at location 0684 (see Figure 5 in the EA) to verify that contaminants are not migrating off site.

Response to Comment Concerning Volume of 100-year Flood Event: DOE agrees that the EA should be revised for a 100-year flood event estimate for the Dolores River. The USGS has provided an estimate of 15,900 cfs at Bedrock, Colorado, and that number will be used in the EA.