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APR 24 2002

Mr. Daniel M. Gillen, Chief
U.S. Nuclear Regulatory Commission
Fuel Cycle Facilities Branch, NMSS
Mail Stop T8A33
Washington, D.C. 20555-0001

Subject: Transmittal of Draft *Groundwater Compliance Action Plan for the Slick Rock, Colorado, UMTRA Project Site*–April 2002

Dear Mr. Gillen:

We are sending your staff (see below) copies of the above-referenced draft document for review and comment.

There are two separate and distinct Title I UMTRA sites associated with Slick Rock, the North Continent site (NC) and the Union Carbide site (UC). The DOE is proposing natural flushing with monitoring and Institutional Controls for meeting compliance with Subpart B of the EPA ground water standards (40 CFR 192).

If you have any questions, please call me at 970/248-7612.

Sincerely,

Donald R. Metzler
Program Manager

Enclosure

cc w/enclosure:
M. Fliegel, NRC
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S. Marutzky, MACTEC-ERS
Project File GWSKR 1.4 (K. Sutton)

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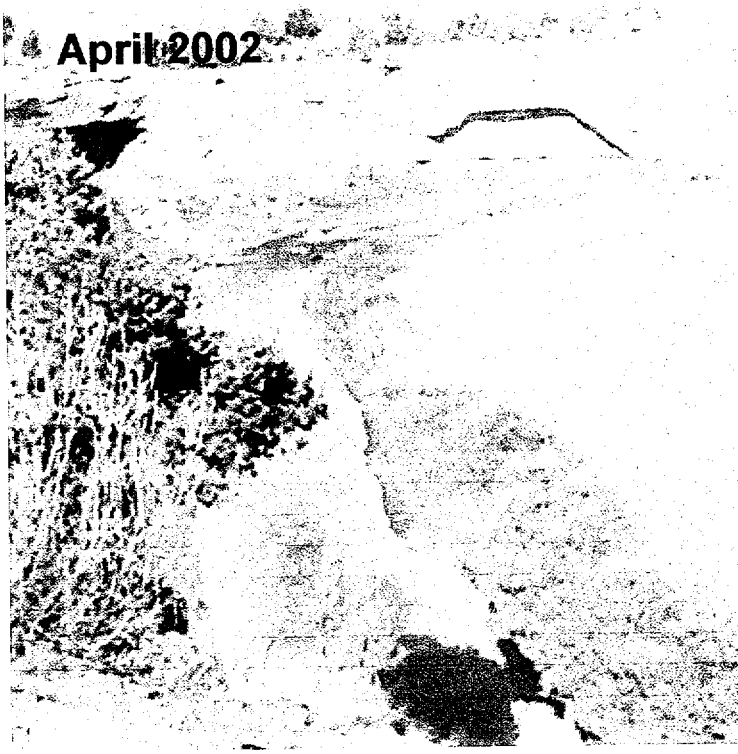
UMTRA
Ground Water Project

Draft Ground Water Compliance Action Plan for the Slick Rock, Colorado, UMTRA Project Site

April 2002



Prepared by the
U.S. Department of Energy
Grand Junction Office

Work Performed Under DOE Contract No. DE–AC13–96GJ87335 for the U.S. Department of Energy

GJO–2002–318–TAR
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April 2002

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Grand Junction, Colorado

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1.0 Introduction

This Ground Water Compliance Action Plan (GCAP) presents the proposed compliance strategy for ground water cleanup at the Slick Rock Uranium Mill Tailings Remedial Action (UMTRA) site located in San Miguel County, Colorado (Figure 1). The Slick Rock site consists of two former uranium-processing sites known as the North Continent (NC) site and the Union Carbide (UC) site. These sites are situated along the banks of the Dolores River and are surrounded by steep juniper-covered hillsides and cliffs of the Dolores River canyon (Figure 2). This GCAP is based on U.S. Department of Energy (DOE) evaluation of information included in the Site Observational Work Plan (SOWP) (DOE 2002). It will serve as a stand-alone modification to the *Remedial Action Plan and Site Design for Stabilization of the Inactive Uranium Mill Tailings Sites at Slick Rock, Colorado* (DOE 1995) to address ground water restoration and compliance with the U.S. Environmental Protection Agency (EPA) ground water cleanup standards for the UMTRA Project Title I sites. This GCAP will be the U.S. Nuclear Regulatory Commission (NRC) concurrence document for compliance with Subpart B of 40 CFR 192 for the Slick Rock site.

The proposed compliance strategy for the Slick Rock sites is based on the compliance strategy selection framework following the steps presented in the *Final Programmatic Environmental Impact Statement for the Uranium Mill Tailings Remedial Action Ground Water Project* (PEIS) (DOE 1996) (Figure 3). National Environmental Policy Act issues and environmental concerns will be addressed in an Environmental Assessment, and this information will be made available to public officials and citizens in the area for their review and comment.

2.0 Ground Water Compliance

To achieve compliance with Subpart B of 40 CFR 192 at the NC site, the DOE proposed action is natural flushing in conjunction with institutional controls (IC) and continued monitoring. Ground water flow and transport modeling has predicted that site-related concentrations of selenium and uranium in ground water in the uppermost aquifer (alluvial aquifer) beneath the NC site will decrease to below the respective maximum concentration limit (MCL) within 100 years (Section 5.3 and Appendix H, DOE 2002).

At the UC site, DOE proposed action to achieve compliance with Subpart B of 40 CFR 192 is natural flushing in conjunction with ICs and continued monitoring. Ground water flow and transport modeling has predicted that site-related concentrations of manganese, molybdenum, nitrate, and uranium in ground water in the alluvial aquifer beneath the UC site will decrease to below the respective MCL (background for manganese) within 100 years. However, ground water flow and transport modeling has predicted that selenium will not decrease below the MCL within 100 years; therefore, the human health risk-based benchmark of 0.18 milligrams per liter (mg/L) is proposed as the alternate concentration limit (ACL) for selenium. Ground water flow and transport modeling has predicted that concentrations of selenium in ground water in the alluvial aquifer will decrease to below the ACL within 100 years.

The selenium ACL is a human health risk-based number derived from standard EPA exposure assumptions for a residential drinking water scenario (EPA 1989) and the use of the reference dose for selenium from the EPA's Integrated Risk Information System database (IRIS). The 0.18 mg/L concentration would result in a Hazard Quotient of 1 for a residential drinking water scenario.

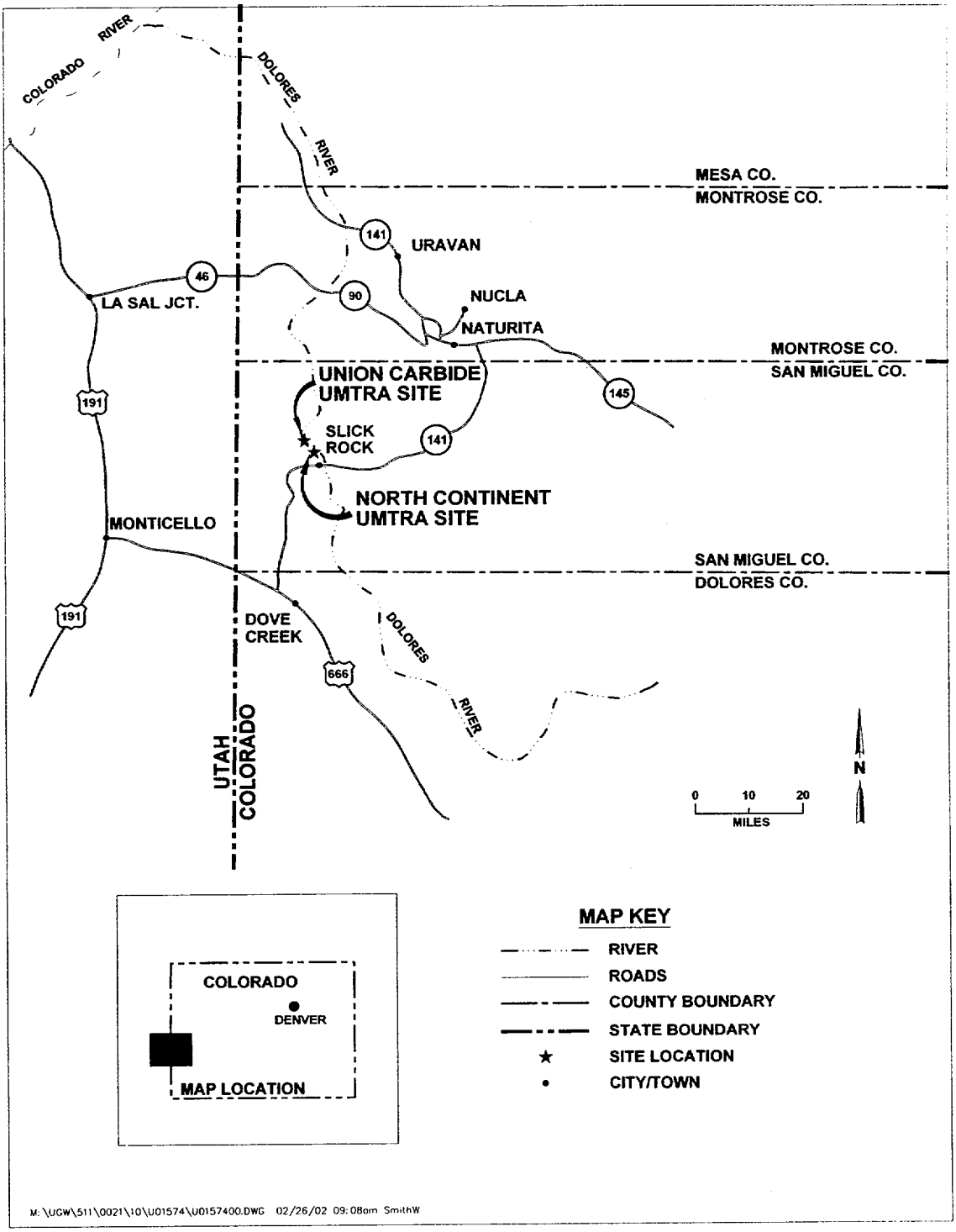

Figure 1. Site Location Map

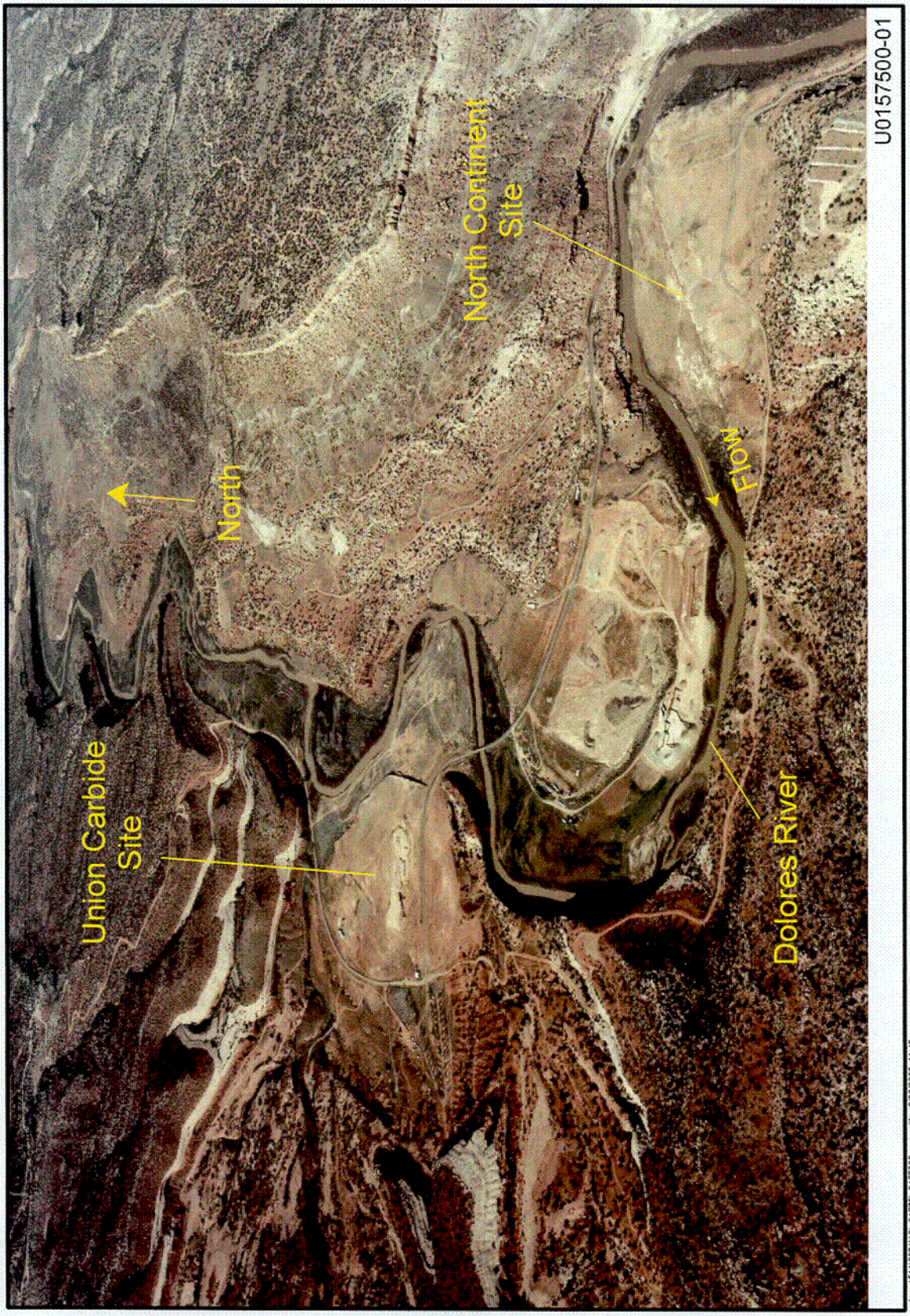

Figure 2. Recent Aerial Photograph of the Slick Rock Sites

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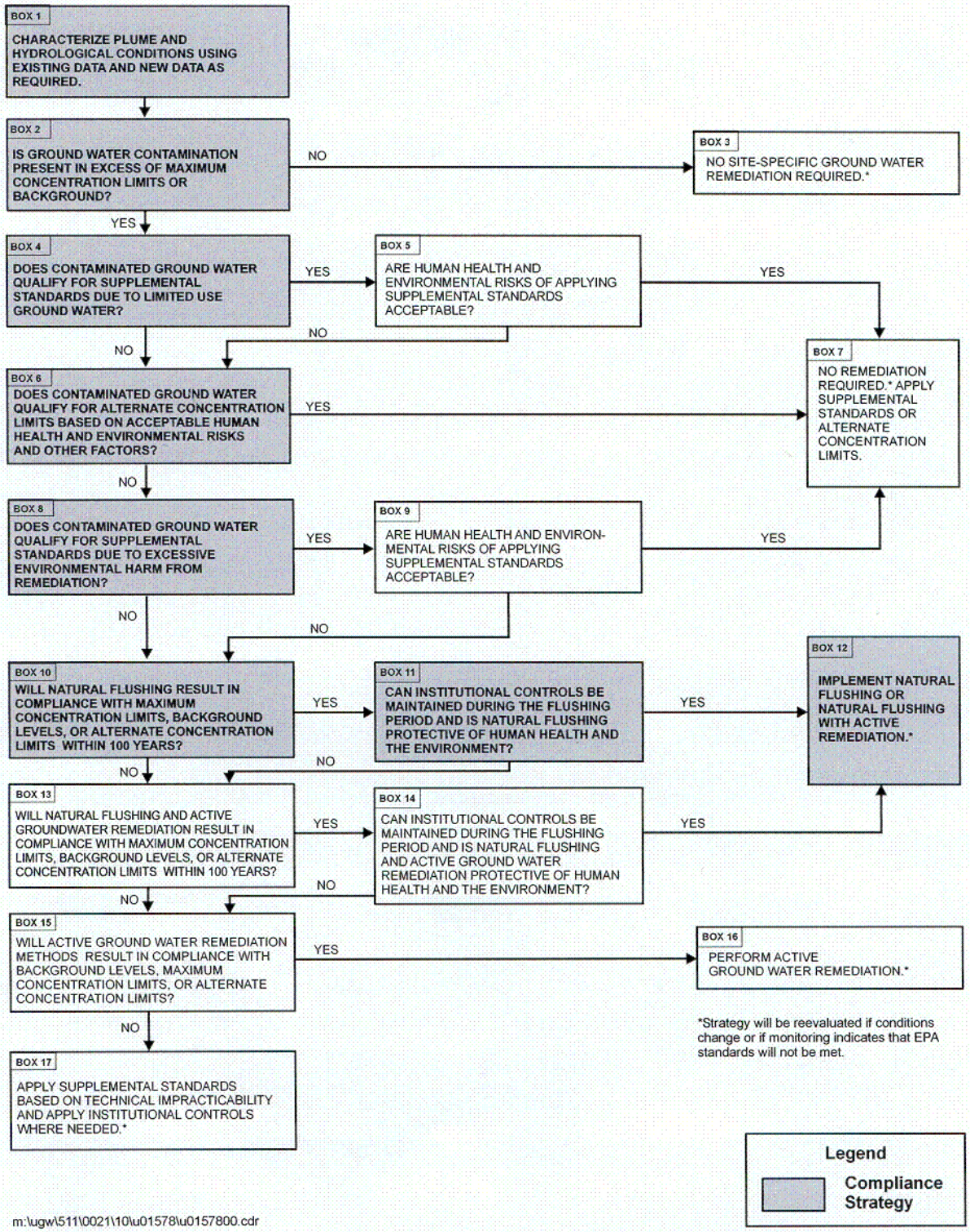

Figure 3. Ground Water Compliance Strategy Flowchart for the Slick Rock Sites

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It is comparable with the Drinking Water Equivalent Level (DWEL) of 0.20 mg/L that was established with the drinking water MCL (EPA 2000). The DWEL represents a lifetime exposure concentration protective of adverse non-cancer health effects that assumes all exposure to a contaminant is from drinking water.

Although modeling results indicate that the human health risk from consumption of ground water from the uppermost aquifer will be acceptable within 100 years, the ground water in the uppermost aquifer will likely exceed the State of Colorado agricultural standard for selenium of 0.02 mg/L. However, the agricultural risk from exposure to ground water from the uppermost aquifer is considered minimal because of an incomplete pathway. Because of the hydraulic characteristics, the uppermost aquifer will not yield enough water to be used as an effective irrigation source. Although the uppermost aquifer will provide enough water to fill a stock tank, the Dolores River adjacent to the site provides an easier alternative for stock watering than drilling a well, with superior water quality. Even though use of the uppermost aquifer for agricultural use is unlikely, the proposed environmental covenant will restrict agricultural use of ground water from the uppermost aquifer until concentrations are below the agricultural standard.

The Entrada Sandstone underlies the alluvium at the UC site. Molybdenum, nitrate, and selenium have been detected in samples collected from Entrada Sandstone wells in concentrations above the respective standards; however, these elevated concentrations are considered a product of drilling and installing the wells through the contaminated alluvial aquifer. The contamination is considered to be isolated to the vicinity around the well and not indicative of widespread aquifer contamination. As a best management practice, these wells will be monitored until concentrations are below the respective standards.

ICs will be maintained and verified until no longer required at the Slick Rock site. Therefore, this compliance strategy will be protective of human health by eliminating the potential for ground water use. ICs will provide an added measure of protection by restricting agricultural use of the ground water until selenium concentrations are below the State of Colorado agricultural standard of 0.02 mg/L. This compliance strategy is also protective of the environment as documented by sampling results from the Dolores River. Future monitoring of ground water and the river will be conducted to verify the progression and completion of natural flushing and verify protection of the environment. This proposed action has been determined by applying the compliance strategy selection framework from the PEIS (Figure 3), consisting of several evaluative steps that are discussed below.

2.1 Assessment of Environmental Data

The first step in the decision process was a review of historical data and identification of data gaps, which led to the production of the *Summary of Site Conditions and Work Plan, Slick Rock, Colorado* (DOE 2000). This plan specified additional characterization work required to obtain data necessary to make decisions regarding remediation of the contaminated ground water. The characterization data were used to formulate the conceptual site model that was used as the foundation for the development of the ground water flow and transport model.

Characterization data also were used to assess risk to human health and the environment posed by contaminants from the former uranium processing sites. The additional characterization work,

conceptual site model, ground water flow and transport modeling, and the updated baseline risk assessment are detailed in the SOWP (DOE 2002). The draft SOWP has been recently revised to address the application of ground water agricultural standards and to address the contamination in Entrada Sandstone wells located on the floodplain at the UC site. These issues are also addressed in Section 2.0 and Section 2.2.2, respectively, of this document.

2.2 Ground Water Contaminants

2.2.1 NC Site

Ground water in the alluvial aquifer beneath the NC site was contaminated by the former uranium processing activities. Uranium is the primary contaminant of potential concern (COPC) in the alluvial ground water, with concentrations up to 1.3 mg/L beneath the middle of the site. In the farthest downgradient portion of the site, uranium 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 are near the MCL, which indicates hydraulic connection of the alluvial aquifer on either side of the Dolores River. Selenium also is a COPC at the NC site; however, the selenium contamination is isolated to one onsite well with concentrations slightly above the selenium MCL of 0.01 mg/L. The distribution of uranium concentrations at the NC site is shown in Figure 4.

2.2.2 UC Site

Ground water beneath the UC site was also contaminated by the former uranium processing activities. COPCs in the ground water at the UC site include manganese, molybdenum, nitrate, selenium, uranium, radium-226, radium-228, benzene, and toluene. All of these COPCs are found in concentrations greater than their respective MCL or background levels in the alluvial aquifer. Contaminant plumes in the alluvial aquifer are all contained onsite, and the radium-226, radium-228, benzene, and toluene contamination is isolated to one well. Manganese contamination is present in several wells, but concentrations are less than 2 times the background level. The primary contaminants in the alluvial aquifer are molybdenum, nitrate, and selenium, with concentrations one (molybdenum) to two (nitrate and selenium) orders of magnitude greater than their respective MCL. The distribution of molybdenum, nitrate, and selenium concentrations in the alluvial aquifer at the UC site are displayed in Figures 5, 6, and 7, respectively.

Underlying the alluvial aquifer at the UC site is the Entrada Sandstone. Since September 2000, concentrations of molybdenum (well 0317), nitrate (well 0324), and selenium (well 0324) exceeded their respective MCL in samples collected from the Entrada Sandstone wells on the floodplain. However, these concentrations are considered a product of drilling and installing these wells through the contaminated alluvial aquifer. This hypothesis is supported by hydrologic data that indicate there is a slight upward vertical gradient between the alluvial and Entrada aquifers and that the hydraulic conductivity in the alluvial aquifer is two orders of magnitude greater than the Entrada aquifer. These hydrologic conditions inhibit ground water from flowing vertically from the alluvial aquifer into the Entrada aquifer. Water chemistry data, in part, also support this hypothesis. Time versus concentration graphs for nitrate and selenium (Figures 8 and 9) in well 0324 show that concentrations have been declining and are currently below their respective standard. Molybdenum concentrations in well 0317, however, have been consistent over the short term (Figure 10).

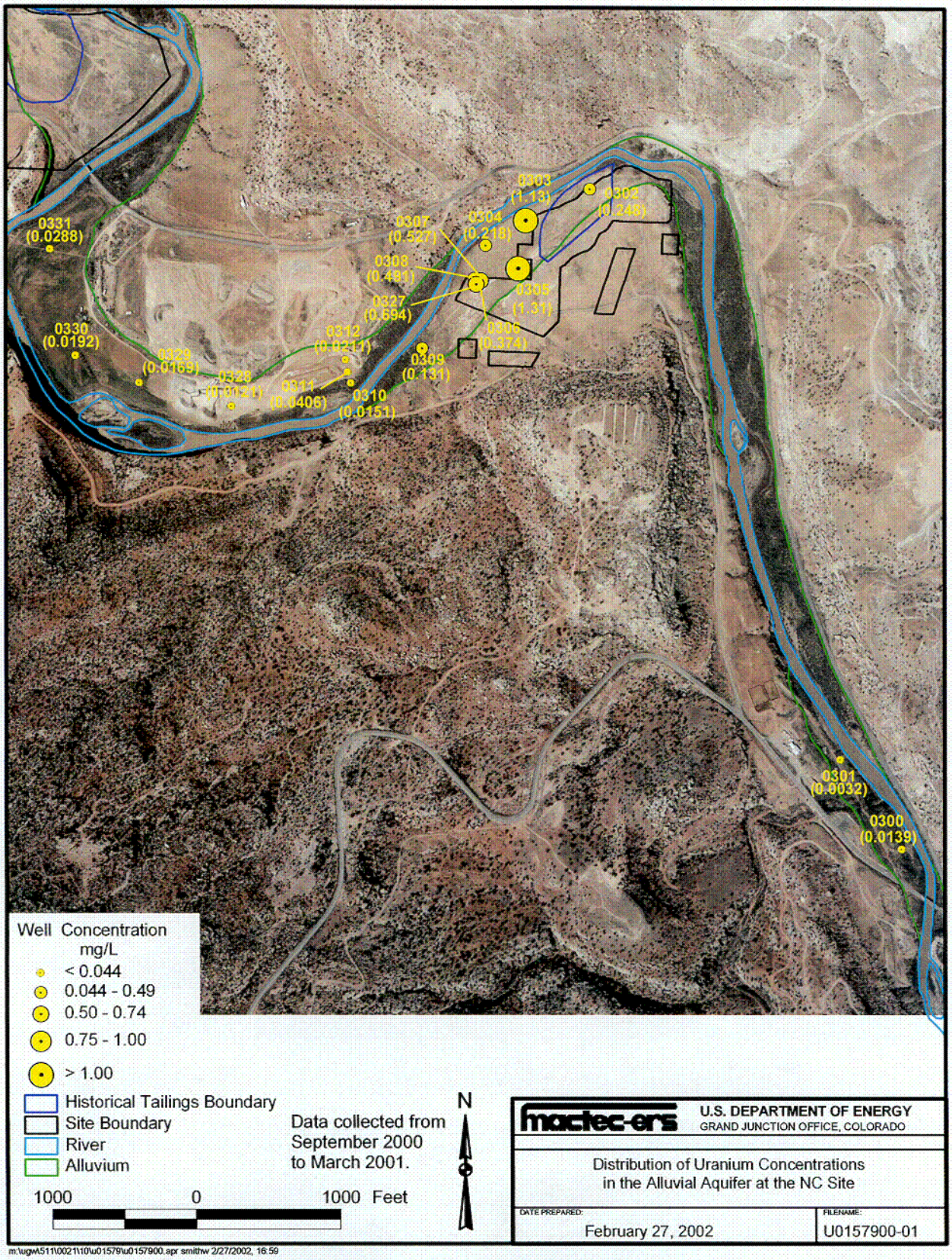

Figure 4. Distribution of Uranium Concentrations in the Alluvial Aquifer at the NC Site

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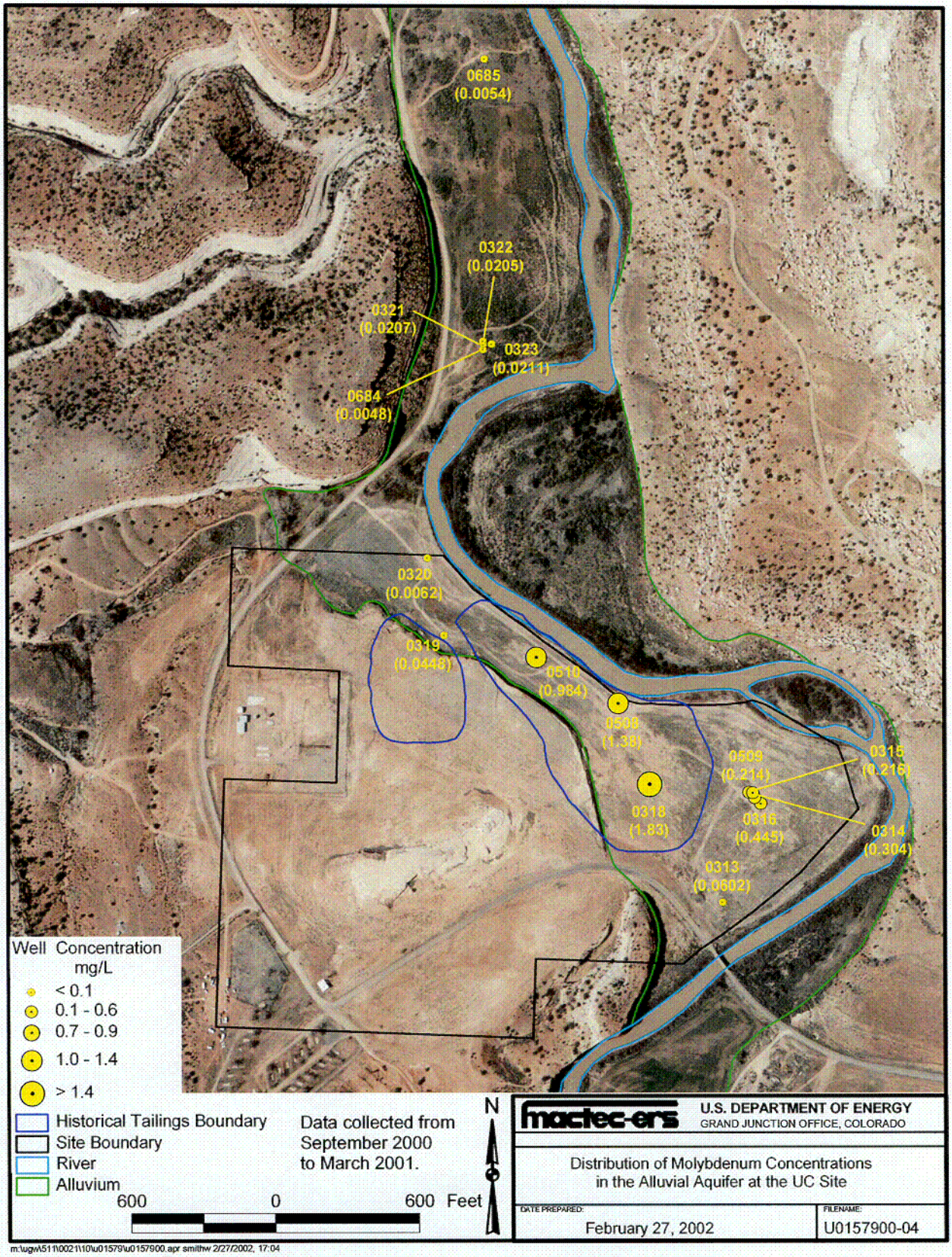

Figure 5. Distribution of Molybdenum Concentrations in the Alluvial Aquifer at the UC Site

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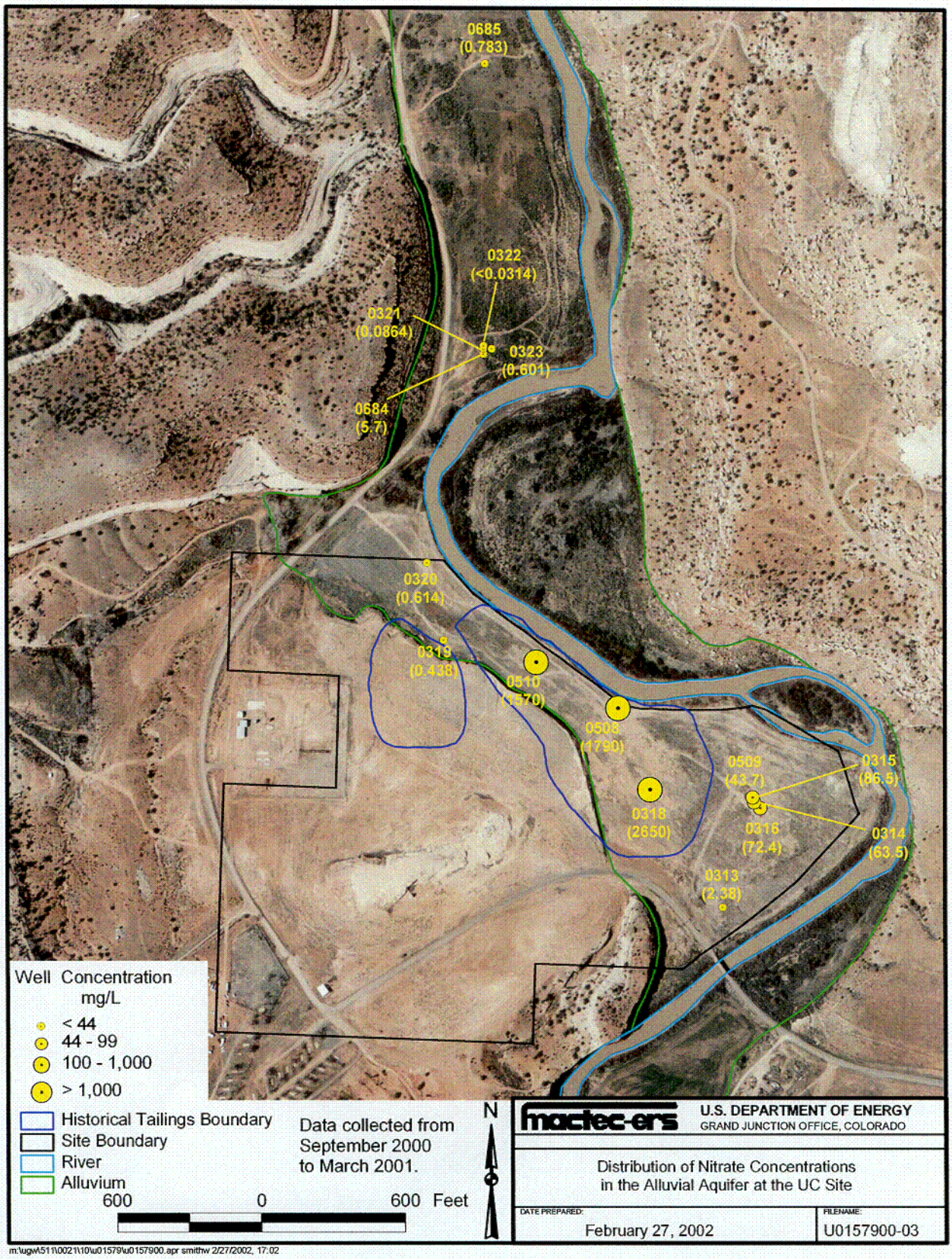

Figure 6. Distribution of Nitrate Concentrations in the Alluvial Aquifer at the UC Site

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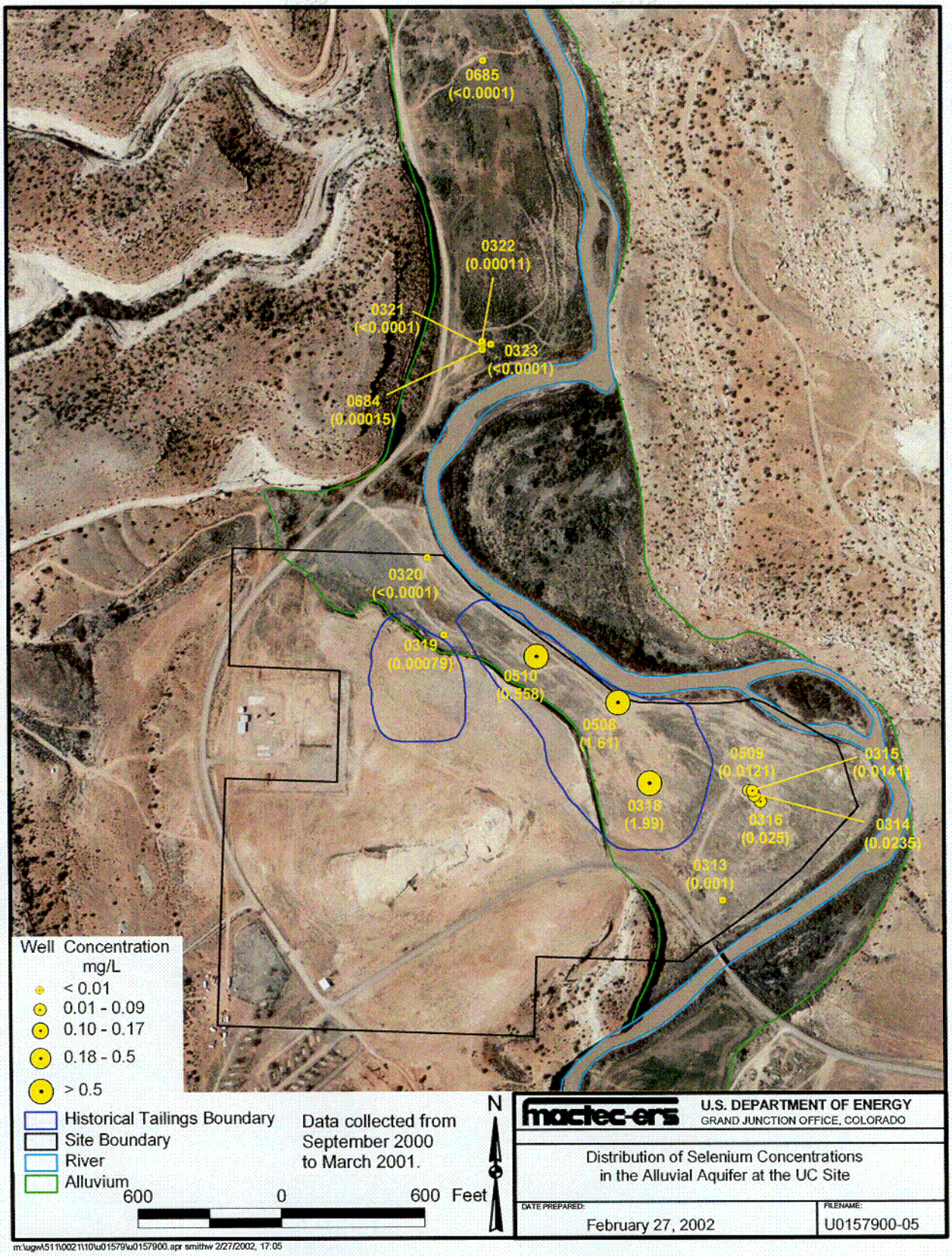

Figure 7. Distribution of Selenium Concentrations in the Alluvial Aquifer at the UC Site

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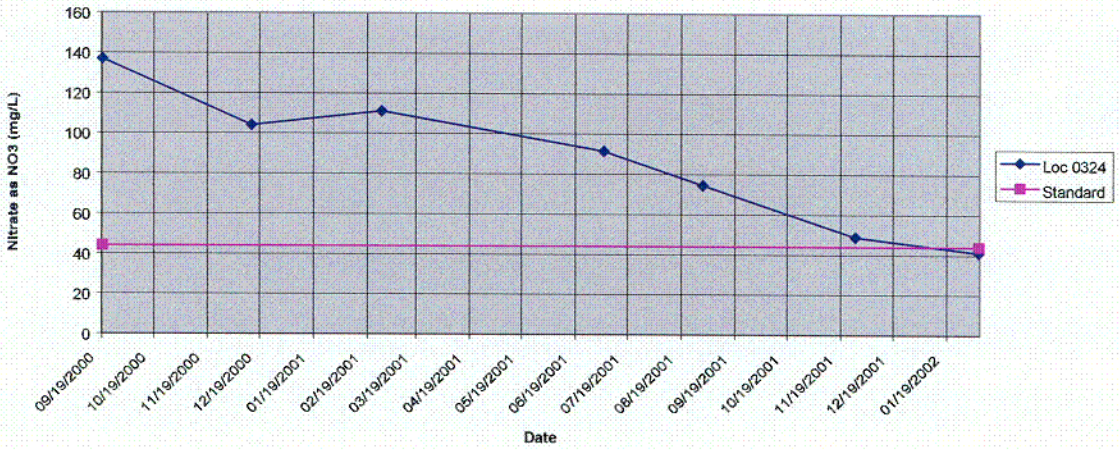

Figure 8. Nitrate Concentrations in Entrada Sandstone Well 0324

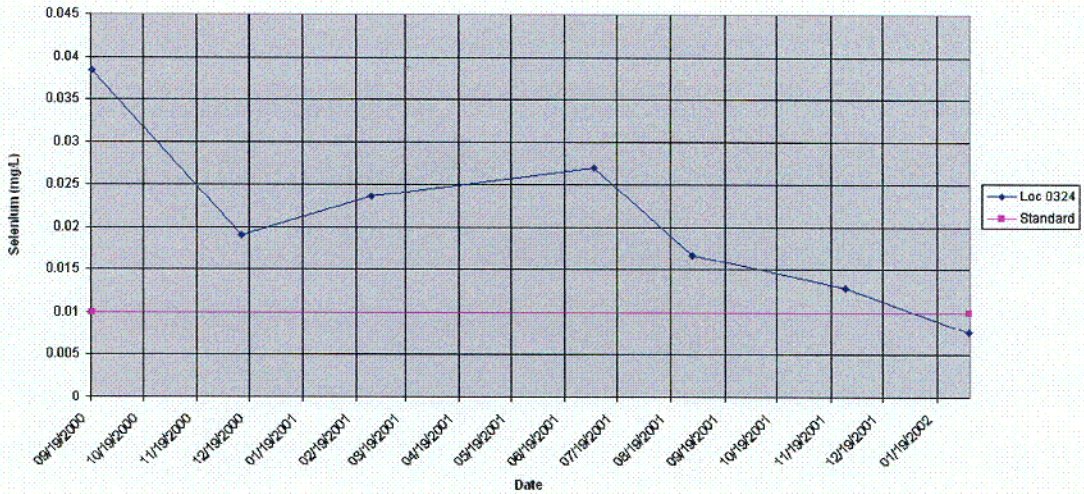

Figure 9. Selenium Concentrations in Entrada Sandstone Well 0324

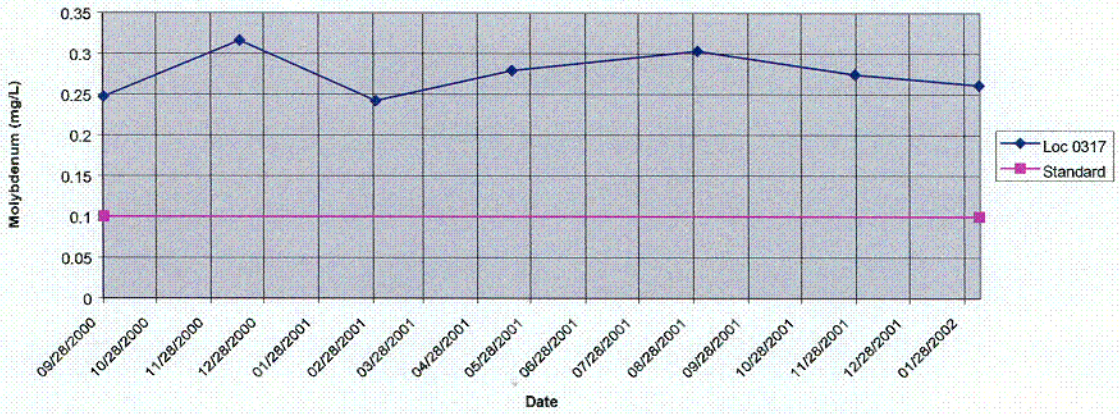

Figure 10. Molybdenum Concentrations in Entrada Sandstone Well 0317

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2.3 Applicability of Natural Flushing

2.3.1 NC Site

A ground water flow and transport model was developed to evaluate if natural flushing will reduce selenium and uranium concentrations to below their respective MCL in the uppermost aquifer (alluvial aquifer) within 100 years. The ground water flow and transport model predicts that selenium and uranium concentrations in the alluvial ground water beneath the NC site will be below their respective MCL within 100 years, which demonstrates that natural flushing is a viable compliance strategy. Ground water modeling results are summarized in Table 1 and are detailed in Section 5.3 and Appendix H of the SOWP (DOE 2002). As shown in Table 1, predicted uranium and selenium concentrations will be below the MCL within 50 years.

Table 1. Predicted Steady State Maximum Concentrations for Nitrate, Manganese, Molybdenum, Selenium, and Uranium

	Modeled Contaminant					
Site	**UC Site**				**NC Site**	
	Nitrate (mg/L)	**Manganese (mg/L)**	**Molybdenum (mg/L)**	**Selenium (mg/L)**	**Selenium (mg/L)**	**Uranium (mg/L)**
Standard	44	3.5	0.1	0.18	0.01	0.044
Source	MCL	Background	MCL	ACL	MCL	MCL
Maximum at 5 years	832.8	5.82	0.750	1.22	0.026	0.435
Maximum at 10 years	412.3	5.50	0.526	0.909	0.022	0.171
Maximum at 15 years	244.9	5.47	0.369	0.715	0.019	0.126
Maximum at 25 years	109.3	5.11	0.207	0.505	0.015	0.065
Maximum at 50 years	26.6	3.60	0.089	0.274	0.008	0.020
Maximum at 60 years	15.7	3.03	0.071	0.225	0.007	0.019
Maximum at 70 years	9.6	2.54	0.057	0.211	0.005	0.017
Maximum at 80 years	6.3	2.13	0.047	0.197	0.004	0.016
Maximum at 90 years	4.6	1.80	0.039	0.181	0.003	0.015
Maximum at 100 years	3.7	1.56	0.032	0.166	0.003	0.014

2.3.2 UC Site

A ground water flow and transport model was developed to evaluate if natural flushing will reduce nitrate, molybdenum, and uranium to below their respective MCL, manganese to below background, and selenium to below the ACL in the alluvial aquifer within 100 years. As shown in Table 1, the ground water flow and transport model predicts the concentrations of these COPCs will be reduced to below their respective benchmark within 100 years, which demonstrates that natural flushing is a viable compliance strategy. Ground water modeling results are detailed in Section 5.3 and Appendix H of the SOWP (DOE 2002).

Two versions of the steady state model (deterministic and stochastic) were developed to simulate site conditions. A steady state deterministic flow and transport model was used as the basis for the stochastic model, which was developed to quantify the uncertainty in flow and transport parameters. Of the five contaminants, only selenium was modeled using both versions. The

remaining contaminants were modeled using the steady state deterministic flow and transport model and results are summarized in Table 1; results of the stochastic model are presented in Table 2. Stochastic modeling results predict the maximum average selenium concentration after 100 years will be 0.125 mg/L, with the concentration dropping below the 0.18-mg/L ACL within 60 years. This stochastic simulation also predicts there is a 14 percent probability the maximum average selenium concentration will be above the 0.18 mg/L ACL after 100 years of natural flushing as shown in Figure 11.

Table 2. Stochastic Modeling Results for Selenium

	Time Interval (yrs)									
	5	10	15	25	50	60	70	80	90	100
Maximum Average Selenium Concentration (mg/L)	0.937	0.621	0.482	0.326	0.194	0.172	0.156	0.143	0.133	0.125

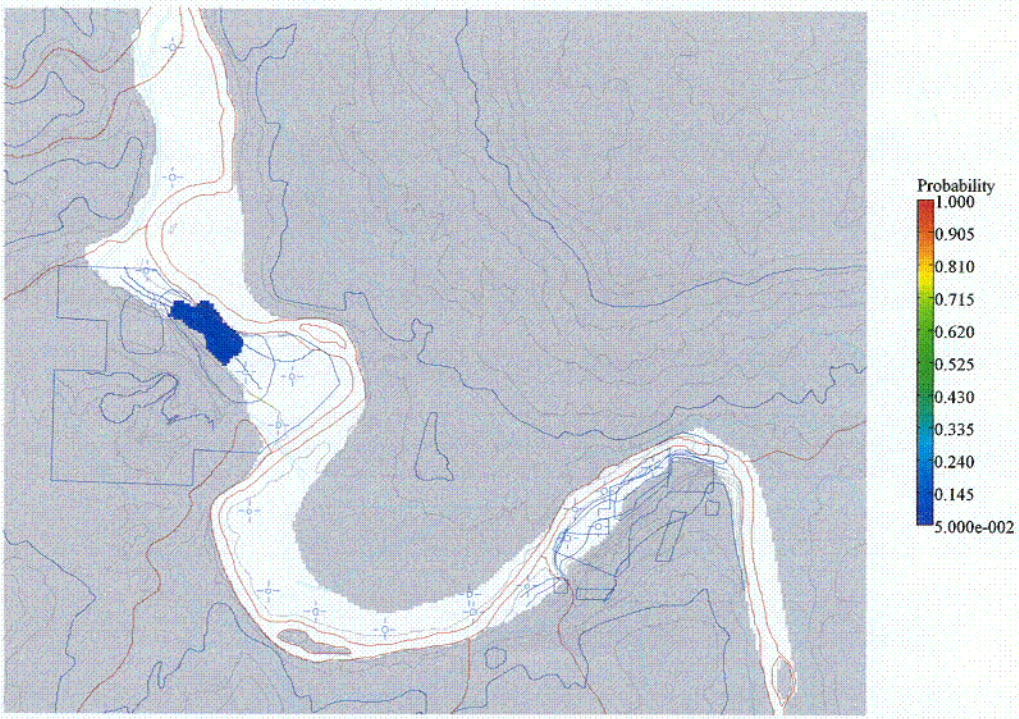

Figure 11. Probability of Selenium Concentration Exceeding the ACL at 100 Years

The natural flushing strategy also will apply to several COPCs that were not included in the ground water flow and transport model. Benzene and toluene were not included in the ground water flow and transport model because it is anticipated that biodegradation, rather than ground water transport, will be the dominant process that controls the fate of these COPCs in the environment. Based on published degradation rates (Mackay et al. 1992), these COPCs should degrade within the 100-year timeframe. Radium-226 and radium-228 also 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. Because the

C08

concentration (6.2 picocuries per liter [pCi/L] average) is close to the standard (5 pCi/L), radium concentrations are expected to fall below the standard within 100 years.

Because contaminants in Entrada Sandstone wells located on the floodplain at the UC site are considered to be a result of well drilling and installation and isolated to the vicinity of the well, use of a predictive ground water model is not required. In lieu of a model, these wells will be monitored until COPCs are below the respective standards.

2.4 Institutional Controls

ICs are restrictions that effectively protect public health and the environment by limiting access to a contaminated medium such as alluvial ground water at the Slick Rock site. If natural flushing is to be protective of human health and the environment, ICs must be maintained during the flushing process to prevent improper access to the ground water. If ACLs are applied to constituents that preclude unrestricted ground water use, ICs are also required to prevent improper use of ground water (i.e., agricultural use).

Separate ICs are being developed for the UC and NC sites to prevent the future use of the potentially harmful contaminated ground water. ICs are required for the 100-year timeframe allowed by regulations for the constituents to flush to an acceptable level. The IC for each property will 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.

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 ground water 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 satisfy the requirements of an IC for permanence, enforceability, and its ability to be maintained and verified.

2.5 Human Health and Environmental Risk

There are no unacceptable risks to human health associated with present conditions at the Slick Rock sites because there is currently no use of ground water from the uppermost aquifer. Future risks to human health will be eliminated because access to the contaminated ground water will be restricted through the use of ICs. After ground water is acceptable as a drinking water source for humans, ICs will still restrict agricultural use of the ground water until ground water concentrations are acceptable for that use. In addition, there are no unacceptable risks to the environment as documented by the surface-water monitoring program at the Slick Rock site. Historical analyte concentrations measured in the Dolores River have been below applicable State of Colorado surface water standards (CDPHE 1998). Future monitoring of water quality in the Dolores River will be conducted to verify that the natural flushing strategy is protective of the environment. Consequently, the proposed compliance strategy of natural flushing in conjunction with ICs and continued monitoring will be protective of human health and the environment.

3.0 Implementation

Implementation of the proposed compliance strategy includes ICs and continued monitoring of ground water and surface water.

3.1 Institutional Controls

The contaminated ground water plume affects portions of the UC and NC sites, both of which are currently owned by UMETCO Minerals (Figure 12). The State of Colorado proposes to enter into an environmental covenant with UMETCO Minerals to restrict domestic use of the ground water. The Environmental Covenant with UMETCO Minerals will be binding on all future landowners, and will exist in perpetuity, but may be modified or terminated per the conditions in the Environmental Covenant. The property owner agrees to notify the Colorado Department of Public Heath and Environment (CDPHE) of any development that has potential to violate the terms of the covenant. In addition, the property owner must annually send a report to CDPHE and DOE certifying compliance, or lack thereof, with the terms of the covenant. The covenant contains enforcement provisions. A copy of the proposed environmental covenant for each property is provided in Appendix A.

An additional IC on the property west of the NC site may be required if uranium concentrations in well 0311 continue to increase. Offsite wells 0310, 0311, and 0312 were installed downgradient and across the river from the NC site to assess uranium migration offsite. Concentrations of uranium in three of seven samples from well 0311 exceeded the MCL of 0.044 mg/L, with a maximum concentration of 0.0557 mg/L. However, elevated uranium concentrations offsite appear to be isolated to well 0311. Samples from wells 0310 and 0312 (adjacent to well 0311) and well 0328 (downgradient of well 0311) have never exceeded the uranium standard. In addition, the ground water flow and transport model predicts uranium concentrations in this portion of the aquifer will not increase significantly over time. Therefore, an IC is not warranted at this time. However, monitoring of well 0311 will continue, and the need for an IC will be reevaluated in 5 years.

3.2 Monitoring

3.2.1 NC Site

Ground water will be monitored during the period of natural flushing to verify modeling results, that is, ensuring that concentrations of uranium and selenium in the ground water are decreasing, and to assess compliance with MCLs. In addition, surface water in the Dolores River will be monitored to verify that the natural flushing strategy is protective of the environment. The proposed ground water and surface-water monitoring program is summarized in Table 3, and sampling locations are shown in Figure 13. Because selenium concentrations are currently below the Safe Drinking Water Act (SDWA) MCL of 0.05 mg/L, and the UMTRA Project MCL of 0.01 mg/L is exceeded in only one well, extensive monitoring for selenium is not warranted. If uranium concentrations continue to increase in well 0311, additional wells may be added to the sampling network to determine the extent of the uranium plume and to determine the need for an additional IC. Samples will be collected on an annual basis for 10 years; after 10 years, the

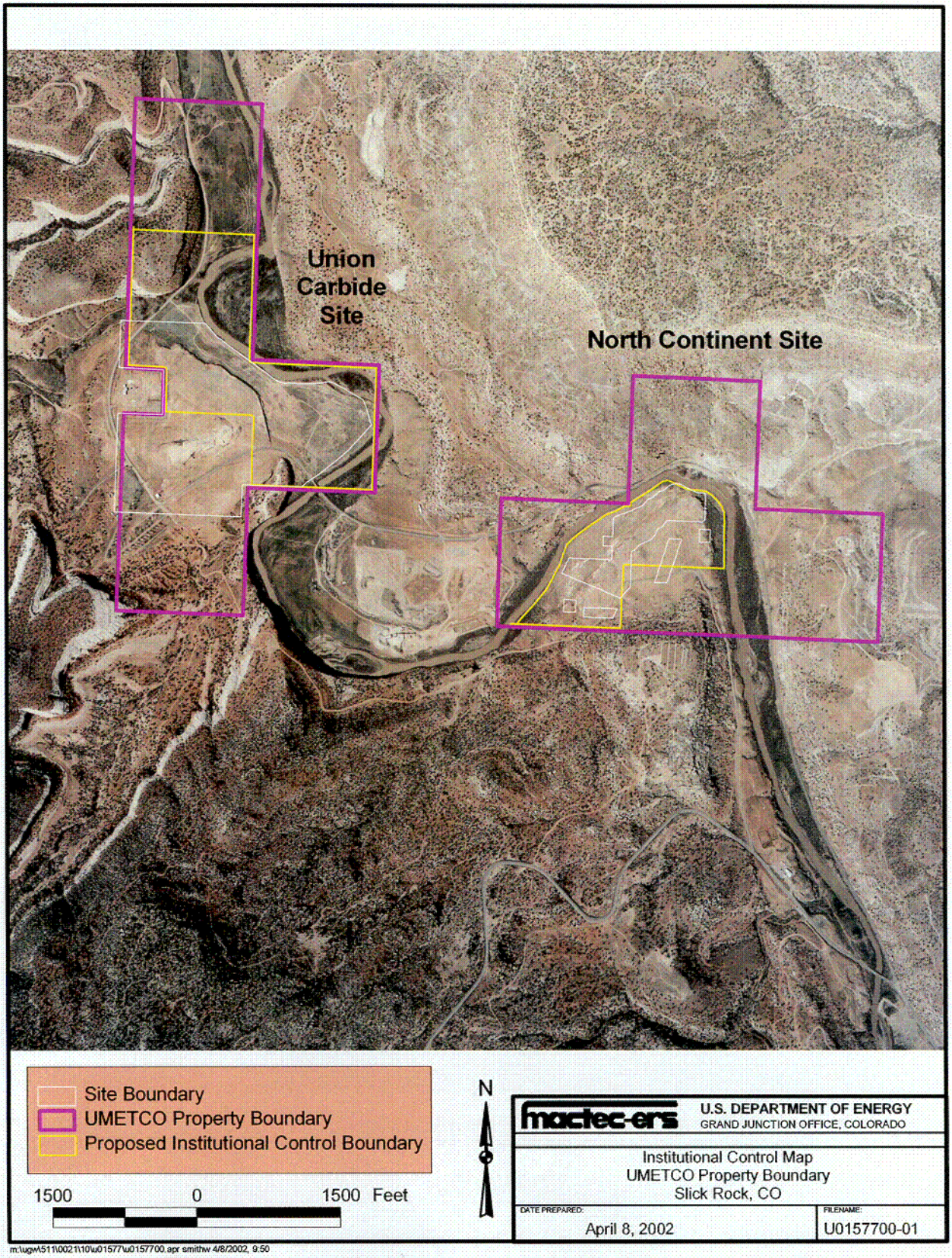

Figure 12. Institutional Control Map, Slick Rock, Colorado

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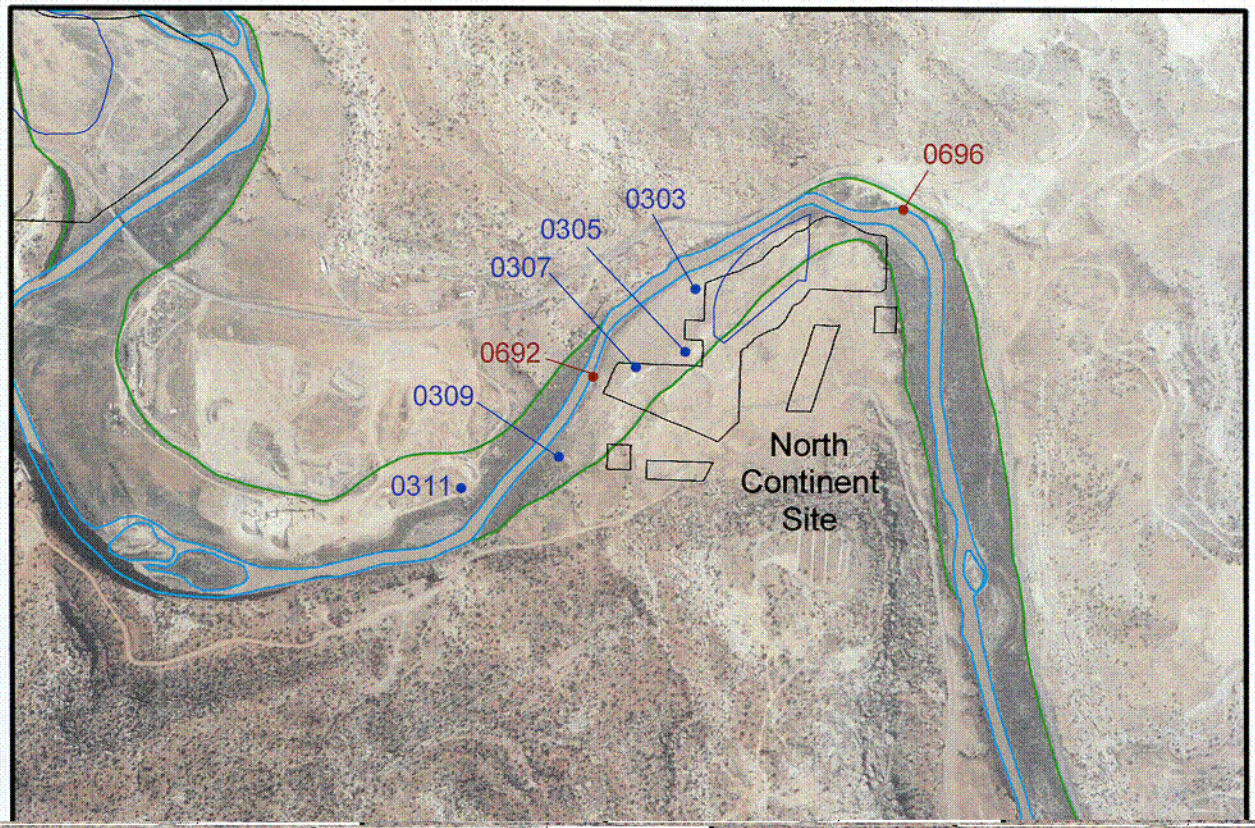
0696
0303
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0311
North
Continent
Site

sampling frequency will be reduced to every 5 years. Natural flushing will be considered complete when uranium concentrations are below the MCL in all wells in the monitoring network and when selenium concentrations are below the MCL in wells 0305 and 0307 for three consecutive sampling events.

Table 3. Proposed Monitoring Program at the NC Site

ID	Matrix	Location	Rationale	Analytes
0696	Surface Water	Upstream	Background for NC site.	Uranium
0692	Surface Water	Adjacent to site	Predicted location where the centroid of the uranium plume intersects the river.	Uranium
0303	Ground Water	On site	Hot spot for uranium.	Uranium
0305	Ground Water	On site	Hot spot for uranium; selenium above the UMTRA MCL.	Uranium, Selenium
0307	Ground Water	On site	Downgradient of hot spots, monitor plume migration.	Uranium, Selenium
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.	Uranium

3.2.2 UC Site

Ground water will be monitored during the period of natural flushing to verify modeling results, that is, ensuring that concentrations of COPCs in the ground water are decreasing, and to assess compliance with applicable benchmarks. Compliance with the selenium ACL of 0.18 mg/L will be assessed at all wells in the monitoring network. Natural flushing will be considered complete when all wells in the sampling network contain concentrations less than the MCL, ACL (selenium only), or background (manganese only) for three consecutive sampling events. In addition, surface water in the Dolores River will be monitored to verify that the compliance strategy is protective of the environment. The potential for environmental exposure to site contaminants exists in the Dolores River because it receives ground water discharge from the contaminated alluvial aquifer. Selenium concentrations in the Dolores River will be compared to the State of Colorado standard of 0.005 mg/L (CDPHE 1998). Entrada Sandstone wells 0324 and 0317 will be monitored until COPC concentrations are below applicable standards for three consecutive sampling events. Samples will be collected on an annual basis for 10 years; after 10 years, the sampling frequency will be reduced to every 5 years. The proposed ground water and surface-water monitoring program is summarized in Table 4 and sampling locations are shown in Figure 14.

3.3 Confirmation Report

Upon regulatory concurrence with the Slick Rock GCAP, the verification-monitoring period will commence. This phase should continue through 2005. At that time, actual ground water monitoring results will be compared with modeling predictions and the effectiveness of the natural flushing compliance strategy will be assessed. If actual ground water conditions in the vicinity of the site are reasonably comparable with the modeling predictions, the Confirmation Report will be prepared. At that point (2006), the site will be turned over to the Long-Term Surveillance and Maintenance (LTSM) Program for long-term management activities.

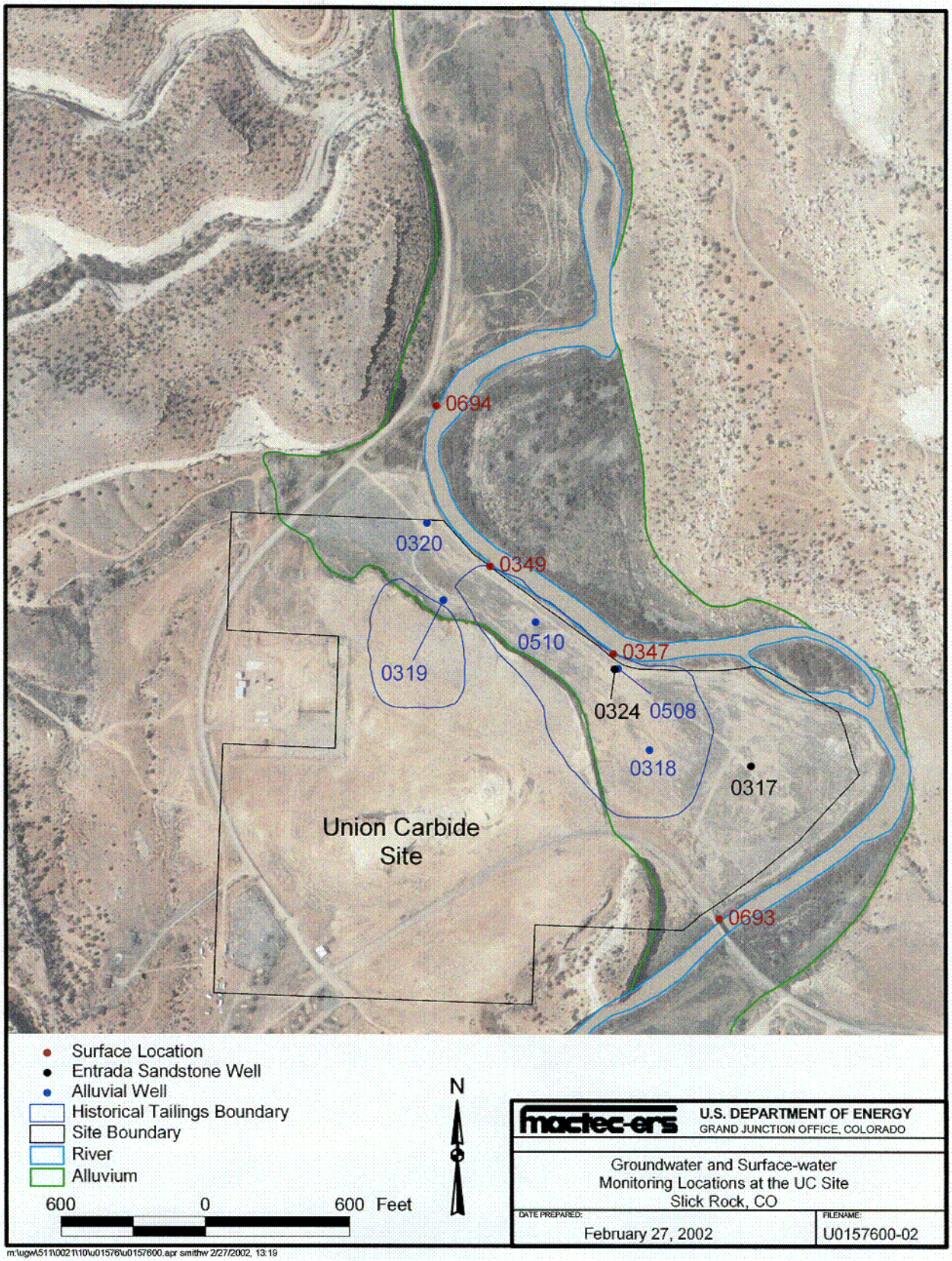

Figure 14. Ground Water and Surface Water Monitoring Locations at the UC Site, Slick Rock, Colorado

C11

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 centroid of the selenium plume intersects the river.	Manganese, Molybdenum, Nitrate, Selenium, and Uranium
0349	Surface Water	Adjacent to site	Predicted location where centroid of contaminant plumes intersect the river.	Manganese, Molybdenum, Nitrate, Selenium, and Uranium
0694	Surface Water	Downstream	Potential for contaminant plumes to discharge to the river at this location.	Manganese, Molybdenum, Nitrate, Selenium, and Uranium
0318	Ground Water	On site	Hot spot for several COPCs.	Manganese, Molybdenum, Nitrate, Selenium, and Uranium
0508	Ground Water	On site	High selenium, nitrate, molybdenum.	Manganese, Molybdenum, Nitrate, Selenium, and Uranium
0510	Ground Water	On site	Edge of former tailings pile, high COPC concentrations.	Manganese, Molybdenum, Nitrate, Selenium, and Uranium
0317	Ground Water	On site	Entrada Sandstone well, exceeds molybdenum MCL.	Molybdenum
0324	Ground Water	On site	Entrada Sandstone well, exceeded nitrate and selenium MCLs.	Nitrate and Selenium
0319	Ground Water	On site	Hot spot for benzene, toluene and Ra-226/Ra-228.	benzene, toluene, ethylbenzene, and xylene, radium-226 and radium-228
0320	Ground Water	On site	Farthest downgradient well on site; monitor plume movement.	Manganese, Molybdenum, Nitrate, Selenium, and Uranium

3.4 Certification Report

Once ground water remediation goals are met, a certification report will be prepared for NRC and state concurrence. This report will be the final closeout document. Monitoring and ICs will be discontinued at this time.

4.0 References

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

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.

U.S. Department of Energy (DOE), 1995. *Remedial Action Plan and Site Design for Stabilization of the Inactive Uranium Mill Tailings Sites at Slick Rock, Colorado*, UMTRA-DOE/AL/62350-21F Rev 0.

———, 1996. *Final Programmatic Environmental Impact Statement for the Uranium Mill Tailings Remedial Action Ground Water Project*, Vol. I, DOE/EIS-0198.

U.S. Department of Energy (DOE), 2000. *Summary of Site Conditions and Work Plan, Slick Rock, Colorado*, GJO–2000–143–TAR, U. S Department of Energy Grand Junction Office, Grand Junction, Colorado.

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

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.

Appendix A

Proposed Environmental Covenant for the Slick Rock Site

This property is subject to an Environmental Covenant held by the Colorado Department of Public Health and Environment pursuant to section 25-15-321, C.R.S.

ENVIRONMENTAL COVENANT

By this deed, UMETCO Minerals grants an Environmental Covenant ("Covenant") this 30th day of January, 2002 to the Colorado Department of Public Health and the Environment ("the Department") pursuant to § 25-15-321 of the Colorado Hazardous Waste Act, § 25-15-101, *et seq*. The Department's address is 4300 Cherry Creek Drive South, Denver, Colorado 80246-1530.

WHEREAS, UMETCO Minerals is the owner of certain property commonly referred to as the North Continent ("NC") Mill site, located at Slick Rock San Miguel County, Colorado, more particularly described in **Attachment A**, attached hereto and incorporated herein by reference as though fully set forth (hereinafter referred to as "the Property"); and

WHEREAS, UMETCO Minerals has disposed of uranium mill tailings at the Property; and

WHEREAS, pursuant to the Site Observational Workplan for the Slick Rock, Colorado UMTRA Project Site, dated September 2001, the Property is the subject of remedial action pursuant to the Uranium Mill Tailings Radiation Control Act, P.L. 95-604 ("UMTRCA") and UMTRCA regulations, 40 C.F.R.§ 192 Subpart B, and;

WHEREAS, UMETCO Minerals desires to subject the Property to certain covenants and restrictions as provided in Article 15 of Title 25, Colorado Revised Statutes, which covenants and restrictions shall burden the Property and bind UMETCO Minerals, its heirs, successors, assigns, and any grantees of the Property, their heirs, successors, assigns and grantees, and any users of the Property, for the benefit of the Department.

NOW, THEREFORE, UMETCO Minerals hereby grants this Environmental Covenant to the Department, and declares that the Property as described in Attachment A shall hereinafter be bound by, held, sold, and conveyed subject to the following environmental use restrictions which shall run with the Property in perpetuity and be binding on UMETCO Minerals and all parties having any right, title or interest in the Property, or any part thereof, their heirs, successors and assigns, and any persons using the land. UMETCO Minerals declares that the United States Department of Energy shall be a third party beneficiary of this Environmental Covenant. UMETCO Minerals, its successors, and all parties having any right, title or interest in the Property, or any part thereof, their heirs, successors and assigns shall hereinafter be referred to in this covenant as OWNER.

1. Use restrictions

   A. No habitable structure may be constructed on the property without properly designed radon mitigation.

B. No wells or drilling or pumping whatsoever shall be permitted or allowed in the alluvial aquifer or the Entrada formation underlying the Property, without the express written consent of the Department. The only exception to the foregoing is for monitoring and remedial wells installed by the Department of Energy, in connection with the on-going, approved remedial activities at the Property.

C. No tilling, excavation, grading, construction, or any other activity that disturbs the ground surface is permitted on the Property, without the express written consent of the Department.

D. No activities that will in any way damage any monitoring or remedial wells installed by the Department of Energy, or interfere with the maintenance, operation, or monitoring of said wells is allowed, without the express written consent of the Department.

2. Purpose of this covenant The purpose of this Covenant is to ensure protection of human health and the environment by minimizing the potential for exposure to any residual radioactive material that remains on the Property. The Covenant will accomplish this by minimizing those activities that result in disturbing the ground surface, and by creating a review and approval process to ensure that any such intrusive activities are conducted with appropriate precautions to avoid or eliminate any hazards.

3. Modifications This Covenant runs with the land and is perpetual, unless modified or terminated pursuant to this paragraph. OWNER may request that the Department approve a modification or termination of the Covenant. The request shall contain information showing that the proposed modification or termination shall, if implemented, ensure protection of human health and the environment. The Department shall review any submitted information, and may request additional information. If the Department determines that the proposal to modify or terminate the Covenant will ensure protection of human health and the environment, it shall approve the proposal. No modification or termination of this Covenant shall be effective unless the Department has approved such modification or termination in writing. Information to support a request for modification or termination may include one or more of the following:

a) a proposal to perform additional remedial work;
b) new information regarding the risks posed by the residual contamination;
c) information demonstrating that residual contamination has diminished;
d) information demonstrating that the proposed modification would not adversely impact the remedy and is protective of human health and the environment; and
other appropriate supporting information.

4. Conveyances OWNER shall notify the Department at least fifteen (15) days in advance of any proposed grant, transfer or conveyance of any interest in any or all of the Property.

5. Incorporation OWNER agrees to incorporate either in full or by reference the restrictions of this Covenant in any leases, licenses, or other instruments granting a right to use the Property.

6. Notification for proposed construction and land use OWNER shall notify the Department simultaneously when submitting any application to a local government for a building permit or change in land use.

7. Inspections The Department shall have the right of entry to the Property at reasonable times with prior notice for the purpose of determining compliance with the terms of this Covenant. Nothing in this Covenant shall impair any other authority the Department may otherwise have to enter and inspect the Property.

8. No Liability The Department does not acquire any liability under State law by virtue of accepting this Covenant, nor does any other named beneficiary of this Covenant acquire any liability under State law by virtue of being such a beneficiary.

9. Enforcement The Department may enforce the terms of this Covenant pursuant to §25-15-321. C.R.S. UMETCO Minerals and any named beneficiaries of this Covenant may file suit in district court to enjoin actual or threatened violations of this Covenant.

10. Owner's Compliance Certification OWNER shall submit an annual Report to the Department, on the anniversary of the date this Covenant was signed by UMETCO Minerals, detailing OWNER's compliance, and any lack of compliance, with the terms of this Covenant.

11. Notices Any document or communication required under this Covenant shall be sent or directed to:

Jeffrey Deckler
Remedial Programs Manager
Colorado Department of Public Health and the Environment
4300 Cherry Creek Drive South
Denver, Colorado 80246-1530

(DOE contact is needed)

UMETCO Minerals, has caused this instrument to be executed this ____ day of _____, 2002.

UMETCO Minerals

By:_____

Title:_____

STATE OF _____)
) ss:
COUNTY OF_____)

The foregoing instrument was acknowledged before me this ___day of _____, 2002 by _____ on behalf of UMETCO Minerals

_____
Notary Public

_____
Address

_____

My commission expires:_____

Accepted by the Colorado Department of Public Health and Environment this _____ day of _____, 2002.

By:_____

Title:_____

STATE OF _____)
) ss:
COUNTY OF_____)

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Notary Public

_____
Address

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WHEREAS, UMETCO Minerals is the owner of certain property commonly referred to as the Union Carbide ("UC") Mill site, located at Slick Rock San Miguel County, Colorado, more particularly described in **Attachment A**, attached hereto and incorporated herein by reference as though fully set forth (hereinafter referred to as "the Property"); and

WHEREAS, UMETCO Minerals has disposed of uranium mill tailings at the Property; and

WHEREAS, pursuant to the Site Observational Workplan for the Slick Rock, Colorado UMTRA Project Site, dated September 2001, the Property is the subject of remedial action pursuant to the Uranium Mill Tailings Radiation Control Act, P.L. 95-604 ("UMTRCA") and UMTRCA regulations, 40 C.F.R.§ 192 Subpart B, and;

WHEREAS, UMETCO Minerals desires to subject the Property to certain covenants and restrictions as provided in Article 15 of Title 25, Colorado Revised Statutes, which covenants and restrictions shall burden the Property and bind UMETCO Minerals, its heirs, successors, assigns, and any grantees of the Property, their heirs, successors, assigns and grantees, and any users of the Property, for the benefit of the Department.

NOW, THEREFORE, UMETCO Minerals hereby grants this Environmental Covenant to the Department, and declares that the Property as described in Attachment A shall hereinafter be bound by, held, sold, and conveyed subject to the following environmental use restrictions which shall run with the Property in perpetuity and be binding on UMETCO Minerals and all parties having any right, title or interest in the Property, or any part thereof, their heirs, successors and assigns, and any persons using the land. UMETCO Minerals declares that the United States Department of Energy shall be a third party beneficiary of this Environmental Covenant. UMETCO Minerals, its successors, and all parties having any right, title or interest in the Property, or any part thereof, their heirs, successors and assigns shall hereinafter be referred to in this covenant as OWNER.

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D. No activities that will in any way damage any monitoring or remedial wells installed by the Department of Energy, or interfere with the maintenance, operation, or monitoring of said wells is allowed, without the express written consent of the Department.

2. Purpose of this covenant The purpose of this Covenant is to ensure protection of human health and the environment by minimizing the potential for exposure to any hazardous substance, hazardous waste, hazardous constituents, and/or solid waste that remains on the Property. The Covenant will accomplish this by minimizing those activities that result in disturbing the ground surface, and by creating a review and approval process to ensure that any such intrusive activities are conducted with appropriate precautions to avoid or eliminate any hazards.

3. Modifications This Covenant runs with the land and is perpetual, unless modified or terminated pursuant to this paragraph. OWNER may request that the Department approve a modification or termination of the Covenant. The request shall contain information showing that the proposed modification or termination shall, if implemented, ensure protection of human health and the environment. The Department shall review any submitted information, and may request additional information. If the Department determines that the proposal to modify or terminate the Covenant will ensure protection of human health and the environment, it shall approve the proposal. No modification or termination of this Covenant shall be effective unless the Department has approved such modification or termination in writing. Information to support a request for modification or termination may include one or more of the following:

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c) information demonstrating that residual contamination has diminished;
d) information demonstrating that the proposed modification would not adversely impact the remedy and is protective of human health and the environment; and
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UMETCO Minerals

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_____
Notary Public

_____
Address

_____

My commission expires:_____

Accepted by the Colorado Department of Public Health and Environment this ____ day of _____, 2002.

By:_____

Title:_____

STATE OF _____)
) ss:
COUNTY OF_____)

The foregoing instrument was acknowledged before me this ___day of _____, 2002 by _____ on behalf of the Colorado Department of Public Health and Environment.

_____
Notary Public

_____
Address

_____

My commission expires:_____

Attachment 1

Application for an Alternate Concentration Limit for the Slick Rock–Union Carbide UMTRA Project Site

Application for Alternate Concentration Limits for the Slick Rock, Colorado, Union Carbide UMTRA Project Site

April 2002

Prepared by
U.S. Department of Energy
Grand Junction Office
Grand Junction, Colorado

Work Performed under DOE Contract No. DE–AC13–96GJ87335

Contents

Figures

Tables

1.0 Introduction

1.1 Purpose

The purpose of this document is to fulfill the Nuclear Regulatory Commission (NRC) requirements for an application for Alternate Concentration Limits (ACLs) for selenium at the Uranium Mill Tailings Remedial Action (UMTRA) Project Union Carbide Slick Rock Site ("UC Site"), Colorado. Much of the information required by the NRC for an ACL application (10 CFR Part 40, Appendix A and NRC 1996) has been compiled in the Site Observational Work Plan (SOWP; DOE 2002) for Slick Rock as well as the Ground Water Compliance Action Plan (GCAP). This document is an addendum to the GCAP. The intent of this addendum is not to duplicate information found elsewhere, but to provide a link between NRC evaluation criteria and relevant detailed discussion pertaining to those criteria in previously prepared documents. NRC guidance for preparing ACL applications for Title II sites (NRC 1996) was used as a model for this application. This document summarizes pertinent information from the SOWP regarding "Factors Considered in Making Present and Potential Hazard Findings" (Table 1 in NRC 1996; also specified in 40 CFR Part 192 with slight modifications). It also identifies sections of the SOWP that contain information corresponding to sections listed in the "Standard ACL Application Format" (Table 2 in NRC 1996). This ensures that all factors and information related to the proposed ACLs have been considered, while minimizing duplication of effort.

NRC's ACL guidance was prepared for Title II UMTRA sites. It is also noted that the guidance can be applied to Title I sites, with modifications made to accommodate the differences between Title II and Title I sites. One of the major differences between these sites is that the regulations for Title I sites (40 CFR Part 192) permit natural flushing as the selected ground water compliance strategy, providing that ground water will reach acceptable levels (UMTRA standards, background, or ACLs) within a period of 100 years. Active remediation alternatives may not be evaluated for sites meeting this criterion, as indicated in the flow chart in Figure 1 of the GCAP. Therefore, data corresponding to the corrective action assessment portion of the standard ACL application may be quite limited, as is the case for the UC site.

Section 2.0 of this document briefly discusses the constituents for which ACLs are proposed and the rationale for the numerical values. Section 3.0 summarizes the factors considered in making hazard findings. Section 4.0 presents the "roadmap" to the SOWP following the standard ACL application format. References are included in Section 5.0.

1.2 Brief Site Background

The Slick Rock UMTRA Project site consists of two former uranium-ore processing facilities, which are referred to as the North Continent (NC) and UC sites. The former Slick Rock processing sites are located along the banks of the Dolores River in San Miguel County, Colorado (Figure 1). The Slick Rock sites are located in a remote area of southwest Colorado near the former Slick Rock Post Office. Steep juniper-covered hillsides and cliffs of the Dolores River Canyon surround the sites. The UC site is approximately 1 mile downstream from the NC site. The UC site is the subject of this ACL application.

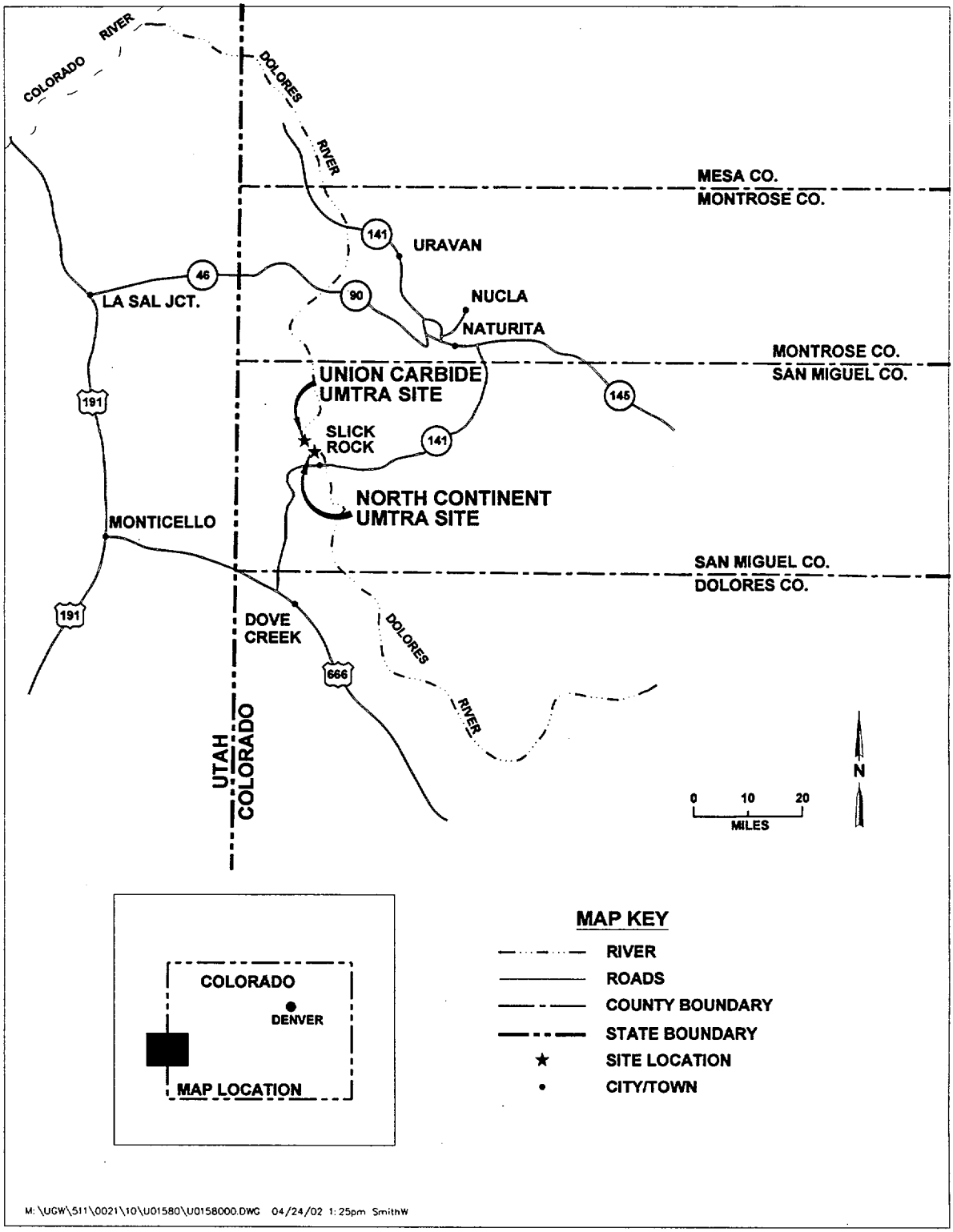

Figure 1. Site Location Map

The NC and UC sites are currently owned by UMETCO Minerals Corporation ("UMETCO"). The NC site is not fenced and is currently used for livestock grazing. Most of the UC site is enclosed with 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.

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. A photograph of the UC mill while it was operating is shown in Figure 2. The UC mill closed in December 1961.

Contaminated material at the UC site consisted of the tailings pile, mill area, and windblown/waterborne contaminated areas. The tailings pile and contaminated land covered approximately 55 acres and contained approximately 642,000 cubic yards of contaminated material (DOE 1997). Figures 3, 4, and 5 show the UC site prior to surface remediation, during surface remediation, and after surface remediation, respectively. Supplemental standards were applied to soil contamination left in place around a natural gas pipeline at the UC site and to soil contamination left in place at a former vicinity property located across the river from the UC site (DOE 1997); supplemental standards areas are shown in Figure 5.

2.0 Proposed ACL

An ACL is proposed for selenium at the UC Site. An ACL for selenium is required because ground water modeling has shown that it will not naturally flush to the UMTRA standard of 0.01 mg/L within the 100 years permitted for natural flushing. However, it will flush to a concentration that is protective for drinking water purposes.

A selenium concentration of 0.18 mg/L is proposed as the ACL. This value corresponds to the risk-based concentration which represents the maximum acceptable risk when used as drinking water on a regular basis (EPA 2002; EPA Region III risk-based concentration table). Using standard exposure assumptions and equations for residential use of ground water (EPA 1989) and accepted toxicity data for selenium (IRIS database), the 0.18 mg/L concentration would correspond to a hazard quotient (HQ) of 1.

Ground water modeling predicts that selenium will reach its proposed ACL within the 100-year period for which natural flushing of ground water is permitted. Institutional controls will prevent ground water use during this time period. The only potentially complete exposure pathway would be where ground water discharges to the Dolores River. Dilution of contaminants as ground water enters the river ensures protection of human health and the environment.

Figure 2. UC Mill During Operation

C12

Figure 3. UC Site Prior to Remediation

C13

Figure 4. UC Site During Remediation

C14

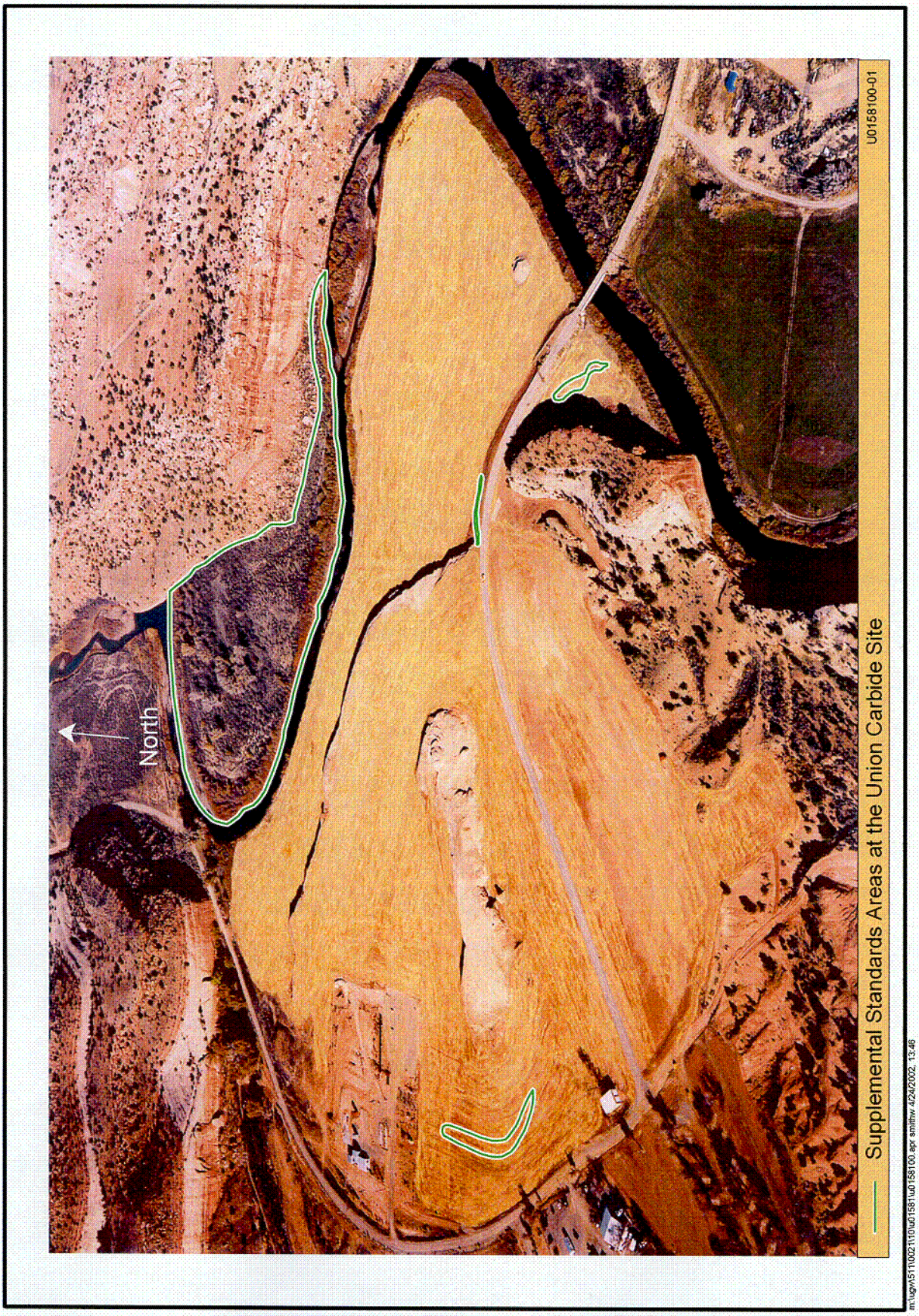

Figure 5. UC Site After Remediation

C15

3.0 Factors Considered In Making Present And Potential Hazard Findings

The list of factors below is from the Title I regulations [40 CFR 192.02(c)(3)(ii)(B)(1) and (2), which differ slightly from those in the NRC Title II guidance, and add another factor to the ground water quality list.

3.1 Potential Adverse Effects on Ground Water Quality

3.1.1 **The physical and chemical characteristics of constituents in the residual radioactive material at the site, including their potential for migration.** No disposal cell is present at the site. Surface remediation was completed in 1996. Subpile soil analysis indicates that no significant contamination remains in place that would contribute to ground water contamination (see SOWP, Section 4.3).

3.1.2 **The hydrogeological characteristics of the site and surrounding land.** The hydrogeology of the site was characterized for input to the flow and transport model (see SOWP, Section 5.1 "Hydrogeology"). There are no surface expressions of contaminated ground water on site.

3.1.3 **The quantity of ground water and the direction of ground water flow.** Ground water flow in the alluvial aquifer is generally west-northwest at a rate ranging from 13 to 300 ft/day. The volume of selenium-contaminated ground water is estimated at approximately 8 million gallons.

3.1.4 **The proximity and withdrawal rates of ground water users.** Selenium contamination is confined to the alluvial aquifer and there are no alluvial ground water users located in the vicinity of the site. Water from the underlying Entrada Sandstone is used to water livestock via a collector system that discharges to a stock tank at a rate of approximately 1 liter per minute. Domestic use ground water in the Slick Rock area is primarily supplied by the deeper Navajo Sandstone aquifer. A domestic well completed in the Navajo Sandstone provides water to two residents in the area as well as their livestock.

3.1.5 **The current and future uses of ground water in the region surrounding the site.** Alluvial ground water is not currently used and is not anticipated for future use. The deeper Navajo Sandstone is the main source of ground water and is not connected to the alluvial aquifer.

3.1.6 **The existing quality of ground water, including other sources of contamination and their cumulative impact on ground water quality.** The upgradient North Continent UMTRA site is the only other source of ground water contamination in the area, but it is not expected to have an impact on the UC site. Background alluvial ground water quality is variable, with some constituents such as manganese and sulfate exceeding secondary water quality standards. Total dissolved solids are also high, with the maximum background concentration of 9,790 mg/L close to the 10,000 mg/L concentration that constitutes limited use.

3.1.7 **The potential for health risks caused by human exposure to constituents.** The only potentially unacceptable risks to humans would occur through regular use of alluvial ground water as drinking water in a residential scenario, which currently does not exist. The only potential exposure would occur where ground water discharges to the Dolores River, and the river dilutes concentrations to acceptable levels. After 100 years of natural flushing, use of ground water as drinking water would not pose risks any greater than using background ground water. Institutional controls will ensure that alluvial ground water will not be used in any manner resulting in human health risks.

3.1.8 **The potential damage to wildlife, crops, vegetation, and physical structures caused by exposure to constituents.** There are currently no exposures of wildlife, crops, or vegetation to contaminated ground water. There are no physical structures on site; exposure of physical structures to ground water would result in no physical damage. Water from the site discharges into the Dolores River and is rapidly diluted to undetectable levels, leaving aquatic life unaffected. Institutional controls will prevent exposure of wildlife, crops, and vegetation to contamination. Eventually, contaminant levels will be low enough that exposure to ground water would result in no potential damage.

3.1.9 **The persistence and permanence of the potential adverse effects.** It is possible that ground water contamination could remain at levels determined to be unacceptable for drinking water for the entire 100-year natural flushing time period. However, during that period of time institutional controls will ensure that no improper use of water occurs that could produce adverse effects. Ground water would be acceptable for unrestricted use after the 100-year natural flushing period.

3.1.10 **The presence of underground sources of drinking water and exempted aquifers identified under §144.7 of this chapter.** There are no sources of drinking water or exempted aquifers that can be affected by contamination at the site. The main source of domestic water is the Navajo Sandstone, which is not connected to the alluvial system.

3.2 Potential Adverse Effects on Hydraulically Connected Surface Water Quality

3.2.1 **The volume and physical and chemical characteristics of the residual radioactive material at the site.** No disposal cell is present at the site. Surface remediation was completed in 1996. Subpile soil analysis indicates that no significant contamination remains in place that would contribute to ground water contamination (see SOWP, Section 4.3).

3.2.2 **The hydrogeological characteristics of the site and surrounding land.** The hydrogeology of the site was characterized for input to the flow and transport model (see SOWP, Section 5.1 "Hydrogeology"). There are no surface expressions of contaminated ground water on site.

3.2.3 **The quantity and quality of ground water and the direction and of ground water flow.** Ground water flow is generally west-northwest at a rate ranging from 13 to 300 ft/day. Background ground water quality applicable standards for some constituents such as manganese and sulfate.

3.2.4 **The patterns of rainfall in the region.** The site receives on average approximately 13.0 inches of total precipitation per year. Rainfall occurs during the summer in high-intensity, short-duration, late afternoon thunderstorms that are conducive to runoff. Precipitation occurs in the winter as snowfall. Precipitation events have no measurable effect on quality of water in the Dolores River as a result of site contamination.

3.2.5 **The proximity of the site to surface waters.** The Dolores River bounds the site on the northeast.

3.2.6 **The current and future uses of surface waters in the region surrounding the site and any water-quality standards established for those surface waters.** The Dolores River in the site vicinity is classified for use as recreation and agriculture. Water quality standards for the river are established in Regulation No. 35 of the Colorado Department of Public Health and the Environment's (CDPHE) Water Quality Control Commission. The river water in the site vicinity does not exceed any of these standards or any of the Colorado state standards established for agricultural water use or water quality criteria for aquatic life. For details about surface water quality, see Section 5.2.1 of the SOWP.

3.2.7 **The existing quality of surface water, including other sources of contamination and the cumulative impact on surface water quality.** Water in the Dolores River is the vicinity of the site is designated high quality by the State of Colorado. The site has only a minor impact on the river water quality which is not considered to be significant. Selenium concentrations are within the range of background.

3.2.8 **The potential damage to wildlife, crops, vegetation, and physical structures caused by exposure to constituents.** There is no potential damage as site contamination has no significant impact on Dolores River quality.

3.2.9 **The persistence and permanence of potential adverse effects.** No adverse affects are currently present in the Dolores River and none are expected in the future.

4.0 "Roadmap" to the Slick Rock SOWP

4.1 General Information

4.1.1 Introduction—Section 1.0 of SOWP
4.1.2 Facility Description—Sections 3.3.2 and 3.4.2 of SOWP
4.1.3 Extent of Ground Water Contamination—Section 5.2.2.3 of SOWP
4.1.4 Current Ground Water Protection Standards—Table 6–2 of SOWP
4.1.5 Proposed Alternate Concentration Limits—Section 2.3.2 of GCAP

4.2 Hazard Assessment

Generally corresponds to Section 6 of SOWP, which contains human health and ecological risk assessments

- 4.2.1 Source and Contamination Characterization—Sections 5.2 and Table 6–2 of SOWP
- 4.2.2 Transport Assessment—Section 5.3 and Appendix H of SOWP
- 4.2.3 Exposure Assessment—Sections 6.1.3.2 and 6.1.3.3 of SOWP for human health; Sections 6.2 and Appendix I of SOWP for ecological risk

4.3 Corrective Action Assessment

A detailed corrective action assessment was not completed for the Slick Rock UC site because it was determined that no remediation with the application of an ACL was preferred over active remediation. However, a qualitative discussion of corrective action measures is included below. Evaluations completed for other similar UMTRA ground water sites were used as a basis for this assessment.

4.3.1 Results of Corrective Action Program

Surface remediation at the UC site commenced in 1995 and was completed in 1996. Tailings and other contaminated surface material were placed in a disposal cell approximately 5 miles east of the Slick Rock site. Contaminated material at the UC site consisted of the tailings pile, mill area, and windblown/waterborne contaminated areas. Supplemental standards were applied to soil contamination left in place around a natural gas pipeline at the UC site and to soil contamination left in place at a former vicinity property located across the river from the UC site (DOE 1997).

UMETCO currently owns the UC site. A deed restriction will be placed on the property that prohibits use of ground water for any purpose without permission of both U.S. Department of Energy (DOE) and CDPHE. This restriction is essentially perpetual, though it can be lifted once concentrations have decreased to levels that permit unrestricted use.

4.3.2 Feasibility of Alternative Corrective Actions

DOE has performed remedial action at the UC site to mitigate exposures to contaminated soils. The cleanup effectively removed the source of the contaminants that were potentially affecting ground water. However, residual contamination does exist in ground water. All contaminants except selenium at the UC site that have cleanup standards will flush to those standards in the 100 years allotted for natural flushing to occur. A risk-based concentration of 0.18 mg/L is proposed as an ACL for selenium; this concentration is protective of human health for drinking water in a residential setting. Ground water modeling predicts that the risk-based concentration can be met in 100 years of natural flushing.

The presumptive remedy for contaminated ground water sites is removal by pumping followed by some form of ex situ treatment ("pump and treat"), which is contaminant-dependent (EPA 1993, EPA 1996). A pump and treat scenario was modeled for the Naturita, Colorado, UMTRA ground water site, which has similar hydraulic characteristics to the Slick Rock UC site. Both sites have thin alluvial aquifers situated over bedrock with saturated thicknesses of

generally less than 10 feet. Both aquifers have similar ranges in hydraulic conductivity and the volume of contaminated water is essentially the same (approximately 8 million gallons). Selenium at the UC site, like vanadium at the Naturita site, is relatively immobile in the subsurface (i.e., the distribution coefficient is relatively high). Both sites are located adjacent to rivers that have comparable average discharge rates.

Modeling for the Naturita site showed that pumping ground water from the aquifer would actually prolong the time period required for remediation compared to natural flushing (DOE 2001). This is because the aquifer is so thin that pumping would cause periodic drying in the vicinity of a pumping well and eliminate water flow through the aquifer matrix. With no water moving through the aquifer near the well, contaminants with an affinity to adsorb to soil, such as selenium, remain adsorbed to the matrix. Because of the similarities between the Slick Rock UC site and the Naturita site, it can be expected that active remediation of the UC site by pump and treat alone would not be effective. As with the Naturita site, the only way to accelerate remediation of the aquifer would be by gradient manipulation and the addition of clean water (either treated site water or water from another source) to help flush the system.

4.3.3 Corrective Action Costs

Detailed cost estimates were not conducted for the UC site remedial alternatives, as a comparative analysis of alternatives was not completed for the Slick Rock SOWP. Costs reported here can be considered as order-of-magnitude estimates and are provided for a relative comparison only. Costs are based on estimates developed for the Naturita site (DOE 2001), which is similar in geology and chemistry to the UC site. Costs are presented for the pump and treat alternative with two treatment options and for the no remediation alternative. The pump and treat options include gradient manipulation; the no remediation alternative includes monitoring. Costs are based on a 10-year period of implementation for comparative purposes. It is assumed that 8 million gallons of water (one pore volume) can be pumped and treated in one year; because of the immobility of the contaminants, it is assumed that pumping of 10 pore volumes is required to meet cleanup goals (i.e., 10 years of pumping).

Costs for pump and treat with distillation as the treatment option are presented in Table 1. Total costs are approximately $5 million. Costs using zero valent iron (ZVI) as the form of treatment are presented in Table 2. Estimated costs for this alternative slightly exceed $2.5 million. For the no remediation alternative, monitoring would be conducted on an annual basis for 10 years; after 10 years the frequency of monitoring would be reevaluated and likely reduced to every 5 years. The cost for one round of monitoring is estimated at $7,000. Monitoring for 10 years would therefore total $70,000.

4.3.4 Corrective Action Benefits

After 100 years of natural flushing, the maximum concentration of selenium would be reduced below the human health risk-based concentration of 0.18 mg/L and would be safe for drinking water purposes. Active remediation might be able to further reduce this concentration, but there are few, if any, tangible benefits from doing so. The Slick Rock UC site is located in a remote area which receives limited use. Significant future development is not expected. Background ground water in the area is generally poor with high concentrations of manganese, sulfate, and TDS. High quality water is available from the deeper bedrock Navajo Sandstone aquifer and usually from the Dolores River (except in drought years). Water in the alluvial aquifer is not of

sufficient quantity to use for irrigation purposes; background alluvial water quality in the area is of insufficient quality for agricultural use. Therefore, remediation of the alluvial aquifer to reduce concentrations of selenium provides no real benefit.

Table 1. Cost Estimate for Pump and Treat, Distillation Operation

Item	Cost
Remedial design/permitting/construction management	$150,000
Well installation/piping/permitting	$125,000
Gradient manipulation/permitting	$300,000
Treatment facility	$2,500,000
Operation and maintenance (10 years at $82,000/yr)	$820,000
Monitoring/sampling costs (10 years at $1,500/yr)	$15,000
Subtotal	$3,910,000
Contingency @ 30%	$1,173,000
Total cost	$5,083,000

Table 2. Cost Estimate for Pump and Treat, ZVI Operation

Item	Cost
Remedial design/permitting/construction management	$150,000
Well installation/piping/permitting	$125,000
Gradient manipulation/permitting	$300,000
Treatment facility	$800,000
Cost of ZVI @ $0.40/pound (@ 650 lb/100,000 gallons for 80 million gallons	$208,000
Operation and maintenance (10 years at $50,000/yr)	$500,000
Monitoring/sampling costs (10 years at $1,500/yr)	$15,000
Subtotal	$2,098,000
Contingency @ 30%	$629,400
Total cost	$2,727,400

4.3.5 As Low As Reasonable Achievable Demonstration

The As Low As Reasonable Achievable (ALARA) concept does not directly apply to the ACL proposed for selenium because the intent of ALARA is to limit exposure to radioactivity. However, the general goal of achieving a cleanup goal that is as low as can reasonably be met is satisfied by applying an ACL for selenium at the site. As described above, it would not be reasonable to pursue active remediation for the very small amount of potential risk reduction that could be realized by doing so, particularly considering the lack of water demand, remote location, availability of alternative water sources, and generally poor quality of background ground water.

4.4 Proposed Alternate Concentration Limit

4.4.1 Proposed Alternate Concentration Limits—Section 2.3.2 of GCAP
4.4.2 Proposed Implementation Measures—Section 7.3 of SOWP; Sections 3.1 and 3.2 of the GCAP)

4.5 References—Section 8 of SOWP

4.6 Appendices and Supporting Information—Appendices A through I of SOWP

5.0 References

10 CFR Part 40. "Domestic Licensing of Source Material," *U.S. Code of Federal Regulations*, June 1, 1994.

40 CFR Part 192. "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings," *U.S. Code of Federal Regulations*, July 1, 1996.

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