ENVIRONMENTAL ASSESSMENT
FOR AMENDMENT TO SOURCE MATERIAL LICENSE SUA-442
FOR GROUND WATER ALTERNATE CONCENTRATION LIMITS

PATHFINDER MINES CORPORATION
SHIRLEY BASIN URANIUM MILL TAILINGS SITE
CARBON COUNTY, WYOMING

PREPARED BY

U.S. NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR MATERIAL SAFETY AND SAFEGUARDS
DIVISION OF FUEL CYCLE SAFETY AND SAFEGUARDS

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1.0 INTRODUCTION

1.1 Background Information

In 1971, uranium milling began at the Pathfinder Mines Corporation (PMC) Shirley Basin site (Site), located near the northeast corner of Carbon County, Wyoming, and continued through 1992. Milling was licensed under U.S. Nuclear Regulatory Commission (NRC) license SUA-442. A total of 8.5 million tons of ore were milled at this site utilizing a conventional acid leach process. The mill was demolished and buried in trenches adjacent to the mill site that were covered by clean soil; PMC is currently installing the engineered cover. The Site currently contains two solid tailings impoundments (No. 4 and No. 5), a solution pond (No. 3), and a small industrial pond (see Figure 1). Pond No. 3 is also the disposal location for waste materials.

In 1992, PMC started decommissioning the land and buildings associated with milling. Tailings reclamation started in 2003. PMC completed grading on impoundment No. 4 and is in the process of installing the radon clay and sand vapor barriers. Grading on impoundment No. 5 is approximately 90 percent complete. Tailings reclamation is scheduled to be completed by the end of 2005.

Mill tailings storage within the impoundments resulted in contaminated seepage that affected ground-water quality in the Surficial aquifer. Surficial aquifer ground water discharges to Spring Creek along the east side of the Site. Ground-water corrective actions started in 1984 with extraction near the base of impoundment No. 5. Over time, injection wells were added on the No. 5 dam and downgradient of the collection (extraction) wells, and more collection wells were added to enhance the restoration system. PMC implemented a tailings dewatering program that has removed a substantial portion of the drainable water from the tailings. The current corrective action program (CAP) includes ground-water extraction using 19 wells and freshwater injection downgradient of the extraction wells (see Figure 2). Freshwater injection along the No. 5 dam ceased in late 2003 to allow PMC to start tailings reclamation.

In March 1985, the NRC established, in License Condition 47, the site ground-water protection standards (GWPS) as the background ground-water concentrations obtained from well MC-14, and approved two point of compliance (POC) wells (NP01 and RPI-19B). The POC is a well or wells very near and downgradient of the tailings, designated by NRC as where the GWPS are to be met. Despite reclamation efforts, current site standards for four of the 13 constituents listed in License Condition 47, uranium, selenium, radium (Ra-226 + Ra-228), and thorium-230, are or could be exceeded at the POC. Furthermore, concentrations of these constituents will not likely be reduced by continued pump and treat methods.

PMC submitted a license amendment request for alternate concentration limits (ACLs) for ground water at the Shirley Basin site on April 3, 2000. The staff submitted requests for additional information (RAIs) regarding the application and PMC provided page revisions dated June 1, 2000, August 29, 2001, October 15, 2001, and November 21, 2002. On December 24, 2002, NRC staff issued a draft Environmental Assessment (EA) for agency review recommending the establishment of ACLs. Comments were received from various Federal and state agencies, which are discussed in Section 1.2.
In accordance with 10 CFR Part 40, Appendix A, Criterion 5B(6), the NRC may establish site-specific ACLs if it can be shown that the constituents will not pose a substantial present or

potential hazard to human health or the environment. It must also be demonstrated that the proposed ACLs are as low as is reasonably achievable (ALARA) after considering practicable corrective actions. PMC provided measurements and models indicating that compliance with the ACLs at the POC would not impact human health and the environment at the point of exposure (POE). For this Site, the POE would be Spring Creek at the proposed long-term area boundary. See Figure 1 for the location of the POC wells, the POE, and the proposed long-term care boundary. This boundary encompasses the land to be deeded to the perpetual custodian, the U.S. Department of Energy (DOE), for monitoring and maintenance of the tailings site, at termination of the PMC license. The NRC would then regulate the Site under a general license, as described in 10 CFR 40.28. Within this transfer (long-term care) boundary, no ground-water usage other than for monitoring (sampling) would be allowed.

1.2 Comments Regarding December 2002 Draft EA

NRC staff received comments from the following agencies: Wyoming Fish and Game Department (WFGD) (January 13, 2003), U.S. Fish and Wildlife Service (FWS) (January 23, 2003), U.S. Environmental Protection Agency (EPA) (January 30, 2003), and the Wyoming Department of Environmental Quality (WDEQ) (June 5, 2003). Appendix A contains a table with individual comments and respective responses. Except for the WFGD, which had no comments, agency comments exhibited two main themes; an environmental impact statement (EIS) would have been more appropriate than an environmental assessment (EA), and the Draft EA did not sufficiently discuss alternatives to ACLs.

NRC staff reviewed the need for an EIS and determined that an EA would be appropriate and could support a Finding of No Significant Impact (FONSI). Details supporting a FONSI are presented in Section 4.0 and summarized in Section 7.0. In general, the NRC staff found that ground-water corrective actions have effectively restored the Surficial aquifer to the extent practicable and that residual contaminant concentrations would not impact human health and the environment. Regarding alternatives to ACLs, Section 2.0 presents an expanded discussion of such alternatives and reasons for dismissing them from further review.

In some of their comments, WDEQ also expressed concerns regarding the lack of water quality and biological data from Spring Creek. NRC staff incorporated this request into an RAI dated September 15, 2003. As a result, PMC performed additional investigations to obtain aquatic biological, surface water quality, and hydrologic data, from Spring Creek and its tributaries. PMC submitted a report presenting the results of these investigations in October 2004 (Intermountain Resources, 2004) (see Section 3.3.1).

1.3 Need for Proposed Action

PMC has been implementing ground-water corrective actions since 1984. According to PMC, it is technically impracticable and economically infeasible to remediate ground water to the Ra-226 + Ra-228, selenium, thorium-230, and uranium GWPSs required by License Condition 47. A review of other remediation alternatives indicates that these would either be equally as technically infeasible or too expensive. Therefore, PMC proposed ACLs for the aforementioned constituents based on the results of hydrogeologic and contaminant transport modeling.

Concentrations of the other licensed ground-water contaminants comply with the GWPSs and would continue to be monitored for compliance with those standards. PMC demonstrated that the ACLs would be protective of human health and the environment through fate and transport modeling and observed geochemical conditions. Upon implementation of the proposed ACLs, PMC would be in compliance with the standards, and the ground-water corrective action would be unnecessary. If future monitoring indicates that the standards are exceeded, corrective action could be required.

Operation of the CAP for over 19 years has resulted in significant restoration of ground-water quality in the Surficial aquifer in the Mine Creek area, the aquifer of concern. The current program consists of: (1) extraction of contaminated ground water, via collection wells, from areas downgradient of the tailings into lined evaporation ponds; (2) completion of the tailings cover in 2005 to reduce the ground water source term by restricting infiltration; and (3) injection of fresh water into the aquifer downgradient of the site to force the contamination plume to the collection wells and to create a hydraulic barrier to further seepage.

The previous tailings dewatering program has lowered water levels in the two tailings impoundments. However, this program ended in 2003 because this operation became increasingly difficult and progressively less efficient as the saturated thickness within the tailings decreased. Dewatering well yields dropped to a fraction of initial rates. Therefore, it was more protective of human health and the environment to begin tailings reclamation to further reduce impoundment seepage potential. Following reclamation, the seepage rate will gradually approach the small rate of recharge through the reclamation cover.

System performance and PMC's modeling results both indicate that continued restoration efforts beyond 2005 would not substantively reduce long-term concentrations at the POC or the POE. For example, a review of the latest pollutographs (concentration vs. time) presented in the 2004 annual ground-water report (PMC, 2005) indicate that only modest changes in restoration have been observed in recent years. Seepage impacts have been contained by collection wells in the area of concern, and concentrations of most constituents have declined only slightly in collection wells and the wells adjacent to the collection wells over the last few years. Furthermore, extraction well yields have diminished significantly due to reduced recharge from dewatering the tailings, elimination of the No. 5 dam injection wells, and reduced injection from the reversal wells; water table depletion from a 5-year drought; and well efficiency loss from pumping at low yields. Considering the arid climate, artificial recharge was the largest source of ground water in the Surficial aquifer. Significant reductions in artificial recharge makes reclamation by ground-water extraction quite difficult and inefficient; however, such a scenario also reduces the ground-water flow and contaminant transport rates, which is a substantial benefit.

1.4 Proposed Action

1.4.1 ACL Program

The proposed action is a modification of the license conditions to NRC license SUA-442, approving the ACLs for four constituents at the site: uranium, selenium, Ra-226 + Ra-228, thorium-230, chloride, sulfate, and total dissolved solids (TDS). Actions required by the license amendment would be as follows:

1) Replace the current GWPS with ACLs for uranium, selenium, thorium-230, and Ra-226 + Ra-228. Add ACLs for chloride, sulfate, and TDS, at the Wyoming DEQ's request. Table 1 contains the proposed ACLs and model-predicted POE concentrations.

2) Establish the POE location at the long-term care boundary along Spring Creek,

as proposed.

3) Perform bi-monthly monitoring for the first 1.5 years for arsenic, barium, beryllium, cadmium, chromium, gross alpha, lead, molybdenum, nickel, Ra-226 and 228, selenium, thorium-230, and uranium, nitrate, chloride, TDS, sulfate, and field parameters (pH, conductivity, and water level). Collect quarterly samples for the aforementioned parameters, thereafter. Samples would be collected from the two POC (NP-01 AND RPI-19B) wells, 11 compliance wells (P-6, MC-7, RPI-8A, MC-10, RPI-10, MC-11, RPI-14, RPI-16A, RPI-18A, RPI-20A, and RPI-21B), and five surface water sample locations (POE, SW-10, SW-2, WEIR-2, and SW1A. Location SW1A is the background surface water sampling location. Ground-water and surface water monitoring would continue until license termination. Figures 3 and 4 present the monitoring well and surface water sampling locations, respectively.

4) Perform correction action if NRC determines that the compliance monitoring results indicate that a ground-water standard has been exceeded. PMC agrees to preserve the essential components of the existing CAP for at least one year until NRC staff is confident that it will no longer be needed.

Table 1
Proposed POE and ACL Concentrations

Constituents	Current Standards	Model-Predicted POE Concentration	Proposed ACLs (POC NP-01)	Proposed ACLs (POC RPI-19B)
Uranium (mg/l)	0.07	0.15	4.400	4.45
Selenium (mg/l)	0.01	0.0056	0.158	0.163
Ra-226 + Ra-228 (pCi/l)	5.0	1.50	12.70	13.76
Thorium-230 (pCi/l)	0.3	0.3	5.53	5.76
Chloride (mg/l)	None	118	3,275	3,712
Sulfate	None	183	4,612	5,056
Total Dissolved Solids	None	649	11,529	12,641

Surface water sampling would not include biological or sediment sampling, as requested by the WDEQ on March 30, 2005. Previous biological monitoring results indicated that PMC seepage has not impacted aquatic communities within the reach of Spring Creek bordering the Site. However, impacts were noted upstream and downstream of the Site where cattle grazing and watering occurred (Intermountain Resources, 2004). Furthermore, the 2004 biological sampling event occurred at a time when Spring Creek was receiving artificial recharge from the Site remediation system. Once PMC deactivates the system, artificial recharge to Spring Creek will cease resulting in lower baseflows, which is itself a factor that can affect aquatic communities. Therefore, NRC staff believes that biological and sediment sampling in Spring Creek will not enhance our ability to determine whether deactivating the CAP system is impacting Spring Creek.

1.4.2 ACL Development

PMC developed ACLs from ground-water flow and contaminant transport models. Model parameter values developed from observed site ground-water conditions were used by PMC to predict the migration of these four constituents during post-restoration conditions. Model output was used by PMC to determine the appropriate ACLs at the POC so that future concentrations at the POE in Spring Creek would be protective of human health and the environment. ACLs represent the maximum predicted concentrations at the POC that could occur within several decades followed by a gradual decline. It should be noted that these ACLs are conservative estimates because retardation was not included in the contaminant transport modeling and PMC operated the CAP for 4 years beyond the period assumed in the modeling effort. Consequently, actual POE and POC concentrations would be likely lower than the model-predicted values.

1.5 Review Scope

1.5.1 Federal and State Authorities

NRC source material licenses are issued under Title 10, Code of Federal Regulations, Part 40 (10 CFR Part 40). In addition, the Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA), as amended, requires persons who conduct uranium source material operations to obtain a byproduct material license to own, use, or possess tailings and wastes generated by the operations. This EA has been prepared in accordance with 10 CFR Part 51, "Licensing and Regulatory Policy and Procedures for Environmental Protection," which implements NRC's environmental protection program under the National Environmental Policy Act (NEPA) of 1969. In accordance with 10 CFR Part 51, an EA serves to: (a) briefly provide sufficient evidence and analysis for determining whether to prepare an EIS or a FONSI; (b) facilitate preparation of an EIS when one is necessary; and c) aid the NRC's compliance with NEPA when an EIS is not necessary. Evidence presented herein includes a detailed description of the proposed action, impacts associated with the proposed action, and effects of alternatives to the proposed action, including the “No-Action” alternative. In undertaking this project, the licensee committed to complying with all applicable Federal and State regulations.

1.5.2 Basis of NRC Review

The NRC staff has assessed the environmental impacts associated with the request for a license amendment to modify the CAP and reclamation plan, and documented the results of the assessment in this report. The staff performed this appraisal in accordance with the requirements of 10 CFR Part 51.

In conducting its assessment, the staff considered the following:

- Information contained in the previous environmental evaluations of the Shirley Basin project;

- Information contained in PMC's application, and supplementary information;

- Information contained in land use and environmental monitoring reports;

- Personal communications with PMC staff for the Shirley Basin project, State of Wyoming, and Federal agencies (see Section 6.0); and

- Information derived from NRC staff site visits and inspections of the Site.

2.0 ALTERNATIVES TO THE PROPOSED ACTION

By letter dated November 14, 2003, PMC responded to an RAI question regarding the need for further analysis of alternatives. Alternatives included in this letter were: the No-Action alternative, extended tailings dewatering, interceptor trench, permeable reactive barrier, reductant injection, and tailings flushing. PMC evaluated alternatives based on cost/benefit and environmental impacts compared to the proposed action.

2.1 No-Action Alternative (Continued Operation of Corrective Action Program)

The current ground-water restoration system consists of Surficial aquifer collection wells located between the tailings area and Spring Creek and freshwater injection wells downgradient of the collection wells. A second set of injection wells was previously located atop the No. 5 dam; however, these were abandoned to allow for tailings reclamation. Collection wells serve to intercept seepage-impacted ground water and prevent downgradient migration. Fresh-water injection is used to increase gradients towards the collection system and accelerate the restoration process. The Surficial aquifer collection/injection system has been operating for 4 years beyond the planned termination.

Under the current CAP, more than 330 million gallons of water have been extracted from the Surficial aquifer, and more than 788 million gallons of fresh water have been injected through 2004. Also, approximately 516 million gallons of water have been pumped from the tailings. PMC discontinued tailings water extraction to allow for tailings reclamation. A limited number of tailings monitoring wells have been preserved to allow for future water level monitoring in the tailings impoundment. Reclaiming and covering the tailings impoundment will effectively minimize the quantity of contaminated seepage entering the Surficial aquifer system, whereas continuing tailings dewatering would not have effectively improved containment. While the current system has not achieved ground-water protection standards for four constituents, it has sequestered contaminated ground water, promoted aquifer restoration, and reduced ground-water flow toward Spring Creek.

Based on the total average pumping rates provided in the 2004 Annual Hydrologic Report (PMC, 2004), it appears that the current CAP is approaching the point of diminishing returns. According to the aforementioned report, 14 of the 19 collection wells yield an annual average of less than 1 gallon per minute (GPM). Low well yields are primarily due to lowering of the water table resulting from the significant reduction of seepage from the tailings impoundment, discontinuation of recharge along the No. 5 dam, reduced injection downgradient of the collection wells from the loss of WR-20 (large capacity supply well), water table lowering due to an ongoing drought, and well efficiency losses. Continued pumping at low well yields would not likely produce a substantive pollutant reduction benefit considering that the CAP has currently drawn back ground-water contamination to within the vicinity of the extraction wells. No environmental consequences would likely be realized by continuing the current CAP.

Operating the current CAP would cost approximately $70,000 per year (PMC, 2005); over 5 years the total cost would be $350,000. Annual operating cost would likely increase, as well, because low well efficiencies cause more frequent well pump malfunctions and well re-development. Consequently, the overall system cost-effectiveness would depreciate to the point of beyond which continued operation would be fruitless. Therefore, NRC staff did not consider this option viable.

2.2 Extended Dewatering of Tailings

In the aforementioned RAI response, PMC provided an alternative that included extended tailings dewatering. However, tailings dewatering ceased at the end of 2003 because of low yields from the tailings wells. In 2001 PMC was dewatering tailings at a total rate (all dewatering wells) of 52 gpm. This rate dropped to 6.7 gpm by 2003. These low yields indicated that only a minimal amount of free water existed; therefore, continued dewatering operations would be of little benefit. Conversely, completing the tailings cover would isolate the tailings and further minimize seepage, which is a significant benefit. Therefore, extended tailings dewatering was eliminated from further consideration and is not analyzed in this EA.

2.3 Interceptor Trench

An interceptor trench would perform essentially the same function as the existing Surficial aquifer ground-water extraction system, which is to extract ground water along a specific alignment downgradient of the contaminant source. The alignment for such a trench would be along the rough alignment of the primary collection well system. Trench dimensions would be 9 to 12 meters (30 to 40 feet) deep and approximately 762 meters (2,500 feet) long. Major excavation would be required to construct a trench of this depth. The total volume of excavation to install the interceptor trench in this configuration is 190,840 cubic meters (250,000 cubic yards).

An interceptor trench would have the operational advantage of consolidating ground-water collection to a single point; however, continued operation of the tailings impoundment for ground-water disposal would be required, delaying tailings reclamation. Utilizing the tailings impoundment would allow seepage to enter the Surficial aquifer depending on rainfall amount, although, the seepage quantity would be quite smaller than that prior to dewatering. Operationally, trench yields would likely diminish rapidly considering that no artificial recharge would be available and the area is still under severe drought conditions. Furthermore, operation of the trench would dewater the Surficial aquifer to the point where yields would be too low to be viable. Aquifer dewatering would also reduce baseflow to Spring Creek, which could impact aquatic communities in Spring Creek.

PMC estimates the cost to install the interceptor trench system at $840,000, reflecting the anticipated difficulties in installing a trench system to an elevation below the current water table. Operational costs will be similar to those of the existing collection system except that initial pumping rates will be very high as the unconfined Surficial aquifer system is further dewatered. Considering the high estimated cost, the benefit realized at the POE will not be significant. The current system has already removed a significant amount of ground-water contamination and has substantially reduced the size of the contaminated area. Furthermore, the current CAP has contributed to water table reductions that would decrease the amount of time the interceptor trench would exhibit significant yields. Environmental consequences would include more extensive dewatering of the Surficial aquifer that will translate into lower Spring Creek baseflows. Considering the costs versus benefits and the environmental consequences, this option was eliminated from further consideration in this EA.

2.4 Permeable Reactive Barrier

Permeable Reactive Barriers (PRBs) utilizing Zero-Valent Iron (ZVI) have been used at a few sites for reduction of uranium and other metals concentrations in ground water. To construct such a barrier at the Site, the maximum depth could approach 21 meters (70 ft) to completely penetrate the Surficial aquifer, and its length could approach 1,525 meters (5,000 ft). The PRB should be larger than an interceptor trench to prevent circumvention of the barrier as the piezometric surface is raised on upgradient side of the barrier.

A funnel-and-gate arrangement would likely be the lower cost PRB configuration for this site. Funnel-and-gate arrangements include an impermeable barrier that directs water to a central opening filled with ZVI. Sources in the literature indicate that PRBs have been successful in reduction of uranium and metals concentrations. However, years after installation, the effectiveness or the porosity of the ZVI media may decline to the point where the media requires replacement/rejuvenation or removal and disposal. If the porosity of the media in the gate is reduced, the funnel-and-gate arrangement becomes a cutoff wall. To prevent eventual surface expression of the ground water upstream of the PRB, adequate flow through the gate must be reestablished or another mechanism of release must be provided through or around the impermeable barrier.

Installing a PRB downgradient of the existing contamination could provide effective ground-water treatment. However, this alternative would also provide no significant benefit to the ground-water resource because the funnel-and-gate arrangement would restrict the viable production zones of the Surficial aquifer to those immediately downgradient of the gate. Also, decreased flow downgradient of the PRB would reduce baseflows in Spring Creek, potentially impacting aquatic communities. Comparing the PRB and the ACL alternative, the actual difference in performance would likely be immeasurable at the POE. This is because both alternatives would reduce Site ground-water discharge to Spring Creek, consequently decreasing pollutant loads, and any pollutant loading to Spring Creek would be significantly diluted by a much larger baseflow.

A PRB would also be very costly. A much smaller PRB constructed at the Monticello, Utah site was reported to cost approximately $1,200,000 (PMC, 2003). The installation cost of a barrier that would be 30 times larger than the Monticello, Utah PRB would likely be on the order of $20,000,000. The combination of high capital costs, extension of reclamation/restoration schedule for construction, unquantifiable benefits, and open questions about PRB longevity make this option extremely unattractive. Therefore, this option was dismissed from further consideration in this EA.

2.5 Bioremediation

Bioremediation for the reduction of concentrations of uranium and other metals has been successful at some sites for both ground water and surface water. For the Shirley Basin site, the approach to bioremediation would likely entail a series of injection wells for a nutrient source, possible inoculation with bacteria, and collection wells to increase gradients and further distribute the nutrients within the ground water. For bioremediation to be effective, injection and collection should occur in the Surficial aquifer below the tailings impoundment to immobilize the maximum amount of uranium possible. This has some disadvantages. First, it would delay tailings reclamation, which would maintain or potentially increase the quantity of contaminated seepage emanating from the tailings. Second, due to the significantly diminished well yields in this area, the ability of the bioremediation system to distribute nutrients and microbes is reduced.

Although not currently necessary, bioremediation would be required in the Surficial aquifer between the tailings and Spring Creek to address potentially untreated contaminated seepage that could emanate from the tailings area. Such a program would be counter-productive because treatment would be required for areas currently restored and the time and cost required to undertake such a program would provide little benefit.

A bioremediation system with 3 years of operation and maintenance is estimated to cost approximately $680,000. This includes a series of new wells to distribute nutrients and operation of the necessary water supply, water disposal, and nutrient injection equipment. A minimum operational time for such a system would likely be 3 years or more with attendant operation of the equipment to introduce nutrients into the injection stream. Considering the disadvantages and cost, this option was dismissed from further review in this EA.

2.6 Reducing Agent Injection

A reductant would be injected into the Surficial aquifer beneath the tailings to reduce the mobility of uranium and selenium. Distribution of the reductant within the Surficial aquifer would likely require additional injection and extraction points within the immediate tailings area similar to the bioremediation option.

This option presents some technical difficulties. Thoroughly distributing the reductant in the tailings would not likely be possible because of current low extraction rates. Also reductant distribution would not be consistent because some portions of the tailings exhibit low permeabilities. Reduction beyond the tailings would not be cost-effective because recharging oxidized water would constantly overcome the reducing agent. Therefore, reductants would have little effect between the tailings and Spring Creek.

The projected costs of implementing a reductant injection program would be very similar to those of the bioremediation program. The same distribution system with additional collection/injection wells would be required and similar water supply and water disposal systems would be necessary. With the same minimum operational time of 3 years, the rough cost estimate of $680,000 for bioremediation is considered appropriate for the reductant injection program.

2.7 Tailings Flushing

Flushing the tailings by injecting fresh water is a technique utilized by Homestake Mining Company at its Grants, New Mexico site. This approach could reduce constituent concentrations in the resident tailings water and the seepage from the tailings. However, such a program could only be utilized with a downgradient ground-water extraction and treatment system to capture potential seepage that may emerge from flushing.

This alternative has some disadvantages. The Homestake site utilized an alkali leach process, while the Shirley Basin site used acid leach. These types of processes could result in differing ground-water oxidation-reduction conditions impacting the effectiveness of the flushing technique. Injecting freshwater into the tailings has the same distribution problems described above for reducing agent injection (Section 2.6). Water that remains in the tailings is much more difficult to extract as reflected by the declining dewatering rates. Injected water will first enter the more permeable tailings that have already been dewatered, and will only intrude into or drive the residual solution after long-term maintenance of injection head. Resaturation of the tailings could potentially reintroduce contamination into the Surficial aquifer beyond the tailings, a condition the NRC staff would not receive favorably. Therefore, this alternative was dismissed from further consideration in this EA.

3.0 DESCRIPTION OF AFFECTED ENVIRONMENT

3.1 Land Use

PMC's Shirley Basin uranium mill tailings site is located in south central Wyoming, approximately 8 km (5 miles) northeast of the former Shirley Basin town site. Figure 1 shows the location of the Shirley Basin tailings with respect to the location of the former uranium mill site. Final mine reclamation, which has created two reclamation reservoirs, is nearing completion for PMC's mine pits to the west and southeast of the tailings. Figure 2 presents the current land ownership for the area.

The surrounding area has been used extensively for uranium mining. PMC's uranium mill tailings site is 4 km (2.5 miles) north of the reclaimed Petrotomics tailings site and several small reclaimed uranium mine sites within close proximity. Utah Construction and Mining Company operated an *in-situ* leaching facility using sulfuric acid immediately east of the Site (Harshman, 1972). Oil and gas exploration has also occurred in the general area. The Heward Ranch, approximately 5 km (3 miles) southeast of the restricted area, is the nearest agricultural residence.

Cattle and sheep are brought to the area for grazing approximately 6 months per year. Wildlife such as pronghorn antelope, deer, sage grouse, and various non-game species continue to utilize the habitat available in the general area. Limited recreational uses of public lands adjacent to the restricted area include hunting, primarily during September-October. The Jenkins Pit, reclaimed by the Abandoned Mine Lands Program as a lake, is open to public access for fishing. The lake is located south-southeast of the Pathfinder site.

The Shirley Basin tailings and mill site is at an elevation of 2,134 to 2,195 meters (7,000 to 7,200 feet) above mean sea level (MSL). The climate is typical of a high desert with average annual precipitation for the Shirley Basin site from 1968 through 1998 at 11 inches/year. These conditions greatly limit future land use.

3.2 Geology

Surficial deposits are the uppermost geologic materials that may have been formed *in-situ* from underlying geologic materials. This unit is a maximum of 21 meters (70 feet) thick and overlies 3 to 18 meters (10 to 60 feet) of claystone and siltstone. Underlying the claystone and siltstone is the White River Formation; the lower member is a tuffaceous siltstone with claystone, sandstone, tuff, conglomerate, and limestone interbedded in some areas. The upper member is a tuffaceous siltstone interbedded with very coarse sandstone and boulder conglomerate.

Underlying the White River Formation is the Wind River Formation, which is the mined uranium-ore-bearing unit at the Site. The Wind River Formation is generally an interbedded siltstone and sandstone with considerable amounts of interbedded lignite (Harshman, 1972). In the central part of Shirley Basin, the Wind River Formation is approximately 152 meters (500 feet) thick. Two members comprise the Wind River Formation, the Lower and Main Wind River units.

3.3 Water Resources

3.3.1 Surface Water

Surface waters in the vicinity of the Shirley Basin tailings include Spring Creek and its tributaries Fox Creek and Mine Creek, the Area 2/8 reclamation reservoir, the Area 3 reclamation reservoir, and the industrial pond. Mine Creek flows result largely from fresh water injection and will likely cease after termination of the CAP. The industrial pond will be augmented during tailings reclamation to serve as a surge/detention pond and will become a small surface water feature that will be dry much of the year, as it will contain only runoff water. Reclamation reservoirs are fed by both surface runoff and ground water and, therefore, will always contain water.

Spring Creek is designated as Class 2C surface water (warm water fisheries, non-drinking water, known to or has potential to support non-game fish populations) (WDEQ Water Quality Rules and Regulations, Chapter 1). Surface-water flow in Spring Creek and Fox Creek is perennial and eventually combines with the Little Medicine Bow River approximately 3.2 km (2 miles) downstream of the tailings area. Spring Creek receives approximately 13 percent of its baseflow from Surficial aquifer discharge, as it flows past the site.

In July 2004, PMC measured stream flows and sampled surface water and stream sediments, as part of a surface water quality assessment (Hydro-Engineering, 2005). Results of the study indicated that flows in Spring Creek were approximately 0.017 cubic meters per second (0.6 cubic feet per second). Water quality results indicated no measurable impacts from the tailings. Sediment samples from Mine Creek exhibited the highest uranium concentrations. This result is due to high evaporation rates near the sampling site. Evaporation at the boggy area at the sampling site concentrates and sequesters metals and salts. This evaporation and concentration process would likely continue until the injection wells are deactivated.

3.3.2 Ground Water

The Surficial aquifer is the saturated unit of primary concern at the Site area and occurs in a confined state near the tailings and an unconfined state between the tailings and Spring Creek. The underlying White River aquifer is confined both above and below. It is hydraulically separated by the claystone and siltstone discussed in Section 3.2. Below the White River Formation is the Wind River Formation, in which two major aquifers have been designated as the Main Wind River aquifer and the Lower Wind River aquifer. A clay and silt aquitard separates the Main and Lower Wind River aquifers. Uranium was mined from the Main and Lower Wind River members in open pits adjacent to the tailings facility.

Seepage from the tailings has impacted portions of the Surficial aquifer in the vicinity of the tailings, and this is the aquifer for which Site standards and the CAP were developed. Ground water in the Surficial aquifer flows east of the tailings and discharges to Spring Creek. The Surficial aquifer is of limited extent, bounded by the reclaimed Area 2/8 pit on the west side of the tailings and by Spring Creek on the northeast side (see Figure 1). Mine Creek is a tributary to Spring Creek, and the bulk of the ground water discharging to Spring Creek is conveyed through more permeable materials in the Mine Creek area.

Surficial aquifer recharge originates from infiltrating precipitation, seepage from the tailings, and the freshwater injection as part of the CAP. Freshwater injection rates far exceed the collection rates from the Surficial aquifer, which forms a ground-water mound or hydraulic barrier.

Deactivating the CAP will result in a substantial reduction in saturated thickness of the Surficial aquifer proximate to areas of injection. Pre-mining and post-reclamation potential yield from the Surficial aquifer is dramatically limited by the relatively small recharge area to this local ground water system. The majority of the affected aquifer area is contained within the long-term care boundary (surface use to be restricted by the Federal government). This is due to the Surficial aquifer flowing into Spring Creek.

By letter dated January 3, 2003, WDEQ classified the ground water underlying the Shirley Basin site as Class I, Domestic Use. WDEQ bases this classification on the fact that concentrations of nonhazardous substances (e.g., sulfate, chloride, TDS) fall below the respective Class I standards (WDEQ, 2003).

3.3.3 Background Water Quality

Background ground-water quality at this site has been monitored since 1979 using well MC-14 which is north of the tailings. The water quality in well MC-14 reflects the derivation of some Surficial aquifer materials from natural mineralization (uranium deposits) (PMC, 2002). Naturally higher levels of uranium, selenium, and radium are expected in this ground water due to contact with this mineralization. The concentrations of uranium and thorium-230, measured at the background well, routinely exceed the site standards, and measured uranium concentrations in Spring Creek upgradient of the site (not influenced by tailings seepage) approach the federal drinking water standard of 0.03 mg/l. Ra-226 + Ra-228 activity at the background well has also exceeded the site standard. In addition, PMC indicated that an ACL for selenium is required primarily because the 0.01 mg/l site standard is impractical in light of the current federal drinking water standard of 0.05 mg/l.

Table 2 presents the average background water quality for Surficial aquifer well MC-14, sampled 1979 to 2000. Background water quality, as measured at well MC-14, has remained relatively consistent.

Table 2
Summary of Background Water Quality Concentrations

Constituents	No. of Samples	Concentrations in Well MC-14			
		Minimum	Maximum	Median	Mean
Uranium, mg/l	61	0.01	0.13	0.08	0.08
Thorium-230, pCi/l	49	<0.20	3	0.2	0.4
Ra-226+228[1], pCi/l	24	0.2	19.5	1.47	2.99
Selenium[1], mg/l	38	<0.001	0.015	<0.001	0.002
Gross Alpha, mg/l	24	<1.0	25.6	2.2	5.33
Barium[1], mg/l	25	<0.02	0.05	<0.20	0.2
Chloride, mg/l	79	<1.00	17.9	5.3	6
Sulfate, mg/l	79	12.4	129	24	26
TDS[2], mg/l	71	186	594	347	350

[1] More than 50 percent non-detects
[2] TDS = Total Dissolved Solids

Background surface water quality values were developed by sampling Spring Creek at upgradient sampling site SW1A. Table 3 contains the background surface water quality values.

Table 3
Summary of Background Water Quality Concentrations

Constituents	Concentrations in Sample SW1A				
	Mean	St. Dev.	Median	Minimum	Maximum
Uranium, mg/l	0.0387	0.0451	0.0216	0.0146	0.203
Thorium-230, pCi/l[1]	0.1563	0.1548	<0.2	<0.2	0.6
Ra-226+228[1], pCi/l[2]				<1.2	<1.4
Selenium, mg/l	0.0018	0.0009	0.002	<0.001	0.003
Chloride, mg/l	10.8	13.8	2.77	<1.0	40.1
Sulfate, mg/l	31.7	27.2	18.5	13.2	92
TDS, mg/l	284.5	101.3	249	196	525

[1.] 93.8 percent non-detects
[2.] 100 percent non-detects

3.3.4 Current and Future Water Uses

Currently no downstream or downgradient residential surface water or ground-water users exist within 9.6 km (6 miles) of the tailings area. The nearest ranch (residence) is approximately 5 km (3 miles) east of the tailings area and is located in the Little Medicine Bow River drainage to the east of Spring Creek. This residence is upgradient of the confluence of Spring Creek and the Little Medicine Bow River and is outside the Surficial aquifer zone. Consequently, no hydraulic communication exists in surface water or alluvial ground water between the tailings and the ranch site. Surface water in Spring Creek is currently used by livestock and wildlife.

The foreseeable future use of water from the Surficial aquifer in this area is not expected to change. Residential or commercial development in the region is highly unlikely due to the relatively isolated and inhospitable environment. The limited extent of the local Surficial aquifer and the accessibility of deeper and more productive aquifers should limit its potential use.

3.4 Ecology

Cattle and sheep are brought to the area for grazing approximately 6 months per year, and wildlife such as pronghorn antelope, deer, sage grouse, and various non-game species continue to utilize the habitat available in the general area. The potential impact to threatened and endangered land species on or near the site was addressed by PMC in the 1998 EA for surface disturbances associated with soil decommissioning. A list of potential threatened and endangered species was provided by the FWS by letter dated September 20, 2002. This list includes the bald eagle (*haliaeetus leucocephalus*), black-footed ferret (*Mustela nigripes*), Canada lynx (*Lynx canadensis*), mountain plover (*Charadrius montanus*), blowout penstemon (*Penstemon haydenii*), Colorado River fish species, and Platte River species. No new species of concern for the site were identified, and no prairie dog towns large enough to support Black-Footed Ferrets exist in the area. Also, the Spring Creek riparian habitat is not suitable for the Mountain Plover and no threatened or endangered species are known to exist in Spring Creek. Furthermore, site activities will not affect the hydrology of the Colorado and Platte rivers.

In response to an NRC RAI dated September 26, 2003, PMC performed a study of aquatic macroinvertebrate diversity and abundance in Spring Creek, Murdock Creek, Mine Creek, Fox Creek, and the Little Medicine Bow River within or adjacent to the Site (Intermountain Resources, 2004). The purpose of the study was to assess aquatic macroinvertebrate populations and stream water quality using ratings obtained from this assessment. This study indicated that no negative surface water impacts were observed due to the tailings. Using the Wyoming Stream Integrity Index (WSII) ratings, the study concluded that water quality was better within the tailings area than in upstream reaches outside the influence of the tailings.

3.5 Meteorology, Climatology, and Air Quality

The Shirley Basin site is at an elevation of 2,164 meters (7100 feet) above mean sea level (MSL). The climate is typical of high desert. A 30-year record through 1998 indicates that the average precipitation is 28 cm/year (11 inches/year). Annual lake evaporation is estimated by Martner (1986) at 119 cm (47 inches). Precipitation is typically greatest in May and June with high intensity thunderstorms a frequent occurrence; evaporation is typically greatest in July and August.

3.6 Socioeconomic

According to 2000 U.S. Census Bureau data, the closest areas of population to the site are Point of Rocks census designated place (CDP), 15 miles southeast of the Site and Medicine Bow, 36 miles south of the Site. Point of Rocks CDP had a population of 3 people in 2000, and Medicine Bow had a population of 274 people. Medicine Bow’s population decreased from 389 in 1990, while Point of Rocks CDP was not listed in the 1990 census data. Carbon County’s population is 15,639 (2000 data), which is down from 16,659 in 1990. Other than sparse private residences (i.e. Hewards Ranch) no notable population centers are located closer than 15 miles of the Site.

3.7 Historical and Cultural Resources

The Site is not known to contain any historical or cultural resources.

3.8 Public and Occupational Health

NRC staff is requiring bi-monthly monitoring for the first 1.5 years followed by quarterly monitoring until license termination. Monitoring will be performed at 13 wells and five surface water locations in Spring Creek. The well network has been designed to track and assess ground-water contamination between the tailings impoundments and as it enters Spring Creek. More frequent monitoring during the beginning of the compliance monitoring program is being required because of the staff's and WDEQ's concern that residual ground-water contamination could result in heavier than predicted pollutant loads to Spring Creek. Such heavy pollutant loads could result in environmental or human health consequences. POC wells, compliance wells, and surface water sampling locations used in this program are listed in Section 1.4.1. Both surface water and ground-water samples will be analyzed for uranium, selenium, arsenic, barium, beryllium, cadmium, chromium, lead, molybdenum, nickel, nitrate, TDS, chloride, and sulfate concentrations, and thorium-230, radium-226 + radium-288 and gross alpha activities. Field parameters of field pH, conductivity, and water levels in wells will also be measured during sampling. The first sampling event will occur within one month of CAP deactivation.

The purpose of this monitoring is to assure that, while PMC remains the licensee, PMC remains in compliance with the ground water standards in the license. Sampling data also allows monitoring of ground water plume movement over time and distance, and assures that ground water contamination does not present an unacceptable risk to human health or the environment in the future. If future data suggests that pollutant concentrations in Spring Creek exceed acceptable levels, then PMC would be required to implement corrective actions.

The DOE will propose a ground water monitoring plan as part of the Long-Term Surveillance Plan, to be approved by the NRC. As custodian of the tailings after termination of the Shirley Basin license, DOE will be responsible for continued monitoring and any needed corrective action under an NRC general license.

3.9 Transportation

The Site is accessible by a series of small roads off of State Route 487. Access by plane is provided by three landing strips approximately 3 miles east of the Site near the confluence of Spring Creek and Little Medicine Bow River.

4.0 EVALUATION OF ENVIRONMENTAL IMPACTS

The alternatives to the proposed action would not result in significantly different environmental impacts because neither the alternatives nor the proposed action should lead to any significant adverse impact. The potential environmental impacts discussed below focus on the proposed action.

4.1 Land Use

Land use will not be affected by the proposed action because no resources will be impacted that are currently being utilized by ranchers and wildlife.

4.2 Geology

The proposed action is not expected to impact any geologic resources.

4.3 Water Resources

4.3.1 Surface Water

Minor changes in baseflow quantity could occur as a result of the proposed action. The current CAP is artificially recharging the Surficial aquifer to produce a hydraulic barrier that enhances recovery of contaminated seepage. This artificial recharge also provides baseflow to Spring Creek. Cessation of CAP activities will reduce the amount of recharge to the Surficial aquifer and, in turn, will reduce the quantity of baseflow to Spring Creek. However, NRC staff views this impact as minor because the proposed action would actually return Spring Creek to its pre-mining baseflow conditions.

PMC flow and transport modeling results indicate that the proposed ACLs will protect surface water quality at the POE. As discussed in Section 4.3.2, in the contaminant transport models, actual contaminant concentrations in surface water would likely be lower than those predicted in the models. Based on the PMC data, surface water impacts will be limited to the receiving stream of Spring Creek and the level of these impacts will not result in measurable environmental degradation. Other water bodies, including the Area 2/8 and Area 3 reclamation reservoirs, will not be affected by tailings seepage.

4.3.2 Ground Water

Currently, the CAP is containing ground-water contamination near the extraction wells at the base of the tailings impoundment. Deactivating the CAP will allow residual contamination to disperse through the Surficial aquifer and migrate toward Spring Creek. Preferential ground-water flow, and consequently contaminant migration, could occur along the alignment of Mine Creek toward Spring Creek due to the presence of more permeable materials. Contaminant migration toward Spring Creek will be delayed due to the residual ground-water divide that has formed from the freshwater injection portion of the CAP.

Ground-water flow and contaminant transport models indicate that contaminants entering Spring Creek will be in low enough concentrations to preclude human health and environmental impacts. Although the model was based on conservative assumptions, the model-derived contamination is likely more conservative because the CAP has been operated longer than the operational period assumed in the model, and the model assumed that no retardation would occur during contaminant transport. As a result, seepage quantities and ground-water gradients toward the Spring Creek are lower, which translates into lower seepage quantities entering the Spring Creek.

Peak concentrations at the POE are expected to occur within several decades after cessation of the CAP and will remain well below livestock water use standards. These peak concentrations will then decline to levels approaching the background water quality in Spring Creek. Peak concentrations at the POE in Spring Creek were conservatively estimated for late season baseline flow in the perennial stream. During much of the year, the flow in Spring Creek is much greater than the late season flow, and impacts of ground water discharge to the stream are lessened.

Despite modeling results, a more robust monitoring scheme (see Section 1.4.1) would be implemented to track ground-water contamination after deactivating the CAP system. Robust monitoring would serve to provide early indications that actual ground-water flow and contaminant transport were not acting, as predicted by the models. As previously stated, under such circumstances corrective actions could be implemented if pollutant concentrations exceeded acceptable levels due to excessive anticipated contaminant transport.

4.4 Ecology

No land disturbance or change to wet meadow habitat are associated with the proposed action. Based on the physical setting of the Shirley Basin site, the only exposure pathway for wildlife or stock near the POE would be ingestion of water from Spring Creek. Usage of water from Spring Creek will not have an impact on stock or wildlife because all POE concentrations are, and will remain, less than the State livestock ground-water use standards.

Minor impacts to aquatic macroinvertebrates could be realized as a result of the proposed action. Aquatic macroinvertebrate abundance and diversity are sensitive to baseflow quantity. Consequently, a reduction in baseflow from CAP deactivation could result in a reduction in both abundance and diversity. However, NRC staff do not consider this impact significant because the proposed action would return Spring Creek to its natural condition prior to mining.

4.5 Meteorology, Climatology, and Air Quality

No meteorological, climatological, or air quality impacts are anticipated from implementing the proposed action.

4.6 Socioeconomic

No socioeconomic impacts are anticipated from implementing the proposed action.

4.7 Historical and Cultural Resources

Protection of cultural and historical (archaeological) resources on the site are addressed in License Condition 20, requiring the licensee to ensure that no disturbance of cultural resources occurs in the future. No potential or identified resource area would be impacted by the approval of the requested ACLs as no land will be disturbed by the proposed action.

4.8 Public and Occupational Health

The ACLs application contains an exposure assessment. Based on the transport and fate modeling results, combined with the evaluation of ambient ground and surface water quality, the modeled hazardous constituent concentrations at the POE will not exceed the livestock use standard for ground water and will not significantly degrade the water quality at the POE. The maximum concentrations at the POE will likely occur within several decades of termination of the CAP, and then will gradually decline until indistinguishable from natural variations.

Uranium was the constituent of most concern and NRC staff concurs with the PMC conceptual model for uranium mobility. The reduction in uranium concentration with extension of the dewatering and Surficial aquifer collection/injection programs is minimal. The differences in maximum POE uranium concentration is small and is within predictive model resolution for each of the restoration scenarios (different periods for continuation of the CAP) examined. Even with a very conservative analysis of the human or animal exposure to the increased uranium concentration, the analyses indicate that there will be no measurable effects on public health or safety under the ACLs alternative.

4.9 Transportation

No transportation impacts are anticipated from implementing the proposed action.

5.0 RESTORATION AND DECOMMISSIONING

Ground-water restoration will continue to be conducted under the CAP, as authorized by the NRC license. Mill decommissioning and tailings area reclamation are governed by NRC regulations and the impacts from the planned decommissioning of land have been addressed in the 1999 EA. Significant or long-term impacts should not occur off-site. On-site restoration will be performed to include regrading and seeding disturbed areas.

6.0 CONSULTATION WITH AFFECTED FEDERAL AND STATE AGENCIES

Most of the information for this document was obtained from the licensee's ACLs application and related correspondence. Previous EAs for site activities related to decommissioning and reclamation have also been used. NRC staff provided the draft EA to, and requested comments of, various agencies (i.e., WDEQ, Bureau of Land Management, DOE, Wyoming State Historic Preservation Office (SHPO)) and other stakeholders. FWS has been consulted on candidate, threatened, and endangered species of Carbon County, Wyoming, and a list of such species possible in the county was provided.

7.0 CONCLUSION

The action that the NRC is considering is approval of a request to replace some of the ground water protection standards in License Condition 47 with ACLs and add ACLs for chloride, sulfate, and TDS, by amending source materials license SUA-442 issued pursuant to 10 CFR Part 40. The alternatives available to the NRC are:

1. Approve the license amendment request as submitted; or

2. Amend the license with such additional conditions as are considered necessary or appropriate to protect public health and safety and the environment; or

3. Deny the request.

Based on its review, the NRC staff has concluded that the environmental impacts associated with the proposed action are not significant and, therefore, do not warrant denial of the license amendment request. Additionally, in the Technical Evaluation Report being prepared for this action, the staff documents its review of the licensee's proposed action with respect to the criteria for ground-water restoration, specified in 10 CFR Part 40, Appendix A, and has no basis for denial of the proposed action. However, because concerns exist regarding impacts to

Spring Creek after CAP deactivation, the NRC staff considers that Alternative 2 is the appropriate alternative for selection.

The NRC staff is considering preparation of a FONSI. The following statements support a FONSI and summarize the conclusions resulting from the draft EA.

1. Potential access to the seepage-impacted ground water is prevented by the inclusion of most of the Surficial aquifer within the long-term care boundary. Therefore, no exposure or environmental impact from tailings contaminated ground water is expected.

2. Impacted ground-water discharges to Spring Creek at rates and concentrations that do not significantly degrade the water quality within this perennial stream.

3. Ground-water fate and transport modeling, conducted by PMC, indicates that revising the ground-water standards to ACLs will cause no degradation to the use of ground water or surface water, as a result of mill related activities, outside the long-term care boundary.

4. The ACLs are protective of public health and safety and the environment.

5. An acceptable compliance ground water monitoring program will be implemented to adequately monitor the future movements of the ground water plume and assure that no significant environmental impacts will occur and that the ACLs will not be exceeded.

6. Ground-water restoration equipment will be preserved for at least one year to allow for rapid corrective actions, if necessary.

8.0 LIST OF PREPARERS

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Stephen J. Cohen, Hydrogeologist, Division of Fuel Cycle Safety and Safeguards, Office of Nuclear Material Safety and Safeguards, NRC.

9.0 REFERENCES

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U.S. Nuclear Regulatory Commission, Request for Additional Information - Shirley Basin Application for Alternate Concentration Limits, July 20, 2001 (ML012050189).

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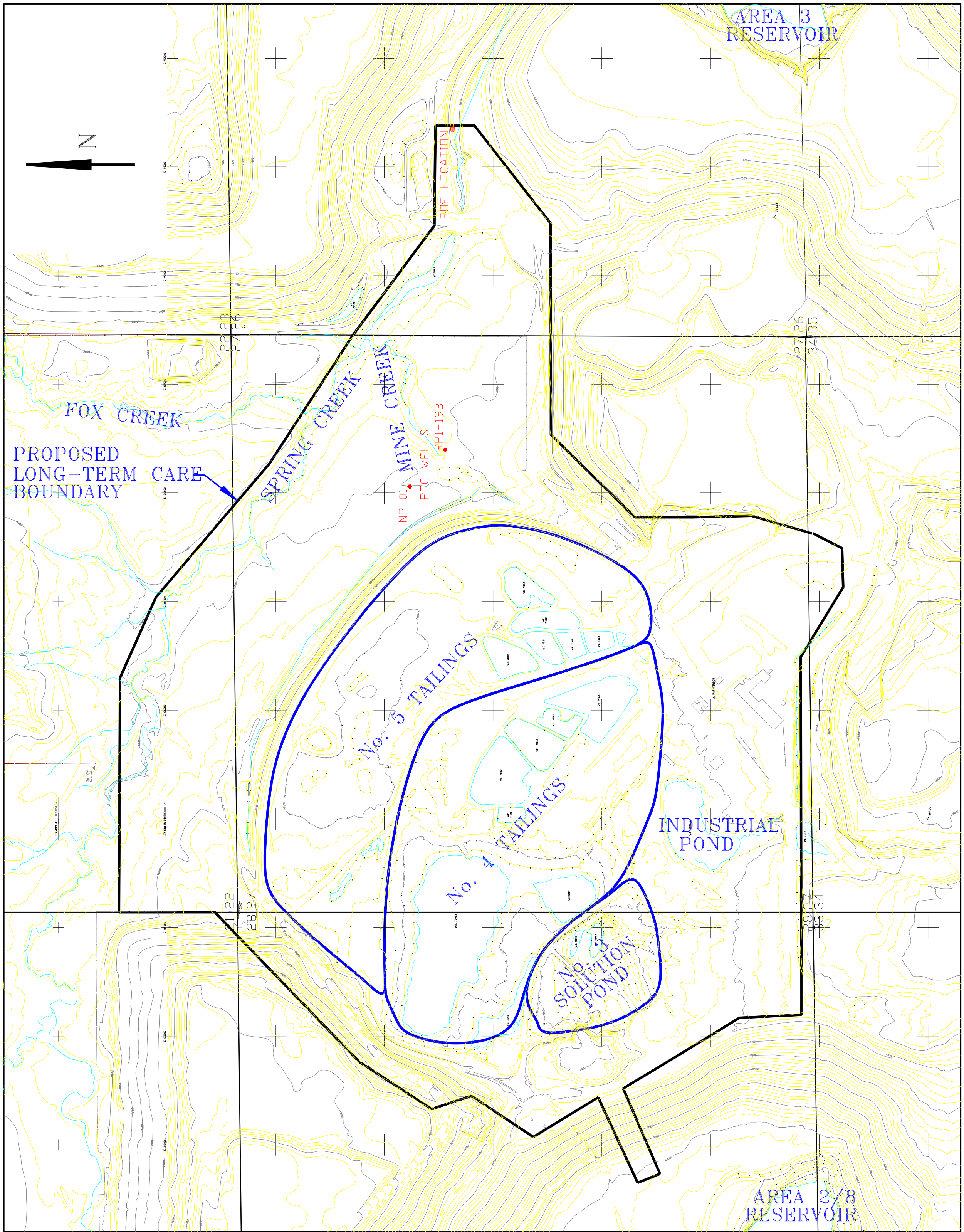


FIGURE 1. LOCATION OF SHIRLEY BASIN TAILINGS

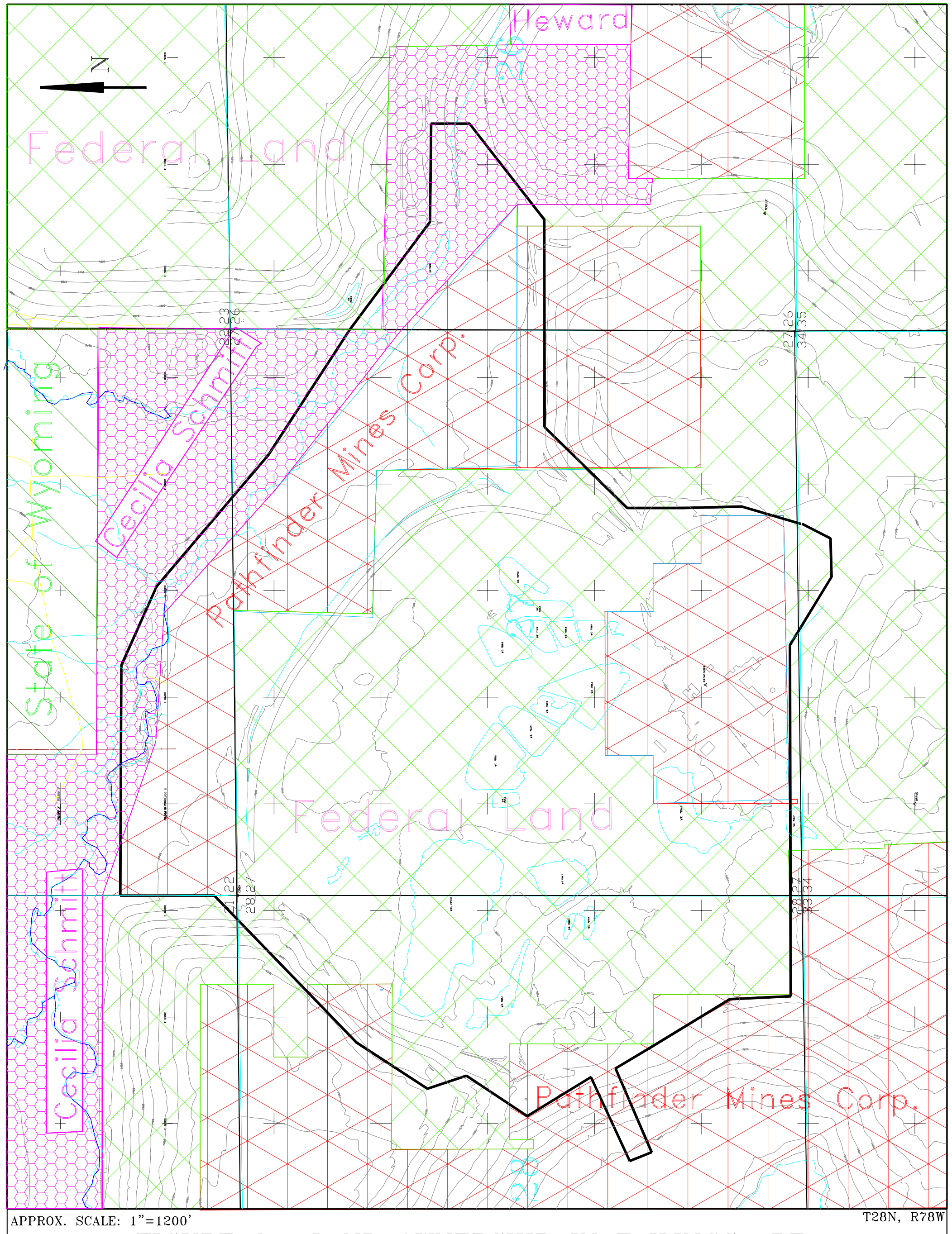
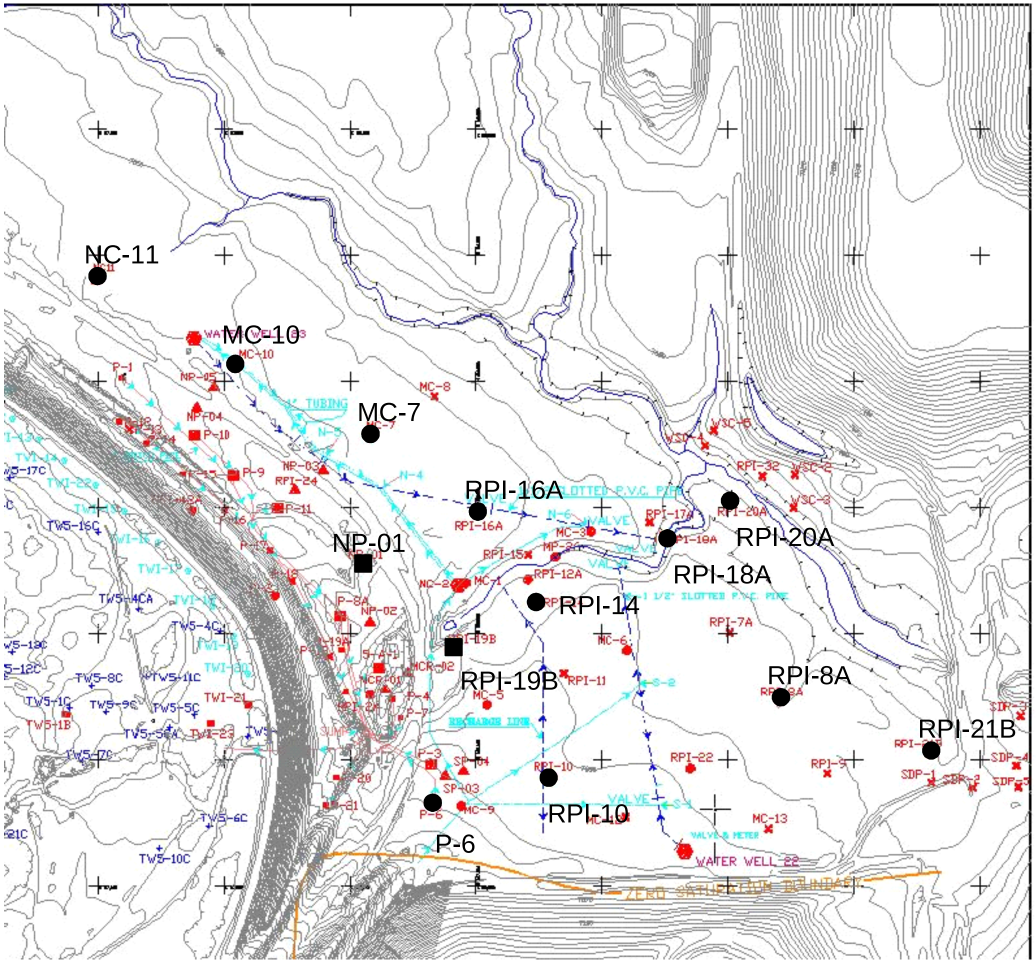


FIGURE 2. LAND OWNERSHIP IN TAILINGS AREA



LEGEND

■ **POC WELL**

● **COMPLIANCE WELL**

FIGURE 3
GROUND-WATER COMPLIANCE
MONITORING NETWORK

BASEMAP: PATHFINDER MINES CORPORATION, 2005

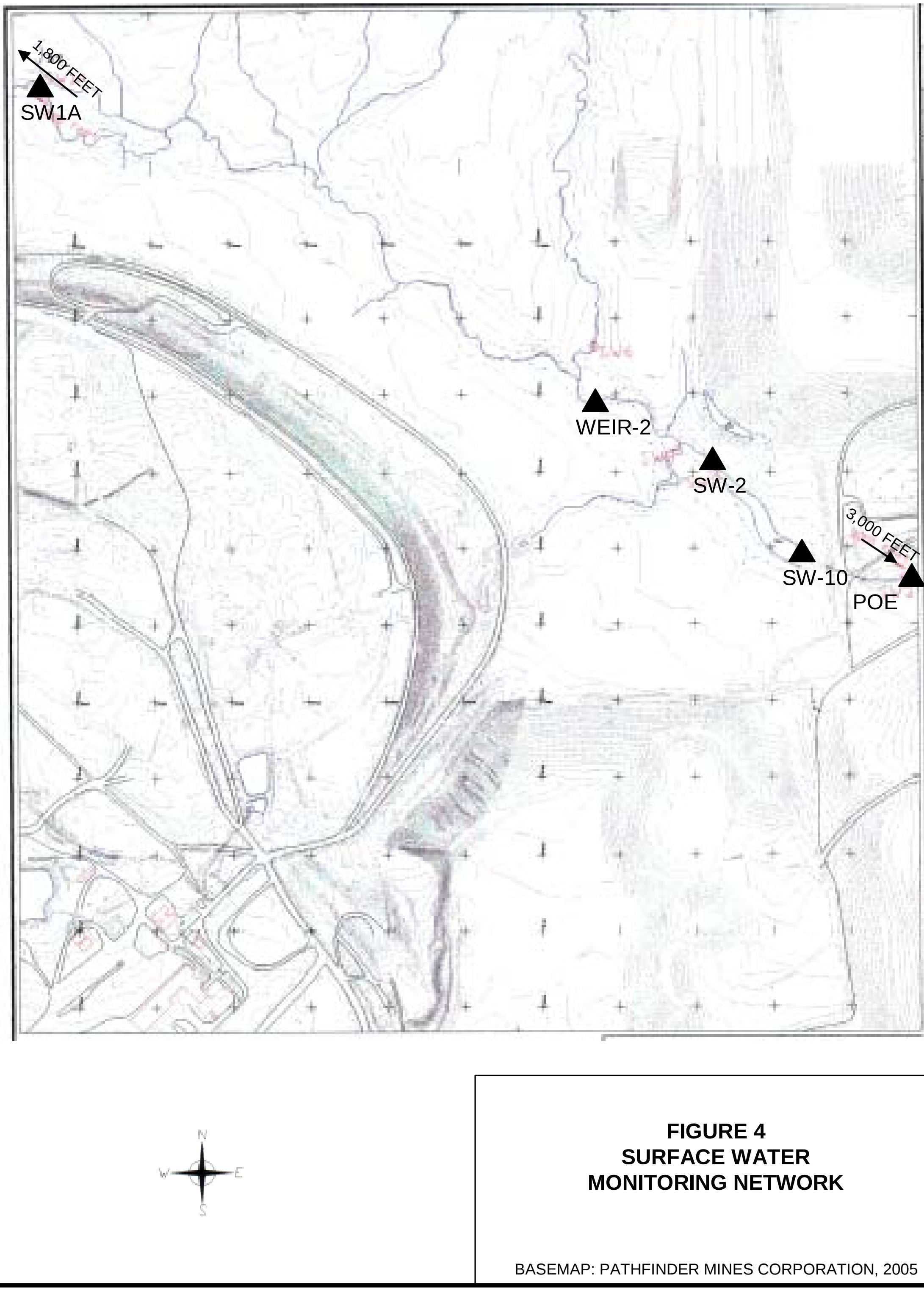


FIGURE 4
SURFACE WATER
MONITORING NETWORK

BASEMAP: PATHFINDER MINES CORPORATION, 2005

APPENDIX A

AGENCY COMMENTS ON DRAFT ENVIRONMENTAL ASSESSMENT AND U.S. NRC RESPONSES

Commenting Agency	Comment	USNRC Response
U.S. Fish and Wildlife Service, Comment Letter dated January 23, 2003 Comment 1	The U.S. Fish and Wildlife Service is concerned with selenium concentrations in groundwater exceeding 2 :g/l. Selenium concentrations greater than 2 :g/l may create a risk for bioaccumulation in fish and sensitive species of aquatic birds (Hamilton 2002) if the groundwater eventually discharges to surface water.	U.S. Fish and Wildlife Service's suggested value is below the standards currently enforced by the Wyoming Department of Environmental Quality (DEQ). Model-predicted time-weighted average values for selenium meet the strictest Wyoming DEQ standard (5 :g/l), while the maximum predicted value only slightly exceeds that standard. The model is also conservative because it assumes no retardation and active remediation continued 4 years beyond the model assumption. Therefore, the NRC staff concludes that the selenium ACL will be protective of human health and the environment.
Comment 2	In summary, the Draft EA should specify how selenium concentrations are reduced in groundwater at the POCs from over 150 :g/l to 5.6 :g/l at the POE. The Draft EA should also clarify if flows in Spring Creek are sufficient to dilute the selenium concentrations in the groundwater discharging into it.	Selenium concentrations are reduced by natural retardation as contamination migrates from the POC to Spring Creek. Currently the site contributes approximately 13 percent of baseflow to Spring Creek; most of this is due to the current ground-water injection program. Once active remediation ceases, the ground-water mound from the injection program will dissipate. This will allow contamination to migrate toward Spring Creek; however, the site's baseflow contribution will also decrease substantially. Considering retardation, reduced discharge, and current Spring Creek flows, selenium concentrations would likely be diluted to meet the applicable standards.

U.S. Environmental Protection Agency Comment Letter dated January 30, 2003. Comment 3	In Section 4 of the EA, “Alternatives to the Proposed Action”, the only viable alternate option to the "No Action Alternative" consisted of an expanded pump and treat program. In examining other possibilities, there was the brief statement that: “Other options, such as in situ bio-remediation, were considered but were determined unproven or inappropriate approaches for conditions at the Shirley Basin site. Therefore, no other method is analyzed in this EA.” We found this analysis and summary statement of other alternatives to the proposed use of alternate concentration limits extremely limited. There was no indication whether NRC had considered in detail other alternatives, especially the use of permeable reactive barriers to constrain the migration of radionuclides and metals to the surface water body at the property boundary.	An expanded discussion of other remedial alternatives has been provided in the final EA. This information obtained from a letter from PMC to the USNRC dated November 14, 2003.

Comment 4	Inclusion in the draft environmental assessment of existing water quality data for Spring Creek at locations: upstream of the Lucky MC site, at the proposed Point of Exposure, and downstream, would have been beneficial in evaluating the proposal. It appears that the stream is not confined solely to federal lands, and, based on the limited information in the environmental assessment, water upstream of the contaminated plume from the tailings impoundment is of higher quality than the proposed alternate concentration limits. The approval of this license amendment may thereby degrade the local water quality.	In 2004, PMC performed aquatic, hydrologic, and water quality surveys to gauge the affect of tailings seepage on Spring Creek.
Wyoming Department of Environmental Quality Comment Letter dated June 5, 2003 Comment 5	We believe that the scope of alternatives considered is unreasonably constrained to simple variations of one technique, in this case continuing with the current action under varying time frames. To limit consideration for other alternatives with simple statements characterizing those alternatives as "unproven" or "inappropriate" is insufficient, given the overall significance of the proposed action; far more discussion and quantification is needed to support NRC's conclusions related to this concern. We believe this discussion is necessary and is more appropriate within the scope and context of an EIS.	See response to Comment 3 regarding additional alternatives.

Comment 6	We believe that the proposed action relies upon natural attenuation (i.e. 'natural flushing') to achieve restoration standards (ACLs), however, this alternative was not discussed as an alternative action. A. Monitored natural attenuation as an alternative remedy should be evaluated for technical practicability and economic reasonableness in terms of achieving the existing groundwater protection standards, as well as in terms of achieving the proposed ACLs. Costs associated with monitoring the (predicted) natural attenuation process must be developed and included in the evaluation of alternatives. We are aware of similar Feasibility Studies for NPL caliber sites where monitoring costs over the period of control outweigh capital and O&M costs associated with active alternative approaches, and demonstrate the need for inclusion in any assessment and comparison of cost effectiveness.	While monitored natural attenuation (MNA) is similar to ACLs there are some basic differences. MNA is a remedial action, whereby natural processes reduce, mass, toxicity, mobility, volume, or concentration of contaminants. EPA permittees are required to monitor MNA progress until restoration goals are met. While ACLs rely on similar natural processes, once an ACL is approved, the licensee is in compliance with standards. At that point, the licensee could apply for license termination and transfer the property to the U.S. Department of Energy (DOE). Therefore, the MNA alternative is not directly applicable to the ACL process. Regarding costs, while MNA could require many years of monitoring, monitoring periods for ACLs are generally shorter. Therefore, ACL monitoring costs are usually low compared to other remedial alternatives.
Comment 7	We believe that the proposed action is not necessarily protective of human health and the environmental as measured by Wyoming law and regulations establishing protective criteria and standards. The apparent conflict between federal and state performance standards warrants full and complete discussion. We believe this discussion is necessary and is more appropriate within the scope and context of an EIS.	Modeled POE concentrations have been compared to Wyoming DEQ standards. The results indicate that modeled POE concentrations for the ACL constituents either meet standards or are within background concentration ranges. Furthermore, Spring Creek is impacted by cattle grazing upstream and downstream of the site. Therefore, contaminant concentrations discharging to Spring Creek will not alter the uses of Spring Creek and will not impact human health or the environment.

Comment 8	The alluvium adjacent to Spring Creek, in a down stream direction, should be more thoroughly evaluated for contamination. Not all of the groundwater will discharge directly into the creek, a significant portion will most likely flow sub-parallel to the creek. An example of the contaminant flow that is not fully understood is located on Page 1 .2-8b of the ACL Application. Uranium contamination on the north east side of Spring creek (opposite side of the creek from the tailings area) is described. The method of contaminant transport is not understood.	The ability for ground water to migrate under Spring Creek was addressed in the August 2001 version of the ACL application. Based on additional well installation and monitoring, ground-water gradients east of Spring Creek flow toward the creek indicating that Spring Creek is a hydraulic boundary. In addition, in January 2004, PMC submitted a report describing the results of the alluvium investigation. This report indicated very little to no ground-water conveyance would occur parallel to Spring Creek
Comment 9	We believe the proposed action likely constitutes a Major Federal action eventually leading to federal control and responsibility because lands within the long-term care boundary (LTCB) will be deeded to the U.S. Department of Energy (DOE) as a result of the proposed action. A. We believe that discussion of long term costs, impacts to natural resources, and related implications (e.g. loss of resource) for both the State of Wyoming and the federal government is necessary and more appropriate within the scope and context of an EIS.	Based on information provided in the revised ACL application, subsequent studies, and response letters, NRC staff concludes that a finding of no significant impact can be supported and that an EIS is not warranted.

Comment 10	B. The draft EA contains no discussion, nor information relating to ownership of the subsurface mineral estate. Given that surface ownership alone, including federal ownership, does not preclude an owner of the mineral estate from accessing the subsurface, a mechanism must be in place to prevent access to the mineral estate in order to prevent exposure to subsurface contaminants.	According to PMC in their November 14, 2003, response, the mineral potential of the tailings area and surrounding area is negligible. There are no federal oil and gas leases, coal deposits, or mining claims except for Pathfinder's unpatented mill sites. A portion of the tailings area is patented mill site claims owned by Pathfinder which will be transferred to federal ownership. A 156.8-acre tract adjoining the tailings area to the northeast is owned by Pathfinder (surface) and the Nall family (mineral estate). Pathfinder proposes to acquire this mineral estate by purchase or trade, as well as both surface and minerals of 65 acres along Spring Creek. These acquisitions will preclude any access for intrusion into subsurface contamination.

Comment 11	We fail to see within the Draft EA any statement that establishment of Alternate Concentration Limits for Groundwater at this site complies at this time with federal law pursuant to 10 CFR Part 40. The draft EA mentions that a Technical Evaluation Report is under preparation to document staff decisions with respect to the criteria for ground water restoration as specified in 10 CFR Part 40, Appendix A. That document is central to a reviewer's ability to evaluate and consider the commission's determinations that the factors (especially those seemingly interpretive or subjective in nature) required to evaluate present and potential hazards to human health and the environment have been fully considered. Many of these factors relate directly to Wyoming's interests in protecting and, when impaired, restoring groundwater and surface water use and quality. Logically expecting that the Technical Evaluation Report is developed prior to drafting the EA, we would request that we be provided a copy of the Report for our review and analysis as soon as possible before future draft EAs and/or draft EIS' for Title II sites in Wyoming are developed.	NRC staff cannot release Technical Evaluation Reports prior to issuing license amendments. These documents contain predecisional information and are strictly for internal use. However, the draft EA was expanded to include additional details regarding technical alternatives and justification for approving the ACL application. If more technical detail is desired, the ACL application and subsequent reports are available to the public on ADAMS.

Comment 12	As has been mentioned in numerous review comments and correspondence, we are concerned that the proposed ACL groundwater standards do not include other contaminants that have been identified in the groundwater at this facility. We ask that standards for chloride, sulfate and total dissolved solids (TDS) be added to the groundwater standards at the site. The standards should be based on the current groundwater "Class of Use" as described in Wyoming's Water Quality Rules and Regulations (WQRR), Chapter 8, MCLs and/or surface water standards as applicable. DEQ will assist NRC in determining these standards for this particular site.	ACLs for chloride, sulfate, and TDS will be included in the license.
Comment 13	Describe how the proposed POE concentrations are protective of human health and the environment when the proposed POE uranium concentration exceeds MCLs and background concentrations? As mentioned in our general comments, Wyoming does not allow any hazardous constituent concentration to exceed MCLs or background levels (whichever is greater) to migrate beyond the LTCB.	Details regarding human health and environmental risks are found in appendices A, B, and C of the revised ACL application. Uranium exposures causing a toxic reaction are primarily through ingestion. Because this water is not currently or is expected to be used for future drinking water, this exposure pathway is not expected to exist. Furthermore, the ACL is the model-predicted maximum concentration that should occur within the first few years after deactivating the CAP. This value is likely conservative because of the modeling assumptions discussed in the response to Comment 1. This maximum concentration is also within the range of background values measured in Spring Creek.
Comment 14	Please describe the methods used to determine the risk to human health and the environment. What values were used to generate the risk?	Appendices A, B, and C of the revised ACL application contain this information.

Comment 15	We are concerned that NRC is proposing only one POE, that being the surface water of Spring Creek. As mentioned in the general comments, a much more thorough evaluation of contamination migration into and adjacent to Spring Creek needs to be performed.	See response to Comment 8.
Comment 16	The EA does not address the slope stability issue at Pit #3 that was described in the August 6, 2001 LQD Inspection Report.	PMC addressed this issue in their November 14, 2003, response to an NRC RAI. PMC states that the slope instability is too far away to affect the site. Therefore, NRC staff conclude that this issue need not be addressed in the EA.