Remedial Programs

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Andrew Bain
U.S. Environmental Protection Agency
Region 9 (SFD-8-2)
75 Hawthorne Street
San Francisco, CA 94105

September 9, 2009

Re: Northeast Church Rock Mind Site
Comment on EE/CA

Dear Mr. Bain:

On behalf of United Nuclear Corporation, General Electric (GE) appreciates the opportunity to review EPA's Engineering Evaluation and Cost Analysis (EE/CA) for the Northeast Church Rock Mine Site (NECR Mine Site), published on May 30, 2009. We also appreciate you and your team's willingness to engage in open dialog throughout the EE/CA process to date.

I enclosed GE's comments on EE/CA. Overall, we believe that the document is a positive step forward to address conditions at the NECR Site. While we disagree with some of EPA's assumptions and positions, we intend our comments to be constructive in the analysis of alternatives for remediation of the NECR Mine Site.

We look forward to continuing to work with EPA, the Navajo Nation and the other stakeholders on this matter. In the meantime, please call me or Lance Hauer if you have any questions. Thank you.

Sincerely,

Randall L. McAlister

Cc: C. Tenley, EPA
D. Richmond, EPA
H. Karr, EPA
L. Williams, EPA
J. Gardner, GE
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# Comments on Engineering Evaluation and Cost Analysis

## Northeast Church Rock Mine Site

September 9, 2009

General Electric Company
on behalf of
United Nuclear Corporation
P.O. Box 3077
Gallup, NM 87305

## INTRODUCTION

### A. Background

General Electric Company (GE), on behalf of United Nuclear Corporation (UNC) [1], appreciates the opportunity to provide EPA with these comments on the Engineering Evaluation and Cost Analysis (EE/CA) for the Northeast Church Rock Mine Site (NECR Mine Site, or Site). EPA released the final EE/CA on May 30, 2009. EPA subsequently extended the deadline for submitting comments until September 9, 2009.

EPA previously provided an advance draft of the EE/CA to stakeholders, including, on December 16, 2008, to UNC/GE. UNC/GE provided comments on that draft, and have also provided their views in other comments and letters. UNC/GE attach, ***and fully incorporate by reference into these comments,*** the following comments previously provided to EPA:

> UNC/GE's comments to EPA Region 9 on the Advance Draft EE/CA, January 23, 2009 (hereafter "UNC Comments on Draft EE/CA") (Attachment A)
>
> UNC/GE's comments to the EPA National Remedy Review Board on the Advance Draft EE/CA, January 14, 2009 (hereafter "UNC/GE Comments to NRRB") (Attachment B)
>
> GE's letter to EPA Region 9 addressing whether the Northeast Church Rock Mill Site is Indian Country, December 11, 2008 (Attachment C)
>
> UNC/GE's letter to EPA Region 9 on the applicability of the CERCLA permit exemption to the UNC Mill Site as a repository for materials removed from the NECR Mine Site, March 3, 2009 (Attachment D)
>
> UNC/GE's letter to EPA Region 9 addressing whether certain New Mexico regulations are applicable or relevant and appropriate to use of the Mill Site as a repository for materials removed from the NECR Mine Site, May 5, 2009 (Attachment E)
>
> UNC/GE's letter to EPA Region 9 transmitting additional data and information requested by EPA in support of the draft EE/CA for the NECR Mine Site, January 10, 2008 (Attachment F)

### B. 2009 Interim Removal Action

To address the current concerns of area residents and the Navajo Nation, UNC volunteered to perform an interim action to remove impacted soils from reservation land designated as the "NECR-1 step-out area." On July 23, 2009 EPA issued an Action Memorandum for an Interim Removal Action to authorize this action ("the 2009 IRA"). The next day, UNC and GE entered into an Administrative Order on Consent with EPA ("the 2009 AOC") to implement the 2009 IRA.

The primary elements of the 2009 IRA are as follows:

[1] UNC and GE are separate corporations. UNC is owned by a GE Aviation business unit, GE Engine Services—Miami, Inc. UNC was acquired in 1997, 15 years after all mining operations had ceased. For convenience only, we refer to UNC and GE collectively as "UNC/GE" in these comments.

- Remove impacted soils above the IRA Action Level of 2.24 pCi/g from reservation lands in the so-called "NECR1 Step-Out Area" and "Unnamed Arroyo #1."

- Regrade and cover the mine spoil area located adjacent to reservation lands and designated as NECR-1 prior to further addressing it in the EE/CA.

- Install erosion and sediment controls to convey surface drainage away from adjacent reservation lands.

- Provide temporary relocation during implementation of the IRA to residents of three homesites on the reservation to avoid inconvenience to residents.

- Conduct sampling and investigation of conditions on and immediately adjacent to the southern portion of Red Water Pond Road (from the intersection with State Highway 566 north to unnamed Arroyo #2).

- Backfill as necessary and revegetate areas impacted by the IRA.

UNC has begun implementation of this work pursuant to the 2009 AOC, under EPA oversight.

## C. Overview of Comments

UNC/GE agree with much of EPA's analysis and evaluation of alternatives in the EE/CA. UNC/GE specifically agree with EPA's conclusion that off-site, out-of-state removal of NECR Mine spoils is the ***least*** acceptable alternative. That alternative presents unacceptable risks and excessive costs, and EPA correctly rejected it.

Nonetheless, as discussed below, UNC/GE disagree with several assumptions, positions, and conclusions discussed in the EE/CA, including the following:

- UNC/GE do not agree with EPA's conclusion that there may be an imminent and substantial endangerment at the NECR Mine Site justifying a removal action. Completed and ongoing actions at the Site have resolved any potential imminent and substantial endangerment.

- UNC/GE continue to believe that the most appropriate remedy for the NECR Mine Site is on-site disposal and capping, which is the presumptive remedy at mine sites exhibiting similar characteristics of relatively large-volume, low-concentration mine spoils, and indeed as was done at the adjacent Quivira uranium mine.

- EPA's background level is incorrectly determined and does not reflect actual area conditions; the action level is similarly incorrectly calculated.

- If EPA selects its currently preferred alternative – construction of a repository on top of existing cells at the Mill Site – then EPA should remain flexible in considering alternative repository designs that can be shown to be protective and effective. A properly designed and constructed Evapotranspiration Cover System (ECT) will prevent water from seeping through the materials and obviates the need for a liner under the repository.

- It is effective and protective to place so-called “principal threat waste” (PTW) in the Mill Site repository. Out of state disposal of that material is unnecessary and adds no additional protectiveness to the remedy.

- EPA should not include any portion of Red Water Pond Road in this response action. Historical information and sampling data show that the conditions on the northern portion of Red Water Pond Road, as well as any deeper impacts that may exist along the entire road, are related to the nearby Quivira Mine, not the NECR Mine. In the 2009 AOC, EPA recognized that further characterization of Red Water Pond Road is necessary before deciding what, if any, actions might be appropriate.

These and other comments are addressed below. UNC/GE offer these views with the goals of improving the understanding of site conditions and supporting an appropriate remedy for the secure disposal of NECR Mine spoils.

## I. There Is No Imminent and Substantial Endangerment That Justifies A Removal Action at the NECR Mine Site

UNC/GE respectfully disagree with EPA’s conclusion in the EE/CA that conditions at the NECR Mine Site may present an imminent and substantial endangerment to public health, welfare or the environment. EE/CA, p. 12. Current conditions at the Site do not present an imminent and substantial endangerment, and the 2009 IRA will address any potential short-term risks.

Under CERCLA, a removal action cannot proceed in the absence of a potential imminent and substantial endangerment. CERCLA §§ 104(a)(1), 106(a). Removal actions are generally limited to 12 months or $2 million. CERCLA § 104(c)(1). While certain exceptions are allowed, *id.*, the action proposed in the EE/CA goes far beyond those limits; EPA estimates that the proposed response action will take 4 years to construct at a cost of more than $44 million.

EPA has also selected an artificially low background concentration of Ra-226 for NECR, and an overly stringent action level. As a result, EPA overstates the risk posed by the Site, which further undercuts EPA’s determination of an imminent and substantial endangerment.

As to the background level, EPA recognizes that to evaluate the potential exposure attributable to the NECR Mine, it is necessary to calculate, and subtract, the background radium levels. EPA selected a background concentration for NECR of 1 pCi/g Ra-226, based on the results of sampling conducted from a limited area believed to be free of impacts from prior mining operations. As UNC and GE have previously commented, EPA has significantly understated the naturally high background levels of radium in the Colorado Plateau generally, and in the specific area of the Site particularly. *See* UNC/GE Comments on Draft EE/CA, p. 3; UNC/GE Comments to NRRB, pp. 5-6. EPA’s selection of a background level here is inconsistent with its determination at other nearby sites. The background level at the neighboring Quivira Mine has been determined to be 4.5 pCi/g. EPA and the Navajo EPA determined that the background level at the nearby Old Church Rock Mine Site is 4.3 pCi/g. EPA and the NRC approved a soil background value of 5.5 pCi/g for Ra-226 at the Homestake Mining Company Mill Site approximately 50 miles from NECR. The lowest nearby background value of which UNC/GE are aware is still nearly twice the background level for NECR – 1.9 pCi/g at the Bluewater Mill Site in New Mexico. ***Most importantly, in 1989 NRC used a background level of 2 pCi/g for the NECR site itself when it evaluated UNC’s removal of tailings***.

In addition, EPA has set an unrealistically and inappropriately low action level in the EE/CA. The level proposed by EPA is 2.24 pCi/g, which is significantly lower than accepted regulatory levels and the level set for the nearby Quivira Mine. Rather, EPA should have used the UMTRCA standard of 5 pCi/g + background, set forth in 40 C.F.R. Part 192. That is a health-based level developed to ensure protective conditions based on an unrestricted use scenario, and it has been widely adopted and implemented as a cleanup standard by EPA and others. *See* UNC/GE Comments to NRRB, pp. 6-7. Even applying EPA's unrealistically low background concentration of 1.0 pCi/g, this calculation would yield an action level of 6 pCi/g based on UMTRCA standards. Employing a more realistic background level would result in a more appropriate action level. The reclamation standard set for the nearby Quivira mine equates to approximately 25 pCi/g. EPA cannot justify a 2.24 pCi/g standard here given these facts.

Instead, EPA based its action level on exaggerated risk assessment scenarios. As explained in UNC/GE's comments to the NRRB (p. 7), UNC was directed to perform a Human Health Risk Assessment that assumed 100% of the meat and eggs, and 50% of homegrown produce consumed by local residents, are raised ***directly within the mine spoils or areas impacted by mine spoils.*** There is no justification for these scenarios.

EPA has not incorporated actual site-specific evidence, and its assumptions are inconsistent with exposure assumptions in EPA's *Exposure Factors Handbook*. UNC/GE Comments to NRRB, p. 7.

When appropriate background and action levels are applied, it is clear that conditions at NECR do not present an imminent and substantial endangerment. For example, applying an action level of 6 pCi/g to current Site conditions, it is evident that current conditions do not present unreasonable risks. The highest levels at the NECR Mine Site are within the fenced, permitted boundary of the Mine, and immediately outside that boundary on the steep slopes near the Mine. *See* EE/CA Figure 1-6. With the exception of Red Water Pond Road (discussed separately below), levels outside the mine permit area are often below EPA's action level of 2.24 pCi/g, and are rarely higher than 6 pCi/g. As expected, the post-remediation radium levels in areas around the home sites that were the subject of the 2007 residential "time-critical removal action" are very low. In fact, of the eleven samples that UNC analyzed from the staged soils excavated during the residential removal, all were below the UMTRCA unrestricted use standard, even using EPA's conservative background level of 1.0 pCi/g, and the average was below EPA's 2.24 pCi/g action level.

Moreover, to the extent EPA has concerns with potential short-term exposure to NECR Mine spoils, the 2009 IRA that UNC is implementing is addressing them. The 2009 IRA includes returning to the NECR Mine all soils with levels above EPA's stringent action level of 2.24 pCi/g that are potentially attributable to historic activities at the NECR Mine. Those soils will be covered and monitored pending long-term disposition of the materials.

## II. Disposal at the Mine Site Is Protective and Cost-Effective

As presented in UNC/GE's comments to the NRRB (pp. 2-3), closure or reclamation in place is the accepted, protective practice for mine sites, including uranium mines. It is the standard remedy for mining sites in the State of New Mexico under multiple regulatory programs, such as the New Mexico Mining Act and similar state laws and programs. It is also the standard preferred remedy under federal mining laws and CERCLA. Many mines have been closed with in-place reclamation "remedies," including the Quivira Mine less than ½ mile from NECR, on the

Navajo reservation. Like other mine sites, the NECR Mine involves reclamation of a large volume of low-risk mine spoils that makes off-site hauling of materials impractical, unnecessary from a protectiveness perspective, higher risk, and not cost-effective.

The EE/CA evaluates two in-place alternatives: consolidating and capping the mine spoils *in situ* (Alternative 3), and constructing a new above-ground repository for the spoils on the NECR Mine Site (Alternative 4). ***Both alternatives (including sub-alternatives) are judged by EPA to be protective of human health and the environment.*** EE/CA, pp. 41, 45, 52. EPA also concludes that both alternatives will comply with ARARs, will provide an effective, long-term solution, and are technically and administratively feasible to implement. EE/CA, pp. 53-55.

However, there is a marked difference among the alternatives in terms of cost. Alternative 3 is estimated by EPA to cost between $25.8–28.5MM, and Alternative 4 has an estimated cost range of $32–34.7MM. EE/CA pp. 44, 47. On the other hand, EPA's proposed alternative, Alternative 5, costs considerably more: $41.6–44.3MM. All three remedies are effective; the primary differentiator is cost. Hence, both of the in-place alternatives are more ***cost-effective*** than the proposed alternative. In the EE/CA, EPA states that the Alternatives, including Alternative 3, offer "similar levels of protection." According to the 1985 Preamble to the National Contingency Plan (NCP), ". . . if all the remedies examined are *equally* feasible, reliable, and provide the same level of protection, the lead agency will select the least expensive remedy. . . ." 50 Fed. Reg. at 47921 (Nov. 20, 1985) (emphasis in original). Given EPA's determination that the alternatives are similarly protective, EPA should select disposal on the Mine Site as the preferred remedial alternative.

## III. Out-of-State Disposal Presents Unacceptable Risks and Excessive Costs

### A. Alternative 2 is Unwarranted

Alternative 2, as described in the EE/CA, is a 9-year remedy involving the excavation and off-site disposal – hundreds of miles and several states away – of a massive amount of soil. UNC has consistently maintained that of all the alternatives on the table, Alternative 2 is wholly unacceptable and cannot be justified.[2]

### B. Alternative 2 Will Generate Significant and Unnecessary Risks

Alternative 2 does not reduce risk, it ***creates*** risk. EPA reaches the same conclusion in the EE/CA:

> This alternative would incur more logistical difficulty, has a greater potential of transport incidents on the public ways and poses ***undue hazards to human health and the environment*** based on estimated trucking emissions, as shown on Table 5.3. With the large number of transport miles and possibility of transport incident ***the alternative presents a higher risk to the general public. Based on these factors Alternative 2 presents the highest risk.*** [EE/CA, p. 56, emphasis added.]

[2] Further details of risks and negative impacts of Alternative 2 are discussed in UNC/GE's Comments on the Draft EE/CA, pp. 4-5, and UNC/GE's Comments to the NRRB, pp. 3-4.

EPA's analysis demonstrates that Alternative 2 is the least appropriate alternative. Alternative 2 would involve major long distance trucking of large amounts of material, which is inherently risky. EPA estimates that 871,000 cubic yards (1.26 million tons) of soil would need to be excavated from the NECR Mine Site and hauled to a licensed and permitted facility such as the U.S. Ecology facility in Grandview, Idaho – a roundtrip of ***more than 1600 miles*** through four states, and through numerous population centers including Ship Rock, New Mexico; Provo, Salt Lake City, and Ogden, Utah; and Twin Falls, Idaho. Alternative 2 would require more than 62,000 round-trips by heavy vehicles, adding up to ***90 million miles*** and nearly 2 million hours of truck travel. Based on these facts and a 2-3 day roundtrip for each truck, EPA estimates that it would take at least nine years to excavate and haul all of this material to Idaho, more than twice as long as the time estimated by EPA for completion of any other alternative under consideration.

Major risks and potential consequences of Alternative 2 include the following:

- Risks to communities and workers from accidents that may occur during transportation such as traffic accidents; resultant spills of material during accidents; and risk of releases of materials during transport,

- Consumption of limited off-site disposal capacity for extremely low-level naturally occurring radioactive materials, and

- Large-scale emissions of greenhouse gases.

To more fully appreciate these concerns, EPA should consider the National Highway Traffic Safety Administration (NHTSA) data on fatality and injury rates attributable to vehicular accidents. Based on the 2006 data obtained from *Traffic Safety Facts, 2006 Data: Large Trucks* (NHTSA, 2008), transport of mine materials to the U.S. Ecology facility would yield a risk of 2 large truck crashes causing fatalities, and 36 non-fatal large truck crashes. Implementation of Alternative 2 also would result in consumption of more than 49 million gallons of diesel fuel, causing emissions of more than 507,000 metric tons of carbon dioxide.

Causing these unwarranted and avoidable impacts is contrary to EPA policy. *See Green Remediation: Incorporating Sustainable Environmental Practices into Remediation of Contaminated Sites,* EPA Pub. No. 542-R-08-002 (April 2008). According to that analysis, one of the "core elements" of green remediation is to "[m]inimize use of heavy equipment requiring high volumes of fuel." Region 9, in particular, has pioneered EPA's effort to evaluate and reduce greenhouse gas emissions from Superfund cleanups, with its "Cleanup-Clean Air Initiative." On a national level, EPA is working closely with ASTM to develop a "green cleanup standard" to encourage the implementation of "net benefit" cleanup solutions that take into account the full range of environmental issues associated with cleanups, including climate change. Indeed, just yesterday, EPA released for public comment its "Superfund Green Remediation Strategy," www.epa.gov/superfund/greenremediation/, with a goal of "reduc[ing] greenhouse gas (GHG) emissions and other negative environmental impacts that might occur during remediation of a hazardous waste site or non-time critical removal actions." Strategy, p. i. EPA noted the importance of considering the energy and environmental impacts of remedial decisions: "[W]hen developing options for remedial actions that are consistent with remedial action objectives, project managers should consider alternatives that include opportunities for reducing the environmental footprint of remedial design and construction activities." Strategy, p. 6.

Alternative 2 is the "least green" alternative considered in the EE/CA. The energy and GHG impacts of this Alternative are radically higher than those projected for the other alternatives, and are wholly inconsistent with sustainable energy and climate change concerns in the U.S. Given EPA's public commitment to "greening" its remedial decisions, the Agency must recognize the disproportionate impacts of an extreme, long-haul remedy of huge volumes of soil that, if selected, would overwhelm the perceived environmental benefits of the remedy.

### C. Alternative 2 is Excessively Costly

In addition to the risks and impacts discussed above, Alternative 2 is excessively costly. EPA's revised estimate for Alternative 2 is ***$293,600,000,*** nearly an order of magnitude more than the next less-expensive option. Yet, as discussed above, the EE/CA concludes that several of the other alternatives are protective of human health and the environment, are implementable, and present far ***fewer*** risks.

As such, under EPA regulations governing remedy selection, EPA cannot select this remedy. Alternative 2 clearly and unequivocally does not meet NCP and CERCLA criteria. EPA acknowledges that "[c]ost is a central factor in all Superfund remedy selection decisions." *The Role of Cost in the Superfund Remedy Selection Process,* OWSER Publication 9200.3-23FS (Sept. 1996), p. 1. That guidance concludes that "[c]ost is a critical factor in the process of identifying a preferred remedy. In fact, CERCLA and the NCP require that <u>every</u> remedy selected <u>must</u> be cost-effective." *Id.*, p. 5 (emphasis in original). The NCP provides that a remedy is only cost-effective "if its costs are proportional to its overall effectiveness." (40 C.F.R. § 300.430(f)(1)(ii)(D)). EPA has determined that the alternatives "offer similar levels of protection." Once alternatives are determined to be similarly protective, cost considerations must be a determining factor in selecting one alternative over the other. Alternative 2 does not meet this test. *See* discussion of costs, p. 6, *supra.*

For all these reasons, EPA properly rejected Alternative 2.

## IV. If EPA Selects Alternative 5A, the "Mill Site Remedy," the Agency Should Not Preclude Designs That Are Protective and Effective

EPA has proposed Alternative 5A as the Agency's preferred alternative. EPA describes the major elements of this alternative as follows:

- Excavation and transport of all mine waste soil with radium above 2.24 pCi/g (10-4), except in the ponds, where excavation would be to a maximum depth of 10 feet; the waste to be consolidated includes ore and protore, waste rock, building foundations and adjacent soil, and contaminated sediment;

- Consolidation of the mine wastes with a cap and liner in an existing disposal cell on the UNC Mill Site, or construction of a new cell at the Mill Site currently under license by the NRC. EPA maintains that if an agreeable design cannot be completed due to administrative or technical issues, then the NECR wastes could be placed in a new, separate repository on the UNC Mill Site. This would require a release of property currently under NRC oversight. In this case, the post-removal site control responsibility of a new repository would remain with EPA;

- Shipment of PTW to an off-site licensed disposal facility, such as at Grandview, Idaho, or an alternative appropriate facility. For waste with total uranium concentrations exceeding 500 mg/kg, it may be viable to reprocess the waste at the White Mesa Mill in Utah or a similar mill;

- Site restoration with erosion and stormwater controls, regrading and revegetation for future grazing; and

- Long-term maintenance for a capped repository, which would occupy an estimated 30 acres and would become part of DOE's legacy management program in perpetuity.

UNC/GE agree that it is feasible to use an existing cell on the Mill Site for the permanent disposition of the NECR Mine spoils. However, in several instances EPA has taken an overly restrictive approach that artificially constrains options for designing the repository. UNC/GE are prepared to work with EPA to assure that, if EPA selects Alternative 5A, the repository will be designed to be protective and effective in the long term, while meeting the CERCLA mandate of cost-effectiveness. With those criteria in mind, UNC/GE offer the following comments on Alternative 5A.

**A. A properly designed Evapotranspiration Cover System will provide a superior long-term solution compared to a prescriptive cover and liner.**

In the EE/CA, EPA has provided a conceptual approach to the Mill Site repository that includes a cap and liner system. Details would be developed in a statement of work and refined during the design stage. EPA has stated several criteria for design of the cap, which can be summarized as follows:

- Longevity

- Radon attenuation

- Revegetation to emulate native plant communities

- Minimization of water infiltration

- Minimization of erosion and biointrusion

UNC/GE agree with EPA's conceptual criteria for the cap. The most effective way to achieve those criteria is by installing a state-of-the-art Evapotranspiration (ET) cover system. An ET cover consists of a single, vegetated soil layer constructed to represent an optimum mix of soil texture, soil thickness, and vegetation cover. The cover is a monolithic soil layer that has adequate soil water storage capacity to retain any infiltrated water until it can be removed via evapotranspiration. ET covers have been deployed throughout the country and are currently the preferred cover systems in arid and semi-arid climates.

A properly designed and constructed ET cover system will not allow any flux of water through the cover, and therefore will not allow waste materials to migrate from the repository. That eliminates the need for a liner. The purpose of a liner is to prevent any water that has passed through the cover system and the deposited mine spoils from continuing downward and threatening the groundwater beneath the proposed site. However, if the ET cover system prevents flux, then there is no need for a liner.

To demonstrate these concepts and the effectiveness of an ET cover system, UNC/GE contracted Dr. Stephen Dwyer of Dwyer Engineering LLC in Albuquerque, NM. Dr. Dwyer is former director of DOE's "Alternative Landfill Cover Demonstration Program," and consultant to and educator for various government agencies including EPA, DOE, BLM, NMED and others on landfill design and construction issues.

Dr. Dwyer's report, "Conceptual Cover Profile Evaluation," is attached to these comments (Attachment G). His analysis on the performance of an ET cover system is based on conservative modeling, natural analog evaluations, and applicable site-specific field data. Dr. Dwyer's analysis demonstrates that an ET cover can be designed and constructed for the Mill Site repository that will eliminate flux, without the need for a liner.[3]

As summarized by Dr. Dwyer, the advantages of ET covers are that they are "composed of natural soils and strive to mimic natural processes as opposed to trying to resist them as is the case with prescriptive engineered barrier systems." As a result, "ET covers are well suited to perform over the long-term which is a key goal of any final cover system."

Moreover, a liner already exists. The existing radon barrier cover system on the Mill Site cells consists of imported, clean, compacted clay soils. This existing, four-foot thick cover system was designed and confirmed by field testing to achieve greater than 90 percent compaction. Based on the texture, compaction, thickness and integrity of the existing cover, it is likely that this cover system would meet or exceed any added protectiveness envisioned by the EPA to be provided by the two-foot thick, clay liner described in the EECA for Alternative 5A. To confirm this, field or laboratory hydraulic testing of the existing cover system easily could be performed during the design process. UNC/GE strongly recommend that, if a liner is to be required by the EPA as part of Alternative 5A, the existing radon barrier cover on the Mill Site cells be evaluated as meeting or exceeding any added protectiveness the agency anticipates from a liner. Dr. Dwyer's analysis provides a strong technical basis for using an ET cover system at the Mill Site and employing the existing cover on the cells as an effective liner without the need for an additional liner. It is important that EPA not preclude this approach in the final Action Memorandum. EPA must allow adequate flexibility for the best technical approach to designing the repository.

### B. If a repository is constructed on the UNC Mill Site, it should utilize the current tailings impoundments.

EPA's preferred alternative, 5A, would involving constructing the repository on top of the existing cells on the Mill Site. Nonetheless, EPA holds open the possibility that the repository could be built elsewhere on the Mill Site. UNC/GE believe that if the Mill Site is used for the repository, placing the materials from the Mine Site over the existing tailings impoundments is the preferred approach.

[3] UNC/GE note further that the geology directly beneath the Mill Site has relatively impermeable layers within it above the groundwater that would further inhibit any potential vertical migration of water. Indeed, EPA concludes in the EE/CA (p. 30) that "[r]ecent analysis by EPA Region 6 has determined that the cells are currently not contributing to the groundwater uranium contamination underlying the UNC [Mill] Site." Since the mine spoils have a mean activity level at least an order of magnitude ***lower*** than the tailings contained in the cells, the additional soils would not increase the risk to groundwater in any event. Moreover, spoils will be drier than the optimum moisture content per ASTM D698 and drier than the respective soil's field capacity, and therefore the tendency of any soil water to move will be upward, not downward.

UNC/GE recommend that EPA consider the following facts:

- Placement of the mine spoils over the existing tailings impoundments will consolidate the waste and reduce the overall footprint on the Mill Site compared to construction of a repository elsewhere on the site that would create a new, additional waste footprint, contrary to EPA's "Superfund Green Remediation" strategy.

- The mine spoils have a lower radon flux than the tailings. As a result, placing the mine spoils over the tailings will create an additional barrier to flux, reducing overall radon emissions from the tailings cell.

- Placement of the mine spoils over the tailings cells will not results in excess settlement. Prior to capping of the tailing impoundments, UNC placed seven feet of coarse tailings over the existing tailings and compacted the existing tailings to 90 percent of their maximum dry density. The cells were closed more than 15 years ago, and primary settlement and secondary consolidation has occurred.

- Placement of the mine spoils over the tailings will not result in migration of groundwater from the tailings. As a principal matter, the tailings are unsaturated. Further, as stated in the EE/CA, EPA Region 6 has determined that "the cells are currently not contributing to the groundwater uranium contamination underlying the Mill Site." Also, the mine spoils contain very little moisture and, as discussed in report prepared by the Dr. Dwyer, installing a properly designed ET cover will essentially eliminate infiltration.

- The impoundments at the UNC Mill Site are constructed to control surface water runoff/run-on consistent with NRC, CERCLA, and DOE requirements. The deposition of mine spoils will not adversely affect the current surface water management controls in place for the tailings cells.

- There are no administrative constraints that would preclude constructing the repository on the current impoundments. UNC/GE have previously commented that no NRC license is needed for the repository. *See* Attachment D. Even if that were not the case, an amendment to UNC's existing license could be processed readily.

For all these reasons, placing the mine spoils on the existing impoundments is the most appropriate approach for constructing a repository at the UNC Mill Site.

### C. Off-site disposal of PTW is unnecessary.

In the EE/CA, EPA has defined "Principal Threat Waste" (PTW) as material containing significantly higher Uranium and Ra-226 concentrations and indicates that off-site disposal of material that contains 200 pCi/g or more of Ra-226 will lower the average Ra-226 activity level at the Mine Site from 42.2 pCi/g to 30.4 pCi/g. However, based on the data provided in the Removal Site Evaluation Report (MWH, October 2007), MWH, on behalf of UNC, has estimated that the average Ra-226 activity level at the Site, including PTW, is 29.6 pCi/g. Therefore, the current Ra-226 level is ***already*** below the average activity level EPA proposes to achieve by removing PTW.

Even assuming the accuracy of EPA's calculations, however, it only relates to the ***definition*** of PTW, not the ***disposition*** of PTW. Merely labeling materials as PTW does not provide justification for separating out those materials for off-site disposal at an out of state facility, because all waste above EPA's action level will be removed from the Mine Site in any event.

Under Alternative 5A, site material would be consolidated in an existing disposal cell on the UNC Mill site, which currently contains coarse and fine tailings with average activity levels of 154 pCi/g and 547 pCi/g, respectively. Removal and off-site disposal of an estimated 10,000 cubic yards of PTW will have no significant effect on the average activity level inside the disposal cells following remedy construction, and hence will not have an effect on long-term management considerations for the disposal cell.

In a letter from UNC/GE to EPA dated January 10, 2008, UNC presented a comparison of Ra-226 activity levels at the NECR site to levels discussed in the Agency's TENORM From Uranium Mining guidance (indicating Ra-226 activity in non-economic materials, or protore, at uranium mine sites typically ranges from 30-600 pCi/g). *See* Attachment F. In addition, UNC has identified only two other uranium mine sites remediated under CERCLA (as opposed to the hundreds of uranium mine sites reclaimed under various state reclamation programs). Those two sites, the Midnite Mine and the White King Mine, had large spoils piles with similar activity levels to NECR. The remedy selected at both those sites was consolidation and capping of uranium mine spoils on-site, and did not identify any PTW requiring off-site disposal.

In light of the added risks associated with off-site transport and disposal of PTW, Alternative 5A presents a higher risk than placement of PTW at the Mill Site. Based on the increased risk and higher costs associated with Alternative 5A, EPA should select Alternative 5 over Alternative 5A.

### D. External considerations should not impede use of the Mill Site for the repository.

EPA notes the need to consult and work with the NRC, which exercises jurisdiction over the materials in the impoundments at the Mill Site. UNC/GE previously stated the company's position regarding potential applicability of the CERCLA permit exemption to construction of the repository on the Mill Site. *See* UNC/GE's letter to EPA Region 9, March 3, 2009 (attached). Regardless of whether EPA adopts that position or concludes that an amendment to the NRC license for the Mill Site is required, UNC/GE are prepared to work with both Agencies to ensure appropriate standards are applied to the repository.

UNC/GE also note that the Navajo Nation has taken the position that the Mill Site is "Indian Country." UNC/GE respectfully disagree.

UNC/GE do not believe that the recent decision in *Hydro Resources, Inc. v. U.S. EPA,* No. 07-9506 (10th Cir., Apr. 17, 2009) (*HRI*) has any impact on this site. *HRI* is inapplicable to this situation. The court in that case reviewed a formal federal determination in the context of the Safe Drinking Water Act that the land in question was Indian Country. No such determination has ever been made for the Mill Site; to the contrary, EPA has treated the Mill Site as outside Indian Country. Even accepting the criteria applied by the 10th Circuit,[4] a determination of Indian Country requires an intensely fact-specific analysis; land does not become Indian Country based solely on a party's claim. That analysis has not been made here.

[4] The 10th Circuit Court of Appeals granted HRI's petition for en banc rehearing on August 24, 2009. It would be particularly inappropriate to conduct a federal evaluation of whether the Mill Site is Indian Country while that review is pending.

If the site-specific analysis were made here, it would demonstrate that the Mill Site is not Indian Country. *See* GE's letter to EPA dated December 11, 2008, Attachment C. In that letter, GE applies the factors of the previous HRI decision, which lead to the conclusion that the Mill Site, based on site-specific factors, is not Indian Country. The Mill Site has historically been subject only to federal regulatory jurisdiction. It is owned in fee by UNC. The federal NRC licenses the site, and EPA Region 6 oversees groundwater remediation at the Mill Site, as opposed to Region 9, which would have oversight if the Mill Site was in Indian Country. The facts here are distinguishable from the facts in that case, and the 10th Circuit in HRI emphasized that its holding is narrow and restricted to the facts of that case.

Further, regardless of any determination of Indian Country, it is not dispositive as to EPA's decision on the proper disposal site for the Mine spoils. The Mill Site may appropriately be used for the repository ***even if*** it is considered Indian Country. Nothing in law or policy provides any veto authority to an Indian tribe irrespective of whether the land in question is Indian Country, any more than a State may unilaterally determine that no waste may be disposed within its boundaries.

**E. EPA should reassess certain proposed ARARs for the Mill Site repository.**

EPA should revise the proposed ARARs in Tables A-1 and A-2 as follows:

1. NESHAPs for radionuclides (40 C.F.R. Part 61, Subpart H) should not be identified as "applicable" requirements. In Table A-1 of the EE/CA, 40 C.F.R. Part 61, Subpart H (the "Subpart H NESHAPs") is identified as "applicable to activities on the UNC NPL site." However, the Subpart H NESHAPs are applicable only to facilities "owned or operated by the Department of Energy. . . ." 40 C.F.R. § 61.90. Subpart H expressly does not apply to "disposal at facilities subject to . . . 40 C.F.R. Part 192." The UNC Mill site is a facility subject to the 40 C.F.R. Part 192 requirements for uranium mills. The Department of Energy does not own or operate the UNC Mill site. Thus, the Subpart H requirements are not applicable at the Mill site, and EPA should revise Table A-1 of the EE/CA to delete the reference to applicability.

2. Navajo Nation requirements are not applicable outside of the reservation boundary at the NECR Mine Site to activities of non-tribal members. Tables A-1 and A-2 of the EE/CA identify as applicable the substantive requirements of the Navajo Nation Pollution Discharge Elimination System program, the Navajo Nation Air Pollution Prevention Act, the Navajo Nation Clean Water Act, and the Navajo Nation Endangered Species List. However, under well-established Supreme Court and 10th Circuit precedent, these laws do not apply as a general matter to non-tribal members activities outside of the reservation boundary, including activities on trust lands such as the NECR mine site. "[T]he inherent sovereign powers of an Indian tribe do not extend to the activities of nonmembers of the tribe." *Montana v. United States,* 450 U.S. 544, 565 (1981). The law is clear that tribes have no inherent power to regulate non-members outside the boundaries of their reservations. *MacArthur v. San Juan County*, 497 F.3d 1057, 1071 (10th Cir. 2007) ("Supreme Court precedent clearly limits the regulatory authority of tribes – at least that which is derived solely from their inherent sovereignty – to the reservation's borders."); *see also id*. ("The notion that inherent sovereignty ceases at the reservation's borders is consistent with [Supreme Court precedent]."); *Plains Commerce Bank v. Long Family Land and Cattle Company, Inc., et al.*, 554 U.S. ___ , 128 S.Ct. 2709, 2720 (June 25, 2008).

3. The references to RCRA "Subtitle C" and "Subtitle D" in the first two rows, second column, of Table A-1 should be reversed. There appears to be an error in the first two

rows of Table A-1. The first row of Table A-1 pertains to “solid wastes,” and thus should reference RCRA Subtitle D. The second row addresses “hazardous wastes,” and therefore should refer to RCRA Subtitle C.

## V. The EE/CA Should Not Address Conditions on Red Water Pond Road

As discussed in UNC/GE’s comments on the Draft EE/CA (pp. 10-11) and as outlined below, UNC/GE believe that the vast majority of any impacts along and beneath Red Water Pond Road are unrelated to historical operations at NECR. EPA recognizes that possibility in the Action Memo for the 2009 IRA, at page 5:

> Elevated Ra-226 in soils near and beneath Red Water Pond Road may be associated with the historical use of this road as a haul road for [the] former mine located to the north of the NECR Mine. Due to the proximity of NECR to the southern portion of RWPR and based on local drainage patterns in this area, past operations at the NECR Mine could have caused some impacts. Additional characterization of RWPR is required to assess the scope of future removal activities.

EPA previously acknowledged in its May 30, 2007, Memorandum entitled “Request for a Time-Critical Removal Action at the NECR Residential Site #2” that Kerr-McGee used Red Water Pond Road as a haul road for the Quivira Mine, and that “[m]ine materials were likely dispersed by the haul trucks during hauling of mine materials in and out of the [Quivira mine] area.”

UNC has agreed to conduct additional characterization of Red Water Pond Road pursuant to the 2009 AOC. Any further decisions regarding that road should await that characterization.

In addition:

- The NECR Mine is geographically remote from Red Water Pond Road; wind and surface water runoff from NECR are unlikely to have transported radionuclides to this area.

- A topographic high is present immediately to the south of the road, obstructing both wind transport and surface water drainage from the NECR Site.

- Results from the RSE investigation show statistically higher activity levels along Red Water Pond Road than in areas between the NECR Mine Site and reservation, indicating that a source other than NECR has caused the impacts to Red Water Pond Road. *See* EE/CA Fig. 1-6, and UNC/GE’s letter of February 28, 2009, providing a statistical analysis of sampling results along Red Water Pond Road.

- Although Quivira reclaimed the surface of its mine, the extent of the reclamation effort is poorly documented, and the reclamation standard was significantly higher than the action level that EPA has proposed for NECR. The Bureau of Land Management (BLM, 1990) required that Quivira reclaim this mine so that gamma radiation levels would be reduced to below 50 uR/hr above background in surface areas around the roadways, mine ponds, vent holes, fence lines, etc., and 57 uR/hr above background for surfaces of the mine spoils area. A value of 50 uR/hr is approximately equivalent to 23.7 pCi/g and the value of 57 uR/hr is approximately equivalent to 27 pCi/g, approximately an order of magnitude above the action level proposed by EPA for NECR. Letter from A. Abee, BLM, to Quivira Mining Co., Oct. 9, 1990. Hence, the activity recently measured along Red Water Pond Road likely is due to historic or ongoing deposition from the Quivira mine, as well as approved cleanup levels at that site, and therefore the road as well as the area immediately adjacent to it should be excluded from this removal action.

Finally, UNC/GE are aware that EPA reached out to parties historically associated with the Quivira Mine to initiate discussions on their potential liability. UNC/GE support that effort, and believe that a separate action, including all potentially responsible parties, is the proper forum for addressing Red Water Pond Road, not artificially including it within the NECR Mine Site.

**CONCLUSION**

UNC/GE appreciate the opportunity to present these comments to EPA. We look forward to continuing to work with EPA, the Navajo Nation, and other stakeholders to ensure that the spoils at the NECR Mine Site are contained in a protective and cost-effective manner.

Attachment A

**Comments on Advance Draft**
**Engineering Evaluation and Cost Analysis**

**Northeast Church Rock Mine Site**

January 23, 2009

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P.O. Box 3077
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## I. INTRODUCTION AND OVERVIEW

United Nuclear Corporation (UNC) appreciates the opportunity to provide EPA with these comments on the Advance Draft of the Engineering Evaluation and Cost Analysis (Draft EE/CA) for the Northeast Church Rock Mine Site (NECR Mine Site, or Site). EPA provided the Draft EE/CA to UNC through GE on December 16, 2008.

UNC believes that the Draft EE/CA is a positive step forward to address conditions at the NECR Mine Site, and agrees with much of EPA's analysis and evaluation of alternatives. Nonetheless, as discussed below, there are some assumptions and positions in the EE/CA with which UNC disagrees. UNC submits these comments with the goals of improving the understanding of site conditions and supporting EPA's consideration of appropriate, cost-effective response action alternatives. These comments are not exhaustive; UNC may expand these views and provide additional comments when EPA formally issues the EE/CA for public comment and proposes a preferred Alternative for the NECR Mine Site. UNC is attaching its recent comments to the National Remedy Review Board (NRRB), which it incorporates by reference.

**<u>UNC's Interest in the NECR Mine and Mill Sites</u>**

UNC has a direct and immediate interest in the evaluation of response actions for the NECR Mine Site. Although UNC is no longer engaged in any mining activities, UNC was the historic operator of the NECR mine from approximately 1968 to 1982. UNC's operations at the site are detailed in the *Site Assessment Report* and the *Final Removal Site Evaluation Report*, prepared for UNC in 2003 and 2007, respectively. Also as discussed in those documents, UNC conducted mine closure activities at the NECR mine between 1986 and 1994, pursuant to its mining lease and under supervision of the U.S. Nuclear Regulatory Commission (NRC). UNC has conducted site evaluations at the NECR Mine Site and, in 2007, conducted a short-term removal action disposing of contaminated soils from residential areas on the Navajo reservation north of the NECR site, as directed by EPA.

The majority of the surface estate of the NECR Mine is located on land owned and held in trust by the United States for the Navajo Nation. Newmont Realty Corp. owns the minerals estate in those areas. UNC owns both the surface and mineral estate on a small portion of the former mine site, including most or all of the former storage area ("the boneyard") and the Non-Economic Materials Storage Area (NEMSA). The UNC-owned property at and adjacent to the Mine Site comprises approximately 61.2 acres located in the Southeast corner of section 34. EPA has identified UNC as the sole PRP at the NECR Mine Site, and looks to UNC to perform the selected remedy. In addition, UNC is the fee owner of the Church Rock Mill Site (the Mill Site), a former uranium mill situated on Section 2 that is contiguous to the NECR Mine Site. Ore from the NECR Mine was processed at the Mill Site. As a result, UNC is a significant stakeholder at the NECR Mine Site.

**<u>Summary of Comments</u>**

UNC generally supports EPA's analysis of alternatives in the EE/CA, particularly the evaluation of and conclusion that Alternative 2 (Excavation and Disposal Offsite of All Wastes) is the highest risk and highest cost alternative. EPA's evaluation of alternatives demonstrates that, with the exception of Alternative 2, several alternatives meet EPA's criteria for selection of a removal action, based on protection of human health and the environment, effectiveness, and implementability. Alternative 2 cannot be justified, particularly given the inherently low risks posed by the NECR Mine Site. It is an extreme remedy that would require the offsite transportation of massive amounts of soil, posing real transportation-related risks and impacts due to energy consumption and the generation of greenhouse gases (GHGs). It is also an order of magnitude more costly than the next less-expensive alternative. In accordance with EPA guidance and the National Contingency Plan (NCP), therefore, the Agency should eliminate Alternative 2 from further consideration.

UNC continues to believe that the best remedy for the NECR Mine Site is either of the on-site alternatives, Alternative 3 (On-site Consolidation and Covering of Mine Wastes) or Alternative 4 (Lined and Capped Repository on the NECR Mine Site). On-site remediation is the standard remedy for mining sites in the State of New Mexico under multiple regulatory programs, such as the New Mexico Mining Act and similar state laws and programs. It is also the standard preferred remedy under federal mining laws and CERCLA. Hundreds of mines in and near the Navajo reservation have been closed with on-site reclamation remedies, including the Quivira Mine, located on the Navajo reservation less than one-half mile from the NECR site. We are aware of only a few offsite disposal remedies for mine reclamation in the entire United States. Thus, any offsite remedy would be a substantial departure from historic practices and federal and state policy.

Most importantly, EPA concludes in the Draft EE/CA that on-site remediation would protect human health and the environment and would meet other criteria for removal actions. The Draft EE/CA concludes that Alternative 3 (on-site consolidation and capping on the mine site) "will protect human health and the environment as the mine wastes exceeding the Action Level would be consolidated and covered on the NECR Mine Site." Draft EE/CA, p. 40. Alternative 3 will also comply with ARARs. Id. The Draft EE/CA draws the same conclusions with respect to Alternative 4 (construction of an above-ground repository on the mine site). Id., pp. 43-44.

In this particular circumstance, though, UNC is the fee owner of the adjacent Mill Site. This presents an opportunity for designing a remedy that removes mine spoils from Trust lands, places them in a fenced and secured area, eliminates the risks of long distance transportation, and is still "on-site" under CERCLA and the NCP. As a result, UNC remains willing in concept to implement some version of Alternative 5 (Above-Ground Repository On the UNC Mill Facility). However, EPA should reconsider the appropriate action level, and should not impose sub-alternatives or design features that make no difference in protectiveness of the remedy (e.g., excessive cap requirements, imposition of a liner, or a requirement to separate and haul a subset of spoils).

## II. THRESHOLD COMMENTS

### A. UNC, and Not General Electric Company, is the Appropriate Party-in-Interest at the NECR Mine and Mill Sites

General Electric Company (GE) is submitting these comments on behalf of UNC, which is the appropriate party-in-interest at the NECR Mine Site. *See United States v. Bestfoods*, 524 U.S. 51 (1998). In 1997, a GE subsidiary acquired Greenwich Air Services for its aircraft engine servicing business. Greenwich Air Services had recently acquired UNC. UNC historically operated the NECR Mine Site, and continues to exist as a corporation in good standing. GE never owned or operated the NECR Mine Site or the Mill Site, nor did it ever manage waste disposal activities at these Sites.

## B. EPA's Determination of Background Radium Levels at NECR is Inconsistent With Background Concentrations in the Area

EPA selected a background concentration for NECR of 1 pCi/g, based on the results of sampling conducted from a limited area believed to be free of impacts from prior mining operations. However, actual background levels vary widely in this region. NECR is located in a geologic area (the Colorado Plateau) of high natural uranium mineralization, where background levels are often higher than 1 pCi/g. *See* EPA's *Technical Report on Technologically Enhanced Naturally Occurring Radioactive Materials from Uranium Mining* (TENORM Report), April 2008, Vol. 1, Figure 1-1 and pages 1-12 and 4-3 ("sites selected for uranium mining will generally have higher levels of natural background"). Other EPA documents cite 2 pCi/g as average background of RA-226 in soil on the Colorado plateau. Significantly higher background levels were established at two other sites in the vicinity of NECR: background at the Quivira mine just north of NECR is 4.5 pCi/g; background at the Old Church Rock Mine south of NECR is 4.3 pCi/g). *Radiological Scoping Survey Summary Report for the Old Church Rock Mine Site*, September 2007.

UNC has provided additional comments regarding the background determination in the attached NRRB submittal at p. 5. Please refer to those comments for additional details.

## C. EPA's Proposed Clean-Up Standard is Overly Conservative

The 2.24 pCi/g RA-226 action level in the draft EE/CA is overly stringent and does not consider site-specific conditions that significantly affect potential risk to human health. The RA-226 action level would be one of the lowest levels for any uranium cleanup in the country, including cleanups conducted in heavily populated residential areas. The UMTRCA unrestricted use standard set forth in 40 C.F.R. Part 192 (5 pCi/g + background) is an appropriate action level for the Site and has been widely used by EPA and other federal and state regulatory agencies at other sites. Please refer to the attached comments to the NRRB at p. 5 and 7 for further discussion of this issue.

# III. KEY ISSUES

## A. Alternative 2 (Excavation and Disposal Offsite of All Wastes) Should Be Deleted From Further Consideration

### 1. Alternative 2 is Unwarranted

Alternative 2 is a nine-year remedy involving excavation and offsite disposal of a massive volume of soil. This extreme and unprecedented remedy is wholly unwarranted from a risk-based perspective. As the discussion above shows, the Draft EE/CA concludes that there are no unacceptable risks relating to on-site disposal. Given that conclusion, there is no inherent risk that justifies excavating and removing huge volumes of soil.

### 2. Alternative 2 Will Generate Significant and Unnecessary Risks

Far from eliminating risk, Alternative 2 <u>creates</u> risk. EPA describes Alternative 2 in the Draft EE/CA as follows:

> This Alternative would incur more logistical difficulty, has a greater potential of transport incidents on the public ways and poses

> ***undue hazards to human health and the environment*** option based on trucking carbon emissions, as shown on Table 5.3. With the large number of transport miles and possibility of transport incident ***the Alternative presents a higher risk to the general public. Based on these factors Alternative 2 presents the highest risk [of the alternatives considered]***. [Emphasis added.]

UNC agrees with these conclusions. Moreover, Alternative 2 is an unprecedented departure from mine cleanups implemented under CERCLA, as well as mine cleanup and reclamation under the Navajo Nation's abandoned mine program and under numerous State programs.

EPA's analysis demonstrates that Alternative 2 is the least appropriate alternative. Alternative 2 would involve major long distance trucking of large amounts of material, which is inherently risky. EPA estimates that 871,000 cubic yards (1.26 million tons) of soil would need to be excavated from the NECR Mine Site and hauled to a licensed and permitted facility such as the U.S. Ecology facility in Grandview, Idaho – a roundtrip of ***more than 1600 miles*** through four states, and through numerous population centers including Ship Rock, New Mexico; Provo, Salt Lake City, and Ogden, Utah; and Twin Falls, Idaho. Alternative 2 would require more than 62,000 round-trips, adding up to 90 million miles and nearly 2 million hours of truck travel. Based on these facts and a 2-3 day roundtrip for each truck, EPA estimates that it would take at least nine years, in the best of circumstances, to excavate and haul all of this material to Idaho.

Major risks and potential consequences of Alternative 2 include the following:

- Risks to communities and workers from accidents that may occur during transportation such as traffic accidents; resultant spills of material during accidents; and risk of incidental releases of materials during transport,
- Consumption of limited offsite disposal capacity for extremely low-level naturally-occurring radioactive materials, and
- Large-scale emissions of greenhouse gases.

To more fully appreciate these concerns, one should consider the National Highway Traffic Safety Administration (NHTSA) data on fatality and injury rates attributable to vehicular accidents. Based on the 2006 data obtained from *Traffic Safety Facts, 2006 Data: Large Trucks* (NHTSA, 2008), transport of mine materials to the U.S. Ecology facility would yield a risk of 2 large truck crashes causing fatalities, and 36 non-fatal large truck crashes.

Implementation of Alternative 2 also would result in consumption of more than 49 million gallons of diesel fuel, causing emissions of more than 507,000 metric tons of carbon dioxide. Causing these unwarranted and avoidable impacts is contrary to EPA policy. *See Green Remediation: Incorporating Sustainable Environmental Practices into Remediation of Contaminated Sites,* EPA Pub. No. 542-R-08-002 (April 2008). According to that analysis, one of the "core elements" of green remediation is to "[m]inimize use of heavy equipment requiring high volumes of fuel." Region 9, in particular, has pioneered EPA's effort to evaluate and reduce greenhouse gas emissions from Superfund cleanups, with its "Cleanup-Clean Air Initiative."

Alternative 2 is the "least green" Alternative considered in the EE/CA. The energy and GHG impacts of this Alternative are radically higher than those projected for the other alternatives, and are wholly inconsistent with sustainable energy and climate change concerns in the U.S.

### 3. Alternative 2 is Excessively Costly

Alternative 2 is the highest cost alternative, presenting costs that are grossly disproportionate to the other alternatives evaluated in the EE/CA (est. $292MM.) The next most expensive option, Alternative 4A, is nearly an order of magnitude less (EPA estimate of $33.4MM). Yet, as discussed above, the Draft EE/CA concludes that several of the other alternatives are protective of overall human health and the environment, are implementable, and present far ***fewer*** risks.

Given these determinations, Alternative 2 does not meet NCP and CERCLA criteria. EPA acknowledges that "[c]ost is a central factor in all Superfund remedy selection decisions." *The Role of Cost in the Superfund Remedy Selection Process,* OWSER Publication 9200.3-23FS (Sept. 1996), p. 1. That guidance concludes that "[c]ost is a critical factor in the process of identifying a preferred remedy. In fact, CERCLA and the NCP require that <u>every</u> remedy selected <u>must</u> be cost-effective." Id., p. 5 (emphasis in original). The NCP provides that a remedy is only cost-effective "if its costs are proportional to its overall effectiveness." (40 C.F.R. § 300.430(f)(1)(ii)(D)). Alternative 2 does not meet this test.

In fact, the NCP provides that an Alternative can be screened out of further consideration altogether, when it provides "effectiveness and implementability similar to that of another Alternative by employing a similar method of treatment or engineering control, but at greater cost" (40 C.F.R. § 300.430(e)(7)(iii)), or when an Alternative has costs that are "grossly excessive compared to the overall effectiveness" of other alternatives. Id. Based on this, Alternative 2 should no longer be considered an acceptable option.[1]

Finally, in light of the excessive costs of and excessive implementation time for Alternative 2, UNC questions whether EPA could lawfully adopt this Alternative as a CERCLA removal action or whether, under the statute and the NCP, Alternative 2 is properly characterized as a remedial action. Under Section 104(b) of CERCLA, removal actions are generally limited to $2 million or 12 months. UNC does not believe that a response action estimated by EPA to cost $292 million and to take nine years to implement can be characterized as a removal action.[2]

## B. Offsite Disposal of "Principal Threat Waste" is Unnecessary

The so-called "principal threat waste" (PTW) can be safely and effectively contained in a repository on the Mine or Mill Site. There is no appropriate basis for requiring offsite, out-of-state disposal of these materials.

It has been standard practice in mine closure projects to dispose of mine spoils on site. The common and generally accepted practice has been to minimize potential exposure by placing

[1] While these authorities primarily discuss the role of costs in the selection of remedial action, they are plainly relevant to an evaluation of the costs of long-term removal actions like the one at hand. The EE/CA is an Engineering Evaluation/***Cost*** Analysis, and EPA guidance requires the consideration of cost in analyzing long-term removal actions.

[2] The fundamental problems with Alternative 2 should also be reflected in Table 5.1, "Summary of Comparative Analysis of Removal Action Alternatives." We have proposed specific changes to that table in Section IV.A of these comments, "Specific Issues."

material with higher activity levels in the center of a reclaimed area or cell, surrounded by materials of lower activity and, in some cases, covered by imported fill.

Extensive sampling results show that uranium and RA-226 levels at NECR are consistent with levels measured at other uranium mine sites. EPA's April 2008 TENORM Report provides data for 40+ uranium mine sites that indicates that uranium levels in low-grade ore are consistently >200-300 mg/kg and for some mine sites greater than 600 mg/kg. At the Midnite mine site in WA, mine spoils with RA-226 levels ranging up to 880 pCi/g were capped on-site.[3] In contrast to these leave-behind values in the hundreds of pCi/g at other mine sites, the draft EE/CA proposes identification and offsite disposal of PTW at NECR to reduce the average leave-behind RA-226 activity concentration from 42.2 pCi/g to 30.4 pCi/g. The repository can easily be designed to achieve the same level of protectiveness without segregating PTW and hauling it away.

Transport of PTW to a facility in Utah for beneficial reuse, while preferable to disposal in Idaho, would nonetheless present similar external cost, risk, and exposure issues as discussed above for Alternative 2. The adverse effects associated with such removal would present greater risk of harm than potential radiological exposures associated with capping the PTW at the Mine or Mill sites.

Disposal of PTW with the other NECR materials is particularly appropriate if EPA selects the Mill Site remedy. The Mill Site is a large, secured area with no access to the public or livestock. As a result, there is no realistic potential for exposure to PTW contained at the Mill Site.

### C. The Mill Site Provides an Appropriate Location for a Repository for Materials From the NECR Mine Site

#### 1. An Engineered Liner is Unnecessary For the Repository

A liner is not needed at the Mill Site in light of the lack of rainfall in the area and the characteristics of the material to be disposed. The climate in the area is arid, with average annual precipitation of only 11 inches and net pan evaporation of approximately 54 inches. Additionally, the impacted materials have a very low moisture content (on average <5%). Therefore minimal infiltration through a repository would occur. Infiltration can also be effectively controlled through the construction of an evapotranspiration (ET) cover with a capillary break, which as discussed at p.8 of the attached NRRB comments, would significantly reduce infiltration versus the cover system proposed by EPA in the EE/CA and would eliminate the need for a liner. In fact many uranium mill sites and hazardous waste sites undergoing closure are incorporating ET covers and do not include a base liner. For example, an unlined cell with an ET cover is planned for the stabilization of Moab Title I uranium mill tailings at the Crescent Junction, Utah, disposal site (Final Remedial Action Plan, February 2008). Also, EPA Region 9 approved an ET cover for the Operating Industries Inc. hazardous waste landfill, a Superfund site located in southern California (*Analysis and Design of Evapotranspirative Cover for Hazardous Waste Landfill*, Journal of Geotechnical and Geoenvironmental Engineering, May 2003). As a follow-up to our discussion on January 20th, UNC will provide additional information on the use and acceptance of ET covers.

[3] At that site, EPA relied on the NCP and its RI/FS guidance to find that the protore and waste rock did not constitute PTW because it "is not highly concentrated and the toxicity and mobility of contaminants associated with this material is largely a function of the amount of material exposed." *See* Midnite Mine Record of Decision, September 2006.

### 2. Disposal of PTW at the Mill Site is Protective and Appropriate

Because 50 pCi/g is protective of a site maintenance worker, and because the surficial cover material would contain no more than 2.24 pCi/g RA-226, removing PTW to reduce the average RA-226 concentration from 42.2 pCi/g to 30.4 pCi/g will not result in any meaningful reduction in risk. Consistent with the EE/CA and with UMTRCA standards, the cap would be constructed and maintained to provide reasonable assurance that releases of Radon-220 would not exceed an average release rate of 20 pCi per square meter per second regardless of whether PTW material is transported offsite. The cap therefore would account for any higher activity levels associated with materials EPA has identified as PTW in the EE/CA.

UNC strongly believes that a liner is not necessary for disposal of NECR materials, even if they include PTW. But if EPA nonetheless decides to require a liner at the Mill Site, it then is abundantly clear from a risk perspective that segregation and offsite disposal of PTW is not required. EPA should allow the disposal of ***all*** mine wastes in the disposal area, including PTW. Disposal of all mine wastes, including PTW, will be protective without a liner. If, despite the lack of technical or legal rationale, EPA requires the offsite shipment of PTW, then EPA should allow beneficial re-use or disposal of those materials at the closest available location, and EPA would have no legitimate basis to require a liner at the Mill Site repository.

### 3. UMTRCA Standards Should Apply to Design of the Repository

Because access to a repository built on UNC property will be restricted in perpetuity, the use of material containing up to 6 pCi/g (UMTRCA unrestricted use standard + EPA's background determination) as cover material would be conservative and would not present any unacceptable risk. The October 2007 *Removal Site Evaluation Report* concluded that a RA-226 concentration of 50 pCi/g is within EPA's risk management range of 1E-06 to 1E-04 for a site maintenance worker. Disposal on the Mill Site in this fashion not only is consistent with UMTRCA standards, but it avoids the risks and carbon emissions associated with transporting borrow material from an offsite source. Please *see* the attached comments to the NRRB at p. 6 for further discussion.

### 4. No License Amendment or Permits Will Be Required for a Mill Site Disposal Remedy

The Draft EE/CA suggests that NRC would need to amend UNC's license for the Mill Site in order to implement Alternative 5, and that this could cause "administrative hurdles." Draft EE/CA, pp. 49, 54. UNC does not believe this to be accurate. Because the Mill Site is adjacent to the Mine Site, activities necessary to support the response action would not require permits or similar administrative approvals due to the permit exemption in Section 121(e)(1) of CERCLA.

Section 121(e)(1) provides that "[n]o Federal, State, or local permit shall be required for the portion of any removal or remedial action conducted entirely onsite." 42 U.S.C. § 9621(e)(1). The purpose of the permit exemption is to facilitate the progress of cleanups by eliminating potentially burdensome and time consuming administrative requirements, while ensuring that underlying substantive requirements are achieved. "CERCLA Compliance with Other Laws Manual," OSWER Directive No. 9234.1-01 (Aug. 8. 1988), p. 1-11. The NCP, 40 C.F.R. § 300.400(e), provides as follows:

> No federal, state, or local permits are required for on-site response actions conducted pursuant to CERCLA sections 104, 106, 120, 121, or 122. The term *on-site* means the area extent of contamination and all suitable areas in very close proximity to the contamination necessary for implementation of the response action.

EPA most recently argued for an expansive reading of the permit exemption in its defense of a challenge to the consent decree for the Hudson River PCBs Site. In the consent decree, EPA had concluded that a parcel of land on the Champlain Canal, 1.4 miles away from the work area (the Hudson River), was nonetheless "on-site," because it was near the work area and the activities to be conducted on the Canal land – construction of a sediment de-watering facility – were integral to the remedial action (dredging in the Hudson River).

The Second Circuit agreed with the United States. As the court noted in its opinion:

> While EPA has indicated that "very close proximity" will generally mean adjacent to the contamination site, *see* 55 Fed. Reg. 8666, 8690 (March 8, 1990), it is plain from examples cited at the time of the [NCP] regulation's promulgation that the "very close proximity" limitation within the definition of "on-site" was intended to afford EPA some flexibility in identifying proximate sites necessary to achieve CERCLA objectives.

*Town of Fort Edward v. United States,* No. 06-5535-cv (2nd Cir., Jan. 3, 2008) (Summary Order at 4). The Mill Site plainly meets the NCP criteria for application of the permit exemption. The two parcels are historically linked: uranium ore extracted from the NECR Mine was milled at the Mill Site. The Mill Site is adjacent to the NECR Mine Site (the two parcels share a common border), which satisfies the NCP criterion of proximity and EPA's own regulatory definition. If EPA selects the Mill Site remedy, it is clearly "necessary for implementation of the response action," satisfying the second NCP criterion, as well.

Longstanding EPA guidance makes clear that the CERCLA permit exemption includes all forms of administrative requirements, not just those actually labeled as "permits." EPA explained the distinction between substantive and administrative requirements in its guidance document "CERCLA Compliance with Other Laws Manual," *supra*, at pages 1-11 to 1-12:

> Section 121(e) of CERCLA codifies EPA's earlier policy that on-site response actions may proceed without obtaining permits. This permit exemption allows the response action to proceed in an expeditious manner, free from potential lengthy delays of approval by administrative bodies. *This permit exemption applies to all administrative requirements, whether or not they are actually styled as "permits."* [Emphasis added.]
>
> * * *
>
> Administrative requirements are those mechanisms that facilitate the implementation of the substantive requirements of a statute or regulation. Administrative requirements include the approval of, or consultation with, administrative bodies, consultation, issuance of

permits, documentation, reporting, recordkeeping, and enforcement. In general, administrative requirements are made effective for purposes of a particular environmental or public health program.

The requirement to obtain or amend a license from the NRC is clearly an "administrative requirement" in that it facilitates the implementation of the substantive requirements of the NRC's regulatory program. As a result, no licensing requirements attach to the disposal of NECR materials on the Mill Site.

EPA should state its determination that the Mill site is "on-site" for the purpose of the permit exemption when it issues the EE/CA for public comment, and delete the discussion concerning potential administrative hurdles posed by this alternative.

## D. Some of EPA's Proposed Applicable or Relevant and Appropriate Requirements (ARARs) Are Not ARARs

EPA should delete or clarify the following requirements identified in ARARs Tables A-1, A-2 and A-3, as well as in EPA's evaluation of compliance with ARARs:

### 1. NESHAPs for Radionuclides (40 C.F.R. Part 61, Subpart H) are not Applicable

The Mill site is expressly excluded from 40 C.F.R. Part 61, Subpart H requirements ("Subpart H requirements").

Table A-1 of the EE/CA states that the requirements of Subpart H are "applicable to activities on the UNC NPL site." To the contrary, Subpart H requirements only apply to a facility "owned or operated by the Department of Energy. . . ." 40 C.F.R. § 61.90. Subpart H expressly does not apply to "disposal at facilities subject to . . . 40 C.F.R. Part 192."

The Department of Energy does not own or operate the UNC Mill site. Thus, the Subpart H requirements are not applicable at the Mill site. Instead, the Mill site is subject to Subpart D, 40 C.F.R. Part 192, which "applies to the management of uranium byproduct materials under section 84 of the Atomic Energy Act of 1954 . . . during and following processing of uranium ores. . . ."

### 2. Navajo Nation Laws

Navajo laws are generally neither "applicable" or "relevant and appropriate" (ARARs) under 42 U.S.C. §121(d) of CERCLA on fee lands outside the reservation, and on non-Trust lands outside the reservation. UNC will provide a further analysis of Navajo Nation ARARs in comments when the final EE/CA is available for public comment.

### 3. New Mexico Hazardous Waste Management Regulations Do Not Apply to Mining Wastes

ARARs Table A-3 identifies the New Mexico hazardous waste management regulations at NMAC 20.4 as potentially applicable to "wastes that are subject to the Act." The "Requirement Synopsis" column in Table A-3 properly recognizes that "source, special nuclear and byproduct material" are excluded from New Mexico and federal hazardous waste regulation. That column should further specify that waste from the extraction, beneficiation and processing of ores and minerals, including uranium ore, are excluded from New Mexico and federal hazardous waste regulation. 40 C.F.R. § 261.4(b)(7); NMAC 20.4.1.200 (incorporating by reference 40 C.F.R. Part 261).

## E. The EE/CA Should Not Address Conditions on Red Water Pond Road

On November 20, 2008, UNC submitted a Work Plan to EPA for conducting an interim removal action on the step out area on the reservation to address impacts potentially related to the NECR site. The Work Plan proposed removing materials from the unnamed arroyo to the confluence with the east-west running arroyo and removing shallow soils above the action level on the reservation. The proposed limits for shallow soil removal were south to the border with the NECR Mine Site, west to the unnamed arroyo, north to the east-west running arroyo, east to 50 feet west of Red Water Pond Road. However, on Table 3.1 of the EE/CA, EPA has included Red Water Pond Road in its volume calculations. UNC does not believe that impacts at Red Water Pond Road are related to NECR.

EPA's unilateral order for the Homesite Removal Action (paragraph 7.a) noted that the area in the vicinity of the home sites, including Red Water Pond Road, is located on the former Kerr-McGee Quivira mine lease area a short distance to the north/northeast of the NECR mine. More specifically, EPA's May 30, 2007 Memorandum entitled "Request for a Time-Critical Removal Action at the NECR Residential Site #2" (Action Memo) acknowledges that Kerr-McGee used Red Water Pond Road as a haul road and that "[m]ine materials were likely dispersed by the haul trucks during hauling of mine materials in and out of the [Quivira mine] area." In addition, the roadbed itself may have been constructed using waste rock or non-economic material from the Quivira mine.

In light of these facts, there is no basis for EPA to presume that the NECR Mine is the source of any elevated levels of radium-226 or radium-228 adjacent to and on Red Water Pond Road. In addition:

- The NECR Mine is geographically remote from Red Water Pond Road and wind and surface water runoff from NECR are unlikely to have transported radionuclides to this area.
- A topographic high is present immediately to the south of the road, obstructing both wind transport and surface water drainage from the NECR site.
- Results from the RSE investigation show higher activity levels along Red Water Pond Road than in areas between the NECR Mine Site and reservation, indicating that a source other than NECR has caused the impacts to Red Water Pond Road.
- EPA must consider that, although Quivira reclaimed the surface of its mine, the extent of the reclamation effort is poorly documented, and the reclamation standard was significantly higher than the action level that EPA has proposed for NECR. The Bureau of Land Management (BLM, 1990) required that Quivira reclaim this mine so that gamma radiation levels would be reduced to below 50 uR/hr above background in surface areas around the roadways, mine ponds, vent holes, fence lines, etc., and 57 uR/hr above background for surfaces of the mine spoils area. A value of 50 uR/hr is approximately equivalent to 23.7 pCi/g and the value of 57 uR/hr is approximately equivalent to 27 pCi/g, approximately an order of magnitude above the action level proposed by the

Region for NECR. Letter from A. Abee, BLM, to Quivira Mining Co., Oct. 9. Hence, the activity recently measured along Red Water Pond Road likely is due to historic or on-going deposition from the Quivira mine, and therefore the road as well as the area immediately adjacent to it should be excluded from this removal action.

As we discussed on January 20th, UNC will provide additional information and analysis supporting its comments with respect to Red Water Pond Road.

### F. The Draft EE/CA Appropriately Reflects the Navajo's Consultative Role at the NECR Mine Site in the EE/CA Process, Rather Than a Concurrence or Veto Role

The Draft EE/CA states that EPA has consulted with the Navajo Nation and has considered the Navajo's interests in the preparation of the EE/CA. Draft EE/CA, p. 2. The consultative role of Indian tribes under CERCLA does not provide tribes with veto power over EPA's selected response action, nor does it contemplate formal concurrence on EPA's eventual selection of a response action. In accordance with EPA guidance the Navajo Nation's consultative role in this situation is limited to the evaluation of response actions on the NECR Mine Site itself. It does not extend to the Mill Site, which is privately-held fee land.

EPA Region 9 policy recognizes that Indian tribes, like states, do not have veto power or formal rights of concurrence for EPA's selected response actions:

> [U]nder the National Contingency Plan, neither states nor tribes have a right of concurrence on EPA's selection of a Record of Decision for remedy selection.

EPA Region 9 Memorandum*, Approach to Consultation with Tribal Governments Regarding Non-Enforcement Related Matters* (October 25, 2005). While this language pertains to remedial actions, there is no basis to distinguish the tribal role in EPA's selection of a removal action under an Action Memorandum.

EPA has cited the federal government's trust responsibility for Native Americans as part of its rationale for providing consideration of Navajo views on the preferred alternatives. The general rule is that government agencies can fulfill the trust duty by compliance with statutes in the same way as for non-Indians. *US v. Mitchell*, 463 U.S. 206, 103 S.Ct. 2961 (1983); *Morongo Band of Mission Indians v. FAA*, 161 F.3d 569 (1998). There can be no trust responsibility for activities and remedies involving the Mill Site, as it is on private fee land outside the reservation and outside "Indian Country." *See Alaska v. Native Village of Venetie*, 522 U.S. 520 (1998). Regardless of the land ownership in question, the trust responsibility does not create a coequal regulatory relationship or any veto or concurrence authority by an Indian tribe.

EPA also cites its *Policy for the Administration of Environmental Programs on Indian Reservations* (November 11, 1984) ("Indian Policy"). However, that policy only applies to ***reservation*** lands, not to ***trust*** lands like the NECR Mine Site or private lands like the Mill Site. Even if it were to apply, the Indian Policy notes that the federal trust responsibility only "assure[s] that tribal concerns and interests ***are considered*** whenever EPA's actions and/or decisions may affect reservation environments." EPA Indian Policy, § 5 (emphasis added).

The steps that EPA has taken to involve the Navajo Nation in this process go beyond what is required under the law and EPA policy. Ultimately, EPA has an independent obligation under

CERCLA and the NCP to select a response action for the NECR Mine Site that meets relevant statutory and regulatory criteria.

## IV. SPECIFIC ISSUES/CORRECTIONS

### A. EPA Should Revise Table 5.1, to Reflect Fundamental Problems With Alternative 2

- Table 5.1 does not reflect the serious technical feasibility and services issues associated with Alternative 2 identified in the text. The Draft EE/CA (p. 55) recognizes that the availability of low level radiation material haulers available is more finite than for other materials, and that the number and duration of truck trips required is very high. The Draft EE/CA further states that "the number of specialized transporting resources is also very high," that securing adequate trucking resources for nine work seasons "will be a challenge," and that Alternative 2 will "incur more logistical difficulty" than other alternatives. Id. To the contrary, the summary in Table 5.1 summarizes Alternative 2 as "Technically and administratively feasible. Services and materials are commercially available." The Table should be modified to reflect the text.

- Under protection of human health and the environment, EPA should state that Alternative 2 will result in substantial carbon emissions from the almost 100 million miles and 2 million hours of truck travel necessary for implementation of this alternative. Additionally, Alternative 2 does not eliminate maintenance as stated on the Table; it simply shifts maintenance to another location.

- Alternative 2 does not reduce the toxicity, mobility or volume of the NECR mine spoils as stated on the Table. Under the NCP, reduction of toxicity, mobility or volume is a distinguishing factor when it is achieved through treatment or recycling. *See, e.g.,* 40 C.F.R. § 300.430(e)(9)(iii)(D).

- The energy consumption and greenhouse gas emissions are radically higher for Alternative 2 than those projected for the other alternatives. Short term risks arising from the massive number of high mileage truck trips, and associated road maintenance, noise, traffic, potential for accidents, and risk of spills are much greater for Alternative 2 than other alternatives. EPA should revise Table 5.1 to reflect the Draft EE/CA's statement that Alternative 2 "presents the highest risk" of the alternatives (p. 55), and that it will take the longest time to implement.

### B. EPA Should Correct Certain Errors and Omissions in the Draft EE/CA

1. In the Executive Summary, EPA states that the Mine Site is "located within Navajo Nation Tribal Trust Lands." Page vii. However, a portion of the Mine Site is fee land owned by UNC. UNC suggests that EPA revise the paragraph to state:

> United Nuclear Corporation (UNC) conducted operations at a uranium mine on the NECR Mine Site from 1968-1982. The majority of the surface estate of the NECR Mine Site is located on land owned and held in trust by the United States for the Navajo Nation. Newmont Realty Corporation owns the mineral estate in those areas. UNC owns both the surface and mineral estate on a portion of the former mine site, including most or all of the boneyard and NEMSA areas. The UNC-owned

property comprises approximately 61.2 acres located in the Southeast corner of section 34. In addition, UNC is the fee owner of the Church Rock Mill Site (the "Mill Site"). The Mill Site is a former uranium mill situated on Section 2 that is contiguous to and southeast of the NECR Mine Site. Ore from the NECR Mine was processed at the Mill Site.

2. UNC requests that EPA revise the second paragraph on Page vii. The site ponds were used as "mine-water settling ponds" and not as "wastewater processing ponds."

3. UNC requests that EPA revise the third paragraph on Page vii. The reference to "contaminated water from dewatering activities" should be revised to indicate "ground water from mine dewatering activities."

4. In addressing background in the Executive Summary, the Draft EE/CA states the "worldwide (crustal) average of radium in soil is 1.0 pCi/g." Page viii. The EE/CA should acknowledge that RA-226 background levels are generally higher on the Colorado plateau (reportedly 2 pCi/g average), as recognized in several EPA documents. *See also* the attached comments to the NRRB at Page 5 for further details.

5. UNC requests that EPA revise the discussion in the third paragraph on Page 2 regarding land use. The Mine Site is fenced and is not currently used for grazing. The site is part of a 1,817 grazing permit (Contract No. CP-06-16-173) the Bureau of Indian Affairs issued to Alta A. Yazzie, Delbert Yazzie, and Tony Tom. The permit holders do not reside adjacent to the NECR Mine Site.

6. UNC requests that EPA revise the discussion regarding the home site removal action to more accurately describe the two separate removal actions. The home site removal action is discussed in the Executive Summary on Page vii, 4$^{th}$ paragraph; on Page 6 under Section 1.3.3; and on Page 15, 4$^{th}$ paragraph. The text should clarify that EPA conducted two home site removal actions. EPA issued UNC an order to dispose of soils excavated by EPA from Home Sites 4, 6, 7, 8, and 9 (comprising of three residences) located west of Red Water Pond Road. EPA then conducted a second removal and disposal action from an additional home site located east of Red Water Pond Road. EPA did not involve UNC in the second removal action, which was in proximity to the Quivira former haul road and mine.

7. The first bullet under Section 1.3.2 should be revised to read, "Removal of contaminated sludge or sediments from the mine water settling ponds, the sandfill areas, and the sediment pad area."

8. UNC requests that EPA revise the last sentence on Page 5, under Section 1.3.1, to accurately reflect that UNC continues to operate recovery wells in Zone 3 of the Gallup Formation.

9. The first sentence of the last paragraph of Section 1.5.1 on Page 9 states "Cleanup activities have removed or buried some of the waste tailings." While tailings sands were pumped into the mine stopes under permit to provide additional mine stability, UNC removed tailings from surface areas at NECR to NRC's satisfaction as part of its mine closure activities (*see* NRC letter of October 31, 1989). Mine spoils, not tailings, are the focus of this EE/CA. This sentence should therefore be stated more generically, *i.e.*, "Cleanup activities have removed or buried some of the mine wastes."

10. In discussing site restoration activities and capping in various sections (e.g., Section 3.3.3 and 3.4.3) EPA assumes clean backfill will be available from a local source. UNC observes that the background and cleanup levels have been set so low in the Draft EE/CA that it cannot be assumed that clean backfill will be able to be sourced locally in the quantities required for capping, site restoration, etc., and this may significantly increase costs, delay cleanup, and impact all of the active removal alternatives.

11. On Page 24, EPA references conducting a Natural and Cultural Resources Survey by a Navajo Nation Archeologist. UNC requests that the text be revised to indicate that a Navajo Nation Archeologist conducted a Natural and Cultural Resources Survey of the 125-acre Mine Permit Area in 2005.

12. Consistent with the comments above regarding Red Water Pond Road, UNC requests that EPA revise the description of the residential "step-out" area on Page 10 to eliminate reference to Red Water Pond Road.

## V. CONCLUSION

EPA should select on-site remediation at the NECR Mine Site, the concept behind both Alternative 3 and 4. The draft EE/CA concludes that these alternatives are protective of human health and the environment, satisfy ARARs, are implementable, and are cost-effective. As a result, CERCLA and the NCP mandate on-site remediation. It is for good reason that on-site remediation is the accepted remedial approach for mine sites across the country. The inherently low risks presented by large-volume, low concentration soils associated with historic mine activities are best dealt with in place.

However, because UNC is a fee owner of the adjacent Mill site, UNC has indicated to EPA its conceptual willingness to site a repository for the NECR mine spoils on its adjacent mill property, off Tribal land in a fenced and secured facility. That remedy provides a redundant level of protection given the already low risks of in-situ remediation. Nonetheless, should EPA select Alternative 5 (Mill site disposal), EPA should reconsider the appropriate action level. EPA also should not impose sub-alternatives or design features that do not make the response action any more protective of human health and the environment (e.g., excessive cap requirements, imposition of a liner, or a requirement to separate and haul a subset of spoils).

There can be no doubt that Alternative 2 – long-haul, offsite disposal – is unacceptable. This approach would break unjustifiably with the established methods for addressing mine waste. The risks, and the environmental and energy impacts associated with this Alternative would be unavoidable and severe. It would take nine years to implement, and the costs are an order of magnitude above the next less-costly alternative. In short, EPA cannot lawfully justify selection of that Alternative under CERCLA and the NCP and should delete it from further consideration in the EE/CA.

# Attachment B

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Andrew Bain
U.S. Environmental Protection Agency
Region 9 (SFD-8-2)
75 Hawthorne Street
San Francisco, CA 94105

January 14, 2009

**Re: Northeast Church Rock Mine Site**
**Comments on Advance Draft EE/CA for National Remedy Review Board**

Dear Mr. Bain:

On behalf of United Nuclear Corporation, we appreciate the opportunity to review EPA's Advance Draft Engineering Evaluation and Cost Analysis (EE/CA) for the Northeast Church Rock Mine Site, provided to us on December 16, 2008, as well as the opportunity to provide input for the National Remedy Review Board's consideration (enclosed).

We look forward to meeting with EPA on January 21, 2009, to discuss the Draft EE/CA. As agreed, we will provide additional written comments to EPA by January 23, 2009. In the meantime, please call Lance Hauer or me if you have any questions. Thank you.

Sincerely,

For

Randall L. McAlister

cc: E. Adams, EPA
M. Montgomery, EPA
H. Karr, EPA
J. Gardner, GE
L. Hauer, GE

**COMMENTS FOR THE NATIONAL REMEDY REVIEW BOARD ON EPA REGION 9's ADVANCE DRAFT ENGINEERING EVALUATION AND COST ANALYSIS FOR THE NORTH EAST CHURCH ROCK MINE SITE**

January 14, 2009

## I. Introduction

General Electric Company submits these comments on behalf of United Nuclear Corporation (UNC).[1] UNC appreciates the opportunity to provide comments to the National Remedy Review Board on the advance draft Engineering Evaluation and Cost Analysis (EE/CA) for the Northeast Church Rock Mine Site (the "NECR Site") prepared by Region 9 (the Region.) The draft EE/CA lists five "removal" alternatives, but does not identify a preferred alternative.

UNC has a direct and immediate interest in the evaluation of response action alternatives and the selection of an appropriate remedy for the NECR mine site. The Region has identified UNC as the sole potentially responsible party to implement any selected response action for the site. Although UNC is no longer engaged in any mining activities, UNC was the historic operator of the NECR mine from approximately 1968 to 1982. UNC conducted mine closure activities at the Site between 1986 and 1994 pursuant to its mining lease and under supervision of the U.S. Nuclear Regulatory Commission (NRC). UNC also conducted a short-term removal action in 2007 under EPA direction, disposing of contaminated soils from a residential area near the Site.

## II. Summary of Comments

UNC believes that the proper remedy for the NECR Site is consolidation and capping on the mine site itself, as conceptually proposed in Alternatives 3 and 4. In the draft EE/CA, the Region concludes that these Alternatives would be protective of human health and the environment. UNC agrees with the Region that Alternative 2, long distance hauling and disposal, is the highest risk alternative. Alternative 2 would take more than twice as long to implement than all other options (9 years minimum vs. 2-3 years for other alternatives), cost an order of magnitude more than all other options ($292MM vs. $25-43MM), and have dramatically greater environmental and human health impacts.

In this particular circumstance, UNC owns fee property adjacent to NECR, at which UNC previous operated a uranium mill (the Mill site). There is ample room at the Mill site to construct a repository for the NECR materials. While UNC believes the Region should select either Alternative 3 or 4, the neighboring Mill site presents an opportunity to implement a relatively cost-effective response that removes mine spoils from trust lands but still provides for "on-site" disposal within the meaning of CERCLA and the NCP. The Mill site removal alternative is evaluated in the EE/CA as Alternative 5. UNC has informed the Region that UNC is conceptually willing to implement some version of Alternative 5, although UNC conceptually prefers Alternatives 3 and 4, and would implement those options as well.

Nonetheless, as detailed below, UNC has several concerns about the evaluation of

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[1] GE Aircraft Engines acquired UNC in September 1997 incidental to its acquisition of Greenwich Air Services, an aircraft engine services company that acquired UNC. UNC continues to exist as a corporation in good standing.

alternatives in the EE/CA and the basis for estimating the protectiveness and costs of each. UNC requests that the Remedy Review Board evaluate the following issues:

- ***Whether EPA should reject an on-site remedy that is protective and is the established and accepted approach for mine closure and cleanups;***

- ***Whether EPA should reject an alternative that would require long-haul, off-site disposal over nearly a decade, when the risks, environmental and energy impacts, and costs of that alternative far exceed every other alternative;***

- ***Whether the assumptions for, and calculations of, the Region's proposed cleanup level for the NECR Site are appropriate and consistent with other sites;***

- ***Whether EPA should require a liner for containing materials removed from the NECR Site, and***

- ***Whether EPA may require the long-haul, off-site disposal of so-called "Principal Threat Waste" (PTW) when there is no technical basis for that requirement.***

## III. On-Site Remediation is Appropriate

On-site closure or reclamation in place is the accepted, protective practice for mine sites, including uranium mines. It is the standard remedy for mining sites in the State of New Mexico under multiple regulatory programs, such as the New Mexico Mining Act and similar state laws and programs. It is also the standard preferred remedy under federal mining laws and CERCLA. Hundreds of mines in and near the Navajo reservation have been closed with on-site reclamation "remedies," including the Quivira Mine, located on the Navajo reservation less than one-half mile from the NECR site.

The primary reason that on-site consolidation is the accepted remedy for mine sites is that these sites typically present issues of large volume, low-risk waste that make off-site hauling of soils impractical, unnecessary to protect public health and not cost-effective. That is the case here.

The Region's own conclusions support on-site disposal. The draft EE/CA concludes that Alternative 3 (on-site consolidation and capping on the mine site) "will protect human health and the environment as the mine wastes exceeding the Action Level would be consolidated and covered or covered in-situ on the NECR mine site." Draft EE/CA, p. 40. Alternative 3 will also comply with ARARs. *Id.* The draft EE/CA draws the same conclusions with respect to Alternative 4 (construction of an above-ground repository on the mine site). Draft EE/CA, pp. 43-44.

As a result, EPA should identify disposal on the NECR site as the preferred alternative. The analysis presented in the EE/CA shows that on-site remediation is protective, attains ARARs, and is cost-effective. On-site disposal would significantly reduce the time needed to carry out the removal, would eliminate risks and costs associated with transportation (discussed below), would achieve exposure reduction equivalent to the other alternatives, and is the most cost-effective alternative.

**IV. EPA Should Eliminate Alternative 2 From Further Consideration Because It Is Unnecessary and Presents Unacceptable Risks and Excessive Costs**

A. Alternative 2 is Unnecessary

Alternative 2 is a 9-year remedy involving the excavation and off-site disposal of a massive amount of soil. This extreme and unprecedented remedy is wholly unnecessary from a risk-based perspective. As the discussion above shows, the draft EE/CA concludes that there are ***no unacceptable risks*** relating to on-site disposal. Given that conclusion, there is no inherent risk that justifies excavating and removing huge amounts of soil.

B. Alternative 2 Will Generate Significant And Unnecessary Risks

Far from ameliorating risk, Alternative 2 ***creates*** risk. The Region sums up Alternative 2 in the Draft EE/CA as follows:

> This alternative would incur more logistical difficulty, has a greater potential of transport incidents on the public ways and poses ***undue hazards to human health and the environment*** option based on trucking carbon emissions, as shown on Table 5.3. With the large number of transport miles and possibility of transport incident ***the alternative presents a higher risk to the general public. Based on these factors Alternative 2 presents the highest risk [of the alternatives considered.]*** [Draft EE/CA, p. 55, emphasis added.]

UNC agrees with these conclusions. Moreover, Alternative 2 is an unprecedented departure from mine cleanups implemented under CERCLA, as well as mine cleanup and reclamation under the Navajo Nation's abandoned mine program and under numerous State programs.

Offsite transport of almost 900,000 cubic yards of soil to the U.S. Ecology facility in Grandview, Idaho, as described in the draft EE/CA (p. 21), would generate significant external costs and risks in connection with the large number of truck trips and associated road maintenance, noise, traffic, risk from accidents, higher fuel usage and increased emissions of green house gases. The human health risk associated with such action cannot be justified, particularly in light of the Region's determination that on-site remediation (including at the Mill site) meets the criteria for removal actions and does not present these impacts.

The likely truck route from the Site to the Grandview, Idaho facility is approximately 800 miles each way, and runs on interstate and primary highways from New Mexico through Colorado, Utah, and into Idaho. UNC estimates that transporting almost 900,000 cubic yards of material would require ***more than 62,000 round-trips***, resulting in ***almost 100 million miles*** traveled and requiring more than ***2 million hours*** of truck travel.

The National Highway Traffic Safety Administration (NHTSA) compiles data on fatality and injury rates attributable to vehicular accidents. Based on 2006 data from *Traffic Safety Facts, 2006 Data: Large Trucks* (NHTSA, 2008), transport of mine materials to the U.S. Ecology facility yields the risk of 2 large truck crashes resulting in fatality, and

36 large truck crashes resulting in injury. Additionally, potential health risks to nearby residents or people along the route can occur due to spills of material during truck accidents and accidental releases of materials during transport. .

Implementation of Alternative 2 would result in consumption of more than 49,000,000 gallons of diesel fuel, causing emissions of more than 507,000 metric tons of carbon dioxide. Causing these unwarranted and avoidable impacts is contrary to EPA policy. *See Green Remediation: Incorporating Sustainable Environmental Practices into Remediation of Contaminated Sites,* EPA Pub. No. 542-R-08-002 (April 2008). According to that analysis, one of the "core elements" of green remediation is to "[m]inimize use of heavy equipment requiring high volumes of fuel." Region 9, in particular, has pioneered EPA's effort to evaluate and reduce greenhouse gas emissions from Superfund cleanups, with its "Cleanup-Clean Air Initiative."

Alternative 2 is the "least green" alternative considered in the EE/CA. The energy and GHG impacts of this alternative are radically higher than those projected for the other alternatives, and are wholly inconsistent with sustainable energy and climate change concerns in the U.S.

C. Alternative 2 Is Excessively Costly

Alternative 2 is the highest cost alternative, presenting costs that are grossly disproportionate to the other alternatives evaluated by the Region (est. $292MM.) The next most expensive option, Alternative 4A, is nearly an order of magnitude less (EPA estimate of $33.4MM). Yet, as discussed above, the Region concludes in the draft EE/CA that several of the other alternatives are protective of overall human health and the environment, are implementable, and present far fewer risks. The NCP provides that a remedy is only cost-effective "if its costs are proportional to its overall effectiveness." (40 C.F.R. § 300.430(f)(1)(ii)(D)).

Given these determinations, Alternative 2 does not meet NCP and CERCLA criteria. EPA acknowledges that "[c]ost is a central factor in all Superfund remedy selection decisions." *The Role of Cost in the Superfund Remedy Selection Process*, OWSER Publication 9200.3-23FS (Sept. 1996), p. 1. That guidance concludes that "[c]ost is a critical factor in the process of identifying a preferred remedy. In fact, CERCLA and the NCP require that every remedy selected must be cost-effective." Id., p. 5 (emphasis in original).

The NCP provides that an alternative can be screened out when it provides "effectiveness and implementability similar to that of another alternative by employing a similar method of treatment or engineering control, but at greater cost" (40 C.F.R. § 300.430(e)(7)(iii)), or when an alternative has costs that are "grossly excessive compared to the overall effectiveness" of other alternatives. *Id.* Alternative 2 should no longer be considered an acceptable option.[2]

[2] UNC questions whether EPA could lawfully adopt this alternative as a CERCLA removal action or whether Alternative 2 is properly characterized as a remedial action. UNC does not believe that a response action estimated by EPA to cost $292 million and to take nine years to implement can be characterized as a removal action.

## V. The Region's Proposed Cleanup Level For The NECR Mine Site Is Inappropriate And Unwarranted

### A. The Reasonably Anticipated Future Land Use of the Site is Livestock Grazing, Not Residential

The Site is a former underground uranium mine. The Site is currently inactive, and human receptors at the Site are limited to facility oversight, security personnel, and UNC representatives. It is fenced to restrict access by livestock. Consistent with reasonably anticipated future land use practices, the future use should be characterized as grazing. The Navajo Nation has acknowledged this.[3]

Notwithstanding, the Human Health Risk Assessment (HHRA) for the site referenced in the EE/CA includes ***residential*** exposure assumptions. The NCP specifies that "only potential exposures that are likely to occur will be included in the assessment of exposures." NCP preamble, 55 Fed. Reg. 8710 (March 8, 1990). Residential exposure is inappropriate for a former uranium mine site. EPA should change the land use categorization to grazing use.

### B. The Background Level Of Ra-226 Established For The Site Is Erroneous

The Region made a significant error in calculating the background level of 1 pCi/g radium (which in turn was used to calculate the 2.24 pCi/g action level to be applied at the Site.) Draft EE/CA, p. 13. The NRRB should recommend that additional samples be taken in the surrounding area to factor into the calculation of the background level of Ra-226 for the site and step-out area.[4]

NECR is located in a geologic area (the Colorado Plateau) of high natural uranium mineralization, where background levels are often higher than 1 pCi/g. See EPA's *Technical Report on Technologically Enhanced Naturally Occurring Radioactive Materials from Uranium Mining* (hereinafter, TENORM Report), April 2008, Vol. 1, Figure 1-1 and page 1-12 (noting that elevated background concentrations of Ra-226 are found in areas with uraniferous sedimentary rocks, such as those found at NECR).[5] EPA has previously stated that "the average background concentration of Ra-226 throughout the

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[3] *See Navajo Nation Position Paper Regarding Current and Potential Land and Resource Uses for the Northeast Church Rock Site* at page 6 (undated, provided to UNC by EPA March 3, 2008) ("Without question the only reasonably anticipated future use for the Northeast Church Rock Site and the surrounding area is livestock grazing."). More recently, the Navajo Nation has sought to move away from this conclusion.

[4] The "step out area" is an area on the Navajo reservation adjacent to the mine permit area.

[5] Although this document confirms background levels of Ra-226 are generally lower in the Eastern U.S. than in the West, background levels at Ra-226 sites UNC has been able to identify in the Eastern U.S. have generally been set at levels equal to or higher than the background determined for the NECR site despite the fact that NECR is located in an area of natural uranium mineralization. Eastern sites with the same or higher Ra-226 background levels include the Kerr McGee West Chicago site in IL (Ra-226 background = 2.2 pCi/g); Fields Brook, Ashtabula, OH (Ra-226 background = 2 pCi/g); Austin Ave. Radiation Site, Delaware Co., PA (Ra-226 background = 1.6 pCi/g); and the Glen Ridge Radium, West Orange Radium and General Gas Mantle sites, all located in NJ (Ra-226 background = 1 pCi/g).

Colorado Plateau is about 2 pCi/g." *Detailed Comments by the U.S. Environmental Protection Agency on the Draft Environmental Impact Statement for the Remediation of the Moab Uranium Mill Tailings Grand and San Juan Counties, Utah* (p. 19).

At the Quivira mines, located immediately north of NECR, the background gamma exposure rate is 9 uR/hr (Quivira, 1987), equivalent to 4.5 pCi/g. At the Old Church Rock Mine facility located south of the NECR site, the Navajo Nation Superfund program and EPA determined that the average background concentration of radium-226 is 4.3 pCi/g. *Radiological Scoping Survey Summary Report for the Old Church Rock Mine Site*, Navajo Nation EPA and EPA Region 9 Superfund Division, September 2007. The NRC approved a Ra-226 soil background value for the Bluewater Mill Site in New Mexico (~50 miles from NECR) of 1.9 pCi/g, and both the NRC and EPA approved a Ra-226 soil background value for the Homestake Mining Company Mill Site in New Mexico (also ~50 miles from NECR) of 5.5 pCi/g *"Second Five-Year Review Report for the Homestake Mining Co. Superfund Site)*, EPA Region 6, September 2006, at p. 16.

C. The Region's Action Level Does Not Take Into Account The Action Level Established For the Nearby Quivira Mine

The 2.24 pCi/g action level proposed in the draft EE/CA (p. 13) does not account for uranium left from the approved and permitted remediation of the Quivira Mine located just north of the NECR site. The Bureau of Land Management (BLM, 1990) required that Quivira reclaim this mine so that gamma radiation levels would be reduced to below 50 uR/hr above background in surface areas around the roadways, mine ponds, vent holes, fence lines, etc., and 57 uR/hr above background for surfaces of the mine spoils area. A value of 50 uR/hr is approximately equivalent to 23.7 pCi/g and the value of 57 uR/hr is approximately equivalent to 27 pCi/g, approximately an order of magnitude above the action level proposed by the Region for NECR. Letter from A. Abee, BLM, to Quivira Mining Co., Oct. 9, 1990.

D. EPA Should Use the UMTRCA Standard As the Site Action Level

The UMTRCA standard set forth in 40 C.F.R. Part 192 (5 pCi/g + background) is an appropriate action level for the Site. Even using an unrealistically low background concentration for the area of 1.0 pCi/g (as in the draft EE/CA, p. 13), the action level for NECR based upon the UMTRCA standard would be 6 pCi/g. Using an action level of 2.24 pCi/g rather than a more appropriate standard of 6.0 pCi/g unnecessarily adds approximately 200,000 cubic yards of soil to the remedy estimate.

EPA expressly acknowledges that the UMTRCA standard is a health-based level developed to ensure protective conditions assuming an unrestricted use scenario. *Standards for Cleanup of Lands and Buildings Contaminated with Residual Radioactive Materials from Inactive Uranium Processing Sites*, 48 Fed. Reg. 590 et seq.; *Use of Soil Cleanup Criteria in 40 CFR Part 192 as Remediation Goals for CERCLA Sites,* Office of Superfund Remediation Technology Information (ORTI) Directive No. 9200.4-25. DOE, with EPA's approval, used UMTRCA standards to remediate interior walls of residential homes at the Monticello Utah Superfund site.

The Part 192 UMTRCA standard has been widely adopted and implemented. It has been:

- Cited for use in cleanup of radioactively contaminated soils under Superfund in EPA's 2007 TENORM guidance (at 4-15).

- Supported for use as a cleanup level in EPA's own CERCLA guidance: *See* OSWER Directive 9200.4-18 (listing Part 192 as ARAR for establishing cleanup levels for radioactive contamination at CERCLA sites); ORTI Directive 9200.4-25 (recognizing that 5 pCi/g > background is health-based standard for use in unrestricted areas).

- Widely applied by EPA at residential sites around the country, including suburban neighborhoods in NJ, PA, IL, CO and elsewhere.[6]

- Adopted by State Conference of Radiation Control Program Directors.

- Accepted and applied by NRC, DOE and USACE.

E. The Region Grossly Exaggerated Risk Assessment Scenarios To Generate An Overly Stringent Cleanup Level

UNC performed the Human Health Risk Assessment under the direction of the Region. The Region directed that UNC assume 100% of the meat and eggs, and 50% of homegrown produce consumed by local residents are raised directly within the mine spoils or areas impacted by mine spoils. Such assumptions are wholly unrealistic and result in overestimation of risk.

Based on the amount of land required to support a grazing animal in this arid environment, as well as grazing limits established by the Bureau of Indian Affairs, even if the mine spoils area were grazed, grazing animals would of necessity obtain the great majority of their forage elsewhere. The 1987/1988 National Food Consumption Survey, as cited in EPA's *Exposure Factor's Handbook*, states that only 12.7% of respondents living in the Western US reported consuming homegrown vegetables. In light of the extreme arid environment, and the extreme winters in the area which result in a short growing season, the percentage of residents within McKinley County that consume homegrown produce is likely even lower. The result of using these unrealistic, overly conservative assumptions is that it generates a 2.24 pCi/g action level that is overly stringent and goes beyond what is necessary to protect human health and the environment, virtually without precedent.

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[6] The Ra-226 soil cleanup levels for all sites surveyed by UNC were greater than 2.24 pCi/g and were typically set at 5 pCi/g + background even for sites located in heavily populated residential areas: Denver Radium, CO (>65 properties impacted by ore processing), 21.1 pCi/g; Kerr McGee West Chicago Sites, IL (includes >650 homes), 7.2 pCi/g; Fields Brook, OH (properties impacted by multiple industrial sources), 7.0 pCi/g; Monticello Mill, UT (homes near former government uranium mill), 7.0 pCi/g; White King, OR (open pit uranium mine), 6.8 pCi/g; Glen Ridge Radium & Montclair/West Orange Radium, NJ (430 homes and 14 municipal properties impacted by nearby radium processing facilities (6.0 pCi/g); General Gas Mantle, NJ (homes in vicinity of former gas mantle facility), 6.0 pCi/g; Austin Avenue Radiation, PA (residential and industrial properties near former radium site), 5.0 pCi/g residential, 6.6 pCi/g commercial;

## VI. A Cap Design Needs to Be Flexible, and Liner is Not Necessary

### A. Conceptual Cap Designs Should be Flexible

The draft EE/CA includes a conceptual cap/cover design for Alternatives 3, 4, and 5, to mitigate radon flux and water infiltration, maximize run off, and reduce exposure rates. Draft EE/CA, pp. 24-25. It would require significant quantities of borrow material to construct a cap. Significant costs and transportation risks would be associated with obtaining and transporting these borrow materials to the site. It is unlikely that suitable borrow material can be found locally given the very low action level set in the draft EE/CA. Given these limitations, the NRRB should recommend that the Region stress the need for flexible capping solutions that will achieve equivalent protectiveness but which will minimize the amount of borrow material required.

UNC has proposed that it use as cover material soils from NECR containing up to 6 pCi/g (UMTRCA unrestricted use standard + background) in the lower layer of any cap, with lower-level materials forming the top layer of the cap. EPA has recognized this concept in its TENORM guidance document, citing *Environmental Remediation of Uranium Production Facilities*, OECD Nuclear Energy Agency and International Atomic Energy Agency, 2002, at pg. 55. The TENORM guidance states that "If [stockpiled sub economic materials] are to be relocated, a specific order for placing them into the containment (e.g., most radioactive material lowest, etc.) may significantly reduce the risk of mobilization [sic] of contaminants and ensuring adverse environmental impacts."

Because access to the repository built on UNC property will be restricted to only periodic site maintenance, the use of on-site material up to 6 pCi/g would be conservative. In the October 2007 *Removal Site Evaluation Report*, a Ra-226 concentration of 50 pCi/g was determined to be within EPA's risk management range of $1E\text{-}^{04}$ to $1E\text{-}^{06}$ for a site maintenance worker. A cap containing material up to 6 pCi/g in the lower layers would offer almost 10 times less risk than use of the 50 pCi/g value referenced in the RSE Report. Moreover, reusing the NECR mine site materials that already meet UMTRCA standards would reduce the risk and carbon emissions associated with transporting significant additional quantities of borrow from a distant off-site location.

### B. An Engineered Liner is Unnecessary for a Mine or Mill Site Repository

There is no need or justification for an engineered lining for the repository, given the stable nature of the materials, the opportunity to prevent unauthorized access to the repository area, and the arid conditions in the area. As noted in section 4.6.1.2 of the draft EE/CA, "although limited data indicate that there is ***no pathway*** between contaminated mine wastes and groundwater, the liner acts as extra protection to isolate the mine wastes." (emphasis added). Thus, an engineered liner would add significant costs without improving the basic protectiveness of the alternative.

There are other measures that can be taken to accomplish the same ends that are more technically appropriate and much more cost-effective (e.g., promoting runoff from the cap and minimizing infiltration). UNC has done preliminary modeling of cell construction approaches based on site climatic conditions. These modeling results indicate that placing mine spoils in a cell with no base liner and a cap that includes a 6" thick gravel layer as a capillary break results in volumetric water flux of 0.0001 gallon/minute, approximately three orders of magnitude less than the volumetric water flux estimated by the model for the Region's capping approach. Accordingly, in this arid environment, mine spoils reclaimed with a proper cover do not leach contaminants at concentrations that present a concern for groundwater.

Considering the significant costs and environmental impacts associated with acquiring and transporting materials for liner installation, a liner requirement should not be imposed and EPA should consider more technically appropriate and cost-effective alternatives such as appropriate cap design.

## VII. Disposal of "Principal Threat Waste" at the Mine or Mill Site is Protective and Appropriate

The so-called "principal threat waste" (PTW) can be safely and effectively contained in a repository on the Mine or Mill Site. There is no appropriate basis for requiring off-site, out-of-state disposal of these materials.

Extensive sampling results show uranium and Ra-226 levels at NECR are consistent with levels measured at other uranium mine sites. EPA's April 2008 TENORM Report provides data for 40+ uranium mine sites which indicates that uranium levels in low-grade ore are consistently >200-300 mg/kg and for some mine sites greater than >600 mg/kg. Ra-226 levels reported at other uranium mines ranged from 294 to 421 pCi/g. At the Midnite mine site in WA mine spoils with Ra-226 levels ranging up to 880 pCi/g were capped on-site. Reducing the average Ra-226 activity concentration from 42.2 pCi/g to 30.4 pCi/g (the reason the draft EE/CA provides for identifying PTW) will not result in any significant reduction of risk to human health and the environment. The repository can easily be designed to achieve the same level of protectiveness without segregating PTW and hauling it away.

At the Midnite Mine site, EPA relied on the NCP[7] and its RI/FS guidance[8] to find that the protore and waste rock did not constitute PTW because it "is not highly concentrated and the toxicity and mobility of contaminants associated with this material is largely a function of the amount of material exposed." *See* Midnite Mine Record of Decision, September 2006. The Region should make the same determination here.

Transport of PTW to the White Mesa Mill in Blanding, Utah for beneficial reuse, while preferable to disposal in Idaho, would nonetheless present similar external cost, risk, and exposure issues as discussed above for Alternative 2. The adverse effects associated with such removal would present greater risk of harm than potential radiological exposures associated with capping the PTW at the Mine or Mill sites.

The two issues of liner and disposal of PTW are interrelated. If EPA decides to require a liner at the Mine or Mill Site, it should then allow the disposal of ***all*** mine wastes in the

[7] National Contingency Plan, 40 CFR § 300.430(a)(iii)B).

[8] "Development of a complete range of treatment alternatives will not be practical in some situations. For example, for sites with large volumes of low concentrated wastes such as . . . mining sites, an alternative that eliminates the need for long-term management may not be reasonable given site conditions, the limitations of technologies, and extreme costs that may be involved." *EPA Guidance for Conducting RI/FS under CERCLA*, Interim Final (EPA, 1988).

disposal area, including PTW. Disposal of all mine wastes, including PTW, will be protective with a substantially redundant margin of safety if a liner is required. If, however, EPA requires the off-site shipment of PTW, then EPA should allow beneficial re-use of those materials at an available uranium mill (e.g., the White Mesa Mill), rather than require out-of-state disposal, and the Region should not require a liner at the NECR mine or mill site repository locations.

## VIII. Summary and Conclusion

EPA should select on-site remediation at the NECR Mine site, the concept behind both Alternative 3 and 4. The draft EE/CA concludes that these alternatives are protective of human health and the environment, satisfy ARARs, are implementable, and are cost-effective. As a result, CERCLA and the NCP mandate on-site remediation. It is for good reason that on-site remediation is the accepted remedial approach for mine sites across the country. The inherently low risks presented by large-volume, low concentration soils associated with historic mine activities are best dealt with in place.

However, because UNC is a fee owner of the adjacent Mill site, UNC has indicated to the Region its conceptual willingness to site a repository for the NECR mine spoils on its adjacent mill property, off Tribal land in a fenced and secured facility. That remedy provides a redundant level of protection given the already low risks of in-situ remediation. Nonetheless, should EPA select Alternative 5 (Mill site disposal), EPA should reconsider the appropriate action level. EPA also should not impose sub-alternatives or design features that do not make the response action any more protective of human health and the environment (e.g., excessive cap requirements, imposition of a liner, or a requirement to separate and haul a subset of spoils).

There can be no doubt that Alternative 2 – long-haul, off-site disposal – is unacceptable. This approach would break unjustifiably with the established methods for addressing mine waste. The risks, and the environmental and energy impacts associated with this alternative would be unavoidable and severe. It would take nine years to implement, and the costs are an order of magnitude above the next less-costly alternative. In short, EPA cannot lawfully justify selection of that alternative under CERCLA and the NCP.

# Attachment C

imagination at work

December 11, 2008

Harrison Karr, Esq.
U.S. EPA, Region 9
75 Hawthorne St., ORC-3
San Francisco, CA 94105

**Re: UNC Church Rock Mill Site/Indian Country**

Dear Harrison,

In response to your request, this letter addresses whether the UNC Church Rock Mill Site (the "Mill Site") is "Indian Country." Several questions have arisen: 1) whether disposal of mine spoil materials from the NECR Mine Site on the Mill Site would be inconsistent with the Navajo Nation's position that NECR wastes should be removed from Indian Country; 2) whether, and the extent to which, if any, EPA should defer to the Navajo Nation with respect to disposal at the Mill Site; and 3) whether the Navajo Nation has a right to concur with EPA's selected response action at NECR.

For the reasons set forth below, the Mill Site is not Indian Country. While EPA has informed us that it will engage in consultation with the Navajo Nation on a "government-to-government" basis, with respect to EPA's selection of the NECR response action, there is no authority for the proposition that EPA should defer to the Navajo Nation with respect to selection of the NECR response action. The Navajo Nation also has no right to concur with, or veto, EPA's selected response action for NECR.[1]

1. Background.

The Mill Site is fee land owned by UNC and is located in T16N, R16W, Section 2, approximately 17 miles northeast of Church Rock in McKinley County, New Mexico. UNC operated the Mill Site as a uranium ore processing facility from June 1977 – May 1982. The Mill Site is bisected by New Mexico State Highway 566, and includes an ore processing area, decommissioned in 1991-92, located to the north and west of the State highway, and a tailings disposal area located to the south and east of the State highway. The Mill Site has had restricted access since the Mill Site was originally licensed by the State.

[1] We note that if EPA does select an alternative that involves removal of mine spoil materials from NECR to the Mill Site, contrary to the overwhelming precedent for reclamation/remediation of mine spoils at the Mine Site where such spoils were generated, EPA will already have deferred to the Navajo Nation's preference to have all mine spoils removed from NECR and disposed of off Indian lands.

The State of New Mexico through the New Mexico Environment Department (formerly the New Mexico Environmental Improvement Division), the Nuclear Regulatory Commission (NRC), and the U.S. Environmental Protection Agency (EPA) have continually exercised regulatory and CERCLA authority at the Site. The State granted UNC the initial source materials license for the Mill Site in May 1977. At that time, New Mexico had Agreement State status under the Atomic Energy Act and was authorized to license the Mill Site. In 1986, the State relinquished its Agreement State status, and the NRC became the licensing authority. Since that time, the Mill Site has been under the jurisdiction of the NRC with respect to licensing authority under the Atomic Energy Act. The Navajo Nation has not to date exercised any regulatory authority over the Mill Site.

EPA became actively involved at the Mill Site in 1981 when the Mill Site was proposed for listing on the first CERCLA NPL. Final listing on the NPL occurred in 1983, and EPA successfully defended that decision in federal appeals court. *Eagle-Picher Industries, Inc. v. EPA*, 822 F.2d 132 (D.C. Cir. 1987). In 1988, EPA and the NRC entered into a Memorandum of Understanding (MOU) for the Mill Site to allow an NRC- and EPA-directed reclamation and corrective action performed by UNC, with NRC as the lead agency. The MOU recognized that EPA would address groundwater contamination under CERCLA, and that the NRC would be responsible for surface reclamation, closure activities and source control. Under the MOU, NRC-regulated reclamation and source control actions at the Mill Site are subject to EPA monitoring and review. Within EPA, Region 6 has lead responsibility for the Mill Site under CERCLA. EPA Region 6 issued a ROD for the Site in 1988, and has issued two five-year review reports for the Mill Site since that date. Had the Mill Site been treated as Indian Country, Region 9 would have such responsibility pursuant to the Memorandum of Agreement EPA Regions 6, 8 and 9 entered into with the Navajo Nation in 1991.

Once reclamation and closure actives are completed at the Site and the NRC terminates the License, the Mill Site property will be released and title to the Mill Site turned over to the United States Department of Energy (DOE) for long-term surveillance monitoring.

Throughout this extensive history of regulatory oversight by the State and the federal government, the Mill Site was never identified as, nor treated as, Indian Country. Until now, the Navajo Nation has never asserted jurisdiction as Indian Country in the over 25 years of regulation of the Mill Site. To suddenly change course would cause disruption, confusion and delay in remediation efforts, and has no legal or policy basis.

2. The Mill Site Is Not Indian Country Under Federal Statute, 10th Circuit, Or Supreme Court Precedent.

In relevant part, 18 U.S.C. § 1151 defines "Indian Country" as: "all *dependent Indian communities* within the borders of the United States whether within the original or subsequently acquired territory thereof, and whether within or without the limits of a state. . . " (emphasis added). The Mill Site is not on the Navajo Reservation, nor is it allotment or trust lands. Thus, the only possible basis for concluding that the Mill Site is Indian Country would be that the Mill Site is a dependent Indian Community.

In *Alaska v. Native Village of Venetie Tribal Government*, 522 U.S. 520 (1998), the Supreme Court narrowly defined the meaning of "dependent Indian communities," holding that this term "refers to a *limited category* of Indian lands that are neither reservations nor allotments, and that satisfy two requirements--*first, they must have been set aside by the Federal Government for the use of the Indians as Indian land; second, they must be under federal superintendence*." *Id.* at 527 (emphasis added). The Mill Site does not meet either of these requirements.

A. The Mill Site Does Not Satisfy *Venetie's* "Set Aside" Criterion.

The Mill Site has not been set aside by the Federal Government for the use of Indians as Indian Country. *Venetie* requires that "[t]he Federal Government must take some action setting apart the land for the use of the Indians 'as such' . . . ." *Venetie*, at 530 n.5, and further instructs that "[T]he federal set-aside requirement ensures that the *land in question* is occupied by an 'Indian community' . . . ." *Venetie*, at 530 (emphasis added). "[B]ecause Congress has plenary power over Indian affairs, *see U.S. Const.*, Art. I, § 8, cl. 3, some explicit action by Congress (or the Executive, acting under delegated authority) must be taken to create or to recognize Indian Country." *Venetie*, at 531 n.6. In *Venetie*, the Supreme Court held that, "[B]ecause Congress contemplated that non-Natives could own the former Venetie Reservation, and because the Tribe is free to use it for non-Indian purposes, we must conclude that the federal set-aside requirement is not met." *Venetie* at 533.

Here, the "land in question" is the Mill Site, not the Pine Dale Chapter, the Church Rock Chapter or the Eastern Navajo Agency. UNC, a non-Indian entity, holds fee title to the Site. UNC is free to use the Site for non-Indian purposes, and has done so for more than 30 years. The federal government has taken no action to set aside the Mill Site as land for use by the Indians "as such". The Mill Site is not occupied by an Indian community; in fact, the sole person living on the site is a non-Indian UNC employee.

Neither Congress nor the Executive Branch acting under delegated authority has created or recognized the Mill Site as Indian Country.[2]

B. <u>The Mill Site Does Not Meet The Federal Superintendence Requirement</u>.

The Supreme Court has emphasized that, "[i]t is the *land in question*, and not merely the Indian tribe inhabiting it, that must be under the superintendence of the Federal Government." *Venetie*, 522 U.S. at 530, n.5. At the Mill Site, no land is under the "superintendence" of the Federal Government. An analysis of relevant facts pertaining to the superintendence criterion demonstrates that the Mill Site, which is the land in question, does not satisfy the federal superintendence requirement:

- As noted above, the Mill Site is fee land owned by UNC that has been subject to State of New Mexico and NRC regulatory control under the Atomic Energy Act for more than 30 years.

- No members of the Navajo Nation live on the Mill Site. Currently, the site is occupied exclusively by a non-Tribal member UNC employee, and is fenced off to restrict access to unauthorized persons.

- The Mill Site does not have even the minimal level of protection of land that existed in *Venetie* (exemption from adverse possession claims, real property taxes, and certain judgments).

- McKinley County assesses property taxes on Section 2 land, and UNC pays these taxes to McKinley County.

[2] "This [set-aside] requirement guarantees that the land is actually occupied by an Indian community. *U.S. v. Arrieta,* 436 F.3d 1246, 1250 (10th Cir. 2006). The Navajo Nation may assert that *Arrieta* supports its position that the Mill Site is Indian Country. *Arrieta* involved a road owned by the Pojoaque Pueblo within the exterior boundaries of the Pueblo. The Tenth Circuit held that, "land owned by an Indian tribe within the exterior boundaries of land granted to the tribe is necessarily part of the Indian community, even if the state performs some services and maintenance with respect to the land." Under these circumstances, the Court stated, "We examine the entire Indian community, not merely a stretch of road, to ascertain whether the federal set-aside and federal superintendence requirements are satisfied." *Id.* at 1250, *citing HRI, Inc. v. EPA*, 198 F.3d 1224, 1229 (10th Cir. 2000) ("HRI I"); *Pittsburg & Midway Coal Mining Co. v. Watchman*, 52 F.3d 1531, 1542-43 (10th Cir. 1995). Most significantly, unlike the road in *Arrieta*, the Mill Site is not within the exterior boundaries of a Reservation or Pueblo, and it is not owned by the Navajo. Additionally, the Mill Site is far more than a stretch of road; it was a sophisticated processing facility covering a large amount of acreage, employing numerous workers, operating entirely independently of the Navajo Nation, and occupied by non-Tribal members as compared to an Indian community.

- The sole access road to the Mill Site is State Highway 566, which, unlike the road in *Arrieta*, is owned and maintained by the State of New Mexico.
- The McKinley County Sheriff's office and the New Mexico State Patrol provide police protection for the Mill Site.
- Emergency medical services for the Mill Site are provided by services based out of Gallup.
- Equipment and supplies for the Mill Site come from Gallup, Farmington, Grants and Albuquerque.
- Contractors working on the Mill Site come from Gallup, Grants, Albuquerque or other communities in New Mexico that are not Indian Country.
- Remedial consultants at the Mill Site are based out of offices in Grand Junction and Steamboat Springs, Colorado.
- Public Service of New Mexico provides electrical services to the Mill Site.
- The Mill Site has water wells and water rights administered by the State of New Mexico.

C. <u>EPA Should Not Apply The "Community Of Reference" Test To The Mill Site</u>.

By its own admission in briefs EPA filed in the 10th Circuit in *Hydro Resources, Inc. v. EPA*, Appeal No. 07-9506 (10th Cir. ___) ("*HRI II*"), the Indian Country determination EPA made and the "community of reference" test that EPA applied concerning the Section 8 HRI property at issue in that case was carefully limited to the site-specific circumstances of the Section 8 land. In its brief, the Agency advised the 10th Circuit that EPA's land status determination for Section 8 was only "for the purpose of determining whether EPA or the State of New Mexico is the appropriate permitting authority for the SDWA UIC program" on the HRI parcel. EPA Brief, at 56. EPA added,

> *The [land status] Determination is not intended to define the Indian Country status of other land within the Church Rock Chapter or elsewhere for other purposes.* Therefore . . . EPA's *site specific and limited determination* should not result in the far-reaching consequences conjured up by HRI.

*HRI II,* EPA Merit's Brief, p. 56 (emphasis added.) Thus, EPA's land status determination in HRI II does not establish precedent for or apply to land *within* the Church Rock Chapter, let alone land outside the Church Rock Chapter like the Mill Site.[3]

Even if a "community or reference" test remains viable after *Venetie* (which it does not for the reasons presented below), the Church Rock Mill Site is strikingly different factually from Section 8. Neither the Church Rock Chapter, nor the Pine Dale Chapter, is an appropriate community of reference. The Mill Site was an active private uranium mill processing facility that relied extensively on surrounding non-Indian communities for its operations, equipment, supplies, services and protection. The Mill Site has been subject to State of New Mexico and NRC regulatory control under the Atomic Energy Act for more than 30 years. It is not located in the Church Rock Chapter, but rather is located near (but not within) the Pine Dale Chapter. *See Blatchford v. Sullivan*, 904 F.2d 542, 548-49 (10th Cir. 1990) (*cert. denied*, 498 U.S. 1035 (1991) (holding that the community of Yah-Ta-Hey within the boundaries of the Rock Springs Chapter was not a dependent Indian community). A non-Tribal member UNC employee resides on the Mill Site and has done so for many years.

The State of New Mexico's position in HRI II is that Section 8 is not Indian Country, and we expect it to take the same position here. In *HRI II*, New Mexico filed an *amicus* brief stressing the importance of limiting any ruling about whether the Section 8 land at issue is Indian Country "to the specific facts applicable to the land in question and to not issue a broad ruling regarding all lands within the boundaries of the Church Rock Chapter." *HRI II, Amicus Curiae* Reply Brief of the State of New Mexico Filed in Support of No Party, p. 1. The State stated in its brief that, even if the Tenth Circuit applies the "community of reference" test from *Watchman*, the test "must be limited *because the State is actively involved in exercising its regulatory authority throughout the area in question*." *Id.* (emphasis added). New Mexico expressly rejected the Navajo Nation's assertion that the HRI land was Indian country: "The State has taken the position before the EPA that the land in question is not Indian Country, and the State has never deviated from that position." *Id.*

To the extent that EPA is considering whether the "community of reference" test articulated in *Pittsburg & Midway Coal Min. Co. v. Watchman*, 52 F.3d 1531 (10th Cir. 1995) should be used to evaluate whether the Mill Site is Indian Country, this test is no longer appropriate to apply after *Venetie.* We recognize that EPA asserted in its

[3] The Section 8 land at issue in HRI II is proximate to the Church Rock Chapter, whereas the nearest Chapter to the Mill Site is the Pine Dale Chapter. As a result, EPA's determination regarding the Section 8 property on its face does not apply to the Mill Site.

February 6, 2007 Land Status Determination and in its briefs to the 10th Circuit in *Hydro Resources, Inc. v. EPA*, Appeal No. 07-9506 (10th Cir. ___) ("*HRI II*"), that the community of reference test remains viable. For reasons including those presented by the petitioners and *amicus* in their briefs in *HRI II*, GE/UNC disagrees. EPA's and the Navajo Nation's position in the *HRI II* litigation misreads *Venetie* and *HRI, Inc. v. Environmental Protection Agency*, 198 F.3d 1224, 1242 (10th Cir. 2000) ("*HRI I*"). The community of reference test no longer is appropriate to use to determine whether the land in question is a dependent Indian community.

In any event, "the law is clear that EPA does not have the power to change the Indian Country status of land – that is a status conferred by Congress." *HRI I*, at 1242. In this instance, Congress has not conferred Indian Country status on the Mill Site, and EPA has made no previous determination that the Mill Site is Indian Country. As noted above, EPA is not bound by its position in *HRI II*, which the 10th Circuit has yet to decide, to conclude that the Mill Site is Indian Country.

3. <u>EPA Has Consistently Treated The Mill Site As Non-Indian Country Outside Of The Navajo Nation's Territorial Jurisdiction</u>.

EPA Regions 6, 8 and 9 entered into a Memorandum of Agreement in October 1991 with the Navajo Nation (the "1991 MOA") concerning "the protection of human health and the environment within the territorial jurisdiction of the Navajo Nation." Among other things, the purposes of the 1991 MOA was to "delineate a one-Region lead and responsibility for implementing the Federal environmental programs on the Navajo Nation."

Under the 1991 MOA, the parties agreed that Region 9 is "the designated one-Region lead and the EPA regional office responsible for all environmental matters affecting the Navajo Nation. . . . The Navajo Nation and Region 9 agree to work together in the implementation of federal environmental laws and regulations on lands *determined to be located within the territorial jurisdiction of the Navajo Nation* located in the states of Arizona, Utah and New Mexico. . . ." (Emphasis added.) The MOA mandates that EPA Region 6 "abstain from further direct Federal implementation or program development activities in the Navajo Nation," except with prior written approval of the Navajo Nation and Region 9 or an executed amendment to the MOA. We are not aware of any such prior written approval or amendment.

EPA Region 6 is and has been the lead Region for CERCLA response actions at the Mill Site. Under the 1991 MOA, Region 6 could not maintain this responsibility if the Mill Site was within the territorial jurisdiction of the Navajo Nation.[4]

4. Even If The Mill Site Is Indian Country, The Navajo Nation Has No Statutory, Inherent Or Other Authority Over The Mill Site That Would Allow The Navajo Nation To Prohibit The Disposal Of NECR Materials At The Mill Site.

The Navajo Nation has no plausible claim of statutorily-conferred power over the Mill Site. Section 126 of CERCLA, which describes the role of tribes, and the NCP contain no provisions that would confer such power. Nor can the Navajo Nation argue that it has inherent authority over the Mill Site. "[T]he inherent sovereign powers of an Indian tribe do not extend to the activities of nonmembers of the tribe." *Montana v. United States,* 450 U.S. 544, 565 (1981). The law is clear that tribes have no inherent power to regulate nonmembers outside the boundaries of their reservations. *MacArthur v. San Juan County*, 497 F.3d 1057, 1071 (10th Cir. 2007) ("Supreme Court precedent clearly limits the regulatory authority of tribes – at least that which is derived solely from their inherent sovereignty – to the reservation's borders."); *see also id.* ("The notion that inherent sovereignty ceases at the reservation's borders is consistent with [Supreme Court precedent].").

In its recent 2008 decision, *Plains Commerce Bank v. Long Family Land and Cattle Company, Inc., et al.*, 554 U.S. ___ , 128 S.Ct. 2709 (June 25, 2008), the Supreme Court relied upon prior Supreme Court precedent to emphasize the limitations of an Indian tribe's inherent authority:

> Given *Montana's* 'general proposition that the inherent sovereign powers of an Indian tribe do not extend to the activities of nonmembers of the tribe,' *Atkinson Trading Co. v. Shirley,* 532 U.S. 645, 651 (2001) (quoting *Montana,* 450 U.S. at 565), efforts by a tribe to regulate nonmembers, especially on non-Indian fee land, are 'presumptively invalid,' *Atkinson,* 532 U.S. at 659.

*Plains Commerce,* 128 S.Ct. at 2720. In *Plains Commerce,* the Supreme Court stressed that *Montana's* general rule restricting tribal authority over nonmembers "is particularly strong when the non-members activities occur on land owned in fee simple by non-Indians." *Plains Commerce,* 128 S.Ct. at 2719. In *Plains Commerce*, the land in question was fee land within the boundaries of the reservation, and Indian jurisdiction

[4] The Mill Site also is not identified as Indian Country in EPA's NPL listing of the Mill Site, nor is it identified as Indian Country in the ROD for the Site or the two Five-Year Review reports for the Site.

was denied. Here the situation is further attenuated, as the Mill Site is fee land *outside* the boundaries of the reservation.

5. EPA's Indian Policy Does Not Provide The Navajo Nation With Veto Power Over Or Require Navajo Nation Consent For The Response Action That EPA Selects For NECR.

Even assuming for sake of argument only that the Mill Site is Indian Country, such a determination would not mandate Navajo Nation consent in order for the Mill Site to be used as a repository for materials from NECR. The Navajo Nation appears to contend in their September 2, 2008 letter from Dave Taylor that EPA's Policy for the Administration of Environmental Programs on Indian Reservations (November 11, 1984) ("Indian Policy") applies to off-reservation lands. However, the Indian Policy repeatedly emphasizes that it applies to reservations, to reservation affairs, and to the reservation populace. It does not state that it applies to Indian Country. Thus, by its own terms, the Indian Policy should not apply to the Mill Site.

But even assuming that the Indian Policy applied off-reservation, it would still not provide the Navajo Nation with veto power over or a consent requirement for any determination by EPA to use the Mill Site as a repository. Even on reservation, the Indian Policy provides:

> In those cases where reservation facilities are clearly owned or managed by private parties and there is no substantial tribal [proprietary] interest or control involved, the Agency will endeavor to act in cooperation with the affected Tribal Government, *but will otherwise respond to noncompliance by private parties on Indian reservations as the Agency would to noncompliance by the private sector elsewhere in the country.*

*EPA Indian Policy, § 8 (emphasis added); see also* December 15, 2004 Memorandum, *EPA Region 9 Approach for Consultation and Coordination with Tribes Concerning Enforcement Against Non-Tribal Facilities and Inspections in Indian Country* ("EPA generally responds in the same manner as it would toward such [privately-held] facilities outside Indian Country, but notifies the affected tribal government of any anticipated Agency action and consults with that tribal government on a government-to-government basis to the greatest extent practicable and to the extent permitted by law.").

Nowhere does EPA's Indian Policy provide the Navajo Nation with veto power over or approval authority for an EPA selected response action under CERCLA. The Indian Policy compares tribal interests and participation with that of States. *See* EPA Indian

Policy, § 2. EPA has maintained for years that States do not have veto power over EPA's selected response actions under CERCLA. Similarly, the Navajo Nation has no such power. EPA Region 9 recognizes this in its October 25, 2005 Memorandum, *EPA Region 9 Approach to Consultation with Tribal Governments Regarding Non-Enforcement Related Matters* (the "Regional Consultation Approach".) Exhibit C to the Regional Consultation Approach includes as an "Examples of Region 9 Consultation Approaches" the following unambiguous statement: "Under the National Contingency Plan, *neither states nor tribes have a right of concurrence on EPA's selection of a Record of Decision for remedy selection*." (Emphasis added.) The same statement would certainly apply to EPA's selection of a removal action under an Action Memorandum.

The Navajo Nation appears to contend that EPA's trust responsibility to tribes mandates that EPA obtain the Navajo Nation's consent for EPA's selected response action at NECR. As stated in EPA's Indian Policy, "[t]he Agency, in keeping with the Federal trust responsibility, will assure that tribal concerns and interests *are considered* whenever EPA's actions and/or decisions may affect reservation environments." EPA Indian Policy, § 5 (emphasis added). While EPA may consider the Navajo Nation's concerns, EPA has an independent obligation under CERCLA and the NCP to select a response action that meets relevant statutory and NCP criteria, including selecting a remedy that, while protective, is also cost effective.

We appreciate your consideration of this letter, and request that you include it within the administrative record for the NECR site.

Sincerely,

Jane W. Gardner
by RSG

Jane W. Gardner

cc: Robert W. Lawrence, Esq. (Davis Graham & Stubbs LLP)
Samuel I. Gutter, Esq. (Sidley Austin LLP)
Gene A. Lucero, Esq. (Latham & Watkins LLP)

Attachment D

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March 3, 2009

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**SUBJECT:** Applicability of CERCLA "Permit Exemption" to Mill Site Remedy for NECR Mine Site Removal Action

Dear Mr. Karr:

On behalf of United Nuclear Corporation (UNC), GE would like to take this opportunity to provide you with its views on whether a Nuclear Regulatory Commission (NRC) license amendment would be required if EPA selects a remedy for the Northeast Church Rock Mine Site (NECR) that includes disposal of NECR mine spoils at the adjacent UNC-owned Mill Site (the Mill Site).

The particular issue that we address is applicability of the CERCLA "permit exemption" to EPA's response action for the NECR Mine Site, to the extent it involves disposal on the Mill Site. As a general matter, Section 121(e) of CERCLA exempts the need to obtain permits (including federal permits) for "on-site" response actions. Consequently, the central question is whether the Mill Site is considered to be "on-site" (i.e., part of the NECR Mine Site) for the limited purpose of disposing of remediation materials from the NECR Mine Site on the Mill Site. Because the NRC license addresses only remediation of the Mill Site, we believe that it is not applicable to the current situation, which only addresses a remedy for mine spoils from the NECR Site.

In its Draft Engineering Evaluation/Cost Analysis (EE/CA) identifying remedy options for the NECR Mine Site, EPA noted that should the response action include disposal at the Mill Site, "[t]he current UNC [NRC] license would need to be amended." Draft EE/CA, p. 49. GE respectfully disagrees. We think it is clear that, as a legal matter, the CERLCA permit exemption in §121(e) obviates the need for UNC to seek an amendment to UNC's NRC license at the Mill Site for these limited purposes, as discussed below. We also provide you with our thoughts on whether there are larger implications for EPA exercising its CERCLA authority at NRC sites in general. For the purposes of this discussion, we assume that the remedy that EPA eventually selects for the NECR Mine Site will include disposal of NECR mine spoils on the Mill Site.

**Introduction and Background**

This case presents unique facts compared to the typical Superfund site and remedy selection process. The NECR Mine Site is on Indian trust land (surface only) adjacent to the Navajo reservation in northwest New Mexico. It is not an NPL site. Although New Mexico is part of EPA Region 6, EPA Region 9 has the lead for all Navajo reservation, allotment, and tribal trust lands, including NECR.

Adjacent to NECR is the former UNC Mill Site, which is on UNC privately owned fee property outside the reservation. Because the Mill Site is not on Navajo lands, EPA Region 6 is the lead EPA region. UNC has an NRC license for nuclear source materials (and its byproducts) at the Site, including the tailings processing area and the tailings ponds, as well as any surface and groundwater impacted by radioactive materials.

The Mill Site is on the CERCLA National Priorities List (NPL). EPA Region 6 has entered into a site-specific Memorandum of Understanding (MOU) with NRC providing that NRC will take the lead for remediation efforts on the surface, and EPA will take the lead on groundwater. In addition, we are aware of a national MOU between EPA and NRC for cooperation for decommissioning and decontaminating NRC licensed sites.

We analyze these issues because of the serious implications to implementing the NECR remedy should a NRC license amendment be required on the Mill Site. As our analysis shows, a license amendment is not required by CERCLA, as implemented by the National Contingency Plan (NCP). Moreover, imposing those requirements here would contravene the fundamental intent of CERCLA to expedite cleanups. This same policy is the basis for the CERCLA permit exemption. The process by which licenses are amended under NRC regulations also would provide a possible opportunity to challenge the CERCLA remedy, in contravention of the government's staunch defense of the bar on pre-enforcement review in CERCLA §113(h). Nor is it necessary: the type of environmental review, public comment and consideration of alternatives that is built into the NRC licensing process is already conducted by EPA in its evaluation of response actions under CERCLA. To the extent that the licensing process involves NEPA review, EPA policy (upheld by courts) is that CERCLA provides the functional equivalent of NEPA review. *See, e.g., Schalk v. Reilly*, 900 F.2d 1091 (7th Cir. 1990); *North Shore Gas Co. v. EPA*, 930 F.2d 1239 (7$^{th}$ Cir. 1991); *Oil, Chemical and Atomic Workers International Union, AFL-CIO v. Richardson*, 214 F.3d 1379 (D.C. Cir. 2000).

We also emphasize the limited purpose of applying the CERCLA permit exemption in this instance. The only issue is whether the permit exemption eliminates the need to seek a license amendment from the NRC to implement the NECR Mine Site response action. As to the source and byproduct materials currently on the site, , NRC retains its full Atomic Energy Act (AEA) authority (subject to the MOUs it has entered into with EPA) to address decommissioning and management.

Analysis of applicability of the CERCLA permit exemption involves several questions. The first two questions address the basic applicability of the permit exemption to the Mill Site remedy, namely, whether disposal of the NECR Mine Spoils on the Mill Site is an "on-site" response action, and whether the license amendment itself is a "permit." The succeeding questions address whether there is anything unique about the jurisdictional relationship between EPA and the NRC at this site that affects application of the permit exemption. Therefore, we address each of these issues in turn:

1. *Is the Mill Site "on-site," within the meaning of the CERCLA permit exemption, for purposes of the NECR Mine Site response action?*

2. *Is the NRC license amendment a "permit" within the meaning of the permit exemption?*

3. *Does NRC's jurisdiction over nuclear source and byproduct materials affect the applicability of the CERCLA permit exemption?*

4. *Does the NRC license provision requiring a license amendment for activities "causing environmental impact" take precedence over the CERCLA permit exemption?*

5. *Do the EPA/NRC MOUs affect applicability of the permit exemption?*

### *1. Is the Mill Site "on-site," within the meaning of the CERCLA permit exemption, for purposes of the NECR Mine Site response action?*

Section 121(e), the CERCLA permit exemption, was added to CERCLA in 1986 as part of the Superfund Amendments and Reauthorization Act (SARA). It provides that "[n]o Federal, State, or local permit shall be required for the portion of any removal or remedial action conducted entirely onsite." EPA has consistently interpreted the term "entirely onsite" to include areas ***near*** the area of contamination that are necessary for implementing the response action. That is the position that EPA took in both the proposed and final amendments to the NCP after SARA. For example, in the proposed amendments, EPA stated that the exemption would apply to action conducted on an area not physically contiguous to the site, if that area and the site were "within reasonably close proximity to one another." *Id*. The Agency's approach was pragmatic, emphasizing the practical need for flexibility "in order to provide expeditious response to site hazards." 53 Fed. Reg. 51406 (Dec. 21, 1988).

That approach informed the final NCP amendments, as well. As promulgated, 40 CFR § 400.300(e)(1) provides:

> No federal, state, or local permits are required for on-site response actions conducted pursuant to CERCLA sections 104, 106, 120, 121, or 122. The term *on-site* means the areal extent of contamination and all suitable areas in very close proximity to the contamination necessary for implementation of the response action.

Thus, EPA adopted a two-part test for determining if a response action is "on-site": ***proximity*** to the contamination, and ***necessity*** for implementation of the response action.

The courts have upheld EPA's definition of "on-site." In the first such case, the NCP amendments were challenged in the D.C. Circuit, including specifically EPA's expansive definition of "on-site." *Ohio v. EPA*, 997 F.2d 1520 (D.C. Cir. 1993). The petitioners argued that "on-site" should be defined with "exactly the same parameters as the area of the contamination, essentially paralleling the CERCLA definition of a 'facility.'" 997 F.2d at 1549. The court rejected that narrow view, and upheld EPA's definition, concluding that in the absence of a statutory definition, EPA's interpretation was reasonable and entitled to judicial deference, especially in light of CERCLA's goal of expediting cleanup of hazardous waste sites. The court concluded that "[t]he statutory scheme is meant to transcend artificial geographical and legal distinctions in order to facilitate remedial action." 997 F.2d at 1549.

In the years following the *Ohio* case, EPA has broadly applied the NCP definition to bring non-contiguous areas within the definition of "on-site." It is commonplace, for example, for EPA to site groundwater pump-and-treat systems at appropriate areas down-gradient from CERCLA sites, without getting federal or state air permits.

Perhaps the most expansive example of EPA's approach arises from the Hudson River NPL site remedy in New York. In that case, the United States defended a Consent Decree challenge by the Town of Fort Edward, which argued that the facility to be used for processing Hudson sediments – 1.4 miles away from the river – was not "on-site." Fort Edward complained that this construction stripped the town of its permitting and approval authority over siting, construction and operation of the processing facility. The district court entered the Consent Decree over the Town's objections, and on appeal the Second Circuit also rejected the town's position. *Town of Fort Edward v. United States*, No. 06-5535-cv (2nd Cir., Jan. 3, 2008). As explained by the Second Circuit:

> While EPA has indicated that "very close proximity" will generally mean adjacent to the contamination site, *see* 55 Fed. Reg. 8666, 8690 (March 8, 1990), it is plain from examples cited at the time of the [NCP] regulation's promulgation that the "very close proximity" limitation within the definition of "on-site" was intended to afford EPA some flexibility in identifying proximate sites necessary to achieve CERCLA objectives. [p. 4]

EPA, through the Department of Justice, vigorously defended the Hudson Consent Decree against Fort Edward's challenge. First, the EPA argued that in the context of the site, 1.4 miles was within the NCP criterion of "proximity to the contamination." "EPA chose the location for the sediment processing/transfer facility in order to maximize remedial efficiency and efficacy, while staying as close as possible to the dredging." Brief of Plaintiff-Appellee United States in *Town of Fort Edward v. United States*, *supra*, p. 19. The government argued that the facility satisfied the NCP criterion of necessity as well, based simply on the site's physical attributes (adequate acreage and proximity to rail lines). *Id.*, pp. 23-24. Finally, the government argued the need for a broad interpretation of "on-site":

> EPA's selection of the Energy Park location for the sediment processing/transfer facility here is consistent with the rationale for the regulation defining the term "on-site:" including areas in very close proximity to the contamination necessary for the remediation gives EPA the

> flexibility it needs to deal with sites where it is difficult or impossible to confine remedial activities solely to the area of contamination. [*Id.*, p. 24]

For purposes of implementing the NECR Mine Site remedy, the Mill Site easily fits within the administrative and judicial precedent discussed above. It satisfies the first prong of the NCP definition in that the Mill Site is "in very close proximity" to the NECR Mine. Specifically, the NECR Mine Site and the Mill Site are *adjacent*. It also satisfies the second prong as well, namely that it is "necessary for implementation of the response action." It has the necessary physical attributes to serve as a disposal location. Once EPA decides that the Mill Site is the best location for disposal of the NECR Mine spoils, it is "necessary" to implement the response action.

For EPA to determine that the Mill Site is not "on-site" for purposes of the implementing the NECR Mine Site remedy would be a clear departure from this body of administrative and judicial precedent implementing the permit exemption. It would also be sharply at odds with the position of the Department of Justice in the Hudson case and elsewhere.

***2. Is the NRC license amendment a "permit" within the meaning of the CERCLA permit exemption?***

If disposal on the Mill Site is "on-site," then the next question is whether an NRC license is a "permit," since both CERCLA and the NCP use the word "permit" to describe the exemption. The terms "permit" and "license" are interchangeable. The Merriam-Webster OnLine Dictionary defines "permit" as "a written warrant ***or license*** granted by one having authority." http://www.merriam-webster.com/dictionary/permit%5B2%5D (emphasis added). In addition, longstanding EPA guidance makes clear that the CERCLA permit exemption includes all forms of administrative requirements, not just those actually labeled as "permits." EPA explained the distinction between substantive and administrative requirements in its guidance document "CERCLA Compliance with Other Laws Manual," at pages 1-11 to 1-12:

> Section 121(e) of CERCLA codifies EPA's earlier policy that onsite response actions may proceed without obtaining permits. This permit exemption allows the response action to proceed in an expeditious manner, free from potential lengthy delays of approval by administrative bodies. ***This permit exemption applies to all administrative requirements, whether or not they are actually styled as "permits."*** [Emphasis added.]
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> * * *
>
> Administrative requirements are those mechanisms that facilitate the implementation of the substantive requirements of a statute or regulation. Administrative requirements include the approval of, or consultation with, administrative bodies, consultation, issuance of permits, documentation, reporting, recordkeeping, and enforcement. In general, administrative requirements are made effective for purposes of a particular environmental or public health program.

The requirement to obtain or amend a license from the NRC is an "administrative requirement" in that it facilitates the implementation of the substantive requirements of the NRC's regulatory program. As a result, it squarely fits within EPA's definition of "permit." Further, given that EPA has identified the substantive requirements of any license amendment as ARARs, there can be no concern that the public would lose any protective conditions that would otherwise be imposed through the license process.

***3. Does NRC's jurisdiction over nuclear source and byproduct materials affect the applicability of the CERCLA permit exemption?***

NRC is authorized to issue licenses for source materials and byproduct material under the AEA and implementing regulations. NRC's regulations establish specific criteria for the reclamation and final decommissioning of tailings and other regulated wastes produced by the milling process, and for the license termination process. Nothing in the AEA or NRC's licensing regulations precludes the application of the CERCLA § 121(e) permit exemption to NRC licensed sites. Nor does CERCLA provide any type of special exception to the permit exemption for NRC-regulated facilities. Thus, the CERCLA permit exemption should still apply to a CERCLA response action.

***4. Does the NRC license provision requiring a license amendment for activities "causing environmental impact" take precedence over the CERCLA permit exemption?***

UNC's Mill Site source materials license from NRC provides:

> Before engaging in any *activity* likely to cause an environmental impact not previously assessed by the NRC, the licensee shall prepare and record an environmental evaluation of such activity. When the evaluation indicates that such activity may result in a significant adverse environmental impact that was not previously assessed or that is greater than that previously assessed, the licensee shall provide a written evaluation of such activities, and obtain prior approval of the NRC in the form of a *license amendment*.

NRC Source Materials License, Condition 13. This license condition does not require a license amendment to place NECR spoils at the Mill Site. The EPA/NRC National MOU requires NRC to defer to EPA when, like here, EPA is undertaking CERCLA actions involving hazardous substances that are outside of NRC's jurisdiction. Because the NECR mine spoils are not source or byproduct materials subject to NRC's regulatory jurisdiction (*see* response to Issue #1 above), disposal of those materials incident to EPA's CERCLA remedy at the Mine Site is not subject to license requirements.

The process for obtaining an NRC license amendment is lengthy and complicated:

(1) In its application, UNC would have to make a showing on how the proposed change in the license would affect the safety of workers, the public and the environment. We believe that this is already addressed through the CERCLA remedy process criteria.

(2) UNC then would be required to develop and submit an "Environmental Report" analyzing the environmental impacts of alternatives. Again, this has already been addressed through the CERCLA process, including evaluation of the NCP criteria.

(3) UNC would then have to conduct a NEPA process, which is lengthy and subject to judicial challenge. As noted, CERCLA provides the functional equivalence of NEPA review.

(4) NRC would conduct a public consultation process, similar to the efforts already made by EPA in its stakeholder meetings and discussions with other agencies.

(5) NRC would then make a determination as to whether the proposed amendment has a "significant impact" on the environment, findings that EPA will make in its Action Memorandum. The NRC's determination, however, is typically subject to judicial challenge. That would set up a clear conflict between judicial review of NRC license decisions and the CERCLA bar on pre-enforcement review of any remedy challenge.

This process could take a year and likely longer, during which time the NECR remedy would be in limbo and little if any work would proceed. Because these considerations are already addressed in the CERCLA process, there is no justification for such delay or for opening up a potential avenue for pre-enforcement judicial review of a CERCLA remedy.

***5. Do the EPA/NRC MOUs affect the applicability of the CERCLA permit exemption?***

EPA and NRC have entered into two MOUs that pertain to the Mill Site. In 2002, EPA and NRC entered into a national, non-site specific MOU regarding "Consultation and Finality on Decommissioning and Decontamination of Contaminated Sites" (the "2002 MOU"). In 1988, EPA Region 6 and NRC Region 9 entered into a site-specific MOU addressing "Remedial Action at the UNC-Churchrock Uranium Mill," 53 Fed. Reg. 37887-37889 (September 28, 1988) (the "Mill Site MOU"). The 2002 MOU supports the proposition that a license amendment is not required for disposal of NECR mine spoils at the Mill Site, and the Mill Site MOU does not address the unique circumstances presented by the NECR Mine Site remedy.

A. The 2002 MOU

The 2002 MOU applies when a facility is licensed by the NRC and is undergoing decommissioning and decontamination, or has completed decommissioning and the NRC has terminated its license. 2002 MOU, p.1; *see* OERR Memorandum Distributing MOU Between EPA and NRC, p.1 (October 9, 2002) (OSWER No. 9295-8-06a) (the "OERR Memorandum") ("This MOU is limited to the coordination between EPA, when acting under its Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) authority, and NRC, when a facility licensed by the NRC is undergoing decommissioning, or when a facility has completed decommissioning, and the NRC has terminated its license."). The OERR Memorandum notes,

> [T]he MOU does not address EPA's role at sites that are being addressed under CERCLA (*e.g.*, a site where a removal action is occurring or that is listed on the National Priorities List (NPL)) or under RCRA Corrective Action authorities, ***except*** when NRC is decommissioning a facility or

> when NRC has completed decommissioning a facility and terminated its license at the same site. The MOU provides new guidance ***only*** when EPA, acting under CERCLA authority, and NRC need to consult during the decommissioning and decontamination process as part of NRC's license termination of a facility. [Emphasis added.]

It further states:

> The MOU does not govern ***how*** response actions (e.g., removal or remedial) are conducted under CERCLA authority at either NPL or non-NPL sites. ***Response actions conducted under CERCLA authority should continue to use the CERCLA response action approach.*** [Emphasis in original.]

*Id*., Section II, Limits to MOU Applicability at CERCLA Sites.

Under the unique facts of this situation, the Mill Site would be brought into the response action as a disposal site; the action is not designed to address conditions at the Mill Site. The disposal of NECR mine spoils is a CERCLA response action that "should continue to use the CERCLA approach." The permit exemption is an integral part of the CERCLA approach.

Further supporting this view, EPA and NRC agreed that EPA will ***not*** defer to NRC when EPA is addressing materials that are outside of NRC's jurisdiction. The 2002 MOU provides:

> NRC will defer to EPA regarding matters involving hazardous materials not under NRC's jurisdiction.

****

> EPA will resolve any CERCLA concerns involving hazardous substances outside of NRC's jurisdiction at NRC licensed sites, including concerns involving hazardous constituents that are not under the authority of NRC.

NRC has previously determined that the material remaining at NECR is not byproduct material. *See Garcia, Pete J., NRC Memorandum dated October 31, 1989, "Cleanup of Tailings at the Northeast Church Rock Mine."*[1] EPA confirms in the draft EE/CA that "[NECR mine wastes] would not be classified under Title II [of UMTRCA]." The NECR mine spoils are also not source material. 10 C.F.R. §40.4; *See New Mexico Mining Commission v. UNC*,57 P.3d 862 (N.M. App. 2002)(holding that "neither the unrefined and unprocessed ore [at the NECR Mine Site nor UNC's activities with respect to the unrefined and unprocessed ore were regulated by NRC.) Therefore, the NECR mine spoils are "outside of NRC's jurisdiction" despite being at the NRC licensed site, and as such, any lead given to NRC in the 2002 MOU would not extend to the disposal of NECR mine spoils under EPA's CERCLA action.

[1] "Based on the equilibrium ratio and U-nat data provided by the licensee, the staff concludes that UNC has adequately removed remaining byproduct material from the mine site. No further action is therefore necessary."

B. The Mill Site MOU

Under the Mill Site MOU, NRC is the lead regulatory agency for byproduct material (tailings) reclamation and closure activities. EPA ensures ARARs are attained, and is the lead for addressing groundwater outside the disposal area. Despite this division of responsibility for remediation of the Mill Site, each agency retains responsibility for assuring compliance with its specific regulatory requirements. EPA and NRC agree to cooperate in the oversight of reclamation and remedial activity at the UNC site.

Because the MOU is limited to determining reclamation and closure activities for the NRC-regulated materials at NRC licensed areas, the MOU is not dispositive here, where the activity in question is a remedy for the NECR Mine Site, a non-NRC regulated site. Although the area for disposal of NECR materials is at the NRC licensed site, any effect of the NECR remedy on the Mill site reclamation and closure will be addressed through imposition of substantive requirements of a license amendment in the ARAR process for the NECR remedy. Thus, the NECR removal action, including disposal of NECR Mine spoils at the Mill Site, is distinguishable from the remedial action occurring at the Mill Site.

## ***Broader Implications***

As the discussions regarding the MOUs indicate, EPA in certain circumstances has deferred to NRC jurisdiction over licensed materials, although for the Mill Site, EPA has already made an exception to the deferral policy by placing the site on the NPL. Beyond that, the facts here are truly unique, and do not fit into the paradigm contemplated by the MOUs or NRC licensing requirements. This is not a decision on how to remediate conditions at the Mill Site. It is a decision to conduct a response action at the NECR site that will use the Mill Site as an effective disposal area. As a result, decision-making for this response action should be driven by the fundamental principles governing CERCLA actions, namely to expedite cleanups and avoid procedural delays imposed by permitting requirements. The salient points supporting the conclusion that the CERCLA permit exemption precludes the need for an NRC license amendment are:

- *The NRC license governs the reclamation and closure of NRC regulated materials at the Mill Site only; not CERCLA actions for the NECR mine site that may occur on part on the Mill Site.*

- *Under the 2002 national MOU, NRC should defer to EPA and EPA's CERCLA approach for the NECR site, including the permit exemption provision.*

- *The Mill Site MOU speaks only to the reclamation and decommissioning process for the Mill Site NRC regulated materials, not to CERCLA remedies for the adjacent NECR.*

- *Requiring a license amendment, with its NEPA process and potential opportunity for litigation, would duplicate the EE/CA environmental review process and risks circumventing the CERCLA bar on pre-enforcement review.*

- *A determination by EPA that the Mill Site is not "on-site" for purposes of the permit exemption would be wholly inconsistent with the United States' legal position in the Hudson River case, the NCP, and EPA guidance.*

- *Requiring a license amendment would significantly delay the implementation of the NECR remedy, in contravention of a basic tenet of CERCLA: expediting CERCLA response actions.*

- *Any substantive requirements of a license amendment will be incorporated through the ARARs process, thus ensuring the same protections as if an amendment were obtained, but in a more expedited and efficient way.*

GE is convinced that the permit exemption in CERCLA §121(e) applies to any NECR remedy that would include disposal at the Mill Site. Given the uniqueness of this situation, we do not see any precedential impacts on the national level or any conflict with the MOUs that are currently in place.

I hope you find this helpful. We would be more than happy to discuss this with you and answer any questions you may have.

Sincerely,

Jane W. Gardner
Senior Counsel/Strategic Advisor

cc: Randy McAlister, GE
Roger Florio, GE
Gene Lucero, Latham & Watkins
Sam Gutter, Sidley Austin
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Attachment E

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Harrison Karr, Esq.
U.S. EPA, Region 9
75 Hawthorne St., ORC-3
San Francisco, CA 94105

May 5, 2009

Re: Comments on New Mexico Proposed ARARs

Dear Mr. Karr:

United Nuclear Corporation (UNC) appreciates the opportunity to provide its comments on New Mexico State ARARs for the NECR Mine Site Engineering Evaluation and Cost Analysis (EE/CA). The New Mexico Environment Department (NMED) and the Energy, Mining and Minerals Division of the Natural Resources Department (EMNRD) provided their ARARs comments in a February 3, 2009 letter to EPA. NMED previously had provided a summary table of potential ARARs to EPA. UNC provides the following comments on the New Mexico submittals.

## *I. New Mexico Solid and Hazardous Waste Regulations*

### A. New Mexico Solid and Hazardous Waste Management Regulations Are Not "Applicable" to the NECR Mine Spoils Disposal.

The State's letter asserts that the cell designed to hold NECR waste under Alternatives 5 and 5A "would have to comply with . . . 2.4 [sic] NMAC (Hazardous Waste Management Regulations)." The letter also requests that EPA "add the Solid Waste Act (20.9.1 NMAC) and the Hazardous Waste Act[1] (20.4 NMAC) to the list of ARARs." For the reasons stated below, UNC respectfully disagrees.

State of New Mexico regulations exclude uranium mine spoils and wastes from solid and hazardous waste regulations. As such, they cannot be "applicable" requirements under CERCLA § 121(d).

Under NMAC § 20.9.2.7.S(9)(c), the term "solid waste" "does not include . . . waste from the extraction, beneficiation and processing of ores and minerals, including . . . overburden from the mining of uranium ore. . . ." Because the definition of "hazardous waste" only includes wastes that are first determined to be "solid wastes," these same wastes are excluded from regulation under New Mexico's hazardous waste program, as

[1] The citations NMED provided are to the New Mexico hazardous and solid waste regulations, not to the New Mexico hazardous and solid waste statutes. UNC assumes that the State was referring to the cited regulations, and not the statute.

well. *See* NMAC § 20.4.1.200 (incorporating by reference 40 C.F.R. § 261.3(a) (defining "hazardous waste" as subset of "solid waste").

In addition, the definition of "hazardous waste" under New Mexico's regulations expressly excludes wastes from the extraction, beneficiation and processing of ores and minerals, including uranium ore. NMAC § 20.4.1.200 (incorporating by reference 40 C.F.R. § 261.4(b)(7), which codifies the "Bevill exemption" for mining wastes). Additionally, "source, special nuclear and byproduct material" are excluded from the definition of solid waste and hazardous waste under New Mexico regulations, NMAC § 20.9.2.7.S(9)(h); NMAC § 20.4.1.200.

For these reasons, the New Mexico solid and hazardous waste regulations are not "applicable" requirements for Alternatives 5 and 5A. EPA recognizes this: ARARs Table A-3 in EPA's Advance Draft of the EE/CA appropriately identifies the New Mexico hazardous waste management regulations at NMAC 20.4 as potentially applicable only for "wastes that are subject to the Act." As shown above, the uranium mine spoils that are the subject of the response action are not "subject to the Act."

B. New Mexico Solid and Hazardous Waste Requirements are Not "Relevant and Appropriate" Requirements.

Given that the New Mexico solid and hazardous waste regulations are not "applicable" for purposes of Alternatives 5 and 5A, the next step is to determine whether they are "relevant and appropriate" to the remedy. As described by EPA, requirements can only be "relevant and appropriate" if they were intended to "address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site." NCP, 40 C.F.R. § 300.5.

The NECR mine spoils are typical high-volume, low-hazard mining wastes. The mine spoils will be disposed of in a high desert, arid environment with insignificant annual precipitation. This is precisely the situation that EPA described when it determined:

> RCRA Subtitle C requirements will generally not be relevant and appropriate for those mining wastes for which EPA has specifically determined that such regulation is not warranted. The reason is that the factors that caused EPA not to regulate these wastes as hazardous include many of the same factors that EPA considers in judging whether a requirement is relevant and appropriate at a particular site.

NCP Preamble, 55 Fed. Reg. 8763–8764 (March 8, 1990). *See* EPA's July 3, 1986 Regulatory Determination for Wastes from the Extraction and Beneficiation of Ores and Minerals, 51 Fed. Reg. 24496, 24499 (July 3, 1986) (EPA's determination not to regulate mining waste as hazardous waste, explaining that, "[m]ining waste management facilities are generally in drier climates than hazardous waste management facilities, thereby reducing the leaching potential"; and "the waste volume generated by mining and beneficiation is considerably larger than the volume of waste generated by other industries subject to hazardous waste control."); *Environmental Defense Fund v. EPA*, 852 F.2d 1309, 1312 (D.C. Cir. 1988) (upholding EPA's Regulatory Determination and noting EPA's finding that mining wastes "generally have lower exposure and risk potential than other industrial wastes").

The same analysis applies to New Mexico's regulation. The State has determined *not* to regulate materials like the NECR mine spoils under its solid and hazardous waste rules. The very same factors as those EPA analyzed lead to the conclusion that New Mexico's regulations are not "relevant and appropriate."

New Mexico's solid and hazardous waste regulations are not suited for use as disposal requirements for the NECR mine spoils. EPA requires a comparison "of the substances regulated by the requirement and the substances found at the CERCLA site" to determine whether a requirement is relevant and appropriate. NCP, 40 C.F.R. § 300.400(g)(2)(iii). The New Mexico Solid Waste Act and its implementing regulations expressly exclude mining wastes. New Mexico Solid Waste Act, 74-9-3.N; NMAC § 20.9.2.7.S(9)(c). The NECR mine spoils are not comparable to the discarded material regulated under New Mexico's solid waste program, or the waste materials regulated under the New Mexico hazardous waste program.

EPA also compares the "actions or activities regulated by the requirement and the remedial action contemplated at the CERCLA site," 40 C.F.R. § 300.400(g)(2)(iv), and of "the type of place regulated and the type of place affected by the release or CERCLA action." NCP, 40 C.F.R. § 300.400(g)(2)(vi). The solid and hazardous waste treatment, storage and disposal activities, and the landfills, recycling facilities, transfer facilities and TSD facilities regulated under New Mexico's hazardous and solid waste program are not analogous to mine site reclamation/restoration activities that would occur under Alternatives 5 and 5A. Based upon the factors in the NCP, New Mexico's solid and hazardous waste regulations are not "relevant and appropriate" to this action.

## ***II. NM Water Quality Regulations***

### A. Atomic Energy Act Regulated Materials Are Not Subject to State Water Quality Regulations.

"Water contaminant" discharges are regulated by NMAC § 20.6.2. However, the regulations exclude "source, special nuclear or byproduct material as defined by the Atomic Energy Act of 1954" from the definition of "water contaminant." NMAC § 20.6.2.7.AAA. Thus, any discharges containing source, special nuclear or byproduct material are excluded from NMAC § 20.6.2, and are not applicable or relevant and appropriate to such discharges.

B. Permit Requirements of State Water Quality Laws Do Not Apply for Alternatives 5 and 5A.

The NMED/EMNRD February 3 letter states that "the cell [for Alternatives 5 and 5A] would have to comply with 20.6.2 NMAC (Water Quality Control Commission Regulations)." The State suggests that "disposal of NECR Mine Site wastes [at the Mill site] may require a Discharge Permit issued by NMED. The proposed cell should be constructed and managed in compliance with the New Mexico Water Quality Control Commission Regulations."

Administrative provisions of NMAC 20.6.2, including permit requirements, are not ARARs. *See* NCP, 40 C.F.R. § 300.5 (limiting definition of "applicable" and "relevant and appropriate" requirements to substantive requirements); NCP preamble, 55 Fed. Reg. 8756 ("Administrative requirements include the approval of, or consultation with, administrative bodies, issuance of permits, documentation, and reporting and recordkeeping. Response actions under CERCLA are required to comply with ARARs, which are defined not to include administrative requirements."). For further discussion, please see UNC's letter to Harrison Karr dated March 3, 2009 discussing the limitations on permitting requirements as applied the NECR CERCLA response action.

As a result, no state discharge permit is necessary for disposal of NECR Mine spoils at the Mill Site.

C. State Groundwater Requirements Are Not ARARs.

NMED/EMNRD's February 3 letter requests that EPA indicate in the EE/CA ARARs Table A-1 that NMAC § 20.6.2 applies to groundwater as well as surface water.

Groundwater remediation is not within the scope of the NECR Mine Site removal action. For removal actions, EPA states that "requirements are only ARARs when they pertain to the specific action being conducted. . . . Requirements pertaining to the cleanup of groundwater contamination would not be ARARs for that [surface debris and contaminated soil] action because the removal action is not intended to address groundwater. . . ." NCP Preamble, 55 Fed. Reg. 8695-8695. Groundwater remediation at the Mill Site is being addressed as part of the Mill Site remedy separate from this action. Under these circumstances, the groundwater requirements in NMAC § 20.6.2 are not applicable, nor are they suited to the NECR Mine Site response action for use as relevant and appropriate requirements.

NMAC § 20.6.2 contains several exemptions that preclude its identification as an ARAR at the NECR Mine Site. Leachate resulting from direct natural infiltration through disturbed materials or entirely through undisturbed materials generally is exempt from discharge permit requirements. NMAC §§ 20.6.2.3105.H and I. Natural groundwater seeping or flowing into conventional mine workings which reenters the ground by natural gravity flow prior to pumping or transporting out of the mine, and which is not used in the mining process, also is exempt. NMAC § 20.6.2.3105.K.

EPA should not identify the abatement requirements for groundwater in NMAC § 20.6.2 as ARARs for the Mill Site disposal of NECR mine spoils because groundwater remediation at the Mill site is being addressed separately under EPA Region VI CERCLA and NRC Atomic Energy Act authorities. These remediation activities are expressly exempt from New Mexico's groundwater abatement requirements. NMAC §§ 20.6.2.4105.A(2) and (4); *see also* NMAC § 20.6.2.7.AAA ("water contaminant . . . does not mean source, special nuclear or byproduct material . . . .").

## ***III. New Mexico Mining Regulations***

### A. Substantive Requirements of the New Mexico Mining Act Are ARARs; Administrative and Procedural Requirements Are Not.

UNC agrees with the State that substantive provisions of the New Mexico Mining Act of 1993, NMSA §§ 69-36-1 to 69-36-20 (NMMA) that are not applicable as a result of the date of the New Mexico Mining Act are relevant and appropriate for the Mine Site itself. However, the NMMA contains significant administrative, judicial, procedural, permitting and penalty provisions, and outlines duties and obligations of officials. For the reasons set forth in Section 2.a. above, these requirements are not ARARs. Permits identified in the NMMA are not required for the response actions on the NECR Mine Site or the adjacent Church Rock Mill site pursuant to CERCLA § 121(e). Additionally, the NMMA does not apply to activities regulated by NRC. "Mining does not mean the . . . extraction, processing or disposal of commodities, byproduct materials or wastes or other activities regulated by the federal nuclear regulatory commission." NMSA 69-36-3.H.

### B. New Mexico Non-Coal Mining Regulations.

The State has proposed NMCA § 19.10 as an ARAR, stating that it "establishes regulations for the permitting and reclamation of lands impacted by mining." UNC generally agrees that the substantive provisions of the New Mexico Non-Coal Mining regulations are ARARs at the Mine Site itself. As discussed above, permitting requirements within these regulations are not ARARs as they are administrative requirements only. NMAC § 19.10.1.7(M)(3) provides that "mining" for purposes of the non-coal mining regulations does not include "the extraction, processing or disposal of commodities, byproduct materials or wastes or other activities regulated by the federal Nuclear Regulatory Commission." The non-coal mining regulations are not ARARs for NRC regulated wastes, materials or activities.

NMAC § 19.10.5.506 is proposed as an ARAR. The State comments that "this provision requires a closeout plan that meets the requirements of the Act," and that it is "applicable to all remedial activities." The State also notes that "the closeout plan has been completed and provisions should be followed." As discussed above, the closeout plan is an administrative requirement, and thus is not an ARAR.

UNC agrees that the substantive provision of NMAC § 19.10.5.507 is a potential ARAR within the previous permit area at the NECR Mine Site. This provisions provides:

> The permit area will be reclaimed to a condition that allows for reestablishment of a self-sustaining ecosystem appropriate for the life zone of the surrounding areas following closure unless conflicting with the approved post-mining land use.

## *IV. The NECR Mine Response Action Will Be Adequately Regulated Through Other Federal and State ARARs*

Even though certain above-identified State mining, water quality, and permitting provisions do not qualify as ARARs for this action, there are substantive federal and state requirements that are ARARs, and ensure that the response action will be protective. UNC generally agrees that other ARARs identified in the State submittal either apply or are relevant and appropriate.

We appreciate your consideration of these comments. Please include this letter in the administrative record for the NECR Mine Site.

Sincerely,

Jane W. Gardner

Jane W. Gardner

Attachment F

**Lance Hauer**
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*Via Email and US Mail*

January 10, 2008

Andrew Bain
U.S. EPA, Mail Code SFD-8-2
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San Francisco, CA 94105

Re: Northeast Church Rock Mine, McKinley County, NM
Transmittal of Additional Information as Discussed on December 17, 2007

Dear Mr. Bain:

UNC would like to thank EPA for its time and interest in meeting with the Company on December 17, 2007 regarding the Northeast Church Rock Mine site (NECR). We believe the meeting was quite productive and appreciate your cooperation and interest. Meetings such as this can only improve the quality of the data and information upon which to base decisionmaking as to an appropriate response action at the site. EPA's candid discussion and cooperative attitude are also appreciated, and we believe a good relationship is being developed among the interested parties. We also are pleased that the Navajo Nation was able to participate by phone, and hope to further communicate with the Nation in the near future.

At the meeting, EPA requested additional available data and information to assist the Agency in preparation of a draft EE/CA for the NECR mine site. This is the first effort to provide such data and information as outlined in my letter of December 21, 2007. As we discussed at our December 17 meeting, UNC believes additional data collection is essential to understand site conditions. UNC will shortly propose a plan to EPA to collect the data. UNC expects this work can be completed by late February or early March.

The information we are providing responds to 3 issues discussed at the December meeting:

***First***, that the data do not support EPA's assumption that 5% of the remaining materials are mill tailings;

***Second***, that Ra-226 Activity Levels in the NECR uranium mine spoils are comparable to the only 2 other uranium mine sites that have been remediated under CERCLA, and have an EPA selected remedy of on-site consolidation and capping, and

***Third***, that EPA's volume estimate of mine spoils is inconsistent with current available data and appears to be significantly overstated.

## I. The Data Do Not Support EPA's Assumption That 5% of the Remaining Site Materials are Mill Tailings

During the meeting EPA indicated that the Agency estimated that 5% of the volume of site materials above the FSL, or approximately 75,000 cubic yards, consists of uranium mill tailings rather than mine spoils (protore/non-economic ore or waste rock), but acknowledged that there is no basis for that assumption at this time. EPA's cost tables also indicate that EPA has assumed tailings are present across the entire site – another assumption for which there is no basis.

Prior to UNC's removal, mill tailings were present only at discrete areas of the NECR site. These areas consisted of the storage pads where tailings sands were stored prior to backfilling, as well as areas that received runoff from those storage pads, as listed below:

- Sandfill Area #1
- Sandfill Area #2
- Sandfill Area #3
- Pond #1
- Pond #2
- Pond #3
- Pond#3A
- Pond Muck Pad (currently referred to as the Sediment Pad)

UNC conducted a comprehensive review of available site data for these areas to evaluate for the presence of residual mill tailings. UNC reviewed this data at the meeting and presented an evaluation of natural uranium (Unat) to Ra-226 ratios for both the 1989 sampling conducted during the tailings removal, and the more recent data collected in 2006-07 as part of the NECR Removal Site Evaluation.

Because Ra-226 activity could result from the presence of either mine spoils or tailings, the only practical way to differentiate between mine spoils and tailings is through review of Unat to Ra-226 ratios. Since over 90% of uranium was extracted by the UNC milling process, the tailings sands were significantly depleted in uranium as compared to mine spoils. Therefore, if a sample contained tailings, the Unat to Ra-226 ratios should have a significant bias toward radium.

<u>1989 Tailings Removal and Sampling</u>: Because uranium mill tailings sands used for mine backfilling operations are regulated as by-product materials by NRC pursuant to section 11(e)(2) of the Atomic Energy Act, the NRC required removal of these materials from the NECR Site pursuant to condition no. 33 of Source Material License SUA-1475 issued to UNC in connection with the nearby Church Rock mill. As the first step in releasing the mine site pursuant to condition no. 33, UNC removed remaining stockpiles of tailings sands from NECR (13,600 tons). UNC next proceeded to excavate and remove material containing residual tailings as determined by the Unat to Ra-226 ratio. As an additional conservative measure for excavation control, UNC averaged the ore and tailings ratios (1.44 and 0.035, respectively) and used the result as an action level to guide additional excavation where sample ratios were below 0.75. Altogether an additional 58,300 tons of material with potential to contain residual tailings was removed, followed by collection of confirmation samples. All work was approved by the NRC.

Attachment 1 provides final data tables for each area from the *Tailings Sand Backfill Cleanup Verification Report* (UNC, April 1989).

Based on the results, the NRC concluded:

> "... the data provided by UNC indicates that all U-nat/Ra-226 ratios following final excavation exceeded the verification ratio of 0.035, and the large majority exceeded the action level of 0.75. ... In addition, staff review of the data for the areas exceeding 7 pCi/g[1] indicates the U-nat values are significantly higher than the low values which would be expected from tailings. <u>*Based on the equilibrium ratio and the U-nat data provided by the licensee, the staff concludes that UNC has adequately removed remaining byproduct material from the mine site. No further action is therefore necessary.*"</u>

(NRC, October 31, 1989, emphasis added).

<u>2006/2007 RSE Samples</u>: Unat to Ra-226 ratios were also developed for the 2006/2007 Removal Site Evaluation (RSE) data collected from the NRC-regulated areas. The average ratios are provided on Table 1 and data and ratio comparisons for each sample are provided on Table 2. All RSE sample results had Unat to RA-226 ratios at least 3 times the tailings ratio of 0.035 and the majority of samples and average results had ratios 1 to 2 orders of magnitude greater than the tailings ratio.

Finally, comparison of the Unat to Ra-226 ratios from the RSE samples containing greater than 100 pCi/g of Ra-226, which is the approximate minimum Ra-226 level in tailings samples and would reasonably be assumed to be present in residual tailings

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[1] NRC determined the cleanup level for areas contaminated by tailings at NECR was 7pCi/g (the UMTRCA standard of 5 pCi/g plus background of 2 pCi/g).

remaining onsite, indicates an average ratio of 1.2, forty times greater than the tailings ratio.

## 2. Ra-226 Activity Levels in the NECR Uranium Mine Spoils Are Comparable to Other Uranium Mine Sites That Have Been Remediated by Consolidation and Capping.

During the December 17 meeting, UNC presented a comparison of Ra-226 activity levels at the NECR site to levels generally discussed in the Agency's 2007 TENORM From Uranium Mining guidance (indicating Ra-226 activity in non-economic materials, or protore, at uranium mine sites typically ranges from 30-600 pCi/g). In addition, UNC looked at levels at the only 2 other uranium mine sites remediated under CERCLA known to UNC (compared to the hundreds of uranium mine sites reclaimed under various state reclamation programs): the Midnite and White King uranium mine sites (located in WA and OR, respectively). Both the Midnite and the White King mines had large spoils piles with similar activity levels to the spoils found at NECR (at Midnite mine Ra-226 activity ranged as high as 880 pCi/g in grab samples and 363 pCi/g in composite samples, and at White King the average Ra-226 activity level in overburden was 53 pCi/g with a maximum of 291 pCi/g). Both of these sites were remediated by consolidation and capping of the uranium mine spoils, which we believe is also appropriate at NECR.

A comparison of activity levels at these three sites is provided in Table 3. In addition, Attachment 2 includes data summary tables and relevant text from the *Midnite Mine Remedial Investigation Report* (URS, September 2005) and *White King/Lucky Lass Record of Decision* (EPA, September 2001).

## 3. EPA's Volume Estimate of Mine Spoils Appears to be Significantly Overstated

EPA has assumed the volume of mine spoils above the Field Screening Level (FSL) is 1.46MM cy, using a generic assumption that Ra-226 activity levels above the FSL extend uniformly to the maximum sample depth in a given area where such Ra-226 activity levels were detected. EPA then multiplied the maximum depth within an area by the surface footprint of each area. Because this approach did not consider the spatial variation in depths of activity levels above the FSL reported in the RSE report, and given the variability in the topography of the native subsurface soils and variability in thickness of mine materials, EPA's volume estimate appears to be significantly overstated.

In Table 4, UNC is providing preliminary volume estimates for the site and step-out areas. You will see that there is a considerable discrepancy between EPA's estimate of ~1.5MM cy and UNC's estimate of approximately ~500,000 cy. UNC bases its estimate on CADD files, interpolating the volumes based on the spatial variation in depths of impacts above the FSL, as well as volumes above an assumed UMTRCA unrestricted use standard of 6 pCi/gm (5 pCi/gm + 1 pCi/gm background). UNC's methodology arrived at estimates of 582,000 and 440,000 cy above the FSL and UMTRCA standard, respectively. In the December 17 meeting, there appeared to be an acknowledgement that the EPA estimate is likely to be overstated and needs to be refined. Obviously the amount of material on the site has a direct and significant impact on the implementation of any removal alternative.

As we agreed in our meeting, both sets of estimates rely on assumptions where subsurface data is largely unavailable. As a result, UNC proposes additional investigation to provide reliable volume estimates, a key element needed for remedy decisionmaking. To fill in these data gaps, UNC is developing a work plan for EPA's review to confirm or refine these estimates. We expect the additional data collection effort to begin later this month, contingent upon EPA approval and weather conditions.

**Summary**

Based on the multiple lines of evidence demonstrating that tailings have been adequately removed, as well as information indicating that activity levels at NECR are typical of similar mine sites, UNC believes there is no basis to assume any significant amount of materials consist of NRC by-product materials, and that there is no basis to consider off-site disposal alternatives based on such an assumption.

UNC is in the process of obtaining or developing additional information relevant to EPA's analysis of removal alternatives and will continue to work with EPA to share this data and discuss appropriate alternatives. We hope to arrange a meeting with EPA near the end of January to go over data and discuss these issues in more detail. However, please feel free to contact Roger Florio or me in the event you have any questions prior to that time.

Sincerely yours,

Lance Hauer
Remedial Project Manager

cc: Harrison Karr, EPA
Mike Montgomery, EPA
David Taylor, Navajo Nation Department of Justice
Roger Florio, GE
Randy McAlister, GE

| Table 1: Unat to Ra-226 Ratio Tailings Sand Backfill Cleanup Verification Results after Final Excavation and RSE Investigation Results NORTHEAST CHURCH ROCK MINE SITE | | |
|---|---|---|
| | Unat to Ra-226 Average Ratio | |
| NECR Area | Tailings Cleanup Verification[1] | 2007 RSE Results |
| Sandfill 1 | 0.89 | 0.9 |
| Sandfill 2 | 1.96 | 1.28 |
| Sandfill 3 | 2.9 | 8.13 |
| Sediment Pad | 1.37 | 4.17 |
| Pond 1 | 5.18 | 2.233[3] |
| Pond 2 | 1.77 | 2.233[3] |
| Pond 3 | 5.16 | 2.844[4] |
| Pond 3a | 7.12 | 2.844[4] |
| NECR Ore/Waste Rock Samples[2] | 1.44 | - |
| Tailings Samples | 0.035 | - |
| | | |

Notes:

1 Following review of the verification sample results, NRC concluded that "Based on the equilibrium ratio and U-nat data provided by the licensee, the staff concludes that UNC has adequately removed remaining byproduct material from the mine site. No further action is therefore necessary." (NRC October 1989 correspondence to UNC)

2 Representative ore, other non-tailings, and tailings samples were analyzed for Ra-226 and natural uranium to establish Unat to Ra-226 ratios in non-byproduct versus byproduct sources. (UNC April 1989 Cleanup Verification Report)

3 Represents average value from both Ponds 1 and 2.

4 Represents average value from both Ponds 3 and 3a.

| Table 2: RSE Investigation Data Unat to Ra-226 Ratio | | | | | | |
|---|---|---|---|---|---|---|
| NORTHEAST CHURCH ROCK MINE SITE | | | | | | |
| Area | Area2 | Sample ID | Depth | $Ra_{226}$ (pCi/g) | $U_{nat}$ (pCi/g) | $U_{nat}$/Ra Ratio |
| Sandfill 1 | Sandfill 1 | SAND1-SS-044 | 0.25 | 11.0 | 1.2 | 0.11 |
| Sandfill 1 | Sandfill 1 | SAND1-SS-027 | 0.25 | 4.4 | 0.7 | 0.16 |
| Sandfill 1 | Sandfill 1 | SAND1-SS-043 | 0.25 | 6.7 | 1.2 | 0.18 |
| Sandfill 1 | Sandfill 1 | SAND1-TP-030 | 1.0-1.5 | 113.0 | 21.7 | 0.19 |
| Sandfill 1 | Sandfill 1 | SAND1-SS-050 | 0.25 | 15.7 | 3.1 | 0.20 |
| Sandfill 1 | Sandfill 1 | SAND1-SS-063 | 0.25 | 20.8 | 4.7 | 0.23 |
| Sandfill 1 | Sandfill 1 | SAND1-TP-049 | 1.0-1.5 | 75.8 | 22.1 | 0.29 |
| Sandfill 1 | Sandfill 1 | SAND1-SS-011 | 0.25 | 5.8 | 1.7 | 0.30 |
| Sandfill 1 | Sandfill 1 | SAND1-TP-049 | 3.5-4.0 | 6.4 | 2.1 | 0.32 |
| Sandfill 1 | Sandfill 1 | SAND1-SS-051 | 0.25 | 1.9 | 0.7 | 0.36 |
| Sandfill 1 | Sandfill 1 | SAND1-SS-030 | 0.25 | 14.3 | 7.3 | 0.51 |
| Sandfill 1 | Sandfill 1 | SAND1-SS-068 | 0.25 | 47.3 | 28.3 | 0.60 |
| Sandfill 1 | Sandfill 1 | SAND1-SS-028 | 0.25 | 0.8 | 0.5 | 0.60 |
| Sandfill 1 | Sandfill 1 | SAND1-SS-009 | 0.25 | 1.8 | 1.3 | 0.72 |
| Sandfill 1 | Sandfill 1 | SAND1-TP-030 | 3.5-4.0 | 4.8 | 3.6 | 0.74 |
| Sandfill 1 | Sandfill 1 | SAND1-TP-063 | 0.5-1.0 | 80.6 | 61.5 | 0.76 |
| Sandfill 1 | Sandfill 1 | SAND1-SS-017 | 0.25 | 2.1 | 1.9 | 0.91 |
| Sandfill 1 | Sandfill 1 | SAND1-TP-043 | 1.0-1.5 | 0.6 | 0.5 | 0.91 |
| Sandfill 1 | Sandfill 1 | SAND1-TP-068 | 0.5-1.0 | 57.4 | 62.7 | 1.09 |
| Sandfill 1 | Sandfill 1 | SAND1-SS-041 | 0.25 | 1.3 | 1.4 | 1.11 |
| Sandfill 1 | Sandfill 1 | SAND1-SS-049 | 0.25 | 16.8 | 28.1 | 1.67 |
| Sandfill 1 | Sandfill 1 | SAND1-TP-068 | 1.5-2.0 | 7.1 | 18.5 | 2.60 |
| Sandfill 1 | Sandfill 1 | SAND1-SS-021 | 0.25 | 2.3 | 8.6 | 3.75 |
| Sandfill 1 | Sandfill 1 | SAND1-TP-063 | 1.5-2.0 | 8.8 | 41.4 | 4.71 |
| Sandfill 1 Stepout | Sandfill 1 | SAND1-SS-053 | 0.25 | 5.4 | 1.7 | 0.32 |
| Sandfill 1 Stepout | Sandfill 1 | SAND1-SS-032 | 0.25 | 3.8 | 1.7 | 0.45 |
| Sandfill 1 Stepout | Sandfill 1 | SAND1-SS-065 | 0.25 | 4.3 | 2.1 | 0.48 |
| Sandfill 2 | Sandfill 2 | SAND2-SS-017 | 0.25 | 36.0 | 6.2 | 0.17 |
| Sandfill 2 | Sandfill 2 | SAND2-SS-016 | 0.25 | 6.1 | 1.7 | 0.28 |
| Sandfill 2 | Sandfill 2 | SAND2-SS-007 | 0.25 | 16.1 | 4.8 | 0.30 |
| Sandfill 2 | Sandfill 2 | SAND2-SS-015 | 0.25 | 4.4 | 1.8 | 0.42 |
| Sandfill 2 | Sandfill 2 | SAND2-SS-006 | 0.25 | 1.2 | 0.7 | 0.57 |
| Sandfill 2 | Sandfill 2 | SAND2-SS-011 | 0.25 | 6.2 | 3.7 | 0.60 |
| Sandfill 2 | Sandfill 2 | SAND2-SS-014 | 0.25 | 0.8 | 0.5 | 0.60 |
| Sandfill 2 | Sandfill 2 | SAND2-SS-010 | 0.25 | 1.2 | 0.8 | 0.68 |
| Sandfill 2 | Sandfill 2 | SAND2-SS-004 | 0.25 | 2.0 | 1.5 | 0.75 |
| Sandfill 2 | Sandfill 2 | SAND2-SS-003 | 0.25 | 3.3 | 2.9 | 0.87 |
| Sandfill 2 | Sandfill 2 | SAND2-SS-019 | 0.25 | 21.6 | 18.8 | 0.87 |
| Sandfill 2 | Sandfill 2 | SAND 2-TP-017 | 1.5-2.0 | 1.9 | 1.9 | 1.01 |

| Table 2: RSE Investigation Data Unat to Ra-226 Ratio | | | | | | |
|---|---|---|---|---|---|---|
| NORTHEAST CHURCH ROCK MINE SITE | | | | | | |
| Area | Area2 | Sample ID | Depth | $Ra_{226}$ (pCi/g) | $U_{nat}$ (pCi/g) | $U_{nat}/Ra$ Ratio |
| Sandfill 2 | Sandfill 2 | SAND2-SS-020 | 0.25 | 27.7 | 28.4 | 1.02 |
| Sandfill 2 | Sandfill 2 | SAND 2-TP-019 | 1.0-1.5 | 1.8 | 2.2 | 1.22 |
| Sandfill 2 | Sandfill 2 | SAND 2-TP-011 | 0.5-1.0 | 1.1 | 1.7 | 1.56 |
| Sandfill 2 | Sandfill 2 | SAND2-SS-012 | 0.25 | 6.2 | 18.0 | 2.91 |
| Sandfill 2 | Sandfill 2 | SAND 2-TP-008 | 0.5-1.0 | 2.4 | 10.5 | 4.37 |
| Sandfill 2 | Sandfill 2 | SAND 2-TP-012 | 1.5-2.0 | 3.8 | 18.2 | 4.78 |
| Sandfill 3 | Sandfill 3 | SAND3-SS-024 | 0.25 | 27.4 | 5.1 | 0.18 |
| Sandfill 3 | Sandfill 3 | SAND3-SS-026 | 0.25 | 19.6 | 5.0 | 0.26 |
| Sandfill 3 | Sandfill 3 | SAND3-SS-025 | 0.25 | 26.9 | 7.5 | 0.28 |
| Sandfill 3 | Sandfill 3 | SAND3-SS-027 | 0.25 | 4.5 | 2.2 | 0.49 |
| Sandfill 3 | Sandfill 3 | SAND3-SS-022 | 0.25 | 1.2 | 0.6 | 0.51 |
| Sandfill 3 | Sandfill 3 | SAND3-TP-025 | 0.5-1.0 | 27.2 | 14.5 | 0.53 |
| Sandfill 3 | Sandfill 3 | SAND3-SS-005 | 0.25 | 66.9 | 59.2 | 0.88 |
| Sandfill 3 | Sandfill 3 | SAND3-SS-009 | 0.25 | 31.9 | 28.4 | 0.89 |
| Sandfill 3 | Sandfill 3 | SAND3-SS-017 | 0.25 | 1.0 | 1.0 | 0.96 |
| Sandfill 3 | Sandfill 3 | SAND3-SS-008 | 0.25 | 1.4 | 2.0 | 1.42 |
| Sandfill 3 | Sandfill 3 | SAND3-SS-002 | 0.25 | 15.3 | 29.2 | 1.91 |
| Sandfill 3 | Sandfill 3 | SAND3-TP-005 | 1.5-2.0 | 28.1 | 54.0 | 1.92 |
| Sandfill 3 | Sandfill 3 | SAND3-TP-005 | 0.5-1.0 | 40.8 | 89.7 | 2.20 |
| Sandfill 3 | Sandfill 3 | SAND3-SS-014 | 0.25 | 123.0 | 271.2 | 2.21 |
| Sandfill 3 | Sandfill 3 | SAND3-SS-010 | 0.25 | 33.4 | 93.2 | 2.79 |
| Sandfill 3 | Sandfill 3 | SAND3-TP-014 | 1.0-1.5 | 84.1 | 334.2 | 3.97 |
| Sandfill 3 | Sandfill 3 | SAND3-SS-006 | 0.25 | 17.4 | 81.5 | 4.68 |
| Sandfill 3 | Sandfill 3 | SAND3-TP-006 | 0.5-1.0 | 8.4 | 69.9 | 8.32 |
| Sandfill 3 | Sandfill 3 | SAND3-TP-009 | 0.5-1.0 | 5.1 | 62.1 | 12.17 |
| Sandfill 3 | Sandfill 3 | SAND3-TP-014 | 0.5-1.0 | 1.2 | 155.5 | 129.57 |
| Sandfill 3 Stepout | Sandfill 3 | SAND3-SS-012 | 0.25 | 1.4 | 1.6 | 1.13 |
| Sandfill 3 Stepout | Sandfill 3 | SAND3-SS-004 | 0.25 | 1.4 | 2.4 | 1.71 |
| Ponds 1 & 2 | Ponds 1 and 2 | POND12-TP-035 | 1.0-1.5 | 417.0 | 195.9 | 0.47 |
| Ponds 1 & 2 | Ponds 1 and 2 | POND12-TP-035 | 2.0-2.5 | 41.5 | 26.6 | 0.64 |
| Ponds 1 & 2 | Ponds 1 and 2 | 1/2-SB-82 [20] | 20.0-21.5 | 1.5 | 1.2 | 0.78 |
| Ponds 1 & 2 | Ponds 1 and 2 | Pond12-SB-71 [5.0] | 5.0-6.5 | 0.9 | 0.9 | 0.99 |
| Ponds 1 & 2 | Ponds 1 and 2 | 1/2-SB-82 [10.0] | 10.0-11.5 | 12.2 | 12.4 | 1.02 |
| Ponds 1 & 2 | Ponds 1 and 2 | 1/2-SB-82 [5.0] | 5.0-6.5 | 14.4 | 15.5 | 1.08 |
| Ponds 1 & 2 | Ponds 1 and 2 | POND12-TP-058 | 4.5-5.0 | 438.0 | 520.5 | 1.19 |
| Ponds 1 & 2 | Ponds 1 and 2 | 1/2-SB-71 [10.0] | 10.0-11.5 | 0.7 | 1.4 | 2.05 |
| Ponds 1 & 2 | Ponds 1 and 2 | 1/2-SB-71 [15.0] | 15.0-16.5 | 1.0 | 2.3 | 2.26 |
| Ponds 1 & 2 | Ponds 1 and 2 | POND12-TP-030 | 2.0-3.0 | 41.3 | 102.1 | 2.47 |
| Ponds 1 & 2 | Ponds 1 and 2 | 1/2-SB-82 [15] | 15.0-16.5 | 1.1 | 3.4 | 3.11 |
| Ponds 1 & 2 | Ponds 1 and 2 | POND12-TP-035 | 9.0-9.5 | 19.6 | 141.1 | 7.20 |

| Table 2: RSE Investigation Data Unat to Ra-226 Ratio | | | | | | |
|---|---|---|---|---|---|---|
| NORTHEAST CHURCH ROCK MINE SITE | | | | | | |
| Area | Area2 | Sample ID | Depth | $Ra_{226}$ (pCi/g) | $U_{nat}$ (pCi/g) | $U_{nat}$/Ra Ratio |
| Ponds 1 & 2 | Ponds 1 and 2 | POND12-TP-030 | 4.5-5.0 | 6.2 | 55.0 | 8.87 |
| Ponds 1 & 2 | Ponds 1 and 2 | POND12-TP-058 | 8.5-9.0 | 1.3 | 40.7 | 31.30 |
| Ponds 1 & 2 | Ponds 1 and 2 | POND12-SS-023 | 0.25 | 62.4 | 19.6 | 0.31 |
| Ponds 1 & 2 | Ponds 1 and 2 | POND12-SS-014 | 0.25 | 96.9 | 32.5 | 0.34 |
| Ponds 1 & 2 | Ponds 1 and 2 | POND12-SS-047 | 0.25 | 73.1 | 25.8 | 0.35 |
| Ponds 1 & 2 | Ponds 1 and 2 | POND12-SS-024 | 0.25 | 26.9 | 11.1 | 0.41 |
| Ponds 1 & 2 | Ponds 1 and 2 | POND12-SS-077 | 0.25 | 487.0 | 289.7 | 0.59 |
| Ponds 1 & 2 | Ponds 1 and 2 | POND12-SS-050 | 0.25 | 13.7 | 8.2 | 0.59 |
| Ponds 1 & 2 | Ponds 1 and 2 | POND12-SS-056 | 0.25 | 11.2 | 6.9 | 0.62 |
| Ponds 1 & 2 | Ponds 1 and 2 | POND12-SS-020 | 0.25 | 2.2 | 1.4 | 0.62 |
| Ponds 1 & 2 | Ponds 1 and 2 | POND12-SS-011 | 0.25 | 1.1 | 0.7 | 0.62 |
| Ponds 1 & 2 | Ponds 1 and 2 | POND12-SS-069 | 0.25 | 161.0 | 113.7 | 0.71 |
| Ponds 1 & 2 | Ponds 1 and 2 | POND12-SS-035 | 0.25 | 78.5 | 58.6 | 0.75 |
| Ponds 1 & 2 | Ponds 1 and 2 | POND12-SS-041 | 0.25 | 3.0 | 2.8 | 0.94 |
| Ponds 1 & 2 | Ponds 1 and 2 | POND12-SS-061 | 0.25 | 26.5 | 25.1 | 0.95 |
| Ponds 1 & 2 | Ponds 1 and 2 | POND12-SB-071 [0-0.5] | 0.25 | 49.9 | 50.6 | 1.01 |
| Ponds 1 & 2 | Ponds 1 and 2 | POND12-SS-042 | 0.25 | 1.0 | 1.0 | 1.03 |
| Ponds 1 & 2 | Ponds 1 and 2 | POND12-SS-058 | 0.25 | 655.0 | 739.7 | 1.13 |
| Ponds 1 & 2 | Ponds 1 and 2 | POND12-SS-019 | 0.25 | 4.7 | 5.3 | 1.14 |
| Ponds 1 & 2 | Ponds 1 and 2 | 1/2-SB-82 [0-0.5] | 0.25 | 177.0 | 232.2 | 1.31 |
| Ponds 1 & 2 | Ponds 1 and 2 | POND12-SS-076 | 0.25 | 2.2 | 5.5 | 2.49 |
| Ponds 1 & 2 SO | Ponds 1 and 2 | POND12-SS-009 | 0.25 | 1.7 | 1.1 | 0.64 |
| Ponds 1 & 2 SO | Ponds 1 and 2 | POND12-SS-063 | 0.25 | 1.2 | 0.9 | 0.74 |
| Ponds 1 & 2 SO | Ponds 1 and 2 | POND12-SS-012 | 0.25 | 1.5 | 1.2 | 0.78 |
| Ponds 1 & 2 SO | Ponds 1 and 2 | POND12-SS-032 | 0.25 | 1.6 | 1.4 | 0.86 |
| Pond 3/3a | Pond 3/3a | POND3-SS-015 | 0.25 | 18.8 | 7.6 | 0.40 |
| Pond 3/3a | Pond 3/3a | 3/3a-SB-61 [15.0] | 15.0-16.5 | 1.5 | 0.7 | 0.46 |
| Pond 3/3a | Pond 3/3a | 3/3a-SB-61 [25.0] | 25.0-26.5 | 1.3 | 0.7 | 0.53 |
| Pond 3/3a | Pond 3/3a | 3/3a-SB-61 [10.0] | 10.0-11.5 | 1.1 | 0.7 | 0.62 |
| Pond 3/3a | Pond 3/3a | POND3-TP-007 | 9.0-9.5 | 0.7 | 0.5 | 0.68 |
| Pond 3/3a | Pond 3/3a | 3/3a-SB-61 [20.0] | 20.0-21.5 | 1.0 | 0.8 | 0.75 |
| Pond 3/3a | Pond 3/3a | POND3-TP-037 [0-0.5] | 0.25 | 7.7 | 6.7 | 0.87 |
| Pond 3/3a | Pond 3/3a | POND3-SS-042 | 0.25 | 1.4 | 1.3 | 0.93 |
| Pond 3/3a | Pond 3/3a | 3/3a-SB-61 [5.5] | 5.5-7.0 | 0.9 | 0.9 | 0.99 |
| Pond 3/3a | Pond 3/3a | POND3-SS-057 | 0.25 | 2.8 | 3.1 | 1.10 |
| Pond 3/3a | Pond 3/3a | 3/3a-SB-61 [0-0.5] | 0.25 | 17.3 | 19.5 | 1.12 |
| Pond 3/3a | Pond 3/3a | POND3-SS-038 | 0.25 | 20.9 | 23.9 | 1.14 |
| Pond 3/3a | Pond 3/3a | POND3-SS-065 | 0.25 | 39.6 | 46.8 | 1.18 |
| Pond 3/3a | Pond 3/3a | POND3-TP-014 | 8.5-9.0 | 0.8 | 1.0 | 1.20 |
| Pond 3/3a | Pond 3/3a | POND3-SS-046 | 0.25 | 19.5 | 23.5 | 1.20 |
| Pond 3/3a | Pond 3/3a | POND3-TP-014 | 6.5-7.0 | 0.8 | 1.0 | 1.28 |
| Pond 3/3a | Pond 3/3a | POND3-SS-063 | 0.25 | 3.8 | 6.0 | 1.59 |

| Table 2: RSE Investigation Data Unat to Ra-226 Ratio | | | | | | |
|---|---|---|---|---|---|---|
| NORTHEAST CHURCH ROCK MINE SITE | | | | | | |
| Area | Area2 | Sample ID | Depth | $Ra_{226}$ (pCi/g) | $U_{nat}$ (pCi/g) | $U_{nat}$/Ra Ratio |
| Pond 3/3a | Pond 3/3a | POND3-SS-001 | 0.25 | 18.1 | 28.8 | 1.59 |
| Pond 3/3a | Pond 3/3a | POND3-SS-059 | 0.25 | 26.9 | 43.1 | 1.60 |
| Pond 3/3a | Pond 3/3a | POND3-SS-007 | 0.25 | 259.0 | 698.6 | 2.70 |
| Pond 3/3a | Pond 3/3a | POND3-SS-029 | 0.25 | 312.0 | 849.3 | 2.72 |
| Pond 3/3a | Pond 3/3a | POND3-SS-027 | 0.25 | 4.7 | 13.1 | 2.78 |
| Pond 3/3a | Pond 3/3a | POND3-SS-014 | 0.25 | 875.0 | 2719.2 | 3.11 |
| Pond 3/3a | Pond 3/3a | POND3-TP-007 | 5.0-5.5 | 4.5 | 16.7 | 3.71 |
| Pond 3/3a | Pond 3/3a | POND3-TP-029 | 3.0-3.5 | 14.3 | 69.9 | 4.89 |
| Pond 3/3a | Pond 3/3a | POND3-TP-029 | 6.0-6.5 | 15.7 | 79.5 | 5.06 |
| Pond 3/3a | Pond 3/3a | POND3-TP-037 | 5.0-5.5 | 2.2 | 11.2 | 5.07 |
| Pond 3/3a | Pond 3/3a | POND3-TP-029 | 9.0-9.5 | 2.1 | 21.1 | 10.05 |
| Pond 3/3a | Pond 3/3a | POND3-TP-037 | 8.5-9.0 | 0.7 | 16.1 | 22.99 |
| Sediment Pad | Sediment Pad | SEDPAD-SS-006 | 0.25 | 38.8 | 14.9 | 0.38 |
| Sediment Pad | Sediment Pad | SEDPAD-SS-025 | 0.25 | 36.7 | 15.0 | 0.41 |
| Sediment Pad | Sediment Pad | SEDPAD-TP-006 | 1.5-2.0 | 92.9 | 47.0 | 0.51 |
| Sediment Pad | Sediment Pad | SEDPAD-SS-008 | 0.25 | 25.8 | 13.6 | 0.53 |
| Sediment Pad | Sediment Pad | SEDPAD-SS-005 | 0.25 | 17.7 | 9.7 | 0.55 |
| Sediment Pad | Sediment Pad | SEDPAD-SS-022 | 0.25 | 104.0 | 58.8 | 0.57 |
| Sediment Pad | Sediment Pad | SEDPAD-SS-07 | 0.25 | 106.0 | 63.3 | 0.60 |
| Sediment Pad | Sediment Pad | SEDPAD-TP-026 | 0.5-1.0 | 86.6 | 61.0 | 0.70 |
| Sediment Pad | Sediment Pad | SEDPAD-SS-015 | 0.25 | 33.4 | 23.8 | 0.71 |
| Sediment Pad | Sediment Pad | SEDPAD-SS-026 | 0.25 | 27.1 | 22.7 | 0.84 |
| Sediment Pad | Sediment Pad | SEDPAD-SS-018 | 0.25 | 1.5 | 1.3 | 0.87 |
| Sediment Pad | Sediment Pad | SEDPAD-SS-020 | 0.25 | 12.8 | 12.1 | 0.95 |
| Sediment Pad | Sediment Pad | SEDPAD-TP-014 | 0.5-1.0 | 165.0 | 172.6 | 1.05 |
| Sediment Pad | Sediment Pad | SEDPAD-SS-014 | 0.25 | 236.0 | 250.7 | 1.06 |
| Sediment Pad | Sediment Pad | SEDPAD-TP-012 | 1.0-1.5 | 84.0 | 100.7 | 1.20 |
| Sediment Pad | Sediment Pad | SEDPAD-TP-014 | 1.0-1.5 | 9.8 | 12.9 | 1.32 |
| Sediment Pad | Sediment Pad | SEDPAD-SS-12 | 0.25 | 118.0 | 248.6 | 2.11 |
| Sediment Pad | Sediment Pad | SEDPAD-TP-021 | 10.0-10.5 | 86.3 | 184.9 | 2.14 |
| Sediment Pad | Sediment Pad | SEDPAD-TP-021 | 5.0-5.5 | 99.7 | 244.5 | 2.45 |
| Sediment Pad | Sediment Pad | SEDPAD-SS-011 | 0.25 | 3.8 | 18.7 | 4.92 |
| Sediment Pad | Sediment Pad | SEDPAD-SS-021 | 0.25 | 85.6 | 1123.3 | 13.12 |
| Sediment Pad | Sediment Pad | SEDPAD-TP-006 | 3.0-3.5 | 2.8 | 60.8 | 21.70 |
| Sediment Pad | Sediment Pad | SEDPAD-TP-012 | 1.5-2.0 | 2.9 | 108.2 | 37.32 |

Notes:
1 Data obtained from the *Removal Site Evaluation Repor* t (MWH, October 2007).

Table 3: Ra-226 Activity at Reclaimed NECR Areas vs. other Uranium Mine Sites
NORTHEAST CHURCH ROCK MINE SITE

| NECR Area | Ra-226 Surface Soil (pCi/g) | | | Ra-226 Subsurface Soil | | |
|---|---|---|---|---|---|---|
| | Low | High | Average | Low | High | Average |
| **NRC Regulated Areas Reclaimed and Released Under NRC License** | | | | | | |
| Sandfill 1 | 0.8 | 47.3 | 10.2 | 0.6 | 113 | 39.4 |
| Sandfill 2 | 0.8 | 36 | 10.2 | 1.1 | 3.8 | 2.2 |
| Sandfill 3 | 1 | 123 | 28.7 | 1.2 | 84.1 | 27.8 |
| Sediment Pad | 1.5 | 236 | 60.5 | 2.8 | 165 | 70 |
| Ponds 1 and 2 | 1 | 655 | 105.9 | 0.7 | 438 | 71.2 |
| Pond 3 | 1.4 | 875 | 102.1 | 0.7 | 15.7 | 3.4 |
| **Areas with No Tailings Exposure** | | | | | | |
| NECR-1 | 7 | 93.3 | 39.3 | 1 | 103 | 21.4 |
| NECR-2 | 1.2 | 160 | 27.7 | 1.2 | 12.6 | 5.9 |
| NEMSA | 0.9 | 2.6 | 1.5 | 0.8 | 140 | 45.4 |
| Vents 3/8 | 1.4 | 137 | 31.5 | - | - | - |
| Trailer Park | 2.1 | 33.2 | 4.2 | - | - | - |
| Boneyard | - | 45.9 | - | 1.1 | 50.7 | 11 |
| **Other Mine Sites** | | | | | | |
| Midnite Mine[1] | 0.74 | 880 | | | | |
| White King (overburden)[2] | | 291 | | | 166 | 53.15 |

Notes:

1 Data obtained from Midnite Mine Record of Decision (EPA, September 2006)

2 Data Obtained from White King/Lucky Lass Record of Decision ( EPA, September 2001).

**Table 4 Summary of Preliminary Volumes of Impacted Soils**
**NORTHEAST CHURCH ROCK MINE SITE**

| Area | Area of Facility (ft2) | Areas >2.24 pCi/g | | | | Areas >6 pCi/g[1] | | | | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Area ($ft^2$) | Depth (ft bgs) | Vol. ($ft^3$) | Vol. ($yd^3$) | Area ($ft^2$) | Depth (ft bgs) | Vol. ($ft^3$) | Vol. ($yd^3$) | |
| **Shaft Pads** | | | | | | | | | | |
| NECR-1 | 570,735 | 628,000 | 4 - 29 | 6,075,000 | 225,000 | 603,400 | 4 - 29 | 5,205,627 | 192,801 | Vols. calculated using raster interpolation for >FSL and > 6 pCi/gm (horizontally & vertically). |
| Buildings | 2,400 | | | | | | | | | |
| Foundations | 49,000 | | | | | | | | | |
| NECR-2 | 317,036 | 425,000 | 1.5 - 5 | 756,000 | 28,000 | 314,000 | 2 | 628,000 | 23,259 | Vols. calculated using raster interpolation for >FSL and > 6 pCi/gm (horizontally & vertically). |
| NECR Drainage | 32,906 | | | | | | | | | Included in NECR-2 area. |
| Foundations | 6,500 | | | | | | | | | |
| **Shallow Areas** | | | | | | | | | | |
| NECR-1 Stepout | | 2,051,870 | 1 | 2,051,870 | 75,995 | 1,092,300 | 1 | 1,092,300 | 40,456 | |
| Contiguous Stepout | | 1,437,370 | | | | 681,300 | | | | Area included in NECR-1 stepout area. |
| Trailer Park | 196,138 | 272,000 | | | | 188,000 | | | | Area included in NECR-1 stepout area. |
| Fuel Storage Area | 32,196 | 300,000 | | | | 184,200 | | | | Area included in NECR-1 stepout area. |
| IX Plant | 37,000 | 42,500 | | | | 16,800 | | | | Area included in NECR-1 stepout area. |
| Non-contiguous Stepout | | 110,000 | 1 | 110,000 | 4,074 | 22,000 | 1 | 22,000 | 815 | Small areas not contiguous with step-out from NECR-1. Includes area adjacent to downstream extent of unnamed arroyo. |
| Magazine | 63,000 | 63,000 | 2 | 126,000 | 4,667 | 16,000 | 2 | 32,000 | 1,185 | |
| Vent 3 | 146,826 | 10,000 | 1 | 10,000 | 370 | 10,000 | 1 | 10,000 | 370 | |
| Vent 8 | 325,228 | 198,300 | 1 | 198,300 | 7,344 | 183,700 | 1 | 183,700 | 6,804 | 0 |
| Sandfill 3 | 101,031 | 172,500 | 2 - 5 | 295,985 | 11,000 | 172,400 | 2 - 5 | 295,985 | 8,800 | |
| Sandfill 2 | 43,716 | 89,000 | 2 - 3 | 106,813 | 4,000 | 59,500 | 1 | 59,500 | 2,204 | |
| Sandfill 1 | 157,361 | 320,000 | 5 | 761,271 | 28,000 | 173,000 | 1 | 761,271 | 22,400 | |
| NEMSA Stepout | | 5,000 | 1 | 5,000 | 185 | 5,000 | 1 | 5,000 | 185 | |
| Pond 1 Stepout | | 120,000 | 1 | 120,000 | 4,444 | 86,300 | 1 | 86,300 | 3,196 | |
| Pond 2 Stepout | | 181,600 | 1 | 181,600 | 6,726 | 159,600 | 1 | 159,600 | 5,911 | |
| Pond 3 Stepout | | 390,800 | 1 | 390,800 | 14,474 | 289,000 | 1 | 289,000 | 10,704 | |
| **Deep Areas** | | | | | | | | | | |
| NEMSA | 186,101 | 220,300 | 3 - 10 | 1,350,000 | 50,000 | 220,300 | 3 - 10 | 1,080,000 | 40,000 | Vol. based on raster interpolation for >FSL and > 6 pCi/gm (horizontally & vertically). Includes results >FSL and > 6 pCi/gm in NE end of Boneyard. |
| Pond 1 Deep | 156,842 | 144,000 | 7 - 12 | 1,389,506 | 51,463 | 10,800 | 5 - 10 | 1,152,000 | 42,667 | |
| Pond 2 Deep | 87,890 | 30,000 | 5 - 6 | 217,817 | 8,067 | 78,500 | 5 - 6 | 165,000 | 6,111 | |
| Pond 3/3a Deep | 262,443 | 260,000 | 6 - 8 | 946,384 | 35,051 | 47,800 | 7 | 334,600 | 12,393 | |
| Sediment Pad | 125,438 | 160,300 | 2 - 12 | 380,120 | 14,079 | 141,000 | 2 - 12 | 380,120 | 11,263 | |
| Unnamed Arroyo | 62,300 | 62,300 | 4 | 249,200 | 9,230 | 62,300 | 4 | 249,200 | 9,230 | Vol. based on raster interpolation for >FSL and > 6 pCi/gm (horizontally & vertically). From ~NPDES-01 to second unnamed arroyo (excludes arroyo upstream of NPDES-01). |
| | | | Total estimated volume = | | 582,170 | Total estimated volume = | | | 440,753 | |

Notes:
1. The 6 pCi/gm is equivalent to the UMTRUCA standard of 5 pCi/gm + the background activity level (1 pCi/gm) determined in the RSE investigation (MWH, October 2007).

## Attachment 1
## Tailings Backfill Cleanup Verification Report Final Data Tables

spCi/gm

# TABLE IV
## Sandfill No. 1 Soils Analysis Uranium/Radium Ratios After Final Excavation

| Sample Location | Radium-226 (pCi/gm) | Uranium (pCi/gm) | U/Ra Ratio |
|---|---|---|---|
| Centerline | | | |
| 000'@0.5' | 0.97±0.16 | 36.2 | 37.32 |
| 0.00'@1.0' | 0.98±0.16 | 17.2 | 17.55 |
| 0.00'@1.5' | 1.13±0.15 | 9.33 | 8.26 |
| 0.00'@2.0' | 0.83±0.15 | 17.9 | 21.57 |
| 125'* | 1.70±0.20 | 0.7 | 0.41 |
| 375'* | 1.32±0.18 | 1.69 | 1.28 |
| 500'@0.5' | 68.7±0.90 | 40.4 | 0.59 |
| 500'@1.0' | 64.4±0.90 | 46.4 | 0.72 |
| East Line | | | |
| 100'-242' | 4.99±0.33 | 1.74 | 0.35 |
| 125'-100'* | 7.74±0.38 | 2.60 | 0.34 |
| 125'-200' | 1.99±0.21 | 1.10 | 0.55 |
| 133'-228' | 9.80±0.10 | 2.37 | 0.24 |
| 166'-218' | 15.70±0.57 | 4.31 | 0.27 |
| 199'-205' | 20.90±0.20 | 3.47 | 0.17 |
| 200'-100' | 13.1±1.00 | 9.90 | 0.76 |
| 233'-185' | 8.70±0.10 | 1.87 | 0.21 |
| 250'-100'@0.5'* | 1.25±0.14 | 0.66 | 0.53 |
| 250'-100'@1.0' | 1.13±0.15 | 0.45 | 0.40 |
| 250'-100'@1.5' | 0.77±0.11 | 0.55 | 0.71 |
| 250'-100'@2.0' | 0.95±0.13 | 0.68 | 0.72 |
| 375'-50'* | 1.05±0.18 | 0.76 | 0.72 |
| 500'-50'@0.5' | 98.8±1.00 | 40.40 | 0.41 |
| 500'-50'@1.0' | 77.8±0.90 | 46.10 | 0.59 |
| 570'-32'** | 5.72±0.36 | 7.91 | 1.38 |

TABLE IV (continued)
Sandfill No. 1 Soils Analysis Uranium/Radium Ratios
After Final Excavation

| Sample Location | Radium-226 (pCi/gm) | Uranium (pCi/gm) | U/Ra Ratio |
|---|---|---|---|
| West Line | | | |
| 125'-50'* | 5.84±0.33 | 3.10 | 0.53 |
| 250'-50'@0.5'* | 0.64±0.12 | 0.48 | 0.75 |
| 250'-50'@1.0' | 0.61±0.10 | 0.46 | 0.75 |
| 250'-50'@1.5' | 0.54±0.11 | 0.59 | 1.09 |
| 250'-50'@2.0' | 0.67±0.14 | 0.38 | 0.57 |
| 300'-50' | 1.8±0.40 | 1.83 | 1.02 |
| 375'-50'* | 2.63±0.23 | 13.60 | 5.17 |
| 500'-50'@0.5' | 98.1±1.0 | 14.80 | 0.15 |
| 500'-50'@1.0' | 90.7±1.0 | 12.60 | 0.14 |

*These samples were taken at locations after cleanup generally within 75 ft. of the initial excavation sample locations they replace.

**This data is the same as that shown on Table III, indicating that additional excavation was not conducted at this location.

TABLE VI
Sandfill No. 2 Soils Analysis Uranium/Radium Ratios
After Final Excavation

| Sample Location | Radium-226 (pCi/gm) | Uranium (pCi/gm) | U/Ra Ratio |
|---|---|---|---|
| Centerline | | | |
| 0.00'@0.5' | 9.0±0.30 | 33.1 | 3.68 |
| 0.00'@1.0' | 14.2±0.46 | 33.1 | 2.33 |
| 0.00'@1.5' | 7.44±0.30 | 23.8 | 3.20 |
| 0.00'@2.0' | 4.83±0.24 | 23.1 | 4.78 |
| 100'** | 95.9±2.4 | 55.5 | 0.58 |
| 200'** | 109.7±2.8 | 129.8 | 1.18 |
| 300'@0.5'** | 6.3±0.6 | 22.9 | 3.63 |
| 300'@1.0'** | 18.6±1.1 | 29.3 | 1.58 |
| 300'@1.5'** | 2.9±0.5 | 23.2 | 8.00 |
| 300'@2.0'** | 3.3±0.5 | 19.5 | 5.91 |
| 375' | 43.5±0.8 | 42.7 | 0.98 |
| 400'@0.5' | 1.1±0.11 | 2.19 | 1.99 |
| 400'@1.0' | 1.08±0.11 | 1.81 | 1.68 |
| 400'@1.5' | 0.77±0.09 | 1.43 | 1.86 |
| 400'@2.0' | 0.85±0.09 | 2.00 | 2.35 |
| 540'* | 4.30±0.2 | 25.8 | 6.00 |
| 640' | 12.4±0.7 | 5.15 | 0.42 |
| East Line | | | |
| 0.00'-50'** | 35.7±1.6 | 80.3 | 2.25 |
| 0.00'-100'** | 27.6±1.3 | 30.7 | 1.11 |
| 75'-50'* | 6.21±0.24 | 35.7 | 5.75 |
| 100'-75' | 26.4±2.00 | 26.4 | 1.00 |
| 200'-50'** | 164.4±3.10 | 218.5 | 1.33 |
| 200'-75'** | 154.9±3.2 | 232.2 | 1.50 |

*These samples were taken at locations after cleanup generally with 75 ft. of the initial excavation samples locations they replace.

**This data is the same as that shown on Table V, indicating that additional excavation was not conducted at this location.

TABLE VI (continued)
Sandfill No. 2 Soils Analysis Uranium/Radium Ratios
After Final Excavation

| Sample Location | Radium-226 (pCi/gm) | Uranium (pCi/gm) | U/Ra Ratio |
|---|---|---|---|
| East Line | | | |
| 375'-50'* | 1.3±0.11 | 4.94 | 3.80 |
| 400'-75' | 2.7±0.40 | 6.50 | 2.41 |
| 450'-50'@0.5'* | 1.8±0.3 | 5.81 | 3.23 |
| 450'-50'@1.0' | 0.9±0.2 | 5.28 | 5.87 |
| 450'-50'@1.5' | 1.1±0.2 | 2.24 | 2.04 |
| 450'-50'@2.0' | 0.8±0.2 | 3.57 | 4.46 |
| 500'-50' | 25.6±0.6 | 9.5 | 0.37 |
| 500'-100'@0.5'** | 52.6±3.1 | 8.49 | 0.16 |
| 500'-100'@1.0'** | 1.3±0.3 | 1.01 | 0.78 |
| 500'-100'@1.5'** | 1.5±0.3 | 1.16 | 0.77 |
| 500'-100'@2.0'** | 1.7±0.3 | 1.19 | 0.70 |
| West Line | | | |
| 0.00'-50'** | 35.8±1.6 | 54.7 | 1.53 |
| 0.00'-100'** | 109.5±2.6 | 58.1 | 0.53 |
| 75'-50'* | 298.0±1.6 | 1,177.0 | 3.95 |
| 100'-75'@0.5' | 66.0±1.9 | 84.6 | 1.28 |
| 100'-75'@1.0' | 72.6±3.7 | 79.3 | 1.09 |
| 100'-75'@1.5' | 36.0±2.4 | 38.3 | 1.06 |
| 100'-75'@2.0' | 62.2±3.4 | 75.7 | 1.22 |
| 200'-50' | 294.6±4.7 | 529.4 | 1.80 |
| 200'-75' | 50.5±2.1 | 34.2 | 0.68 |
| 375'-50'* | 4.22±0.2 | 12.4 | 2.94 |
| 500'-75' | 19.3±0.2 | 19.6 | 1.02 |

*These samples were taken at locations after cleanup generally with 75 ft. of the initial excavation samples locations they replace.

**This data is the same as that shown on Table V, indicating that additional excavation was not conducted at this location.

TABLE VIII
Sandfill No. 3 Soils Analysis Uranium/Radium Ratios
After Final Excavation

| Sample Location | Radium-226 (pCi/gm) | Uranium (pCi/gm) | U/Ra Ratio |
|---|---|---|---|
| Centerline | | | |
| -50'@0.5'** | 121.0±1.1 | 84.0 | 0.69 |
| -50'@1.0'** | 101.0±1.0 | 99.6 | 0.99 |
| -50'@1.5'** | 51.1±0.75 | 99.6 | 1.95 |
| -50'@2.0'** | 63.4±0.88 | 86.0 | 1.36 |
| 0.00' | 105.0±3.5 | 102.0 | 0.97 |
| 100' | 61.7±2.7 | 108.0 | 1.75 |
| 125'@0.5' | 73.6±0.88 | 137.5 | 1.87 |
| 125'@1.0' | 39.7±0.62 | 145.1 | 3.65 |
| 125'@1.5' | 24.4±0.5 | 188.4 | 7.72 |
| 125'@2.0' | 18.3±0.44 | 66.2 | 3.62 |
| East Line | | | |
| -100'-50' | 72.3±2.9 | 121.0 | 1.67 |
| 0.00'-50'* | 19.7±0.49 | 248.9 | 12.63 |
| 75'-50' | 28.9±0.52 | 211.6 | 7.32 |
| 100'-100' | 35.0±2.10 | 12.6 | 0.42 |
| West Line | | | |
| -100'-50' | 116.0±3.4 | 109.0 | 0.94 |
| 0.00'-50' | 129.0±1.3 | 167.5 | 1.30 |
| 75'-50' | 44.8±0.67 | 52.1 | 1.16 |
| 100'-40' | 37.2±1.9 | 29.6 | 0.80 |

*These samples were taken at locations after cleanup generally within 75 ft. of the initial excavation samples locations they replace.

**This data is the same as that shown on Table VII, indicating that additional excavation was not conducted at this location.

TABLE X
Pond Muck Pad Soils Analysis Uranium/Radium Ratios
After Final Excavation

| Sample Location | Radium-226 (pCi/gm) | Uranium (pCi/gm) | U/Ra Ratio |
|---|---|---|---|
| Centerline | | | |
| 250' | 479.0±5.7 | 785.5 | 1.64 |
| 300'@0.5' | 146.9±3.2 | 3927.0 | 26.73 |
| 300'@1.0' | 138.0±3.3 | 185.0 | 1.34 |
| 300'@1.5' | 165.0±3.3 | 146.0 | 0.88 |
| 300'@2.0' | 150.0±3.1 | 158.0 | 1.05 |
| 400'@0.5'* | 126.0±2.8 | 177.0 | 1.40 |
| 400'@1.0' | 78.0±2.5 | 113.0 | 1.45 |
| 400'@1.5' | 80.5±2.5 | 110.0 | 1.37 |
| 400'@2.0' | 96.1±2.7 | 140.0 | 1.46 |
| 500'@0.5' | 249.0±4.2 | 273.2 | 1.10 |
| 500'@1.0' | 227.0±3.9 | 197.0 | 0.87 |
| 500'@1.5' | 158.0±3.6 | 143.0 | 0.91 |
| East Line | | | |
| 250'-50' | 18.1±1.1 | 37.6 | 2.09 |
| 300'-50' | 219.0±4.3 | 377.0 | 1.72 |
| 400'-50'@0.5' | 163.7±3.3 | 341.5 | 2.09 |
| 400'-50'@1.0' | 86.0±2.4 | 70.7 | 0.82 |
| 400'-50'@1.5' | 142.0±3.3 | 85.3 | 0.60 |
| 400'-50'@2.0' | 34.2±1.7 | 58.5 | 1.71 |
| 500'-30' | 66.0±2.2 | 99.0 | 1.49 |
| 500'-50' | 26.5±1.4 | 24.9 | 0.94 |
| 600'-50' | 19.6±1.2 | 22.5 | 1.15 |

TABLE X (continued)
Pond Muck Pad Soils Analysis Uranium/Radium Ratios
After Final Excavation

| Sample Location | Radium-226 (pCi/gm) | Uranium (pCi/gm) | U/Ra Ratio |
|---|---|---|---|
| West Line | | | |
| 250'-50'* | 34.7±2.3 | 67.4 | 1.94 |
| 250'-100' | 191.1±3.5 | 251.1 | 1.31 |
| 300'-50'* | 106.0±3.0 | 223.0 | 2.10 |
| 300'-100'* | 219.6±4.0 | 251.0 | 1.14 |
| 400'-50' | 150.7±3.3 | 211.7 | 1.40 |
| 400'-100'@0.5' | 106.2±2.8 | 100.7 | 0.95 |
| 400'-100'@1.0' | 29.1±1.6 | 117.0 | 4.02 |
| 400'-100'@1.5' | 13.6±1.1 | 73.1 | 5.38 |
| 400'-100'@2.0 | 4.6±0.7 | 87.7 | 19.07 |
| 500'-50'** | 58.2±2.0 | 63.2 | 1.09 |
| 550'-100' | 103.0±2.7 | 171.0 | 1.66 |
| 600'-50'* | 183.0±5.0 | 182.0 | 0.99 |
| 600'-100'@0.5'* | 121.0±3.1 | 323.0 | 2.67 |
| 600'-100'@1.0' | 107.0±3.0 | 456.0 | 4.26 |
| 600'-100'@1.5' | 104.0±3.0 | 283.0 | 2.72 |
| 600'-100'@2.0' | 109.0±3.1 | 377.0 | 3.46 |
| 600'-150' | 61.9±2.1 | 129.8 | 2.1 |
| 700'-50' | 27.0±1.4 | 15.4 | 0.57 |
| 700'-100' | 90.9±2.5 | 73.4 | 0.81 |
| 700'-150' | 107.3±2.8 | 109.3 | 1.02 |
| 750'-150' | 158.3±3.4 | 187.9 | 1.19 |

*Only area(s) requiring selective excavation.

**This sample was taken after cleanup to replace location 500'-50' east.

TABLE XII

Pond No. 1 Soils Analysis Uranium/Radium Ratios

After Final Excavation

| Sample Location | Radium-226 (pCi/gm) | Uranium (pCi/gm) | U/Ra Ratio |
|---|---|---|---|
| Centerline | | | |
| 50'* | 27.0±2.3 | 1322.0 | 48.96 |
| 100' | 42.8±2.9 | 383.0 | 8.95 |
| 125'@0.5'*** | 717.0±2.2 | 1092.0 | 1.52 |
| 125'@1.0' | 799.0±2.3 | 1265.0 | 1.58 |
| 125'@1.5' | 549.0±2.1 | 1064.0 | 1.94 |
| 125'@2.0' | 581.0±2.0 | 1380.0 | 2.38 |
| 200' | 46.1±2.9 | 264.0 | 5.73 |
| 400'@0.5' | 307.0±5.3 | 409.0 | 1.33 |
| 400'@1.0' | 108.0±3.1 | 121.0 | 1.12 |
| 400'@1.5' | 289.0±5.2 | 377.0 | 1.30 |
| 400'@2.0' | 206.0±4.2 | 239.0 | 1.16 |
| East Line | | | |
| 100'-50'** | 414.6±5.8 | 658.0 | 1.59 |
| 100'-75'@0.5'*** | 464.0±6.8 | 672.0 | 1.45 |
| 100'-75'@1.0' | 208.0±4.5 | 336.0 | 1.62 |
| 100'-75'@1.5 | 231.0±4.8 | 376.0 | 1.63 |
| 100'-75'@2.0' | 10.5±1.0 | 14.9 | 1.42 |
| 200'-50'@0.5' | 379.0±6.2 | 403.0 | 1.06 |
| 200'-50'@1.0' | 399.0±6.4 | 457.0 | 1.15 |
| 200'-50'@1.5' | 406.0±6.4 | 591.0 | 1.46 |
| 200'-50'@2.0' | 377.0±6.2 | 565.0 | 1.50 |
| 300'-50'** | 367.1±5.2 | 424.0 | 1.16 |
| 300'-85'** | 303.2±5.1 | 395.0 | 1.30 |
| 400'-50'** | 291.6±4.4 | 468.0 | 2.13 |

*This sample was taken after cleanup to replace Center Line-25'.

**This data is the same as that shown on Table XI, indicating that additional excavation was not conducted at this location.

***Extra samples at same or new location.

TABLE XII (continued)
Pond No. 1 Soils Analysis Uranium/Radium Ratios
After Final Excavation

| Sample Location | Radium-226 (pCi/gm) | Uranium (pCi/gm) | U/Ra Ratio |
|---|---|---|---|
| **West Line** | | | |
| 100'-50'** | 65.9±2.4 | 129.0 | 1.96 |
| 100'-100'** | 163.2±3.7 | 170.0 | 1.04 |
| 100'-150'** | 24.9±1.4 | 26.4 | 1.06 |
| 100'-200'** | 107.4±3.1 | 263.0 | 2.45 |
| 200'-50'** | 381.2±5.9 | 541.0 | 1.42 |
| 200'-85'** | 55.1±2.1 | 49.8 | 0.90 |
| 200'-100'@0.5'*** | 107.0±3.4 | 538.0 | 5.03 |
| 200'-100'@1.0' | 439.0±6.9 | 780.0 | 1.78 |
| 200'-100'@1.5' | 511.0±7.2 | 968.0 | 1.89 |
| 200'-100'@2.0' | 550.0±6.9 | 780.0 | 1.42 |
| 300'-50'** | 177.3±3.5 | 196.0 | 1.11 |
| 300'-80'** | 69.7±2.2 | 71.7 | 1.03 |
| 400'-50'** | 107.7±3.0 | 99.5 | 0.92 |
| 125'-226' | 125.0±0.9 | 172.5 | 1.38 |
| 125'-340' | 7.2±0.1 | 70.4 | 10.06 |

*This sample was taken after cleanup to replace Center Line-25'.

**This data is the same as that shown on Table XI, indicating that additional excavation was not conducted at this location.

***Extra samples at same or new location.

TABLE XIV

Pond No. 2 Soils Analysis Uranium/Radium Ratios

After Final Excavation

| Sample Location | Radium-226 (pCi/gm) | Uranium (pCi/gm) | U/Ra Ratio |
|---|---|---|---|
| Centerline | | | |
| 30' | 2.7±0.5 | 4.1 | 1.52 |
| 50' | 165.7±3.7 | 235.7 | 1.42 |
| 100'@0.5'* | 10.1±0.4 | 26.4 | 2.61 |
| 100'@1.0' | 1.0±0.1 | 9.4 | 9.09 |
| 100'@1.5' | 0.9±0.1 | 12.7 | 13.66 |
| 100'@2.0' | 0.6±0.1 | 6.9 | 11.86 |
| 150' | 114.1±2.9 | 288.6 | 2.53 |
| 200'@0.5'** | 143.0±3.7 | 255.0 | 1.78 |
| 200'@1.0' | 74.6±2.5 | 108.0 | 1.45 |
| 200'@1.5' | 27.6±1.5 | 34.9 | 1.26 |
| 200'@2.0' | 12.5±1.1 | 18.0 | 1.44 |
| 240' | 368.6±4.7 | 836.7 | 2.27 |
| East Line | | | |
| 30'-50'* | 141.0±5.6 | 193.7 | 1.37 |
| 30'-75' | 20.3±1.0 | 26.9 | 1.33 |
| 100'-40'** | 69.8±0.9 | 106.8 | 1.53 |
| 150'-25' | 414.9±5.1 | 734.2 | 1.77 |
| 200'-15' | 53.9±1.8 | 112.7 | 2.09 |
| West Line | | | |
| 30'-50'* | 195.0±5.9 | 317.0 | 1.63 |
| 30'-75' | 2.7±0.4 | 2.4 | 0.89 |
| 100'-20'@0.5'** | 120.0±3.4 | 215.0 | 1.79 |
| 100'-20'@1.0' | 138.0±3.7 | 229.0 | 1.66 |
| 100'-20'@1.5' | 59.9±2.5 | 116.0 | 1.94 |

*Only area(s) requiring additional excavation.

**Extra sample at the same or new location.

TABLE XIV (continued)
Pond No. 2 Soils Analysis Uranium/Radium Ratios
After Final Excavation

| Sample Location | Radium-226 (pCi/gm) | Uranium (pCi/gm) | U/Ra Ratio |
|---|---|---|---|
| West Line | | | |
| 100'-20'@2.0' | 73.2±2.7 | 112.0 | 1.53 |
| 100'-30'** | 14.1±0.4 | 34.5 | 2.45 |
| 150'-30' | 347.7±4.8 | 546.4 | 1.57 |
| 200'-15' | 85.0±2.1 | 199.8 | 2.35 |

*Only area(s) requiring additional excavation.

**Extra sample at the same or new location.

TABLE XVI
Pond No. 3 Soils Analysis Uranium/Radium Ratios
After Final Excavation

| Sample Location | Radium-226 (pCi/gm) | Uranium (pCi/gm) | U/Ra Ratio |
|---|---|---|---|
| Centerline | | | |
| 50'@0.5' | 35.0±1.9 | 80.7 | 2.31 |
| 50'@1.0' | 91.3±3.0 | 171.0 | 1.87 |
| 50'@1.5' | 101.0±3.3 | 121.0 | 1.20 |
| 50'@2.0' | 2.8±0.5 | 39.0 | 13.93 |
| 100'@0.5'* | 879.0±7.9 | 1163.0 | 1.32 |
| 100'@1.0' | 452.0±6.4 | 503.0 | 1.11 |
| 100'@1.5' | 315.0±5.4 | 487.0 | 1.55 |
| 100'@2.0' | 421.0±6.2 | 754.0 | 1.79 |
| 150' | 677.2±7.2 | 687.3 | 1.01 |
| East Line | | | |
| 50'-10'** | 56.1±.74 | 741.0 | 13.21 |
| 50'-25' | 21.9±1.3 | 38.3 | 1.75 |
| 65'-20'@0.5'** | 44.7±0.67 | 2413.0 | 53.98 |
| 65'-20'@1.0' | 33.6±0.58 | 2275.0 | 67.71 |
| 65'-20'@1.5' | 68.7±0.83 | 689.0 | 10.03 |
| 65'-20'@2.0' | 110.7±1.05 | 310.0 | 2.80 |
| 75'-25'@0.5'** | 52.7±2.4 | 3226.0 | 61.21 |
| 75'-25'@1.0' | 88.9±3.1 | 2070.0 | 23.28 |
| 75'-25'@1.5' | 132.0±3.2 | 597.0 | 4.52 |
| 75'25'@2.0' | 106.0±2.9 | 2823.0 | 26.63 |
| 95'-15'** | 130.9±1.13 | 827.0 | 6.32 |

TABLE XVI (continued)
Pond No. 3 Soils Analysis Uranium/Radium Ratios
After Final Excavation

| Sample Location | Radium-226 (pCi/gm) | Uranium (pCi/gm) | U/Ra Ratio |
|---|---|---|---|
| West Line | | | |
| 50'-50' | 151.9±3.6 | 1401.0 | 9.22 |
| 50'-75' | 52.6±2.1 | 370.1 | 7.04 |
| 75'-30'@0.5'** | 102.0±2.8 | 101.0 | 0.99 |
| 75'-30'@1.0' | 1.1±0.3 | 13.7 | 12.45 |
| 75'-30'@1.5' | 1.7±0.3 | 5.11 | 3.01 |
| 75'-30'@2.0' | 2.4±0.4 | 6.69 | 2.79 |
| 100'-50' | 918.0±7.7 | 1136.6 | 1.24 |
| 100'-75' | 24.8±1.3 | 89.8 | 3.62 |
| 150'-25' | 44.2±1.9 | 195.6 | 4.43 |

*Only area(s) requiring additional excavation.

**Extra sample at the same or new location.

TABLE XVIII
Pond No. 3A Soils Analysis Uranium/Radium Ratios
After Final Excavation

| Sample Location | Radium-226 (pCi/gm) | Uranium (pCi/gm) | U/Ra Ratio |
|---|---|---|---|
| Centerline | | | |
| 20'* | 28.9±1.6 | 151.0 | 5.22 |
| 50'** | 10.7±0.9 | 50.4 | 4.71 |
| 100'** | 7.6±0.8 | 37.6 | 4.95 |
| 200'@0.5' | 46.2±2.3 | 1352.0 | 29.26 |
| 200'@1.0' | 31.2±1.7 | 232.0 | 7.44 |
| 200'@1.5' | 17.2±1.3 | 117.0 | 6.80 |
| 200'@2.0 | 42.0±4.2 | 244.0 | 5.81 |
| 300' | 11.9±1.2 | 39.2 | 3.29 |
| 400'@0.5' | 1.3±0.4 | 52.4 | 40.31 |
| 400'@1.0' | 1.2±0.3 | 48.8 | 40.67 |
| 400'@1.5' | 0.9±0.3 | 45.1 | 50.11 |
| 400'@2.0' | 0.8±0.2 | 45.1 | 56.38 |
| 500' | 63.8±2.7 | 260.0 | 5.82 |
| 600'@0.5' | 76.4±3.0 | 480.0 | 6.28 |
| 600'@1.0' | 46.3±2.1 | 134.0 | 2.89 |
| 600'@1.5' | 21.9±1.5 | 31.7 | 1.45 |
| 600'@2.0' | 20.9±1.3 | 28.0 | 1.34 |
| 700' | 18.9±1.8 | 85.0 | 4.50 |
| East Line | | | |
| 100'-50' | 41.5±2.3 | 25.7 | 0.62 |
| 200'-50' | 20.5±1.6 | 153.0 | 7.46 |
| 300'-50' | 16.7±1.5 | 91.6 | 5.49 |
| 300'-75' | 19.6±1.6 | 159.0 | 8.01 |
| 400'-50' | 17.3±1.5 | 54.5 | 3.15 |
| 500'-50' | 53.9±2.6 | 447.0 | 8.29 |

TABLE XVIII (continued)
Pond No. 3A Soils Analysis Uranium/Radium Ratios
After Final Excavation

| Sample Location | Radium-226 (pCi/gm) | Uranium (pCi/gm) | U/Ra Ratio |
|---|---|---|---|
| East Line | | | |
| 500'-75' | 61.0±2.8 | 266.0 | 4.36 |
| 600'-50' | 35.2±2.5 | 25.1 | 0.71 |
| 700'-50' | 12.4±0.9 | 30.2 | 2.44 |
| West Line | | | |
| 50'-75' | 37.2±2.1 | 994.0 | 26.72 |
| 100'-75' | 6.2±0.8 | 45.8 | 7.39 |
| 200'-75' | 7.4±0.9 | 25.3 | 3.42 |
| 300'-75' | 17.9±1.5 | 131.0 | 7.32 |
| 400'-75' | 2.1±0.5 | 17.0 | 8.10 |
| 500'-100' | 40.2±2.2 | 414.0 | 10.30 |
| 600'-100'@0.5' | 17.2±1.4 | 192.0 | 11.16 |
| 600'-100'@1.0' | 22.9±1.5 | 87.7 | 3.83 |
| 600'-100'@1.5' | 2.8±0.4 | 26.8 | 9.57 |
| 600'-100'@2.0' | 2.9±0.5 | 26.8 | 9.24 |
| 600'-200' | 54.5±2.6 | 1262.0 | 23.16 |
| 700'-100' | 19.3±1.6 | 255.0 | 5.18 |
| 700'-200' | 40.3±2.2 | 414.0 | 10.27 |

*Only area(s) requiring additional excavation.

**Extra sample at the same or new location.

Attachment 2

Data Summary Tables and Applicable Text from the *Midnite Mine Remedial Investigation Report* and *White King/Lucky Lass Record of Decision*

MIDNITE MINE RI

# Table 5-105
## SUMMARY OF ANALYTICAL RESULTS FOR MINED AREA COMPOSITE SURFACE MATERIAL SAMPLES

| Parameter (1) | Units | Number of Samples | Number of Detects | Background Limits | | Minimum | Maximum Detected Value |
|---|---|---|---|---|---|---|---|
| | | | | BL (2) | RBL (3) | | |
| **Inorganics** | | | | | | | |
| Chloride | mg/kg | 16 | 16 | 14.1 | 9.64 | 0.186 | 4.77 |
| Nitrate | mg/kg | 13 | 13 | 3.09 | 3.09 | 0.0240 | 1.03 |
| **Nitrite** | mg/kg | 16 | 7 | 0.120 | 0.0600 | <0.0200 | 0.082 |
| Nitrogen, Ammonia | mg/kg | 14 | 14 | 64.8 | 64.8 | 0.134 | 2.25 |
| Phosphate-P | mg/kg | 16 | 12 | 21.0 | 17.7 | <0.200 | 2.28 |
| Phosphorus | mg/kg | 16 | 16 | 1,550 | 1,130 | 279 | 577 |
| **Sulfate** | mg/kg | 16 | 16 | 20.8 | 13.9 | 1.81 | 2,655 |
| **Metals** | | | | | | | |
| Total Aluminum | mg/kg | 36 | 36 | 24,100 | 24,100 | 4,140 | 33,700 (5) |
| Total Antimony | mg/kg | 3 | 3 | 1.40 | 1.40 | 0.650 | 0.780 |
| Total Arsenic | mg/kg | 36 | 30 | 234 | 234 | <4.00 | 137 |
| Total Barium | mg/kg | 36 | 36 | 548 | 417 | 18.7 | 251 |
| **Total Beryllium** | mg/kg | 36 | 36 | 1.51 | 1.16 | 0.510 | 2.91 |
| **Total Cadmium** | mg/kg | 36 | 32 | 0.468 | 0.405 | <0.0400 | 1.80 |
| **Total Calcium** | mg/kg | 16 | 16 | 10,100 | 7,690 | 730 | 35,200 |
| **Total Chromium** | mg/kg | 36 | 36 | 19.2 | 16.3 | 2.90 | 33.7 |
| Total Cobalt | mg/kg | 36 | 36 | 23.8 | 23.8 | 2.90 | 19.9 |
| **Total Copper** | mg/kg | 36 | 36 | 41.8 | 41.8 | 5.70 | 62.8 |
| **Total Iron** | mg/kg | 36 | 36 | 37,700 | 28,900 | 7,750 | 61,700 |
| **Total Lead** | mg/kg | 36 | 36 | 21.8 | 18.5 | 8.00 | 43.0 |
| **Total Magnesium** | mg/kg | 16 | 16 | 3,680 | 3,170 | 1,420 | 10,100 |
| **Total Manganese** | mg/kg | 36 | 36 | 1,530 | 1,330 | 428 | 2,750 |
| Total Mercury | mg/kg | 36 | 6 | 0.134 | 0.130 | <0.0200 | 0.0500 |
| **Total Molybdenum** | mg/kg | 16 | 16 | 5.60 | 2.97 | 2.50 | 31.9 |
| **Total Nickel** | mg/kg | 36 | 36 | 30.2 | 20.9 | 3.10 | 33.0 |
| **Total Potassium** | mg/kg | 16 | 16 | 3,020 | 2,740 | 1,550 | 7,950 |
| Total Selenium | mg/kg | 36 | 16 | 0.520 | 0.520 | <0.240 | 64.0 (5) |
| **Total Silver** | mg/kg | 36 | 21 | 0.110 | 0.110 | 0.0700 | 0.480 |
| Total Sodium | mg/kg | 16 | 16 | 338 | 291 | 43.7 | 241 |
| **Total Thallium** | mg/kg | 36 | 36 | 0.300 | 0.300 | 0.170 | 0.840 |
| **Total Uranium, Calculated** | mg/kg | 16 | 16 | 45.7 | 45.7 | 42.9 | 482 |
| **Total Vanadium** | mg/kg | 16 | 16 | 44.3 | 38.3 | 9.40 | 91.2 |
| **Total Zinc** | mg/kg | 36 | 36 | 68.0 | 60.9 | 32.0 | 204 |

# Table 5-105
## SUMMARY OF ANALYTICAL RESULTS FOR MINED AREA COMPOSITE SURFACE MATERIAL SAMPLES

| Parameter (1) | Units | Number of Samples | Number of Detects | Background Limits | | Minimum | Maximum Detected Value |
|---|---|---|---|---|---|---|---|
| | | | | BL (2) | RBL (3) | | |
| **Other Parameters** | | | | | | | |
| **Total Alkalinity** | mg/kg | 16 | 14 | 241 | 191 | <8.00 | 610 |
| **Bicarbonate Alkalinity** | mg/kg | 16 | 14 | 241 | 191 | <8.00 | 610 |
| Carbonate Alkalinity | mg/kg | 16 | 0 | 9.00 | 9.00 | <8.00 | <9.00 |
| pH | SU | 16 | 16 | NA | NA | 2.83 | 7.97 |
| Total Organic Carbon | mg/kg | 16 | 16 | NA | NA | 739 | 20,700 |
| **Radionuclides** | | | | | | | |
| **Lead 210** | pCi/g | 16 | 16 | 5,610 (4) | 6.30 | 20.0 | 260 |
| **Polonium 210** | pCi/g | 16 | 16 | 9.28 | 6.92 | 17.0 | 320 |
| Protactinium 231 | pCi/g | 3 | 3 | NC | NC | 14.9 | 22.4 |
| **Radium 226, Calculated** | pCi/g | 16 | 16 | 8.92 | 8.92 | 24.4 | 363 |
| Radium 228 | pCi/g | 16 | 16 | 7.72 | 5.30 | 2.08 | 4.84 |
| Thorium 227 | pCi/g | 16 | 2 | 113 | 113 | -2.86 | 20.9 |
| **Thorium 228** | pCi/g | 16 | 1 | 4.49 | 3.34 | -10.80 | 3.8 |
| **Thorium 230** | pCi/g | 16 | 16 | 8.68 | 8.68 | 27.9 | 288 |
| **Thorium 232** | pCi/g | 16 | 9 | 4.24 | 3.15 | <1.48 | 10.9 |
| **Uranium 234** | pCi/g | 36 | 36 | 19.5 | 19.5 | 0.810 | 196 |
| **Uranium 235** | pCi/g | 36 | 26 | 0.624 | 0.394 | 0.0400 | 17.2 |
| **Uranium 238** | pCi/g | 36 | 36 | 15.2 | 15.2 | 0.650 | 159 |

Notes:
(1) Parameters in bold exceed background limits for the URS samples
(2) 99% Upper Tolerance Limit for the URS background surface material sample data set
(3) 95% Upper Prediction Limit for the URS background surface material sample data set
(4) The BL calculated for this parameter is not reasonable; all results compared to the RBL
(5) The maximum result is from an SMI sample
NA = Not Applicable
NC = Not calculated; insufficient sample results

# Table 5-106
## SUMMARY OF ANALYTICAL RESULTS FOR MINED AREA GRAB SURFACE MATERIAL SAMPLES

| Parameter (1) | Units | Number of Samples | Number of Detects | Background Limits | | Minimum | Maximum Detected Value |
|---|---|---|---|---|---|---|---|
| | | | | BL (2) | RBL (3) | | |
| **Metals** | | | | | | | |
| Total Aluminum | mg/kg | 11 | 11 | 24,100 | 24,100 | 13,100 | 18,200 |
| Total Antimony | mg/kg | 11 | 0 | 1.40 | 1.40 | <1.00 | <1.30 |
| **Total Arsenic** | mg/kg | 11 | 11 | 234 | 234 | 5.80 | 239 |
| Total Barium | mg/kg | 11 | 11 | 548 | 417 | 33.0 | 120 |
| **Total Beryllium** | mg/kg | 11 | 9 | 1.51 | 1.16 | 0.600 | 1.80 |
| **Total Cadmium** | mg/kg | 11 | 2 | 0.468 | 0.405 | <0.200 | 0.780 |
| **Total Calcium** | mg/kg | 11 | 11 | 10,100 | 7,690 | 782 | 74,800 |
| **Total Chromium** | mg/kg | 11 | 11 | 19.2 | 16.3 | 10.8 | 21.8 |
| Total Cobalt | mg/kg | 11 | 11 | 23.8 | 23.8 | 2.00 | 17.2 |
| **Total Copper** | mg/kg | 11 | 11 | 41.8 | 41.8 | 14.5 | 83.0 |
| **Total Iron** | mg/kg | 11 | 11 | 37,700 | 28,900 | 17,300 | 65,300 |
| **Total Lead** | mg/kg | 11 | 11 | 21.8 | 18.5 | 9.60 | 73.5 |
| **Total Magnesium** | mg/kg | 11 | 11 | 3,680 | 3,170 | 2,310 | 10,500 |
| **Total Manganese** | mg/kg | 11 | 11 | 1,530 | 1,330 | 309 | 1,430 |
| Total Mercury | mg/kg | 11 | 0 | 0.134 | 0.130 | <0.100 | <0.140 (4) |
| **Total Nickel** | mg/kg | 11 | 11 | 30.2 | 20.9 | 3.00 | 30.2 |
| **Total Potassium** | mg/kg | 11 | 11 | 3,020 | 2,740 | 1,870 | 4,050 |
| Total Selenium | mg/kg | 11 | 0 | 0.520 | 0.520 | <0.810 | <1.10 (4) |
| **Total Silver** | mg/kg | 11 | 2 | 0.110 | 0.110 | <0.400 | 0.620 |
| **Total Sodium** | mg/kg | 11 | 11 | 338 | 291 | 143 | 1,970 |
| **Total Thallium** | mg/kg | 11 | 7 | 0.300 | 0.300 | <1.30 | 2.50 |
| **Total Uranium** | mg/kg | 11 | 11 | 45.7 | 45.7 | 12.6 | 422 |
| **Total Vanadium** | mg/kg | 11 | 11 | 44.3 | 38.3 | 20.8 | 132 |
| **Total Zinc** | mg/kg | 11 | 11 | 68.0 | 60.9 | 31.4 | 135 |
| **Radionuclides** | | | | | | | |
| Gross Alpha | pCi/g | 11 | 11 | NC | NC | 52.6 | 9,288 |
| **Radium 226** | pCi/g | 103 | 98 | 8.92 | 8.92 | 0.0740 | 880 |
| Radium 228 | pCi/g | 11 | 8 | 7.72 | 5.30 | 0.00300 | 7.66 |
| Thorium 228 | pCi/g | 11 | 6 | 4.49 | 3.34 | 0.575 | 3 |
| **Thorium 230** | pCi/g | 29 | 29 | 8.68 | 8.68 | 1.28 | 591 |
| **Thorium 232** | pCi/g | 11 | 6 | 4.24 | 3.15 | <0.430 | 4.52 |
| **Uranium 234** | pCi/g | 29 | 29 | 19.5 | 19.5 | 1.26 | 412 |
| **Uranium 235** | pCi/g | 29 | 28 | 0.624 | 0.394 | 0.0630 | 18.9 |
| **Uranium 238** | pCi/g | 29 | 29 | 15.2 | 15.2 | 1.30 | 417 |

Notes:
(1) Concentrations or activities of parameters in bold are greater than the RBL for SMI or E&E samples
(2) 99% Upper Tolerance Limit for the URS background surface material sample data set
(3) 95% Upper Prediction Limit for the URS background surface material sample data set
(4) The maximum concentration or activity is reported as non-detect value above the RBL
NC = Not calculated; insufficient sample results

400 foot drop-off downstream of the Mines site prevents migration of fish upstream. This report also identifies several non-mining related impacts (i.e., over-grazing, timber harvesting, road construction/maintenance) which make it unlikely that a cold-water fish population (i.e., salmonids) could live in the creek in the vicinity of the Mines site under current conditions. Also see Section 7.2.1 Risk Assessment - Ecological Setting- which further describes the ecological habitat at the Mines site.

## 5.3 SUMMARY OF REMEDIAL INVESTIGATION ACTIVITIES

### *5.3.1 Nature and Extent of Contaminants*

As part of the RI, field investigations were conducted from early June to early November 1995 and from June to October 1996. Soil, air, ground water, sediment, and surface water samples were collected in areas upgradient of the Mines site, on and adjacent to the Mines site, and downgradient of the Mines site. Two and three rounds of data were collected in 1995 of ground water and surface water, and additional surface water and ground water samples from selected locations in 1996. (Also see Section 9.3.2 for a discussion of post-RI sampling at the White King pond.) In addition to this information, data obtained prior to the RI by the U.S. Forest Service was also used in development of the RI report. The nature and extent of soil, ground water, surface water, and sediment contamination is summarized below and discussed in detail in the RI report. The following discussion focuses on the primary constituents of concern at the Mines site.

#### 5.3.1.1 Air

Two types of RI air monitoring were conducted at the Mines site. The first type was daily ambient air monitoring with a particulate monitor to ensure the safety of the field crew. The second type was a long-term (3-month) monitoring event for ambient radon activities. Action levels for particulates were derived from health risk factors for arsenic, an identified inorganic constituent at the Mines site. Radon levels were compared to the household advisory level of 4 pCi/L. The results indicated that both particulates and radon levels were below action or guidance levels and similar to locations upgradient of the stockpiles.

#### 5.3.1.2 Soils

Several reports have shown that naturally occurring elevated concentrations of arsenic and radium-226 are present in alluvial soils in and around the Mines site. During the RI, several different approaches were used to take this fact into consideration and account for the naturally elevated "background" concentrations found in the vicinity of Mine site. EPA selected preliminary local soil background levels using a 95th percent upper tolerance level of samples that were not adjacent to or under the stockpiles because these samples could have been impacted from mining activities. EPA selected local soil background levels of 6.8 pCi/g radium-226 and 442 mg/kg for arsenic at the White King mine. Local soil background levels also were calculated for the Lucky Lass mine because of different geochemical characteristics of the ore body. The Lucky Lass values for radium-226 and arsenic are 3.6 pCi/kg and 5.4 mg/kg, respectively.

Local background was adopted as a Preliminary Remediation Goal (PRG) at both mines except for arsenic at the Lucky Lass mine where the PRG is the arsenic soil standard of 38 mg/kg. These values may need to be re-evaluated during remedial action as more information is collected on background levels underneath or adjacent to the stockpiles.

As part of the RI, individual constituents were evaluated during a preliminary screening to identify primary and secondary constituents of concern in soils and overburden materials. The screening process consisted of comparing the 90 percent upper confidence limit (UCL) concentrations of the detected constituents for various areas of the Mines site to the most stringent available regulatory standard or 5 times the background value if no standard existed. If the 90% UCL concentration was greater than the standard or 5 times the background value, the constituent was selected for evaluation as a contaminant of concern. **Tables 5-1 through 5-8** compare the stockpile materials to standards (if available) or background (native soil near or below the stockpiles and local background) for the various media at the Mines site. (EPA soil screening levels were not used because the Mines site is located in a naturally mineralized area, for which the EPA standards do not account). As a result of this process, 8 constituents were selected for detailed evaluation at the White King Mine: antimony, arsenic, mercury, thallium, uranium-234, uranium-238, radium-226, and thorium-230. Arsenic and Radium-226 were evaluated at the Lucky Lass Mine. **Table 5-1** compares the White King stockpile surface and subsurface soils to background and standards and **Table 5-2** provides this comparison for Lucky Lass stockpile soil.

**White King Protore Stockpile**

The average concentration profiles for arsenic and radium-226 in the White King protore stockpile are presented in **Table 5-3.** Elevated concentrations of arsenic correlated closely with activities of uranium-238 and radium-226. The highest concentration of arsenic in the surface soil was 4,140 mg/kg. The highest concentration in surface soil adjacent to the protore stockpile was 895 mg/kg. The highest concentration of arsenic in the subsurface soil in the stockpile was 13,794 mg/kg at a depth of 6 feet. For radium-226 the highest activity in surface soil (collected at 2.5 feet) was 64.6 pCi/g and subsurface soil was 87 pCi/g at approximately 8 feet below the surface.

**White King Overburden Stockpile**

The average concentration profiles for arsenic in the White King overburden stockpile are also presented in **Table 5-3**. Elevated concentrations of arsenic correlated with elevated activities of uranium-238 and radium-226. The highest concentration of arsenic in the overburden stockpile surface soil was 769 mg/kg. The highest concentration in surface soil adjacent to the stockpile was 822 mg/kg. The highest concentration of arsenic in the subsurface soil within the stockpile was 11,700 mg/kg at a depth of 2.5 feet. The average concentration of arsenic was the greatest in the 2.5 to 5 ft. interval. For radium-226 the highest activity in surface soil (collected at 2.5 feet) was 291 pCi/g. The highest activity in the subsurface was 166 pCi/g collected at approximately 15 feet below the surface.

**Lucky Lass Overburden Stockpile**

Average concentration profiles for arsenic are presented in **Table 5-3**. The concentration of arsenic at the Lucky Lass Mine is consistently lower than that found at the White King Mine. The highest concentration of arsenic in the surface soil was 11.9 mg/kg and the highest concentration in the subsurface soil within the stockpile was 7.6 mg/kg at a depth of 7.5 feet. The highest concentration of arsenic in the native soil below the overburden stockpile was 17.7 mg/kg at a depth of 3 feet below the stockpile-native soil interface. The highest concentration of arsenic in the surface soil immediately adjacent to the overburden stockpile was 15.0 mg/kg indicating possible erosion of the stockpile material. For radium-226 the highest activity in surface soil was 4.85 pCi/g. The highest activity in subsurface soils was 8.3 pCi/g at a depth of approximately 20 feet below the surface. The highest activity of radium-226 in the surface soil adjacent and nearby the overburden stockpiles was 72.4 pCi/g in the Lucky Lass meadow.

**Off-Stockpile Areas**

The focus of the RI sampling was on the stockpiles and adjacent "off-pile" areas. There are also other smaller areas where overburden or ore was spilled or dumped during mining operations including haul roads. These areas were characterized with radiation surveys as part of the DEIS-RI/FS. The radiation surveys were designed to map out the areas and depths of greatest radioactive contamination outside the waste piles. The results of these surveys are illustrated in **Figures 11-5 and 11-6** which show a number of areas that potentially exceed cleanup levels.

In summary, arsenic and the radionuclides in the uranium series are the constituents of concern in soils based on their frequency and magnitude of detection. Average arsenic concentrations and radionuclide activities in the White King protore and overburden stockpiles are similar. Arsenic concentrations and radionuclide activities in the Lucky Lass stockpile were significantly less than the White King stockpiles.

The highest activity/concentrations of radionuclides and inorganics are found in the stockpiles. Ground water and subsurface soil sampling data indicate that limited migration has occurred into the soils below the stockpiles. Radionuclide and inorganic activity/concentrations are significantly less in the Lucky Lass stockpile as compared to the White King stockpiles.

**5.3.1.3 Surface Water**

**Augur Creek**

During the course of the RI, surface water samples were collected from various locations along Augur Creek. All surface water samples were analyzed for dissolved and total metals, as well as several radium, thorium, and uranium isotopes. Surface water samples were collected from White King and Lucky Lass ponds during 1995-1996.

**Table 5-4** provides a comparison of the Augur Creek, Seep, and Drainage Channel Surface

# APPENDIX B

# TABLES FOR THE RECORD OF DECISION

# WHITE KING/LUCKY LASS SITE

## TABLE 5-1 -White King Surface and Subsurface Soil—Comparisons to Standards

| | Surface and Subsurface Soil | | | UMTRA | 90% UCL | Selected for | 90% UCL | Selected for |
|---|---|---|---|---|---|---|---|---|
| | Background | | 5Xs Background[a] | Soil Standards | Pile Concentration | Detailed Discussion[d] | Off-Pile Concentration | Detailed Discussion[d] |
| **Inorganics (mg/kg)** | | | | | | | | |
| Aluminum | 106000 | | 530000 | NV | 23365 | N | 43783 | N |
| Antimony | 9.9 | UJ | 49.5 | NV | 76.4 | Y | 5.47 | N |
| Arsenic | 5.2 | | 26 | NV | 2315 | Y | 111 | Y |
| Barium | 598 | | 2990 | NV | 160 | N | 277 | N |
| Beryllium | 2 | | 10 | NV | 4.27 | N | 2.49 | N |
| Cadmium | 0.67 | | 3.35 | NV | 0.45 | N | 0.36 | N |
| Chromium | 57.2 | | 286 | NV | 15.2 | N | 28.2 | N |
| Cobalt | 3[illegible] | | 139 | NV | 9.27 | N | 17.45 | N |
| Copper | 61.2 | | 305 | NV | 31 | N | 43.3 | N |
| Iron | 64800 | | 324000 | NV | 17834 | N | 30348 | N |
| Lead | 13.6 | | 68 | NV | 64.4 | N | 12.8 | N |
| Manganese | 1640 | | 8200 | NV | 408 | N | 1478 | N |
| Mercury | 0.06 | U | 0.3 | NV | 11.3 | Y | 0.48 | Y |
| Molybdenum* | NA | | —— | NV | 535 | N | 8.07 | N |
| Nickel | 68.7 | | 344 | NV | 16.6 | N | 31.3 | N |
| Selenium | 0.63 | UJ | 3.15 | NV | 2.04 | N | 3.6 | N |
| Silver | 0.95 | | 4.75 | NV | 0.57 | N | 1.12 | N |
| Strontium* | NA | | ----- | NV | 74.9 | N | 52.1 | N |
| Thallium | 0.47 | | 2.35 | NV | 3.87 | Y | 1.26 | N |
| Vanadium | 159 | | 795 | NV | 35.4 | N | 77.3 | N |
| Zinc | 88.8 | | 444 | NV | 54.2 | N | 62 | N |
| **Radionuclides (pCi/g)** | | | | | | | | |
| Uranium 234 | 0.7 | | 3.5 | NV | 24.3 | Y | 12.5 | Y |
| Uranium 238 | 0.73 | | 3.65 | NV | 23.2 | Y | 13.1 | Y |
| Radium 226 | 0.31 | | 1.55 | 5.36[b]/15.31[c] | 35.8 | Y | 1.2 | N |
| Radium 228 | 0.53 | | 2.65 | NV | 0.92 | N | 0.54 | N |
| Thorium 228* | NA | | —— | NV | —— | N | —— | N |
| Thorium 230 | 1.15 | | 5.75 | NV | 37.4 | Y | 2.63 | N |
| Thorium 232 | 0.75 | | 3.75 | NV | 0.99 | N | 0.49 | N |

a - When the background concentration was undetected, 5 times the detection limit was used

b - UMTRA surface soil standard is the background value plus 5 pCi/g

c - UMTRA subsurface soil standard is the background value plus 15 pCi/g

d - The compounds selected for detailed discussion had 90% UCL concentrations greater than the standard (or greater than 5 times background if no standard exists)

NA - Not analyzed

NV - No value

* Pre-RI data did not have background samples collected

U = Undetected

J = Estimated

Table 5-3 Stockpile Soil Comparisons

| | White King Protore Pile | | | | White King Overburden Pile | | | | Lucky Lass Overburden Pile | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ave Conc. Surface Soil | Ave. Conc. 2.5-10ft | Ave. Conc 10ft-Nat | Ave. Conc. Native-10ft. | Ave Conc. Surface Soil | Ave. Conc. 2.5-10ft | Ave. Conc 10ft-Nat | Ave. Conc. Native-10ft | Ave Conc. Surface Soil | Ave. Conc. 2.5-10ft | Ave. Conc 10ft-Nat | Ave. Conc. Native-10ft |
| Antimony | 32.9 | 39.61 | 103.38 | 12.5 | ND | 89.3 | 7.65 | ND | ND | ND | ND | 4.53 |
| Arsenic | 3945.25 | 2797.5 | 776.43 | 1086 | 769 | 3677.6 | 756.45 | 59.53 | 11.9 | 3.68 | 2.28 | 6.42 |
| Mercury | NR | 10.51 | 3.87 | 13.1 | NR | 20.77 | 2.34 | 0.98 | ND | ND | ND | ND |
| U -234 | NR | 54.77 | 12.09 | 9.32 | NR | 22.88 | 12.22 | 2.98 | NR | 1.87 | 1.76 | 4.46 |
| U-238 | NR | 54.08 | 12.25 | 8.11 | NR | 20.2 | 11.09 | 2.8 | NR | 2.02 | 1.81 | 4.18 |
| Ra-226 | NR | 36.88 | 11.66 | 6.58 | NR | 53.14 | 28.37 | 1.64 | NR | 1.99 | 1.43 | 2.33 |
| Ra-228 | NR | 0.89 | 0.87 | 0.52 | NR | 1.11 | 0.87 | 0.48 | NR | 1.11 | 1.07 | 0.84 |
| Th-230 | NR | 61.77 | 10.28 | 6028 | NR | 51.85 | 22.06 | 2.74 | NR | 1.71 | 1.48 | 4.6 |
| Th-232 | NR | 1.07 | 0.88 | 0.89 | NR | 1.27 | 0.8 | 0.4 | NR | 1.01 | 1.23 | 0.86 |

Inorganics - mg/kg
Radionuclides - pCi/g
ND- Non-detected
NR- No result

# Attachment G

# CONCEPTUAL COVER PROFILE EVALUATION

**NORTHEAST CHURCHROCK MINE**
**GALLUP, NM**

**PREPARED FOR:**
**UNITED NUCLEAR CORPORATION**
**an indirect subsidiary of**
**GENERAL ELECTRIC COMPANY**
**640 Freedom Business Center**
**King of Prussia, PA 19406**

**PREPARED BY:**
**STEPHEN F. DWYER, PHD, PE**
**DWYER ENGINEERING, LLC**
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**ALBUQUERQUE, NM 87123**

**September 2009**

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## EXECUTIVE SUMMARY

The Northeast Church Rock (NECR) Mine Site is to be closed and reclaimed in accordance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and consistent with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). EPA has published guidance in its 1993 "Guidance on conducting Non-Time-Critical Removal Actions under CERCLA." An Engineering Evaluation/Cost Analysis (EE/CA) was prepared by the United States Environmental Protection Agency (EPA), Region 9 to evaluate Non-Time-Critical Removal Action (NTCRA or "removal action") alternatives for soil and sediment (mine wastes) at the Northeast Church Rock (NECR) Mine Site. The preferred alternative from this EECA includes excavation and removal of mine soil waste from designated areas; deposition of this material on an existing disposal cell or construction of a repository on the mill facility and covering this soil with an approved cover system. It also includes transporting removed principal threat mine waste off-site to an off-site landfill such as that located in Grandview, ID. All disturbed areas are then to be revegetated and stabilized against erosion and storm water.

This paper describes an Evapotranspiration (ET) Cover System that is capable of meeting the stated design objectives described in the EECA while producing a net zero flux. The ET cover concept is described in section 2. The expected performance of the cover system is based on:

1. Unsaturated flow modeling described in section 3;
2. Natural analog studies described in section 4; and
3. Applicable field data described in section 5.

Modeling was performed to evaluate an ET Cover profile utilizing native soil and vegetation and typical climate data for the site. The results demonstrated that a soil profile less than 2-ft (61 cm) thick will produce a net zero flux. That is, no precipitation will penetrate the cover and move into the underlying buried mine soil waste. Because the design requires long-term effectiveness, extreme climate conditions were also evaluated. The wettest year on record that occurred in 1906 produced more than double the average precipitation volume for the year. Using this weather data, a cover profile less than 3-ft (91 cm) thick using the coarsest soils tested would also produce a net zero flux. Further sensitivity analyses using very conservative assumptions demonstrated that even if the wettest year on record occurred in consecutive years that a cover profile less than 3-ft (91 cm) would still produce a net zero flux.

Natural analog studies performed at the site provide evidence that the effective maximum penetration depth for precipitation for typical climatic conditions is less than 2-ft (61 cm). Calcium carbonate and gypsum were identified in significant concentrations at a depth of about 18-in (45 cm) revealing that these salts generally precipitated out at this maximum soil depth. Furthermore, native vegetation rooting depths were also found within this upper 18-in (45 cm) of soil

reinforcing that this is the maximum depth of precipitation infiltration for typical site conditions.

Finally, a summary of applicable field data was provided that demonstrated an ET Cover will outperform a prescriptive cover containing a clay barrier layer and geosynthetic membrane at this site. The ET Cover will also provide more stability and longer-term performance than a cover containing a product with a limited lifespan.

This paper summarizes the evaluation of a conceptual ET cover profile for hydraulic performance only based on a combination of measured field data, data from the literature, and assumed values. This paper does not describe a final cover design. The data used to evaluate the cover profile will be refined for final design. Furthermore, the final cover profile will be enhanced to include erosion resistance and biointrusion protection as warranted.

## 1.0 INTRODUCTION

An Engineering Evaluation/Cost Analysis (EE/CA) was prepared by the United States Environmental Protection Agency (EPA), Region 9 to evaluate Non-Time-Critical Removal Action (NTCRA or "removal action") alternatives for soil and sediment (mine wastes) at the Northeast Church Rock (NECR) Mine Site. The site is located about 16 miles northeast of Gallup in McKinley County, New Mexico. The site is a semi-arid climate averaging about 12-inches of precipitation per year at an elevation of about 7000-ft above sea level. The vegetation is generally categorized as a pinyon-juniper landscape with shrubs and native grasses. The near surface soil is predominantly a clay loam.

The NECR mine was an underground Uranium mine active from 1968 to 1982, when it went to stand-by status. The primary ore mined was coffinite. The primary elements of the Preferred Alternative from the EECA include:

- Excavation and transport of all mine waste soil with radium above 2.24 pCi/g (10-4), except in the ponds, where we would excavate to a maximum depth of 10 feet; · The waste to be consolidated includes ore and protore, waste rock, building foundations and adjacent soil, and contaminated sediment; · Consolidation of the mine wastes with a cap and liner in an existing disposal cell on the UNC mill site, or construction of a new cell at the UNC mill facility currently under license by the U.S. Nuclear Regulatory Commission (NRC);
- Principal threat mine wastes taken to an off-site licensed controlled disposal facility, such as at Grandview, ID, or an alternative appropriate facility. For waste with total Uranium concentrations exceeding 500 mg/kg, it may be viable to reprocess the waste at the White Mesa Mill in Utah or a similar mill;

- Site restoration with erosion and storm water controls, regrading and revegetation for future grazing; and
- Long-term maintenance for capped repository, which would occupy an estimated 30 acres and would become part of DOE's legacy management program in perpetuity.

According to the EE/CA, if an agreeable design cannot be completed due to administrative or technical issues, then the NECR wastes could be placed in a new, separate repository on the UNC Mill Site. This would require a release of property currently under NRC oversight. In this case, the PRSC responsibility of a new repository would remain with EPA.

## 1.1 Regulatory Status

EPA identified a list of Applicable, Relevant and Appropriate Requirements (ARARs) for the site in the EECA. As stated in the EECA, the main objective of this removal action is to mitigate risks posed to human health and the environment by on-site contamination and to restore the land for use by nearby residents and the Navajo Nation. EPA's characterization of the Site identified the primary environmental concern to be radiological contamination. According to EPA, the presence of Radium and Uranium could pose a risk to the air quality by emitting radon, alpha, beta and gamma radiation. Persons traversing the Site may be exposed to contaminated dust by inhalation or ingestion of contamination adsorbed to particulate matter. Incidences of direct contact with natural and mechanically generated dust during these activities account for known contamination exposure scenarios faced at the Site. According to the EPA's NECR Removal Site Evaluation Report (RSE) radium is present in significantly elevated concentrations in soil and sediment. Because the contaminants have been transported via wind and water processes to areas around or adjacent to the site, humans, EPA states that plants and animals may experience exposures through the food chain, air or surface or groundwater.

Stated objectives from the EECA for the cover system to be deployed over the deposited mine soil waste include:

- Cover longevity;
- Radon attenuation;
- Rooting medium;
- Minimize flux;
- Minimize erosion;
- Limit biointrusion.

## 2.0 ET COVER CONCEPT

An ET Cover consists of a single, vegetated soil layer constructed to represent an optimum mix of soil texture, soil thickness, and vegetation cover (Dwyer et al

2006). The ET Cover is a monolithic soil layer that has adequate soil water storage capacity to retain any infiltrated water until it can be removed via ET (Figure 1). ET Covers have been deployed throughout the country and are currently the predominate cover systems in arid and semi-arid climates. The EPA maintains a fact sheet on ET Covers available on the internet (http://www.clu-n.org/download/remed/epa542f03015.pdf#search='evapotranspiration%20epa%20fact%20sheet).

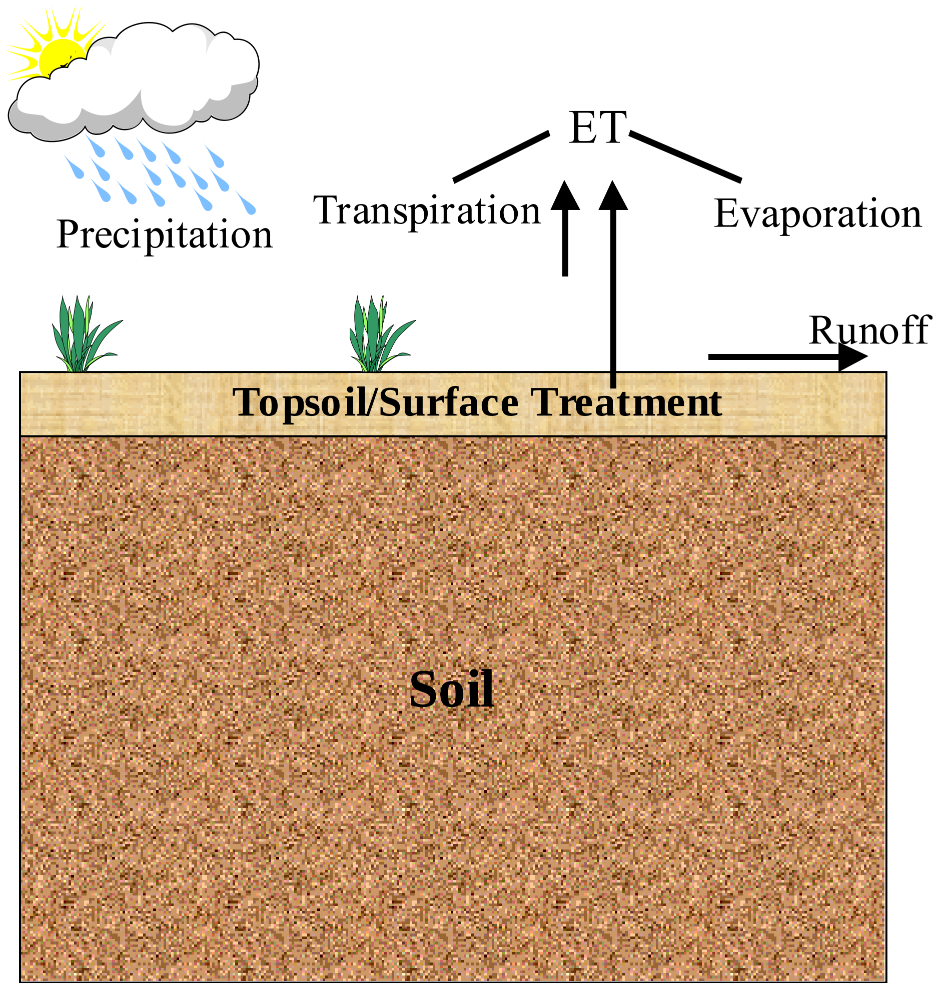



**Figure 1**
**Typical ET Cover Profile**

The ET Cover is based on the "store and release" concept whereby the cover soil is designed to act like a sponge. Any infiltrated water is held in this "sponge" until it can be released via ET. ET is defined as the combination of evaporation from the soil surface and transpiration through vegetation. Previous research has shown that a simple soil cover can be very effective at minimizing percolation and erosion (Khire 1995, Scanlon et al. 2002, Dwyer 2003, Benson et al, 2005, Dwyer et al 2006).

ET provides the mechanism to remove stored water from the cover soil layer. Water can move upward in response to matric potential gradients induced from evaporation drying the upper portion of the cover soil layer. Matric potential gradients can be many orders of magnitude greater than the gradient component due to gravity. Evaporation from the surface will decrease the water content and increase the matric potential of the soil, resulting in an upward matric potential gradient and inducing upward flow.

Plant transpiration also relies upon matric potential gradients to remove water from the cover soil layer. Figure 2 shows the large matric potential difference between the soil and atmosphere. In dry environments, the total potential difference between soil moisture and atmospheric humidity can be up to 1000 atmospheres (bars) (Hillel 1998). The largest portion of this overall potential difference occurs between the leaves and the atmosphere. The larger the soil-plant-atmosphere potential gradient, the more effective an ET Cover System can be. For this reason, well-vegetated cover systems are very effective in regions where the demand for water is greater than the supply of water because these regions are characterized by large potential evapotranspiration compared to precipitation.

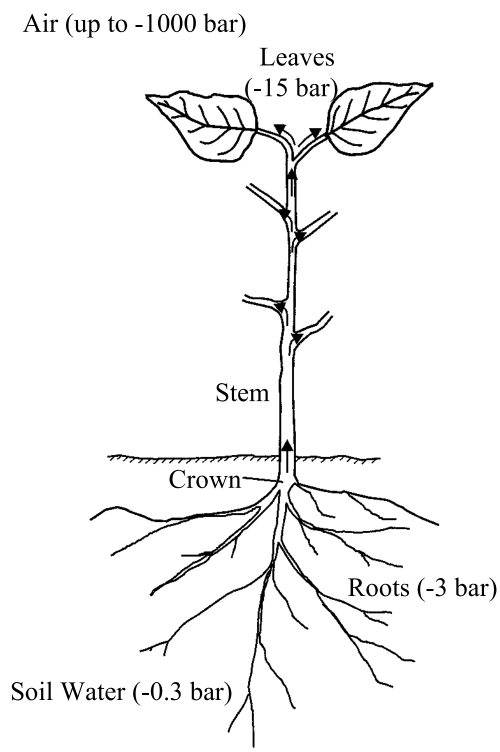



**Figure 2**
**TYPICAL SOIL-PLANT-ATMOSPHERE WATER POTENTIAL VARIATION**
**(Hillel 1998)**

In summary, ET covers are composed of natural soils and strive to mimic natural processes as opposed to trying to resist them as is the case with prescriptive engineered barrier systems. For this reason ET covers are well suited to perform over the long-term which is a key goal of any final cover system.

The primary reason ET Covers perform well in dry climates such as the NECR site is that the demand for water referred to as potential evapotranspiration (PET) is much greater than the supply of water or precipitation. Figure 3 shows a graphical representation of the site's PET versus precipitation for each month of an average precipitation year. It can be seen that the demand for water is greater for all months than the supply of water.

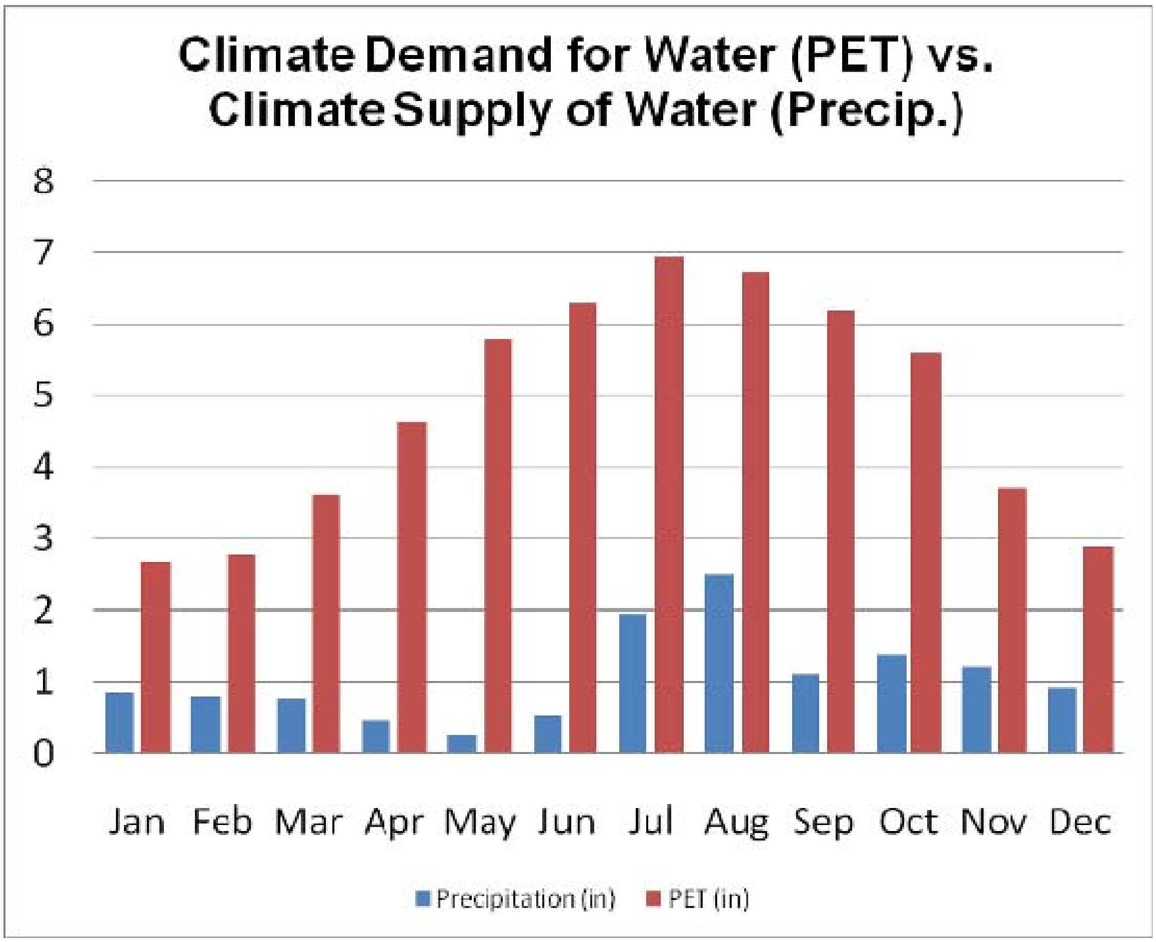



**Figure 3**
**MONTHLY PRECIPITATION VS. PET FOR FT. WINGATE, NM**

## 3.0 MODELING

Historically, HELP (Schroeder et al, 1994) has been the software utilized to predict water balance in landfill systems including the final cover. However, it is now recognized that this software has its limitations (ITRC 2003). Software more applicable for the analyses of water flow within an alternative earthen cover system is based on the Richard's Equation (ITRC 2003). The Richards Equation is as follows:

$$\frac{\partial\theta}{\partial t} = \frac{\partial}{\partial z}\left[K(\psi)\left(\frac{\partial\psi}{\partial z} + 1\right)\right] - \Lambda(z,t)$$

Where:

*K* is the hydraulic conductivity,

$\psi$ is the pressure head,

*z* is the elevation above a vertical datum,

$\theta$ is the water content,

*t* is time, and

$\Lambda(z,t)$ = a sink term for root water uptake.

UNSAT H (Fayer 2000) has been one of the most commonly used unsaturated flow packages for soil cover designs and was therefore used in this exercise to predict the water balance through the cover profile. UNSAT H is an unsaturated modeling software that was designed specifically for earthen covers. It has been recommended for use on alternative earthen covers in the ITRC (2003) and EPA (2004) design guidance documents.

UNSAT H was used to determine a cover profile based on the Dwyer et al (2006) "Point of Diminishing Returns." This method addresses the intent of landfill closure regulations regarding minimization of flux through the cover system. The cover profile is modeled utilizing an upper boundary condition composed of site-specific climate data; the minimum depth of cover soil is established at the point where flux is minimized or steady state conditions are established. This depth is considered the minimum cover depth required to minimize percolation. That is, the cover's "point of diminishing returns" is established at a depth whereby an additional inch of soil will no longer reduce the flux through that cover profile.

## 3.1 OVERVIEW OF UNSAT-H

UNSAT-H has been used to design many recent alternative earthen cover designs (Dwyer 2003). UNSAT-H is a one-dimensional, finite-difference computer program developed at the Pacific Northwest National Laboratory by Fayer and Jones (1990). UNSAT-H can be used to simulate the water balance of earthen covers as well as soil heat flow (Fayer 2000). UNSAT-H simulates water flow through soils by solving Richards' Equation and simulates heat flow by solving Fourier's heat conduction equation.

A schematic illustration showing how UNSAT-H computes the water balance is shown in Figure 4. UNSAT-H separates precipitation falling on an earthen cover into infiltration and overland flow. The quantity of water that infiltrates depends on the infiltration capacity of the soil profile immediately prior to rainfall (e.g., total available porosity). Thus, the fraction of precipitation shed as overland flow depends on the saturated and unsaturated hydraulic conductivities of the soil included in the final cover. If the rate of precipitation exceeds the soil's infiltration capacity, the excess water is shed as surface runoff. UNSAT-H does not consider absorption and interception of water by the plant canopy or the effect of slope and slope-length when computing surface runoff since it is a 1-dimensional model.

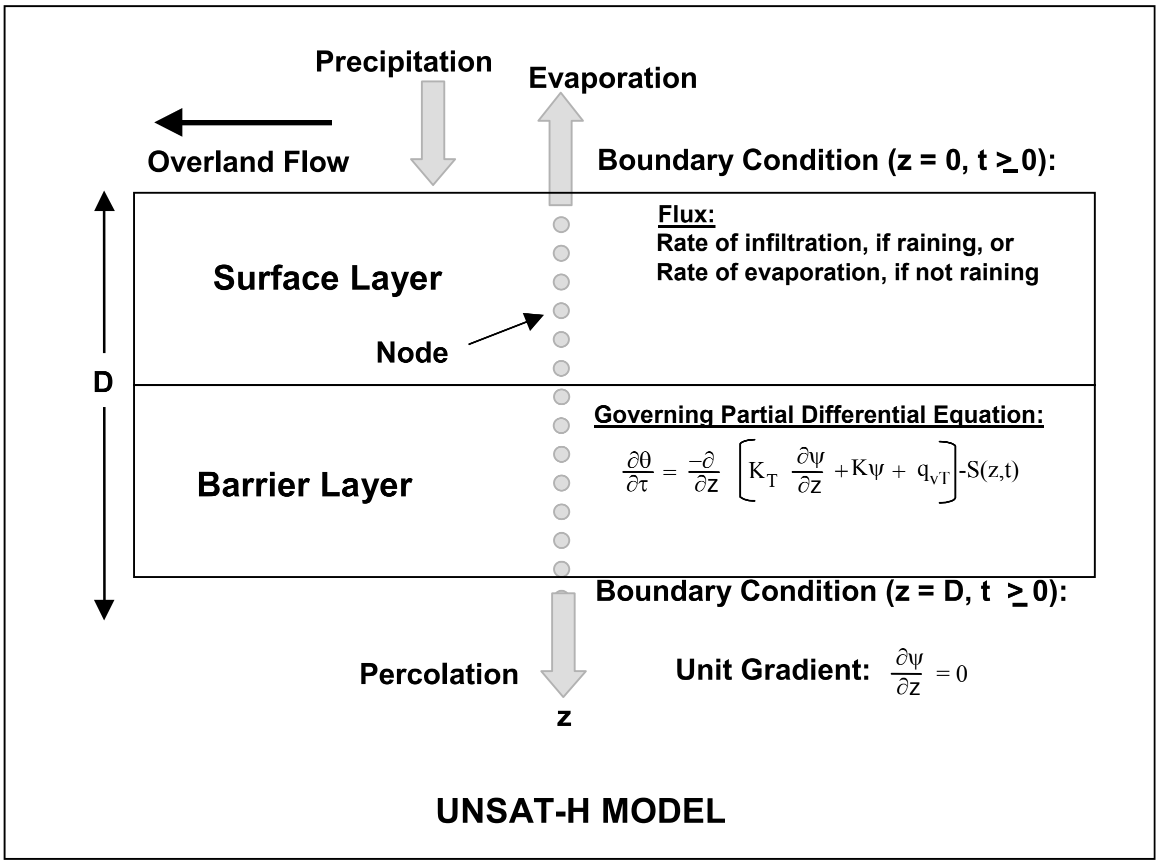



**Figure 4**
**SCHEMATIC REPRESENTATION OF WATER BALANCE COMPUTATION BY UNSAT-H (modified from Khire 1995)**

Water that has infiltrated a soil profile during an UNSAT-H simulation moves upward or downward as a consequence of gravity and matric potential. Evaporation from the cover surface is computed using Fick's law. Water removal by transpiration of plants is treated as a sink term in Richards' equation. Potential evapotranspiration (PET) is computed from the daily wind speed, relative humidity, net solar radiation, and daily minimum and maximum air temperatures using a modified form of Penman's equation given by Doorenbos and Pruitt (1977). Soil water storage is computed by integrating the water content profile. Flux from the lower boundary is via percolation. UNSAT-H, being a one-dimensional program, does not compute lateral drainage.

## 3.2 INPUT PARAMETERS

A set of input parameters were developed for simulations using UNSAT-H for the ET cover profile. These parameters were developed based on field and laboratory measurements, values from the literature, and assumed values. This data will be refined for the final cover design. The cover profiles modeled were 1-dimensional and conservatively assumed to be flat. This is a conservative assumption since the planned deployment of the soil cover profiles is on sloped surfaces where infiltration is decreased because some of the precipitation contacting the surface runs off.

### 3.2.1 MODEL GEOMETRY

The model geometry was based on the expected depth of the cover system. Multiple soils were evaluated based on field measurements made in borrow areas 1 and 2 (Figure 5).

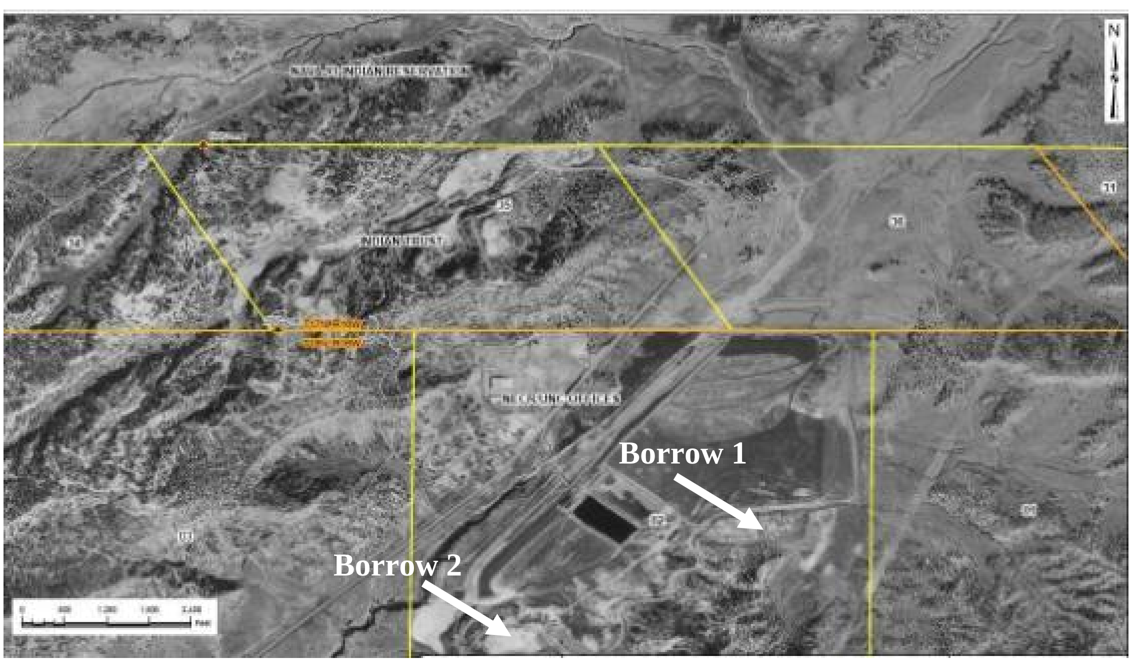



**Figure 5**
**Borrow Site Locations**

### 3.2.2 BOUNDARY CONDITIONS

The profiles were modeled multiple times using various climate data as an upper boundary condition. Weather data available through the United States Department of Commerce, National Climate Data Center was evaluated (http://cdo.ncdc.noaa.gov/pls/plclimprod/poemain.accessrouter?datasetabbv=SOD&countryabbv=&georegionabbv=). There were five nearby weather stations utilized from Ft. Wingate to Gallup, NM. These data sets provided for weather from 1896 to the present. Two climate scenarios were initially evaluated: (a) average climate year (1949) consisting of an annual precipitation of 11.7 inches (29.7 cm) of precipitation distributed similar to that found in figure 3; and (b) an extreme climate scenario consisting of the wettest year on record (1906) with an annual precipitation of 23.8 in (60.4 cm) of precipitation. This extreme year represents a year with more than double the average annual precipitation for the site. The National Climate Data Center summary for the site stated that the wettest year on record occurred in 1941 and was 21.5 in (54.7 cm) of precipitation, but a detailed analysis of the daily values found that the year of 1906 was more extreme. The precipitation depth in 1906 was 23.8 in (60.4 cm). The PET during this period was calculated via New Mexico State University's Potential and Actual Crop Evapotranspiration Wizard. This software package available on the internet at http://weather.nmsu.edu/pet/JS_pet.htm was utilized to calculate daily PET values based on the daily weather data from 1997. The maximum and minimum daily temperatures, daily precipitation value, site latitude, and a site specific calibration coefficient of 0.16 were input parameters used to calculate PET (Samani and Pessarkli, 1986). The Samani method used to calculate PET correlates very well with the Penman method utilized within UNSAT H (Samani and Pessarkli, 1986).

The flow of water across the surface and lower boundary of the cover profile of interest is determined by boundary condition specifications. For infiltration events, the upper boundary was set to a maximum hourly flux (representative of local conditions). For these runs it was conservatively set to 0.4 inches (1 cm) per hour that produced minimal runoff while maximizing infiltration. The UNSAT-H program partitions PET into potential evaporation ($E_p$) and potential transpiration ($T_p$). Potential evaporation is estimated or derived from daily weather parameters (Fayer 2000). Potential transpiration is calculated using a function (Equation 1) that is based on the value of the assigned leaf area index (LAI) and an equation developed by Ritchie and Burnett (1971) as follows:

$$T_p = PET\,[a + b(LAI)^c] \quad \text{where } d \le LAI \le e \qquad \textbf{Equation 1}$$

where:

a,b,c,d, and e are fitting parameters;

a = 0.0, b = 0.52, and c = 0.5, d = 0.1, and e = 2.7 (Fayer 2000)

The UNSAT-H program then partitioned the daily PET values into $E_p$ and $T_p$. $T_p$ was calculated using a function developed by Equation 1 above. The PET or climatic demand for water versus the amount of rain is graphically presented above in Figure 3 for an average climate year.

The lower boundary condition used was set as a unit gradient. This boundary condition was placed deep in the soil profile modeled; well beneath the cover and any transient moisture activity to ensure it had no impact on predicting the depth that produces the “point of diminishing returns”.

### 3.2.3 VEGETATION DATA

Vegetation will generally increase ET from the cover because a plant’s matric potential or suction is orders of magnitude higher than that of the soil (Figure 2). The input parameters representing vegetation include the LAI, rooting depth and density, root growth rate, the suction head values that corresponds to the soil’s field capacity, wilting point, and water content above which plants do not transpire because of anaerobic conditions. The onset and termination of the growing season for the site are defined in terms of Julian days. A percent bare area is also defined in the UNSAT H model and is often based on visual observation of undisturbed areas near the evaporation ponds. The maximum rooting depth should be based on expected vegetation characteristics. The root length density (RLD) in UNSAT H is assumed to follow an exponential function such as that defined in Equation 2:

$$RLD = a \exp(-bz) + c \qquad \textbf{Equation 2}$$

where:

a,b, and c are fitting parameters

z = depth below surface

The parameters used for the RLD functions in Equation 2 were: a = 0.315, b=0.0073, and c = 0.076 (Fayer 2000). The time required for maximum rooting depth establishment was set at full depth beginning on day 1. The rooting depth was conservatively set at 2-feet (60 cm) based on field observations. This is very conservative given roots from pinyon and juniper as well as the native shrubs and grasses can easily reach depths much greater than this.

An average LAI of 1.8 was used (Dwyer 2003). The onset and termination of the growing season for the site were Julian days 75 and 299, respectively. The LAI was transitioned from 0 to 1.8 starting with Julian day 75 to 135. Day 135 through 250, the full LAI equal to 1.8 was utilized. The LAI was then transitioned down from 1.8 to 0 from Julian day 250 to 299. This was conservative since it is realistic that plants can transpire year round at this site. An average percent bare area of 75% was used in the UNSAT H model based on visual observation of native vegetation in the surrounding area. The assumed percent bare area of 75% essentially reduces the maximum LAI to 0.45 (25% of 1.8).

### 3.2.4 SOIL PROPERTIES RELATED TO VEGETATION

Suction head values corresponding to the wilting point, field capacity, and a head value corresponding to the water content above which plants do not transpire because of anaerobic conditions were defined. Matric potential or suction heads are generally written as positive numbers, but in reality are negative values. Consequently, the higher the value, the greater the soil suction. The maximum water content a soil can hold after all downward drainage resulting from gravitational forces is referred to as its field capacity. Field capacity is often arbitrarily reported as the water content at about 10.8 ft (330-cm) of matric potential head (Jury et al. 1991). Below field capacity, the hydraulic conductivity is assumed to be so low that gravity drainage becomes negligible and the soil moisture is held in place by suction or matric potential.

Not all of the water stored in the soil can be removed via transpiration. Vegetation is generally assumed to reduce the soil moisture content to the permanent wilting point, which is typically defined as the water content at 656.2 ft (20,000 cm) of matric potential head for native grasses. This 656.2 ft (20,000 cm) value was conservatively used although some shrubs present near the site could remove water from the soil to a suction of 3280.8 ft (100,000 cm) (Hillel 1998). Evaporation from the soil surface can further reduce the soil moisture below the wilting point toward the residual saturation, which is the water content at an infinite matric potential. The head corresponding to the water content below which plant transpiration starts to decrease was defined as 32.2 ft (1000 cm) (Fayer 2000). The head value corresponding to the water content above which plants do not transpire because of anaerobic conditions was defined at 4-in (10 cm) based on the assumed moisture characteristic curves for the utilized soil hydraulic properties.

### 3.2.5 SOIL PROPERTIES

Two separate borrow sources were evaluated for use as cover soil. The particle size characteristics of these soils are summarized in table 1.

**Table 1**
**SUMMARY OF PARTICLE SIZE CHARACTERISTICS[1] (AMEC 2008)**

| Description | Gravel | Coarse Sand | Medium Sand | Fine Sand | Silt | Clay | USDA Classification |
|---|---|---|---|---|---|---|---|
| Borrow 1 | 0 | 0.2% | 1.4% | 34.2% | 30.5% | 33.6% | Clay Loam |
| Borrow 2 | 0 | 0 | 2.6% | 43.6% | 24.1% | 29.6% | Sandy Clay Loam |

[1]ASTM C422-63

Soil hydraulic properties were obtained based on grain size distributions of soil samples summarized in AMEC (2008). This data was then used to classify the soil according to the United States Department of Agriculture (USDA) soil classification system (Table 1 and Figure 6). Data from Rawls et al (1982) was then utilized for the classified soils to determine their unsaturated and saturated hydraulic properties (Table 2). For the final cover design, these properties will be laboratory and/or field measured for the specific borrow soil to be used. For this conceptual cover profile evaluation, it was felt that values from the literature for the specific soils planned for use in the cover system should be satisfactory to provide an indication of cover performance.

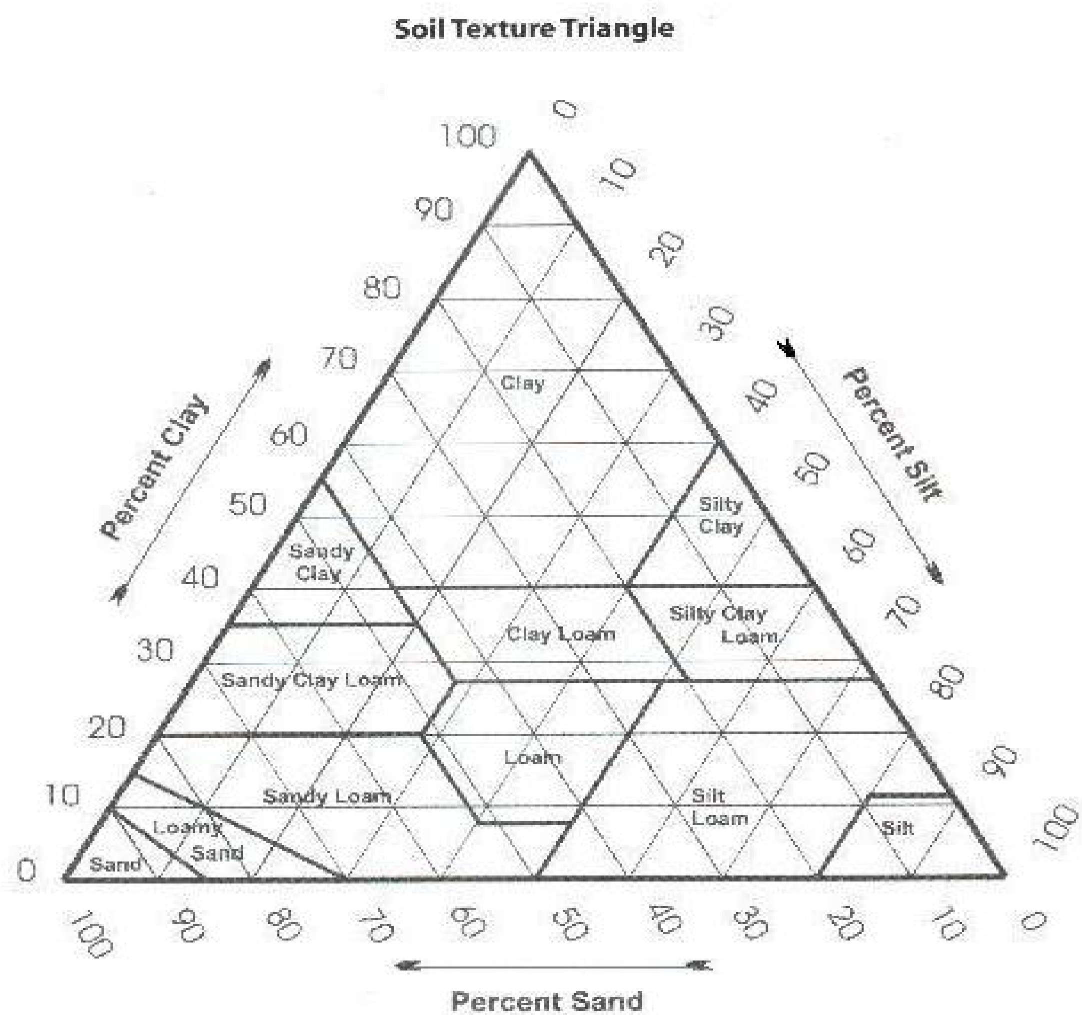



**Figure 6. USDA Soil Classification**

**Sand:** Soil particles between 0.05 and 2.0 mm in size
**Silt:** Soil particles between 0.002 mm and 0.05 mm
**Clay:** Soil particles smaller than 0.002 mm (2 microns) in size

The Mualem conductivity function was used to describe the unsaturated hydraulic conductivity of the soils. The van Genuchten 'm' parameter for this function is assumed to be'1-1/n'; 'n' being one of the established van Genuchten parameters. The initial soil conditions were expressed in terms of suction head values that correspond to the average moisture content between each soil layer's field capacity and permanent wilting point determined from each respective soil layer's moisture characteristic curve. The initial suction value for cover soil modeled UNSAT H was set at a value of 10,000 cm (Table 2). To help minimize any biases associated with the assumed initial suction value for the cover soil, the average precipitation year was modeled for 10 consecutive years using the final year to report predicted results.

**Table 2**
**SOIL HYDRAULIC PROPERTIES (Rawls et al 1982)**

| Soil | Depth BGS[1] | $K_{sat}$ (cm/hr) | Van Genuchten Parameters | | | |
|---|---|---|---|---|---|---|
| | | | $\theta_s$ | $\theta_r$ | α (1/cm) | n |
| Borrow 1 | 0 to 6 in | 2.3E+01 | 0.075 | 0.39 | 0.039 | 1.194 |
| | 6 to 18 in | 2.3E+00 | 0.075 | 0.39 | 0.039 | 1.194 |
| | below 18 in | 2.3E-01 | 0.075 | 0.39 | 0.039 | 1.194 |
| Borrow 2 | 0 to 6 in | 4.3E+01 | 0.068 | 0.33 | 0.036 | 1.25 |
| | 6 to 18 in | 4.3E+00 | 0.068 | 0.33 | 0.036 | 1.25 |
| | below 18 in | 4.3E-01 | 0.068 | 0.33 | 0.036 | 1.25 |

[1] BGS = below ground surface

Each soil type {clay loam and sandy clay loam}, was individually modeled to determine its applicability as a cover soil. It is understood that hydraulic properties such as a soil's initial saturated hydraulic conductivity can change with time, often increasing in response to external factors such as wet/dry cycles, freeze/thaw cycles, and biointrusion (Dwyer 2003). The computer simulations performed attempted to take these potential future soil changes into account by altering the hydraulic conductivity value of the given soil texture based on its depth below ground surface (BGS). Initial runs for each soil type consisted of three layers: a loosely placed upper soil (top 6-inches [15 cm]) over a loose soil (6 to 18-inch depth [15 to 45 cm]) over a moderately compacted thicker soil layer (below 18-inch [45 cm] depth). The loosely placed upper cover soil layer was set at 6-in (15 cm) deep with a saturated hydraulic conductivity of two orders of magnitude greater than that shown for the moderately compacted soil because it is assumed this layer will be scarified for seeding; is where the majority of roots reside; and is most affected by freeze/thaw and wet/dry cycles. The next layer was set at a saturated hydraulic conductivity of one order of magnitude greater than that applied to the moderately compacted soil because it is believed the soil density at this depth will relax with time due to freeze/thaw and wet/dry cycles resulting in an increased saturated hydraulic conductivity; and the majority of the remainder of the roots not in the upper 6-inches resides in this layer. The bottom layer utilized the saturated hydraulic conductivity value that is representative of the representative soil classification (Rawls et al 1982).

## 3.3 MODELING RESULTS

Percolation results from the redistribution of water through a soil profile in response to gradients in the energy state of the water. Flux is defined as the percolation rate through a given soil profile. Other mechanisms that might induce water redistribution, such as geothermal gradients and barometric pressure fluctuations, have been shown to be minor contributors to water flow in most instances (Jones 1978, Gee and Simmons 1979). Water redistribution is dependent on the soil profile hydraulic properties. The following sections describe results of specific profiles modeled.

### 3.3.1 AVERAGE CLIMATE YEAR

UNSAT H was used to estimate the minimum depth of cover required. This set of output data is intended to satisfy the applicability of the soils evaluated for use as a cover soil and determine a minimum cover thickness. The depth of cover soil required to minimize flux is based on the Point of Diminishing Returns (PODR) Method developed by Dwyer et al (2006). The 'point of diminishing returns' is defined as the depth at which flux is minimized; that is, the depth at which an additional increment of soil will no longer reduce the flux. This method allows for the determination of the minimum cover profile depth for a given soil to satisfy the intent of the regulations governing covers: minimize flux. The PODR depth is summarized in Table 3.

**Table 3**
**Minimum Cover Depth Required: Average Climate Weather**

| Soil Sample | Point of Diminishing Returns (PODR) depth & Depth that Minimizes Flux |
|---|---|
| Clay Loam (Borrow 1) | 22 in (57 cm) |
| Sandy Clay Loam (Borrow 2) | 22 in (57 cm) |

For the average climate data, both soil textures produced a zero flux at the PODR depth (Figures 7 and 8). This depth is achieved for both soil textures at a depth of 22-in (57 cm) below ground surface (BGS). That is, an ET Cover with a depth of at least 22-in (57 cm) will yield a net zero flux when subjected to typical climatic conditions at the site with native soils and vegetation.

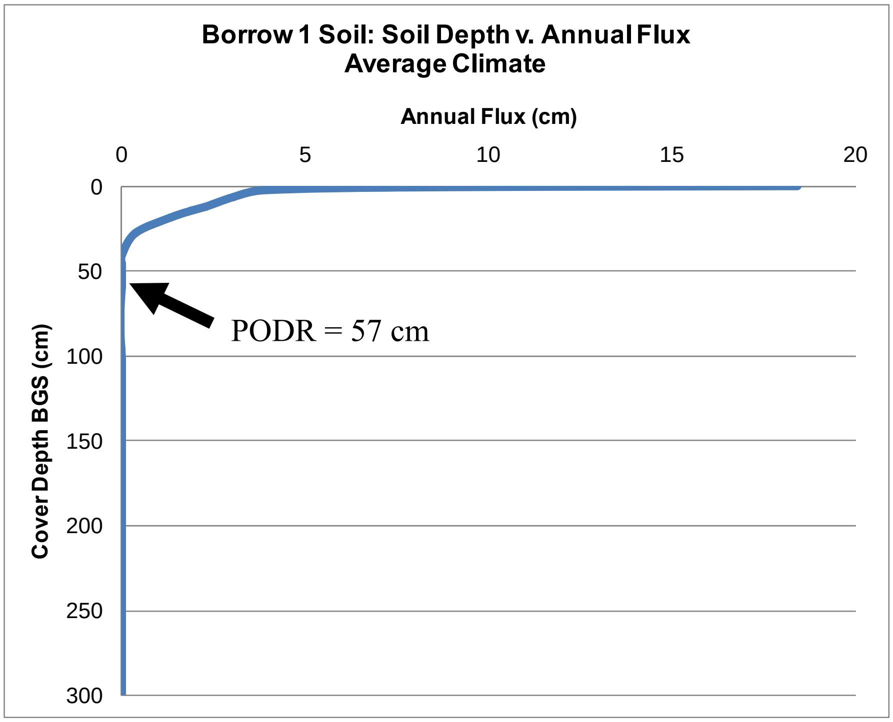



**Figure 7**
**PODR: Clay Loam Soil with Average Climate Data**

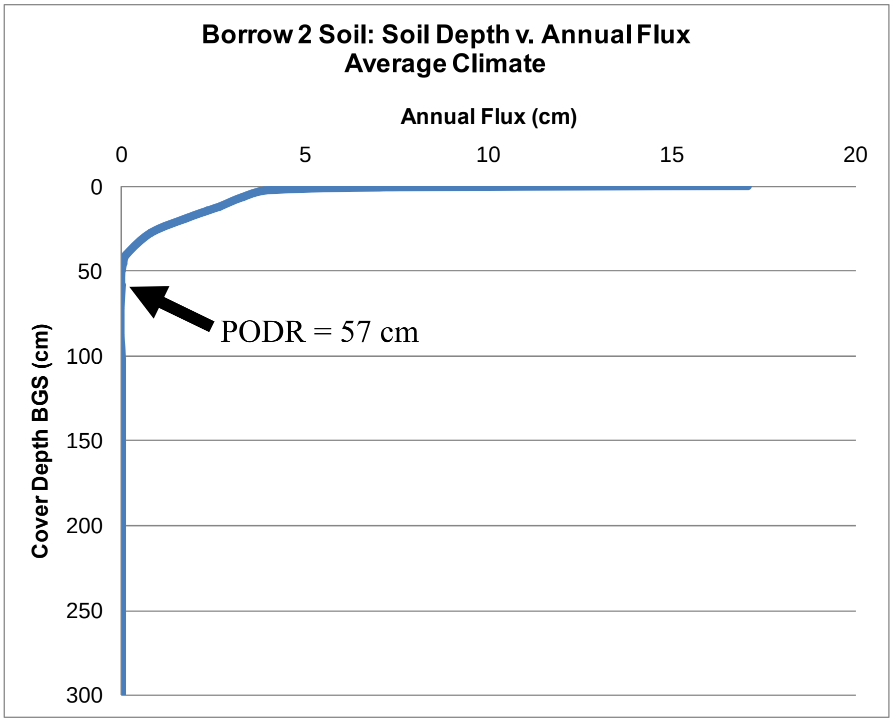



**Figure 8**
**PODR: Sandy Clay Loam Soil with Average Climate Data**

### 3.3.2 EXTREME CLIMATE YEAR

The same cover profiles and soil textures were then modeled utilizing the wettest year on record as the upper boundary condition. The wettest year on record occurred in 1906 and produced more than twice the average depth of precipitation: 23.8 in (60.4 cm). Ten average weather years were modeled in front of this extreme year to minimize any biases in the output from assumed initial conditions. The corresponding PODR depths are summarized in Table 4.

**Table 4**
**Minimum Cover Depth Required: Extreme Climate Weather**

| Soil Sample | Depth that Produces Minimum Flux |
|---|---|
| Clay Loam (Borrow 1) | 27.6 in (70 cm) |
| Sandy Clay Loam (Borrow 2) | 35.4 in (90 cm) |

Utilizing the extreme climate data, both soil textures produce a zero flux at the point of diminishing returns (Figures 9 and 10). The PODR depth is achieved for clay loam using the wettest year on record at 27.6-in (70 cm). The PODR depth is achieved for sandy clay loam using the wettest year on record at 35.4-in (90 cm). That is, an ET Cover with a depth of less than 3-ft (91 cm) for either soil texture will yield a net zero flux when subjected to this extreme climatic condition for the site with native soils and vegetation.

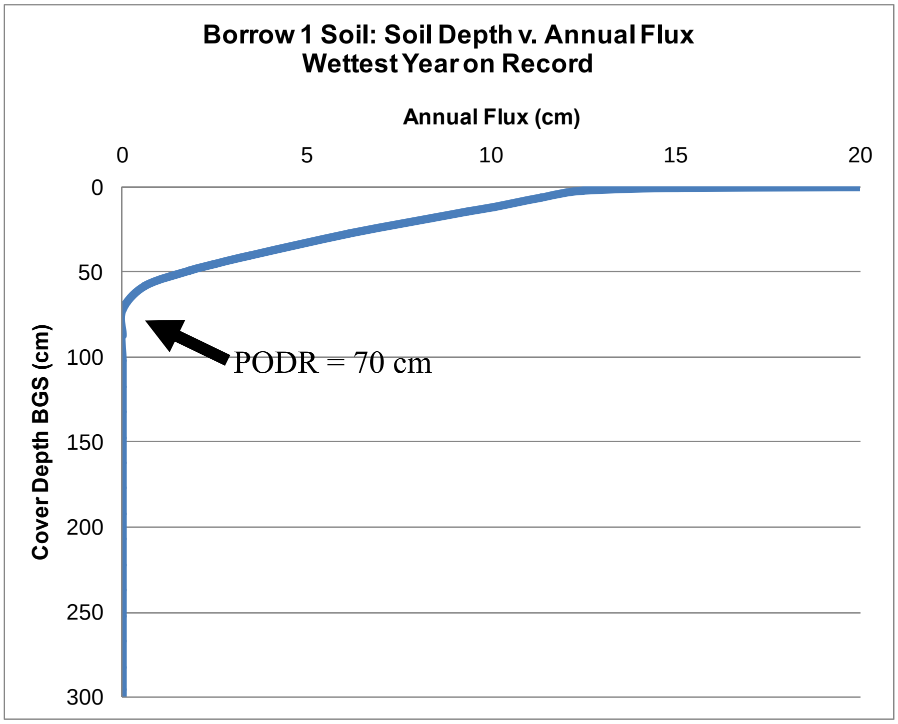



**Figure 9**
**PODR: Clay Loam Soil with Wettest Year on Record**

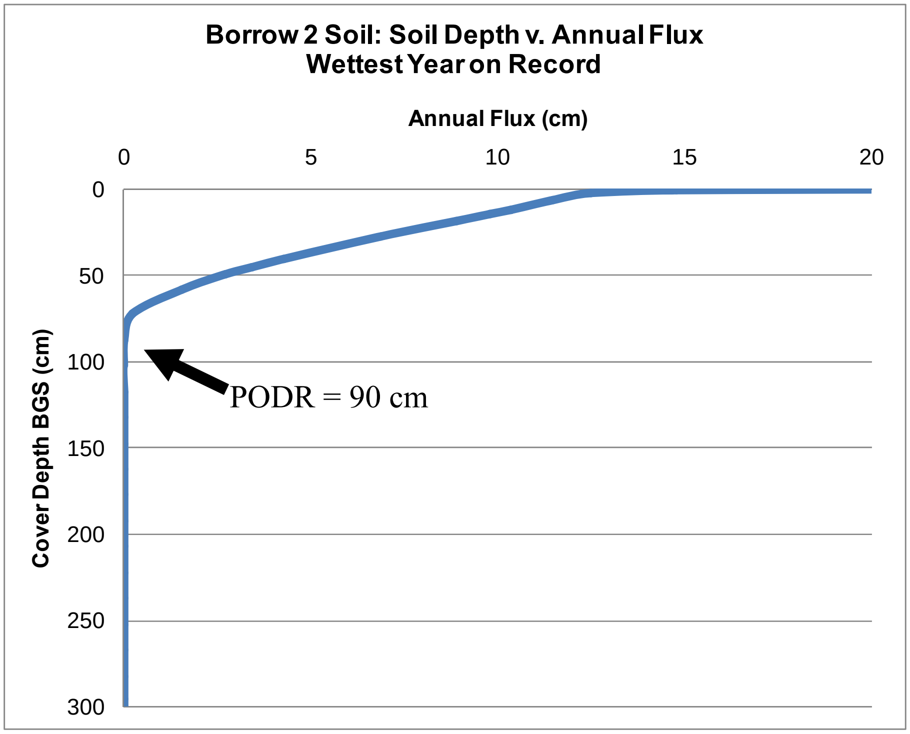



**Figure 10**
**PODR: Sandy Clay Loam Soil with Wettest Year on Record**

## 3.4 SENSITIVTY ANALYSES

Two of the design objectives stated in the EECA for any cover system is that it minimize flux and remain effective for a minimum of 1000 years (at least 200 years). This paper evaluates a conceptual profile of native soils and vegetation for deployment at the NECR site. It does not take into account erosional or biointrusion aspects of a cover that will be included in the final design profile.

To help address the water balance of the cover profile for a long-period of time, a sensitivity analysis of the modeled cover input parameters and boundary conditions were evaluated. It was found that the native soils are an excellent source for cover material and that any of the evaluated soils are adequate to minimize flux. The aforementioned analyses revealed that the most sensitive item for this site is the upper boundary condition or the climate data utilized.

The following sensitivity analysis summarizes the model output for the two soil textures (clay loam and sandy clay loam) evaluated under another climate scenario. The wettest year on record was modeled in back-to-back years. Although this scenario is extreme and highly unlikely given the past weather data available, this scenario reveals that even under this overly conservative scenario; the cover profile still performs very well. The same soil profiles evaluated in sections 3.1 to 3.3 were utilized while only altering the climate data. An average climate year was modeled for ten consecutive years prior to the back-to-back wettest year on record evaluation to minimize biases from assumed initial conditions.

The wettest year on record (1906) was modeled with output summarized in section 3.3.2. This wettest year was then placed in consecutive years to evaluate the output and the ability of the soil profile to continue to minimize flux. Table 5 summarizes the depth of the PODR for each previous scenario including this extreme sensitivity analysis. The data provided in table 5 is that from the final year of each respective analysis. Table 6 provides a summary of the water balance variables for each respective analysis.

**Table 5**
**Sensitivity Analysis Results**

| Sensitivity Analysis Climate Data Used | Depth of PODR | |
|---|---|---|
| | Clay Loam (Borrow 1) | Sandy Clay Loam (Borrow 2) |
| Average Year | 22 in (57 cm) | 22 in (57 cm) |
| Wettest Year on Record | 27.6 in (70 cm) | 35.4 in (90 cm) |
| Wettest Year on Record 2 consecutive years | 31.5 in (80 cm) | 43.3 in (110 cm) |

**Table 6**
**Sensitivity Analysis Water Balance Results**

| Year | Precipitation | PET | Transpiration | Evaporation | Runoff |
|---|---|---|---|---|---|
| Average Year | 11.7 in (29.7 cm) | 58.0 in (147.3 cm) | 1.4 in (3.7 cm) | 10.3 in (26.1 cm) | 0 |
| Wettest Year on Record | 23.8 in (60.4 cm) | 59.0 in (149.9 cm) | 4.0 in (10.1 cm) | 18.7 in (47.6 cm) | 0 |
| Wettest Year on Record: 2 consecutive years | 23.8 in (60.4 cm) | 59.0 in (149.9 cm) | 4.2 in (10.8 cm) | 19.5 in (49.4 cm) | 0 |

Figures 11 and 12 provide a graphical summary of the PODR depth for each respective sensitivity analyses. It can be seen in Figure 11 that for clay loam soil, even if the wettest year on record occurred in consecutive years; flux would be minimized at a relatively shallow depth. Figure 12 shows that although sandy loam soil will allow infiltration to move deeper in the soil profile, a de minimus flux is achieved at a relatively shallow depth.

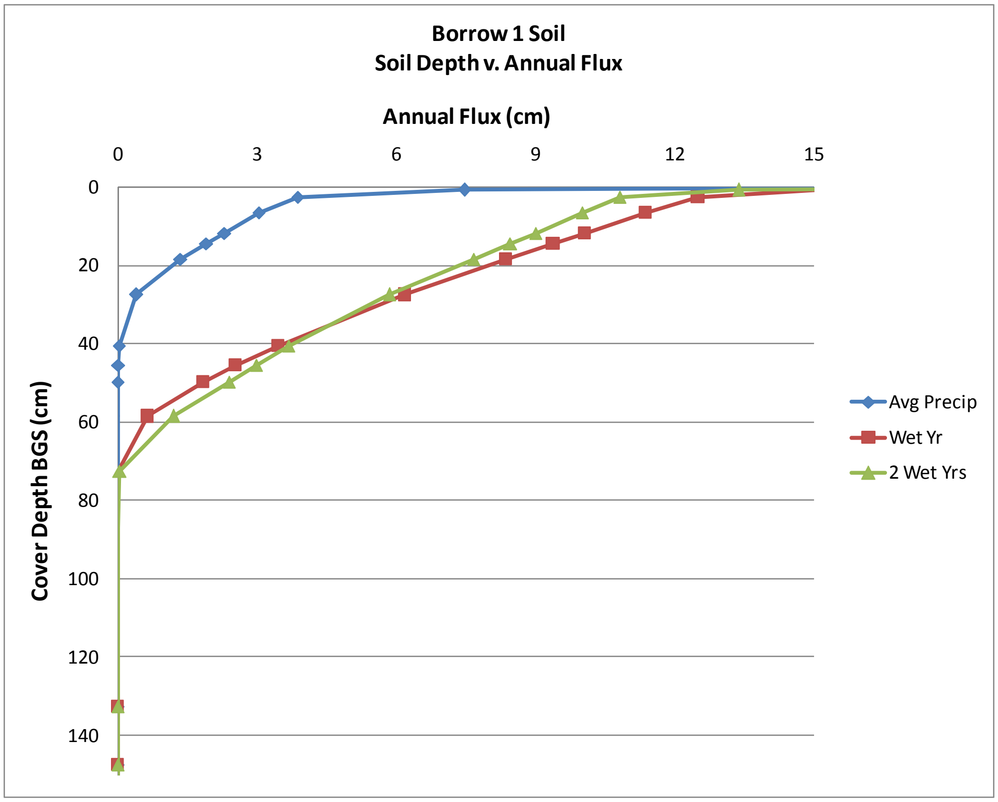



**Figure 11**
**PODR for Sensitivity Analyses: Clay Loam Soil**

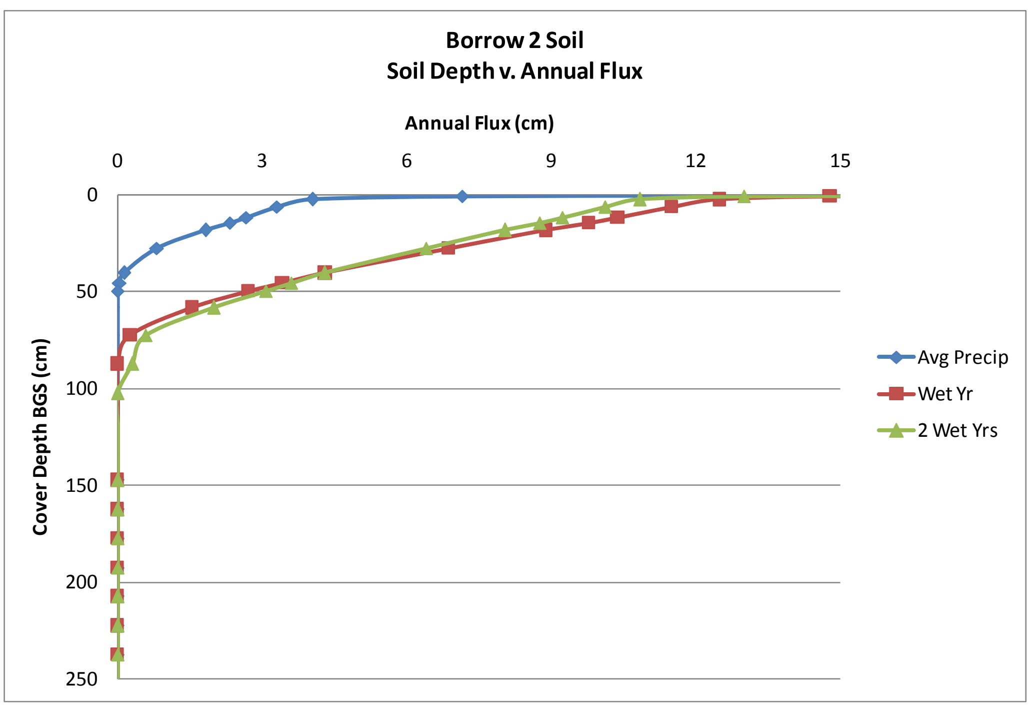


**Figure 12**
**PODR for Sensitivity Analyses: Sandy Clay Loam Soil**

## 4.0 NATURAL ANALOGS

Conventional engineering approaches for designing landfill covers often fail to fully consider ecological processes. Natural ecosystems effective at capturing and or redistributing materials in the environment have evolved over millions of years. Consequently, when contaminants are introduced into the environment, ecosystem processes begin to influence the distribution and transport of these materials, just as they influence the distribution and transport of nutrients that occur naturally in ecosystems (Hakonson et al., 1992). As the ecological status of the cover changes, so will performance factors such as water infiltration, water retention, ET, soil erosion, gas diffusion, and biointrusion. The objective in constructing an effective landfill is to design the cover so that subsequent ecological change will enhance and preserve the encapsulating system. Consideration of natural analogs can enhance a cover design by disclosing what properties are effective in a given environment or what processes may lead to possible modes of failure. These factors can in turn be avoided during the design and construction phases. Natural analog studies provide clues from past environments as to possible long-term changes in engineered covers. Analog studies involve the use of logical analogy to investigate natural and archaeological occurrences of materials, conditions, or processes that are similar to those known or predicted to occur in some part of the engineered cover system (Waugh 1994).

An objective for designing a cover for the NECR site, given the longevity requirements, is to accommodate long-term environmental processes with the goal of sustaining performance with as little maintenance as possible. The performance of any NECR cover will change in the long term as the environmental setting inevitably evolves in response to natural processes. Understanding how environmental conditions may change is crucial to designing, constructing, and maintaining long-term cover systems. Effective modeling and performance assessment require scenarios based on both current and possible future environmental settings. Natural analog studies help identify and evaluate likely changes in environmental processes that may influence the performance of engineered covers; processes that cannot be addressed with short-term field tests or existing numerical models (Chatters et al 1990, Waugh et al. 1994).

### 4.1 NATURAL ANALOG EVALUATION

One application for analog studies (Suter et al 1993, Mulder and Haven 1995, Dwyer 1997, Waugh and Smith 1997) is to assess the effectiveness of undisturbed native soil profiles on or near the NECR mine site. Trenching west of the existing tailings covers and borrow area 1 (Figure 5) in an undisturbed area was performed. This allowed for a cursory evaluation of the typical maximum depth of infiltration. The depth of vegetation roots from native grasses and shrubs were noted as well as the depth of calcium carbonate deposits or formation of a caliche layer (Figure 13). Soils in semiarid and arid regions commonly have carbonate-rich horizons at some depth below the surface. The position of the $CaCO_3$ bearing horizon is therefore related to depth of leaching, which, in turn, is related to climate (Birkeland 1984).

The origin of carbonate horizons involves carbonate-bicarbonate equilibria (Birkeland 1984), as shown by the following reactions:

$$\underset{g}{CO_2} + \underset{l}{H_2O}$$

$$\uparrow\downarrow$$

$$\underset{c}{CaCO_3} + \underset{aq}{H_2CO_3} \Leftrightarrow \underset{aq}{Ca^{2+}} + \underset{aq}{2HCO_3^-}$$

Carbon dioxide partial pressures in soil air are 10 to more than 100 times that in the atmosphere; this decreases the pH, which, in turn, increases $CaCO_3$ solubility. The partial pressure of $C0_2$ is high as a result of $C0_2$ produced by root and microorganism respiration and organic matter decomposition. Thus, one would expect the highest $C0_2$ partial pressure to be associated with the A horizon located near the surface, with values diminishing down to the base of the zone of roots. In arid and semi-arid regions, the quantity of water leaching through the soil is also generally greater near the surface than at depth. Thus, as the water moves vertically through the soil, the $Ca^+$ and $HCO^{3-}$ content might increase to the point of saturation after which further dissolution of $CaCO_3$ is not possible. Combining the effects of high $C0_2$ partial pressure and downward-percolating water, we might visualize the formation of a $CaCO_3$-rich horizon as follows. In the upper zone of the soil, $Ca^{\mathbf{2+}}$ may already be present or may be derived by weathering of calcium-bearing minerals. Due to plant growth and biological activity, $C0_2$ partial pressure is high and forms $HCO^{3-}$ upon contact with water. Water leaching through the profile can carry the $Ca^{2+}$ and $HCO^{3-}$ downward in the profile. Precipitation of $CaCO_3$ to form a caliche horizon would take place by a combination of decreasing $C0_2$ partial pressure below the zone of rooting and major biological activity and the progressive increase in $Ca^{\mathbf{2+}}$ and $HCO^{3-}$ concentrations with depth in the soil solution as the water percolates downward and water is lost by ET. The position (depth) of the $CaCO_3^-$ bearing horizon is therefore related to depth of leaching, which, in turn, is related to the climate.

Figure 13 shows the sidewall of an excavated trench from an undisturbed site west of borrow area 1 (Figure 5). The concentrations of salts found dramatically increased in concentrations at about 18-inches (45 cm) BGS revealing that this is the typical maximum infiltration depth for precipitation at this site. Extreme infiltration events could potentially move deeper than this 18-inch depth, but as the area dried this moisture would likely move back up in the profile and be removed via ET. The moisture being drawn upward after an extreme infiltration event is a consequence of the energy gradients produced by the site-specific extreme climatic demand for water or PET as illustrated in figures 2 and 3. This is another advantage of ET Covers – they allow for moisture beneath a cover profile to move up and be removed from the profile via ET. Figure 14 shows a chunk of calcium carbonate removed from this depth since the Figure 13 does not have a pronounced visible interface between topsoil and caliche and/or gypsum. A site near Albuquerque, NM (about 90 miles west of the NECR site) that has similar vegetation, climate, and elevation as the NECR site shows a more visible interface between topsoil and calcium carbonate.

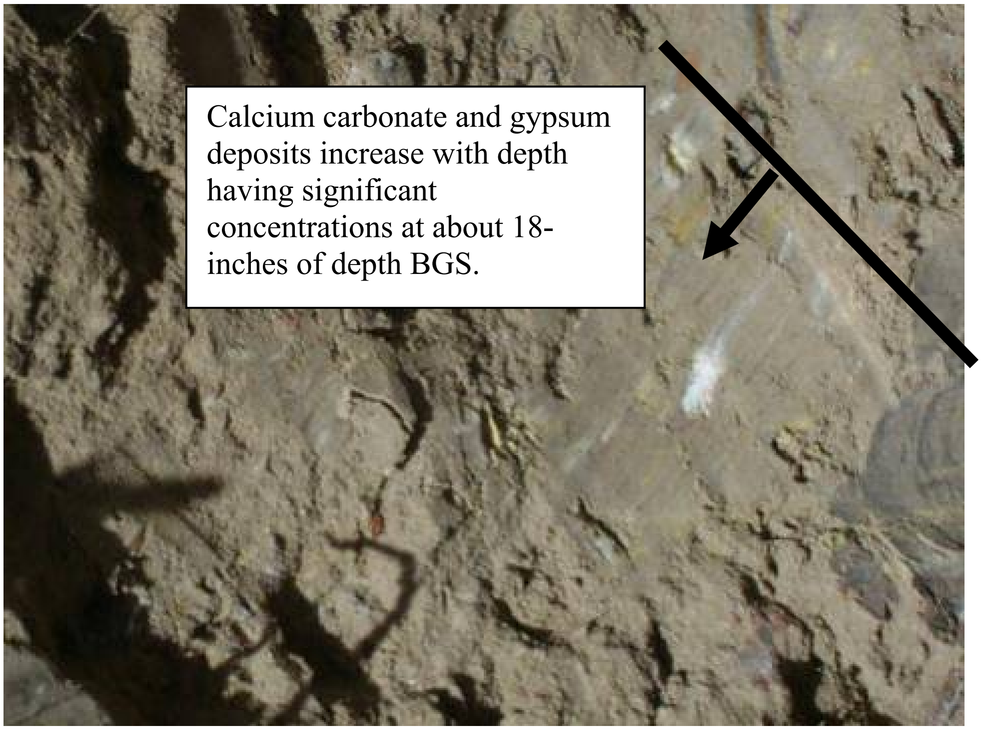



**Figure 13**
**Sidewall of Excavated Trench Showing Salt Deposits @ 18-inch BGS**

**Figure 14**
**Chunk of Calcium Carbonate Removed from Trench Shown in Figure 13**

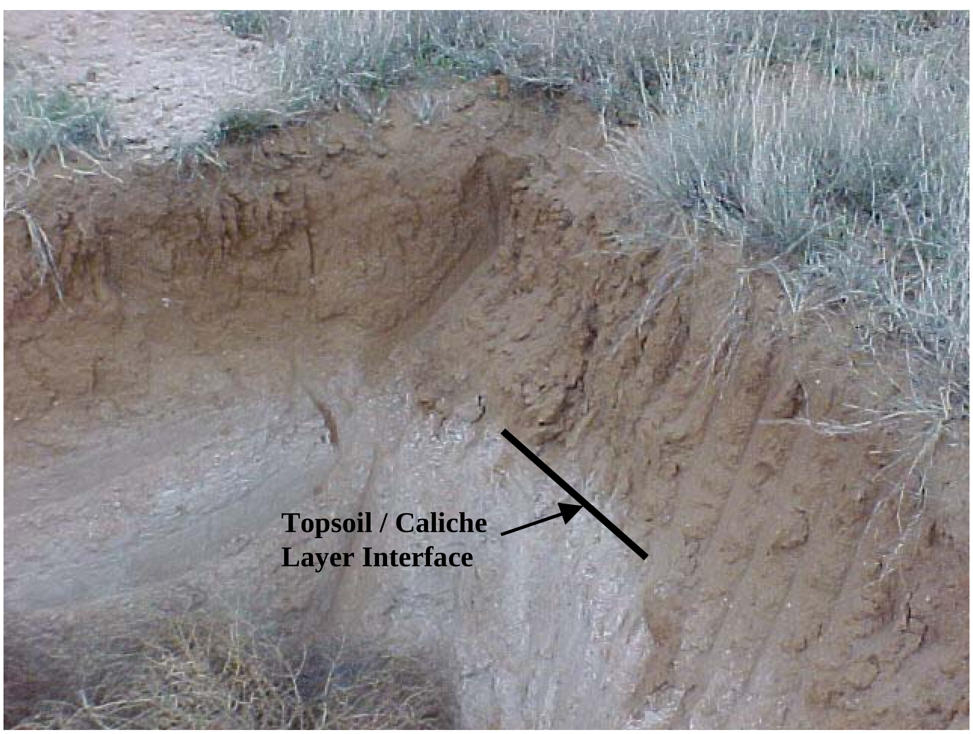



**Figure 15**
**$CaCO_3$/Soil Interface at Shallow Depth at site near Albuquerque, NM**

A more visible natural analog at the NECR site is the position of native vegetation roots found in the trench excavated in an undisturbed area. The trench was placed where roots from grasses, shrubs, and trees were visible. As seen in Figure 16, the majority of roots are found in the upper 18-inches of the soil profile, while a few woody roots penetrate deeper. The roots in the upper soil profile such as the native grasses tend to extract moisture content to soil suction values of about 20,000 cm or the wilting point for these plants. Shrubs and trees can extract moisture from the soil at higher suction values up to 100,000 cm (Hillel 1998). These roots tend to move downward during dry periods when the upper soil moisture is very dry and the suction values are very high. Thus the few deeper woody roots from trees and shrubs are not indicative of typical infiltration depths but rather the plant’s ability to extract moisture at deeper depths during drier periods. The plants in the upper 18-inches as seen by the large volume are indicative of typical infiltration depths where moisture is more easily extracted from soil higher in moisture content and lower in suction values such as after a precipitation event.

**Figure 16**
**Native Vegetation Root Depth**

## 5.0 FIELD DATA

The EPA and States in the Western United States have permitted multiple alternative cover systems based on applicable field data. Applicable field data is available on the EPA web site (http://www.clu-in.org/download/remed/epa542f03015.pdf#search='evapotranspiration%20epa%20fact%20sheet); the EPA's Alternative Cover Assessment Program (ACAP) web site (ftp://ftp.dri.edu/pub/ACAP/); and EPA Technology Innovation web site (http://cluin.org/products/altcovers/).

One of the most widely used data sets is that from a large-scale demonstration performed at Sandia National Laboratory in Albuquerque, NM. This project evaluated alternative covers side-by-side with prescriptive cover profiles (Dwyer 2003). This study was referred to as the Alternative Landfill Cover Demonstration (ALCD). There were six cover designs being tested in this demonstration project: two baseline cover profiles (prescriptive RCRA Subtitle 'D' and Subtitle 'C' Covers respectively) and four alternative cover designs (an ET Cover, two different Capillary Barrier System designs, and a cover featuring a Geosynthetic Clay Liner (GCL)). This study was endorsed by the Western Governors Association and was reviewed annually for its technical merit by a consortium of regulators and technical experts such as the National Academy of Science.

The demonstration allowed for testing of the cover profiles under both ambient and stressed conditions. During stress tests of the cover profiles, water was evenly applied to the plots to evaluate the subsequent water balance variables for each cover profile. Extreme summer events were simulated such as severe thunderstorms as well as winter and spring events such as large snow falls and expedited melting of snow during low transpiration periods.

The results showed that a well designed ET Cover composed of 3.5 ft (107 cm) of native soil performed as well as or better than a prescriptive cover over 5-ft (152 cm) thick containing a 2-ft (61 cm) thick clay barrier layer and geomembrane. A capillary barrier profile also performed very well. Both the capillary barrier and ET Cover produced zero flux after the vegetation on them matured.

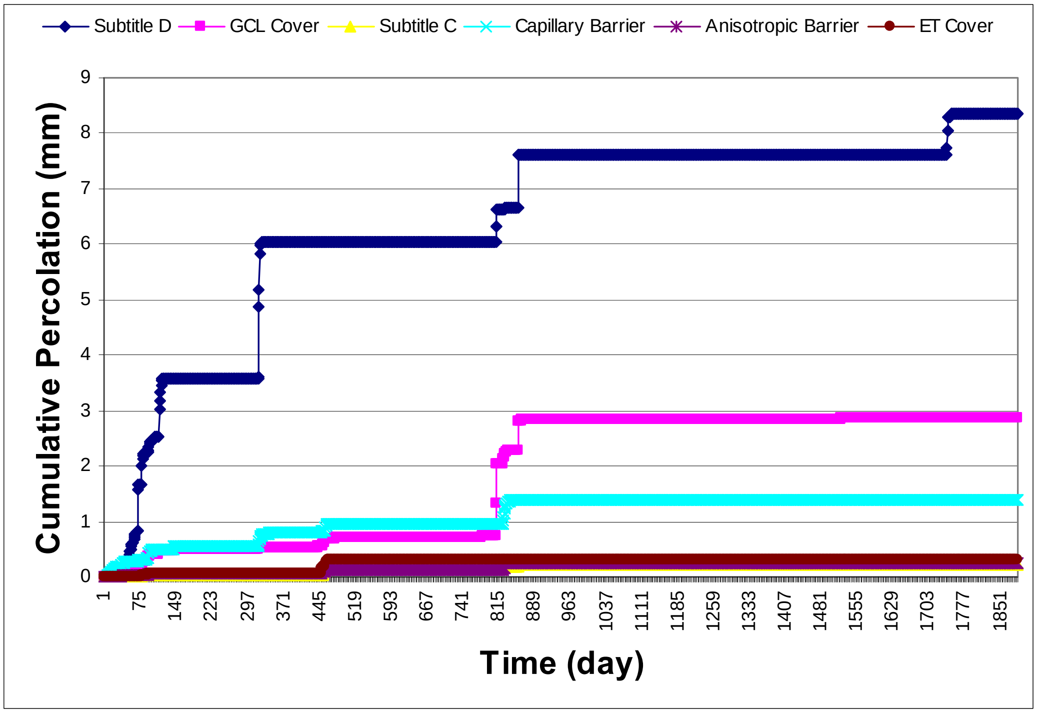
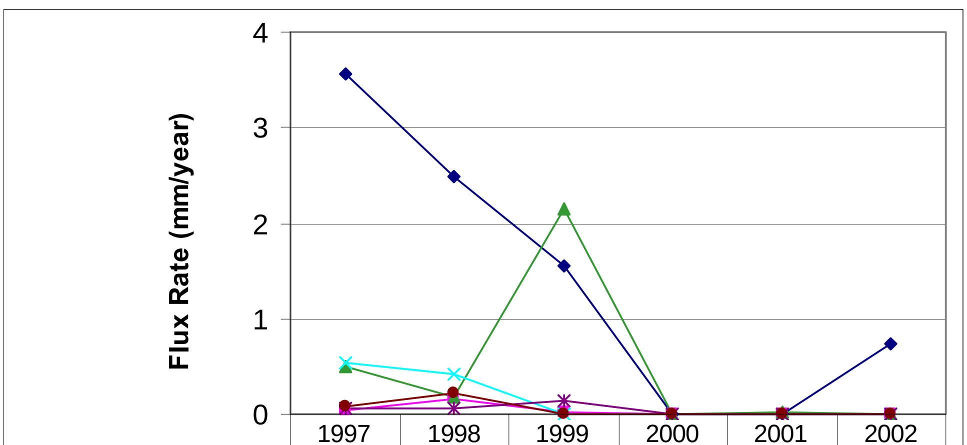



**Figure 17**
**Cumulative Percolation for the Six Test Covers**




| | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 |
|---|---|---|---|---|---|---|
| Subtitle D | 3.56447 | 2.47911 | 1.56115 | 0.00000 | 0.00000 | 0.73966 |
| Subtitle C | 0.04131 | 0.15161 | 0.01756 | 0.00000 | 0.00000 | 0.00000 |
| GCL Cover | 0.50628 | 0.18831 | 2.15408 | 0.00018 | 0.02091 | 0.00000 |
| Capillary Barrier | 0.54412 | 0.40907 | 0.00000 | 0.00008 | 0.00002 | 0.00005 |
| Anisotropic Barrier | 0.05135 | 0.06888 | 0.13937 | 0.00035 | 0.00047 | 0.00021 |
| ET Cover | 0.07546 | 0.21837 | 0.00538 | 0.00002 | 0.00000 | 0.00000 |

**Figure 18**
**Annual Flux for the Six Test Covers**

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