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Moab DEIS Comments
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Comments on Moab DEIS

The Grand Canyon Trust and other conservation groups listed at the end of these remarks appreciate the opportunity to submit comments on the Draft EIS ***Remediation of the Moab Uranium Mill Tailings.***[1] It is our position that the Klondike Flats or Crescent Junction offsite alternatives offer the best balance of long-term isolation of the wastes at reasonable cost. Onsite stabilization is fraught with many uncertainties regarding critical issues that could result in impoundment failure and release of contaminants into the City of Moab and the Colorado River, as well as the virtual certainty that ground and surface water treatment under this alternative will be much less successful than if the tailings were removed. We also find that the analysis of socioeconomics completely ignores the likely consequences of tailings pile failure for the local and regional economies, despite the fact that these costs could easily dwarf the entire cost of tailings reclamation under any scenario.

General Concerns

Importance of the Colorado River
In our view, a central shortcoming of the DEIS is its consistent failure to recognize the overriding importance of two primary issues. The first is the extraordinary importance of the Colorado River to the natural systems and human societies of the Southwestern U.S. No other resource except air is more critical to this region. Every drop of the river is already appropriated for human use, as drinking water for 26 million people and irrigation for some of the country's most high value food crops. The region served by the river is the nation's fastest growing area, so allocation of this scarce water source will almost certainly become an even more dominant theme of western society over the coming decades and centuries.

[1] (Note: It is difficult to organize comments on the DEIS as written because the principal subjects are divided up and discussed repetitively in many parts of the document. Thus, for example, groundwater compliance strategies are discussed in detail in the introduction in several places, again in chapters 2.3, 3.1.6, 3.2.4, 3.3.5, 3.4.5, 4.1.3, 4.2.3, 4.3.3, 4.4.3, 4.6.3, and throughout the regulatory requirements and appendices. When these comments suggest changes in the DEIS, reference is usually made only to one or two of the prime discussions in the document, rather than trying to comprehensively suggest changes in every applicable section, even though all such corrections are implied by the comments.)

One hundred years ago the Colorado flowed free into the Gulf of California. In the intervening time, more money has been spent per gallon putting this river to use for human benefit than any other sizeable river on earth. Trying to predict use of the river over the coming millennium reveals the limits of imagination, but the only responsible course it to assume that the water will be incredibly precious. None of these matters is discussed in the DEIS, despite the massive and ongoing contamination of the river by tailings discharge, and the threat of catastrophic tailings pile failure.

Never looking into the future, DOE always proceeds as though there is no significant human use of the river in the vicinity and resolutely defines the issue as simply the protection of aquatic organisms and river runners in the vicinity near the tailings pile. This failure is so important that it nearly invalidates the entire DEIS as a decision-support tool. On page 4-56, there is a matter-of-fact discussion of scenarios in which radioactive wastes and other toxins might be spread throughout the river and riparian zone for a hundred miles, concluding, "A major tailings release is not anticipated to significantly increase risks to human populations downstream of Lake Powell." That is the extent of analysis for a disaster that could turn life in three states and part of Mexico upside down, and that would carry a staggering price tag.

As we will point out in these comments, this conceptual failure resonates throughout the DEIS, biasing many of the risk analyses, rendering the ground and surface water treatment plans inadequate, and leading to the wrong conclusions about the consequences of possible tailings pile failure. This is why the governors of Utah, New Mexico, Arizona, Nevada and California wrote DOE on 12/29/04 saying, "We want to make it clear that any remediation other than an off-site option is unacceptable." Similarly, on February 9, 2005, the entire Utah congressional delegation wrote Secretary Bodman to say, "We believe the only appropriate action is to move the tailings pile from the banks of the river." We agree.

Failure to Adequately Plan for the Long Term

The second outstanding issue given short shrift in the DEIS is the necessity of planning a reclamation that will truly isolate the wastes over the long term. The National Academies' Board on Radioactive Waste Management points out in its Report to DOE that "the tailings represent a hazard that essentially lasts forever." They go on to say,

> "DOE should…recognize that there is no physical basis for a line to be drawn at 1,000 years; indeed…the hazards to humans and ecosystems from the mill tailings will last far longer than any period of regulatory compliance."

Throughout the DEIS are references to the EPA standard at 40 CFR 192.02 (a) that control of mill tailings shall be designed to "Be effective for up to one thousand years, to the extent reasonably achievable, and, in any case, for at least 200 years." This was written in recognition of the fact that radioactivity in the tailings will have declined by less than 1% after a millennium. The Klondike and Crescent Junction offsite alternatives offer excellent prospects of complying with the letter and spirit of this standard. But, for

the onsite alternative, when the DEIS evaluates the durability of structures proposed to be built directly in the path of powerful floods, this standard seems to have been interpreted to mean, "We hope they might last for as long as 200 years," and when considering a fully expected gush of concentrated contaminants to the river, "Don't worry, it won't happen until 1,100 years out." These games with numbers are completely unacceptable when the water supply for the Southwest is at stake. Uncertainties with such serious consequences must be resolved through extreme caution, and that is systematically lacking in the DEIS with regard to the long term stability of onsite reclamation.

The Requirement to Minimize Maintenance

This point is reinforced by consideration of a rarely mentioned section of the EPA standard at 40 CFR 192.02 (d), which says, in its entirety, "Each site on which disposal occurs shall be designed and stabilized in a manner that minimizes the need for future maintenance." What this standard really requires is a tailings impoundment so robust and stable that it will still be going strong at 1,000 years, with good prospects of lasting far longer.

That is likely unachievable with onsite reclamation at the difficult Moab site, as the DEIS makes clear. On page 2-176 DOE explains that it does not believe issues like river migration need to be resolved before making a reclamation decision, because continuous monitoring will allow for remedial actions in the future if assumptions turn out to be wrong. Yet, on page 2-171 is a discussion describing the ways migration of the river could increase contaminant levels and require expenditures for riprap walls and other remedies up to tens or hundreds of millions of dollars. At the extreme, the DEIS says, perpetual treatment or mitigation might be required, or the tailings would have to be relocated after all onsite costs and efforts had been committed. This potential disaster illustrates why DOE's regulatory guidance mandates selection of a reclamation alternative that calls for minimum maintenance.

This minimum maintenance standard has the same preeminent weight in law as the 200-1,000 year timeframe, the requirement to control radon releases, and the requirement to protect groundwater, yet DOE does not quote it in the DEIS, nor give much priority to its dictate, because that requirement argues so heavily against capping the tailings on wet alluvium in the floodplain of a famously unpredictable river. As with underestimating the importance of the Colorado River, these comments will show that the DEIS is compromised in many places by the failure to truly envision and plan for what the river might do over a thousand years, or to imagine changes at the Moab site and in society during that time. These fundamental failures and all the errors arising from them must be corrected in the FEIS in order to allow selection of the best Preferred Alternative.

Regulatory Requirements

42 USC 7912 (f) (3) Ignored

Section 1.1 of the DEIS, which recounts the regulatory history of DOE's involvement with the Moab site, arbitrarily omits a key provision of law. Page 1-31 of the DEIS says that the *Floyd Spence Act* requires that "DOE prepare a remediation plan to evaluate the

costs, benefits, and risks associated with various remediation alternatives." This is presented as the primary legal driver behind the entire DEIS. However, the *Floyd Spence Act* contains an even more specific provision regarding the Moab site, one that was the centerpiece of the legislation long before the last minute addition of the language DOE quotes in the DEIS. This provision is codified at 42 USC 7912 (f) (3):

> Remediation—Subject to the availability of appropriations for this purpose, the Secretary shall conduct remediation at the Moab site in a safe and environmentally sound manner that takes into consideration the remedial action plan prepared pursuant to section 3405 (i) of the Strom Thurmond National Defense Authorization Act for fiscal Year 1999 (10 U.S.C. 7420 note; Public Law 105-261), including—
> ***(A) ground water restoration; and***
> (B) ***the removal, to a site in the State of Utah, for permanent disposition and any necessary stabilization, of residual radioactive material and other contaminated material from the Moab site and the floodplain of the Colorado River."*** (emphasis added)

Legislators intended this language to result in removal of the mill wastes from the flood plain of the river. Utah Senator Bob Bennett said, upon passage of the bill, "Bottom line; the tailings will be moved" (personal communication). California Congressman George Miller, who also played a leading role in writing and supporting the legislation, said, "The tailings will be moved" (personal communication).

The intent of this language is entirely consistent with DOE practice throughout the UMTRA program. Every tailings pile located beside a river (with the exception of the Shiprock site, which is on a high bluff) was removed to a safer location, despite the fact that DOE had no such specific legislative guidance regarding sites other than Moab. Moreover, the Moab site is far larger than any of the other tailings piles, and is more polluting to the river than all of the other sites combined. It is also threatened by the largest, wildest river, since the Gunnison and Dolores rivers and numerous streams have added their flows to the Colorado between the Grand Junction site and the Moab site. DOE must explain in the FEIS how it is interpreting its own regulations to reach this point where the biggest, most polluting and most threatened tailings pile may be the only one left beside a river, despite the fact that this site also has the most specific legislative mandate to be removed. Failure to so explain will render any onsite disposal decision arbitrary and capricious in the extreme.

Groundwater Remediation

Inappropriate Application of Supplemental Standards
An essential part of the DEIS is DOE's assertion that the groundwater compliance strategy will be almost independent of the decision about where and how to reclaim the tailings pile. Whether the 11.9 million tons of tailings and their 21.6 million cubic feet of

highly contaminated pore water are left in place seeping into the groundwater or completely removed is considered to have no effect on the appropriate plans for cleanup.

The DEIS does not come close to explaining the credibility of this counter-intuitive conclusion. However, central to the logic is an unacceptable partitioning of the ground water from the surface water to which it is hydraulically connected right at the site boundary. DOE has decided to authorize itself to apply Supplemental Standards because the aquifer under the pile qualifies as "limited-use groundwater" due to its high TDS content, despite the fact that this aquifer, and the millsite contaminants in it, discharge directly into the water supply for 26 million people at the site boundary at levels far exceeding standards for many regulated substances (page 1-39 and following; 2-90 and following). Arsenic, cadmium, molybdenum, nitrate, radium, selenium, uranium and gross alpha exceed 40 CFR 192 maximum concentration limits, and ammonia and sulfate exceed risk-based concentrations. It is unacceptable to assert, as the DEIS does on page 1-40, 2-90, and elsewhere, that discharge of such groundwater to the Colorado River "pose(s) no risk to humans."

Humans use all the water in the Colorado River, and there is no safe minimum dose of uranium. After a millennium, our descendents may be reverently lifting water out of this river in thimbles. Moreover, within decades, the City of Moab will likely be much larger and drawing drinking water directly from the river. The conclusion that people will not be affected by poisoning the river is one of the pernicious results of the failure to place adequate weight on the importance of the Colorado River to the human communities of the Southwest, or to clearly envision changes over the long regulatory time periods. Instead of this compliance strategy that simply defines away risks to humans, DOE must lay out a plan for permanently removing the mill related contaminants from the groundwater before they reach the river. If it is more expensive and complex to do this with the tailings in place, then that is a major strike against that option.

Finally, Dr. Kip Solomon's work has shown that the Colorado is probably not a complete barrier to the passage of contaminated groundwater across to the Moab side of the river. Elevated uranium concentrations are found in groundwater beneath the Matheson Wetland Preserve in a pattern that suggests subsurface transfer beneath the river. This is another pathway for the tailings contaminants to affect human receptors. The DEIS acknowledges this on page 2-172, where it says that the under-river flow could prohibit achieving protective surface water criteria, a situation that could result in perpetual groundwater remedial action. Uncertainties of this sort, that could involve huge costs and human health risks, should be written in large red letters in the FEIS. Essentially all the many uncertainties of this nature are about the onsite alternative. The offsite alternatives are much more nearly certain to result in long term isolation of the wastes without the need for maintenance. The FEIS should group all these potentially catastrophic uncertainties together in one chart and highlight which alternatives they apply to.

Groundwater Standards as Promulgated Already Reflect Cost/Benefit Analysis
The DEIS does not consider the fact that the groundwater standards were originally promulgated after careful weighing of costs and benefits. It is

inappropriate to perform another round of cost/benefit analysis when determining if standards can be met onsite. For example, in the January 11, 1995 *Federal Register Notice* through which EPA announced the "Final Rule Regarding Groundwater Standards for Remedial Actions at Inactive Uranium Processing Sites," the Administrator includes a section titled "Costs," which states,

> "In 1983, Congress amended UMTRCA to provide that when establishing standards the Administrator should consider, among other factors, the economic costs of compliance. We have considered these costs in two ways. First, we compared them to the benefit, expressed in terms of the value of the product--processed uranium ore--which has led to contamination of groundwater at these sites. We estimate the present value of the processed uranium ore from these sites as approximately 3.9 billion dollars (1989 dollars). The estimated cost of compliance is approximately 5.512% this value, and we judge this to be a not unreasonable incremental cost for the remediation of contamination from the operations which produced this uranium. As a second way of considering the economic costs of compliance, we examined the cost of alternative ways to supply the resources for future use represented by these groundwaters. As noted earlier, water is a scarce resource in the Western States where this cleanup would occur. When other resources have been exhausted, the only remaining alternative to cleaning up groundwater in the vicinity of these sites is to replace this water by transporting water from the nearest alternative source. Our analysis of the costs of doing this indicates that it is significantly more costly to supply water from alternative sources than it would be to clean up the groundwater at these sites. We have concluded, therefore, that this final rule involves a reasonable relationship between the overall costs and benefits of compliance."

When DOE proposes in the DEIS to accept levels of contamination of ground water far higher than EPA standards, this decision must not be based on cost considerations that have already been factored into the standards.

One Groundwater Compliance Strategy, Very Different Results
On the other hand, the proposed groundwater compliance strategy may simply be the only technically feasible plan due to the difficult constraints of the site. Among other things, the tailings pile itself blocks access to much of the contaminated groundwater, over-pumping the groundwater will bring highly saline water to the surface, and all wells, pipelines, trenches and treatment facilities installed between the pile and the river will be subject to damage or destruction from periodic flooding.

If this is the only achievable plan, rather than the best plan, DOE must acknowledge these limitations and prepare to do everything it can to minimize further contamination of the groundwater and hydraulically connected surface water that provides critical wildlife habitat and irreplaceable drinking water. And it is in this regard that the offsite

alternatives, which remove the source of contamination and result in permanent cleansing of the aquifer, have enormous benefits over the onsite alternative.

The difference in expected performance of the groundwater compliance strategy under different remediation alternatives is partially expressed on page 2-109:

> "Because seepage from the tailings pile represents a long term source of groundwater loading, an onsite disposal decision could result in longer term ground water remediation; higher concentrations of residual groundwater contamination would also be expected to remain at the conclusion of the remediation time period (see figure 2-43). The longer operational time period would also result in a corresponding increase in operational costs of the system. Uncertainties associated with model predictions for the onsite disposal alternative involve both the time to meet steady state conditions and the question of whether the target goals could be met."

The issue of whether target goals can ever be met if the tailings are left in place is another of the red letter uncertainties that should play a central role in selection of an alternative. The choice is a stark one. Today, the tailings pile is leaking an estimated 28,800 gallons per day of pore water with mean concentrations of 61 pCi/l of radium-226 (12x the MCL), 15.6 mg/l uranium (355x the MCL), and 1,100 mg/l ammonia (366x the acute lethal dose for fish) into the groundwater (DESI page 3-11). This toxic seepage would be completely stopped and replaced with flushing rainwater within 10 years under the offsite alternatives, but will continue forever with onsite remediation.

At page 4-7 the DEIS says that the cap is expected to reduce infiltration, from the current rate of 20 gpm to 0.8 gpm, 130 years after installation of a 5×10^{-8} cm/second cap (the tightest yet built), but the National Academies Committee warns in its report to DOE that tailings caps routinely become two orders of magnitude more permeable over time, so influx rates may well be higher than those modeled. The increasing leakiness of the cap over time is not analyzed in the DEIS.

This is another critical uncertainty, as shown in Figure 2-43. Somehow, DOE predicts identical reductions in groundwater ammonia over 75-80 years, whether the tailings and their seepage are left in place or removed, but thereafter concentrations plunge quickly and permanently to near zero in the offsite scenario while hovering close to the acute lethal dose essentially forever under the onsite scenario. Small errors in estimating either the seepage rates or the concentrations of contaminants could result in never reaching groundwater targets, yet Table 2-33 shows that ammonia concentrations could be ten times as high as predicted. If true, onsite remediation will never achieve groundwater goals and remediation will continue indefinitely. DOE must revise this entire section in the FEIS to show that the groundwater treatment results are not at all equivalent depending on the reclamation option chosen.

Long Term Performance of the Groundwater Compliance Strategy
The discussion of the long term performance of the groundwater strategy fails to consider the effects of periodic flooding on the infrastructure that must be built in the floodplain of the river. Page 2-99 tells us to expect 50-150 extraction wells and/or 2,000 feet of shallow trenches in this flood prone area, and page 2-104 goes on to describe the need for emission controls, holding tanks, water lines, electrical lines, chemical storage areas, and pumps. All of this $10 million investment must be expected to withstand a 100-year flood with its fast moving driftwood logs, erosion and mud. Again, this is why the alternatives that actually reach acceptable goals through natural flushing are far better than those requiring a lot of technology and maintenance. A discussion of these problems is necessary in the FEIS.

These expected river floods have another effect on the performance of the groundwater treatment system. Page 4-10 reveals that simulations of the 1984 flood of 70,000 CFS show that this river stage will add 4.4 million gallons of water to the tailings, which then will drain at 307 gpm (more than 15 times the current rate) for ten days. This is expected to raise groundwater ammonia concentrations by 2 mg/l (66% of the acute lethal dose for fish) over ten years. However, the document trivializes this result and the sure prospect for future repeats by saying, "However, the effects of a tailings inundation would decline rapidly over a period of approximately 20 years after the flood event." Here again, the DEIS has lost sight of the unacceptability of contaminating the Colorado River for decades. What aggravated contamination will result from a repeat of the 1884 flood, estimated at 125,000 CFS? How about the 500-year flood, or the PMF, which will flood the pile to a depth of 25 feet? The FEIS must discuss these floods with a proper appreciation of their inevitability and their effects on renewed contamination if the tailings are reclaimed onsite. Somehow, the selection of a preferred alternative must focus on the common sense of remarks in the DEIS like the one on page 2-120, which says, "In contrast to the onsite disposal and No Action alternatives, the offsite disposal alternative presents no risk of these recurrences of surface water contamination at the Moab site because the tailings pile will be removed."

The third significant long term problem with groundwater treatment under the onsite alternative involves the probable presence of an ammonia salt layer in the upper part of the pile. Ammonia in this layer of the tailings is concentrated to 18,000 mg/l, and this extremely toxic pore water is expected to sink down, eventually reaching the groundwater in 1,100 years. This will result in resumption of non-protective surface water quality for an estimated 440 years (DEIS page 2-114). It completely violates the spirit of the 40 CFR 192 standards to minimize the importance of this situation simply because it is predicted (with no discussion of confidence limits) to occur just after the period of regulatory compliance has ended. The population of the Southwest will likely curse our memories if the tailings are left in place to add this surprise to their water supply.

Finally, the DEIS tells us that onsite tailings disposal will ultimately fail even if there are never any catastrophic floods or earthquakes. The tailings pile is gradually settling due to

natural basin subsidence and will be permanently immersed in the groundwater after 7,000-10,000 years. “Ground water beneath the Moab site would remain contaminated, would not be protective of human health, and would continue in perpetuity to discharge contaminants to the surface water at concentrations that would not be protective of aquatic species” (DEIS page 2-119). The words are somber, though DOE refuses to recognize how critical the river might be to a civilization that far in the future. This dismal outcome is obviously beyond the limit of regulatory compliance, but why on earth should we plan for it when there are straightforward alternatives that completely avoid the problem?

Compliance Strategy is Likely Not Protective of Aquatic Organisms
DOE recognizes the difficulty of predicting how various water treatment plans will affect aquatic organisms. “The variables affecting prediction accuracy are many, and the system of contaminant transport and the interaction between groundwater and surface are complex, largely due to the dynamic nature of river stage and backwater area morphology” (DEIS page 2-109). The plan is in error, however, when DOE concludes that it will be conservative and protective of aquatic organisms to aim for the acute lethal dose in groundwater, with no allowance for dilution in surface water.

First, the acute standard of 3 mg/l ammonia aimed at is too high by a factor of five. The State of Utah believes that the chronic and acute standards should both be set at 0.6 mg/l ammonia (DEIS page 2-176). This is corroborated by the Columbia Biological Lab results showing mortality of fish introduced to the near shore waters of the Colorado. Concentrations of ammonia in the range of 3 mg/l kill the fish; that is why this is called the acute lethal dose.

The goal in groundwater is important, because groundwater truly is not much diluted in some of the most important fish habitat. The conservatism assumed in the DEIS is not real. The young fish depend on side channels and backwaters where groundwater remains relatively undiluted. These are the areas where ammonia concentrations in surface water of up to 1,800 mg/l have been measured, with resultant 100% fish mortality. Young pikeminnows rely principally on these backwater areas for the first 2-4 years of life (DEIS page 3-36). If the goal of 3 mg/l ammonia is reached in groundwater, then significant areas of critical habitat will be kept at a level right at the threshold of lethality for the duration of the active groundwater treatment program. Trying to cut it close on river contamination like this is unwise because the sensitivity analysis shows that the tailings seepage concentration is the key factor in determining whether targets will be met (DEIS page 2-108), and DOE has assumed seepage concentrations near the bottom of the expected range.

The active flushing program may alleviate this situation, but at the cost of complete disregard of the maintenance minimization standard at 40 CFR 192. Would DOE so casually allow for radon releases high above the 40 CFR 192 standard? Again, the groundwater treatment infrastructure will be constructed in the floodplain of the river, subject to possible major flooding, so it is far wiser to remove as much of the future contamination as possible through offsite remediation. This will also offer another

benefit not analyzed in the DEIS at all: if the tailings are removed, DOE will be able to install extraction wells across the entire 130 acres above the most intense part of the legacy plume. These will be farther from the river than the system described in the DEIS, hence safer from flooding.

Page 3-27 of the DEIS describes the existence of a large plume of high TDS, ammonia laden water from the tailings pile that has sunk to a neutrally buoyant level in the deeper brine beneath the mill wastes. If the tailings were moved to an offsite location, would it not be possible to complete an extraction well within the plume and remove this potential source of future surface contamination from the groundwater? The FEIS should examine this possibility.

River Migration and Major Flooding

The DEIS is most deficient and diverges most radically from the opinions of other experts in its evaluation of the possibilities and consequences of tailings pile failure from flooding or migration of the Colorado River over the thousand year regulatory period. Since such a failure is the most important thing that could possibly occur at the Moab site, this is an unacceptable weakness in the DEIS. Additionally, the analyses on which DOE relies to reach its conclusions are not adequately described in the DEIS, but scattered in many other technical reports, placing an unreasonable burden on interested citizens who are trying to inform themselves.

River Migration
In the 11/2003 Letter Report "Migration Potential of the Colorado River Channel Adjacent to the Moab Project Site," DOE relies on a skewed analysis of scanty data to conclude that subsidence of the Moab Valley will gradually cause the river to migrate south, away from the tailings pile. This seems counter to the facts in several ways. First, the bedrock canyon upstream from Moab will continue to aim and concentrate the energy of the river directly toward the tailings pile as it enters the Moab Valley, and this location and orientation will not change. Second, the most recent data show that the valley fill is deepest north of the present location of the river, so a reasonable projection of greatest future subsidence would lead to the conclusion that the river will migrate north if subsidence is the controlling factor (USGS *Initial-Phase Investigation of Multi-Dimensional Streamflow Simulations in the Colorado River, Moab Valley, Grand County, Utah, 2004* Figure 5, page 19). Third, the sediment load carried by the Colorado River is hundreds of times greater than what is needed to compensate for valley subsidence, so the most likely scenario is that the river will continue to meander back and forth across the extreme north end of the valley, including the site of the tailings pile, as it has been doing for thousands of years. DOE seems to be willfully drawing the wrong conclusion when it interprets the fact that the tailings pile is underlain by coarse river cobbles to mean that the toe of the pile is now armored against floods. Floods put all those cobbles there during events of great violence at the tailings site.

DOE also concludes that the channel is stable in its present location. Properly registered aerial photographs, however, reveal that the main channel has moved about 300 feet

north in the reach just above the tailings pile since 1962. This large change probably resulted from construction of a small check dam on the south side of the river by Atlas workers who were attempting to deepen the flow along the north bank to increase the efficiency of their water pumps. The fact that a tiny bar can move the river hundreds of feet in decades shows how unpredictable the channel can be across this flat alluvial fan.

DOE's conclusion that the river is moving south also relies on the existence of river gravels on a terrace near the mouth of courthouse Wash and on driftwood recovered from a well boring north of the present Highway 191. That these are north of the present river course is adduced to mean that the river is moving south. However, even momentary study of aerial photographs of the Moab Valley makes clear that the supposed river terrace was never part of the normal course of the Colorado River. For that to be true, the river would have had to exit the mouth of the canyon, make an extreme right-hand turn, and run directly into the mouth of Courthouse Wash with its towering cliffs. It is far more likely that the river gravels were deposited there during a major flood event, probably during glacial times. Likewise, the buried wood probably was deposited and reburied during the deep scouring associated with flooding in the river. These bits of information tell us more about the dynamic nature of the river floodplain than about long term trends in channel location. The USGS *Initial-Phase Investigation of Multi-Dimensional Streamflow Simulations in the Colorado River, Moab Valley, Grand County, Utah, 2004* concludes that large floods will subject the entire north bank of the river to flows exceeding 12-feet/second, which will consequently be carrying large, highly erosive gravels that can deeply scour the river bed and cut away the river bank in dramatic fashion.

DOE also argues that floods in Courthouse Wash are likely to deposit sediments on the north side of the river, pushing the channel south. Courthouse Wash has no alluvial fan on the north side of the river, however. It is a high energy stream with a large drainage area, and floods in the drainage tend to occur when the Colorado flows are lowest. At these times, Courthouse Wash floods may exceed the flow in the river by a factor of three or more, causing the floods to jet across the river and deposit sediments on the south bank and in the Matheson Wetland. Aerial photographs support this interpretation. The net result would be to push the Colorado north, toward the tailings pile, just as the Atlas workers' dam did.

For all these reasons, the State of Utah and others have questioned the accuracy and reasonableness of DOE's predictions. It is troubling that there appears to be a consistent pattern of the agency downplaying the risks of leaving the tailings in the floodplain of the river. DOE acknowledges the disagreement, but counters by saying that monitoring at the site will allow future managers to take appropriate action to armor the pile, increase groundwater treatment, or ultimately move the tailings to a safer location if agency predictions turn out to be wrong. Without repeating at length our reminder that standards require DOE to plan for minimum maintenance, we point out that while such actions might be possible in the event of gradual river migration, changes in the channel are more likely to occur suddenly during a flood, making mitigating measures impossible. Even if it is possible to take action in time, investing hundreds of millions in moving the tailings

after investing hundreds of millions capping them in place is one of the worst possible outcomes from this remediation decision. That is why Loren Morton, of the Utah Division of Radiation Control, described river migration as a "deal breaker." These truly critical shortcomings of the onsite alternative are obscured in the mass of relatively trivial information in the DEIS. DOE should rewrite it in a format that allows readers to understand the big issues without getting lost in the detritus. And DOE should eliminate from consideration the onsite alternative with its credible risk of total failure.

Catastrophic Floods

The person at DOE who will make the decision on the preferred alternative should be required to view the existing photo(s) of the 1917 flood event, when the Colorado River flowed at 76,000 CFS. When looking at the image of the river bursting out of the upstream portal and spreading in rapids all across the Matheson Wetland, this person should be informed that in 1884 there was a flood of 125,000 CFS. Then, this decision-maker should view aerial photos of the valley to understand that the tailings pile was built near the center of the alluvial fan that such floods have built where they break out of the upstream bedrock portal. The tailings pile is built atop coarse cobbles that are periodically scoured away and re-deposited by these floods. In the Probable Maximum Flood calculated by DOE (300,000 CFS), the flood waters would be 25 feet deep at the tailings pile, scouring to a depth of 25-50 feet (deeper scour reduces the depth, but increases the velocity of the floods striking the tailings pile). Since these kinds of floods are essentially certain to occur during the regulatory period, one wonders why the onsite alternative has not been rejected out of hand?

DOE's response seems to have two parts: first, big floods will dissipate their energy in the Matheson Wetland and in whirling around the Moab Valley in a sort of lake, so the tailings impoundment will be able to withstand deep inundation without collapsing. This view is directly contradicted by the recent USGS river modeling cited above, which is the most credible study to date.

The USGS study shows that the tailings pile is well within the 100-year floodplain and that it obstructs the overbank flow during these large floods. Water velocities sufficient to carry large gravels with great erosive force will hit the tailings pile and the northern bank of the river throughout the entire Moab Valley reach of the river. During the 100-year flood, these high erosive forces will inundate the tailings pile to a depth of 4 feet, and a PMF event will bury the tailings in 25 feet of fast moving water, even if the channel stays in its present location. Should the even more extreme erosive forces acting on the riverbank cause the channel to shift, the result would be sudden and devastating. As the predicted surface water elevation charts in the report show (Figure 17 and following), these large floods will cover the entire Matheson Wetland and substantial parts of the community of Moab, entering the Wetland at 40,000 CFS during a flood of one half the PMF. Failure of the tailings pile under these conditions would devastate the community. None of this is discussed in the DEIS. The FEIS must be rewritten to incorporate the USGS modeling results and make them count in the selection of the preferred alternative.

The second part of DOE's response to the likelihood of flood induced impoundment failure is that it will not really matter if it happens. This is where the chronic underestimation of the importance of the river causes the DEIS to go most badly off track.

Beginning on page 4-53, the DEIS examines a tailings failure during a 150,000 CFS flood. As noted, the first error in this analysis is its failure to discuss the deposition of tailings material far up into the City of Moab. If the valley becomes a lake, as DOE asserts, then the tailings will be spread across the footprint of that lake, with devastating and extraordinarily expensive consequences for the community. This issue is completely ignored in the DEIS.

The DEIS goes on to describe the deposition of tailings material throughout the river channel and in the riparian area all the way down through Lake Powell. It is worth noting that the calculations of expected contaminant concentrations are probably incorrect in several important ways. First, the analysis assumes that the Green River will provide a diluting flow of 125,000 CFS, but the likelihood of a simultaneous historic flood from that completely separate drainage basin is vanishingly small. Second, the analysis does not say what diluting volume is used in the calculation for Lake Powell, but that reservoir is now holding just 8 million acre feet and may never be filled again now that the upper basin is beginning to appropriate its full share. Moreover, during the long regulatory timeframes, the reservoir will be filled with sediment and Glen Canyon Dam likely decommissioned. If the dilution calculation assumed anything like the reservoir's full 26 million acre foot volume, then it is in error.

Despite these conceptual and computational problems, the DEIS still paints a picture of disaster. The length of the river corridor all the way down past Lake Powell would be covered with radioactive wastes, with uranium and ammonia at levels 5-10 times the maximum protective criteria for aquatic species all the way to Lake Powell. As shown in Table 4-18, radium, which becomes the main contaminant of concern in pile failure scenarios, would be at levels of 515-2,060 pCi/g at the Green River, as compared to the 40 CFR 192 standards of 5-15 pCi/g. Yet, without really examining what contaminants might reach human receptors in this river reach or downstream, the DEIS simply says, "A major tailings release is not anticipated to significantly increase risks to human populations downstream of Lake Powell" (DEIS page 4-56). This is simply not good enough as an analysis of the health risks of dumping millions of tons of toxins into the water supply for 26 million people. It also balances savings in the cost of remediation against potentially far larger costs to local and regional economies.

Such a flood and tailings failure would be, for a time, the main news story in the nation. The city of Moab would be evacuated. Unimaginable amounts would be spent on clean up of the city and the river corridor. As the Metropolitan Water District wrote in its letter to Dr. Kai Lee, Chair of the National Research Council on Long Term Institutional Management of DOE Legacy Waste Sites, the 26 million downstream consumers of Colorado River water buy bottled water if they perceive the safety of their tap water is threatened. If just one in 40 downstream users switched to bottled water after such an

event it would cost the citizens of the Southwest $240 million dollars within a year. Another omission in the DEIS is the failure to consider the effect of a tailings failure on the recreational economy of southeast Utah. Visits to Moab, river trips and the use of Lake Powell would all be drastically curtailed, with impacts running to hundreds of millions of dollars. The DEIS does not analyze these outcomes, despite the fact that the economic consequences are about as large as the entire costs of the millsite reclamation. Though these economic issues have been repeatedly raised with both DOE and NRC before it, they have never been analyzed in a decision document.

Summary

The DEIS compares an onsite remediation with several offsite options, but the document attempts to minimize the stark differences between these options. Either the Klondike or Crescent Junction alternative would almost certainly result in long term isolation of the wastes from the human and natural environment without the need for significant maintenance.

Compared with the near ideal Klondike and Crescent Junction alternatives, the White Mesa alternative is an expensive, high tech boondoggle that will cause unacceptable impacts to the White Mesa Ute tribe and numerous sacred cultural sites, as well as along the length of the 85 mile pipeline or truck route. It offers no benefits except the questionable one of consolidating wastes at a site with numerous environmental drawbacks. DOE would be at a complete loss trying to explain how that alternative could be chosen as the preferred one, and we hope that we do not have to witness the attempt in the FEIS.

The DEIS examines the onsite alternative at great length despite the fact that is should be dropped from consideration. As a near unanimous chorus of elected officials and scientists has said, it is not acceptable to leave 12 million tons of mill wastes leaking into the Colorado River, directly in the path of a major flood. Every possible savings from capping in place is offset by a huge risk of tailings failure. Onsite reclamation simply shifts the well defined burden of cost from the federal government, where it belongs, to an unspecified but possibly much larger burden of health risks and costs for the population of the Southwest. On page 2-177 the DEIS says, “Human and ecological risks, long and short term environmental impacts have been fully developed and evaluated in this EIS.” That will only be true if the eventual decision is to relocate the tailings. It is long past time to make the decision to remove these mill wastes from the bank of the river and the water supply for 26 million people.

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