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MEMORANDUM FOR: Leo B. Higginbotham, Chief
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FROM: Malcolm R. Knapp, Chief
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SUBJECT: WMGT REVIEW OF RIVERTON DRAFT REMEDIAL ACTION PLAN
TECHNICAL ASSISTANCE REQUEST 84098

WMGT has completed its review of the Riverton Draft Remedial Action Plan in response to Technical Assistance Request 84098.

Our review was performed as a coordinated branch effort led by William Ford. The attached document consists of three sections. summary comments delineated by discipline, detailed comments also by discipline, and a list of needed references and data. The other contributors were William Dam, Ted Johnson, Mike Blackford, David Brooks, and John Starmer. If you have any questions or comments please contact Mr.Ford at x74697.

Original Signed By

Malcolm R. Knapp, Chief
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Enclosure:
As Stated

RECORD NOTE: Mr. J. Valdes was available to assure that comments on geology regarding the DRAP are consistent with those in DEA.

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GEOTECHNICAL BRANCH REVIEW
OF THE
RIVERTON DRAFT REMEDIAL ACTION PLAN

SUMMARY COMMENTS

GEOLOGY AND HYDROGEOLOGY

The Draft Remedial Action Plan, the Draft Environmental Assessment, and the Processing Site Characterization Report do not contain sufficient geologic and hydrologic data to adequately describe the site and reach a defensible conclusion on the extent of groundwater contamination and the appropriate remedial action.

Baseline groundwater values must be defined in order to determine the extent of contamination and the water quality classification of the unconfined aquifer.

The groundwater restoration section should discuss the use of such techniques as preventing the use of water from contaminated aquifers until they are safe to use. Techniques such as condemning the aquifer to prevent their use or requiring treatment prior to use should be considered.

SURFACE WATER HYDROLOGY

Based on the information presented in the RAP, it appears that a PMF on the Wind River, with spillage to the southeast toward the tailings pile, will likely constitute the basis for the design of the erosion protection which will be placed on the tailings pile and in the drainage ditches around the pile. It is, therefore, very important to provide a conservative and/or reasonable estimate of the PMF on this stream in order the estimate the upper limit of flood potential at the site. The analyses and the information presented in the RAP indicate that the Wind River PMF estimate of 403,000 cfs and the spillage estimate of 100,000 cfs from the Wind River toward the site may be too optimistic, i.e., these estimates may be too low.

Specifically, the RAP design analyses are deficient in the following areas: 1) PMP reductions for the drainage basins were not appropriately applied; 2) the infiltration rates used in the PMF analyses may not be justified due to the steepness and evidence of significant runoff in the basins; 3) the times of concentration for the Wind River may not have been properly estimated; 4) the water surface profile analyses were based on incomplete and possibly inaccurate topographic data; 5) the failure of upstream dams need to be evaluated in those cases where the dams will not safely store or pass a PMF. Further analyses and justifications need to be provided in these areas to support a conclusion that the site can be designed to meet U.S. Environmental Protection Agency standards.

GEOCHEMISTRY

The DRAP states that "Remedial measures should conform to EPA guidelines, which state that the site should be assessed to establish "any corrective or preventive programs found necessary to meet relevant State and Federal Water Quality Standards" and that the provisions of the standard should be met for at least 200 years and up to 1000 years when reasonably achievable (Federal Register, 1983)". Since it is stated in the DRAP that some State of Wyoming groundwater contamination limits are exceeded, restoration is not optional and an aquifer restoration plan should be presented in the RAP sufficient to meet the EPA guideline.

The approach to modeling adopted by DOE for planning of remedial actions, and for support of the chosen remedial action plan is reasonable. It should be emphasized however, that no remedial action can be based solely on computer modeling. In reviewing the modeling presented in the DRAP, the staff considered whether:

1) The computer codes are based on proven technology that is thoroughly verified and documented in an acceptable manner;
2) The computer models employed are validated by well documented history matching that adequately demonstrates the uncertainties involved in the process and how these uncertainties are accounted for in any predictive modeling which follows;
3) The predictive modeling upon which the remedial action is based, and which supports the action chosen, considers a reasonable suite of conceptual models which illustrate the alternatives which were considered during the design stage and which played any role in the ultimate choice of the preferred plan; and,
4) The computer modeling is described in enough detail that the NRC staff could check the modeling results if necessary, but at a minimum could reconstruct the modeling process as it was executed by the DOE (contractor).

A major failing of the DRAP and the supporting documents which have been made available to NRC by the DOE, is that the above statements (1-4) are not adequately documented. The DRAP and supporting documents do not present enough detail concerning what was done, so that an independent reviewer could follow the process from start to finish; and could, if necessary, reproduce essential aspects of the modeling performed. In addition, it is not obvious, based on the available information, that adequate alternative conceptual models have been developed and tested. Further, it was not clear that the action chosen adequately ensures that the EPA standard will be met and that public health and safety will be protected. Until such documentation is available, no statements, findings, or remedial action plans supported by modeling can be accepted.

A key factor in arriving at this remedial action plan is that the nature of the aquifers at the site will prevent contamination of the local (eg. St. Stephens School) and regional (eg. Riverton Municipal) water supply. To accomplish this, data is presented that supports the existence of an unconfined alluvial aquifer containing poor quality water that overlies a confined aquifer system of good quality. However, the supporting data discussed in the DRAP can also be interpreted to indicate that these aquifers could be interconnected. Thus, based on the available information, contamination of the alluvial aquifer could, over the long term, lead to contamination of the deeper aquifer and the domestic water supply. This issue concerning the interconnection of aquifers needs to be unambigiously determined in order to assess if the remedial action is correctly designed.

A key factor in developing this remedial action plan is the determination that no broad movement of most radionuclides, heavy metals, and toxic non-metals away from the tailings has occurred. However, the DRAP discusses data that show that uranium, sulfate and molybdenum have moved and are moving away from the pile. In addition, the DRAP has not considered the potential for organic contamination that is related to the solvent extraction process used at the Riverton Mill or the organic debris that is to be buried in the pile. Since organics are known to mobilize heavy metals, their presence may significantly effect the release and movement of comtaminants. Finally, while the text indicates that both acid leach and carbonate leach tailings were produced, the text only describes the acidic tailings. Because migration of heavy metals is generally enhanced by alkaline conditions, carbonate tailings may be a source of significant groundwater contamination. These problems need to be assessed in order to provide the basis for statements concerning movement of contaminants.

The buffering/neutralization/immobilization of contaminants at the base of the tailings pile by the sediments underlying the pile is presented as a major conclusion of the DRAP (DRAP, Pages 88, 89, and 95). However, the actual buffering or immobilization capacity is only inferred. The importance of buffering capacity to the proposed remedial action is not clearly stated. We infer from the text that DOE believes this zone will be an effective barrier to the movement of contaminants into the alluvial aquifer. If this is the case, the importance of this aspect of the geochemistry should be stated explicitly, not just implied. Finally, the buffering capacity of the sediments should be determined and evaluated over 200 to 1000 years and this information factored into the final remedial action decision.

The environmental effects of leaving the tailings in place without a slurry wall has not been assessed in either the DRAP, the DEA, or the PSCR. Using or not using a slurry wall leads to widely differing conceptual models and scenarios for contaminant movement. This assessment must be made before the ramifications of stabilization in place can be considered.

The determination of the direction of contaminant migration is key to the development of this remedial action plan. The discussion in the DRAP focuses on contaminant migration in the direction of and into the Little Wind River. However, the maps used to support this contention suggest that there is movement in the opposite direction toward the Wind River. This is important because without an adequate determination of the extent of contaminate movement away from the tailings pile, any remedial action plan could fall short of its intended purpose. The RAP should address this problem.

SEISMIC RISK

Earthquake design parameters presented in the RAP are not supported by the documents referenced. This is important because this discrepancy leads to confusion in identifying the appropriate parameters necessary for seismic stability design. The inconsistencies should be addressed.

DETAILED COMMENTS

GEOLOGY AND HYDROGEOLOGY

Section 3.2, ¶5, Page 12

Although the DRAP does not address the effects of possible fractures at the site, packer test data in the Draft Environmental Assessment indicate that fractures may occur at the site. This is important because fractures can provide rapid flow paths for contaminant movement from the site and if they are determined to be active faults they may pose a significant seismic hazard. The RAP should address this problem.

Section 3.2, ¶5, Page 12

The RAP should include a geologic map with appropriate strike and dip information and geologic cross-sections based on specific drill hole data and extending beyond the boundaries of the site. This information should be provided in order to determine (1) if the slurry wall can be keyed correctly, (2) if the slurry wall can function as a hydrologic barrier, (3) if faulting exists at the site and (4) to describe the geohydrologic characteristics of the site laterally and vertically.

Section 3.2, ¶5, Page 12

Geologic columns and descriptions indicate that the upper unit of the Wind River Formation exhibits a large variation in stratigraphy, both in vertical and lateral directions. The result is that the river terrace gravels sometimes lie on shales and sometimes on sands of the Wind River Formation. This is important, because if sands in the Little Wind River Formation subcrop under the tailings pile and then subcrop again outside the slurry wall they could provide pathways of water movement into and out of the tailings pile even if the slurry wall is keyed correctly into shales and siltstones below the unconfined aquifer. This problem should be addressed.

Section 3.3, ¶5, Page 13

The geomorphologic evaluation of the DRAP cannot be completed until the 1984, SHB report "Geologic Hazard Evaluation, Riverton Site, UMTRAP" has been reviewed, since this is a key reference in support of the DRAP conclusions.

Section 3.5, ¶3, Page 15

The DRAP states that there is no communication between the unconfined system and the confined system. However, if communication exists then contamination could move from the unconfined aquifer to the confined aquifer beneath. Data which do not support the hydrogeologic separation of the two aquifers are:

(1) The two 24 hour pump tests designed to check confinement between the confined and unconfined groundwater systems reported water rises rather than no changes or drawdowns at the end of testing (before the pump had been shut off). This means that during the tests the aquifers could have been recharging, which might have overwhelmed any drawdown effects from pumping due to interconnection. If this happened, communication could exist between the aquifers, but the pump tests would not have detected it.

(2) The groundwater quality samples from the confined aquifer at the site have higher than background concentrations, which appear to be evidence of contamination in the shallow confined aquifer system.

(3) It is stated that the difference in tritium concentrations between the unconfined and confined aquifers is evidence of noncommunication. The unconfined aquifer contains water with high tritium values and the deep confined aquifer system contains water with low tritium values. High tritium values are due to waters that entered the aquifer system after atomic bombs had been tested above ground, whereas the low tritium values are due to waters that entered the aquifer system before atomic bombs had been tested above ground. Therefore the logic is that the two aquifers contain different waters and must be separate aquifer systems. However, a different interpretation is also possible. In this interpretation the aquifers are in communication, but it takes longer than the time since the end of testing for the water from the unconfined system to reach the deep confined system.

These discrepancies should be addressed in order to support the contentions about the lack of communication between the aquifers.

Section 3.5, ¶5, Page 16

The DRAP shows contamination flowing into the Little Wind River, but neither the DRAP, the Draft Environmental Assessment, or the Processing Site Characterization Report describe the effect of that contamination on the Little Wind River. For example, water samples up stream and down stream of the site could have been analysed to determine the extent and magnitude of the contamination. Without such information it will be difficult to predict the present and future effects of the pile on Little Wind River water quality.

Section 3.5, ¶4, Page 17

The DRAP and the Draft Environmental Assessment both state that the unconfined system has poor quality water. However, baseline water quality values for the unconfined aquifer have not been adequately determined through field sampling and the literature support for this conclusion does not appear to be sound. The only references sited in support of this conclusion are FBDU, 1981, and McGreevy et. al.,1969. The FBDU, 1981, report states that "unconfined ground waters are not used for municipal or domestic water supplies in the Riverton area because of insufficient quantity or poor chemical quality"(page 2-6), but does not reference or present any data to support this conclusion. McGreevy et. al., 1969, on Plate One indicates that the water quality for the unconfined aquifer ranges from very good (SpCond. 60 micromohs/cm) to bad (SpCond. 1850 micromohs/cm) and concludes (page I-59) that "Ground water recovered from the area would probably be suitable for irrigation, or if marginal in quality, could be diluted with surface water and used." Therefore it cannot be concluded that the unconfined aquifer has poor quality water and is of little use. Baseline water quality values should be determined.

Section 5.5.3, ¶3, Page 28

The DRAP states that "large volumes of organic materials may be buried elsewhere in the site (away from the tailings) where differential settlement is of less concern". However, the RAP does not describe how contaminated organic material will be disposed of and the environmental effects of disposal. The RAP should provide these descriptions.

Section 5.5.6, ¶4, Page 31

The text states that the only groundwater protection measure that will be considered is a slurry wall around the tailings pile. However, the text does not indicate, in either Section 5.5.6 or Appendix B, Section B.3.0 how the public will be protected from existing and future groundwater contamination. The groundwater restoration section should discuss the need for and use of such techniques as preventing the use of water from contaminated aquifers until they are safe to use. For example, St. Stephens School, which is located south of the site near the Little Wind River is reported in Plate One and in Table Three(page I-83) of McGreevy et. al., 1969, as obtaining some of it's water from a well completed in the unconfined aquifer and the Wind River Formation. Institutional controls such as condemning the aquifer to prevent the use of contaminated water or requiring that the water be treated prior to use should be considered.

Section 5.6.9, ¶1, Page 39

Figure 3.4 shows that Borrow Site 2 will be located directly adjacent to the tailings pile. The Draft Environmental Assessment states that this borrow pit will not be restored, but will be left open for the use of the owner. This suggests that the gravel around the pile may be mined in the future. The RAP should determine how the pile will be protected from inadvertent erosion or collapse of the high wall from future mining in Borrow Site 2 ; how close future mining can come to the restored tailings pile without compromising its long term stability; and if mining in Borrow Site 2 will force the irrigation ditch to be moved.

Section 5.6.9, ¶1, Page 39

The DRAP says that cover material may be obtained adjacent to the pile. However, if this gravel has become contaminated through geochemical reactions with the groundwater, contaminated material may be placed on the pile. The DRAP should address this potential problem.

Section B.3.3.1, ¶4, Page B-75

Based upon our modeling of site pump test data using information in the Draft Environmental Assessment significant inconsistencies have been found to indicate that some of the pump test analysis may be incorrect. If this is so then the modeling data in the DRAP, which will be used to make future decisions about the Remedial Action Plan may also be incorrect. Therefore the DRAP or the Draft Environmental Assessment should include tables and plots of all pump test data and analysis.

Section B.3.3.1, ¶4, Page B-75

None of the models or flow nets take into account the effect that the irrigation ditches and farmlands in and around the site have on the groundwater flow in the unconfined aquifer. Because the irrigation ditches are unlined (McGreevy et. al., 1969) and built on top of the unconfined aquifer, when they are flowing they are probably the major contributor of groundwater to the aquifer. Since the area receives very little precipitation during the year this could be the major source of recharge for the unconfined aquifer around the tailings site. Indeed, this may explain the water table rise in the tailings in the summer months. Further, since the irrigation ditches bound the site on the north, the east and the west, they may act as groundwater flow barriers forcing the contaminant plume to flow towards the Little Wind River. Because the irrigation ditches may be a major factor in predicting the future performance of any restoration alternatives the text should address the effect that irrigation ditches have on groundwater flow at the tailings site.

Section B.3.4.2, ¶4, Page B-97

The DRAP states that "the maximum amount of time required for complete flushing of the existing contamination" from the tailings pile to the Little Wind River "would be approximately 1223 days or 3.4 years." Since the processing of tailings stopped 21 years ago it seems that with the flushing rate described above that there should have been ample time to dewater the tailings and transport all the contamination to the Little Wind River. However, in reality there is a contaminate plume between the tailings pile and the Little Wind River. This suggests that the estimate of the flushing rate is too high or that the plume is not a relic plume and represents present day contaminate movement from the pile. The source of present and future ground water contamination should be adequately supported, described and projected.

Section B.3.5, ¶22, Page B-106

The ground water restoration cost/benefit analysis estimates a groundwater market value of $100/acre-ft. The DRAP argues that since it costs more than a $100/acre-ft. to clean up the groundwater contamination, the groundwater should not be restored. Therefore, how the RAP should describe how the $100/acre-ft. cost was obtained (i.e., can a replacement source for this groundwater be readily obtained at a $100/acre-ft).

Section B.3.5, ¶22, Page B-106

If the public will be allowed to use the contaminated groundwater without treatment, the cost/benefit analysis should consider possible health and agriculture cost/benefits or the restoration plan should describe how the public will be protected for the next 200 to 1000 years if the groundwater is not restored.

SURFACE WATER HYDROLOGY

Section B.4.3.2, Page B-118

In computing the peak discharge for the Wind River, the PMP should be areally reduced for only the drainage area of the Wind River (2300 square miles). Flow in the Little Wind River, coincident with the peak flow in the Wind River, can be calculated using the areally-reduced PMP for the combined drainage area

(4300 square miles) of the two streams. This is important because it appears, from an examination of the depth-area-duration charts in Hydrometeorological Report No. 55, that an increase in the precipitation and resulting flood peak may result. The peak flood for a given drainage area should be based on the appropriate PMP rainfall amounts for that drainage area. (Note that the peak water level or peak velocity at the site could be produced by some other combination of flood events; these combinations may also need to be analyzed to determine the worst-case conditions).

Section B.4.3.2, Page B-119

In order to determine the overall acceptability of the modeling of the peak PMF flow, additional information will be needed. Accordingly, provide a copy of the HEC-1 computer final printout which details the modeling performed for the determination of peak flows on the Wind River and Little Wind River.

Section B.4.3.2, Page B-120

The infiltration rate of 0.5 inches/hour used in the HEC-1 PMF analyses may be too great, based on our observations made in the site vicinity and upstream drainage areas of the Wind River. The presence of steep terrain in upper portions of the basins, in conjunction with gullied hillsides and flood plains in lower portions of the basin, indicates that significant runoff can occurr and has, occurred. This indicates that soils in the area may not be representative of those soils cited in the Corps of Engineers (COE) report on soil infiltration, which was the basis of the infiltration rate used.

Accordingly, the COE report and maps which provide the basis for selection of the infiltration parameters used should be provided. In addition, further justification of the infiltration losses, particularly in those areas where the terrain is rocky and steep and in those areas where severe runoff has occurred in the past is necessary. The discussion should be directed at justifying the selection of an infiltration loss (at saturation) of 0.5 inches/hr and appropriateness of the COE report.

Section B.4.3.2, Page B-121

Given the configuration and slope of the Wind River Basin, estimates of lag time, time of concentration, and time-to-peak appear to be too long. It is stated that the values of time-to-peak presented in Table B.4.4 were determined using velocities calculated from Manning's equation and using cross-section and slopes from USGS quadrangle sheets. Based on our evaluations it appears that the time to peak of the hydrograph should be shorter than 51 hours, for a Wind River basin length of 114 miles (p.B-109). The computations in the RAP indicate that the average channel velocity would be approximately 2-3 feet per second. However, average channel velocities of steep mountain streams are normally considerably greater than 2 - 3 feet per second, and are probably in the range of 10 - 15 feet per second for a major flood. This would result in shorter times of concentration, which could produce PMF flood peaks that are considerably greater than those estimated. Accordingly, provide the justification for use of such times of concentration, lag times, times to peak of the hydrographs, and the results of your computations, including the channel cross-sections, stream slopes, channel flows, and 'n' values used in the analyses.

Section B.4.5, Page B-123

Since all HEC-2 modeling of water surface profiles have not been completed at this time, the surface water modeling strategy may not be adequate to fully characterize the flood potential which exists for this site. Review of the hydraulic analyses in Appendix B indicate that additional studies should be performed to determine the design water level and velocity for design of erosion protection at the site. The use of cross-sections derived from topographic maps, visual observations, and aerial photographs is questionable for use in determining flood profiles and velocities, especially when the flood flow constitutes the design basis for protection of the site. While the data may be adequate (depending on the reliability of the data used and judgement used in cross-section construction and layout), several of the cross sections should be verified by either a field survey or additional aerial photography. This is particularly important because topographic features outside the site area could have significant effects on flood profiles and flood velocities at the site.

Because preliminary calculations indicate that the flow may split upstream of the site in the Wind River, it is particularly important to carefully characterize the topographic features which will control the amount of flow which splits and flows directly toward the site from the Wind River. Accordingly, it will be necessary to provide detailed cross-sections and/or other topographic data which defines the area controlling flow toward the site. This information should be gathered and documented as early as possible, because of the potential effects on further flood analyses. All future HEC-2 analyses should be based on the additional information that has been gathered or on data that have been verified, as discussed above.

Section B.4.1, Page B-110

During a recent site visit to several upstream dams and reservoirs in the Wind River basin, it was noted that there are several dams and reservoirs which may not have adequate capacity to safely store or discharge a PMF. These observations are based on comparison of approximate spillway capacities with enveloped historic flood data for the region. Since the PMF is likely to be even larger than those enveloped flood peaks, it is possible that a PMF could result in failure(s) of these dams. Even though the owner or builder of the dam indicates that it will withstand a PMF, it will be necessary to re-evaluate and verify the spillway and impoundment capacity, in light of recent changes (NOAA, 1984) to values of precipitation or estimates of PMF flood peaks.

Accordingly, DOE should determine the capability of all reservoirs in the Wind River basin to safely store or pass a PMF. If it is determined that an impoundment has not been designed for a PMF and could possibly fail under PMF conditions, it will be necessary to determine the effects of the dam failure at the site. The methods used to determine the effects of the dam failure should be well documented and/or decidedly conservative with respect to time of failure, coincident flood peaks, routing method, etc. The unsteady flow and routing analyses used for each dam that will fail under PMF conditions should be discussed. These analyses should be performed for all dams, unless it can be documented that the height of dam, size of the impoundment, or its distance from the site would not produce conditions at the site which (when added to the PMF at an appropriate time during the flood) are more severe than the PMF.

Section B.4.5, Page B-123

Based on the information provided in the RAP, it is not possible to assess the methods, computations, and assumptions used to determine riprap sizes in the ditches surrounding the site and on the side slopes of the pile. Accordingly, provide a copy of the calculations used to estimate riprap sizes required for the ditches around the site. Discuss the design considerations used to select the input parameters to the various models which were used to estimate peak flow and velocities in the ditches.

GEOCHEMISTRY

Section 3.4, ¶8 and 9, Page 15

This section discusses background radiation and the dispersal of contamination from the tailings piles to adjacent soils. The DRAP indicates that contaminants are dispersed by wind and water erosion. Dispersal due to groundwater movement was not considered. Figure B.3.14 of the DRAP shows that this could be important. The figure clearly indicates that uranium is moving away from the pile in at least the S.E. direction, and is preferentially accumulating in an area along the Little Wind River. Thus, the contaminated soils associated with groundwater movement, as well as movement due to wind and water erosion should be considered when evaluating the areal extent of contaminated soils away from the tailings piles. For example solid materials that may have been contaminated by groundwater transport may be a significant concern at the site, since the unconfined aquifer (which has been contaminated) has been mined as a source of gravel in the past and may be mined as a source of gravel in the future; if for no other reason than its proximity to the town of Riverton. The RAP should consider this problem and indicate if the public needs to be protected from the mining of contaminated gravel and how.

Section 3.5, ¶2, Page 15

An important factor in the development of this DRAP is the contention that the movement of contamination due to groundwater flow is "predominantly" towards the Little Wind River (South-Southeast). The use of the word "predominantly" suggests flow in directions other than towards the Little Wind River. In fact, Figure B.3.14 (p. B-93/DRAP) suggests some elevated uranium concentrations in the opposite direction, towards the Wind River (North-Northeast). This movement is also supported by the sulfate map (DRAP, Figures B.3.15, Page B-94) and data from wells 14 and 15 (DEA, Table D.2.9, Page D-71). The extent of contamination in those directions that are not "predominant" has not been discussed in the DRAP or supporting documents available to the NRC staff for review. Further, there is no information to support the statement that "the groundwater discharges to the Little Wind River . . ." This statement needs to be supported because of its bearing on the ultimate fate of contaminants.

Section 3.5 ¶3, Pages 15 and 17; and Section 5.5.6, ¶1, Page 30; Section B.3.1, ¶9, Page B-65; Section B.3.3.1, ¶3, Page B-75; Section B.3.4.1, ¶9, Page B-95; Section B.3.4.1, ¶10, Bullet 1, Page B-95; Section B.3.4.1, ¶10, Bullet 3, point 2, Page B-95; and Section B.3.5, ¶1, Page B-103

Tritium concentrations are being used as support for differentiating between an unconfined alluvial aquifer and a deeper, confined system. The tritium data supporting this contention indicates high values in the alluvial aquifer and relatively low values deep in the confined system. The lower tritium values were obtained from a sandstone aquifer, approximately 320 feet deep. The argument is made that the high concentrations in the alluvial water are representative of post atomic testing (1952) and therefore the low tritium concentration in the deeper waters indicate no connection between aquifers sampled. However another interpretation of this information is that it takes more than 30 years for the groundwater to flow from the unconfined system to the deep confined system. DOE must consider groundwater movement on a scale of 200 to 1000 years in order to be relevant to the long-term compliance standards.

Also, data presented by DOE (in the Riverton DEA Section D.2.3.4, Page D-78, Table D.2.13) indicates that maximum pH values range between 7.50 and 9.55 in down-gradiant domestic wells within the deep groundwater system. These wells are 200 to 250 feet deep and contain alkaline to moderately alkaline waters. The high pH's (particularly those above 9) suggest that the confined aquifer may be mixing with the contaminant plume from the carbonate leach tailings. In addition to suggesting mixing, this could be significant because the mobility of uranium and other heavy metals is greatly enhanced under alkaline conditions.

Finally according to DOE data (DEA, Section D.2.3.4, Table D.2.11, Page D-74), dissolved constituents in the confined aquifer are elevated above background concentrations. These data indicate concentrations much higher than background for the constituents Mo (1.1 mg/l), Ni (0.1 mg/l), Ca (260 mg/l), SO_4 (747 mg/l) and TDS (1450 mg/l, a factor of three higher than the Wyoming domestic groundwater) for well RVT-106-83 in the first "confined" sandstone aquifer. This suggests the possibility of connection with water in the alluvial system.

Section 3.5, ¶5, Page 17

Constituents of the mill tailings have not been adequately characterized. For example, two types of leaching processes were used at Riverton, resulting in acidic and carbonate mill tailings. However, neither the DRAP or the associated DEA have considered the carbonate tailings as a source of contamination. Information concerning the amounts and location of the different tailings are needed because the potential for migration may be increased under alkaline conditions. Thus, carbonate tailings should be addressed in detail; otherwise, the pore water chemical data and geochemical modeling will not necessarily represent the presence of both the carbonate and acidic tailings. Secondly, solvent extraction, which uses various organic solvent , was used at Riverton. Analyses are needed for at least total organic carbon (TOC) and total organic halogen (TOX) to indicate if organics are significant contaminants. Finally, DOE (DEA, Section 3.6.2) describes radium concentrations in solids and sediments at Riverton. Although geochemical data for other potential heavy metal contaminants in solids and sediments are available (eg. GECR, 1983), DOE does not present the data or address this information. Heavy metals in the sediments may be a source of groundwater contamination. Thus the significance of solid phase heavy metal contamination needs to be considered in the remedial action plan.

Section 4.4, ¶1, Page 19; Section 3.5, ¶4, Page 17; Section 5.5.6, ¶1, Page 30; and Section B.3.3.5, ¶1, Page B-103

This paragraph suggests that the water in the alluvial aquifer is unimportant because it is not being used for domestic purposes. However, while it is not generally being used for domestic purposes, it is being used for irrigation and stock watering and therefore has some value. This usage also poses the potential for surface contamination and needs to be addressed.

Further, the paragraph states that ". . . contaminants have not endangered the residential wells. . . " However, since these wells must penetrate the alluvial aquifer the potential for leakage from the unconfined aquifer into the (domestic) water supply (from poorly completed wells) needs to be presented and discussed.

Finally, this paragraph states that aquifer restoration will be evaluated. However, some State of Wyoming groundwater contamination limits are exceeded (DRAP, Page 17, ¶ 2). Therefore, restoration is not optional (DRAP, Page 8, and Page B-63) and an aquifer restoration plan should be presented as part of the proposed DRAP.

Section 4.5.2, ¶5, Page 21; Section 5.2, ¶1 and 2, Page 23; Section 5.5.6, ¶3 and 5, Page 31; Section B.3.1, ¶13, Page B-66; and Section 3.3.2, ¶4, Pages B-85 and 86 and Figure B.3.10

A key concept in this remedial action plan is the use of a slurry wall rather than a liner under the tailings as a means for ground-water protection. However, the modeling being done to support the use of a slurry wall has not been completed, and it appears that the liner concept is not being investigated at all, even though the slurry wall is suggested as an alternative to the liner. Although the final design may vary to a limited extent, the effects of using or not using a liner or a slurry wall is likely to have dramatic affects on contaminant production and movement. Stabilization in place cannot be evaluated from the standpoint of contaminant migration until these key studies have been completed, integrated into the DRAP and a conclusion reached on whether a slurry wall is to be part of the remedial action design or not.

Section 5.5.6, ¶3 and 5, Page 31; Section B.1.2.3, ¶1, Page B-5; and Section B.3.5, ¶1, Page B-103

It is mentioned that the movement of contaminants through the slurry walls will be attenuated by the clay materials in the wall. This raises the question of whether the slurry wall is to be a sorption barrier, a diffusion barrier, or both. If sorption is key to controlling contaminant excursions, the mobility of contaminants is dependent on the valence state of the mobile species, and the (anionic or cationic) exchange capacity of the clays. This contention needs to be supported by appropriate sorption data and/or information indicating that diffusion through the clay barrier (even without sorption) will be a slow process, if DOE wants to take credit for the attenuation characteristics of the clay materials.

Section 9.10, ¶ all, Pages 61-63

The quality assurance plan does not meet the requirements of 10CFR50 Appendix B or NAQ-1. An attempt should be made to make the proposed QA program compatible with NRC regulations and industry standards as appropriate.

Section B.3.1, 14, Page B-63

That "Most of the infiltration precipitation is lost through evapotranspiration processes" is not supported by any data or analyses presented in the DRAP or referenced supporting documents. Infiltration and recharge rates and their variation through time are critical parameters for determining groundwater flow, as well as fluid flow and the movement of contamination within the tailings (cf. DEA, p. B79, ¶5). Present and predicted infiltration and recharge rates through the tailings piles are critical to the definition of leachate production rates. DOE should present more detail of their analysis of infiltration/evapotranspiration/recharge to support their contention that recharge, and therefore leachate production is and will be minimal over a period of 200 to 1000 years (cf. DRAP, Figure B.3.17 and supporting discussions)

Section B.1.3.1(b), ¶4, Page B-8; and Section B.3.4.1, ¶10, Bullet 1, Point 2, Page B-95

This section discusses the dispersal of contamination from the tailings pile to adjacent solids. Figure B.3.14 shows that at least uranium is moving away from the pile in both of the N.W. and S.E. directions and is accumulating in an area along the Little Wind River. Contaminated solids associated with groundwater transport have not been included in this analysis of contamination movement. Thus, the accumulation of contamination down-gradient from the pile due to groundwater movement needs to be addressed. Contamination in the N.W. direction has yet to be evaluated. The evaluation of contamination migration needs to be evaluated more completely in order to evaluate the effectiveness of the proposed remedial action.

Section B.1.3.1, Page B-11 and B-12, Figure B.1.4 and Table B.1.3

Figure B.1.4 depicts the boring locations for the borehole data contained in Table B.1.3. In order to review the figure, the boring locations need to be keyed to the hole identification numbers listed in Table B.1.3.

Section B.1.3.1, Page B-12, Table B.1.3

Table B.1.3 presents insufficient information concerning missing values. According to the footnote at the bottom of the figure these data are missing because (1) "lack of measurements" or (2) "totally inexplicable data behavior." The reasons for the lack of measurements needs to be explained, and the exclusion of "inexplicable" data needs to be explained and justified.

Section B.3.4.1, ¶2, Figure B.3.11, Pages 88 and 89

This section implies that the buffering or neutralization capacity of the sediments underlying the tailings pile is key to the prevention of movement of contaminants into the alluvial aquifer. However, the information presented suggests only that a zone of neutralization exists, which implies nothing about the buffering capacity of the system. In order to evaluate the potential for contamination movement over the long-term, (200 to 1000 years) the buffering capacity of the system needs to be considered.

Section B.3.4.1, Pages B-92, B-93 and B-94; Figure B.3.13, B.3.13, B.3.15

The sulfate, uranium and molybdinum plumes in Figures B.3.13, B.3.14, and B.3.15 show contaminant movement in the groundwater from the tailings pile to the Little Wind River. In fact, the uranium plume shows that uranium is being reconcentrated along the edge of the river. In addition, no evidence has been presented that indicates where the groundwater contamination is moving once it reaches the river. Further, the uranium and sulfate plume both indicate that they may also be moving north-northwest towards the Wind River. Contaminant movement in this direction has not been discussed. Finally, the data constraints on the molybdenum plume have not been plotted on the map. Plotting the molydenum concentration data from DEA Table D.2.9 (DEA, Page D-71) onto the DRAP molybdenum plums map (DRAP, Figure D.2.15) indicates that this contaminant plum extends towards both the Little Wind River and the Wind River. Otherwise, the contours could not be reproduced. The major concern here is the direction and extent of contaminant movement. The data presented in the DRAP and the DEA does not preclude movement to the North-Northwest. Contaminant movement towards the Wind River as well as towards the Little Wind River needs to be considered.

Section B.3.4.1, ¶10, Pages B-95 and B-96

Bullet 4 suggests that the migration of radionuclides, metals and most toxic non-metals has been limited by the neutralization of tailings water by carbonate minerals in the "foundation" geologic deposits and alkaline ground water. Bullets 5 and 6 extend this observation to suggest that no broad movement of contaminants away from the tailings pile has or will take place, and that transported contamination will diminish over time. However, neither the DRAP, the DEA nor the PSCP explain what chemical species were examined to reach this conclusion. The DRAP or one of it reference documents should list the radionuclides, heavy metals, and toxic non-metals that were examined and found not to be a problem are well as those that were found to be a problem. Before statements can be made concerning future expectations, consideration will have to be given to the expected continuation of leachate buffering at the site because if the acid tailings water is not neutralized, then associated contaminants could move into the aquifer system.

Section B.3.4.2, ¶all, Pages B-97, B-102 and B-103

The DRAP and supporting documents present insufficient information on the modeling strategy for WMGT staff to assess the adequacy of the modeling effort. It appears that the modeling effort is incomplete in terms of predictive modeling. In particular, inadequate information is presented documenting the models used in the analysis. This is true of the TRUST and TRUMP codes (for which published documentation exists), as well as the DYNAMIX code (for which no documentation apparently exists). In addition, the details of the history matching or model calibration exercises are presented in a fragmented manner in the DEA and DRAP, or are not available to NRC staff for review (cf. LBL, 1984).

For example, the use of the sulfate plume as a case of history matching appears flawed since its "match" is not demonstrated to be as good or better than any other possible match. Further, the parameters used to achieve the purported "match" are not presented in the DEA, DRAP or any of the supporting documents available to NRC staff at the time of the review. Therefore it is not possible to judge the adequacy of the history match that was discussed.

Also, the predictive modeling and alternative conceptual model development are not presented or are presented in such a skeletal manner that the adequacy of these aspects of the modeling exercise cannot be assessed. For example, the model presented considers only acid mill tailings at one site, the "Site B" of the LBL studies. The scenarios developed for the alkaline leach tailings and the information gathered on those tailing should be included in the DRAP and in supporting documents and made available.

The reliance on the sulfate plume observations and modeling results for decision making is a case in point. The history match has not been shown to be the optimal match nor are the alternatives considered, presented. Still, the sulfate plume is taken as representative of other contaminants, and it is used as the basis for findings related to the proposed remedial actions. However, comparison of Figure B.3.18 and B.3.14 shows that sulfate does not behave the same as molybdenum. Furthermore, the behavior of other contaminants is not discussed adequately to demonstrate that they behave in a manner similar to sulfate. Discussion of the behavior of major contaminants such as sulfate as compared to the behavior of trace contaminants such as molybdenum, selenium and most importantly uranium should be included in the DRAP and supporting documents such as the DEA. Finally, modeling can only be used as support for the remedial action plan chosen, not as the basis of the plan (refer to Page B-97/DRAP).

SEISMIC RISK

Section 3.3, ¶ 1 of 2, Page 13

There is nothing in the reference cited in the first paragraph, (Applied Technology Council, 1978), that directly pertains to the statement on regional seismicity. The second paragraph, concerning earthquake design parameters, contains the same discrepancy noted in the NRC comments on the October, 1984 Draft Environmental Assessment. The information presented in the RAP on the Maximum Credible Earthquake (MCE) and the site ground motion does not correspond with information presented in Table 1 of the referenced report (SHB, 1983). These inconsistencies should be corrected in the RAP in order to adequately determine seismic hazard at the site.

REFERENCES CITED

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