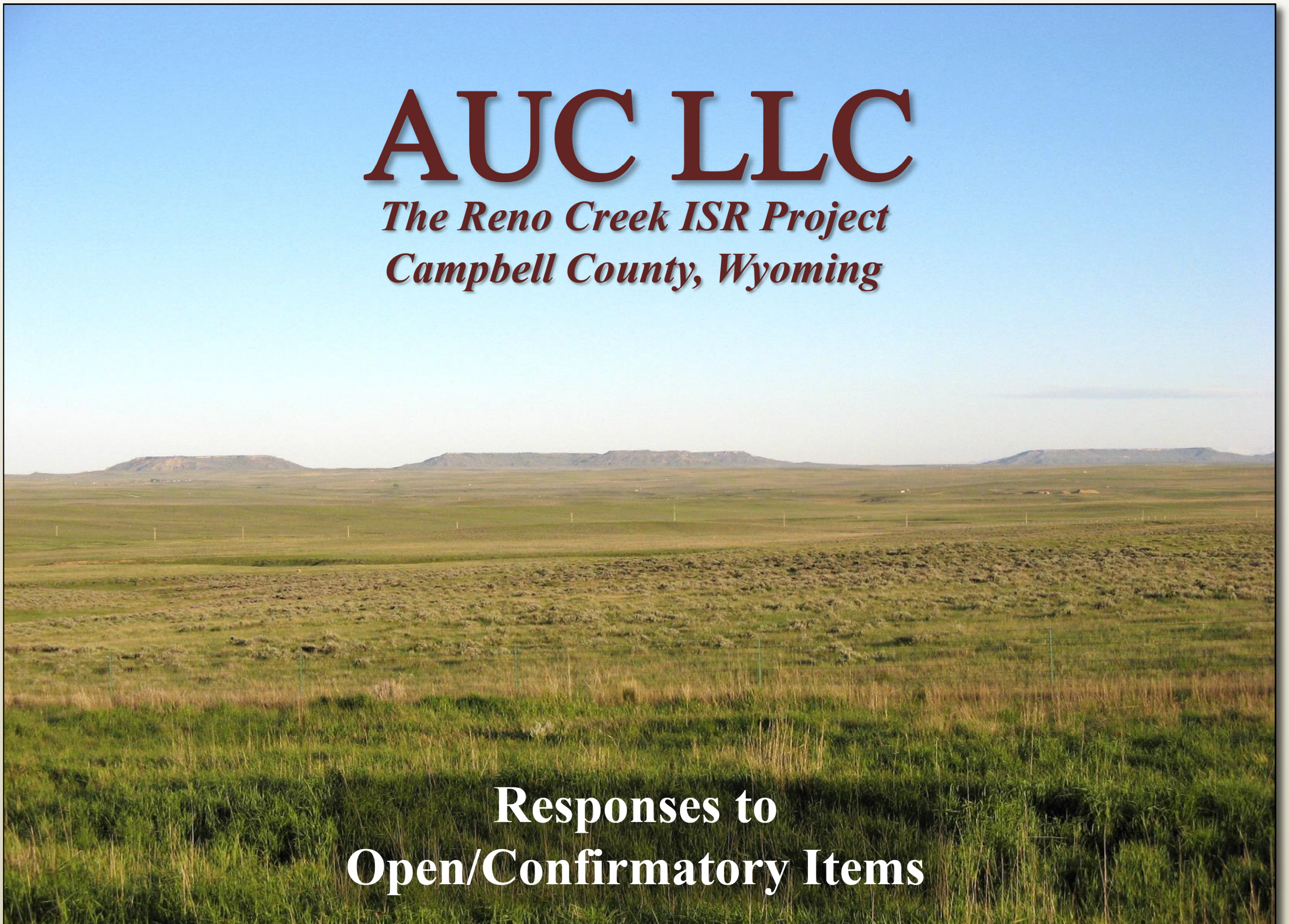
USNRC APPLICATION

Combined Source and 11e.(2) Byproduct Material License



April 2015

AUC LLC
1536 Cole Blvd., Suite 230
Lakewood, Colorado 80401

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HYDROGEOLOGY OPEN ITEMS

1(a): Draft SER Section 2.3.3.4; TR Section 2.6.3; RAI Response N/A
Plugging Abandoned Drill Holes

AUC states that approximately 2665 drill holes and plugged wells had been installed by others and 100 cased wells have been plugged. AUC has drilled an additional 807 drill holes of which 45 drill holes were completed as cased wells and the remainder were plugged and abandoned. AUC further states that 12 drill holes have been found in the southwestern portion of project area at which AUC opened the drill holes to its total depth, performed geophysical logging and abandoned the drill hole.

In the future, AUC proposes to (1) open drill holes to its total depth, performed geophysical logging on abandoned drill holes that may yield information beneficial to AUC; (2) plug old drill holes in proximity of future production units if the hydrogeologic testing indicates leakage through the old drill holes "might" be a problem; (3) not plug drill holes because the 1982 Hydrogeologic Integrity Evaluation Report documents a "strong" indication that re-plugging of old drill holes "may not" be necessary; and (4) plug any old "open" hole that may be encountered while working anywhere in the Project Area.

The above commitments are insufficient for staff's reasonable assurance finding that the applicant can confine the possession and use of source and byproduct material to the locations and purposes authorized (10 CFR 40.41(c)). Consistent with previous ISR licenses, staff will be issuing a license condition which requires abandonment and plugging of all wells within a wellfield prior to hydrogeologic testing for the wellfield hydrogeologic data package.

1(a) Response

AUC agrees to the staff-proposed license condition, subject to finalizing the actual wording of the condition. AUC has reviewed such a condition in the Strata License (Condition 10.12) and finds it acceptable.

2(b): Draft SER Section 2.4.3.4; TR Section 2.7.2.3; RAI Response N/A
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The above commitments are insufficient for staff's reasonable assurance finding that the applicant can confine the possession and use of source and byproduct material to the locations and purposes authorized (10 CFR 40.41(c)). Consistent with previous ISR licenses, staff will be issuing a license condition which requires abandonment and plugging of all wells within a wellfield prior to hydrogeologic testing for the wellfield hydrogeologic data package.

1(b) Response

AUC has revised TR Section 5.7.8.1.4, Production Unit Hydrologic Data Package to include the addition of a potentiometric surface contour map for the Overlying Aquifer. The potentiometric surface contour map will be developed using data gained from the installation of the Production Unit (PU) overlying monitor wells, previously installed regional OM wells and OM wells from prior PU hydrologic data packages. An additional bullet will be added to the description of the contents of the Production Unit Hydrologic Data Package as follows:

"A potentiometric surface contour map for the Overlying Aquifer will be developed."

3(c): Draft SER Section 2.4.3.4; TR Section 2.7.2.3; RAI Response 19(d)
SM Unit Uppermost Aquifer

AUC states that the SM unit is perched, non-contiguous and low yielding and thus is not an aquifer. If the SM unit is not an aquifer it cannot be the uppermost aquifer.

Staff does not find the arguments in the application and responses to staff's RAIs that the SM unit is not an aquifer. Two nearby livestock water supply wells are screened at depths consistent with the depth for the SM unit (Summary of Wells Sampled for Pre-Operational Environmental Program (revised December 2014) on page 2-65). AUC needs to commit to modifying the TR to remove references that the SM unit is not an aquifer.

1(c) Response

AUC has revised the TR and removed all references stating that the SM unit is not an aquifer. Even though the data do not support the notion that the SM hydro-stratigraphic zone is a regional aquifer, the SM unit may reasonably be characterized as locally exhibiting some aquifer characteristics with a limited areal extent. Therefore, AUC will also commit to monitoring the upper most aquifer in the event of a spill or leak be it the SM unit or the OM aquifer.

4(d): Draft SER Section 2.5.3.2; TR Section 5.2.6; RAI Response 19(d)
Preoperational sampling of Nearby Well within 2km

In response to RAI 19, AUC clarified several tables and reported two new wells and one longstanding well that was excluded from the pre-operational monitoring program. Based on guidance in Regulatory Guide 4.14 and NUREG-1569, AUC committed to sampling these wells prior to operations in RAI Response 19(d).

Criterion 7 of 10 CFR Part 40 Appendix A requires conducting the pre-operational monitoring program prior to any major site construction. Staff will include a pre-operational license condition that requires AUC to sample all wells within 2 kilometers of the project area and providing NRC with a report that lists all known wells (functional and non-functional) and their intended use, if known, within 2 kilometers of the project area.

1(d) Response

AUC agrees to the staff suggested license condition.

5(e): Draft SER Section 2.5.3.2; TR Section 5.2.6; RAI Response N/A
Annual Survey to Document Wells within 2km

Based on guidance in Section 5.2 of NUREG-1569, AUC committed to providing a land use survey in its annual report to NRC. As part of the land-use survey, NRC staff will incorporate a license condition that AUC perform an annual survey of water supply wells within 2 kilometers of the project boundary.

1(e) Response

AUC agrees to the staff suggested license condition.

6(f): Draft SER Section 2.5.3.2; TR Section 2.7.2.10.2; RAI Response 16
Resample Well PZM2 for First Two Sampling Events

In Table 2.7B-31 of TR Addendum 2.7-B, AUC presents the laboratory data for 10 PZM wells sampled quarterly for the pre-operational characterization and, in Table 2.7B-31a of the RAI 16 response, AUC presents the laboratory data for 8 non-baseline PZM wells which were sample one time only (one well was sampled twice and one well was sampled for only uranium and the field parameters). AUC did not discuss the water quality sampling results except for summary tables of exceedances to State or Federal standards or summary figures consisting of Piper or Stiff Diagrams.

Based upon staff's review, results for several parameters for the first two sampling events for well PZM2 are distinct from the results for the latter two sampling events. Compared to the last two sampling events, the first two events yielded higher pH levels and lower uranium and other radionuclides. The field data sheets for the first sampling event notes that the high pH was attributed to the recent well development. Staff also notes that the first two sampling events were conducted using non-dedicated equipment whereas the latter two sampling events were conducted using dedicated sampling equipment. Use of non-dedicated equipment required installation immediately prior to sampling/purging and use of low-flow sampling was insufficient.

Therefore, staff finds that the first two sampling events are not representative of the aquifer and require a license condition for AUC to resample this well for two sampling events to complete the pre-operational characterization data because the Standard Review Plan requires four quarterly sampling events to document seasonality.

1(f) Response

AUC agrees to two quarters of pre-operational resampling of monitor well PZM2. AUC will sample PZM2 in the summer and fall quarters, since they are the sampling periods referenced with higher pH levels.

7(g): Draft SER Section 2.5.3.2; TR Section 2.9.8.1; RAI Response 22
Prohibit Low-Flow Sampling Methodology for Groundwater Monotoring Programs

AUC utilized a modified low-flow groundwater sampling methodology to sample wells for the site characterization. In its response to RAIs, AUC justified the use of low-flow sampling methodology by citing the benefits of a low-stress to the aquifer, well construction that permits placement of the pumps in the well screen, a study that showed the pump placement within the well screen does not significantly affect the water quality, and specifying procedures (e.g., minimum purge volume based on sampling equipment volumes) used in its low-flow sampling methodology. AUC then states in TR Section 5.7.8 that low-flow purging methodology may be used for the subsequent groundwater protection monitoring programs (i.e., wellfield baseline and excursion monitoring programs).

Staff finds that, while the sampling method may be sufficient to obtain site characterization data, this methodology is not appropriate for the groundwater protection monitoring programs. Staff requests that the applicant modify the application to specifically state that low-flow sampling will not be conducted as part of the groundwater protection programs and/or that staff will impose a license condition because staff has to have reasonable assurance that the proposed monitoring program is sufficient to detect a release and provides accurate baseline data. Staff will not verify that a wellfield hydrogeologic data package if the baseline data were collected using the low-flow sampling methodology, nor verify standard operating procedures for sampling under the groundwater detection monitoring programs that utilize the low-flow sampling methodology or accept excursion monitoring program data using low-flow sampling methodology.

1(g) Response

The following text has been added to TR Section 2.9.8.1 to replace the reference to the use of the low-flow sampling method:

"Although low flow sampling procedures were used to collect groundwater samples from wells for the preoperational monitoring program, low-flow sampling will not be use as part of the groundwater protection program during operations of the Reno Creek Project. AUC will employ the more traditional method of well sampling by using a downhole submersible pump during uranium recovery operations to establish PU and monitor well baseline groundwater values and to monitor for excursions."

In addition, the following reference to low-flow purging has been deleted from TR Section 5.7.8.1.5:

"Low-flow purging may also be used in certain instances to prevent pulling of process fluids to the monitor well from excessive purging which ensures only formation water is sampled."

8(h): Draft SER Section 3.1.3.2; TR Section 3.1.3.1; RAI Admin 18
Use of Method 4 Well Construction

AUC proposed four methods for well construction/completion. The first three (3) methods are those typically used by the industry (i.e., screen interval under-reamed after cementation with telescoping screen) whereas the fourth method is unique as far as methods proposed by an ISR applicant (i.e., screen and casing installed with the annulus space filled with sand, grout and cement. AUC utilized well construction Method 4 for installation of the first approximately 27 wells used for the pre-license site characterization and states that the well construction Method 4 may be used for the monitoring wells in the groundwater detection monitoring programs. In response to RAI ADMIN-18, AUC anticipates using 2-inch diameter wells (completed using Method 4) for the piezometer/leak detection wells related to the storage pond.

Staff finds that well construction Method 4 is used widely in the shallow, small diameter wells for numerous environmental studies and is consistent with approved standards (see ASTM D5092- 04). Therefore, staff agrees that this Method may be appropriate for shallow wells including those for the pond detection systems. However, staff finds that the applicant's description of well construction Method 4 is too generalized to be acceptable for wells in the groundwater detection monitoring program. For example, the applicant's placement of material in the annulus by free fall is not consistent with WDEQ's rule that specifies placement of material by tremie pipe. Furthermore, the applicant's specifications provide a "minimum" thickness of the sand filter pack but do not provide a maximum thickness. The lack of a maximum thickness may result in the sand filter pack for a well providing a conduit for fluid migration and/or difficulties for well abandonment if the sand filter were significantly longer than the PVC screen length. Well construction Method 4 also presents a problem with well abandonment. The applicant's proposed abandonment procedures of filling the well casing with cement would not eliminate Method 4 sand filter pack as a potential conduit for fluid migration.

Therefore, staff will require the applicant's commitment to not use well construction Method 4 for monitoring wells that could be affected directly by the ISR operations and a license condition that the existing UM, PZM and OM wells constructed using Method 4 are abandoned by removing the sand filter pack prior to plugging the well.

1(g) Response

AUC agrees with the staff conclusion that well construction Method 4 should not be used in the groundwater monitor well detection program for PUs. However as the reviewer noted, wells constructed by Method 4 are appropriate for shallow, small diameter wells for the use of environmental studies, which are consistent with approved standards (ASTM D5092-04), including the pond leak detection systems, determination of effects of surface spills and leaks, including failed MIT tests, and similar applications. AUC will not employ Method 4 for monitoring wells that could be affected directly by ISR operations. Therefore AUC will add the following text to TR Section 3.1.3.1:

"AUC will only install wells constructed by Method 4 in the use of the pond leak detection system, determination of shallow effects of surface spills and leaks, including failed MIT tests, and similar applications. AUC will not employ Method 4 for monitoring wells that could be affected directly by ISR operations."

9(i): Draft SER Section 3.1.3.2; TR Section 7.2.5.2; RAI Response N/A
Wellhead Protection Features

The applicant states that leak detection sensors will be included in the well head sumps but does not include a description of the wellhead completions. The details should discuss protection of the wellhead from accidental damage, freezing from cold temperatures and spills or leaks consistent with guidance in the Standard Review Plan. The wellhead enclosure will have the ability to contain small leaks and incorporate a leak detection system to notify the applicant of a leak before it is released to the environment.

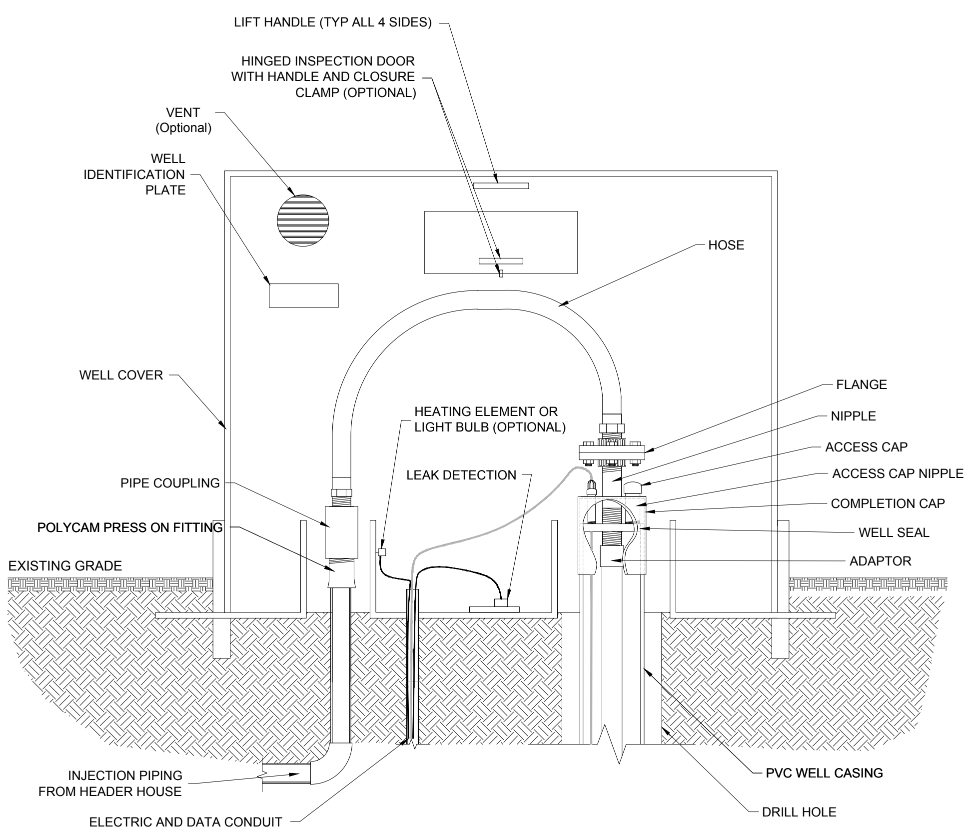
Therefore, staff will require a commitment from the applicant to modify the application to include a diagram which depicts the wellhead completion details.

<u>1(i) Response</u>

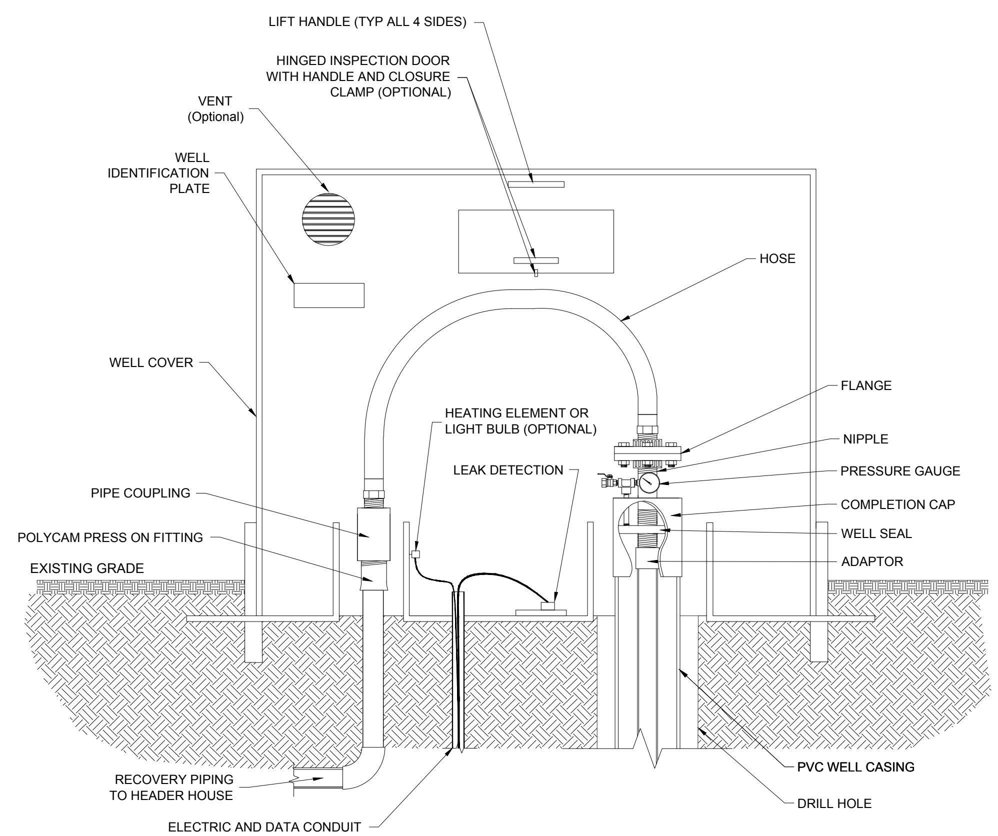
The following text has been added to TR Section 7.2.5.2 to enhance the discussion on wellhead completions and protection:

- Each wellhead will be covered by a rigid and durable material in order to provide freeze protection and to prevent debris from entering the wellhead area.
- There will be leak containment around the well.
- There will be leak detection at the well heads.
- The opening where the well casing comes up through the bottom of the container will be sealed.
- Each wellhead will be clearly seen and will have an identification label with its unique number indicated on both the wellhead cover and the wellhead itself
- The ground below the spill containment box will be properly stabilized before installing to prevent settling.

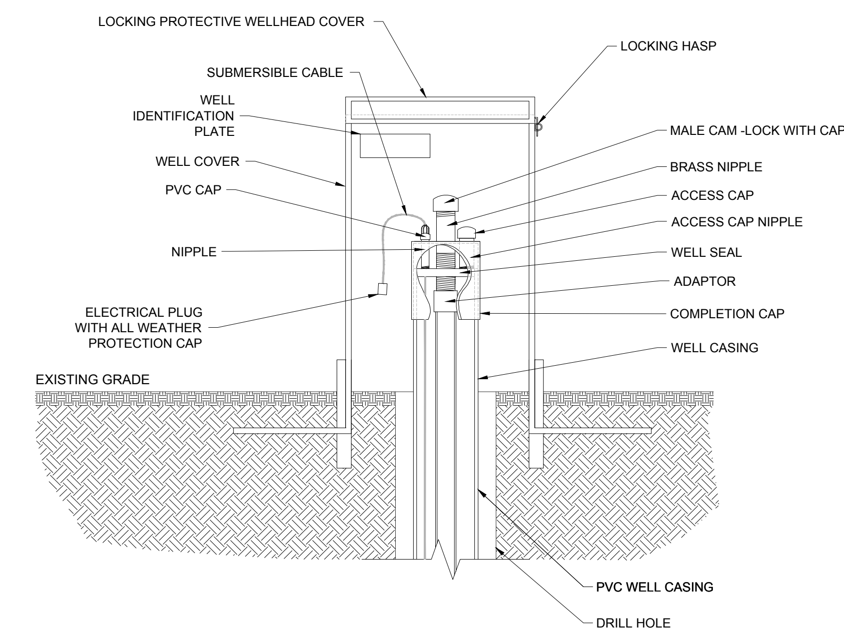
The following diagram have been added to TR Section 7 and labeled as Figure 7-1: Typical Wellhead Details.



TYPICAL
RECOVERY WELLHEAD



TYPICAL
INJECTION WELLHEAD



TYPICAL
MONITORING WELLHEAD

DRAWING ISSUE TYPES: PRB = PRE-BID POB = POST-BID IFC = ISSUED FOR CONSTRUCTION POI = POST ISSUED FOR CONSTRUCTION

NO:	DATE	CADD	CHECK	APP'D	ISSUE / REVISION DESCRIPTION	NO:	DATE	CADD	CHECK	APP'D	ISSUE / REVISION DESCRIPTION

AUC LLC
LAKEWOOD, COLORADO

NOT FOR CONSTRUCTION REVIEW SET ONLY

TREC, Inc.
Engineering & Environmental Management
www.treccorp.com

BOZEMAN OFFICE
1800 West Koch, Suite 6
Bozeman, MT 59715
Tel: (406) 586-8364
Fax: (406) 522-8460

CASPER OFFICE
900 Werner Court, Suite 150
Casper, WY 82601
Tel: (307) 265-0696
Fax: (307) 265-2498

GREAT FALLS OFFICE
600 Central, Suite 204
Great Falls, MT 59401
Tel: (406) 952-0745

BUTTE OFFICE
521 East Front Street
Butte, MT 59701
Tel: (406) 491-0912

IF THIS BAR DOES NOT EQUAL ONE INCH ADJUST SCALES ACCORDINGLY

PROJECT NO.:	CADD:	CHECKED BY:	APPROVED BY:	PLOT DATE:
2012-250	RRU	RMD		

TYPICAL WELLHEAD DETAILS
RENO CREEK ISR PROJECT

FIGURE
7-1

DRAWING: Z:\CURRENT_PROJECTS\2010-100 AUC RENO CREEK PERMIT APP\CAD\FIGURES\2010-100_WELLHEAD_DETAILS.DWG

10(j): Draft SER Section 2.5.3.2; TR Section 2.9.8.1; RAI Response 22
Commit to Fully or Partially Penetrating Wells for Perimeter Wells

AUC does not commit to having fully or partially penetrating screens for monitoring wells in the perimeter monitoring ring. Such a commitment is a criterion in the Standard Review Plan.

AUC will have to commit to either fully or partially penetrating screens for monitoring wells and provide justification in the application.

<u>1(j) Response</u>

The following text has been added to TR Section 5.7.8.1.3, Monitoring Well Baseline Water Quality:

"The perimeter monitor wells will be constructed with screens that partially penetrate the PZA. The screens in the perimeter monitor wells will cover the same intervals of the PZA that are screened for uranium recovery operations in the PU. As discussed in Section 6.2 of the Groundwater Model Report, vertical conductivity should be less than the horizontal conductivity due to the anisotropy within the PZA with respect to hydraulic conductivity. By using partially penetrating screens rather than screening the entire PZA sandstone a potential excursion will be easier to identify, rather than being masked by excessive screen lengths due to this property of the PZA."

11(k): Draft SER Section 2.5.3.2; TR Section 2.9.8.1; RAI Response 22
Screened Horizon for OM Wells

AUC states the thickness of the OM aquifer may exceed 20 feet. The Standard Review Plan instructs staff to ensure the monitoring program provides early time detection of an excursion. Having the overlying wells screened in the lowermost portion of the overlying aquifer provides the best potential to detect an excursion.

AUC will have to commit to screening the lowermost 20-foot horizon if the OM aquifer is greater than 20 feet.

1(k) Response

The following text has been added to TR Section 5.7.8.1.3, Monitoring Well Baseline Water Quality:

"If the overlying aquifer sand thickness is twenty feet or less, then the monitor wells will be screened across the entire sand interval. If the overlying aquifer sand thickness is greater than twenty feet, then the lowermost 20-foot horizon of the overlying aquifer will be screened."

12(l): Draft SER Section 2.5.3.2; TR Section 2.9.8.1; RAI Response 22
Monitoring the Lower Sand if CBM well is located within Production Area

If a CBM well exists within a production area, staff finds that at least one monitoring well in the OM aquifer should be located immediately (within 500 feet) of that well to ensure the casing cement does not provide a conduit for fluid migration. For the underlying aquifer, staff agrees with the applicant and will not require monitoring of the UM aquifer. However, should a CBM well be located within a production area, staff will require that at least one well in the first transmissive sand underlying the PZM aquifer (immediately below the Badger Coal).

This requirement will be a license condition.

1(l) Response

AUC agrees to a license condition for the reviewer's comments based on the following discussion points:

"If CBM wells are present within a PU boundary then AUC will provide a plan to NRC prior to finalizing the design of the wellfield package, describing:

- Where AUC intends to locate OM wells in relation to the CBM wells, i.e. within 500 feet;
- An explanation of why UM well(s) are not needed; or
- How AUC intends to include UM wells in the wellfield package."

13(m): Draft SER Section 2.5.3.2; TR Section 2.9.8.1; RAI Response 22
Abandon Existing Wells Constructed by Method 4

The extended sand horizon for the existing wells used for the site characterization will act as conduits from lixiviant migration if one of the existing wells is located within a production area. The well will increase the flare within the production aquifer. Staff will include a license condition to have the well properly abandoned prior to start of operations in any such wellfield.

1(m) Response

AUC agrees to the staff suggested license condition to have each preoperational baseline well constructed using Method 4 with extended sand horizons be properly abandoned prior to the start of operations of any such wellfield in which they are located.

14(n): Draft SER Section 2.5.3.2; TR Section 2.9.8.1; RAI Response 22
Request to Abandon BLM's All Night Well if located within a Wellfield

BLM's well cluster is likely located within the applicant's proposed Production Area 12A. Staff will include a license condition that AUC contact BLM to abandon the well prior to operations in that production area.

1(n) Response

AUC agrees to a license condition regarding the BLM All Night Cluster. Prior to the development of the wellfield containing the BLM All Night cluster, AUC will submit a plan to NRC with the following information:

- Describe what is to be done with the BLM well screened in the PZA; and
- Document BLM's concurrence with the plan.

15(o): Draft SER Section 2.5.3.2; TR Section 2.9.8.1; RAI Response 22
Abandon Existing Wells Constructed by Method 4

AUC did not describe with sufficient detail its propose QA/QC program. Staff will include a pre-operational license condition requiring submittal and approval of a QA/QC program.

1(o) Response

AUC agrees to the staff suggested license condition requiring submittal and approval of a QA/QC program prior to the commencement of operations of the Reno Creek Project.

16(p): Draft SER Section 2.5.3.2; TR Section 2.9.8.1; RAI Response 22
Perimeter Wells Limited to 400 feet (Distance and Spacing)

Staff finds AUC's numeric groundwater flow model setup may have biased the predictive simulations. As a result, staff revised the model (e.g., modified boundary conditions, 5 layers, limited number of hydraulic zones, etc.) in an effort to evaluate the predictive simulations.

The revised model demonstrated that the effective hydraulic conductivity and storativity are slightly lower than those used in the model by AUC. Based on these results, and the fact that AUC acknowledged that the pumping test results suggest potential preferential pathways, staff will require 400-foot spacing and distance for wells in the perimeter ring in both the fully and partially saturated areas.

Staff will include a license condition for this requirement.

1(p) Response

AUCs hydrogeological consultant Petrotek Engineering Corporation (Petrotek) has completed its review of the groundwater model provided by NRC simulating hydraulic conditions for the AUC Reno Creek ISR Project. In Petrotek's opinion, the NRC groundwater flow model does not present a compelling argument demonstrating that installing perimeter ring monitor wells at 400-foot spacing and distance in the fully saturated areas will improve excursion detection and recovery over a 500-foot spacing and distance. However, as NRC staff notes, since there is the potential for preferential pathways within the PZA, AUC agrees to a license condition requiring 400-foot spacing and distance for wells in the perimeter ring in both the fully and partially saturated areas.

NRC ENGINEERING OPEN ITEMS

In its initial application, AUC stated that "Prior to commencement of pond construction, AUC will submit to NRC a backup storage pond design plan based on the site specific geotechnical investigation." AUC identified several components of the design that would be provided at a later date, including:

- *Site and material characterization;*
- *Configuration and location;*
- *Slope stability analysis;*
- *Settlement;*
- *Liquefaction potential analysis;*
- *Pond storage/freeboard analysis;*
- *Surface water diversion design;*
- *Erosion protection design (embankment slopes and diversion ditches);*
- *Liner design;*
- *Leak detection system design;*
- *Hydrostatic uplift analysis;*
- *Construction specifications;*
- *Quality control testing program (methods and frequencies);*
- *Operational inspection plans; and*
- *Closure plans.*

NRC staff issued several requests for additional information related to storage pond design, RAIs 32, 33, 34, 35, 39 and RAI 40. Staff has reviewed AUC's responses to these RAIs and has identified the following open items.

2(a): Draft SER Section 4.2.3; TR Section 4.3.5 (12/2014 Revised RAI Response 39) Slope Stability Analysis

In its response to RAI 39, AUC stated that it would submit a slope stability analysis for the backup storage ponds prior to NRC licensing. To date, this analysis has not been submitted to the NRC staff. The staff cannot make a reasonable assurance finding that the ponds meet the requirements of 10 CFR Part 40, Appendix A, Criterion 5A(5) without reviewing a slope stability analysis. The NRC staff observes that Section 2 of Regulatory Guide 3.11 outlines acceptable methods for slope stability analyses. AUC can resolve this open issue by submitting a copy of the analysis.

2(a) Response

AUC had Inberg-Miller Engineers of Casper Wyoming perform a static and pseudo-static slope stability analysis on the proposed backup storage pond in accordance with Regulatory Guide 3.11, "Design, Construction, and Inspection of Embankment Retention Systems at Uranium Recovery Facilities," U.S. Nuclear Regulatory Commission, Washington, DC, November 2008. AUC has included the final revised report in this submittal as Appendix A. AUC has also included the report in the TR as TR Addendum 4-C, Revised Slope Stability and Seismic Deformation Report.

The following text has been added to TR Section 4.5.3:

"A static and pseudo-static slope stability analysis on the proposed backup storage pond is provided in TR Addendum 4-C."

2(b): Draft SER Section 4.2.3; TR Section 4.3.5 (12/2014 Revised RAI Response 39) Settlement Calculations

In its response to RAI 39, AUC provided a narrative explanation regarding the low potential for settlement of the pond embankment. However, in its response to RAI 33, AUC identified an anticipated settlement amount of 0.5 ft. The response to RAI 33 did not provide information or calculations supporting 0.5 ft of settlement. To be able to reach a reasonable assurance finding related to 10 CFR Part 40, Appendix A, Criterion 5A(4) and (5), the staff needs to be able to review a calculation of anticipated settlement of the backup storage pond embankments. AUC can resolve this open issue by preparing and submitting an analysis of embankment settlement.

2(b) Response

AUC had Inberg-Miller Engineers of Casper Wyoming perform an embankment settlement analysis on the proposed backup storage pond in accordance with Regulatory Guide 3.11. AUC has included the final report in this submittal as Appendix B. AUC has also included the report in the TR as Addendum 4-D, Settlement Analysis Letter.

The following text has been added to TR Section 4.5.3:

"An embankment settlement analysis is provided in TR Addendum 4-D."

2(c): Draft SER Section 4.2.3; TR Section 4.3.5 (12/2014 Revised RAI Response 39) Liquefaction Potential

In its response to RAI 39, AUC provided a narrative explanation regarding liquefaction potential for Wyoming. The response has a general discussion of liquefaction in Wyoming and did not appear to consider or evaluate the potential for liquefaction based on soil conditions at the Reno Creek site. Without this information, the staff cannot make a reasonable assurance finding that the ponds meet the requirements of 10 CFR Part 40, Appendix A, Criterion 5A(5) without reviewing a liquefaction potential analysis. AUC can resolve this open issue by submitting a copy of the analysis.

2(b) Response

The following discussion on liquefaction potential has been included in TR Section 4.3.5:

"AUC had TREC, Inc. assess the potential for liquefaction at the site of the proposed backup storage pond based on screening criteria provided in the NRC Regulatory Guide 3.11, Design, Construction and Inspection of Embankment Retention Systems at Uranium Recovery Facilities (NRC, 2008). A result of the analysis based on soil conditions at the Reno Creek site (Inberg-Miller Engineers "Subsurface Exploration and Geotechnical Engineering Report) indicate that as required a minimum of three of the five screening criteria are satisfied. This indicates that liquefaction is not likely and the potential for liquefaction can be dismissed. A discussion regarding each of the five screening criteria is provided below.

- *Geologic age and origin* - Fluvial, lacustrine, or aeolian deposit of Holocene age are identified as having an elevated liquefaction potential. Based on the Wyoming State Geological Survey Map for the project location, the site is located within the Wasatch Formation of Eocene age, indicating low liquefaction potential.
- *Fines content and plasticity index* - Liquefaction potential in a soil layer increases with decreasing fines content and plasticity of the soil. The *Subsurface Exploration and Geotechnical Engineering Report* prepared by Inberg-Miller, dated July 9, 2012, documents soil conditions for the project site. Multiple borings were drilled in the vicinity of the proposed backup pond (see Addendum 4-A, borings B9 to B12). Each of the four borings show cohesive soils with greater than 50 percent fines and a liquid limit generally greater than 35 percent. Based on these soil conditions, the potential for liquefaction is low.
- *Saturation* - Although soils with low water content have been reported to liquefy, at least 80- to 85-percent saturation is generally deemed to be a necessary condition for soil liquefaction. Borings were completed to 21.5 feet below grade and no

groundwater was observed. The proposed pond will be lined and include leak detection such that saturation from stored liquid is extremely low. Surface runoff during rainfall events is conveyed around the pond and through the site such that soil saturation due to rainfall is also low. Based on these soil conditions, the potential for liquefaction is low.

- *Depth below ground surface* - If a soil layer is within 15.24 meters (50 feet) of the ground surface, it is more likely to liquefy than deeper layers. Based on the available boring data, soil conditions in the upper 21.5 feet are not conducive to liquefying. Soil data is not available for depths greater than 21.5 feet.
- *Soil penetration resistance* - Soil layers with a normalized standard penetration test (SPT) blowcount less than 22 have been known to liquefy and an SPT value of less than 30 as the threshold to use for suspecting liquefaction potential. SPT blowcounts documented for borings B9 to B12 range from 11 to 58 and generally increase with depth. The available data does not support reduced potential for liquefaction."

2(d): Draft SER Section 4.2.3; TR Section 4.3.5 (12/2014 Revised RAI Response 33 and 39)
Freeboard Analysis

In its response to RAI 39, AUC provided a storage and freeboard analysis for the backup storage ponds. The analysis presented anticipates wave run up of 1.1 ft. However, it is not clear to the staff which method AUC used to calculate wave run up. The regulations in 10 CFR part 40, Appendix A, Criterion 5A(4) require that a surface impoundment be designed to prevent overtopping of a pond resulting from wind or wave actions. AUC can resolve this open issue by identifying, in writing, the method used to calculate wave run up.

2(d) Response

The following text along with the storage and freeboard analysis (Response to RAI 33) for the backup storage pond has been included in TR Section 4.3.5:

"The storage and freeboard analysis was performed using the methodologies provided by the U.S. Army Corps of Engineers (ACOE). The ACOE Coastal Engineering Manual (ACOE, 1989) was used to determine the design wave height. Supplementary ACOE references were also used (ACOE, 1984 and ACOE, 1997) to determine wave runup and wind tide effects. Manuals referenced in this analysis were the Engineer Manual 1110-2-1414, "Water Levels and Wave Heights for Coastal Engineering", U.S. Army Corps of Engineers Service, Washington, DC, July 1989, Engineer Manual 1110-2-1420, "Hydrologic Engineering Requirements for Reservoirs", U.S. Army Corps of Engineers Service, Washington, DC, October 1997 and Shore Protection Manual, Vol.II U.S. Army Corps of Engineers Service, Vicksburg, Mississippi – 1984."

2(e): Draft SER Section 4.2.3; TR Section 4.3.5 (12/2014 Revised RAI Response 39) Liner System Design

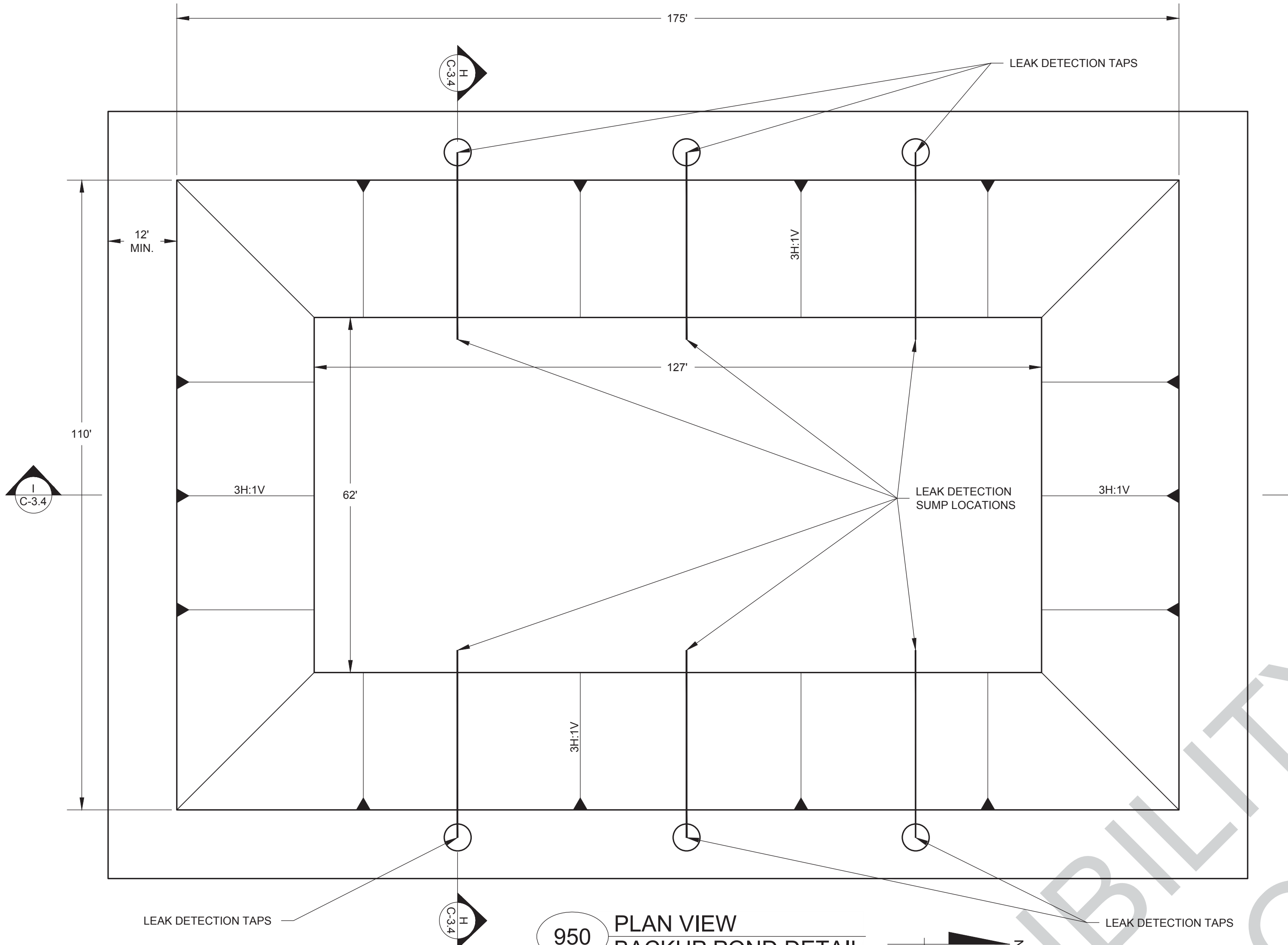
In its response to RAI 39, AUC stated that the liner system design was contained in Technical Report section 4.3.5.1. NRC staff reviewed the information in the technical report and understands that AUC intends for the liner to consist of the following components (listed from top to bottom):

- *A 0.036 inch thick (minimum) high density polyethylene (HDPE) or polypropylene (PP) liner;*
- *A drainage layer to serve as a leak detection system;*
- *A 0.036 inch thick (minimum) secondary liner; and*
- *Foundation material.*

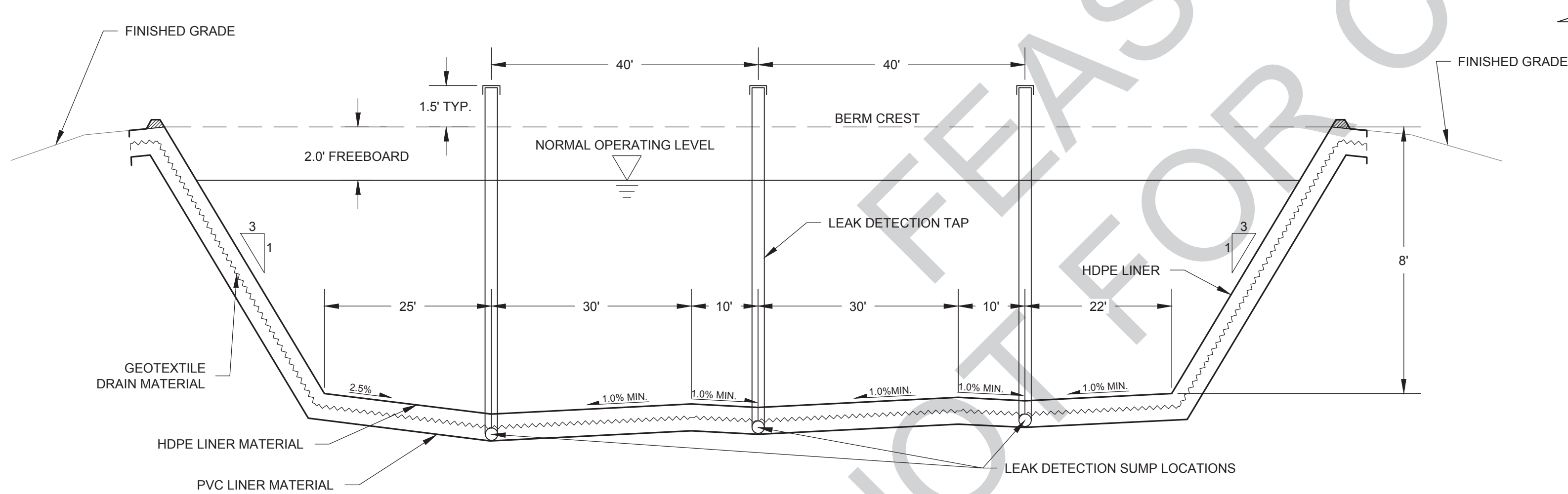
NRC staff reviewed the drawings presented in Attachment 3A (ADAMS Accession No. ML13219A203) and the liner thickness was not identified on the drawings. As required by 10 CFR Part 40, Appendix A, Criterion 5A(2), the NRC staff has to have reasonable assurance that the liner system has appropriate chemical properties and sufficient strength to withstand contact with liquid and the stress of daily operation. AUC can resolve this open issue by clarifying that it intends to use a geosynthetic liner with the material and thicknesses identified above in the backup storage pond.

2(e) Response

Sheet C-3.4, Grading: Backup Pond Details of the civil engineering package titled "Civil_Site-20121002" located in TR Addendum 3-A (reference RAI 39) has been revised to reflect AUC's commitment to use a geosynthetic liner with the material and thicknesses identified above. The proposed thickness of the liners has been added to the engineering drawing.



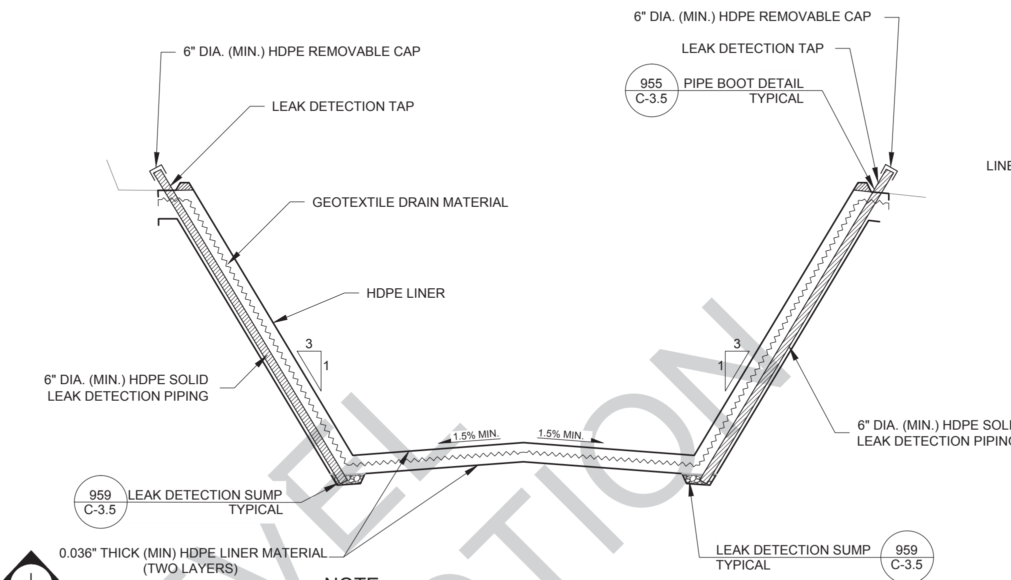
950 PLAN VIEW
BACKUP POND DETAIL
NTS



II CROSS SECTION: BACKUP POND NORTH/SOUTH
BACKUP POND DETAIL
NTS

NOTE:

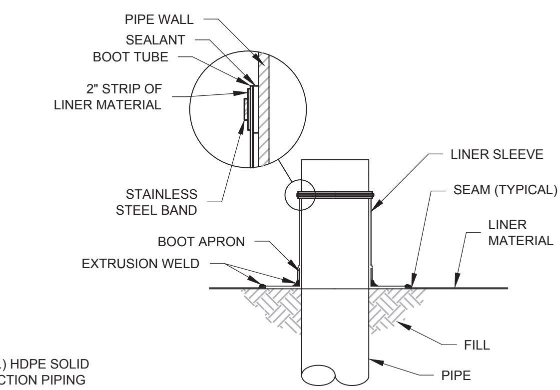
1. LINER SUB-BASE PREPARATION OF NATIVE SOILS TO BE COMPACTED TO 95% (MIN.) OF STANDARD PROCTOR



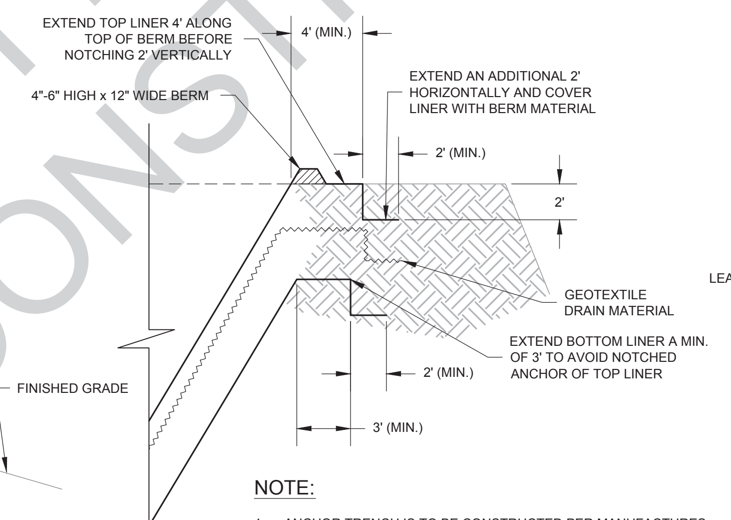
NOTE:

1. LINER MATERIALS SHOWN AS SEPARATED FOR VISUAL CLARITY. PVC LINER, GEOTEXTILE, AND HDPE LINER ABUTTED AGAINST EACH OTHER. PRIMARY AND SECONDARY LINERS WILL BE A MINIMUM OF 0.036" THICK

HH CROSS SECTION: BACKUP POND EAST/WEST
BACKUP POND DETAIL
NTS



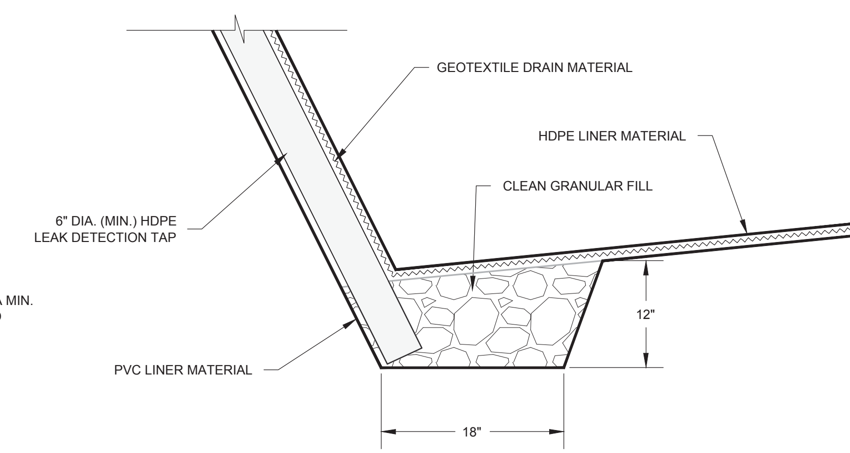
955 PIPE BOOT DETAIL
BACKUP POND DETAIL
NTS



NOTE:

1. ANCHOR TRENCH IS TO BE CONSTRUCTED PER MANUFACTURES RECOMMENDATIONS.
2. LINER MATERIALS SHOWN AS SEPARATED FOR VISUAL CLARITY. PVC LINER, GEOTEXTILE, AND HDPE LINER ABUTTED AGAINST EACH OTHER.
3. REMOVE ALL DELETERIOUS AND LINER DAMAGE CAUSING DEBRIS PRIOR TO INSTALLING PVC LINER.

957 LINER ANCHOR DETAIL
BACKUP POND DETAIL
NTS



959 LEAK DETECTION SUMP
BACKUP POND DETAIL
NTS

NOTES:

1. ALL LINER PRODUCTS ARE TO BE INSTALLED PER MANUFACTURES RECOMMENDATIONS
2. LEAK DETECTION TAP: 6" MIN. DIA. HDPE PIPE
3. LEAK DETECTION TAPS USED AS WATER RETRIEVAL POINTS

FEASIBILITY LEVEL
NOT FOR CONSTRUCTION

Dig Safely.
If you need a locate please call this number 811 or 800-849-2476

DRAWING REVISIONS TYPES: 1 PRE-BID 1 POST-BID 1 POST IFC

NO:	DATE	CADD	CHECK	APP'D	ISSUE / REVISION DESCRIPTION	NO:	DATE	CADD	CHECK	APP'D	ISSUE / REVISION DESCRIPTION

AUC LLC

90% REVIEW SET
NOT FOR CONSTRUCTION

TREC, Inc.
Engineering & Environmental Management
www.treccorp.com

BOZEMAN OFFICE: 1800 West Koch, Suite 6, Bozeman, MT 59715, Tel: (406) 586-8364, Fax: (406) 522-8460
CASPER OFFICE: 900 Werner Court, Suite 150, Casper, WY 82601, Tel: (307) 265-0696, Fax: (307) 265-2498
GREAT FALLS OFFICE: 600 Central, Suite 204, Great Falls, MT 59401, Tel: (406) 952-0745
BUTTE OFFICE: 521 East Front Street, Butte, MT 59701, Tel: (406) 491-0912

IF THIS BAR DOES NOT EQUAL ONE INCH ADJUST SCALES ACCORDINGLY

PROJECT NO.:	CADD:	CHECKED BY:	APPROVED BY:	PLOT DATE:
2012-250	TBK	RRU	SLH	10/2/2012 3:31 PM

GRADING: BACKUP POND DETAILS
RENO CREEK PROJECT
PREPARED FOR
AUC LLC
CAMPBELL COUNTY, WYOMING

SHEET C-3.4

DRAWING: Z:\Current_Projects\2012-250_AUC_Prefeasibility_Study\020-CAD\Sheets\Civil Site\2012-250_C03-GRADING.dwg

2(f): Draft SER Section 4.2.3; TR Section 4.3.5 (12/2014 Revised RAI Response 32 and 39)
Construction Specifications

In its response to RAI 39, AUC stated that construction specifications were located on drawings C-3.3 and C-3.4 of Addendum 3-A. The NRC staff also reviewed the response to RAI 32, which did contain some information on specifications for the drainage layer. The NRC staff was able to locate some specifications, such as the 95 percent compaction requirement for the subgrade below the liner and the transmissivity of the drainage material. However, the NRC staff has not been able to identify the minimum strength requirements for geosynthetics planned for use in the liner system. Note that 10 CFR part 40, Appendix A, Criterion 5A(2), 5A(4), and 5A(5) applies to both design and construction of surface impoundments. AUC can resolve this open issue by identifying engineering properties for items used in construction of the storage pond liner system.

2(f) Response

Per the NRC Permit Application, the pond liner (primary and secondary containment layers) will be a minimum of 36 mil. thickness HDPE or polypropylene. Accordingly, minimum tensile strength properties will be 228 lb/in break strength and 126 lb/in yield strength (ASTM D 6693, min. avg. value)

2(g): Draft SER Section 4.2.3; TR Section 4.3.5 (12/2014 Revised RAI Response 39) Quality Control for Pond Construction

In its response to RAI 39, AUC stated that quality control plan for pond construction could be found in TR section 4.3.5.3. NRC staff reviewed this section of the TR and observed that it addressed operational pond inspections. NRC staff has not been able to identify a quality control plan for pond construction. The NRC staff observes that proper quality control during construction is the best way to minimize the potential for leaks during operation. Note that 10 CFR part 40, Appendix A, Criterion 5A(2), 5A(4), and 5A(5) applies to both design and construction of surface impoundments. AUC can resolve this open issue by providing a quality control plan for construction of the ponds. The plan should address testing techniques and frequencies to evaluate items such as: engineering properties of materials used in construction; seam integrity; compaction of earthen materials, etc.

2(g) Response

AUC will employ an Engineering Procurement Construction Management (EPCM) firm for initial construction of the project. The EPCM will integrate a Quality Control (QC) program for pond construction in accordance with guidance provided in Reg Guide 3.11 into its site wide QC program. The site wide QC requirements are embedded into the construction specifications that are developed as part of the final project engineering design package, but before pond construction begins. Prior to pond construction, AUC will notify NRC staff when the site wide QC program is available at the site for inspection.

The following text has been added to TR Section 4.3.5 as a commitment by AUC to comply with Regulatory Guide 3.11:

"As part of the construction plans a licensed professional engineer will develop detailed specifications for excavation, embankment construction, subgrade preparation and liner placement. The plan will include testing techniques and frequencies to evaluate engineering properties of materials used in construction, compaction of earthen materials and seam integrity of the installed liner. The AUC pond Quality Control (QC) plan will be integrated into the site wide QC construction plan and contain the following construction parameters:

- A geotechnical or construction inspector will be on site during embankment construction.
- Appropriate fill material will be taken from an approved, designated borrow area free of objectionable materials.

- Areas on which fill is to be placed will be scarified before its placement.
- The compaction requirements for the fill material will include the percent of maximum dry density for the specified density standard, allowable range of moisture content, and maximum loose lift thickness.
- Fill material will be compacted with appropriate compaction equipment such as a sheepsfoot, rubber-tired, or vibratory roller. The number of required passes by the compaction equipment over the fill material may vary with soil conditions.
- Fill material will contain sufficient moisture to allow the required degree of compaction to be obtained with the equipment used.
- Field density tests will be performed regularly throughout the embankment construction. Many factors influence the frequency and location of control tests. Typically, a routine control test should be performed for every 764.5 to 2293.6 cubic meters (1000 to 3000 cubic yards) of compacted material or as directed by the geotechnical engineer.
- Proper subgrade preparation during construction will be performed for the installation of the liner system. The site of the retention system will be cleared of all debris, vegetation, and potential root systems. The surface will be graded so that it is smooth and free of protruding rock particles. The soil will be moisture conditioned as required to prevent it from drying out before the liner is put into use.
- To the extent possible, synthetic liner seams will run up and down and not across a slope. They should not be located near the crest of a slope. Seams will be tested for integrity along their entire length using methods recommended by the manufacturer. Seaming will be performed only under the supervision of experienced personnel.
- Accepted construction standards and specifications for embankments, such as those developed by the USDA Soil Conservation Service or the U.S. Army Corps of Engineers, will be followed.
- Additional QC items will be added as determined through consultation between the pond liner vendor and AUC's EPCM to conform to site conditions."

2(h): Draft SER Section 4.2.3; TR Section 4.3.5 (12/2014 Revised RAI Response 40) Disposal Capacity

In its response to RAI 40, AUC stated that it does not plan to use land application as a liquid disposal method. Additionally, AUC does not plan to construct an additional backup storage pond. The NRC staff understands that AUC intends to use a tank within the processing building to provide some liquid waste storage capacity between the plant and the disposal wells. The NRC staff is aware of the need to provide adequate disposal capacity, especially upon startup of the facility. NRC staff has observed situations where the ability of a licensee to dispose of liquid byproduct material is compromised during startup of a facility. This can happen as a result of diminished disposal well injection capacity, a leak in a pond liner system, or other unanticipated events. AUC can resolve this open issue by clearly committing to maintaining a certain minimum disposal capacity and by committing to reduce production flows if a disposal issue arises.

2(h) Response

AUC agrees to revise the TR to reflect AUC's commitment to operate its production, including the generation of wastewater requiring disposal in Deep Disposal Wells, to levels that AUC's Deep Disposal Well capacity can handle within permit limits. In the event that some part of AUC's Deep Disposal Well capacity becomes unavailable, AUC will reduce is production rate to restore its ability to dispose of all wastewater.

The following text has been added to TR Section 4.3.5:

"In the event that some part of AUC's Deep Disposal Well capacity becomes unavailable, AUC will reduce its production rate to restore its ability to dispose of all wastewater."

HEALTH PHYSICS OPEN ITEMS

3(a): RAIs 20, 23, 24, 25, and 26
Pre-Operational Environmental Monitoring

Due to the change in the location of the Central Processing Plant (CPP), NRC staff identified additional sampling that needs to be conducted to be consistent with Regulatory Guide 4.14. These issues were identified in RAI, 20, RAI 23, RAI 24, RAI-25, and RAI-26. This change affected air particulate, air radon, direct radiation, soil vegetation and livestock sampling. AUC committed to conduct additional sampling in the October 2014 Public Meeting. Regulatory Guide 4.14, Revision 1, Regulatory Position C.1 states that a complete pre-operational report with twelve consecutive months of data should be submitted prior to beginning milling operations. Prior to the start of operations, monitoring data, including airborne radon measurements, should be submitted to the NRC staff.

NRC staff request that AUC consolidate the aforementioned open items, including all previous environmental data reported in the original application into one final pre-operational environmental report (prior to the final approval of the license), and provide a date for submittal to NRC.

3(a) Response

AUC has prepared the requested Baseline Environmental Report on Radiological Measurements in accordance with Regulatory Guide 4.14 guidance.

The report includes all information previously submitted in the initial TR, in RAI responses, and in special submissions (first two rounds of vegetation analysis, RAIs-23 and-24), plus the results of the meat sampling (RAI-25) and analysis. Included in the data tables are place holder locations for the future sampling results from air monitor stations AM7 and AM8 (RAI-20), plus the third round of vegetation sampling and analysis. Additional place holders are included to complete preoperational monitor and stock well sampling as identified in Open Items 1(d) and 1(f). In addition, all uranium concentration values are reported as activity (RAI-26) as required in Regulatory Guide 4.14.

The data tables are organized in a way to make it clear which data are to be used for the official baseline analysis and fall under the label "Relocated". However, other data generated, but which will not be in the official baseline because it was collected for an initial CPP site are included but are denoted as "Initial".

The report is included as part of this submission package, however it also is submitted as a separate stand-alone document and will not be included in the SML application. An updated finalized report will be resubmitted following the final sample data collections.

3(b): RAI 74 (includes RAIs 37 and 50)
Effluent Monitoring

NRC staff could not determine from the original application how AUC will meet NUREG-1569 Acceptance Criteria 4.1.3(2). AUC captured the RAIs and consolidated the responses in RAI-74. NRC staff had additional concerns and requested clarification of the use of MILDOS. NUREG-1569 Acceptance Criteria 4.1.3(2) states that monitoring and control systems for the facility are appropriate for the types of effluents generated. The intended purposes of measurement devices are clearly stated and criteria for monitoring are provided. The acceptance criteria from Section 5.7.7.3 of this standard review plan needs to be met.

NRC request that AUC update RAI-74 and discuss in more detail how MILDOS will be used to assess emissions from the wellfields and any other potential sources. AUC will discuss specifically the source terms used in MILDOS to compute quantities (wellfields) and any concentrations and radiation dose to receptor points and provide a date for submittal to NRC.

3(b) Response

AUC has produced a final revised RAI-74 response that comprehensively discusses the use of MILDOS to assess emissions from the wellfields and other potential sources. AUC has included the final revised RAI-74 response in this submittal as Attachment C. The TR will be revised in accordance with the commitments included in the RAI response.

The presentation by Dr. H.R. Meyer given at a recent conference in Corpus Christi, Texas referenced in the revised RAI-74 response was included in AUCs revised RAI Response Package submitted December 23, 2014 in Appendix E. It is not re-submitted here.

3(c): Additional Meteorology RAI identified in March 26, 2014 Public Meeting Meteorological Representativeness

NRC staff is reviewing the information provided by AUC in the report "Demonstration of Long- Term Representativeness of On-site Meteorological Data" dated, October 2014. Regulatory Guide 3.63 recommend that the continuous twelve month period of data collected on-site be representative of a concurrent period of meteorological data from a National Weather Service (NWS) station with long-term and short-term periods.

There is no additional information needed at this time. This issue is still pending and a decision will be reached and documented in the summary of this public meeting.

3(c) Response

AUC awaits the NRC's decision.

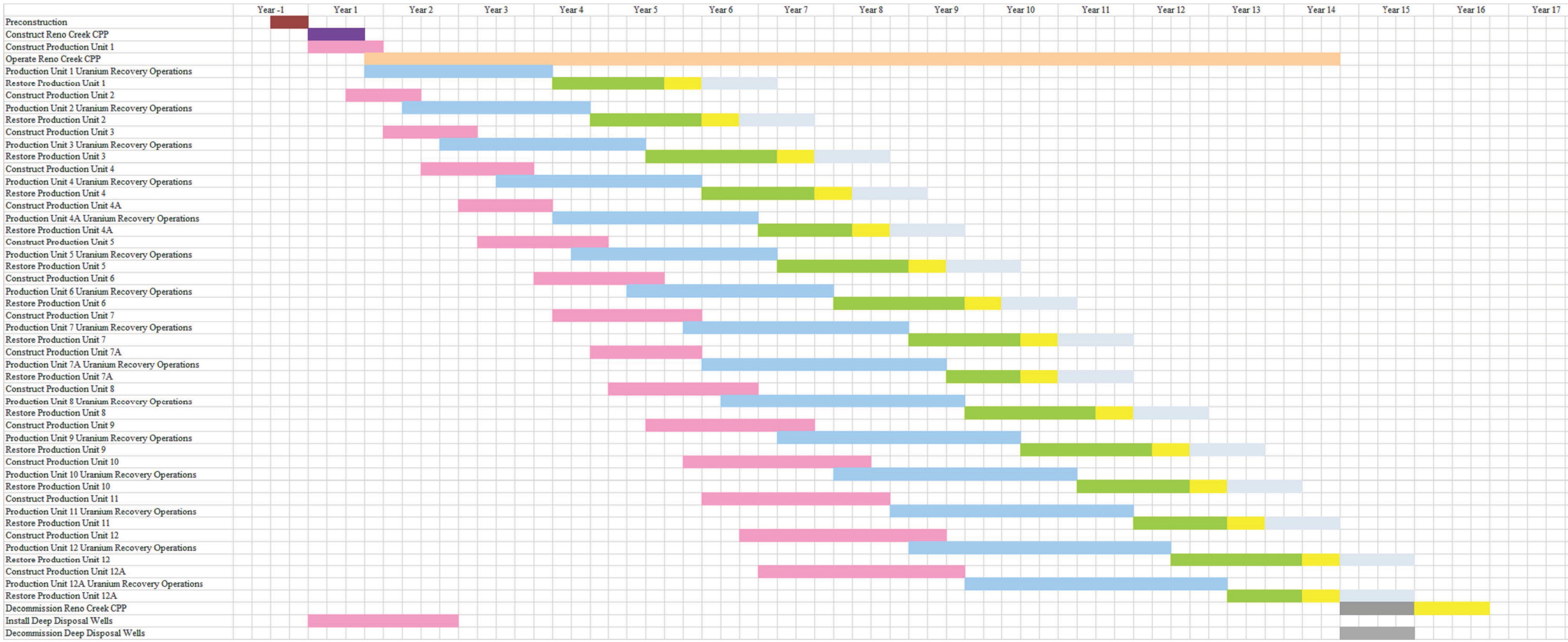
NRC MISCELLANEOUS OPEN ITEMS

4(a): Draft SER Section 1.3; TR Section 1 (12/2014 Revised RAI-2 Response)
Proposed Project Schedule

RAI-2 stated if AUC commits to implement a phased decommissioning approach, revise Figure 1-3 (Proposed Project Schedule) to show how the approach affects the start of decommissioning activities, but AUC's revised RAI-2 response but did not include a revised Figure 1-3. Staff notes that AUC's revised RAI response package contains an Appendix F that includes a figure of the Proposed Project Schedule which appears to incorporate a couple changes that do not appear in Figure 1-3 (such as, preconstruction activities prior to installation and construction activities, and changes to the figure legend. The staff requests that AUC commit to ensure Figure 1-3 is consistent with any other Proposed Project Schedule for this application.

4(a) Response

AUC has replaced the original Figure 1-3 in TR Section 1 with the revised Figure 1-3, Proposed Project Schedule. The revised figure is consistent with the figure contained in Appendix F. AUC has also replaced ER Figure 1-6 to ensure consistency for this application.



PREPARED FOR

AUC LLC
LAKEWOOD, CO

PROPOSED RENO CREEK PROJECT
CAMPBELL COUNTY, WY

TREC, Inc.
Engineering & Environmental Management
900 Werner Court
Suite 150
Casper, WY 82601
Phone (307) 265-0696
Fax (307) 265-2498
www.treccorp.com

Legend

- CPP Operations
- Production Unit Uranium Recovery Operations
- Production Unit Reclamation and Decommissioning
- Plant and DDW's Reclamation and Decommissioning
- Regulatory Review Period
- Groundwater Restoration
- Well Field Construction
- Preconstruction
- Construct CPP

DRAWN BY: EGS
CHECKED BY: CAT
APPROVED BY: RMD

Proposed Project Schedule

REV #	DESCRIPTION	BY	DATE
0	Revised Schedule per Client Request	RHK	07/20/12
1	Revised Schedule per RAI	EGS	05/19/14
2	Revised Schedule per RAI	EGS	09/16/14

FIGURE 1-3

Path: O:\WY_Projects\2010-100_AUC_Reno_Creek\Project_MXD\Submittal\RAI_NRC_r1\Project_Schedule.mxd

4(b): Draft SER 5.1.3; TR Section 5.1; RAI Response N/A
Integration between Plant Construction and Plant Management

TR Section 5.1 does not address the integration between plant construction and plant management. Also, AUC's Organization Chart in Figure 5-1 shows the Plant Manager position under the General Manager, but it does not show where plant construction and plant maintenance are in the organization. The Standard Review Plan, Section 5.1.3, Acceptance Criteria #2 states "The organizational structure shows integration among groups that support the operation and maintenance of the facility. If the facility is new, integration between plant construction and plant management should be detailed." The staff requests that AUC add clarifying text in the TR to address the integration between plant construction and plant management. Also, clarify the role of the Plant Manager position in Figure 5-1 relative to the integration between plant construction and plant management.

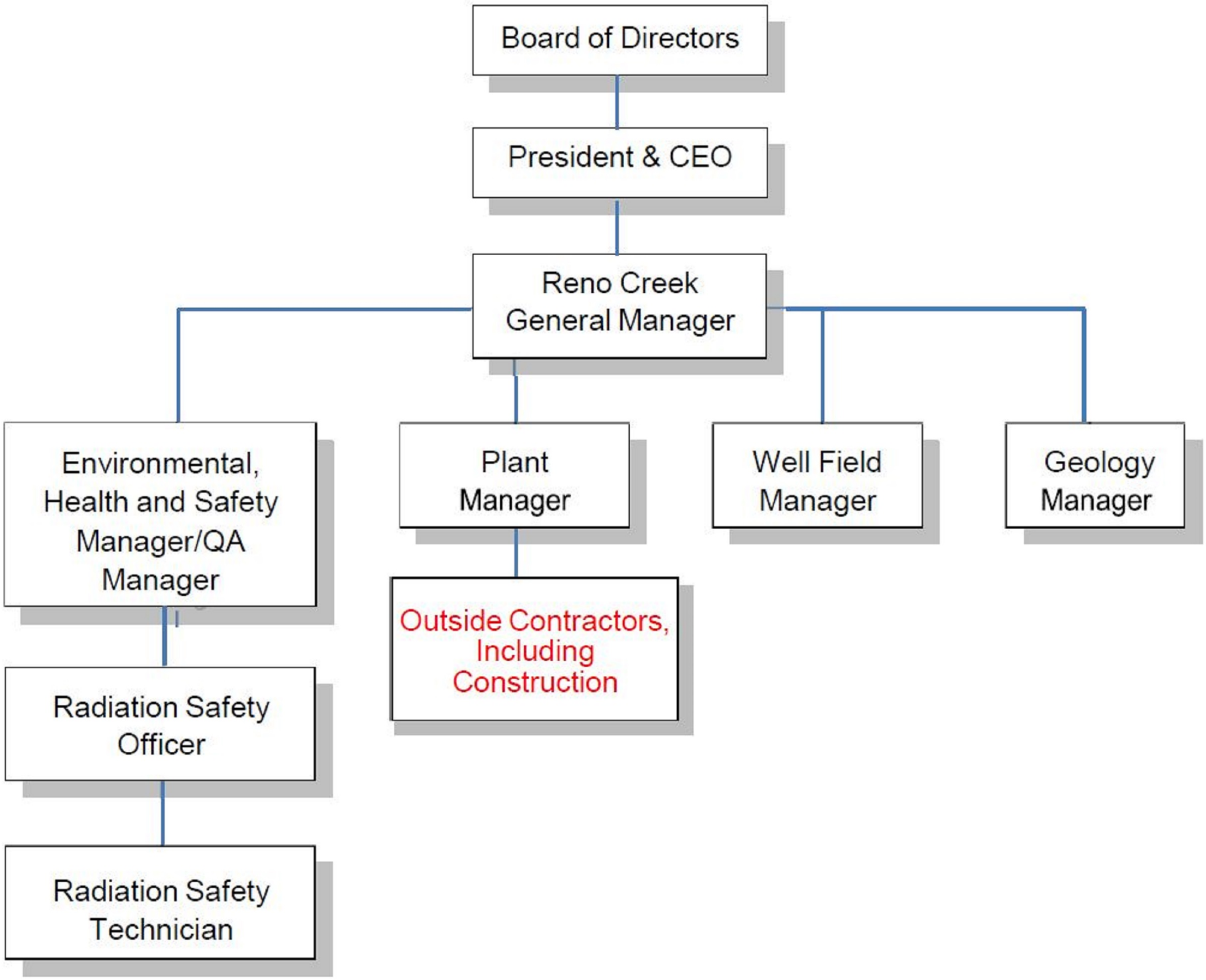
4(b) Response

AUC agrees to revise the TR to reflect the modified Figure 5-1, attached below. This figure shows that the Plant Manager is responsible for construction and vendor activities for the Project.

The following text has been added to TR Section 5.1.3:

"The Plant Manager will report to the General Manager. As part of his duties, the Plant Manager will be responsible for construction and vendor activities for the Project."

Figure 5-1: AUC Organizational Chart



4(c): TR Section 5.2
RSO or Individual with Equal or Equivalent Qualifications

In TR Section 5.2, AUC should revise or clarify wording when referring to an individual equal or equivalent qualifications to the RSO. For example, Section 5.2.1 states "All procedures involving radioactive material will be review and approved by RSO or individual with equal qualifications…", and Section 5.2.5 states that the third member of SERP will be the "RSO, or equivalent, with the responsibility for assuring that changes conform to radiation safety and environmental requirements." In referring to an individual with equal or equivalent qualifications to the RSO, AUC needs to clarify and/or demonstrate how this individual has equal or equivalent qualifications.

4(c) Response

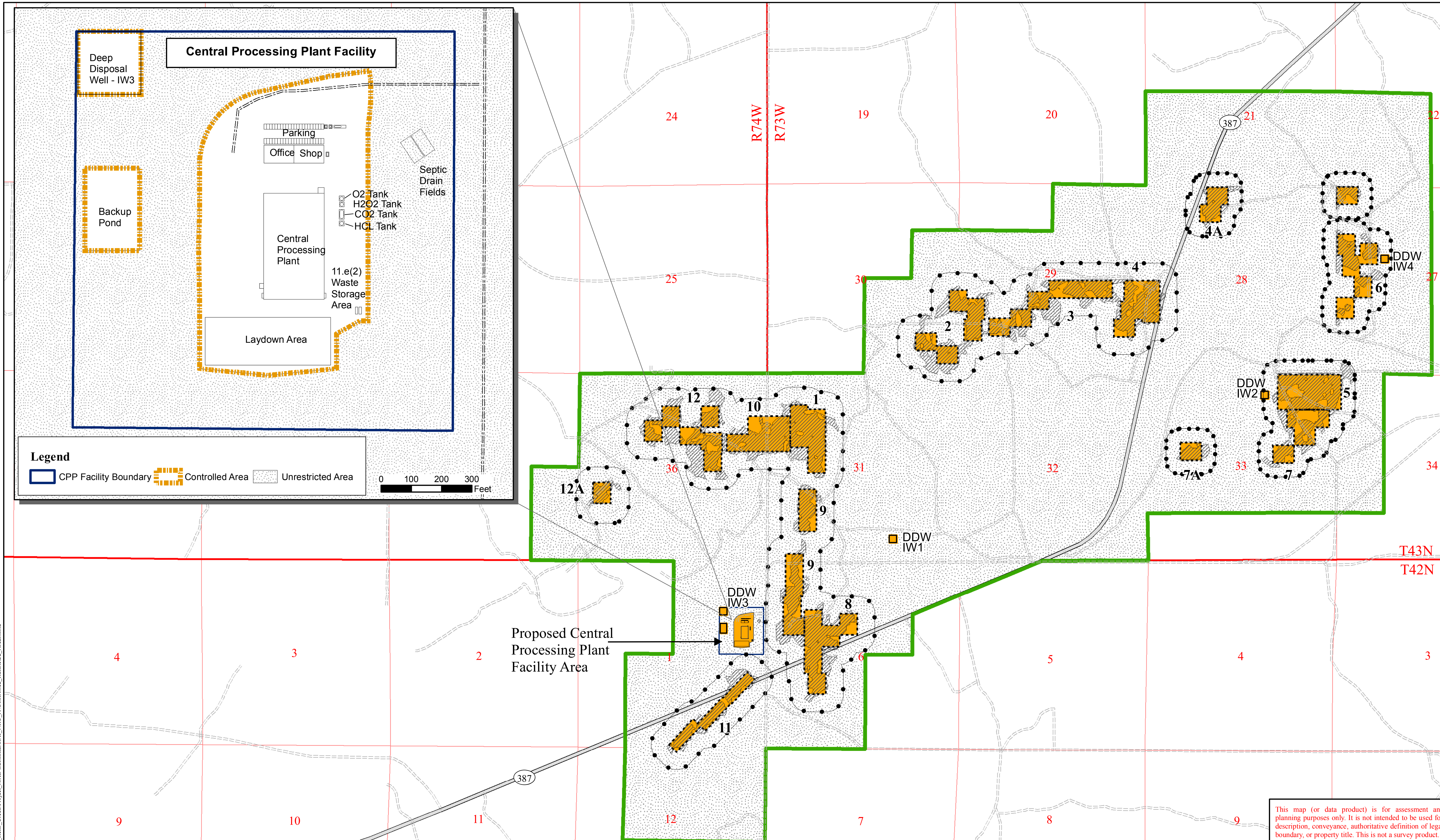
TR Sections 5.2.1 and 5.2.5 have been revised by removing terminology that refers to an individual with qualifications equal or equivalent to the RSO. Specifically, the following text has been removed from the first paragraph of Section 5.2.1: "or individual with equal qualifications". The following text has been removed from the first paragraph of Section 5.2.5: "or equivalent". Only the RSO will be authorized to approve procedures involving radioactive materials, and only the RSO will have the responsibility to assure that changes conform to radiation safety and environmental requirements.

4(d): TR Section 5.6
CPP Facility Controlled Area

AUC's revised response to RAI-44 added a new Figure 5-2, which shows the controlled area around the CPP. This figure includes an enlarged view of the CPP Facility showing a fenced controlled area that appears to encompass the backup storage pond. However, Figure 3-1 of the TR appears to show the backup storage pond and CPP Facility as 2 separate fenced enclosures. AUC should ensure that the controlled area in Figure 5-2 and Figure 3-1 are consistent.

4(d) Response

AUC revised the controlled area in TR Figure 5-2 to be consistent with the controlled area shown in TR Figure 3-1. Figure 3-1 and Figure 5-2 now show identical controlled areas. The newly revised TR Figure 5-2 has been included in TR Section 5 and supersedes the Figure 5-2 shown in the response to RAI-44. The revised Figure is 5-2 is shown below.



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Fax (307) 265-2498
www.treccorp.com

Legend
- Proposed Project Boundary
- Ore Body
- Production Unit
- Monitor Well Ring
- Controlled Area
- Unrestricted Area

Additional information regarding Controlled, Restricted, and Unrestricted areas can be found in TR Section 5.6

1:30,000

0 0.25 0.5 1 Miles

N E S W

DRAWN BY: EGS
CHECKED BY: RMD
APPROVED BY: RMD

Controlled and Unrestricted Areas

REV #	DESCRIPTION	BY	DATE	FIGURE
0	Draft for Review	EGS	3/31/14	5-2
1	Revision for RAI package	EGS	11/25/14	
2	Revision for RAI package	EGS	03/26/15	

4(e): TR Section 5.6

Surveillance

TR Section 5.6.1 states "All access to containers and vehicles where licensed material is located when not in storage will be locked, if possible, and under surveillance." 10 CFR Part 20, Subpart I, Section 20.1802 (Control of Material not in Storage) states "The licensee shall control and maintain constant surveillance of licensed material that is in a controlled or unrestricted area and that is not in storage." AUC needs to explain the difference between "under surveillance" and "maintain constant surveillance".

4(e) Response

AUC has revised the text in TR Section 5.6.2 to comply with 10 CFR Part 20, Subpart I, Section 20.1802 (Control of Material not in Storage). The text has been revised as follows:

"All access to containers and vehicles where licensed material is located when not in storage will be locked, if possible, and AUC personnel will maintain constant surveillance of the licensed material."

APPENDIX A:
Slope Stability and Seismic Deformation Report

REVISED Slope Stability and Seismic Deformation Report

Prepared for:

AUC, LLC
1536 Cole Boulevard, Suite 330
Lakewood, CO 80401

Reno Creek Project
Wright, Wyoming

July 29, 2014
REVISED September 12, 2014

17590-CX

Prepared by:

INBERG-MILLER ENGINEERS
1120 East "C" Street
Casper, WY 82601

TABLE OF CONTENTS

INTRODUCTION

A static and pseudo-static slope stability analysis was performed on the proposed backup storage pond at the proposed Reno Creek In-situ uranium processing plant. An embankment settlement analysis was also performed. The stability analysis and embankment settlement analysis were performed in accordance with the U.S. Nuclear Regulatory Commission Regulatory Guide 3.11.

PROJECT INFORMATION

We understand that a backup storage pond, having approximate dimensions of 100 feet by 200 feet, is anticipated to consist of a HDPE geomembrane liner placed above a drainage geonet for leak detection. The depth of the pond is 8 feet while the operating level will be 6 feet. The pond will be constructed on a sloping site, with the majority of the pond within excavation and the down slope embankment being approximately 7 feet of fill.

The slope stability analysis was performed for the final construction condition. In addition, the pond was analyzed in the full condition with high groundwater and pseudo-static state to check the embankment stability under wet conditions as well.

CRITICAL SECTION

The critical section for the proposed pond construction was determined to be that of H-H, shown on plan sheet C-3.4 of the TREC, Inc plans dated October 2, 2012 located in Appendix A. Cross-section H-H was determined critical based on the length of the slope and height of the embankment in comparison with the other cross section. The analysis included the proposed embankment soil however, the geosynthetic layers were not included in the stability analyses. Typically, geosynthetics add strength to the soil therefore removing them from the model is considered conservative.

MATERIAL PROPERTIES

Material classifications for the site soils were determined from the subsurface exploration and geotechnical engineering report dated July 9, 2012. Strength parameters were correlated to the material classifications to determine input values for the slope stability analyses. In addition, consolidation information for the site soils was determined from the above mentioned report.

Table 1. Properties for all soil and MSW modeled within the cross-sections.

Material	***Model Color***	***Friction angle*** (ϕ)	***Cohesion*** *(lb/ft^2)*	***Density*** *(lb/ft^3)(wet)*
Native Sandy Clay	Brown	20	300	125
Compacted Sandy Clay	Tan	20	400	135
Very Stiff Clay	Olive	10	1,000	135

PEAK HORIZONTAL GROUND ACCELERATION

The site was determined to be within a seismic impact zone according to the United States Geological Survey (USGS) Seismic Hazard Mapping Project Map, 2012 edition. The Peak Horizontal Ground Acceleration (PHGA) was determined from the web based USGS Seismic Hazard Analysis Tools-Hazard Curve Application version 1.0.1. The Hazard Curve Application can be located at this web address http://geohazards.usgs.gov/hazardtool/application.php. Latitude and longitude for the center of the site were input into the web based application and the PHGA value was determined to be 0.1447 for a 2% probability of exceedance in 50 years. A screen print of the analysis is included in Appendix A.

STABILITY EVALUATION OF CRITICAL CROSS-SECTIONS

The global stability of the proposed pond was modeled using Slope/W in the Geostudio 2012 suite of software. A slope stability analysis was run on the critical cross-section of the proposed embankment using Morgenstern-Price methodology. The Morgenstern-Price methodology meets the requirements within the U.S. Nuclear Regulatory Commission Regulatory Guide 3.11 for equilibrium and will produce factors of safety with less than five percent error. The observed minimum factors of safety for static and pseudo-static were 3.19 and 1.84, respectively.

REFERENCES

Inberg-Miller Engineers "Subsurface Exploration and Geotechnical Engineering Report – Reno Creek Project Campbell County, Wyoming", July 9, 2012

Nuclear Regulatory Commission "Regulatory Guide 3.11 – Design, Construction, and Inspection of Embankment Retention Systems at Uranium Recovery Facilities" January 2008.

CLOSURE

This report has been prepared for the exclusive use of our client, AUC LLC, for a slope stability and settlement evaluation of the proposed Reno Creek in-situ uranium recovery facility. Any future written documents that address comments or questions regarding this report, constitute the "entire report". Inberg-Miller Engineers' conclusions, opinions, and recommendations are based on the entire report.

INBERG-MILLER ENGINEERS

Ben Hauser, P.E., G.I.T.
Geotechnical Engineer

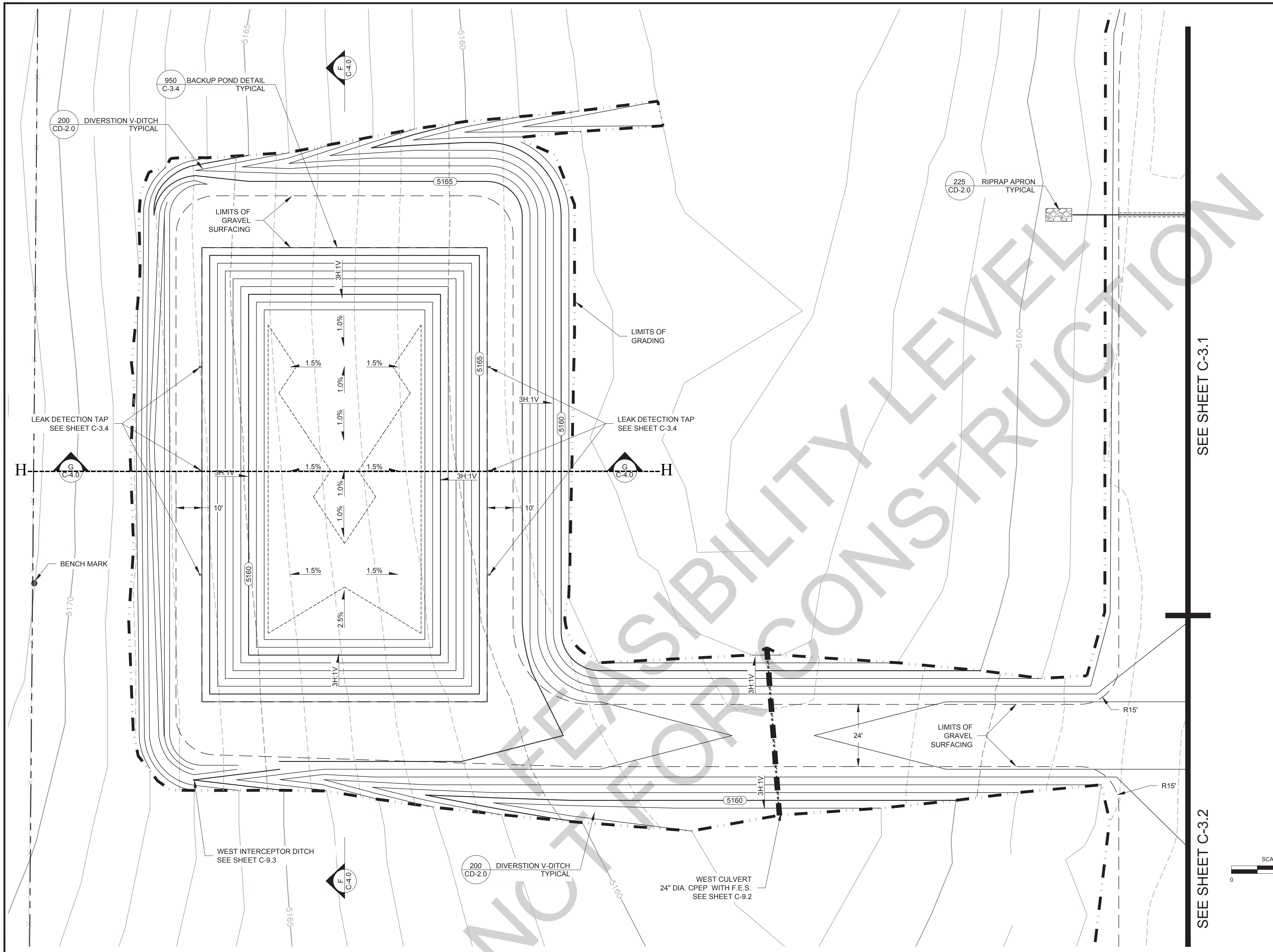
REVIEWED BY:

Steven F. Moldt, P.E.
President

BH:SFM\\IME01\projects\17590-CX AUC LLC Reno Creek Stability\Stability\17590-CX Slope Stability REVISED Report.docx

Professional Engineer (Civil)
BEN HAUSER
13592
Date 9/12/14
WYOMING

APPENDIX A



N

SCALE IN FEET

0 20 40

NOTES:

1. CULVERT SIZING AND DITCH LOCATIONS TO BE FINALIZED ON 95% SUBMITTAL WITH FINAL PLACEMENT AND LOCATIONS OF EQUIPMENT
2. CONTRACTOR TO SMOOTH TRANSITIONS IN GRADING
3. SLOPES TO BE SEEDED AND REVEGETATED AS PER THE SWPPP
4. PIPING TO AND FROM THE POND NOT SHOWN FOR CLARITY

BACKUP POND
TOP AREA OF POND = 0.44 ac
TOTAL DEPTH = 8.0'
OPERATING LEVEL DEPTH = 6.0'
FREEBOARD = 2.0'
TOTAL VOLUME = 105,000 CF
OPERATING VOLUME = 70,000 CF

Dig Safely.
If you need a locate please call this number 811 or 800-849-2476

DRAWING REVISIONS TYPES: 1 PRE-BID 1 POST-BID 1 POST IFC

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PROJECT NO.:	CADD:	CHECKED BY:	APPROVED BY:	PLOT DATE:
2012-250	TBK	RRU	SLH	10/2/2012 3:31 PM

GRADING: BACKUP POND
RENO CREEK PROJECT
PREPARED FOR
AUC LLC
CAMPBELL COUNTY, WYOMING

SHEET
C-3.3

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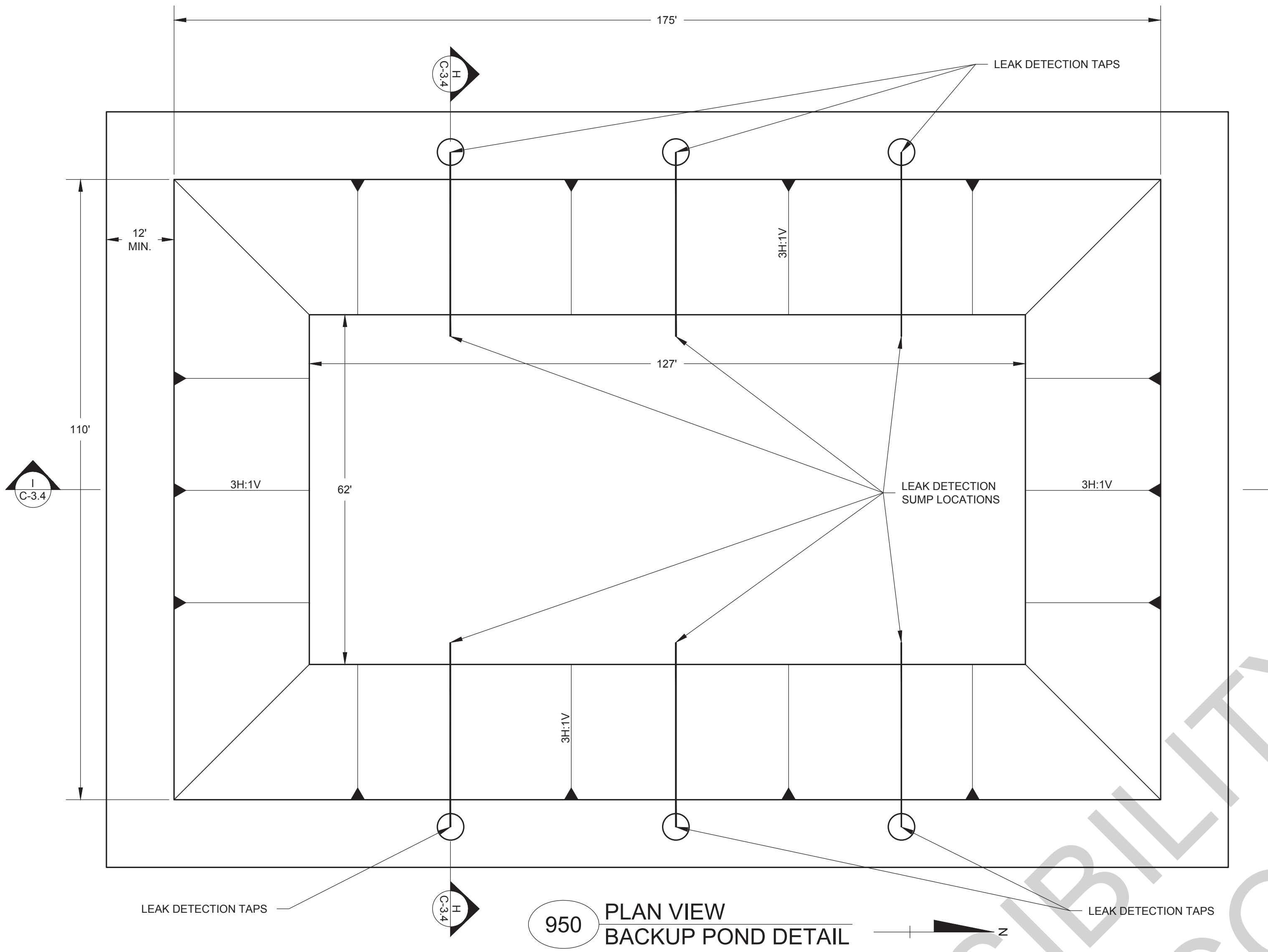
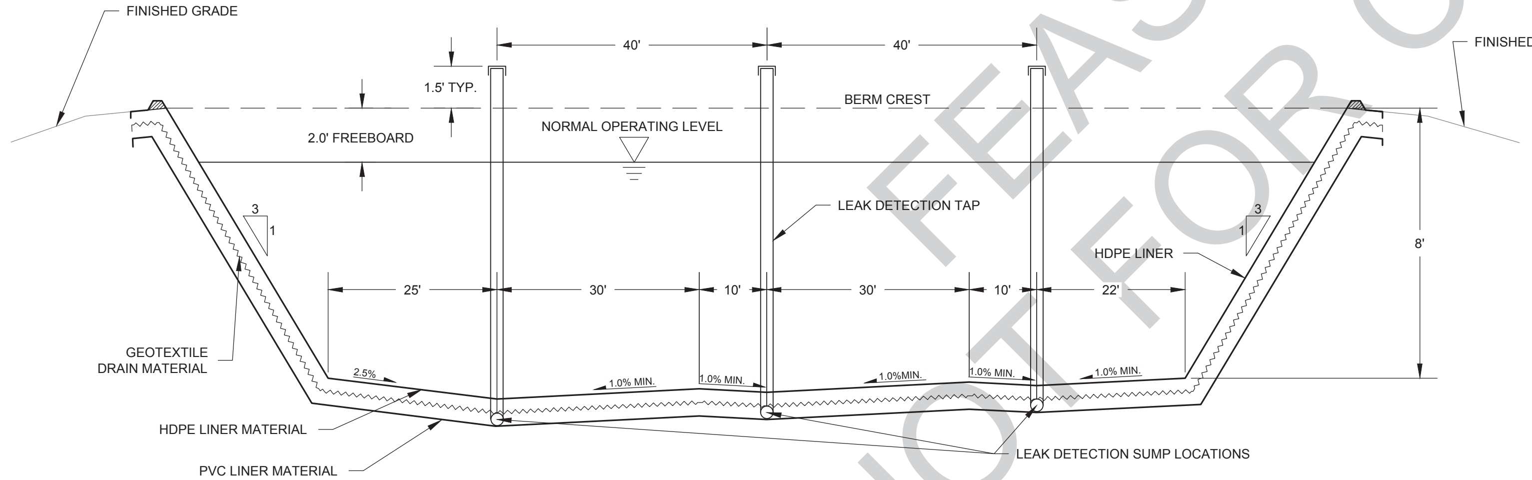


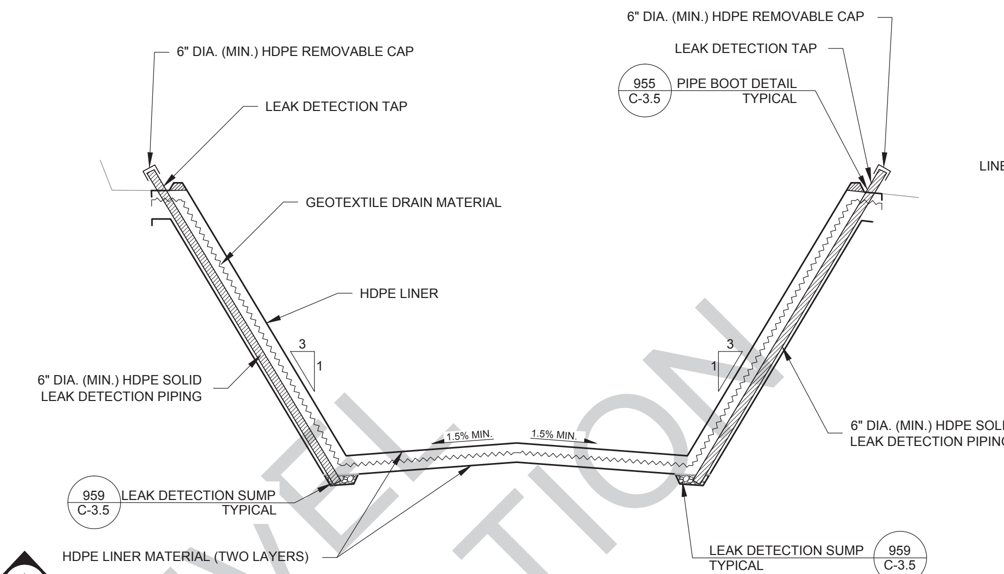
950 PLAN VIEW
BACKUP POND DETAIL
NTS



II CROSS SECTION: BACKUP POND NORTH/SOUTH
BACKUP POND DETAIL
NTS

NOTE:

1. LINER SUB-BASE PREPARATION OF NATIVE SOILS TO BE COMPACTED TO 95% (MIN.) OF STANDARD PROCTOR



NOTE:

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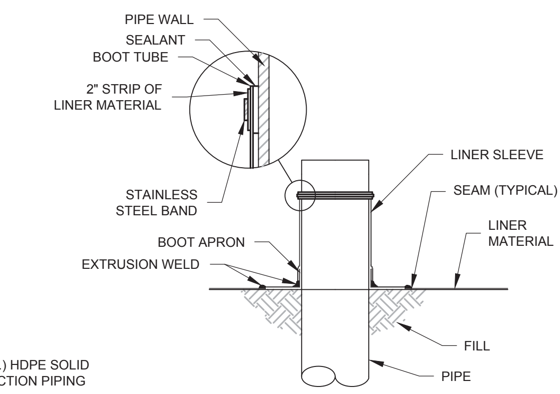
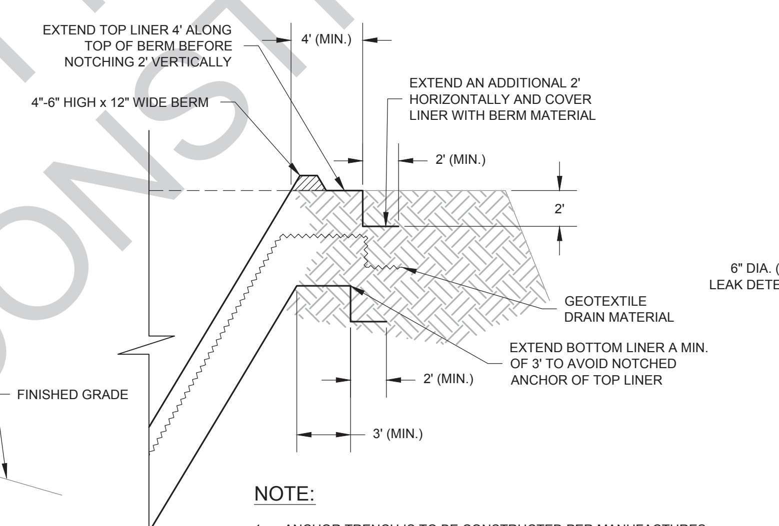
HH CROSS SECTION: BACKUP POND EAST/WEST
BACKUP POND DETAIL
NTS



955 PIPE BOOT DETAIL
BACKUP POND DETAIL
NTS



NOTE:

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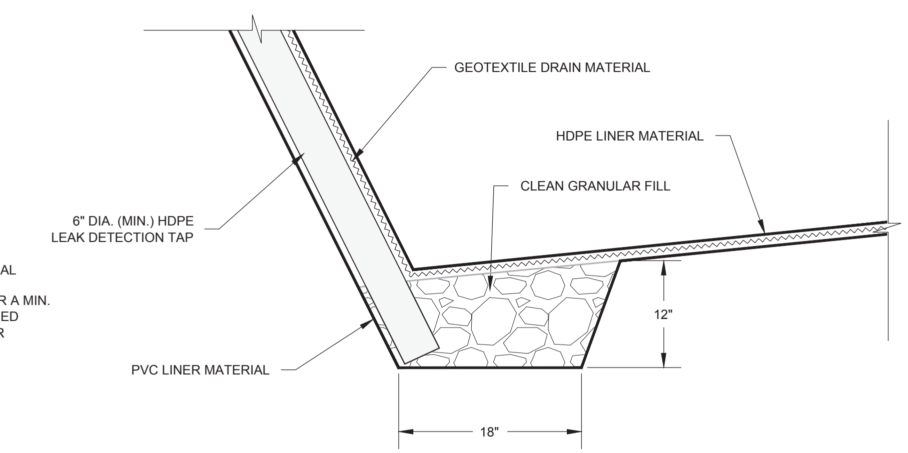
957 LINER ANCHOR DETAIL
BACKUP POND DETAIL
NTS



959 LEAK DETECTION SUMP
BACKUP POND DETAIL
NTS

NOTES:

1. ALL LINER PRODUCTS ARE TO BE INSTALLED PER MANUFACTURES RECOMMENDATIONS
2. LEAK DETECTION TAP: 6" MIN. DIA. HDPE PIPE
3. LEAK DETECTION TAPS USED AS WATER RETRIEVAL POINTS

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GRADING: BACKUP POND DETAILS
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PREPARED FOR
AUC LLC
CAMPBELL COUNTY, WYOMING

SHEET
C-3.4

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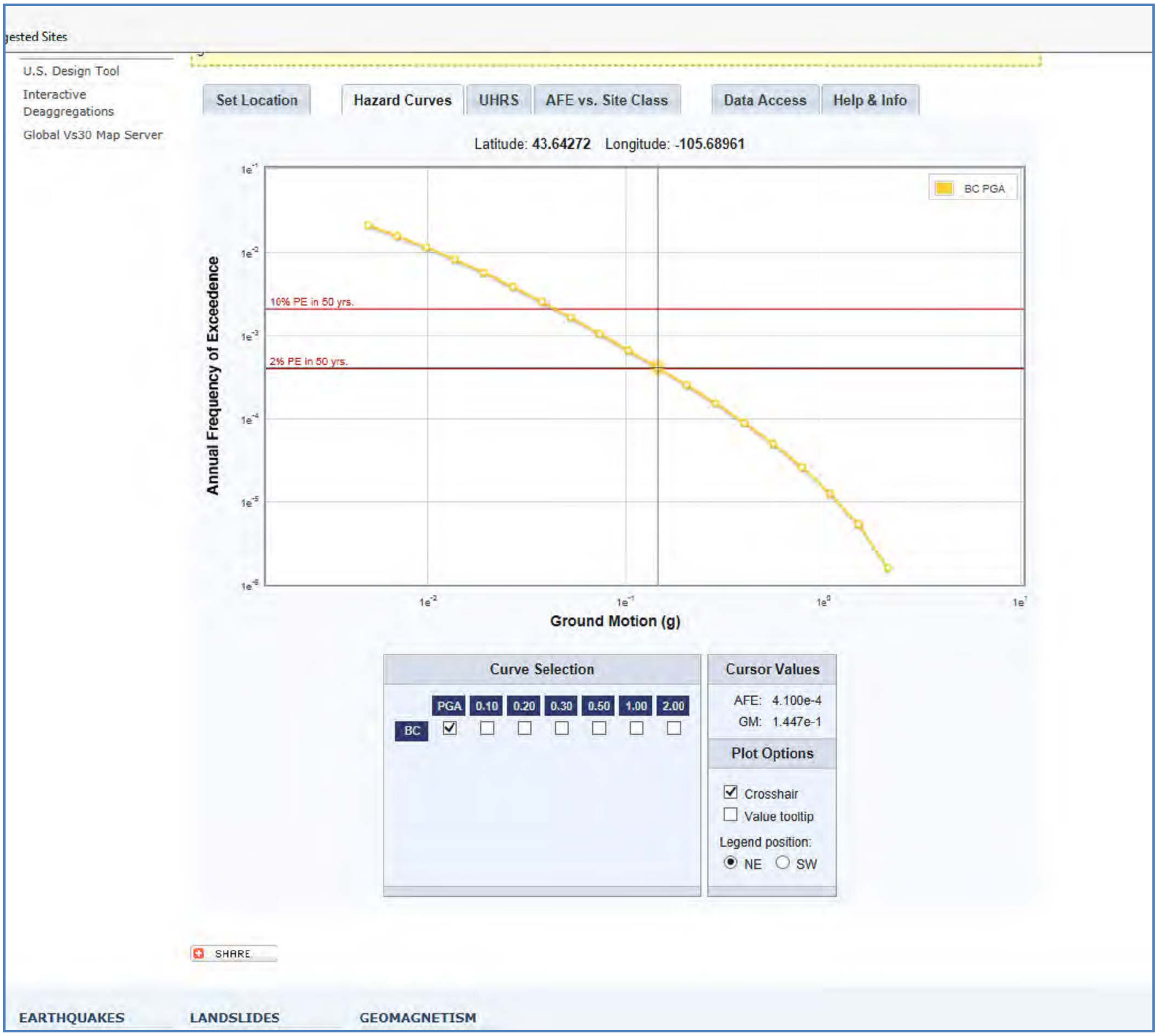
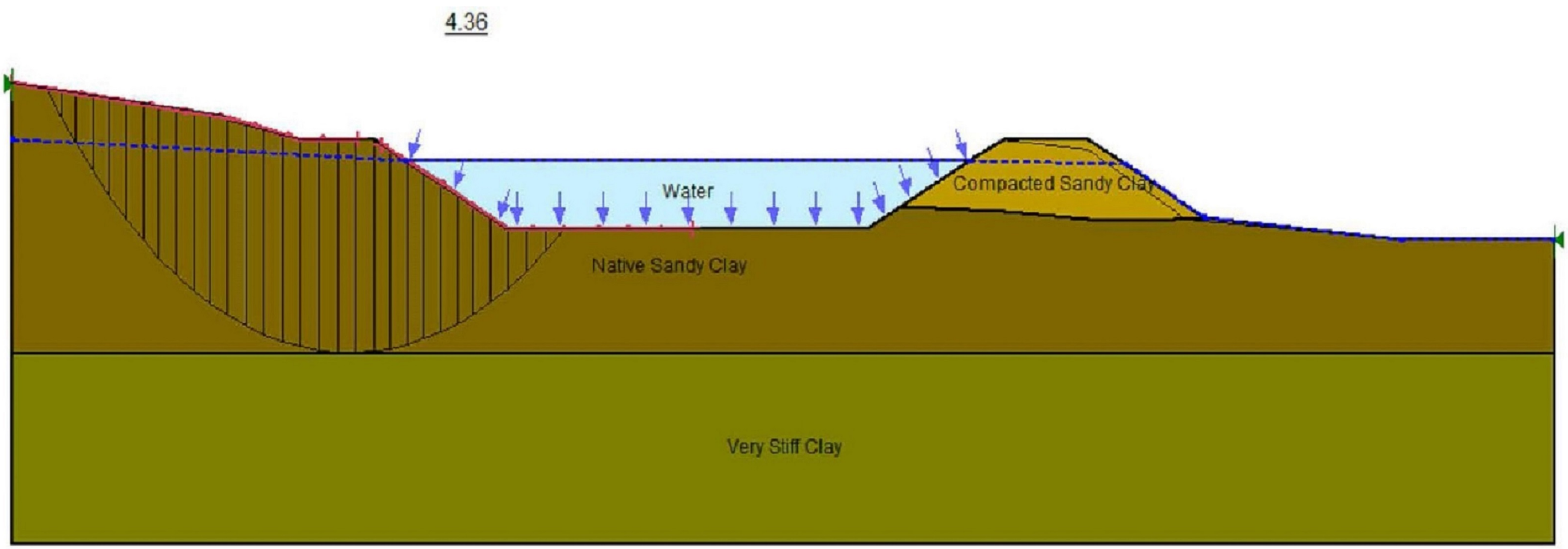


gested Sites
U.S. Design Tool
Interactive Deaggregations
Global Vs30 Map Server
Set Location
Hazard Curves
UHRS
AFE vs. Site Class
Data Access
Help & Info
Latitude: 43.64272 Longitude: -105.68961
BC PGA
10% PE in 50 yrs.
2% PE in 50 yrs.
Annual Frequency of Exceedence
Ground Motion (g)
Curve Selection
PGA 0.10 0.20 0.30 0.50 1.00 2.00
BC
Cursor Values
AFE: 4.100e-4
GM: 1.447e-1
Plot Options
Crosshair
Value tooltip
Legend position:
NE SW
SHARE
EARTHQUAKES
LANDSLIDES
GEOMAGNETISM

Appendix B

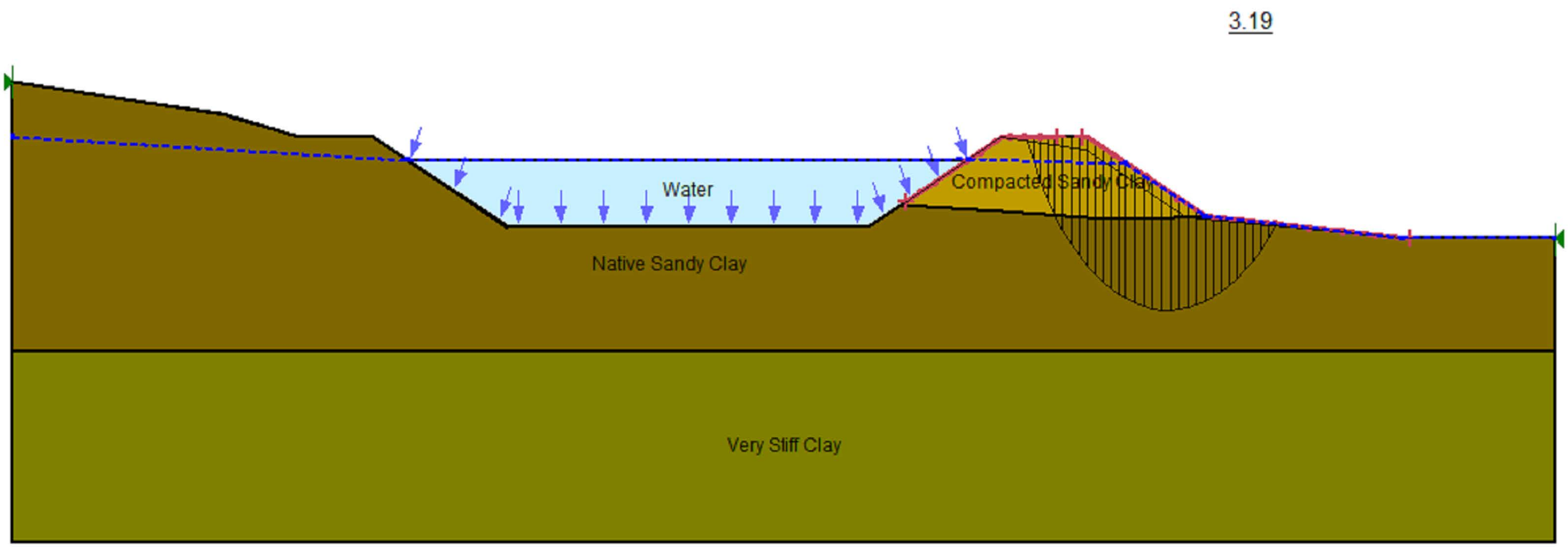
Static analysis for cross-section H-H using the Morgenstern-Price methodology (Entry and Exit) (July 29, 2014) (Not to scale)



Material properties

Compacted Sandy Clay	Tan	Soil model = Mohr-Coulomb, γ = 135 pcf,	C = 400 psf,	ϕ = 20°.
Native Sandy Clay	Brown	Soil model = Mohr-Coulomb, γ = 125 pcf,	C = 300 psf,	ϕ = 20°.
Very Stiff Clay	Olive	Soil model = Mohr-Coulomb, γ = 135 pcf,	C = 1,000 psf,	ϕ = 10°.

Static analysis for cross-section H-H using the Morgenstern-Price methodology (Entry and Exit) (July 29, 2014) (Not to scale)



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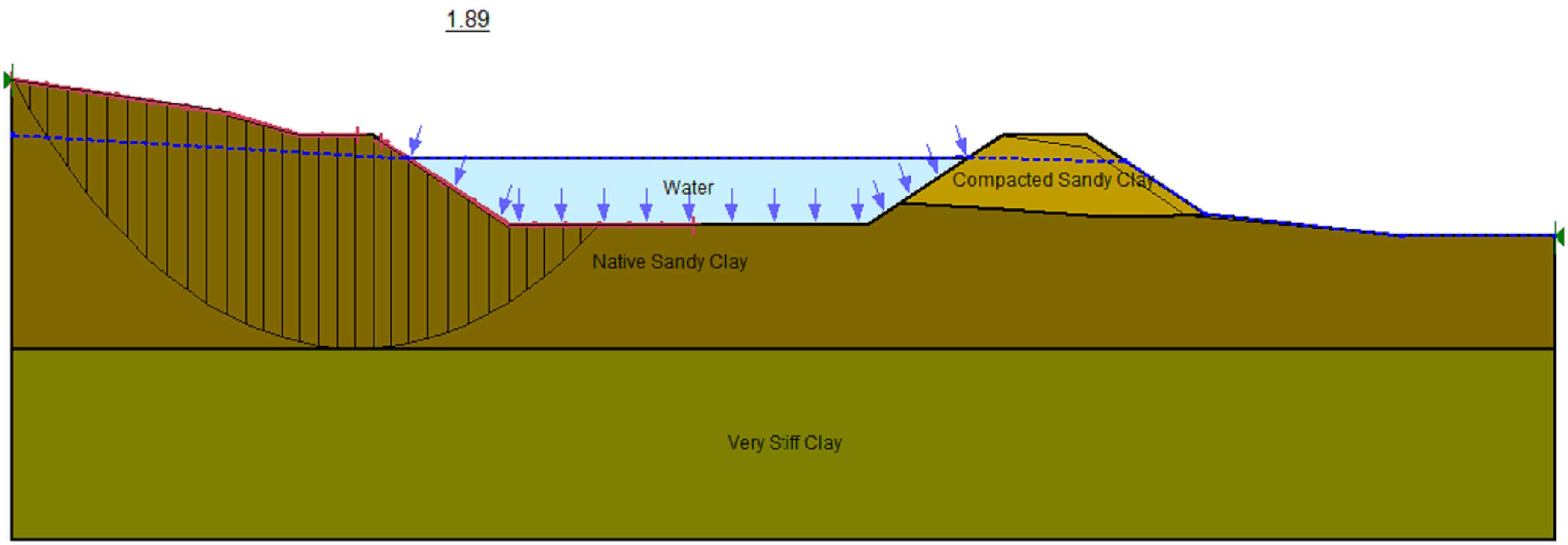
Psuedo-static analysis (PHGA = 0.1447) for cross-section H-H using the Morgenstern-Price methodology (Entry and Exit) (July 29, 2014) (Not to scale)



Material properties

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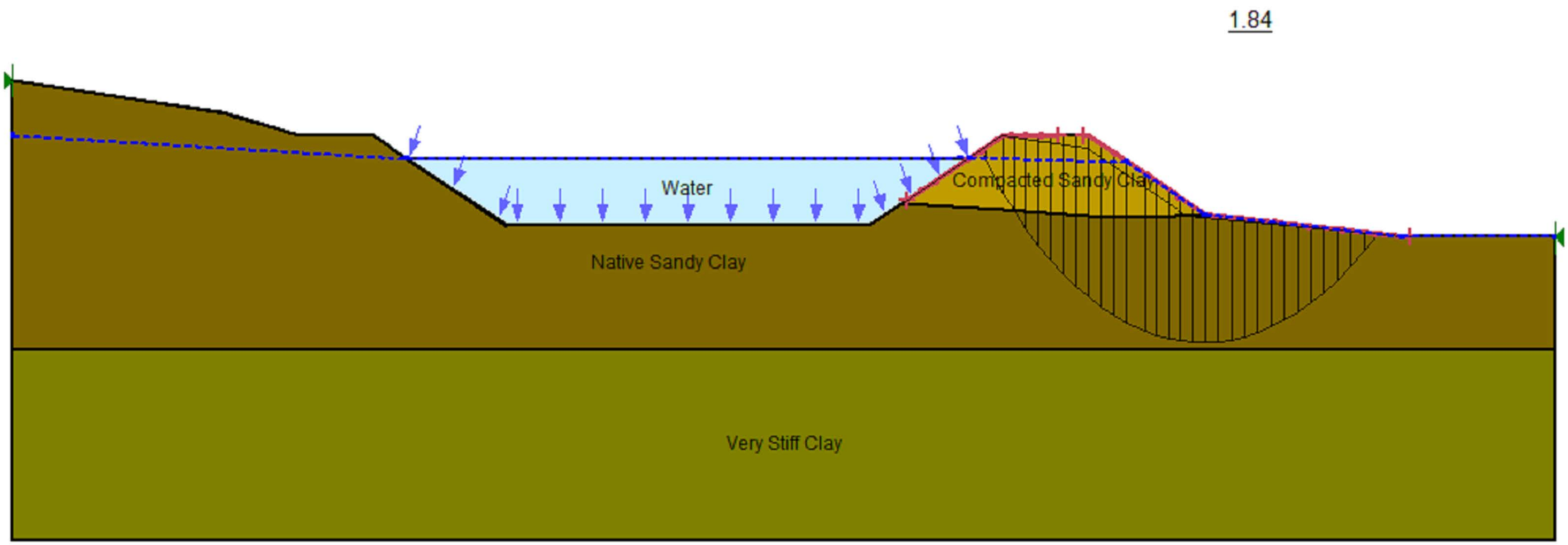

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riverton@inberg-miller.com

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307-577-0806
307-472-4402 (fax)
casper@inberg-miller.com

350 Parsley Boulevard
Cheyenne, WY 82007
307-635-6827
307-635-2713 (fax)
cheyenne@inberg-miller.com

193 W Flaming Gorge Way
Green River, WY 82935
307-875-4394
307-875-4395 (fax)
greenriver@inberg-miller.com

830 E. Richards Suite #1
Douglas WY 82633
307-359-7000
307-460-7600 (fax)
ctwiford@inberg-miller.com

APPENDIX B:
Embankment Settlement Analysis

September 12, 2014 17590-CX

Leland Huffman
AUC, LLC
1536 Cole Boulevard, Suite 330
Lakewood, CO 80401

RE: Embankment Settlement Analysis
Reno Creek Project
Wright, Wyoming

Dear Mr. Huffman:

Project Information

We understand that a backup storage pond, having approximate dimensions of 100 feet by 200 feet, is anticipated to consist of a HDPE geomembrane liner placed above a drainage geonet for leak detection. The depth of the pond is 8 feet while the operating level will be 6 feet. The pond will be constructed on a sloping site, with the majority of the pond within excavation and the down slope embankment being approximately 7 feet of fill. The settlement analysis was performed for the final construction condition.

Embankment Settlement Analysis

A settlement analysis of the proposed pond was completed using the site specific material properties. The model predicts the approximate settlement which can be expected within the embankment after final construction grading has been completed. The maximum settlement of 0.35 feet occurred in the eastern embankment of the proposed pond where approximately 7.1 feet of fill will be placed on the native sandy clay. The analysis is attached. It should be noted that no analysis of the tensile strain of the geosynthetics has been completed. This is primarily due to the fact that the geosynthetics specifications were not available at the time of this report. As the pond design progresses the specified geosynthetics should be designed to allow for the approximate 5 percent strain expected.

References

Inberg-Miller Engineers "Subsurface Exploration and Geotechnical Engineering Report – Reno Creek Project Campbell County, Wyoming", July 9, 2012

Nuclear Regulatory Commission "Regulatory Guide 3.11 – Design, Construction, and Inspection of Embankment Retention Systems at Uranium Recovery Facilities" January 2008.

Closure

This letter has been prepared for the exclusive use of our client, AUC LLC, for a settlement evaluation of the proposed Reno Creek in-situ uranium recovery facility. All information referenced in the letter, as well as any future written documents that address comments or questions regarding this letter, constitute the “entire report”. Inberg-Miller Engineers’ conclusions, opinions, and recommendations are based on the entire report.

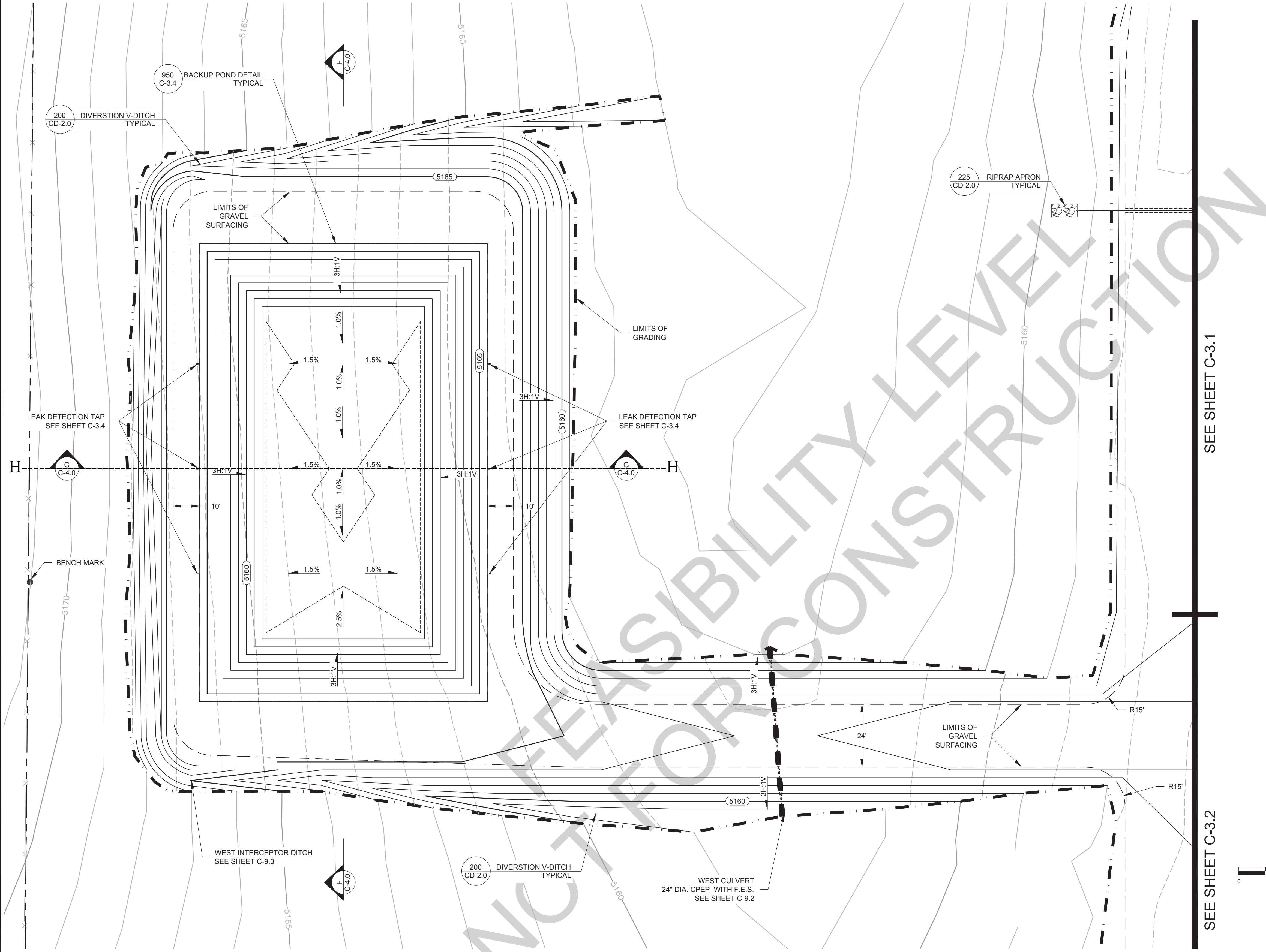
If you have any questions, please contact us at 307-577-0806.

Sincerely,

INBERG-MILLER ENGINEERS

Ben Hauser, P.E., G.I.T.
Geotechnical Engineer

BH:cno\\\IME01\projects\17590-CX AUC LLC Reno Creek Stability\Settlement Analysis Letter.docx



FEASIBILITY LEVEL NOT FOR CONSTRUCTION

NOTES:

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2. CONTRACTOR TO SMOOTH TRANSITIONS IN GRADING
3. SLOPES TO BE SEEDED AND REVEGETATED AS PER THE SWPPP
4. PIPING TO AND FROM THE POND NOT SHOWN FOR CLARITY

BACKUP POND
TOP AREA OF POND = 0.44 ac
TOTAL DEPTH = 8.0'
OPERATING LEVEL DEPTH = 6.0'
FREEBOARD = 2.0'
TOTAL VOLUME = 105,000 CF
OPERATING VOLUME = 70,000 CF

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GRADING: BACKUP POND
RENO CREEK PROJECT
PREPARED FOR
AUC LLC
CAMPBELL COUNTY, WYOMING

SHEET
C-3.3

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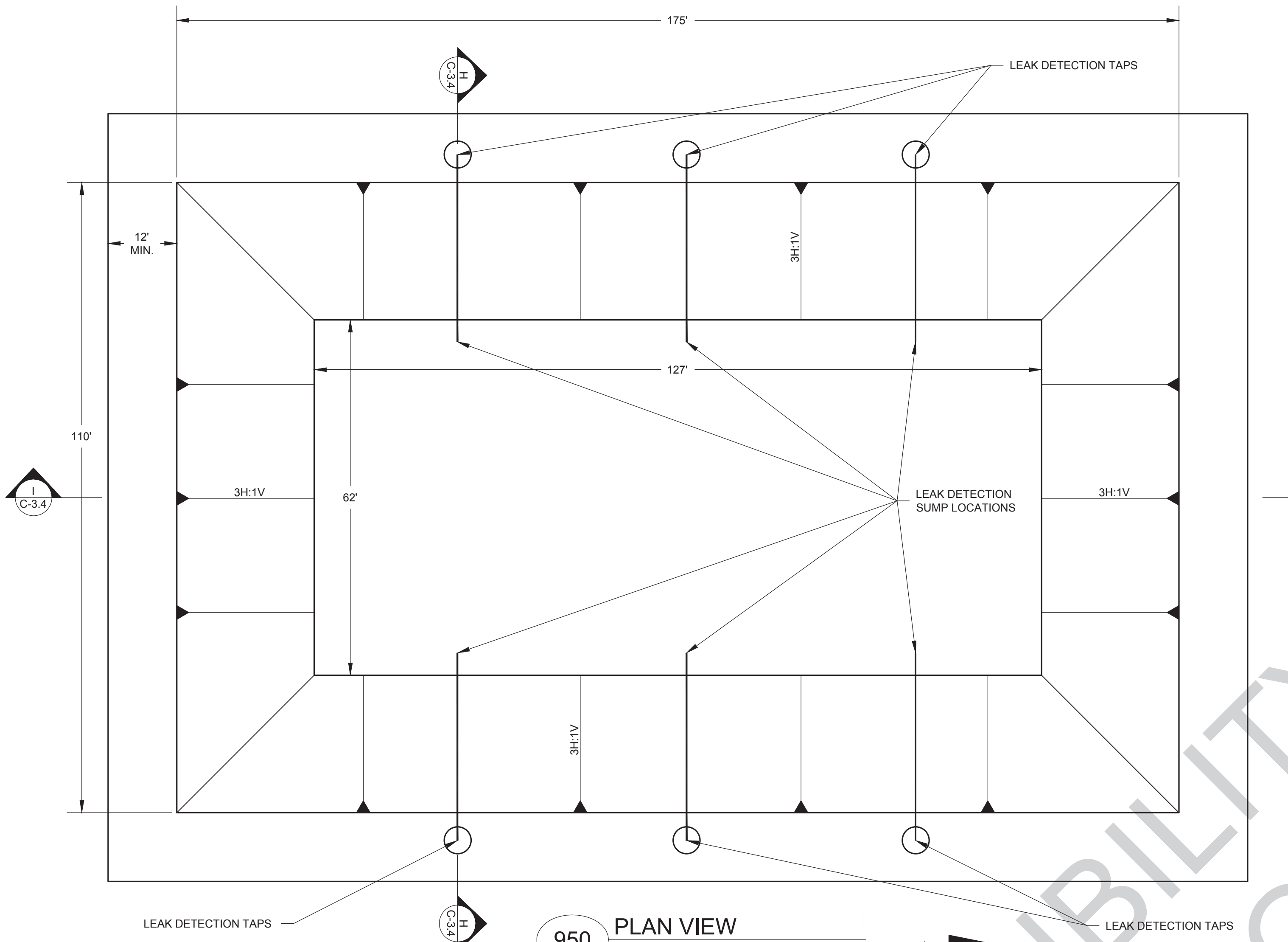
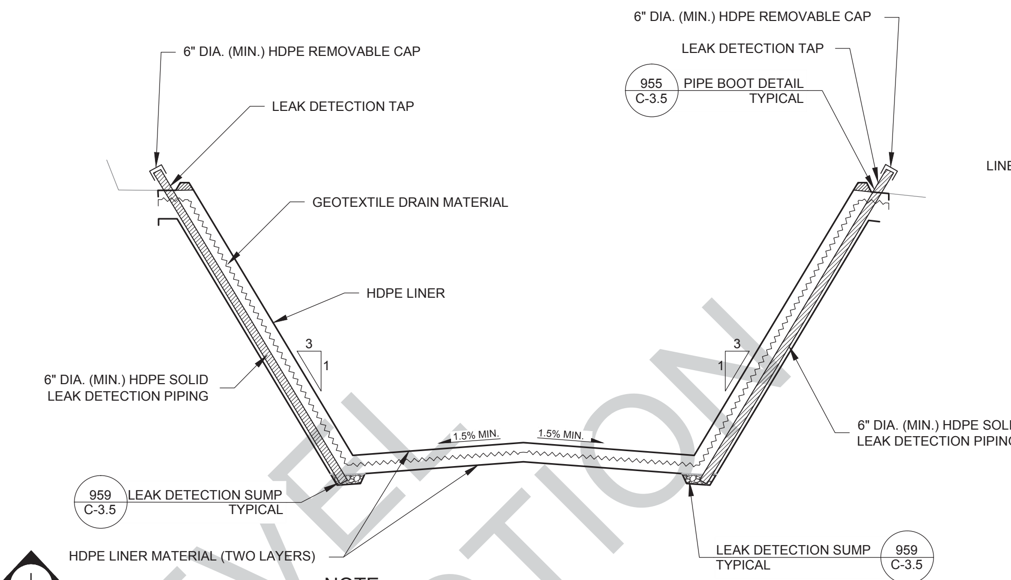


950 PLAN VIEW
BACKUP POND DETAIL
NTS



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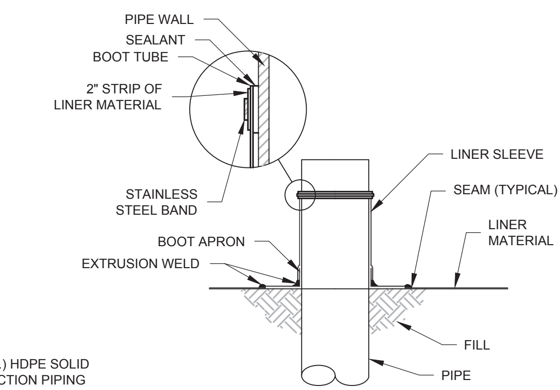
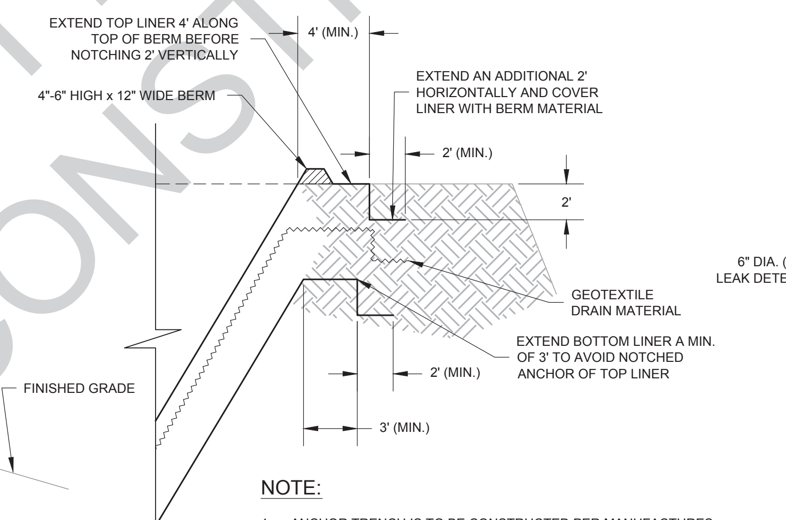
HH CROSS SECTION: BACKUP POND EAST/WEST
BACKUP POND DETAIL
NTS



955 PIPE BOOT DETAIL
BACKUP POND DETAIL
NTS



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BACKUP POND DETAIL
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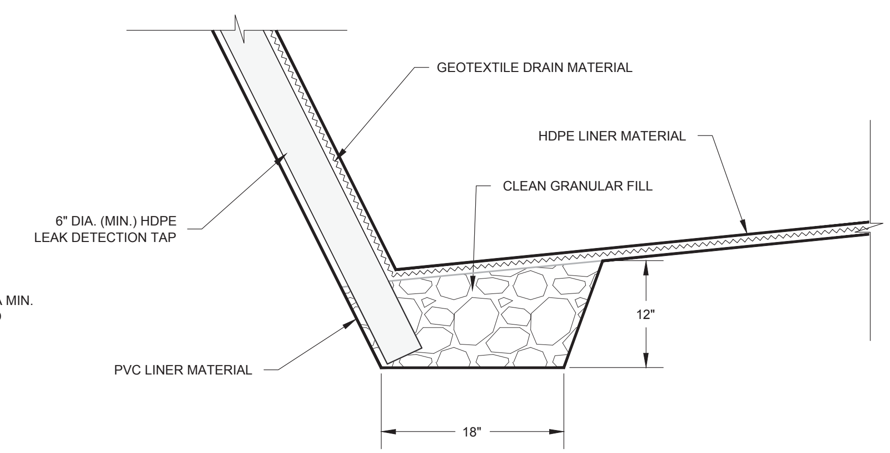

959 LEAK DETECTION SUMP
BACKUP POND DETAIL
NTS

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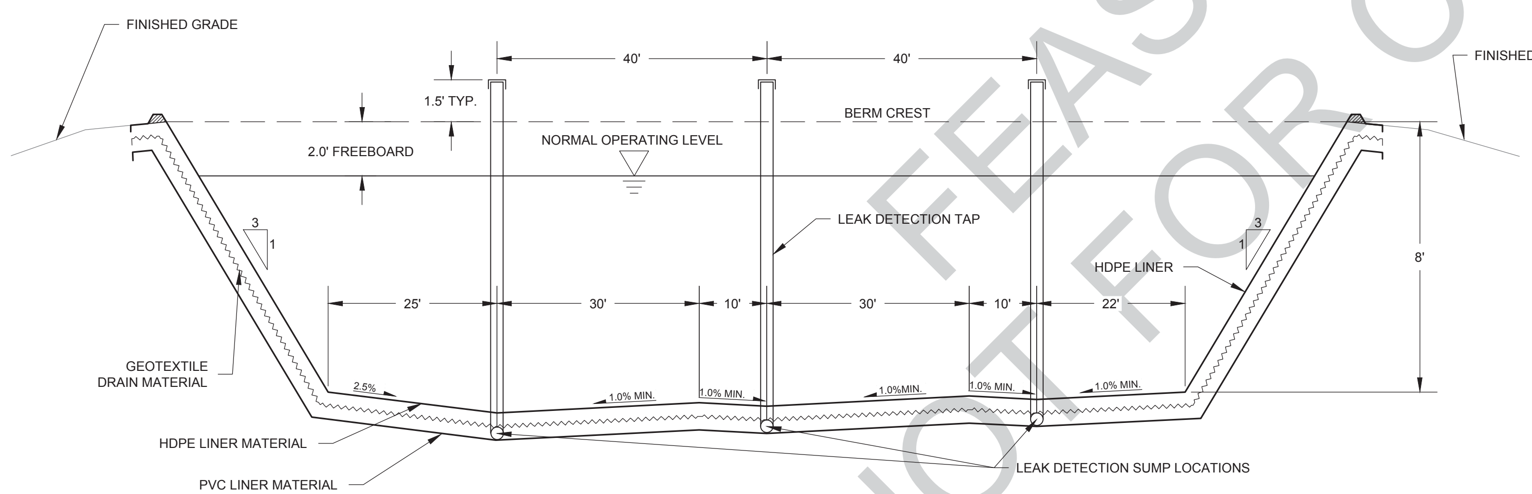

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RENO CREEK PROJECT
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CAMPBELL COUNTY, WYOMING

SHEET
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Change in Grade After Settlement
Section H-H
Initial Grade
Final Grade
5168
5166
5164
5162
5160
5158
5156
Elevation (ft)
0
50
100
150
200
250
300
Length (ft)

Embankment Settlement Table - Section H-H

Point	Initial Elevation (ft)	Fill Depth (ft)	Settlement (ft)	Final Elevation (ft)	Stationing (ft)
A	5166.3	0	0.00	5166.30	64
B	5158	0	0.00	5158.00	88
C	5158	0	0.00	5158.00	152
D	5161.7	1.7	0.13	5161.57	163
E	5166	6.5	0.34	5165.66	176
F	5166	7.1	0.35	5165.65	191
G	5162.6	3.9	0.24	5162.36	201
H	5159	0	0.00	5159.00	212
I	5157	0	0.00	5157.00	247

APPENDIX C:
NRC Requests Related to RAI 74

NRC REQUESTS RELATED TO RAI 74

The applicant needs to respond to the following information requests:

a(1) Identify the air concentration limit for Radon-222 that it will use to determine compliance with 10 CFR 20.1301 and 10 CFR 20.1302 during operations.

a(2) Provide an explanation and identify how radon (radon-222) progeny will be factored into analyzing potential public dose from operations consistent with 10 CFR Part 20, Appendix B, Table 2.

b) Provide an explanation of how, in accordance with 10 CFR 40.65, the quantity of the principal radionuclides from all point and diffuse sources will be accounted for, and verified by, surveys and/or monitoring.

The NRC also provided additional clarifications related to the above request:

1) *Identify all potential air and gaseous effluent release points.*
2) *Discuss how each potential air and gaseous effluent release point will be monitored and how this information (or data) will be incorporated into the 10 CFR 40.65 report.*
3) *Discuss the type of radiation measuring device and measurement of the effluent and how the measurements will be converted to a total quantity (expressed in Curies) and a release rate (Curies per unit time).*
4) *Discuss how the measurements from each potential air and gaseous effluent release point will be expressed as a quantity (as described in 10 CFR 40.65).*
5) *If the applicant chooses to measure at a fence line (or restricted or control area), the applicant should demonstrate how the data from the measurements at a fence line will be extrapolated back to an effluent release point to identify the quantities of the principal radionuclides released to the environment.*

c) *Discuss how it will employ this method to demonstrate compliance during operations, including if it intends to differentiate the radon concentration from the plant and the radon concentration from background.*

d) Evaluate and provide a description of the member(s) of the public likely to receive the highest exposure from licensed operations consistent with 10 CFR 20.1302.

NRC Information Request a(1)

Identify the air concentration limit for Radon-222 that it will use to determine compliance with 10 CFR 20.1301 and 10 CFR 20.1302 during operations.

a(1) Response

To determine compliance with 10 CFR 20.1301 and 10 CFR 20.1302, AUC will use the 10 CFR 20 Appendix B, Table 2 air concentration limit for Radon-222 with daughters present.

NRC Information Request a(2)

Provide an explanation and identify how radon (radon-222) progeny will be factored into analyzing potential public dose from operations consistent with 10 CFR Part 20, Appendix B, Table 2.

a(2) Response

The following text has been added to TR Section 5.7.1 identify how radon (radon-222) progeny will be factored into analyzing potential public dose from operations:

"10 CFR 20.1302 requires demonstration by measurement or calculation that the total effective dose equivalent to the individual likely to receive the highest dose from the licensed operation does not exceed the annual dose limit. A dose assessment using a combination of measured and calculated values will be employed by AUC to show compliance with this regulation.

Radtrak monitoring devices will be placed near the locations of the maximally exposed member(s) of the public. Annual average radon concentrations as measured by these Radtrak devices will be employed in the annual dose calculations required by 10 CFR 20.1302. Meeting the dose limit, radon progeny included, requires measurement of very small differences between the natural background concentration and any excess concentration associated with AUC facility releases. Radon background values, determined using data from AUC air sampler station AM#6-2 (see TR Figure 2.9-1 for the AM#6-2 location) will be subtracted from other measured values before determining annual dose to individual(s). Unless this background correction is applied, natural variations in ambient radon concentrations could lead, in error, to reported doses in excess of the public dose limit. The locations of the most-highly-exposed individuals, per current MILDOS calculations using site meteorological data, are noted in the Reno Creek application Technical Report's MILDOS assessment, Addendum 7-A to the current TR revision.

Background radon, most of which is released from natural soils at relatively large distances from the AUC facility, results in decay products on the AUC site which have had much greater time periods to grow toward equilibrium than AUC-process-related radon decay products. Background-associated radon progeny will generally be at much higher equilibrium ratios than AUC release-related progeny. Doses calculated using the higher equilibrium fractions would be higher than doses calculated using the actual equilibrium fractions associated with radon released from the AUC facilities. AUC will not assume that its operations-associated radon progeny are at or near equilibrium with radon at the

locations where dose is to be calculated. AUC will instead use project-specific equilibrium fractions to determine public dose.

The actual equilibrium ratios associated with Project-related releases cannot readily be measured in the field at the low radon progeny concentrations required to show compliance with the public dose limits. Even if such measurements were feasible, an unknown and potentially large fraction of the result would be associated with background radon progeny, for the reasons just discussed. It is not possible to separate the two values based on field measurements. A value measured using the modified Kusnetz method would be intermediate between the two, leading to calculation of doses that may be significantly higher than those actually associated with AUC's operations.

Therefore, the MILDOS computer code will be used by AUC to calculate the AUC-release-associated radon/progeny equilibrium fractions at the Radtrak monitors located at the operational air sampling stations, and at other locations as required. This combination of radon concentrations measured at the operational monitoring stations, and calculated equilibrium ratios based on source-specific releases and locations, provides the most accurate method to determine radon and progeny dose in unrestricted areas.

The radon source terms used in MILDOS to determine the location-specific equilibrium fractions will be those developed for the CPP/Production Areas. Source term development is described in, "I. Specification of Emissions from the General Central Processing Plant Area", Page 10 of this document, and, "II. Specification of Emissions from the Production Units", Page 14.

MILDOS is an appropriate system to use to determine facility-specific equilibrium fractions, using the Reno Creek site-specific meteorological data. (Please see the inset discussion, "Comparison of Predicted Rn Concentrations to Measured Rn Concentrations", found on Page 15 of this document, for a summary of measurement data useful in the evaluation of MILDOS' utility to predict radon and decay product concentrations in air.) The MILDOS code is currently being revised to add user options and more efficient input of parameters. The new version has not yet been released, but the MILDOS methodology used to calculate radon decay product equilibrium fractions has remained the same since its initial development. The project manager for the MILDOS revision recently confirmed by telephone with AUC consultant staff that, through Version 3.10 of MILDOS, released in February 2012, concentrations of radon decay products and working levels are based on calculations described in NUREG/CR-0553, also known as the Uranium Dispersion and Dosimetry Code (UDAD), discussed below.

The ingrowth of radon decay products is dependent on the radioactive half-lives and the transit time from the release point to the modeled receptor location. As given in the UDAD report Eq. 3.2, the concentration of radon daughters is given by:

$$\chi_n(r) = \chi_1(r)\left(\prod_{i=2}^{n}\frac{0.693}{T_i}\right)\left\{\sum_{i=1}^{n}\left[\frac{\exp\left(-0.693\, r/T_i u\right)}{\prod_{\substack{j=1\\ j\neq i}}^{n} 0.693\left(\frac{1}{T_j}-\frac{1}{T_i}\right)}\right]\right\}$$

for n= 2-7; i is the i^{th} radionuclide in the table below.

Radionuclide	Decay type	Half-life	n	E_n (MeV)	L_n x 10^6 ($WL/pCi/m^3$)
Rn-222	Alpha	3.8 days	1	5.49	-----
Po-218	Alpha	3.05 min	2	6.00	1.03
Pb-214	Beta	26.8 min	3	-----	5.07
Bi-214	Beta	19.7 min	4	-----	3.73
Po-214	Alpha	10^{-6} min		7.68	Negligible
Pb-210	Beta	22 yrs	5	-----	-----
Bi-210	Beta	5 days	6	-----	-----
Po-210	Alpha	143 days	7	5.31	-----

The Working Level is defined as any combination of short-lived radon daughters in one liter of air that will result in the ultimate emission of 1.3 x 10^5 MeV of alpha energy. Working levels in UDAD eq. 3.3 are determined by:

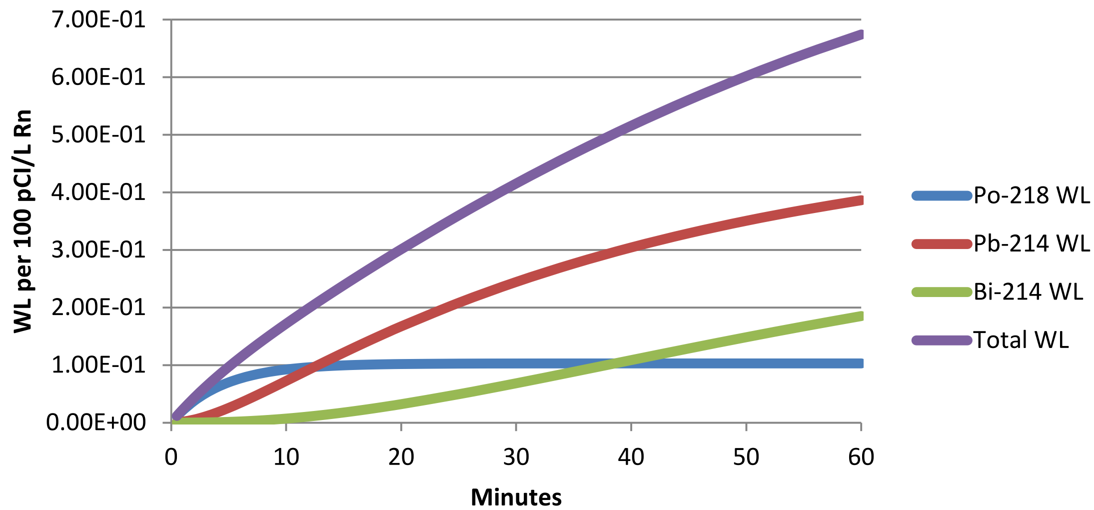
$$WL(r,\theta) = \sum_{n=2}^{4} L_n \chi_n(r,\theta)$$

where X_n is the nth radon daughter concentration calculated by eq. 3.2, and L_n is the working level conversion factor for radon daughter n, given by:

$$L_n = \frac{2.846 \times 10^{-10}}{\lambda_n}\sum_{j=n}^{4} E_n(\alpha) \quad \frac{WL}{pCi/m^3}$$

and $E_n(\alpha)$ is the potential alpha energy for the n^{th} radon daughter as shown in the table above.

Example results are shown in the figure below.



The average time of flight of the radon from its release point to a modeled receptor is calculated by MILDOS from meteorological data input by the user. Within 60 minutes of the release of radon gas, total working level reaches nearly 70% of the equilibrium value. For the AUC facility and its average wind speeds, a packet of radon released from either the CPP or any of the proposed production areas would reach the site boundary and nearest residents within average times much shorter than this, indicating that equilibrium fractions much less than unity are appropriate for the facility's dose calculations.

Dose Determination Method Summary:

Because:

1) Radon-associated dose is largely a function of the radon progeny ingrowth fraction, and

2) An attempt to directly measure the equilibrium ratio associated with radon released by the Reno Creek facility, in an environment heavily influenced by natural background values, will lead to incorrect results, and

3) Use of an equilibrium ratio approaching unity would lead to dose determinations that may be significantly higher than reality.

AUC will use MILDOS to calculate source-weighted (see below), location-specific equilibrium fractions to calculate dose to the most-highly-exposed member(s) of the public.

This methodology uses MILDOS to apply site-derived meteorological data and the known radon sources (the CPP and the active production areas), to calculate the sum of the source-specific radon concentrations at each target location. This approach represents an appropriate methodology, since an ISR's radon source term typically arises at widely-separated locations on a site. A single-source estimate of the AUC-releases-related equilibrium fraction would not be representative. AUC will determine equilibrium fractions directly from the MILDOS output.

Public dose determination is *not* based on MILDOS calculations of radon concentrations using this approach; it is based on actual radon measurements. Radtrak units, operated in accordance with AUC and Landauer protocols to optimize sensitivity and accuracy (see, "Discussion: Enhancing Radtrak Accuracy", Page 18 of this document) provide actual radon concentration data for the dose calculations.

This approach was discussed in a presentation by Dr. H.R. Meyer at a recent conference in Corpus Christi, Texas. That presentation is being transmitted with this RAI response package; development of a source-weighted, location-specific equilibrium fraction is covered in detail in the presentation.

Using the Radtrak-measured radon concentrations from the operational air monitoring stations, and the MILDOS-calculated, source-weighted equilibrium fractions, doses will be calculated annually for the individual(s) determined to be the most highly exposed member(s) of the public. Occupancy factors will be taken into account for these calculations.

NRC Information Request (b)

Provide an explanation of how, in accordance with 10 CFR 40.65, the quantity of the principal radionuclides from all point and diffuse sources will be accounted for, and verified by, surveys and/or monitoring.

The NRC later provided additional clarification items related to this request:

1) *Identify all potential air and gaseous effluent release points.*
2) *Discuss how each potential air and gaseous effluent release point will be monitored and how this information (or data) will be incorporated into the 10 CFR 40.65 report.*
3) *Discuss the type of radiation measuring device and measurement of the effluent and how the measurements will be converted to a total quantity (expressed in Curies) and a release rate (Curies per unit time).*
4) *Discuss how the measurements from each potential air and gaseous effluent release point will be expressed as a quantity (as described in 10 CFR 40.65).*
5) *If the applicant chooses to measure at a fence line (or restricted or control area), the applicant should demonstrate how the data from the measurements at a fence line will be extrapolated back to an effluent release point to identify the quantities of the principal radionuclides released to the environment.*

NRC Information Request b(1)

Identify all potential air and gaseous effluent release points

b(1) Response

The following text has been added to TR Section 5.7.7.2 to identify all potential air and gaseous effluent release points for radon:

"AUC expects radon-222 to be the primary radioactive airborne effluent to be released from the Central Processing Plant (CPP). However, because radon will decay during residence time in the CPP, radon decay products will also be released from the CPP ventilation system. The Reno Creek CPP will contain columns and tanks that will require venting to atmosphere either in a batch mode or continuously. As discussed in TR Section 4.2, separate, independent ventilation systems consisting of ducting and/or piping attached to the points of release will be installed for all indoor process tanks and vessels where radon could be expected. The Reno Creek Project processes that may release radon or its decay products are listed below. In some cases vented tanks will be connected to the same release vent through a manifold.

- Ion exchange columns: The down flow IX columns are under pressure during normal operations. When the resin gets fully loaded, the resin will be transferred from the column to the elution circuit. In order to transfer the resin, the column must be de-pressurized by venting the column to outdoor atmosphere. All of the columns will be connected to a single vent manifold system.
- The resin will cross a resin shaker for cleaning before entering the elution vessel. Once in the elution vessel the uranium will be stripped from the resin. This part of the process will probably require one vent system. The elution solution is transferred to the precipitation tanks and the stripped resin is returned to an IX column.
- The precipitation tanks will require their own vent system to exhaust CO_2 generated during the precipitation process.
- Processes that use RO permeate to mix chemicals such as sodium carbonate, sodium chloride or sodium sulfide (for groundwater restoration) from make-up tanks will be vented.
- The waste water and brine tanks will be vented.
- The precipitated yellow cake will be moved to the filter press and on to the dryer system. The uranium will remain wetted until it reaches the vacuum dryer and the

dryer system does not produce emissions; no vent monitoring of these subsystems is possible.
- The CPP building will release radon and decay products through the building ventilation system.
- Potential radon release points that are distant from the CPP include header houses and well/piping systems within the wellfields.

AUC will specify the amount of each of the principal radionuclides released to the environment from the CPP and the Production Units, as required in 10 CFR 40.65, using methodologies discussed in the following pages."

NRC Information Request b(2) through b(5)

2) *Discuss how each potential air and gaseous effluent release point will be monitored and how this information (or data) will be incorporated into the 10 CFR 40.65 report.*
3) *Discuss the type of radiation measuring device and measurement of the effluent an how the measurements will be converted to a total quantity (expressed in Curies) and a release rate (Curies per unit time).*
4) *Discuss how the measurements from each potential air and gaseous effluent release point will be expressed as a quantity (as described in 10 CFR 40.65).*
5) *If the applicant chooses to measure at a fence line (or restricted or control area), the applicant should demonstrate how the data from the measurements at a fence line will be extrapolated back.*

Items (2) through (5) Response

AUC has revised the text in TR Section 4.2.2, "Reporting Effluent Releases" to incorporate the following discussion. The AUC Response is broken into two sections:

I. Specification of Emissions from the Central Processing Plant Area, and

II. Specification of Emissions from the Production Units.

I. Specification of Emissions from the Central Processing Plant Area

Regulatory Guide 8.37, Section C.3.1 states that, when practical, releases of airborne radioactive effluents should be from monitored release points (e.g., monitored stacks, discharges, vents), to ensure that the magnitude of such effluents is known with a sufficient degree of confidence to estimate public exposure. Flow rates through fans represent one of several parameter groups that can be used to calculate releases of radioactive material.

Radon releases resulting from the presence of radon within the overall CPP volume (not within specific tanks, discussed below) will be determined by measuring the average radon concentration within the building, and multiplying that concentration times the building's average exhaust fan flow rate for the 10CFR40.65 six month period of interest. The average radon concentration in the plant will be measured using a Landauer Radtrak integrating radon monitor, employing existing AUC methodologies and recent Landauer modifications to enhance Radtrak sensitivity and accuracy (see "Discussion: Enhancing Radtrak Accuracy", Page 18 of this document). The location of the radon monitor is shown in revised Figure 5-3, provided in response to RAI-45. The rate of CPP air release from the

exhaust fans will be determined from an air balance report to be developed by the system supplier, based on final building design specifications.

The Radtrak device reports average radon concentration in pCi/l. The total activity released can be calculated by multiplying the average building concentration in pCi/l by the total air volume exhausted from the building during the six month period, in liters. The result is then divided by 10^{12} pCi/Ci to specify the quantity of radon released during the period, in Curies. AUC will use Radtrak devices to monitor radon concentration, since the devices integrate over the entire period of interest and provide a more accurate measure than can be developed using active scintillation cells and grab sampling.

However, at the direction of the NRC if specified, weekly Lucas cell radon concentration sampling could instead be employed by AUC to monitor concentrations in the CPP, rather than Radtrak-based monitoring. After an eventual determination that extended intervals between sampling would be acceptable, in accordance with NRC Regulatory Guide 8.30 and with NRC concurrence, AUC would perform Lucas cell measurements at longer intervals. The average of these radon concentration measurements performed at the specified location (see Figure 5-3 in AUC's response to RAI 45) over the six month period, would then be used in place of the average concentration reported by the Radtrak device. Lucas cell measurement is further discussed later in this section. In either case, the six-month-average radon concentration will be used to specify radon release for the 10CFR40.65 semiannual report, using ventilation flow rates as described here.

Exhaust volumes are calculated using exhaust fan flow rates in l/min, multiplied by the number of minutes in a six month period, multiplied by the fraction of the period that the fans were operating. Recording devices will monitor the exhaust fans, providing a record of run time to be used to calculate that fraction. During times when the fans are not operating, an anemometer will be used to measure the exhaust flow. Volumes determined using these flow rates will be added to the release volume calculated for the exhaust fans. If the anemometer is unable to measure the exhaust flow, the manufacturer-specified stall rate (lowest detectable flow rate) of the instrument will be used. The total volume (exhaust fan plus anemometer-monitored volume) will be used to calculate the six-month radon release, in Curies.

Plant Emissions of Radon from Vented Tanks

Releases of radon from vented tanks will be calculated by measuring the concentration of radon being emitted from the exhaust vent, and determining the flow rate of gaseous effluent from the vent. The measured radon concentration in pCi/l, multiplied by the

effluent flow rate in l/m, multiplied by the number of minutes during which venting takes place, divided by 10^{12} pCi/Ci, gives the total radon release in Curies for the measured event. Total radon release, in Curies, from vented tanks for the six month 10CFR40.65 reporting period, is calculated by adding the event measurement totals over all measured events that occur during a six month period.

Active scintillation cells (Lucas cells) will be used to regularly measure the concentration of radon within each vent. For continuously vented tanks, concentration measurements will be taken quarterly. For intermittently vented tanks, concentration measurements will be taken at least once per quarter when venting occurs during that quarter, and during the period determined by AUC (see discussion below) to have the highest likely radon concentrations in effluent gas. For continuously vented tanks, the measured concentrations will be averaged over the six month reporting period, to determine the total quantity of radon released from each vent during the period. For intermittently vented tanks, the measured concentration will be multiplied by the total gaseous effluent vented to the outside environment during the specific venting event. This allows calculation of the total quantity of radon released from that vent during that event. Total radon released over a six month period from that vent will be determined by assuming that other, unmonitored venting events (records will be kept by AUC to identify each such event), released the same quantity of radon as the measured quantity for that quarter, or for another representative quarter (a quarter with similar operational status), if monitoring did not occur during the subject quarter. The total quantity of radon released from intermittently vented units is the sum of the radon release quantities, measured and assumed, for the six-month period.

To perform a radon concentration measurement, the user must extract an effluent gas sample from the sampled vent line into the Lucas cell. Cells are evacuated using a vacuum pump prior to sampling, in order to draw the gas sample into the cell. Prior to sampling, flow will be drawn through the sampling tube connected to the vent for a period sufficient to ensure that the sample to be taken will be representative of the vent's contents. These periods will be specific to each vent/sampling tube system, and will be determined during final CPP systems design.

Inside the Lucas cell, the extracted radon gas undergoes radioactive decay to its progeny. The decay of radon and its short-lived decay products create alpha particles that strike the scintillator lining of the Lucas cell. These light pulses interact with photomultiplier tubes which convert the light pulses to electrons and greatly amplify the resulting electric current. An electronic pulse counting device records the total number of the resulting electronic pulses. There is a relationship between the number of pulses counted and the activity of the

radon gas in the cell; the Lucas cell system can thus provide a measurement of the activity, in pCi, of the radon gas that was drawn into the cell. The relationship between the counts recorded by the system and the activity of the radon sample is determined when the Lucas cell system is sent to a vendor laboratory for calibration in accordance with NIST methodology.

After sampling a vent and performing the Lucas cell analysis, the radon activity measurement in pCi is divided by the Lucas cell volume in liters, resulting in a measured radon concentration in pCi/l. This activity is divided by 10^{12} to convert to Ci/l, and the result is multiplied by the average flow rate for the quarter sampled, a flow rate determined by AUC for the specific sampled vent, to calculate the quantity of radon released for the quarter, in Ci. Over the six month 10CFR40.65 reporting period, the totals, all sampling events, all vents, are added together to determine the quantity of radon released, in Curies, for the period. During periods when certain vents are not open to the outdoor environment, AUC will assume that no radon is released from such vents.

The use of scintillation cells to characterize radon concentrations is an approved method, as outlined in Method 115 from 40 CFR 61 Appendix B. While the method describes the use of scintillation cells for underground mining and tailing piles, it is appropriate here.

The use of Radtrak integrating detectors is an accepted monitoring method, used by NRC licensees for the monitoring of radon in the environment to determine radon-related radiation dose to members of the general public. AUC notes that Radtrak use within the CPP to determine average radon concentrations for the purposes of 10CFR40.65 reporting is similar, and therefore appropriate.

Measurements of radon from tank vents will be performed at least once per quarter. Samples will be taken during periods with the highest predicted concentrations. Highest predicted concentrations will be assumed to occur when all tanks connected to a vent manifold are open for ventilation. To test this latter assumption, multiple measurements during the first two quarters of CPP operation will be made, until AUC determines the period of highest concentration. After significant changes in systems potentially affecting tank venting or flow rate, measurements will be performed to re-validate the determined periods of highest radon concentration.

Reporting Total Released Radon

Radon release quantities from the two sets of sources noted above (general CPP building radon emissions and vented tank radon emissions) will be added together and the resulting

total, in Curies, will be reported semiannually per 10 CFR 40.65 requirements. Effluent releases will be compared to design objectives. Results that exceed design objectives will be addressed in the semi-annual effluent report.

These results will also be used to develop the CPP-specific portion of the radon source term employed by MILDOS to determine source-specific and location-specific radon progeny equilibrium fractions used to calculate doses to the public, as described in AUC's response to NRC Information Request (c) on Page 20 of this document.

General Plant Emissions - Particulate Radionuclides

The design basis of the AUC CPP facility includes systems that prevent particulate radionuclide releases to the CPP. A combination of closed circuit vacuum dryer technology, and process wetting where the potential for exposed solid process material exists, will be used by AUC to ensure that this is the case. No vented tank particulate emissions are anticipated. Some radon decay products will be created via radon decay within the CPP.

Radon decay product air concentrations within the CPP building will be measured using a continuous working level monitor with digital data storage capability, located near the center of the CPP building (see Figure 5-3 in AUC's response to RAI 45). Radon decay product concentrations will be averaged over the six-month 10CFR40.65 reporting period.

Sampling for other airborne radioactive particulates will be performed using a pump drawing air through a 47 mm glass fiber filter located near the center of the CPP building (see Figure 5-3 in AUC's response to RAI 45). The filters will be exchanged weekly to prevent excessive dust loading, and the six-month collection (26 filters) will be analyzed as a single sample by a qualified laboratory. The laboratory will report the total activity in pCi, for uranium, Th-230, Ra-226 and Pb-210. A record of the total operating time for the air filter pump (calibrated annually or per the manufacturer's specification) will be maintained. The laboratory-reported activity for each radionuclide will be divided by the total air flow volume that passed through the filters. The results represent the average CPP air concentration for each of these radionuclides during the six-month measurement period.

The average concentrations of these particulate nuclides, in pCi/l, will be multiplied by the total facility air flow (determined in the same manner as for the radon calculations discussed in *Emissions of Radon from the General Central Processing Plant Area,* above) in liters. The result, pCi of each nuclide released from the CPP during the six month period, will be divided by 10^{12} pCi/Ci to produce a six-month release value, in Curies, for each

radionuclide. These data will be reported in the six month 10CFR40.65 report to the NRC. Any exceedance of AUC's design basis for particulate radionuclide release will be addressed in the report.

II. Specification of Emissions from the Production Units

During the period that a Production Unit (containing header houses and well fields) is operating or undergoing groundwater restoration, the potential exists for emissions of radon. Particulate radionuclides will not be released from these Production Unit sources. Given the large number of potential radon release points in these areas, most of which have no air flow systems allowing measurement of radon quantity released, an alternative method will be applied by AUC to meet 10CFR40.65 semiannual "quantities released" reporting requirements for the Production Units. To meet these reporting requirements, AUC will monitor radon releases via a system employing sets of 8 Radtrak high-sensitivity monitors uniformly located around a Production Unit's fenced perimeter. Radon background values will be subtracted from the data acquired via these monitors.

To specify the quantity of radon released during a six-month period, MILDOS-AREA will be run in an iterative fashion to determine a source term that best predicts actual, measured results. A first-cut "straw man" radon source term (radon release rate), with the radon source located at the production unit's centroid, will be entered into MILDOS-AREA. Other site-specific information including current meteorological data will also be input. The code will then be executed to calculate average radon concentrations at the eight perimeter monitoring locations. A comparison will then be made by the RSO to determine whether the MILDOS results are sufficiently similar (see criterion, below) to the Radtrak-measured values. If not, the process will be repeated, modifying the MILDOS input source term and re-running the code, until the MILDOS-calculated concentrations are sufficiently similar to the perimeter measured values. That final source term will be converted to Curies, and reported as the production area radon release for the six month period of interest.

The following discussion provides greater detail concerning this methodology.

Method Basis, Details and Technical Justification: Specifying Production Unit Radon Releases

10CFR40.65 notes that a licensee authorized to possess and use source material in uranium milling must submit a report within 60 days after January 1 and July 1 each year, specifying the quantity of each of the principal radionuclides released to unrestricted areas in liquid and in gaseous effluents during the previous six months of operation. AUC's Production Unit radon release data for this report will based on the differences between monitored background radon concentrations, measured at the site background monitoring station identified in AUC's RAI-20 response as AM#6-2, and radon concentrations measured by

the production unit's fenced perimeter Radtrak monitors. Subtraction of offsite, background concentrations of radon is appropriate because 10CFR40.65 requires specification of the quantity of radionuclide actually released by AUC's operations, not total radon measured in the environment.

As noted, there is no single potential radon release point associated with AUC production units. Instead, potential releases are spread over a large production area which includes header houses, well fields and other systems. It is not technically feasible to monitor most of these potential release points, and monitoring of "smaller potential releases" is neither justified by risk to the public, nor required by 10CFR40.65 which specifically allows estimation of smaller release quantities. Rather than attempting to monitor a few release points and extrapolate to total released quantities, AUC instead will specify the total amount of radon released from a Production Unit to the unrestricted environment.

AUC will use Radtrak radon monitoring devices, placed on the Production Unit's fenced perimeter, to measure the concentrations of radon in the vicinity of this large set of potential release points.

Determining Radon Releases from Production Units

Given accurate measurement (see "Discussion: Enhancing Radtrak Accuracy", Page 18 of this document) of radon concentrations during a six-month period for which radon release rates are to be reported per 10CFR40.65, the Radtrak-measured data will be used to specify the quantity of radon, in Curies, released from a Production Unit. The methodology to be used to meet this requirement is described below.

First, to determine the perimeter radon concentrations associated with AUC's releases in a Production Unit, radon background concentrations, as measured at AM#6-2 during the six month period of interest, will be subtracted from each of the eight fenced perimeter monitor's results. This is because only radon actually released within the production unit is to be reported for 10CFR40.65 purposes. Net negative results, likely to occur at the very low environmental radon concentrations expected for radon releases from an ISR wellfield, will be treated as useable numbers for this purpose, since rounding such values up to zero concentration would result in an overestimate of production unit radon releases.

The following discussion (inset, italics), developed from publicly-available records from the Cotter uranium mill/tailings site, is inserted here to illustrate such considerations during the use of MILDOS to estimate radon concentrations. The data also show that

environmental radon concentrations, even when associated with a relatively large uranium tailings impoundment source term, are net negative roughly 50% of the time (see column "Net", below).

Comparison of Predicted Rn Concentrations to Measured Rn Concentrations

There are two approaches to comparing Rn concentrations at boundary locations, predicted using the MILDOS model, to Rn concentrations measured at those same locations. Both approaches involve calculating the ratio of the measured value vs. the predicted value (M/P). An M/P ratio of 1.0 indicates that the model perfectly predicts the measured value. An M/P ratio of 10 indicates that the model greatly underestimates the measured value.

MILDOS does not consider background concentrations. So, to create an M/P ratio, measured values include environmental background radon concentrations, which must be subtracted from the measurements to estimate the influence of the site. This might be called the "net" approach, where both the measurement and the prediction are net of background.

Given the small concentrations of environmental radon actually associated with an ISR site's wellfield radon releases, and the ubiquitous presence of radon at significant concentrations in the natural environment, this "net" approach may result in negative net measured values. MILDOS predictions are always positive, non-zero values; using net values often results in negative M/P ratios, as shown in the table below, using 2013 data from air sampling stations around the Cotter uranium facility.

	M/P ratio for Rn-222	
Location	**Net**	**Gross**
AS-202	1.75	1.10E+00
AS-203	1.74	1.08E+00
AS-204	3.07	1.26E+00
AS-206	-0.78	9.27E-01
AS-209	-0.56	6.43E-01
Shadow Hills	3.19	1.11E+00
Nearest resident	-4.20	6.61E-01
Oro Verde #3	-11.79	7.87E-01
Lincoln Park #2	4.87	1.13E+00
Mean	-0.30	9.66E-01

Given the dominance of background, the "gross" approach, in which background is not subtracted from the measured values and is added onto each MILDOS prediction, yields more useable results in terms of establishing MILDOS predictive accuracy, as shown above. For each modeled location, background radon concentration, measured distant from the Cotter site, was added to the MILDOS prediction. Measured values were not corrected for background. Hence, the calculated M/P ratios do a better job of illustrating the influence of background and the relatively small importance of the site's Rn contribution. On the whole, for the locations shown, the M/P ratio is 0.966. These results indicate that even for the large, exposed radon tailings area at the Cotter former uranium mill site, with some radon monitoring locations very close to the tailings, radon at the site boundary is not significantly in excess of background.
(Reference: Dr. Craig Little, Technical Memorandum: Responses to Sept 11, 2014 letter to Jim Cain from Colorado Department of Public Health and environment. October 23, 2014.)

Next, given net radon concentration results for the 8 wellfield perimeter Radtrak monitoring locations, MILDOS will be run, initially using a unit release rate (Curies/unit time), to establish relative calculated concentrations at the 8 locations. The release rate will then be adjusted iteratively to produce a "best fit" set of concentrations, calculated by MILDOS, for the 8 monitor locations. "Best fit" will be defined as being achieved when the calculated concentration set's average value is within 5% of the measured average net value from the perimeter Radtrak detectors.

Current onsite meteorological station data will be employed for these MILDOS calculations: The radon monitoring six-month period being analyzed will determine the six-month period selected to extract meteorological data to be utilized for these MILDOS runs.

Note that, per the draft MILDOS-AREA User's Guide (September 1998, Argonne National Laboratory), the MILDOS code was field-tested early in its development, with the following result: "A validation study of MILDOS-AREA was conducted using measured Rn-222 concentration and flux data from the Monticello, Utah uranium mill tailings impoundment. The results of this study demonstrated that use of MILDOS-AREA can result in generally good agreement between model-generated and measured Rn-222 concentrations." MILDOS is an appropriate tool for the estimation of environmental radon concentrations.

MILDOS uses meteorological data via conversion to a "STAR" set: The STAR data array FREQ is used to provide the average fractional occurrence frequency of wind speed, wind direction and atmospheric stability. Data is supplied for the sixteen wind directions, six wind speed ranges, and six Pasquill atmospheric stability categories. Average morning (DMM) and afternoon (DMA) mixing heights are provided. Note that no meteorological data dates or date ranges are input; a six-month data summary is useable for MILDOS calculations.

Finally, once the best fit MILDOS input parameter set has been determined, the resulting adjusted input value (radon release rate in Curies per unit time) will be multiplied by the release period to specify the total six-month release. The quantity of radon released will be specified, in Curies, and will be reported in the semiannual 10CFR40.65 report. Any exceedance of AUC's design objectives will be specifically noted within the report.

These results will also be used to develop the Production-Area-Specific radon source term employed by MILDOS to determine source-specific and location-specific radon progeny equilibrium fractions used to calculate doses to the public, as described in AUC's response to NRC Information Request (c) on Page 20 of this document.

Enhancing Radtrak Accuracy

Specification of production area radon release quantities per 10CFR40.65 requirements, and calculation of public dose per 10CFR20, depends on confidence in the accuracy of Radtrak detectors in AUC's perimeter monitoring ring. AUC employs methods to enhance Landauer's Radtrak integrating radon monitor device accuracy; AUC will also employ enhancements recently implemented by Landauer, to optimize sensitivity and accuracy of the Radtrak monitoring system. These are described below:

- AUC will deploy only Landauer high-sensitivity Radtrak environmental radon monitors. These detectors utilize the same polymer detector elements employed for lower-sensitivity measurements performed in areas where radon concentrations are relatively high. However, the high-sensitivity units are read by Landauer using larger fields of view, increasing the number of tracks counted and improving overall sensitivity.
- At a recent USNRC workshop held in Bethesda, MD, Landauer staff stated that past problems with reported radon concentrations using Radtrak devices appear to have been related to seal leakage in the bags used to store and ship Radtrak detectors. AUC will employ detectors packaged according to Landauer's recently revised sealing process. This process includes vacuum packaging, such that seal leakage can be easily observed as expanded storage bags at the point of customer deployment, or when Landauer retrieves stored background samples. This process will reduce measurement errors associated with radon tracks accumulated during storage/shipment.
- Several years ago, AUC staff noticed an anomalous reading in a data set returned by Landauer for Radtraks deployed at pre-operational Reno Creek air sampling stations. The anomaly involved a negative result (a less-than-zero measured radon concentration indicated within the data details). AUC's discussions with Landauer staff determined that, on occasion, routine subtraction of Landauer's unexposed, background radon detector data can lead to such a reading. Further discussion identified the potential source of the problem: the polymer track etch element is subject to surface defect variability from supplier batch to batch. The number of such defects that, after etching, presents as alpha tracks and is thus counted as radon decay progeny alpha particle interactions is small. But, that small number can be relatively large when compared to the small number of actual alpha particle tracks seen in detectors from onsite monitoring stations with very low environmental radon concentrations. When Landauer's stored, unexposed background detector

results are subtracted from field samples using a different batch of the polymer, the unexposed detector count total may exceed the total from a field sample, leading to negative results. Conversely and more important, an unusually low surface defect rate on a stored background sample, subtracted from a field sample's results, could lead to an incorrect, high reported radon concentration. At the allowable public dose limits specified in 10CFR20, a small error in net counts can lead to an apparent public dose limit violation.

- Compounding the problem was the background sample protocol in use by Landauer, involving the averaging of results from the unexposed, background detectors across several batches of the sensitive polymer. Again, an unusually low rate of surface imperfections in one of these batches, when averaged with other unexposed detector data, could reduce the average background value to be subtracted enough to bias, in error, the field detector's reported result significantly high, leading to regulatory compliance issues.
- To resolve this problem, Landauer agreed to compare AUC's field-exposed detectors only to unexposed, background detectors from the same track etch polymer batch and to document the testing with every report. This reduces the likelihood of errors resulting in either high or low radon concentration reported results. Subtracted background data are now from the same polymer batch.
- Also at the noted USNRC Bethesda conference, Landauer staff presented data showing that reported results at very low radon concentrations, such as those often found at the Reno Creek site, are extremely sensitive to very small changes in the number of Radtrak detector-measured alpha tracks. This is because only a few net alpha tracks are actually seen on a detector at these very low environmental radon concentrations. It is therefore possible that either measurement or statistical outliers could lead to an incorrect reporting of 10CFR20-defined public dose exceedances at the AUC facility. This is because of the very low facility-related radon concentration increase that signals such an exceedance. Therefore, AUC will employ additional methods to reduce the likelihood of such errors, as discussed in the next three bullet items:
    - To maximize Radtrak detector sensitivity while conforming to 10CFR40.65 semiannual reporting requirements, AUC will deploy Radtrak devices for six month periods, rather than the usual three-month exposure period. This doubles the average number of alpha-particle-related tracks seen on field-exposed detectors, significantly increasing sensitivity.

- To conform to 10CFR40.65 requirements to summarize the program quarterly, two sets of Radtrak detectors will be deployed at each monitoring location during operations. One of these two sets will be exchanged every three months to meet the quarterly summarization requirement, but each set will have been deployed for six months prior to its exchange. This AUC protocol thus provides maximized detector sensitivity while meeting 10CFR40.65 requirements.
- Because a statistical or actual measurement outlier at a nearest-resident monitoring location could lead to an apparent public dose exceedance, AUC will increase the number of detectors deployed at critical locations. Sets of three high-sensitivity Radtrak monitors will be deployed at maximally-exposed-individual location(s). Sets of three Radtrak monitors will also be placed at the site's background location (location AM#6-2 as noted in revised TR Figure 2.9-1). RSO-directed data evaluation and statistical analysis, including the option to exclude a detector whose results exhibit outlier reported values, will be used to determine the most-valid average concentration for each of these locations. The use of at least three Radtrak detectors at critical locations reduces the likelihood that an individual outlier value will lead to a reported public dose exceedance.

Note: AUC will continue to observe progress made by Landauer and others in the use of Radtrak devices. AUC will also continue to work with Landauer to modify protocols to improve Radtrak radon monitoring. AUC is confident that the protocols it currently employs, supplemented by improvements as noted, will result in accurate Radtrak measurements during operations.

NRC Information Request (c)

Discuss how it will employ this method to demonstrate compliance during operations, including if it intends to differentiate the radon concentration from the plant and the radon concentration from background.

(c) Response

AUC plans to differentiate the radon concentration from the plant vs. background when determining dose for the most highly exposed member of the public, as discussed in Item (a2), Page 3 of this document. AUC also plans to correct for background radon concentrations when specifying radon releases from production areas, as discussed in Item II, Page 14 of this document.

Per the methodology described in Item (a2) of this document, AUC will demonstrate compliance with the 10 CFR 20.1302 public dose limit via radon concentration measurements, combined with MILDOS calculations of the location-specific equilibrium fractions. Radon source term values, for the CPP and the active production areas, will be determined via the methods presented in Sections (2-5) I and (2-5) II (Pages 10 and 14 of this document, respectively). These source terms will be applied, as described in Section (a2), to calculate the AUC-release-associated radon/progeny equilibrium fractions at the Radtrak monitors and other locations as required. The Radtrak-measured radon concentrations at receptor locations, and the calculated equilibrium fractions, will be used to determine public doses.

AUC will comply with the semiannual principal radionuclide release reporting requirements of 10 CFR 40.65 using the methodology described in Item (b), Page 7 of this document. The methodology uses measurements and gaseous effluent release data to specify radon and particulate radionuclide releases from the CPP, and a combination of measurements and MILDOS site-specific calculations to specify radon releases from active production areas. Please refer to Item (b) for additional discussion.

NRC Information Request (d)

Evaluate and provide a description of the member(s) of the public likely to receive the highest exposures from licensed operations consistent with 10 CFR 20.1302.

(d) Response

The MILDOS code, applying site-specific meteorological data, is used to identify members of the public most likely to receive the highest dose from radon and progeny associated with AUC's Reno Creek facility during operations. Best estimates of radon source terms from the CPP and wellfield operations have been used to identify these individuals prior to operations. The most recent input data sets and MILDOS output, plus a discussion of the methodology, are presented in the AUC Technical Report, Addendum 7-A. Rather than repeat portions of that MILDOS study here, the reviewer is referred to that section of the revised AUC Technical Report to review the methodology used to identify the most highly exposed individual(s).

Please also see AUC's response to NRC Information Request (a2), Page 3 of this document, for additional information concerning identification of the most highly exposed individuals during facility operations.

Please also see AUC's response to the NRC RAI-20 query: that response provides a map of proposed operational air sampling stations, including monitors for air particulate, radon and gamma radiation. Monitoring station AM#8 is placed close to the nearest ranch building, determined via MILDOS site-specific calculations to be the location of the most highly exposed individual(s) during much of the facility operational period.

In addition, during facility operations and using MILDOS with then-current data, AUC will re-evaluate the location(s) of the most highly exposed members of the public at least annually. The first such re-evaluation will occur during the first three months of facility operation, to take into account updated meteorological and monitoring data. If an individual other than the above-identified ranch house resident is determined during such re-evaluation to potentially be the most highly exposed individual, dose calculations will be performed using conservative inputs. Immediate NRC notification will be performed if an exceedance of the 10CFR20.1302 public dose limit is indicated, and actions to reduce dose to ALARA levels will be initiated.