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**Unreviewed Disposal Question Evaluation:
Backfill Soil Compaction Requirements**

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Executive Summary

An evaluation has been performed of the issues identified within the attached Categorical Exclusion Unreviewed Safety Question (see Attachment A) and the associated Problem Identification Report (PIR) entitled “Backfill Soil Compaction Requirements” (Kukraja 2002). The primary issue evaluated was that the “clean backfill” placed over trenches during the operational period does not have a saturated hydraulic conductivity equal to or less than the value of 1×10^{-5} cm/s as outlined within Table C.1-3 of the Performance Assessment (PA) (WSRC 2000). This 1×10^{-5} cm/s criterion was subsequently made Criteria 5 of the Categorical Exclusion Unreviewed Safety Question, Attachment 1, USQ and UDQ Categorical Exclusion Criteria, Section 2 – UDQ Categorical Exclusion Criteria (WSRC 2002).

This evaluation has determined that the saturated hydraulic conductivity of the “clean backfill” is most likely within the range of 1×10^{-3} to 1×10^{-4} cm/s. Based upon this determination an analysis of water percolation through slit trench waste covered with a “clean backfill” with a saturated hydraulic conductivity of 1×10^{-3} cm/s has been conducted for the operational period. This has been performed in order to determine whether or not the 1×10^{-5} cm/s is a necessary UDQ criteria. The water percolation analysis has demonstrated that modification of the assumed saturated hydraulic conductivity of the slit trench “clean backfill” from 1×10^{-5} cm/s to 1×10^{-3} cm/s is inconsequential in relation to the flux of water through the waste. This two-orders of magnitude increase in saturated hydraulic conductivity resulted in less than a 10% increase in water flux through the entire waste thickness during the 25-year operational period.

During the PA 100-year capped period the “clean backfill” does not control the water flux through the waste; the cap does. Therefore during the capped period the assumed saturated hydraulic conductivity value of the “clean backfill” is not critical to the flux determination. Finally during the failed period (i.e. after the 100-year capped period), the PA already assumes that the saturated hydraulic conductivity of the “clean backfill” is 1×10^{-3} cm/s. Therefore no further consideration of the saturated hydraulic conductivity of the “clean backfill” during this period is required.

Based upon this evaluation it is recommended that UDQ Criteria 5, which requires a “clean backfill” saturated hydraulic conductivity of 1×10^{-5} cm/s, be removed as an UDQ criterion.

Introduction

One intent of DOE Order 435.1 (USDOE 1999a), as expressed in the performance assessment/composite analysis guidance (USDOE 1999c), is to ensure that proposed changes in wasteforms, containers, radionuclide inventories, facility design, and operations are reviewed to ensure that the assumptions, results, and conclusions of the DOE approved performance assessment (PA) (WSRC 2000), and composite analysis (CA) (WSRC 1997), as well as any Special analyses (SA) that might have been performed, remain valid (i.e., that the proposed change is bounded by the PA and CA) and the changes are within the bounds of the Disposal Authorization Statement (USDOE 1999b). The goal is to provide flexibility in day-to-day operation and to require those issues with a significant impact on the PA's conclusions, and therefore the projected compliance with performance objectives/measures, to be identified and brought to the proper level of attention. It should be noted that the term performance measure is used to describe site specific adaptations of the DOE Order 435.1 Performance Objectives and requirements (e.g., performance measures such as applying drinking water standards to the groundwater impacts assessment).

The intent of this document is to provide an evaluation of the issues identified within Problem Identification Report (PIR) number 2002-PIR-26-0050 (Kukraja 2002).

Issues Identification

Categorical Exclusion Unreviewed Safety Question, Attachment 1, USQ and UDQ Categorical Exclusion Criteria, Section 2 – UDQ Categorical Exclusion Criteria, Criteria 5 (WSRC 2002) states the following:

“The backfill used to cover a disposal trench during the trench’s operational phase meets the nominal hydraulic conductivity listed in Table C-12 of the Performance Assessment.”

PIR number 2002-PIR-26-0050 (Kukraja 2002) identifies the following issues:

- 1) Operational backfill placement over disposal trenches (i.e. the “clean backfill” of Table C.1-3) does not meet the nominal saturated hydraulic conductivity of 1×10^{-5} cm/s specified within Table C.1-3 of the PA (WSRC 2000). That is, the saturated hydraulic conductivity of the “clean backfill” is greater than 1×10^{-5} cm/s, rather than equal to or less than 1×10^{-5} cm/s.
- 2) Document numbering of WSRC-RP-94-218, Section C, incorrectly identifies pages C-1 through C-68 as WSRC-RP-98-218.
- 3) Section 2 – UDQ Categorical Exclusion Criteria, Criteria 5 incorrectly identifies the table number as C-12 rather than C.1-3 as it should.

The following are items of note concerning the issues listed above:

- Throughout the remainder of this evaluation the operational backfill placed over disposal trenches will be denoted as the “clean backfill”. This is to distinguish it from the controlled compacted backfill (i.e. structural fill) that will be placed in conjunction with installation of the closure cap, which will be installed after disposal operations have ceased.
- The “clean backfill” as discussed in this evaluation consists of soil originally removed from the trench, which is subsequently used to cover the waste and bring the trench to grade during the operational period. “Clean backfill” is utilized over slit trenches, Engineered Trenches, and Components-In-Grout Trenches.
- Section 2 – UDQ Categorical Exclusion Criteria, Criteria 5 is applicable to only trenches over which “clean backfill” is placed during facility operations. Therefore the criterion is only applicable to slit trenches, Engineered Trenches, and Components-In-Grout Trenches. It is not applicable to the LAW Vaults, IL Vaults, or the Naval Reactor Components Disposal Pads.
- The table number that the Section 2 – UDQ Categorical Exclusion Criteria, Criteria 5 should have referenced is Table C.1-3 of the PA (WSRC 2000), since that table is applicable to slit trenches and by extension Engineered Trenches. The slit trench modeling has been utilized to represent Engineered Trenches, since Engineered Trenches were not explicitly modeled in the PA. PA Table C.1-9 is applicable to Components-In-Grout Trenches (WSRC 2000). Tables C.1-1, C.1-2, and C.1-4 apply to LAW Vaults, IL Vaults, and Naval Reactor Components Disposal Pads, respectively, and are therefore not applicable (WSRC 2000). Therefore Tables C.1-1, C.1-2, and C.1-4 will not be considered further in this evaluation.

Background Information

Two vadose zone slit trench scenarios were modeled within the PA ((WSRC 2000) that included the “clean backfill” with a hydraulic conductivity of 1×10^{-5} cm/s. As indicated above slit trench modeling has been utilized to represent Engineered Trenches. The two slit trench scenarios modeled were:

- A Slit Trench Operational Scenario (labeled the Intact Scenario in the PA) from 0 to 25 years prior to placement of the closure cap and
- A Slit Trench Capped Scenario from 25 to 125 years after placement of the closure cap.

The PA also models a slit trench failed scenario (i.e. after the 100-year capped period). However for this scenario the PA already assumes that the saturated hydraulic conductivity of the “clean backfill” is 1×10^{-3} cm/s. Therefore no further consideration of the saturated hydraulic conductivity of the “clean backfill” is required in this evaluation for this scenario.

The Slit Trench Operational Scenario model consisted of a 20-foot wide by 15-foot high waste layer covered by a 5-foot thick “clean backfill” embedded within a native soil matrix. The bottom of the trench was assumed to be approximately 25 feet above the water table. The saturated hydraulic conductivities of the waste, “clean backfill”, and the native soil were all specified as 1×10^{-5} cm/s.

The Slit Trench Capped Scenario model consisted of the same 20-foot wide by 15-foot high waste layer covered by a 5-foot thick “clean backfill” embedded within a native soil matrix all with the same 1×10^{-5} cm/s saturated hydraulic conductivity as the Operational Scenario model. In addition above this material the Capped Scenario model included from bottom to top a 2- to 3-foot thick controlled compacted backfill layer, a 2-foot thick clay layer, a 1-foot thick gravel layer, and a 3-foot thick topsoil layer. The top of the 2- to 3-foot thick controlled compacted backfill layer was assumed to be sloped at 2 percent to promote lateral drainage out of the 1-foot thick gravel layer. The saturated hydraulic conductivity of the overlying gravel and clay layers were taken as 1×10^{-2} cm/s and 1×10^{-7} cm/s, respectively.

One vadose zone Components-In-Grout Trench scenario was modeled within the PA (WSRC 2000) that included a backfill layer above the waste with a saturated hydraulic conductivity of 1×10^{-6} cm/s. This was a Capped Scenario similar to that described above for the slit trench. In addition the saturated hydraulic conductivity of the concrete that encapsulates the waste was taken as 1×10^{-8} cm/s. The PA also models a failed Components-In-Grout Trench scenario (i.e. after an assumed 300 years). However for this scenario the PA already assumes that the saturated hydraulic conductivity of the backfill layer is 1×10^{-3} cm/s at 300 years. Therefore no further consideration of the saturated hydraulic conductivity of the backfill layer is required in this evaluation for this scenario.

The computer program, PORFLOW, was utilized in the PA to generate steady-state flow fields for each of the scenarios based on an assumed 40-cm/year infiltration through the top surface in each scenario. The 40-cm/year infiltration assumption was based on past infiltration studies conducted at SRS. This infiltration rate was assumed to be constant, and none of the 40 cm/year infiltration was lost to runoff or evapotranspiration (i.e. all of it eventually reached the water table). Based on past SRS studies the 40-cm/year infiltration assumption already accounted for losses due to runoff and evapotranspiration.

Supporting Analysis of PIR Issue Number 1

As outlined above PIR number 2002-PIR-26-0050 identified issue number 1 as follows:

Operational backfill placement over disposal trenches (i.e. the “clean backfill” of Table C.1-3) does not meet the nominal saturated hydraulic conductivity of 1×10^{-5} cm/s specified within Table C.1-3 of the PA (WSRC 2000). That is, the saturated hydraulic conductivity of the “clean backfill” is greater than 1×10^{-5} cm/s, rather than equal to or less than 1×10^{-5} cm/s.

Additionally the PIR provides the following discussion relative to PIR issue number 1:

“At Solid Waste, the practice has been to excavate a trench and use excavated material as back fill to the original ground level. There is virtually no compaction feasible during this back fill process. The soil characteristics and lack of controls (i.e. moisture & compaction), both are not conducive to achieving the hydraulic conductivity required.”

Table 1 provides information on the saturated hydraulic conductivities of various granular materials found or utilized at SRS. The table also provides the Unified Soil Classification System (USCS) and the source of the data for each of the granular materials listed. Based on past soil sampling in E-Area, the top twenty feet of soil appears to typically consist of clayey sand (SC) with some silty sand (SM), low plasticity clay (CL), and sand (SW or SP). Clayey sand (SC) consists of material with a greater than fifty percent sand-sized fraction and a minimum twelve percent clay-sized fraction. Since the bulk of the soil consists of SC material, the remainder of this discussion will focus upon that soil type.

As seen in the table natural deposits of SC material and SC material, which has been compacted under controlled conditions, have a saturated hydraulic conductivity range from $2\text{E-}04$ to $6.7\text{E-}06$ cm/s. In general the saturated hydraulic conductivity of SC material decreases with increasing clay content. As a further comparison, the average saturated hydraulic conductivity of the SC material placed as part of the Old Burial Ground Soil Cover was determined to be $8\text{E-}05$ cm/s (Johnson and Jensen 2001). The Old Burial Ground Soil Cover was placed utilizing SRS borrow pit material that had been pre-qualified for structural fill, and it was placed under controlled compaction and moisture conditions (i.e. it is controlled compacted backfill).

As indicated in the PIR, placement of the “clean backfill” over trenches uses the soil excavated from trenches and the soil is bulldozed into place. No soil pre-qualification and no compaction and moisture controls are instituted for placement of the “clean backfill”. Therefore it is not likely that the nominal saturated hydraulic conductivity of the “clean backfill” would be as low as the Old Burial Ground Soil Cover average (i.e. $8\text{E-}05$ cm/s). Further, it is not likely that the nominal saturated hydraulic conductivity of the “clean backfill” would be as high as that of poorly graded fine sand (i.e. $4.2\text{E-}03$ cm/s from Table 1). The saturated hydraulic conductivity of the Table 1 poorly graded fine sand represents sand with essentially no fines content (i.e. no silt or clay) that has not been compacted (i.e. it has been poured in place). Whereas the “clean backfill” typically has a significant fines content (i.e. in general at least twelve percent) and while it has not received controlled compaction, it has received some level of compaction from the bulldozer used to place it. Based upon this analysis the nominal saturated hydraulic conductivity of the “clean backfill” as currently placed over slit trenches and the Engineered Trench is anticipated to be in the range of 1×10^{-3} to 1×10^{-4} cm/s.

Table 1
Typical Saturated Hydraulic Conductivities of SRS Materials

| Material | USCS Classification | Saturated Hydraulic Conductivity (cm/s) | Data Source |
|---|---------------------|---|--|
| Clean Poorly Graded Medium Sand (engineered material) | SP | 0.45 to 0.05 | Phifer et al., 2001 |
| Clean Poorly Graded Fine Sand (engineered material) | SP | 4.2E-03 | Estimated from Phifer et al., 2001 and Riha 1993 |
| Natural Silty Sand Deposit | SM | 1E-03 to 1.4E-05 | Unpublished SRS Specific Data |
| Controlled Compacted Silty Sand | SM | 3.2E-04 to 5.8E-05 | Johnson and Jensen 2001 |
| Natural Clayey Sand Deposit | SC | 2E-04 to 6.7E-06 | Unpublished SRS Specific Data |
| Controlled Compacted Clayey Sand | SC | 1.6E-04 to 2.7E-05 | Johnson and Jensen 2001 |
| Natural Silt Deposit | ML | 1.3E-06 | Unpublished SRS Specific Data |
| Controlled Compacted Kaolin | CL | 1E-07 | Phifer 1991 |
| Natural Clay Deposit | CL & CH | 3.5E-08 | Unpublished SRS Specific Data |

Based upon this analysis the PIR assessment that the saturated hydraulic conductivity of the “clean backfill” is greater than 1×10^{-5} cm/s appears to be correct. Although the saturated hydraulic conductivity of the “clean backfill” is apparently greater than that specified in UDQ criteria, Section 2, Criteria 5, a determination must be made whether or not a “clean backfill” saturated hydraulic conductivity of 1×10^{-5} cm/s is a necessary UDQ criterion. Such a determination has been made based upon an analysis of the percolation of water through the waste with an assumed “clean backfill” saturated hydraulic conductivity of 1E-03 cm/s (i.e. the highest anticipated value of saturated hydraulic conductivity). Both the Operational Scenario and Capped Scenario, as described above, have been assessed.

In the case of the PA Slit Trench Operational Scenario model infiltration through the top surface of the model was set at a constant 40 cm/year, independent of the saturated hydraulic conductivity of any of the model layers. A 40 cm/year infiltration rate is equivalent to an infiltration rate of 26.3 ft³/year over a one foot length of the typical slit trench width (i.e. twenty feet). Since none of this infiltration was assumed to be lost to runoff and evapotranspiration and since the model domain did not allow losses out the sides, all of it eventually reached the water table. Additionally since the PA model assumed that the saturated hydraulic conductivity and other hydraulic properties of the waste, interim soil cover, and the native soil were the same (i.e. a saturated hydraulic conductivity of 1×10^{-5} cm/s), uniform vadose zone flow occurred throughout the model domain. Figure 1 provides a depiction of this uniform flow field. As seen in the figure water uniformly infiltrated through the vadose zone to the water table, regardless of whether it was

through the waste, interim soil cover, or native soil. In all cases where all the layers have the same hydraulic conductivity and other hydraulic property values, the infiltration through all segments of the vadose zone will be uniform regardless of the exact hydraulic property values.

In order to assess the impact of “clean backfill” with a saturated hydraulic conductivity of $1\text{E-}03$ cm/s, the flow portion of the PA Operational Scenario model was modified and rerun using this higher “clean backfill” saturated hydraulic conductivity. This was accomplished by using the PA topsoil hydraulic properties for the “clean backfill”. All other model input remained the same as that in the PA. Figure 2 provides a depiction of the flow field and volumetric flux produced by this modification to the PA Operational Scenario model. As with the PA Operational Scenario model this modification had the infiltration through the top surface of the trench set at a constant $26.3\text{ ft}^3/\text{year}$ over a one foot length of the trench width, independent of the saturated hydraulic conductivity of any of the model layers. Again all of this infiltration eventually reached the water table. However in this modification a uniform vadose zone flow did not occur throughout the model domain as it had in the PA Operational Scenario model. The modified “clean backfill” with a saturated hydraulic conductivity of $1\text{E-}03$ cm/s caused the volumetric water flux into the waste over the width of the trench to increase to $29.8\text{ ft}^3/\text{year}$. This means that a two-orders of magnitude increase in saturated hydraulic conductivity resulted in a 13.3 % increase in water flux into the waste. However of this 13.3 % increase $3.1\text{ ft}^3/\text{year}$ or 88.6 % of the increase entered the top of the waste zone and quickly exited the sides of the waste zone, without passing entirely through the thickness of the waste zone. The water flux out the bottom of the waste increased to $26.7\text{ ft}^3/\text{year}$. This means that a two-orders of magnitude increase in saturated hydraulic conductivity resulted in a 1.5 % increase in water flux out the bottom of the waste. These small increases in water flux are considered insignificant compared to other assumptions and uncertainties associated with the PA Operational Scenario model. Additionally a subsidence sensitivity study conducted in 2000 (Collard 2000) evaluated a subsidence scenario in which ten percent of a slit trench area subsided resulting in increased infiltration through the waste in that area. The study concluded that increased infiltration through ten percent of the area resulted in “an early peak for a small amount of waste, and a late peak for the remainder of the waste” with the net affect being that the overall concentration peak was reduced (Collard 2000). These results from the subsidence sensitivity study could be analogous to the increased water flux through a small portion of the trench sides modeled here. That is this increased water flux could actually result in the reduction of the overall concentration peak.

In the case of the PA Slit Trench Capped Scenario model infiltration through the top surface of the trench was also set at a constant $26.3\text{ ft}^3/\text{year}$ over a one foot length of the trench width, independent of the hydraulic conductivity of any of the model layers. Again all of this infiltration eventually reached the water table. However in this scenario the gravel layer overlying the clay layer diverted the bulk of the infiltrating water away from the underlying layers, and the hydraulic conductivity of the “clean backfill” was not a controlling factor influencing the water flux through the waste. Therefore a modification of the assumed saturated hydraulic conductivity of the “clean backfill” from 1×10^{-5} cm/s to 1×10^{-3} cm/s for this scenario is insignificant.

In the case of the PA Components-In-Grout Trench Capped Scenario model infiltration through the top surface of the trench was also set at a constant $26.3\text{ ft}^3/\text{year}$ over a one foot length of the trench width, independent of the hydraulic conductivity of any of the model layers. Again all of this infiltration eventually reached the water table. However in this scenario the gravel layer overlying the clay layer diverted the bulk of the infiltrating water away from the underlying layers and “the hydraulic properties of the concrete cocoon control the influx of water through the waste ... “ (WSRC 2000). Therefore the hydraulic conductivity of the backfill layer was not a controlling factor influencing the water flux through the waste. Therefore a modification of the

assumed saturated hydraulic conductivity of the backfill layer from 1×10^{-6} cm/s to 1×10^{-3} cm/s for this scenario is insignificant. Due to the insignificance of the backfill layer, this evaluation will not further consider the Components-In-Grout Trenches.

Based upon this assessment it is recommended that Categorical Exclusion Unreviewed Safety Question, Attachment 1, USQ and UDQ Categorical Exclusion Criteria, Section 2 – UDQ Categorical Exclusion Criteria, Criteria 5 (WSRC 2002) be removed as an UDQ criterion. The criterion states the following:

“The backfill used to cover a disposal trench during the trench’s operational phase meets the nominal hydraulic conductivity listed in Table C-12 of the Performance Assessment.”

It is further recommended that the following be performed in order to improve the assumptions associated with material properties and reduce associated modeling uncertainties of future PA revisions:

- Actual sampling and testing of the “clean backfill” should be performed in order to assess its in-placed hydraulic properties and provide verification that the anticipated properties utilized in this evaluation are appropriate. Significant work has been performed to assess the actual hydraulic properties of the “native soil” (i.e. the Vadose Zone Characterization and Monitoring Project), but no such work to date has been performed on the “clean backfill”.
- Vadose modeling is currently planned as a follow-up to the existing Vadose Zone Characterization and Monitoring Project. As time and budget allow this “3-dimensional modeling” should incorporate the results from any sampling and testing of the “clean backfill”. Additionally as time and budget allow both slit trenches and Engineered Trenches should be included in the modeling effort, and parametric studies of the waste hydraulic properties for both types of disposal facility should be included.
- Infiltration assumptions should be reevaluated or modeled in future PA revisions.

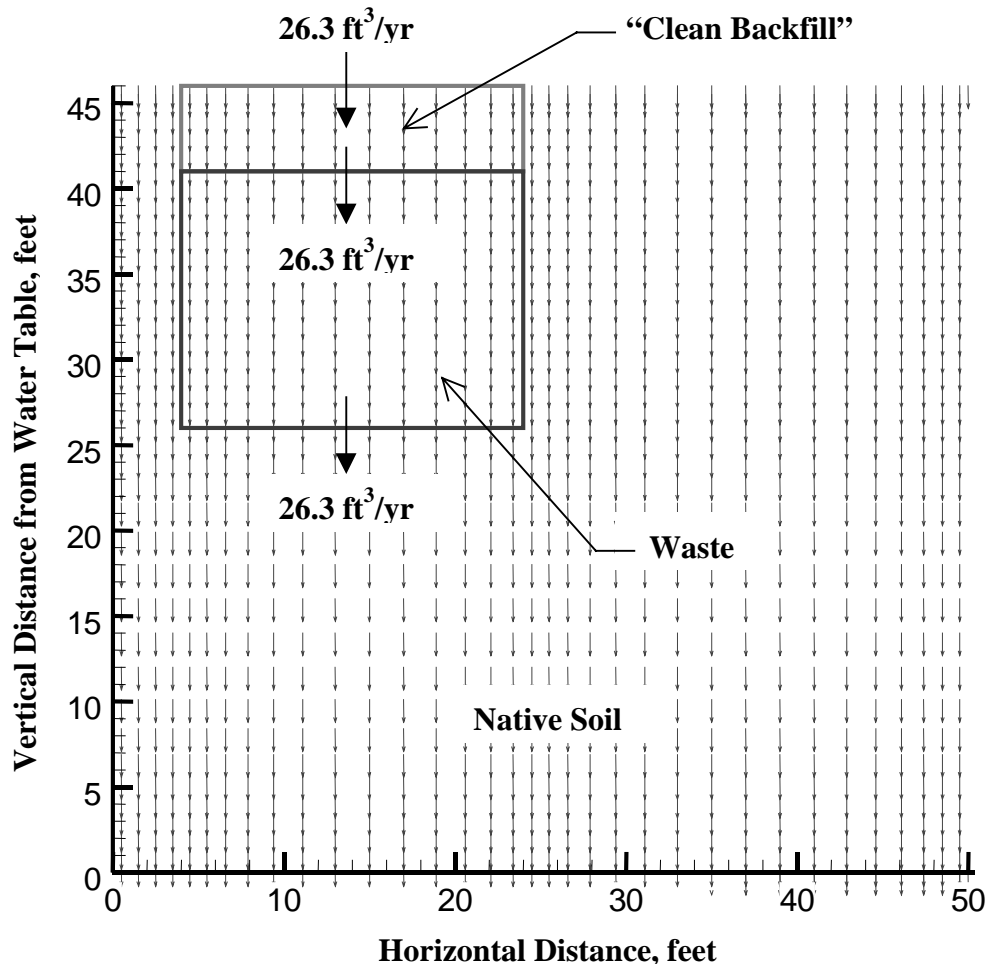


Figure 1
PA Slit Trench Operational Scenario Model
1E-05 cm/s "Clean Backfill" – Flow Field with Volumetric Water Flux

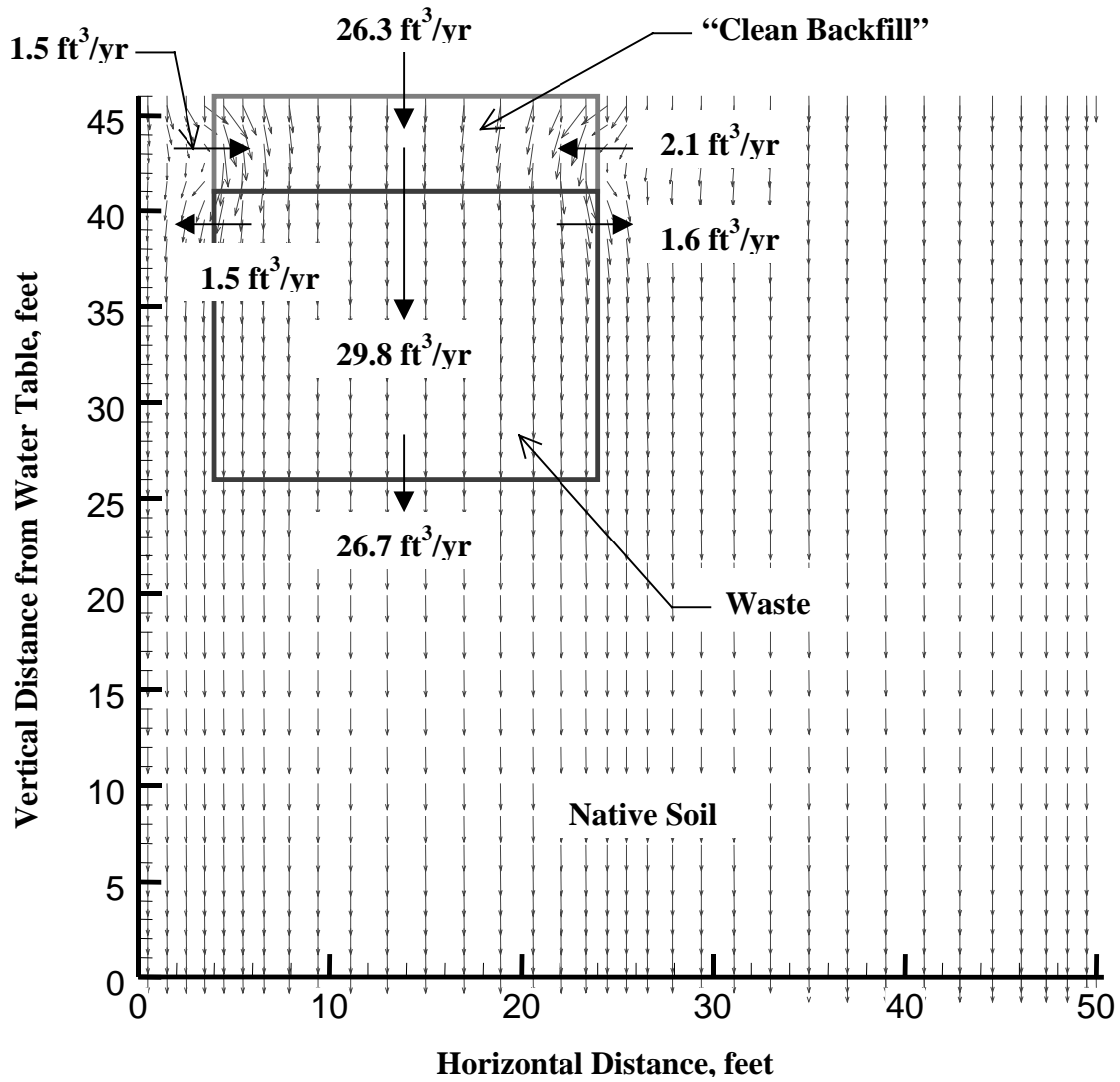


Figure 2
Modified PA Slit Trench Operational Scenario Model
1E-03 cm/s "Clean Backfill" – Flow Field with Volumetric Water Flux

Supporting Analysis of PIR Issues Number 2 and 3

As outlined above PIR number 2002-PIR-26-0050 identified issue number 2 as follows:

Document numbering of WSRC-RP-94-218, Section C, incorrectly identifies pages C-1 through C-68 as WSRC-RP-98-218.

No analysis of this PIR issue is required. This PIR statement is correct. It is recommended that this PA typographical error be appropriately noted so that it is corrected in future revisions of the PA as appropriate.

As outlined above PIR number 2002-PIR-26-0050 identified issue number 3 as follows:

Section 2 – UDAQ Categorical Exclusion Criteria, Criteria 5 incorrectly identifies the table number as C-12 rather than C.1-3 as it should.

As actually stated PIR issue number 3 makes reference to Tables C.1-2, C.1-3, and C.1-4. The only table number that is applicable is Table C.1-3 of the PA (WSRC 2000), since that is the only table of the three applicable to slit trenches and by extension Engineered Trenches. Tables C.1-2 and C.1-4 apply to IL Vaults and Naval Reactor Components Disposal Pads, respectively, and are therefore not applicable to slit trenches and Engineered Trenches. If as recommended above Criterion 5 is removed there is no need to correct the table number. However if Criterion 5 remains, it is recommended that the reference to “Table C-12” be corrected to read “Table C.1-3”.

Evaluation

1. Does the proposed activity involve a change to the Performance Assessment or exceed PA performance measures/conclusions?

No. The above analysis demonstrates that modification of the assumed saturated hydraulic conductivity of the “clean backfill” from 1×10^{-5} cm/s to 1×10^{-3} cm/s is relatively insignificant. This two-orders of magnitude increase in saturated hydraulic conductivity resulted in a 13.3 % increase in water flux into the waste and a 1.5 % increase in water flux out the bottom of the waste during the 25 year operational period. During the subsequently assumed 100 year capped period the closure cap gravel drainage and clay barrier layers divert the bulk of infiltrating water away from the underlying “clean backfill”, and it is no longer a controlling factor influencing the water flux through the waste.

2. Does the proposed activity involve a:

- a. change to the basic disposal concept as described in the PA?

No. The basic disposal concept remains the same. This evaluation only involves the modification of the assumed hydraulic properties of the “clean backfill” to those of the from PA topsoil. Primarily a saturated hydraulic conductivity change from 1×10^{-5} cm/s to 1×10^{-3} cm/s.

b. change to the analyses or radionuclide limits as described in the PA?

No. The small increase in water flux through the entire waste zone during the assumed 25 year operational period due to modification of the assumed saturated hydraulic conductivity of the "clean backfill" from 1×10^{-5} cm/s to 1×10^{-3} cm/s is considered insignificant. The "clean backfill" is no longer a controlling factor influencing the water flux through the waste during the subsequently assumed 100-year capped period. Therefore, changes to the analyses and radionuclide limits described in the PA and the WAC derived from them are not required.

c. change in the disposal authorization that leads to a significant change in projected dose?

No. Nothing in this evaluation requires either a change in the Disposal Authorization Statement or any change in the projected dose for E-Area operations.

d. change in the results in the approved PA that is greater than 10%?

No. This analysis shows that a two-orders of magnitude increase in assumed saturated hydraulic conductivity of the "clean backfill" results in a 13.3 % increase in water flux into the waste and a 1.5 % increase in water flux that travels through the entire waste thickness during the 25 year operational period. This clearly results in less than a 10% increase in water flux through the entire waste thickness. It is also understood that the "clean backfill" is not a controlling factor influencing the water flux through the waste during the subsequently assumed 100-year capped period.

e. change of greater than 10% in the dose calculated in the approved PA?

No. The dose due to this change was not calculated in this analysis. However since this change results in an insignificant increase in water flux through the entire waste zone only during the 25 year operational period and has even less effect later, this change should not result in a dose greater than 10% of that calculated in the approved PA.

3. Does the proposed activity modify the analysis or conclusions provided in the Composite Analysis?

No. The change will keep the performance of the E-Area facility within the DOE performance objectives and thus modify neither the analysis nor the conclusions provided in the Composite Analysis.

4. Does the proposed activity change the Disposal Authorization Statement?

No. This evaluation shows that this change will not require a change in the established PA and therefore it is not necessary to change the Disposal Authorization Statement.

Conclusions

The above analysis demonstrates that modification of the assumed saturated hydraulic conductivity of the "clean backfill" from 1×10^{-5} cm/s to 1×10^{-3} cm/s is insignificant in relation to the flux of water through the waste versus other PA modeling uncertainties. This two-orders of

magnitude increase in saturated hydraulic conductivity resulted in a 13.3 % increase in water flux into the waste and a 1.5 % increase in water flux out the bottom of the waste during the 25 year operational period. This clearly results in less than a 10% increase in water flux through the entire waste thickness. The “clean backfill” is not a controlling factor influencing the water flux through the waste during the subsequently assumed 100-year capped period. Based upon this assessment it is recommended that Categorical Exclusion Unreviewed Safety Question, Attachment 1, USQ and UDQ Categorical Exclusion Criteria, Section 2 – UDQ Categorical Exclusion Criteria, Criteria 5 (WSRC 2002), which requires a “clean backfill” saturated hydraulic conductivity of 1×10^{-5} cm/s be removed as an UDQ criterion.

It is further recommended that the following be performed in order to improve the assumptions associated with material properties and reduce associated modeling uncertainties of future PA revisions:

- Actual sampling and testing of the “clean backfill” should be performed in order to assess its in-placed hydraulic properties and provide verification that the anticipated properties utilized in this evaluation are appropriate. Significant work has been performed to assess the actual hydraulic properties of the “native soil” (i.e. the Vadose Zone Characterization and Monitoring Project), but no such work to date has been performed on the “clean backfill”.
- Vadose modeling is currently planned as a follow-up to the existing Vadose Zone Characterization and Monitoring Project. This 3-dimensional modeling should also utilize the results from any sampling and testing of the “clean backfill”. Additionally both slit trenches and Engineered Trenches should be included in the modeling effort, and parametric studies of the waste hydraulic properties for both types of disposal facility should be included.
- Infiltration assumptions should be reevaluated or modeled in future PA revisions.

Finally the following recommendations are made regarding PIR issue numbers 2 and 3:

- PA document number typographical error should be appropriately noted so that it is corrected in future revisions of the PA as appropriate.
- If as recommended above Criterion 5 of the Section 2 – UDQ Categorical Exclusion Criteria is removed there is no need to correct the table number. However if Criterion 5 remains, it is recommended that the reference to “Table C-12” be corrected to read “Table C.1-3”.

References

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WSRC 2002. *Categorical Exclusion Unreviewed Safety Question*, (Cat X USQ # USQ-SWE-2002-0097). Westinghouse Savannah River Company, Aiken, South Carolina. 2002.

Attachment A
Categorical Exclusion Unreviewed Safety Question

CATEGORICAL EXCLUSION UNREVIEWED SAFETY QUESTION
{ USQ-SWE-2001-0049 superseded by USQ-SWE-2002-0097 }

| CAT X USQ # | SEQ. # | DATE | EO / QR | REFERENCE DOCT ID | REV. # | BRIEF DESCRIPTION / JUSTIFICATION |
|-------------------|--------|------------|--------------|---|--------|--|
| USQ-SWE-2002-0097 | 2357 | 10-28-2002 | J.L. Kukreja | WSRC-RP-94-218, "Radiological Performance for the E-Area Low-Level Waste Facility" | 1 | The proposed activity is to document an error in LLW Performance Assessment. The hydraulic conductivity for backfill cannot be met. Reviewed against Section B of the Cat X USQ. All questions were answered No. This activity was also reviewed against the UDO criteria in Section 2 and determined that criteria 5 cannot be met. The table C-12 referenced is incorrect. See attached documents for details. |

Signature: *J.L. Kukreja*

Note: The Brief Description/Justification section is more than the document title. Please input justification.

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