Evaluation of Insufficient Cover Thickness at Crescent Junction Disposal Cell Edge

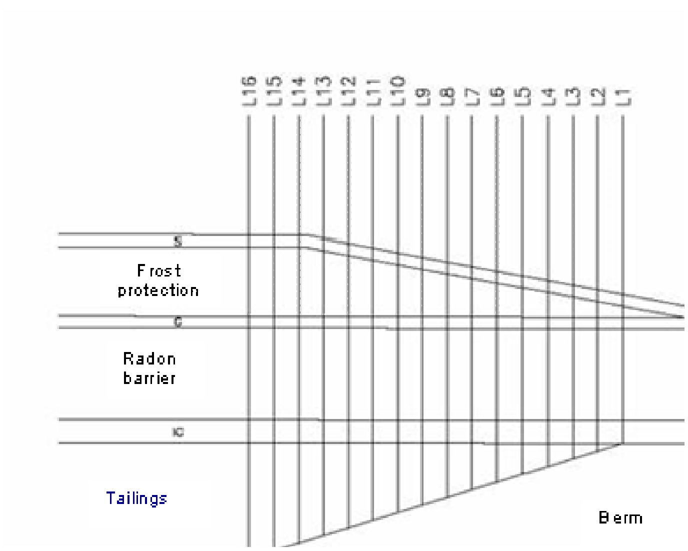
There is no doubt that the south edge and part of the west edge of the waste cell do not have enough cover thickness. To address the lack of thickness two approaches were considered:

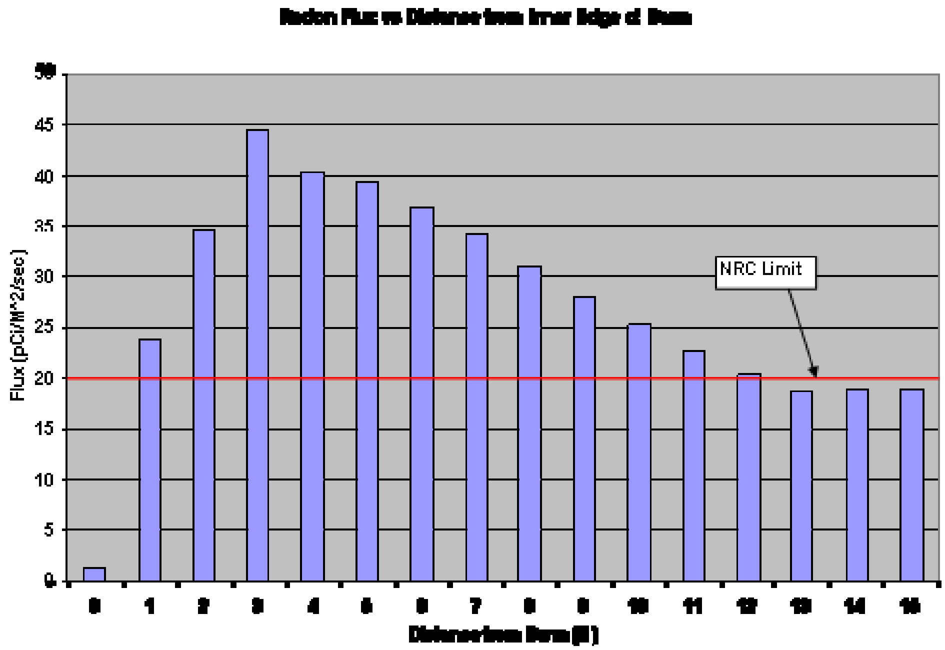
1. <u>Evaluate the insufficient cover thickness to determine whether or not it is a concern.</u>
To determine if a problem exists, we would evaluate whether the lack of cover thickness results in radon flux at the landfill surface above the allowable limit. If radon flux at the landfill surface is under the NRC limit of 20 pCi/m^2/sec, there is no problem with the thin cover edge. If radon levels are above the limit, a different alternative would be required.

2. <u>Provide the required cover thickness.</u>
Develop a design that increases the edge thickness to 8.5 feet and provides full cover thickness over the waste in all locations.

The RadonC program was utilized to perform a series of calculations of radon flux at the landfill surface and the results show that allowable radon levels are exceeded. The following sketch shows the edge section for which the radon calculations were performed. Calculations were performed at one foot intervals from the edge of the berm to 15 feet inside the berm. The following graph summarizes the calculation results. The graph shows that the NRC radon limit is exceeded across the edge strip of the landfill where there is insufficient cover thickness.

Edge of Cover Along the Perimeter Berm





We cannot, therefore, demonstrate that the insufficient cover thickness does not matter.

Four alternatives for increasing the edge thickness were suggested, including:

1. Modify the outboard slope of the cell from 5:1 to 4:1 to produce a wider perimeter berm and extend the full thickness of the cover over all of the tailings;
2. Install a bentonite blanket (a Geosynthetic Clay Liner, such as Claymax) beneath the low-permeability radon barrier to substitute for reduced radon barrier thickness along the edge.
3. Maintain the 5:1 outboard slope and widen the perimeter embankment by 12.5 feet. This would extend the full thickness of the cover over all of the tailings; and,
4. Remove a strip of tailings approximately 14 ft wide and 2.6 ft deep along the edge. The excavated material would be replaced by interim cover and radon barrier and would provide full cover thickness along the edge.

Alternative evaluation and selection

The four alternatives for increasing the edge thickness were evaluated to determine which alternative would result in the least re-work and cost and would not require complete re-evaluation by NRC.

1. Modify the outboard slope from 5:1 to 4:1

To modify the outboard slopes from 5:1 to 4:1 would require slope stability and slope armoring / rock sizing calculations to be performed again and would constitute a concept change that would require a re-evaluation by NRC. In addition, soil could not simply be added to the surface of the existing 5:1 slope to modify the slope to 4:1, as shown in Figure A, below. To meet the existing specifications for the perimeter berms, the existing slope would have to be cut back as much as 10 feet and additional fill would be installed in horizontal layers wide enough to compact each layer with compaction equipment, as shown in Figure B. Cut volume required to modify the existing outboard slopes to 4:1 would be approximately 13,000 cubic yards and the fill volume to extend the slope 10 feet would be 50,000 cubic yards. Compaction testing of the fill would be required. The location of the toe of the new 4:1 slope will not change, therefore there is no impact on existing roads or other facilities. The only exception would be the ditch along the east side of the water storage pond that would be displaced by the fill and would have to be relocated to a higher elevation.

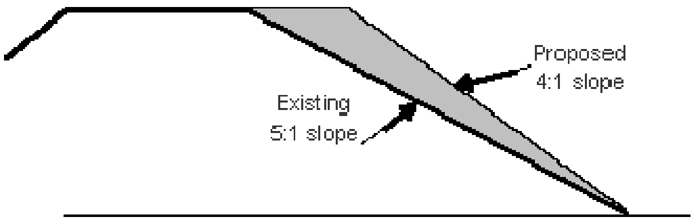


Figure A

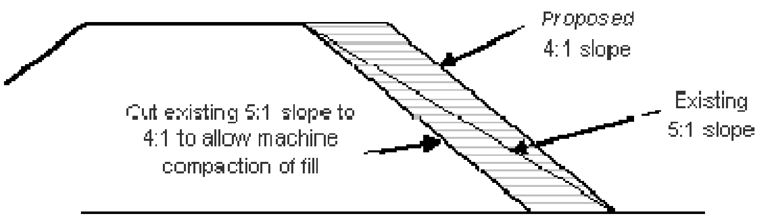


Figure B

This approach was not considered viable due to the significant amount of work to revise design drawings and calculations, conduct another review cycle with NRC, and the large amount of field work required to cut and fill the existing perimeter berms to change the slope.

The engineering effort to modify the outboard slope from 5:1 to 4:1 would be approximately 380 hours, but there is no guarantee that this approach will produce a usable end result. The slope stability calculations for a 4:1 slope may not yield the required safety factor.

380 hours would include:

- 100 hours to redo the calculations for slope stability, runoff, and rock armoring;
- 160 hours to revise all of the construction and final cover site plans, grading plans and details;
- 60 hours to create all of the Quality Assurance documentation; and,
- 60 hours to create documentation for NRC review of a new perimeter slope concept.

2. Install a Bentonite layer

Bentonite mats, or Geosynthetic Clay Liners (GCLs), are used to create very low permeability layers in landfill liners and covers. The conductivity of GCLs is in the range of 1×10^{-9} cm/sec, or a couple of orders of magnitude less conductive than the Mancos shale soil used to make the radon barrier. GCLs consist of natural Bentonite clay, are about ¼ inch thick, and have very low conductivity when hydrated.

Bentonite when wet swells and seals against moisture and when dry it shrinks and returns to powder form. If this was a standard GCL application, where the GCL is installed to limit the migration of water, it would be ideal. When excess water is present, the water would hydrate the Bentonite causing it to swell and seal. The problem is that radon is a gas and if the Bentonite dries out, the radon will pass through it. It is not a good application for Bentonite. The NRC would know that, and it might prompt NRC to ask the unanswerable question of what will happen to the moisture content of the radon barrier over time. We don't want to be put in the position of having to demonstrate that the low-permeability radon barrier will maintain its moisture content for 1000 years. We followed all of the low-permeability layer design guidance but we don't want to open that line of inquiry, so we would rather not propose the inclusion of a GCL.

The engineering effort to install a Bentonite layer was not estimated.

3. Maintain the 5:1 Slope and Widen the Perimeter Berm

If the perimeter berm was 12.5 feet wider, the cover would be full thickness over 100% of the tailings. The runoff calculations, rock armoring and slope stability would not change, but it would take approximately 60,000 cubic yards of fill to widen the berms. The 60,000 cubic yards of soil would be diverted from placement in the wedge north of the disposal cell, and the wedge calculations would have to be revised to account for a smaller volume of wedge soil. To construct the widened berm, the soil would have to be placed in horizontal layers, keyed into the existing section of the berm, compacted, and tested. The widened slope on the south side would impact the location of the existing construction road that is adjacent to the bottom of the berm slope. The south perimeter berm of all future disposal cells and a portion of the east perimeter berm would have to be widened for this option. This approach does not change any design concepts that would require substantial re-evaluation by NRC. The wedge changes would have to be reviewed.

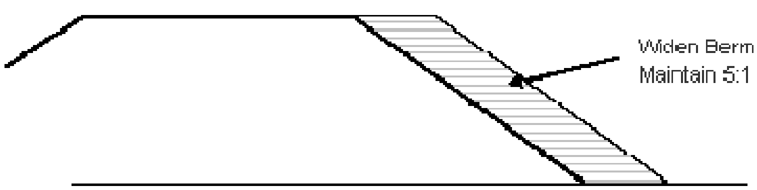


Figure C

The engineering effort to widen the Perimeter Berm 12.5 feet would be approximately 340 hours.

340 hours would include:

- 80 hours to revise the wedge calculations;
- 160 hours to revise all of the construction and final cover site plans, grading plans and details;
- 60 hours to create all of the Quality Assurance documentation; and,
- 40 hours to create documentation for NRC review of the revised wedge concept.

4. Replace a Strip of Tailings along the Edge with Clean Soil to Provide Full Cover Thickness

A strip of tailings along the edge of the waste cell perimeter berm would be removed and replaced with clean soil to provide full cover thickness over the waste at the edge (see Figure D, below). A one foot thick layer of clean clay soil has already been placed over waste materials as interim cover. This layer of interim cover would have to be stripped off and stockpiled, then tailings waste would be removed an additional 1.6 feet in depth. The total amount of material impacted by this concept is less than 5,000 cubic yards, most of which is in future waste cell phases and has not yet been placed. Only approximately 800 cubic yards of tailings material would have to be relocated. It would be a tedious chore to excavate the strip of tailings approximately 3,500 feet long (800 cubic yards of tailings) in a manner that limits the spread of contamination. Tailings material that has not yet been placed (in future cell phases) would be installed in accordance with the revised edge design and would have full cover thickness.

The engineering effort to design the edge strip replacement has already been completed.

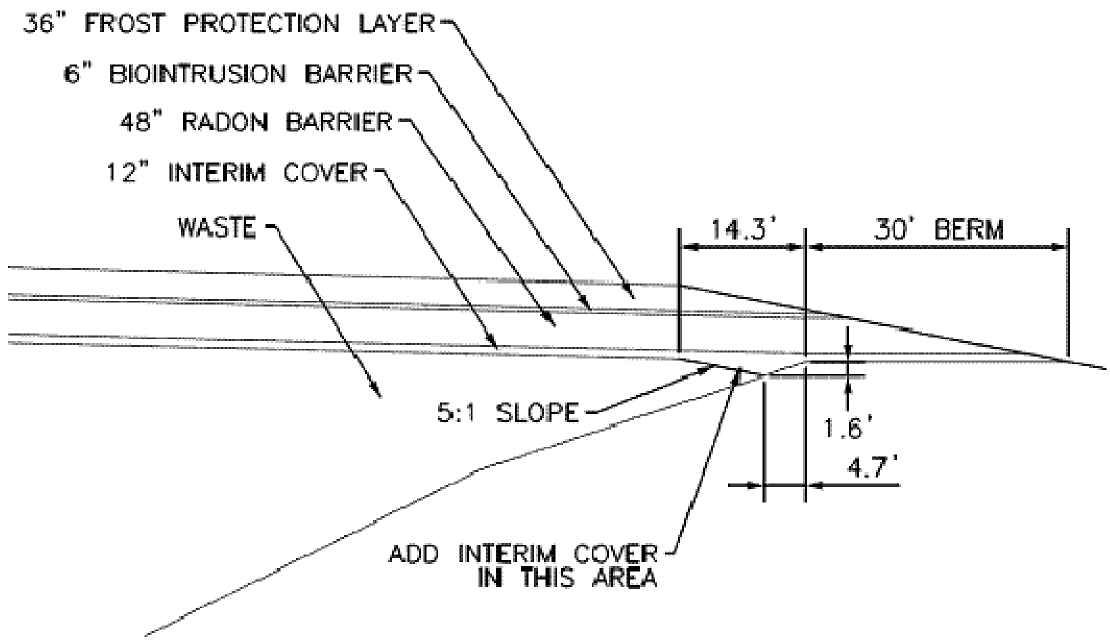


Figure D. Edge Strip Removal and Replacement

Alternative 4, Replace a Strip of Tailings along the Edge with Clean Soil to Provide Full Cover Thickness, was developed and submitted to Energy Solutions immediately after the insufficient cover thickness was discovered. It is the alternative which causes the least disruption to the existing design and NRC approval, and it would require the least re-work of material by construction forces. It is the recommended alternative.

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