Extending Facility Life by Combining Embankments: Permitting Energy*Solutions’* Class A Combined Disposal Cell

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ABSTRACT

Energy*Solutions’* Class A low-level radioactive waste management operations are limited to a 540-acre section of land in Utah’s west desert. In order to optimize the facility lifetime, Energy*Solutions* has launched an effort to improve the waste disposal utilization of this acreage. A chief component of this effort is the Class A Combined embankment. The Class A Combined embankment incorporates the footprint of both the currently licensed Class A cell and the Class A North cell, and also includes an increase in the overall embankment height. By combining the cells and raising the height of the embankment, disposal capacity is increased by 50% over the two-cell design. This equates to adding a second Class A cell, at approximately 3.8 million cubic yards capacity, without significantly increasing the footprint of disposal operations. In order to justify the design, Energy*Solutions* commissioned geotechnical and infiltration fate and transport evaluations, modeling, and reports. Cell liner and cover materials, specifications, waste types, and construction methods will not change. Energy*Solutions* estimates that the Class A Combined cell will add at least 10 years of capacity to the site, improving utilization of the permitted area without unacceptable environmental impacts.

INTRODUCTION

Energy*Solutions’* Class A low-level radioactive waste (LLRW) management operations are limited to a 540-acre section of land in Utah’s west desert. In order to optimize the facility lifetime, Envirocare has launched an effort to improve the utilization of this acreage for waste disposal. A chief component of this effort is the Class A Combined embankment.

On May 27, 2005, Envirocare submitted an amendment request to the Utah Department of Environmental Quality, Division of Radiation Control (DRC) to permit the Class A Combined embankment (1). The Class A Combined embankment will encompass the areas occupied by the existing Class A and Class A North embankments, and will also increase the height of the embankment by 18 feet at the shoulder over the current design. Only Class A wastes will be disposed in the combined embankment.

As of late November 2006, regulatory review and a public comment period are complete, with a final decision on the amendment request anticipated in early 2007. The regulatory review process included three rounds of formal interrogatories regarding various aspects of the design and operation of the combined embankment; and concluded in May 2006. Waste placement in the newly-approved disposal capacity will begin shortly after final approval, starting on top of existing waste placed in the southern portion of the Class A embankment. This area will be brought to the new design top of waste so that settlement monitoring and cover construction can begin.

THE CLASS A COMBINED EMBANKMENT

The Class A Combined embankment will be approximately 85 feet tall at its highest point. The effect will be approximately 75 feet tall above native grade, since Energy*Solutions* excavates approximately 10 feet below native grade for clay liner construction. The Class A Combined embankment has a larger top slope area than the existing embankments, resulting in a greater height increase at the crest than the 18 foot increase at the embankment shoulder. Therefore, the combined embankment will be approximately 30 feet taller than the currently existing Vitro, LARW, and 11e.(2) embankments at the site.

The footprint of the Class A Combined embankment will be roughly twice the size of the existing Vitro embankment. Embankment liner, cover, and waste placement specifications will be unchanged from existing approved standards, with one minor distinction. The drainage layer rock immediately above the clay radon barrier will be thicker than in previous designs, to provide additional drainage capability for the larger cover surface area. Waste types will remain as Class A bulk and containerized materials as currently received and disposed.

Figure 1 provides an aerial view of a portion of the Clive site, with the Class A, Class A North, and Vitro embankments identified. Figure 2 provides the same view with the Class A Combined embankment footprint. The aerial photograph was taken in September, 2006.

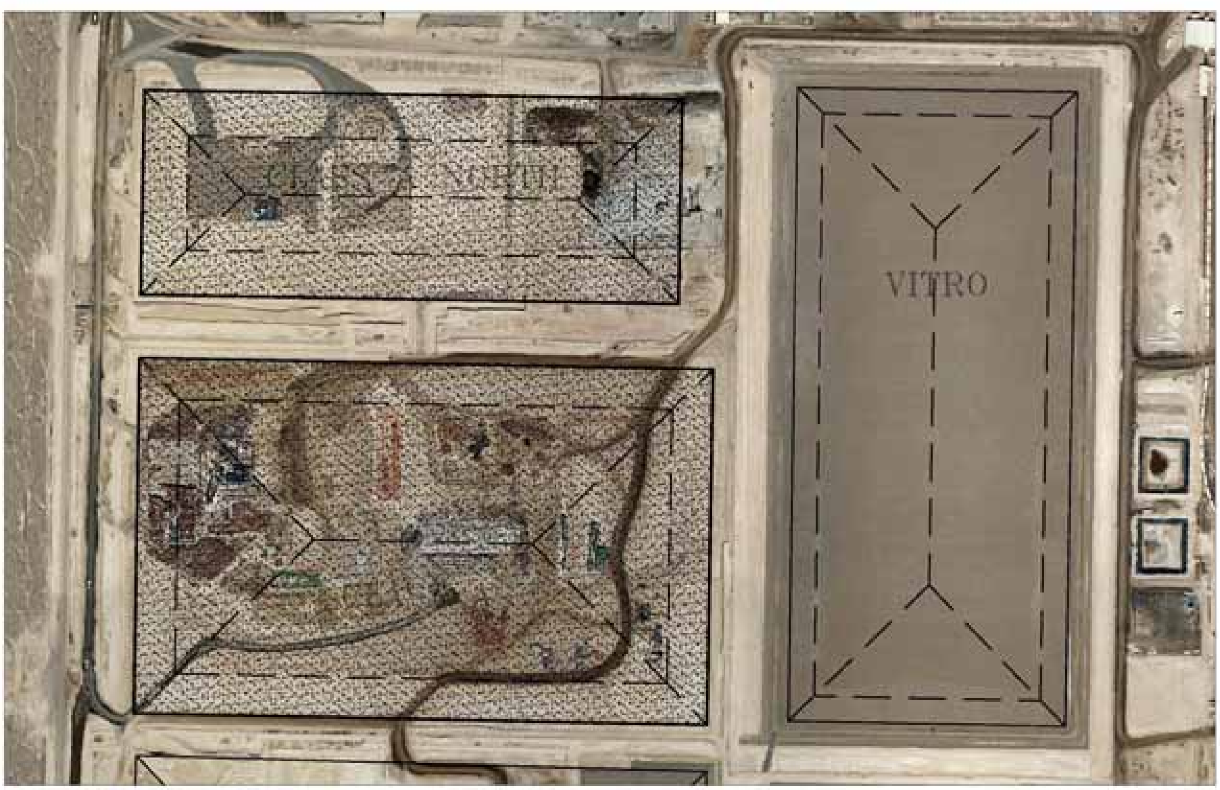

Figure 1 Aerial view of Energy*Solutions* Clive site with Class A, Class A North

Figure 2 Aerial view of Energy*Solutions* Clive site with Class A Combined

A combined embankment simplifies management of site drainage, environmental monitoring, and settlement monitoring. Increasing capacity without increasing the overall footprint will allow more waste material to be disposed with less use of natural resources. Specifically, by placing more waste material under a combined embankment cover, waste is disposed more efficiently since more waste is placed under approximately the same volume of cover soils and rock. This is an issue of both economic and natural resource efficiency, since cover soils and rock are a locally mined natural resource.

The Class A and Class A North cells are located adjacent to each other in the northwest corner of the Clive facility, with waste disposal operations in each cell beginning in 2000 and 2005, respectively. The two embankments are separated by approximately 250 feet to allow for drainage ditches, groundwater monitoring wells, and inspection/access roads specific to each embankment. Also, the Class A North embankment is slightly shorter in the east-west dimension than the Class A embankment; the combined embankment brings the eastern footprint of waste placement out slightly so that the Class A Combined embankment has a regular rectangular footprint. By combining the embankments, this area can be used for waste placement.

Figure 3 provides a plan view of the Class A Combined embankment superimposed on the Class A and Class A North embankment footprints, including location of the Containerized Waste Facilities within each cell. Figure 4 provides similar north-south and east-west cross sections.

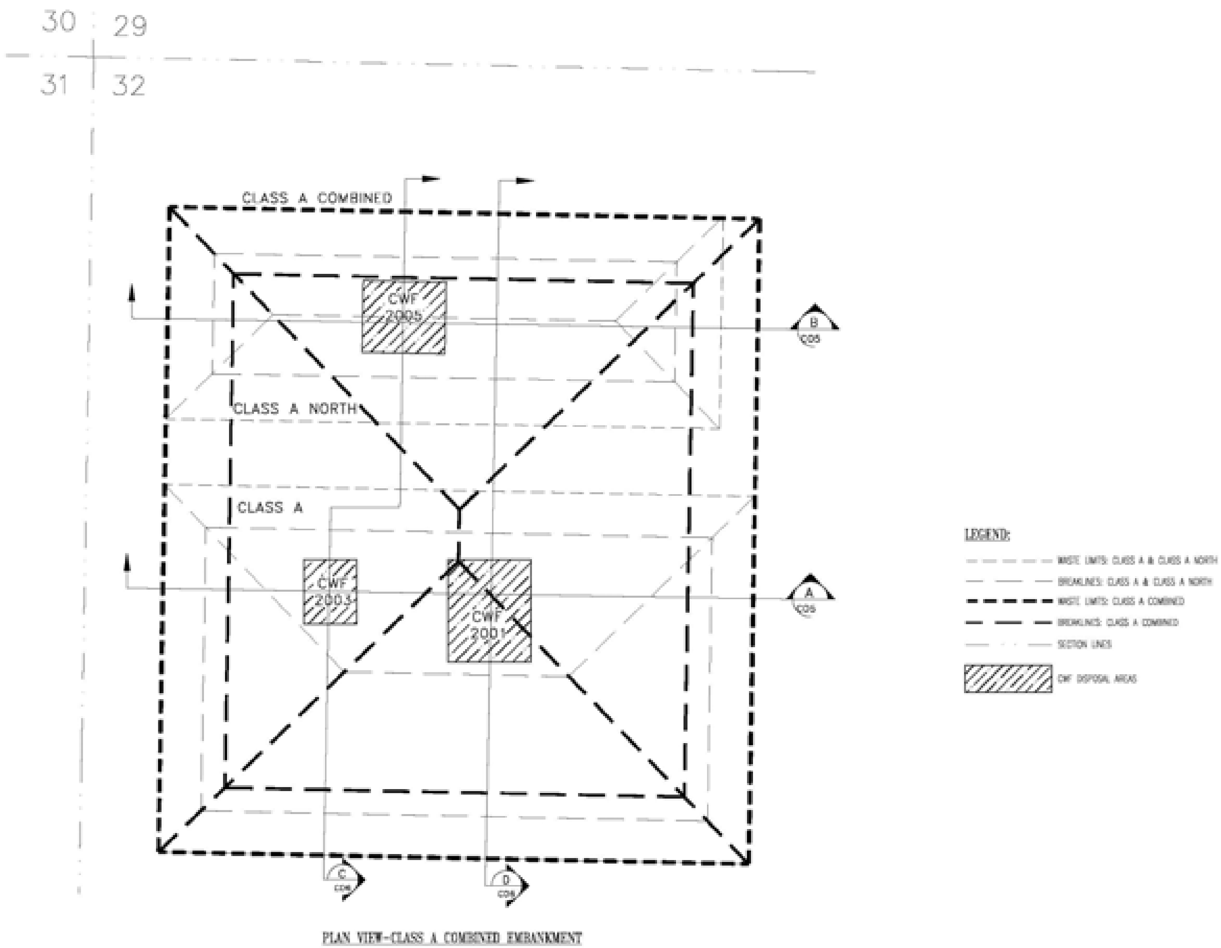

Figure 3 Class A Combined embankment plan view

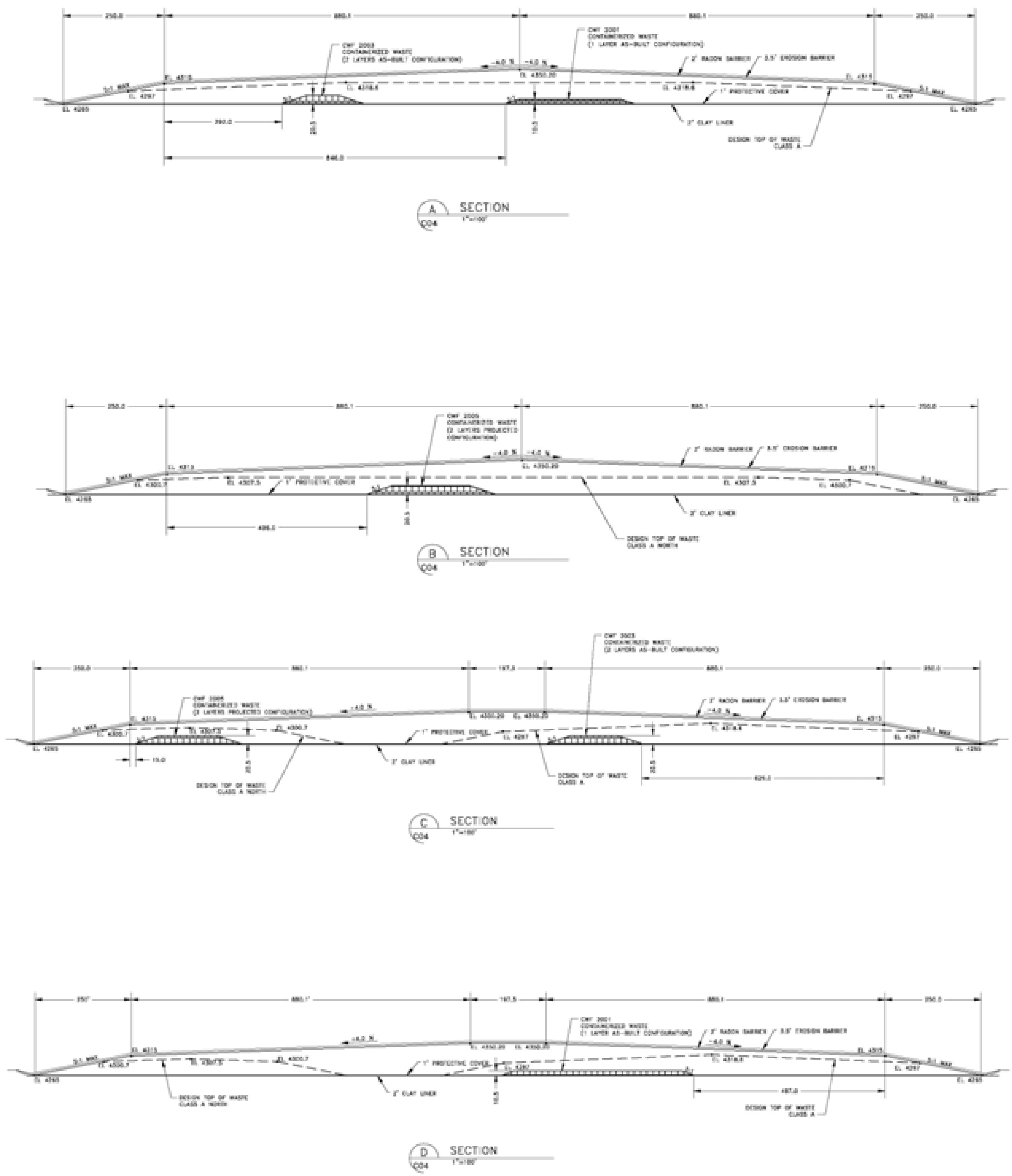

Figure 4 Class A Combined embankment cross sections

By combining the cells and raising the height of the embankment, disposal capacity is increased by 50% over the two-embankment design. The capacity increase is a result of both the reclaimed area between the embankments and raising the overall embankment height. See cross sections C and D in Figure 4.

The combined embankment will have a capacity of approximately 9.8 million cubic yards, compared to the existing total permitted capacity of approximately 6.0 million cubic yards for the Class A and Class A North embankments. This equates to adding a second Class A cell, at approximately 3.8 million cubic yards capacity, without significantly increasing the footprint of disposal operations. Energy*Solutions* estimates that the Class A Combined cell will add at least 10 years of capacity to the site.

PERMITTING THE CLASS A COMBINED EMBANKMENT

With the Class A Combined embankment, Energy*Solutions* has proposed to utilize a portion of the facility that is already approved for LLRW disposal; therefore, siting criteria do not need to be revisited in the permitting process. Similarly, waste types and characteristics are not changed from existing approvals. Waste placement in the combined embankment will follow the same procedures and limitations as currently applied in the Class A and Class A North cells.

Therefore, the permitting process and supporting technical evaluations are simplified somewhat compared to review of an entirely new embankment design, location, and waste placement method. Nonetheless, the Utah Division of Radiation Control conducted an exhaustive review of all components of the embankment design. Technical review took one year to complete following the initial application. Public comment and resolution of those comments has taken an additional 6 months as of November 2006. The new embankment geometry triggered two main areas of technical review: geotechnical stability and infiltration fate and transport modeling. Other technical review matters are also discussed briefly below.

Geotechnical Evaluation

Embankment stability has been evaluated by AMEC Earth & Environmental on behalf of Energy*Solutions*, including an update to regional seismic hazard data and additional site-specific geotechnical characterization work (2). The seismic hazard data had not been re-evaluated for over 20 years and was considered to be both poorly documented and excessively conservative by current standards. Site-specific geotechnical characterization was found to be essentially unchanged from that used in previous evaluations. This data was then used to evaluate the static and seismic stability of the combined embankment. The study concludes that the combined embankment will meet stability, settlement, and differential settlement criteria.

In order to establish a basis for the geotechnical evaluation, Energy*Solutions* had to first define the embankment geometry. In the past, Energy*Solutions* had attempted to simplify geotechnical evaluations by defaulting embankment height to be consistent with previous approvals, dating to the Vitro embankment's rough geometry. Because the regional seismic hazard data and site-specific geotechnical characterization were being updated concurrent with development of the Class A Combined embankment, Energy*Solutions* elected to evaluate increasing the height of the waste column at the same time. While this made technical review and regulatory approval more complex, the increased waste capacity justified the time and effort involved.

Energy*Solutions* initially tasked AMEC with assessing what the maximum height of waste could be before the embankment failed to meet static or seismic stability criteria. In essence, this analysis would develop a design criterion for the maximum height of the embankment. Using the existing seismic design criteria, AMEC concluded that an increase of 18 feet at the embankment shoulder would meet the performance criteria. However, when considered with the updated seismic hazard inputs, AMEC estimated that an increase of 58 feet could be supported. Either dimension would easily fit within permitted embankment heights for municipal, tailings, and hazardous waste landfills currently in operation around the country. Since there was uncertainty as to what degree DRC would permit Energy*Solutions* to take credit for the updated seismic hazard inputs, a design height increase of 18 feet was selected. In that way, conservatism is retained in the embankment design.

The geotechnical analysis included field verification of existing geotechnical characterization and an update to the regional seismology used for analysis. The regional seismology had not been updated in over 20 years, although it had been reviewed as part of license renewals over that time. The geotechnical analysis also evaluated impacts of the increased waste height, finding that factors of safety for static and seismic stability were not unacceptably compromised.

Waste settlement and differential settlement projections were also evaluated. Concurrent with permitting the Class A Combined embankment, but as a separate licensing action, Energy*Solutions* has been working to improve waste compaction during initial placement. A component of this effort is a program to monitor embankment settlement and differential settlement after waste placement is complete, before beginning construction of the final cover. This approach increases reliance on real-world evaluation of embankment behavior and performance and decreases the need to rely on projections and modeling. Nonetheless, rough estimations of settlement and differential settlement were completed in order to provide a basis for licensing the combined embankment.

Infiltration Fate and Transport Model

Infiltration fate and transport modeling has been conducted by Whetstone Associates on behalf of Energy*Solutions* (3). The model concludes that the Class A Combined embankment will meet the performance criteria, with several isotope-specific limits. Similar limits currently apply to the Class A and Class A North embankments.

The infiltration fate and transport model was completed using methods and input assumptions standardized in previous modeling of Energy*Solutions'* disposal cells, with the exception of the site's evaporative zone depth (EZD). EZD was increased in this model compared to previous models, based on data developed from Envirocare's Cover Test Cell.[1] Essentially, a water balance for the Cover Test Cell confirms that the site-specific EZD is considerably deeper than

[1] A discussion of Envirocare's Cover Test Cell was presented at WM '03. Data collected from completion of the Cover Test Cell in January, 2002 through September, 2005 were analyzed in support of the revised EZD.

previously modeled; thus, it is appropriate to revise the infiltration fate and transport model accordingly.

However, the technical review concluded that there is not yet enough data to support a revised EZD for the Clive site. Energy*Solutions* then revised the model to revert to the previously-accepted EZD. This caused some isotopes to have unacceptably low concentration limits for disposal. Upon evaluation of the model, it was determined that the increased surface area of the combined cell was leading to increased infiltration because of the large collection area for rainfall. In order to improve drainage at the critical surface of the radon barrier clay, the lower filter zone was increased from 6" thick to 24" thick. This change increases the drainage capacity of the layer so that infiltration is reduced and the isotopic limits drop to acceptable concentrations.

Other Technical Review Matters

While the majority of technical review attention was focused on the geotechnical evaluation and the infiltration fate and transport model, regulatory review was not limited to these subjects. Other areas of technical review included confirmation that the new embankment geometry would not affect the facility's compliance with radiological dose and release criteria; environmental monitoring; impact on Containerized Waste Facilities; and financial assurance funding.

Since the Class A Combined embankment does not introduce new waste types or handling procedures, potential radiological dose to facility personnel and the public is addressed by existing dose assessments. Of course, Energy*Solutions* bore the burden of confirming this to DRC as part of the regulatory review process.

Environmental monitoring of the combined cell is actually somewhat simplified compared to the previous two-embankment design. With separate Class A and Class A North embankments, downgradient groundwater monitoring required a set of monitoring wells between the embankments. Under the combined design, these wells can be eliminated from the groundwater monitoring network. This results in 6 fewer wells subject to operational and post-closure monitoring. Similarly, 4 soil monitoring stations sited between the separate embankments can be eliminated. Figure 5 displays the environmental monitoring network for the Class A Combined embankment, indicating the eliminated monitoring stations.

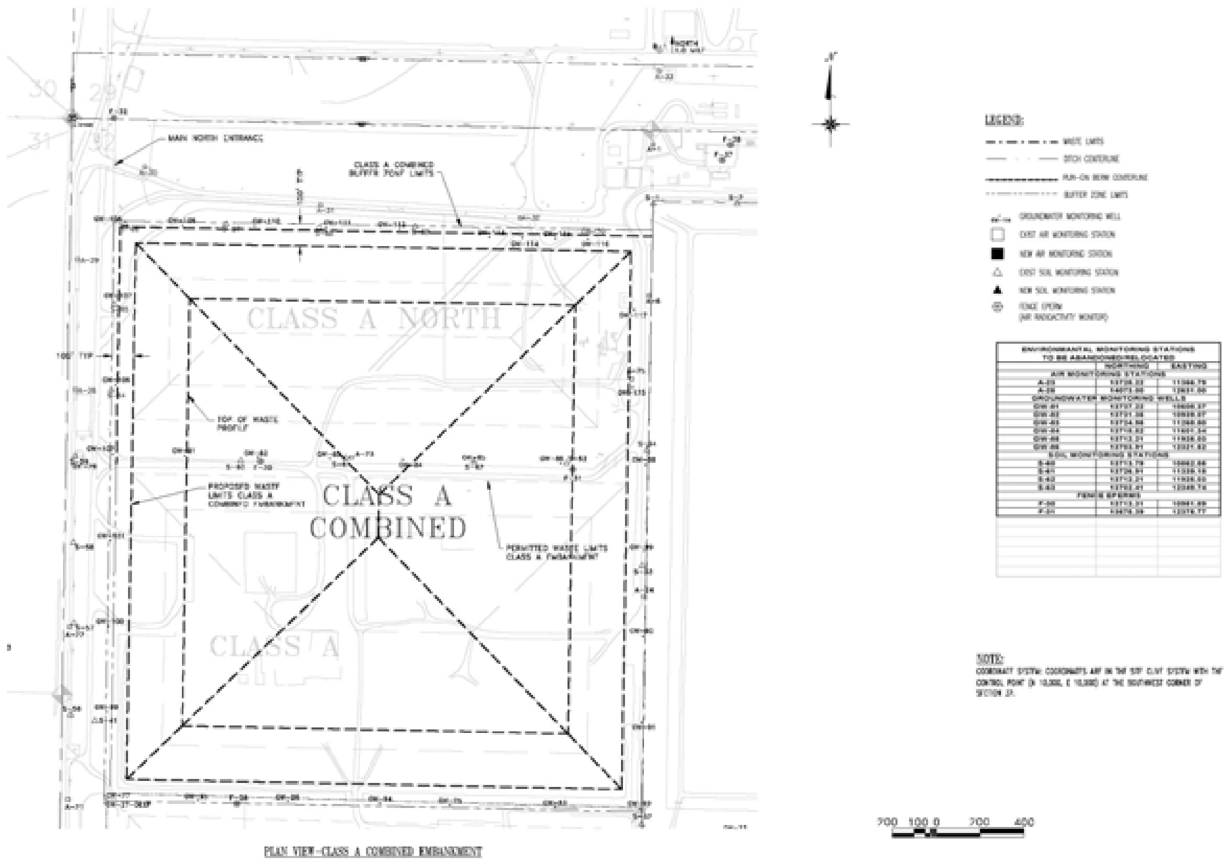

Figure 5 Environmental monitoring for the Class A Combined embankment

In licensing the CWF disposal concept, an important design parameter was the thickness of bulk soil disposed between the CWF and the cover. This soil serves the function of moderating differential settlement in the case that the headspace void in CWF containers collapses. In developing CWF placement methods, the top of the CWF was at an average depth of 14 feet below the base of the cover and the entire CWF was located beneath the top slope of the embankment. These conditions continue to be met with the combined embankment design.

Financial assurance for institutional control is based on permitted embankment geometries, waste management facilities, and the supporting environmental monitoring network. Therefore, the cost calculations that form the basis for Energy*Solutions'* surety funding needed to be re-evaluated to account for the Class A Combined embankment. Because the waste placement footprint is essentially unaffected and the new embankment geometry does not require new waste management facilities, the only significant change is to the long-term groundwater monitoring network. Because less monitoring wells are needed for the combined geometry as compared to the two-embankment design as discussed above, this network and associated long-term costs actually shrink. However, this reduction is more than offset by the increased thickness of the drainage rock needed. In the end, the financial assurance needed slight increases.

BENEFITS OF COMBINED EMBANKMENT GEOMETRY

The chief benefit of the Class A Combined embankment is improved utilization of the existing area permitted for LLRW disposal at Energy*Solutions'* Clive facility. This improved utilization is estimated to add at least 15 years to the facility life.

Improved disposal utilization comes with a minimum increase in liner and cover area that needs to be constructed. Therefore, fewer of these natural resources are needed per unit of LLRW disposed, resulting in a slight decrease in the marginal costs for these items.

By combining the cells, Energy*Solutions* will be able to reduce the number of environmental monitoring stations and groundwater wells at the site. This slightly reduces operational and post-closure monitoring costs without compromising environmental protection. However, these cost reductions are offset by the increased material cost for the thicker drainage layer in the combined cell cover design.

The capacity increase comes without any impact to existing or planned site waste management infrastructure, such as rail lines and storage pads. Because site infrastructure such as haul roads are already in place to deliver waste to both the Class A and Class A North embankments, no additional infrastructure is needed for waste placement in the combined embankment.

CONCLUSION

The Class A Combined embankment has been developed to optimize disposal capacity within Energy*Solutions'* currently approved LLRW management and disposal site limits. Permitting this embankment geometry required detailed geotechnical and infiltration fate and transport modeling, as well as supplemental evaluations of radiological impacts, environmental monitoring, waste placement, and surety impacts. These issues have all been satisfactorily addressed to Energy*Solutions'* regulators at the Utah Division of Radiation Control. Energy*Solutions* estimates that the Class A Combined cell will add at least 10 years of capacity to the site, improving utilization of the permitted area without unacceptable environmental impacts.

REFERENCES

1. Envirocare of Utah, Inc. May 27, 2005. "Radioactive Material License #UT2300249 and Ground Water Quality Discharge Permit No. UGW450005. Amendment and Modification Request – Class A Combined Embankment."
2. AMEC Earth & Environmental, May 27, 2005, "Geotechnical Study: Increase in Height and Footprint".
3. Whetstone Associates, May 2006, "Energy*Solutions* Class A Combined (CAC) Disposal Cell Infiltration and Transport Modeling Report".