CERCLA D3 RI/FS COMMENT AND RESPONSE SUMMARY

Comments by: **TDEC Division of DOE Oversight**
Comments Received: August 6, 2015
Title of Document: Remedial Investigation/Feasibility Study for Comprehensive Environmental Response, Compensation, and Liability Act Oak Ridge Reservation Waste Disposal Oak Ridge, Tennessee
Revision No.: D3 [to be managed as a D1]
Document No: DOE/OR/01-2535&D3
Date: March 31, 2015

Comment #	Comment	DOE Response
TDEC.G.001	Subsequent to the D2 RI/FS, DOE has taken the position that state regulations governing the disposal of LLRW are not relevant and appropriate to the disposal of DOE radioactive wastes; therefore the state rules should not be considered Applicable or Relevant and Appropriate Requirements (ARARs) for the EMDF. While DOE states it is obligated to abide by DOE Orders, it is also DOE's position that the orders should not be cited as requirements or to be considered guidance (TBC) in Records of Decision and other CERCLA agreements. As a consequence, TDEC rules regulating LLRW were removed as ARARS from the D3 RI/FS, as were DOE Orders listed as TBC. TDEC strongly disagrees with DOE's position and EPA has indicated they disagree as well. It is TDEC's position that the substantive requirements of TDEC 0400-20-11, Licensing Requirements for Land Disposal of Radioactive Waste, are relevant and appropriate to the management and disposal of LLRW authorized by the FFA under CERCLA and, in fact, intrinsic to the CERCLA process. While TDEC agrees DOE Orders are not ARARs as defined in CERCLA, the orders nevertheless represent DOE's regulatory responsibilities under the Atomic Energy Act, as well as its obligation to maintain the facility in perpetuity. Consequently the orders require consideration in Records of Decision and associated CERCLA documentation to the extent that they form a basis for a more stringent requirement than the TDEC rules. The expectation is that the more restrictive requirement will apply, as is typical of the CERCLA process. The above does not preclude DOE from pursuing the EMDF under its own authority, subject to state oversight as provided by the Tennessee Oversight Agreement.	Agreement has been reached on including ARARs for NRC-based TDEC rules regulating LLRW as 'relevant and appropriate' and DOE Order (Manual) references as to be considered (TBC) guidance.
TDEC.G.002	There is currently no consensus between DOE, EPA and TDEC regarding which laws are applicable and/or relevant and appropriate. Until agreement is reached on ARARs, there will be no way to determine if a given proposed site, facility design, and associated waste acceptance criteria will meet CERCLA remedial action goals. If agreement cannot be reached on ARARs, DOE should use the remaining capacity at EMWMF judiciously and, if EMWMF capacity is inadequate to accommodate all waste streams generated by CERCLA actions that are necessitated by imminent risk to human health and the environment, pursue disposal options outside of CERCLA for those waste streams. These options could include on-site disposal of radioactive waste under DOE authority, on-site facilities permitted for mixed waste, and off-site disposal.	Agreement has been reached on ARARs to be included in the RI/FS, with only some minor points to be worked out.
TDEC.G.003	The proposed location for the EMDF conflicts with siting criteria for TSCA, Solid Waste, and	There are no Solid Waste requirements in the ARARs table that the (D3 version)

	LLRW disposal facilities and associated guidance issued by the EPA and NRC. More specifically, the EMDF, as proposed, would be located approximately 650 yards from the nearest DOE boundary and over steep slopes (>30%), shallow watertable, zones of upwelling groundwater, wetlands, seeps, springs, a stream, and complex geohydrology. While not a natural feature, the extensive underdrain system proposed to collect groundwater beneath the facility and discharge it local streams, provides a direct and rapid pathway for the dispersion of contaminants to Bear Creek and via Bear Creek to Poplar Creek and the Clinch River: a condition the siting requirements specifically attempt to avoid. While the siting requirements for LLRW disposal facilities tend to be the most restrictive, the location proposed for the EMDF also fails to meet siting requirements for TSCA and Solid Waste disposal facilities. For example, the TSCA rules require: the bottom of the landfill liner to be greater than 50 feet from the historical high water table; there be no hydraulic connection between the site and standing or flowing surface water; and the landfill be located in an area of low to moderate relief. The TDEC Solid Waste Rules require subtitle D landfills to be located at least 200 feet from the normal boundaries of springs and streams. As the TDEC rules regulating LLRW facilities have been removed from consideration in the D3 RI/FS, a discussion of the these requirements relative to the proposed EMDF location is provided in Attachment A. While there may be no site on the ORR that will meet all the siting requirements, it seems likely there are better location(s) that could accommodate the bulk of the waste, if more rigorous sequencing, segregation, recycling, and size reduction of waste were practiced. A Site-Wide Radioactive Waste Management Program as required by DOE Order M 435.1-1 would be expected to facilitate such an effort. In any case, it is TDEC's expectation that the EMDF meet all pertinent regulations, unless officially waived and the waiver appropriately documented.	proposed location or the revised (D4 version) proposed locations do not meet. DOE agrees that there are two siting requirements under TSCA, and one siting requirement under NRC-based LLRW (identical to one of the two TSCA requirements) that the proposed locations do not meet as written. Regarding the NRC-based LLRW requirement at 10 CFR 61.50(a)(8) and TDEC 0400-20-11-.17(1)(h), justification has been given to TDEC and EPA that, while this is a relevant requirement, it is not appropriate and therefore it is not included in the ARARs tables. Regarding the TSCA requirement at 40 CFR 761.75(b)(3), a TSCA waiver is requested in the D4 document revision to two parts in that requirement; justification is given (See Chapter 4 in Appendix H). Under TSCA, provisions are made to receive waivers if suitable justification can be made (justification that demonstrates the proposed operation of the facility "*will not present an unreasonable risk of injury to health or the environment from PCBs when one or more of the requirements of paragraph (b) of this section are not met*". Of the two TSCA requirements, one (requiring a 50-ft buffer below the facility liner system to the high seasonal water table) is very routinely granted by EPA to sites around the country. Justification to receiving this waiver (based on equivalent protectiveness provided by a 10-ft buffer of specific hydraulic conductivity and based on waste characteristics expected regarding PCBs and no unreasonable risk to the environment and public from those PCBs by not meeting the requirement) is given in the document. In addition to that justification, evidence is given whereby the second part of the TSCA requirement (regarding the connection between ground water and surface water) is met through engineered features. Justification for receiving a TSCA waiver for the EBCV Site, from the topography requirement given at 40 CFR 761.75(b)(5), is given in the D4 RI/FS. See Section 4.2 of Appendix H. Regarding the distance to DOE boundaries, refer to the response to TDEC.S.3, which discusses the groundwater divide and ridge that is located between the public and proposed facility locations. The issue of building on existing terrain >30% in slope, in zones of upwelling groundwater, and over a stream might be mitigated by selecting a different site and/or reduction of landfill footprints. Some issues however will be present regardless of the location chosen within Bear Creek. Shallow water table, wetlands, seeps, springs, and complex geohydrology have been well documented all along Bear Creek Valley. The siting configuration presented in the D3 RI/FS was developed based on the criteria that consolidation of ORR Brownfield locations and providing adequate volume were high priority for a new landfill. The D4 will look at other alternatives that do not place such a high emphasis on these two factors. The density of seeps and springs in Bear Creek means that complete elimination of any underdrain systems for a new landfill is not feasible. Additionally, the TSCA waiver will be required for any of the presented siting options in the revised D4 RI/FS. The RI/FS identifies these possible waivers; however the final decision on waivers granted by regulators is solidified in the ROD. The RI/FS assumes the most rigorous sequencing possible; virtually all of the waste soils are used as fill in the document volume analysis. Segregation,

		recycling, and limited size reduction (to meet physical WAC) are performed at the generating project site, as discussed in the RI/FS (refer to Section 5.1.5). DOE agrees a site-wide plan could address management of waste in terms of the methods to reduce waste as mentioned in this comment. However, this is a programmatic issue and as such is not discussed in the RI/FS.
TDEC.G.004	To overcome limitations of the location proposed for the EMDF, DOE proposes various engineered barriers,[1] but fails to provide substantial technical justification of their equivalency over time in the risk assessment and funding for their maintenance and monitoring beyond 100 years. Due to the long-term hazards presented by uranium and other long-lived radioisotopes, NRC's view has been that engineered barriers (e.g., cap components, drains) can improve performance, but are expected to degrade over time and become ineffective. Consequently, State and NRC LLRW regulations rely heavily on the natural characteristics of a site to isolate wastes in the long-term and, thereby, protect the public health and environment. As stated in TDEC Rule 0400-11-.17(1)(a): *The primary emphasis in disposal site suitability is given to isolation of wastes, a matter having longterm impacts and to disposal site features that ensure that the long-term performance objectives of Rule 0400-20-11-.16 are met, as opposed to short-term convenience or benefits.* In this context, NRC's Performance Assessment Working Group in NUREG 1573 recommends any credit given for engineered barriers in performance assessments be specified and technically justified on a case-by-case basis. For periods over 500 years, NUREG 1573 advises it is unreasonable to assume any physical engineered barrier can be designed to function long enough to influence the eventual release of long-lived radionuclides.[2] While the risk assessment in the RI/FS assumes some engineered components degrade (synthetics),others retain their initial functionality indefinitely. For example, clay components in the cap are assumed to retain the same hydraulic conductivity for a million years and, thereby, their ability to restrict water infiltration into the waste to 0.43 inches/year. This despite the degradation of the geomembrane and drainage layer; challenges presented by the location; the potential for differential settlement of the cap; no funds allocated for maintenance past 100 years; and evidence that the hydraulic conductivity of compacted and amended clays can increase over relatively short periods. It is also unclear how the underdrain could be repaired, if it clogged or otherwise failed over the course of time and at what expense, given it would be covered by 2.5 million cubic yards of waste (a large proportion of which would have been created by adding clean soils to fill void space). All engineered barriers are subject to long-term degradation and are apt to require maintenance to remain protective of human health and the environment over the course of time. This needs to be reflected in the EMDF risk and performance assessments and taken into account in the cost analysis.	DOE's view coincides with NRC's view that engineered barriers can improve performance, but are expected to degrade over time and become ineffective. Modeling parameters (e.g., infiltration rate) have been adjusted in the D4 version to demonstrate this degradation over time. This degradation is partially accounted for in a two-fold increase in the hydraulic conductivity of the amended clay layer in the cap. Additionally, differential settlement of the cap is accounted for in an assumed erosion of the top layer of the cap and a decrease in the lateral drainage afforded by the drainage layer over the clay layers of the cap. Justification for the longevity assumed for various engineered features has been improved in the document (see Appendix H, Section 4.1.2). Regarding the cost to maintain the cap through the 1,000 year compliance period, these were included in the D3 RI/FS through the application of a Perpetual Care Fee. However, in response to other comments on this D3 document, DOE has evaluated the Perpetual Care Fee against a 1,000 year maintenance period (which includes two $7M repairs to the cap) The Present Worth of the perpetual care fee exceeded the cost of 1,000 years of maintenance, so the perpetual care fee was included in the lifecycle cost. Justification is given in the document (see Sections 6.2.2.4.8 and 7.2.2.3) regarding the longevity of the underdrain materials and its performance. Redundancy such as using both a blanket drain and trench drain is utilized to provide factors of safety for long-term underdrain function. Some clogging could occur over the period of compliance, but by oversizing the system, specifying the correct materials, incorporating multiple drain layers, and executing proper site prep before construction, even with diminished long-term function the drain system would be capable of managing the reduced water flow expected in the underdrain post-closure. Note that this engineered feature (underdrain) does not serve the purpose of "influenc(ing) the eventual release of long-lived radionuclides" as quoted by the commenter from NUREG 1573 and therefore is not categorized by that document as having a 500 year functioning period. The purpose of the underdrain is to maintain the groundwater table well below the waste/liner/buffer. By initially providing a hydraulic conductivity 4 to 5 orders of magnitude higher than surrounding materials it is highly unlikely that the underdrain would clog to the point that it would stop functioning during the compliance period (clogging to the point of non-functioning would require that

[1] As defined in NUREG 1573 an "*Engineered barrier is a man-made structure or devise designed to improve the land disposal facility's ability to meet the performance objectives of 10 CFR Part 61 described in Subpart C, meaning the ability to isolate and contain waste, to retard and minimize possible release of radionuclides to the environment*."

[2] U.S. Nuclear Regulatory Commission. NUREG- 1573: *A Performance Assessment Methodology for Low-Level Radioactive Waste Disposal Facilities: Recommendations of NRC's Performance Assessment Working Group*. October 2000. fhttp://pbadupws.nrc.gov/docs/ML0037/ML003770778.pd (Last visited 07/06/2015)

		the hydraulic conductivity in the underdrain decrease by at least 5 orders of magnitude, a phenomena that is highly unlikely to occur). The long-term implications of eventual failure of the underdrain system (and reduction in the thickness of the unsaturated zone) for EMDF performance are considered in sensitivity evaluations of the groundwater model suite (MODFLOW/MODPATH/MT3D) and the PATHRAE model. These evaluations are described in Appendix H Section 4.5
TDEC.G.005	This RI/FS maintains that many toxic, hazardous, and radioactive substances can be disposed in the proposed EMDF with no limits on concentration or restrictions on chemical form. The analysis is based on a risk assessment that uses limited exposure pathways for a resident located where the calculated future risk is minimal in comparison with that computed for a resident at many alternate locations in Bear Creek Valley. The risk assessment relies on assumptions of homogeneity and equilibria that result in best case scenarios for transport of most hazardous substances in ground water. The model does not incorporate degradation of key barrier layers in the facility, even over geologic time frames, resulting in unrealistic estimates of infiltration rates over thousands of years. The risk assessment does not consider other sources of contamination in Bear Creek Valley. The risk assessment presented in this document is therefore unusable to establish waste acceptance criteria that would protect human health and the environment. To the extent possible, the methodology described in "*Performance Assessment for the Class L-II Disposal Facility*" (ORNL, 1997, ORNL/TM-13401) should be used as a template for development of a credible WAC. TDEC recognizes this document as a competent radiological performance assessment for a Bear Creek Valley site.	DOE strongly disagrees that the RI/FS maintains that many toxic, hazardous, and radioactive substances can be disposed in the proposed facility without limits. DOE recognizes and indicates in Chapter 2 and again in Section 6.2.3 of the RI/FS that many wastes are not acceptable (excluded) from disposal in an on-site disposal facility. They are explicitly stated as being unacceptable for disposal in the facility in Chapter 2 and again in Section 6.2.3, and ARARs are included that address many of these exclusions. This includes any waste that is not acceptable in a RCRA subtitle C or TSCA hazardous waste landfill, with the exception of the radionuclides (because they are not addressed by RCRA or TSCA). Additionally, listed RCRA waste is noted in Chapter 2 as excluded from disposal in any on-site facility. For radionuclides, the modeling performed to determine preliminary analytic waste acceptance criteria (PreWAC) results in limits on more than half of the radionuclides that are modeled (in excess of 30 nuclides). The number of nuclides limited by this modeling for an ORR facility far outnumbers nuclides with limits imposed by any other disposal facility, federal or commercial, currently operating. Other limits imposed on nuclides for administrative reasons (e.g., transuranic limits or greater than class C limits) are summarized in a new flowchart and table (see Revised Section 6.2.3 of the main document). The D3 version of the RI/FS stated that these administrative limits would be specified in a WAC Attainment (or Compliance) Plan; however, the D4 now explicitly states these limits. Appropriate (or even any) numerical limits for some of the excluded contaminants may not be able to be mathematically determined through the modeling that is completed, which is based on the subsurface movement of the contaminants and factors-in the propensity of the contaminant to remain attached to soil particles as well as the radioactive decay of the contaminants, and time it takes for contaminants to reach a receptor. Exposure pathways examined in the model include a farmer drinking water from a well. This is by far the most conservative pathway analysis for a future receptor – it is not a "limited exposure pathway". This scenario is significantly more conservative than the proposed (EBCV) site allows as this site is located in a future DOE-controlled industrial use area, which restricts use of groundwater as a drinking source, and would allow a scenario whereby under CERCLA a worker is the receptor, with a much more limited exposure than is used in the RI/FS and for the determination of waste limits. In addition, more conservative assumptions for groundwater well location (closer to the cell and along the axis of maximum contaminant concentration) have been made for the risk assessment and PreWAC development in the D4 revision if the RIFS. Note the document (revisions in Appendix C) specifically discusses that the decision on how to treat Hg-contaminated debris lies first with the demolition

		contractor/project, and that treatment may occur via multiple different pathways that might also include off-site disposal or possibly on-site treatment by macroencapsulation. Thus the RI/FS addresses hazardous waste disposal under RCRA and TSCA statutes and proposes disposal of all hazardous waste per those requirements. Modeling to further limit hazardous waste disposal is not required by RCRA or TSCA rules. However, as this is a CERCLA facility, demonstration of meeting the NCP requirements (risk range and hazard index) must be completed. As well, within the 1000 year post-closure compliance period, the performance of the facility is demonstrated through modeling to meet applicable ambient water quality criteria in surface water and maximum concentration limits in possible drinking water. Meeting these limits through modeling imposes further limits, if necessary, on acceptance of nuclides and hazardous contaminants thus ensuring protection of the public and the environment. DOE disagrees that "best case" scenarios of transport were modeled. Overly conservative assumptions were made regarding the degradation of certain key barriers (geosynthetics failing at 100 years). DOE has agreed to incorporate more degradation of key barriers (clay and drainage layers) in combination with less conservative assumptions regarding geosynthetics that will result in a higher infiltration rate over times exceeding 1,000 years, with the understanding that modeling past 1,000 years carries a high degree of uncertainty. Plume maps of contaminant travel outside the on-site facility show very little interaction with other on-site sources. DOE O 435 requires an assessment of the combination of all sources in the area of an on-site disposal facility. This Composite Analysis (CA) has been completed and will be shared with regulators once the DOE review has been completed.
TDEC.G.006	TDEC acknowledges that there are very few, if any, preferable sites on the Oak Ridge Reservation to dispose of radioactive, hazardous, and toxic waste than the site selected in this RI/FS. TDEC does not believe that there is a site on the Oak Ridge Reservation that would accommodate a contiguous land-based waste disposal facility of the size DOE has proposed and meet TDEC rules that would apply to either a permitted radioactive waste disposal facility or a new commercial hazardous waste landfill. Likewise, we have not located an area with the requisite footprint that could be permitted under toxic waste rules. The basis for waivers of siting requirements must be founded on both a robust facility design and waste acceptance criteria that restricts the contaminant loading of any substances that are likely to persist past the expected life of the engineered features. As opposed to a good site, which has intrinsic characteristics that will provide a buffer to attenuate a future release and sufficient time to implement a corrective action, if necessary, the protectiveness of design and restrictions on waste inventory rely on human implementation and are subject to human error. In this RI/FS, the proposed waste acceptance criteria hardly limit the loading of toxic substances at all. More mercury would be allowed in the facility than was lost to the environment at Y-12, and an amount of depleted uranium comparable to that disposed in Bear Creek Burial grounds could be accepted. The strategy offered in this document leaves only the facility design as a single line of defense against future releases of contamination. This approach seems inconsistent with the approach DOE typically takes toward worker health and safety, nuclear criticality, compliance with environmental permits or any number of other issues that might involve risk to human health and the environment, where multiple lines of defense are preferred. TDEC	DOE agrees with TDEC, that the ORR has limited land that is suitable for use as a land disposal facility for radioactive and hazardous waste. However, of the limited land available, several sites are now identified in the D4 RI/FS (as opposed to only a single site that was presented in the D3 RI/FS) that are suitable for siting a land disposal facility. All require waivers to certain siting criteria, in particular the TSCA requirement to provide a 50 ft buffer between the base of the liner and the historical high water table, as well as a waiver to the site having a connection between groundwater and surface water. Engineering features described in the RI/FS provide constructed substitutes for these siting criteria (for example, underdrains will serve to break the contact between groundwater and surface water in the landfill footprint, and the hydrogeologic buffer provided, while not 50 feet in depth, will provide equal protection with a material having a higher hydraulic conductivity). More justification and description of these features, as well as support for their expected lifetimes, is given in the revised D4 document, Sections 4.1.and 4.2. DOE strongly disagrees with the statement in the comment that "more mercury would be allowed in the facility than was lost to the environment at Y-12." If this were true, EVERY waste lot accepted in the landfill would have a concentration of mercury in excess of 700 ppm. In fact, mercury containing waste debris and soils only accounts for a (conservatively) estimated 15% of all waste to be

	does not think this strategy toward waste disposal is acceptable.	disposed in a future on-site facility. Additionally, all mercury (D009) waste that is accepted in an on-site facility must meet RCRA disposal requirements – that is, if the waste demonstrates the toxicity characteristic (D009) it must be treated to meet land disposal restrictions stipulated under 40 CFR 268.40, 268.45, and 268.49. From characterization results on the Alpha-5 building (the most contaminated mercury-use facility), an estimated 95% of waste that exceeds a 247 ppm concentration of mercury would require treatment; and the characterization indicated that only 12% of the facility's structure would require that treatment (which if extrapolated to all mercury-use facility waste means that of the 15% of Hg suspect waste, only 1.8% would be considered mercury-contaminated (D009) and would require treatment). Furthermore, elemental mercury waste is excluded from the landfill (it is a liquid). Elemental mercury waste that has been treated (amalgamated) will be treated at off-site facilities and will therefore be disposed off-site as well. Likewise, a similar analysis could likely be made regarding the statement that the limits on depleted uranium would allow more source than is present in the Bear Creek Burial Grounds. The strategy offered in the RI/FS does NOT only rely on the facility design; a significant amount of work was completed to determine preliminary waste acceptance criteria, based on hypothetical future receptor exposure that greatly limits the contaminant inputs to the facility. The PreWAC were also limited to meet maximum concentration limits (MCLs) of contaminants in future drinking water, per the Safe Drinking Water Act. The revised version of the RI/FS (D4) also determines if PreWAC limits must be further lowered to ensure that appropriate ambient water quality criteria in surface water are met per the Clean Water Act to protect water resources and ecological receptors during the 1000 year post-closure compliance period. As a note, the analytic PreWAC that have been calculated in the D4 RI/FS are more stringent that those put forth in the D3 RI/FS. Additionally, the D4 RI/FS will include some administrative WAC limits such as greater than Class C limits (see Section 6.2.3).
TDEC.G.007	As opposed to the EMWMF, where DOE Orders are listed in the Record of Decision as "To Be Considered" guidance for on-site disposal of CERCLA generated waste, this RI/FS does not include DOE Order requirements. As DOE states it is obligated to abide by its orders, it is TDEC's position that DOE demonstrate that the proposed facility will comply with the requirements of DOE Order M 435.1-1 by completing a performance assessment, composite analysis, preliminary closure plan, and preliminary monitoring plan for the proposed facility. Based on a full review by DOE's Low-Level Waste Disposal Facility Federal Review Group, DOE should secure a disposal authorization statement, prior to decisions under CERCLA. TDEC anticipates that such a demonstration of compliance with the requirements of DOE Orders will prevent inconsistencies with the regulatory approach under CERCLA and address inadequacies in site selection and characterization and fate and transport modeling that remain problematic in this RI/FS.	DOE intends to obtain a DAS for this facility, with a preliminary DAS expected prior to the ROD. OREM intends to work with the appropriate review groups at both OR and DOE-HQ to achieve the preliminary DAS, and has begun this process. Moreover, as each requirement under DOE O 435.1 is completed, the resulting analysis will be provided to TDEC and EPA for review. However, DOE does not expect to receive full approval via a DAS by LFRG prior to submitting this RI/FS. As this RI/FS does not constitute a decision under CERCLA, but rather a compilation of information to support future decisions (e.g., the ROD), DOE does not interpret this comment as requiring a DAS prior to the RI/FS submittal. As a note, the fate and transport modeling conducted under the D4 RI/FS has been significantly modified to address comments put forth by both the state and EPA. Site selection has been broadened in the D4 RI/FS to include additional sites as well as a hybrid alternative (small site and off-site disposal combined). Regarding characterization, TDEC has in fact stated that further characterization is not warranted until a site is selected.
TDEC.G.008	The approach to waste disposal of future generated CERCLA waste mirrors the approach taken	The statement "*the Oak Ridge Reservation does not offer a potential disposal site*

	almost twenty years ago to authorize waste disposal at the EMWMF. Despite doubts that the EMWMF will ultimately afford long term protection of human health and the environment, TDEC does believe that the EMWMF has provided risk reduction in the near term. The facility provides isolation of contaminants that were migrating freely into the environment, both offsite and onsite near ORR boundaries. The EMWMF has also allowed for timely demolition of deteriorating structures that contained significant inventories of radioactive material and has provided a cost effective disposal option that has facilitated brownfield development. However, the Oak Ridge Reservation does not offer a potential disposal site that provides better intrinsic isolation of contamination from the environment or property boundaries than many of the areas where contaminated facilities or environmental media are currently located. This leads to questions about the degree of risk reduction that can be achieved by consolidation of contaminants in a single disposal facility on the ORR, particularly for contaminants that persist in the environment for centuries and millennia. At present, few areas remaining on the ORR are scheduled for clean-up to free release status, which leads to further questions about the degree of risk reduction that may be realized by relocation of contamination, even in the short term. DOE does not provide, either in this RI/FS or in CERCLA documentation that authorizes clean-up actions on the ORR, a comprehensive analysis of the reduction in risk that would be achieved through on-site disposal, including the potential for environmental releases during the CERCLA action and during transport to the disposal site. Consequently, TDEC suggests that attempting to build a facility that will meet all CERCLA goals and still accommodate all waste expected to eventually be generated from the demolition of legacy buildings and soil removal actions may be misguided. To justify the use of CERCLA to authorize on-site disposal of waste generated by on-site CERCLA actions, reduction in risk due to consolidation of waste and isolation of contamination should be used as a tool to screen candidate waste streams for on-site disposal. If, based on projected land-use, no significant reduction in either short term or long term risk can be clearly demonstrated for a CERCLA action that relocates the contamination to an on-site disposal facility, the waste generated by the proposed activity should not be a candidate for on-site disposal of CERCLA waste.	*that provides better intrinsic isolation of contamination from the environment or property boundaries than many of the areas where contaminated facilities or environmental media are currently located."* is true, but misleading. It is true, because essentially the locations, or "sites", of those contaminated ORR facilities and media as they currently exist are in the same or similar environmental situations as any site would be that might be selected for an on-site disposal facility on the ORR. Those facilities/media sit on the same subsurface formations, in the same valleys, and receive the same rainfall. However, DOE does not intend to place waste resulting from cleanup of those contaminated facilities/media at an on-site disposal location without first preparing the site, incorporating all the engineered features including natural materials (e.g. clay, siliceous rock) that transform a "site" into a land disposal facility, operating that facility under strict policies (including numerical waste limits) to maintain protection of human health and the environment, and closing that facility using man-made and natural materials that greatly limit the disposed waste from exposure to elements (most specifically rainfall) that would leach those contaminants into the environment in an unacceptable manner over extensive time frames. The statement is misleading, because without a doubt, engineered features of a land disposal facility – buffers, liners, cap, leachate collection and treatment, underdrains, etc., along with limitations on acceptance of contaminants at that facility as determined through detailed risk assessments, which ensure acceptable human health/environmental risks are met for an extraordinary amount of time – will afford a significant reduction in risk for the final disposal of contaminated facilities/media as compared to the "do nothing scenario" implied by this comment, a scenario in which facilities/media in their present state, left unchecked in the environment and exposed to elements over long periods of time, will deteriorate resulting in contaminant transport that will eventually present a much higher and unacceptable risk to public health and the environment. TDEC and EPA comments have questioned the results of the risk assessment completed in the D3 RI/FS, and DOE has responded with a revised D4 risk assessment incorporating requested changes, which ensures protection as required under CERCLA. The waste limits (PreWAC) set by this risk assessment are a "tool to screen candidate waste streams for on-site disposal" as indicated is needed in this comment. [Note that the RI/FS discusses the development of a WAC Attainment (Compliance) Plan that is developed through tri-party agreement if an on-site facility is the selected alternative. This document further describes and limits acceptance of waste in an on-site facility.] The statements in this comment seem to disregard the extensive investigations, studies, and subsequent decisions that have been made under CERCLA concerning the cleanup of ORR contaminated facilities and media that are independent of the situation analyzed by this RI/FS. This CERCLA Disposal RI/FS is concerned with the safe and compliant disposal of the majority of waste (but not all waste as is stated by this comment) resulting from remedial decisions that have been made outside of this document (waste exclusions are delineated in the RI/FS). Those recommendations and decisions on cleanup of individual facilities and media clearly indicate the path for risk reduction, in most of those cases, is demolition/remediation and disposal of the waste. This CERCLA

		investigation and future decision is concerned with where to dispose of that CUMULATIVE waste (not on an individual basis as is implied by this comment). The cumulative management of the majority of waste is the concern of the RI/FS. Three alternatives are assessed. The "No Action" alternative is, again, independent of the decisions to accomplish cleanup, but concerns the decision to NOT consider disposal of the waste in a cumulative manner. The No Action leaves disposal decisions to the individual projects. A result of this would most likely be disposal (by truck) to off-site commercial facilities, accomplished on a project-by-project basis. The remaining alternatives are off-site disposal (via a "cumulative", concerted approach) and on-site disposal (via a new landfill sited on the ORR). Multiple criteria under CERCLA are used to differentiate the alternatives, and select the most beneficial one. The most significant CERCLA criterion is protection of human health. The cumulative off-site disposal (Alternative) of this large volume of waste, in toto, in terms of short-term risk based on historical factual data, is estimated to result in numerous fatalities/injuries (due to waste transport) compared to on-site disposal. The No Action (individual sites shipping waste via truck in most cases) would result in at least four times as many fatalities. The On-site Alternative conducts a risk assessment that maintains the human health risk within the accepted cancer risk range: 1 in 10,000 to 1 in 1,000,000 chance of contracting cancer for a resident farmer (a hypothetical, future situation) through setting contaminant limitations on waste that may be disposed on-site. These results provide the most compelling and decisive comparison of the alternatives from a human health protection standpoint, which supports on-site disposal over off-site disposal (or no action). Other comparisons are made and have merit – for example, off-site arid disposal facilities offer better long-term risk reduction to human health than do on-site facilities – but do not compel selection of one alternative over the other as does "risk of multiple fatalities (single to double digits), projected based on historical and factual data" versus "risk of fractional cancer incidents, projected based on hypothetical future scenarios".
TDEC.G.009	Shallow groundwater and steep slopes are part of a formula for structural instability. An inadvertent intruder will not adequately evaluate this threat and the risk to future resident farmer(s) in event of structural failure needs to be evaluated. Further, Appendix H does not include an inadvertent intruder scenario and states it will be performed as part of DOE order compliance. The EMWMF intruder scenario assumes the intruder will not come in contact with material in steel boxes and considering steel deteriorates in the ground over time, this does not seem protective. An intruder scenario should also be included for EPA and TDEC review.	Structural failure is closely examined in final design. The terrain, slopes, and ability of the site and design to accommodate waste, and the capacity (height) of the waste capable of safely being disposed is evaluated and engineering calculations carried out to ensure stability. Stability in terms of earthquake analysis is determined as well in detailed design, and again, only acceptable risk is allowed. More detail will be added to the D4 RI/FS to explain how this issue is dealt with. The intruder analysis is required under DOE O 435.1 and will be completed; results will be provided to TDEC and EPA for review. Any results that indicate an adjustment to the Preliminary WAC is needed will be incorporated in the finalization of WAC. DOE agrees that intruder scenario will not consider the intruder to be stopped by steel box.

TDEC.G.010	There are a number of uncertainties that complicate the evaluation of the cost of various alternatives that are discussed in the document. Are there any total operating costs per cubic yard of waste disposed at EMWMF? If not then it's difficult to perform an objective evaluation for off-site disposal, transportation, volume reduction, etc.? With respect to the cost of volume reduction, the longer the delays on implementing the use of volume reduction equipment, then the lower the cost benefit analysis becomes for the use of volume reduction equipment.	Operating costs for the on-site alternative are included in the RI/FS cost evaluation. These costs are based on the current, actual costs for operation of the EMWMF (see Appendix I, Section 3.2.2.3 page I-25 where the operational cost, annual, for EMWMF was provided as the basis of the cost for the on-site alternative). Any cost of volume reduction that is analyzed in this RI/FS is for future waste and a future state or condition. The comment implies that purchase and use of VR equipment should be undertaken now, and factored into the analysis as existing equipment. Such an action is outside the scope of this document, and is a programmatic matter.
TDEC.G.011	Based on the information submitted in this document, TDEC does not agree that a waiver for placement of mercury in the disposal cell prior to treatment is appropriate. Thermal mercury treatment or macro encapsulation at the point of generation should be considered.	Treatment of mercury-contaminated waste (including thermal treatment) is discussed in Appendix C. It is not an option for selection in any alternative. A possible regulatory path (Corrective Action Management Unit) under RCRA is discussed in Appendix C.
TDEC.S.001	**Page ES1, Paragraph 3: …"** *The EMWMF RI/FS (DOE 1998) was the first document in the CERCLA process that led to the construction and operation of EMWMF. As a follow-on to that process, this RI/FS utilizes relevant information from the EMWMF RI/FS with revisions and updates to describe and analyze current conditions.* **"** The EMWMF RI/FS discussed in paragraph 3 of this page did not anticipate a number of problems encountered during the construction and operation phases of EMWMF. Due to inadequate facilities to handle water at the EMWMF, as well as sloppy practices during the implementation of removal actions and during transport of waste to the facility, environmental releases of contaminants that had previously been isolated from the environment occurred. Groundwater levels beneath the EMWMF footprint proved higher than predicted and intruded into the facility buffer despite the installation of an underdrain system. The approach to waste characterization and waste acceptance was project specific and not readily amenable to regulatory audit. After approval of the EMWMF RI/FS, Proposed Plan, and Record of Decision, TDEC staff had the opportunity to review a number of groundwater studies done in Bear Creek Valley and to conduct a tracer test in the Maynardville Limestone adjacent to the EMWMF. Additional insight into the hydrogeology of Bear Creek Valley has raised additional concerns about the validity of fate and transport modeling used in the 1998 RI/FS, which was questioned in comment submitted by TDEC in a letter prior to RI/FS approval. Consequently, when scoping for an additional CERCLA waste disposal facility began, TDEC requested that the new facility have technically defensible waste acceptance criteria (WAC) that would allow easier verification of WAC attainment and that the facility not be built over a "blueline" stream, thus avoiding many problems with groundwater levels below the facility as well as a direct connection of the site to surface water. The regulatory framework that was used to authorize the EMWMF is used as a template for the EMDF, but key issues which were not satisfactorily resolved for the EMWMF during the past decade of operations have not been addressed in any revision of the document now under review.	A Lessons Learned section has been included in the conceptual design discussion in the RI/FS that addresses some of the issues brought up in this comment. Individual responses are provided here to comments: "..due to inadequate facilities to handle water at the EMWMF"…Leachate collection piping has been sized larger for the future on-site facility to accommodate higher leachate volumes. Upgrades at the EMWMF have occurred since its inception. The original RI/FS and ROD for the facility envisioned a much smaller operation and it was sized accordingly. Several water management components have been upgraded since that time, and upgrades continue to occur. For example, about 1 M gal of contact water tank capacity has been added; contact water ponds provide approximately 2 M gal of capacity; operational and equipment changes over the years have significantly accelerated the ability to fill, sample, and analyze contact water; and leachate storage tanks' capacities were increased by 60%. Finally, the future proposed facility will add an additional 1.5 M gal of leachate storage capacity. "..sloppy practices during the implementation of removal actions and during transport of waste to the facility, environmental releases of contaminants that had previously been isolated from the environment occurred ." This unsubstantiated statement does not refer to design, construction, operation or in fact any aspect of an on-site disposal facility. Additionally, DOE would like to note that, in terms of the ongoing cleanup efforts, with removal and disposal of millions of pounds of waste through demolition of contaminated facilities and remediation of contaminated media there will undoubtedly be some minor releases and/or incidents. DOE would make every effort to contain such a release, and if a release were to occur, it would be immediately dealt with. "Groundwater levels beneath the EMWMF footprint proved higher than predicted and intruded into the facility buffer ….". DOE disagrees. The issue referred to here is the presence of elevated pneumatic piezometer readings (located beneath the waste, in the footprint). The pressure being measured may indicate elevated groundwater levels or the waste mass being added to the footprint in this area. The situation continues to be monitored and additional data are being gathered to allow an informed assessment. The 2013 UCOR Report (*Engineering Feasibility*

		Plan for the Elevated Ground water Levels in the vicinity of PP-01, EMWMF) addresses these water level issues in great detail. The D3 RI/FS conceptual design combats the groundwater issues that EMWMF encountered in several new ways. The EMDF design includes a much more extensive underdrain system. The system is placed directly along the various paths of the NT valleys across the site to capture and drain shallow ground water and is installed during initial construction, not retrofitted after construction. The design employs greater use of structural fill to build up the site higher above the water table. The underdrain trenches create lowered base level elevations for the post-construction water table several feet below the existing NT valley floor elevations. The proposed site is located farther up Pine Ridge, reducing the effects of upgradient recharge. The upgradient trench/French drain system captures and diverts surface water runoff and topsoil stormflow zone water, further reducing recharge to the water table in upgradient areas. Particularly important in contrast to the EMWMF, the upper headwater valleys of the EMDF stream is completely cutoff from surface water recharge and supplanted with extensive underdrain features. The groundwater studies and the nature of TDEC's "additional insight into the hydrogeology" of BCV are not specifically described here by TDEC. But the well-developed karst flow system within the Maynardville Limestone and adjacent Copper Ridge Dolomite along the southern axis of BCV was well known and thoroughly documented in the BCV RI Report in 1997, prior to the 1999 EMWMF ROD (See Chapter 2, and Appendix C & D of the BCV RI Report for extensive details). By 1997, it was very clear that rapid ground water flow and commingling between Bear Creek surface water and Maynardville ground water (and related contaminant plumes) occurs. The 2001 TDEC tracer testing provided additional information to support the likelihood of rapid flow within the karst network that was clear by 1997. In fact, the Maynardville Limestone is not located adjacent to the EMWMF or other proposed EMDF sites in BCV. These site footprints are separated from the Maynardville by the outcrop belts of the Dismal Gap (Maryville) and Nolichucky Shale formations where limestone karst features are absent. These formations are several hundred feet across and composed of predominantly clastic rocks which provide a "buffer" zone between the footprints and the Maynardville karst, wherein ground water contaminant migration is likely to be attenuated and considerably slower. The hydraulic conductivity of fracture networks in these formations have been demonstrated to be typically one or more orders of magnitude less than hydraulic conductivities in the Maynardville (See for example Table E.1 in the ORNL Performance Assessment for the WBCV LLWDDD site). DOE agrees that fate and transport modeling of BCV is difficult but urges TDEC to work with DOE by providing more specific comments and recommendations related to modifications and improvements to the current suite of models to improve the accuracy and realism of modeling results. The fate and transport modeling conducted in the D3 RI/FS has been updated and refined in the D4 RI/FS, to reflect the potential for higher rates of infiltration and contaminant migration through the vadose and saturated zones. These modifications, as well as other modifications to assumptions, have resulted in a more stringent PreWAC, and address the concerns raised by this comment and

		similar specific TDEC comments. The D4 RI/FS review of tracer tests in Section 2.13.5 of Appendix E has been revised to more clearly define the differences between ground water flow and contaminant transport within the predominantly clastic fractured rocks that underlay most of BCV versus that within the karst flow system of the Maynardville Limestone and Copper Ridge Dolomite. "The approach to waste characterization and waste acceptance was project specific and not readily amenable to regulatory audit." And ".. that would allow easier verification of WAC attainment .." Verification of WAC compliance is outside the scope of the RI/FS, but is discussed in the document as it is part of the development of a WAC Attainment (Compliance) Plan, which is to be developed as a tri-party primary document. While individuals at TDEC have indicated vocal and written concern over constructing an on-site facility over a blue line stream and requested more justification for doing so, TDEC as an entity has not in writing requested that it "not be built over a blueline stream". The Phase I investigation of the EMDF Site 5 location next to the EMWMF was coordinated with TDEC staff and intended to ameliorate any concerns that TDEC (and EPA) might have concerning Site 5 as a viable location. TDEC approval of and comments on the work plan (TDEC letter dated November 27, 2013) for that investigation did not indicate that the site would be rejected on the basis of its location across the upper NT-3 valley or make any recommendations for avoiding Site 5 on the basis of its footprint across a "blue line" stream. DOE would certainly have not implemented the Phase I investigation if there had been indications from TDEC (or EPA) that Site 5 was inappropriate. It should be made clear that TDEC's assertion in this comment that the site not be located across a "blueline" stream contradicts with their written approval for conducting the Phase I investigation. "..key issues which were not satisfactorily resolved for the EMWMF during the past decade of operations have not been addressed in any revision of the document now under review". DOE feels that the revision of the RI/FS (D4 version) to be submitted based on these comments and those received from EPA on the D3 version of the RI/FS will satisfactorily address the issues raised (including site hydrology issues, PreWAC limits, and lessons learned), and additionally the D4 version offers additional sites for consideration as well as a hybrid alternative that combines a small on-site facility with off-site disposal.
TDEC.S.002	**Page ES1, Paragraph 3:"** *As a follow-on to that process, this RI/FS utilizes relevant information from the EMWMF RI/FS with revisions and updates to describe and analyze current conditions. Consistent with the EMWMF RI/FS, this RI/FS analyzes three alternatives:***"** Despite some analysis of combined off-site and on-site disposal options (see comments on section 5.4), the three alternatives presented in this document do not provide the flexibility needed to evaluate optimum waste disposal options for future waste generated by CERCLA actions in Oak Ridge. There is little justification for this choice of alternatives, other than consistency with the EMWMF RI/FS, and a no-action alternative does not provide a baseline risk that can serve as a comparison for risk reduction. The choice of alternatives seems to	The revised RI/FS includes several new alternatives, including (1) additional Bear Creek Valley on-site location at West BCV; (2) additional dual site option, two footprints, one in East Bear Creek Valley to the west of EMWMF and one west of the Bear Creek Burial Grounds, and (3) a Hybrid Alternative that includes a small on-site facility (site directly west of EMWMF) and off-site disposal of the remaining CERCLA waste. EMWMF modeling is continuing to be updated. Through the water FFS, a path to update the EMWMF ARARs is being pursued.

	reflect the assumption that another waste disposal facility similar to the EMWMF can be legally sited under CERCLA on the Oak Ridge Reservation (ORR) without significantly more stringent restrictions on waste acceptance than those in place for the current facility. Reassessment of performance modeling and an evaluation of the attainment of applicable or relevant and appropriate requirements (ARARs) at EMWMF are overdue, and should be completed before the FFA parties consider authorization of a similar waste disposal facility. Suggestions for additional remedial alternatives are given in comments on page ES3.	
TDEC.S.003	**Page ES1, Paragraph 4:** *"Unlike a typical remediation project, the purpose of this RI/FS is not to evaluate alternatives for cleaning up a contaminated site. The purpose of this RI/FS is to develop, screen, and evaluate the alternatives for waste disposal against CERCLA criteria designed to address statutory requirements and feasibility. The RI/FS provides support for an informed selection decision about disposal of CERCLA waste."* A better discussion of how this RI/FS is consistent with the purpose of the remedy selection process (40 CFR 300.430 (a)(1)) is needed. A baseline risk assessment is not performed, and little is presented in the way of argument that provides information on the actual reduction of risk to human health and the environment by the various alternatives considered. A reader well-acquainted with legacy contamination in Oak Ridge might heuristically infer some significant degree of short-term risk reduction for the on-site disposal alternative and considerable long-term risk reduction for the off-site option, as discussed in Chapter 3. However, the use of CERCLA to authorize waste disposal as proposed in this RI/FS is justified primarily by the largely unstated assumption that consolidation of waste generated by demolition of contaminated facilities into an engineered disposal facility will lead to substantial risk reduction. In cases where buildings are contaminated with hazardous materials that are mobile but not persistent in the environment, a qualitative argument is adequate support for this assumption. To make the case more generally, as is implied in this document, would require a more facility specific comparison of alternatives. The rationale behind the general assumption that consolidation will necessarily lead to risk reduction is undercut further in Oak Ridge by: (1) no current proposed plans for consolidation of significant quantities of contaminated environmental media associated with, or proximal to, the ORR facilities that will generate the bulk of candidate waste streams, (2) the lack of sites on the ORR with geologic and hydrologic characteristics appropriate for long-term isolation of contamination, and (3) no location on the ORR that is not close to property boundaries, leaving little buffer area between the disposal facility and the public, a problem exacerbated by ongoing plans to release additional properties currently held by the federal government.	Consolidation of waste disposal (compared with no consolidation of waste disposal) will lead to timelier cleanup at a reduced cost, with likely risk reduction in the process. This assumption is the result of a comparison between the "No Action", (e.g., no consolidation of CERCLA waste disposal) and ALL action alternatives. The "No Action" alternative leaves decisions on how/where to dispose of a project's CERCLA waste to the individual project/contractor completing that single cleanup (e.g., one building or a small group of buildings). This will then be repeated by all projects (some 100 demolition and remediation projects). This leads to great inefficiencies through repetition - more expenses through repetition and individual contracting and trucking of waste as opposed to transporting by rail or disposing on-site; increased likelihood of waste storage as opposed to disposal; greatly increased short-term risk involved in packaging and transporting waste to off-site disposal by truck when compared to on-site disposal or consolidated rail movement; due to higher costs, extension of cleanup schedules for projects as well as the entire ORR (on the order of decades) which in itself poses greater risk to both human health and the environment as well as to the cleanup completion as a whole; and greatly increased costs due to all of the above. In addition to more timely cleanup and reduced costs, Action Alternatives can offer projects/contractors reduced risk over No Action by providing an existing disposal route, whether that be on-site disposal (landfill) or off-site disposal (consolidated rail) that is readily implementable as opposed to projects/contractors faced with meeting transportation requirements individually, arranging transportation and disposal (likely by trucking that poses higher risk to the public and environment), or storing waste for possibly long time periods (again, posing higher risk to public and environment over disposal). Given the above underlying assumption (words which are added to the revised RI/FS in Chapter 3), and its conclusion that an Action Alternative is needed, versus the No Action Alternative, the next step, and the focus of the RI/FS, is to assess each alternative in its ability to meet CERCLA criteria, and then to compare the alternatives to each other, to support the selection of the alternative that best fulfills the nine CERCLA criteria. While the reviewed version of the RI/FS (D3 version) selected an alternative, this revision to be submitted (D4 version) will not select an alternative, but will complete the assessment described. This comment states that a baseline risk assessment is not completed. This is correct, and a baseline risk assessment (which is the risk posed by "no action") cannot be completed as defined under CERCLA because the waste has not been generated yet and characterization is very limited, and the full implications of the risk (inability to complete cleanup on the ORR, excessive storage of waste, reactions of states to thousands of truck transfers of waste through their cities, etc)

		cannot be quantified. Instead, a risk assessment is completed for on-site disposal (assumed waste placement in an on-site facility – and the risk posed to human health & environment short- and long-term which is based on meeting Remedial Action Objectives) to determine limits on future waste to be expected from a containment perspective, and off-site disposal (transport of waste for disposal). These "preliminary" risk assessments allow for comparison of the alternatives from a human health and environment protection standpoint. Lastly, this comment states that the rationale leading to this RI/FS is further unsupported because: (1) "(DOE has) *no current proposed plans for consolidation of significant quantities of contaminated environmental media associated with, or proximal to, the ORR facilities that will generated the bulk of candidate waste streams."* (2) "(there is) *lack of sites on the ORR with geologic and hydrologic characteristics appropriate for long-term isolation of contamination*" and (3) "(there is) *no location on the ORR that is not close to property boundaries, leaving little buffer area between the disposal facility and the public, a problem exacerbated by ongoing plans to release additional properties currently held by the federal government.*" Regarding (1) above, DOE has current plans (regulatory approved decision documents under CERCLA) to address remediation/consolidation of some contaminated media; those media that are not yet addressed by decision documents are associated with projects (scheduled and funded) in the OREM baseline to develop the appropriate documents and decisions under CERCLA, and are accompanied by projects (scheduled and funded) that have assumptions as to the remedial action to be deployed. Those resulting wastes are considered in the RI/FS for disposal, and yes, there is uncertainty associated with the waste volumes to be generated. That is one reason DOE has proposed in this RI/FS a positive uncertainty in waste volumes to be generated in the future, so that if assumptions result in underestimations of waste, this RI/FS has that additional waste volume accounted for (as opposed to comments that suggest the uncertainty is too high or not necessary). Regarding (2) above, DOE disagrees that there is a lack of sites on the ORR that could effectively isolate waste long-term. DOE has acknowledged and continues to acknowledge that there is no perfect site for long-term isolation, but with engineered features and limited waste acceptance criteria, the several sites proposed in the revised RI/FS (only EBCV site is modeled and in fact demonstrates attainment of CERCLA risk ranges well into the future – other sites included in the RI/FS are expected, if modeled, to demonstrate with acceptable waste acceptance criteria, attainment of CERCLA risk ranges as well) can successfully contain CERCLA waste for the long-term. Short-term containment is provided through engineered features whose longevity is supported in the document. (see Section 7.2.2.3) In answer to (3) above DOE agrees that the proposed sites in Bear Creek Valley appear to be close to the DOE boundary, and therefore close to the public. However, what this comment fails to note is that Pine Ridge sits between the sites and the public, and is a groundwater divide, meaning the groundwater on the DOE side and location of the proposed disposal facility flows away from the DOE boundary and the public, and toward the interior of DOE property. Additionally,

		the comment fails to note that those properties or areas in Bear Creek Valley slated for release to the public, if deemed suitable for waste disposal on-site, would be re-evaluated for future use and would require a re-designation of future land useage.
TDEC.S.004	**Page ES2, Paragraph 1: "***The remedial action objectives (RAOs) for alternatives evaluated in this RI/FS are:* ☐*Prevent direct or indirect exposure of a human receptor to future-generated CERCLA waste that exceeds a human health risk of 10-4 to 10-6 Excess Lifetime Cancer Risk (ELCR) or Hazard Index (HI) of 1 to 3.* ☐*Prevent releases of future-generated CERCLA waste, or waste constituents that exceed a human health risk of 10-4 to 10-6 ELCR or an HI of 1 to 3, or that do not meet applicable or relevant and appropriate requirements (ARARs) for environmental media. This is accomplished through compliance with chemical specific ARARs, maximum concentration limits in waters that are current or potential sources of drinking water considering site-specific background levels, or risk based levels for chemicals without ARARs.* ☐*Prevent ecological exposure to future-generated CERCLA waste.* ☐*Facilitate timely cleanup of ORR and associated facilities"* The data and analyses presented in this document are not sufficient to assure that the remedial action objectives (RAOs) listed in bullets 2 and 3 on this page and stated again in Chapter 4 will be met. Human exposure levels may be kept acceptably low, but this is contingent on institutional controls and development of protective waste acceptance limits. Future impacts to water resources cannot be evaluated with the approach used in this document, which is to assess risk to a hypothetical resident using groundwater and surface water pathways. The receptor is placed at a distance 460 meters from the facility oblique to the direction of flow paths that would originate from the facility. Maximum concentration limits in waters that are current or potential sources of drinking water are evaluated only at this location. Despite the inevitability of future releases from the proposed facility to both surface water and groundwater, the requirements of neither the Safe Drinking Water Act nor the Clean Water Act (e.g., general water quality criteria, as given in chapter 0400-40-03 of Tennessee Rules) are listed as chemical specific ARARs. In addition, this RI/FS predicts (see tables H-6 and H- 7) that peak concentrations in Bear Creek of a number of contaminants of principle concern will, using limits imposed by the pre-WAC established by the risk assessment in Appendix H, exceed either ambient water quality criteria or derived concentration standards that implement *DOE Order (O) 458.1, Radiation Protection of the Public and the Environment*. While TDEC challenges many of the assumptions used in the risk analysis, TDEC does agree with the RI/FS that the preferred alternative will not protect water resources. More detailed comments on evaluation of impacts to water quality can be found in comments on Appendices E, G, and H. The fourth bullet is very general and does not necessarily imply reduction of risk to either human health or the environment. While not inconsistent with the goals of CERCLA, an evaluation of risk reduction specific to the generation and disposal of each candidate waste stream would be necessary to show that this was an appropriate objective in every case where CERCLA waste might be generated.	The D4 RI/FS demonstrates protection of water resources and ecological protection by comparing predicted surface water concentrations of contaminants to the most limiting Ambient Water Quality Criteria (AWQC), and adjusting calculated preliminary WAC (PreWAC) to maintain SW concentrations at or below the AWQC for the compliance period. Additionally, the RAOs have been updated in the revised document to reflect the goal of meeting AWQC. AWQC are promulgated through the Clean Water Act as given in chapter 0400-40-03 of Tennessee Rules, which is referenced as part of the RAO. The Safe Drinking Water Act (SDWA) is indirectly referenced in the RAO (e.g., "compliance with maximum concentration limits in water that are current or potential sources of drinking water...", these MCLs are promulgated through the SDWA). The revised RAO clarifies this. The surface water concentrations given in Table H-6 and H-7 are predictions based on an assumed starting value of 1 Ci/m3 of a contaminant in the landfill. This is NOT the allowable (PreWAC) limit of the contaminant, but rather just a starting value to then calculate the limit. Therefore, the table lists surface water concentrations corresponding to this basis (1 Ci/m3). Those values would be adjusted once the PreWAC limit is determined. This will be clarified in the revised document. For the D4 revision, the model output based on the assumed initial concentration has been removed from the body of Appendix H and is part of Attachment B (the values, as a basis only, will likely be moved to a new attachment). The 4th RAO has been deleted.

TDEC.S.005	**Page ES2, Paragraph 3 et seq: *"WASTE VOLUMES AND CHARACTERIZATION"*** The RI/FS appears to have done a good job of establishing an upper bound for the potential volume of waste to be disposed on-site. However, as stated above, the preferred alternative fails to protect water resources. To form an adequate basis for an alternative that is consistent with all the goals of CERCLA, an estimate should be established for the most probable and minimum waste volumes to be disposed on-site consistent with a more defensible set of waste acceptance criteria and aggressive waste minimization and volume reduction efforts. An attempt to better quantify the uncertainty in waste volume estimate would also be helpful. More detailed discussion of waste volume estimates can be found in comments on Appendices A and B.	As stated in responses above, the protection of water resources in the revised RI/FS is demonstrated through meeting appropriate AWQC in surface waters, through modeling. Further modifications to the parameters in the fate and transport modeling, and assumptions (e.g., dilution field used) have been made and resultant PreWAC are more stringent than D3 RI/FS results. An aggressive approach was taken to waste minimization in that the waste soils were used almost 100% as debris waste fill. This is consistent between the D3 and revised D4 RI/FS versions. Waste volume uncertainty of 25% is justified through a detailed uncertainty analysis included in a new Table 2-5, in Chapter 2. The low and high-end waste volume estimates in this analysis bound the 2.2 M CY capacity defined in both the D3 RI/FS and D4 version of the document.
TDEC.S.006	**Page ES3, Paragraph 4:** *"Demolition of several large facilities at the Y-12 National Security Complex will result in large volumes of mercury-contaminated debris. This debris is assumed to be treated and disposed by macroencapsulation within EMDF, as part of the On-site Disposal Alternative, or transported off-site for compliant treatment/disposal in the Off-site Disposal Alternative."* This requires waiver of Land Disposal Restriction rules, which has not been granted at this time. This RI/FS does not present sufficient information to evaluate the merits of such a waiver. Thus, a more appropriate evaluation of alternatives would include an alternative with on-site disposal and another with off-site disposal for this candidate waste.	The possibility of conducting in-cell macroencapsulation (ICM) of Hg-contaminated debris will be revised in the D4 version of the RI/FS. It is presented as an possibility; however, the decisions on how a demolition project chooses to treat it's Hg-contaminated debris is outside of this RI/FS, and so the disposal alternatives analyzed do not consider ICM. ICM is discussed as an option in Appendix C and appropriate regulatory pathway is designating the facility as a Corrective Action Management Unit (CAMU), also discussed in Appendix C. As requested by EPA and TDEC in-cell macroencapsulation is not presented in this RI/FS as part of an alternative.
TDEC.S.007	**Page ES3, Paragraph 4: *"Remedial Alternatives"*** As stated in other comments, TDEC does not agree that this document establishes either a technical or regulatory basis for on-site disposal. In conjunction with establishing this basis, other alternatives should be evaluated and carried forward. These include (1) an on-site low level radioactive waste (LLRW) disposal facility authorized under DOE Orders, with off-site disposition of TSCA and RCRA mixed waste, (2) on-site disposal of mixed TSCA/LLRW waste authorized and off-site disposition of RCRA mixed waste, (3) disposal at smaller sites and at sites further west in Bear Creek Valley, and (4) alternatives that consider aggressive steps toward waste minimization and volume reduction. Several of these alternatives were considered in this RI/FS, but were eliminated in preliminary screening due to costs. Given that this document does not provide evidence that the preferred alternative can meet other goals of CERCLA, cost alone is not an adequate reason for eliminating alternatives.	The revised RIFS considers three onsite alternatives encompassing three possible sites in Bear Creek Valley. Additionally, the revised RI/FS does include a hybrid alternative that considers on-site disposal in a smaller footprint landfill in combination with disposal of the remainder of waste through off-site commercial facilities. Because of the very limited size of the on-site facility, the on-site disposal is combined with volume reduction in this alternative. Other on-site alternatives evaluated in the revised RI/FS include a multiple site (Dual Site) option that includes two small footprint landfills, as well as a full size (up to 2.8 M cubic yard) landfill to be located in West Bear Creek Valley (in a Greenfield). DOE does not at this time feel a LLW/Mixed waste facility should be developed solely under DOE authorization because the waste projected to require disposal includes TSCA and RCRA waste contaminants under the authority of EPA and the state. As waste that will result from future CERCLA actions, the disposal of this waste should remain under CERCLA authority and DOE believes this future waste can be compliantly disposed of on-site.
TDEC.S.008	**Page ES4, Paragraph 2:** *"By design, the analytic WAC of a new facility would ensure risk to future receptors would not exceed risk criteria (10-5 ELCR or an HI of 1 in the first 1,000 years and maximum concentration limits in current or potential drinking water). This RI/FS provides results of fate and transport analysis which demonstrate that analytic preliminary waste acceptance criteria (PreWAC) for the proposed EMDF would meet applicable risk and dose criteria and be protective."* The fate and transport analysis presented in this document is flawed in many respects. The limitations of the models used to predict fate and transport, and the consequent potential for underestimation of future contamination levels in ground water	The D4 RIFS contains substantial revisions to exposure and modeling assumptions. In particular, the location of drinking water wells is now assumed to be along the predicted axis of maximum concentration with the contaminant plume, and largely outside of the influence of other BCV sources of contamination. PATHRAE model parameterization of the vadose zone has been extensively revised. These improvements to the modeling approach are documented in revisions to Appendix H.

	and surface water will be addressed in comments on Appendix H. More generally, as noted in Chapter 3 of this document with respect to long term risk posed by the proposed facility, there is currently considerable uncertainty in any estimate of values for a number of parameters that control future risk. Typical ways to minimize impacts of this uncertainty for fate and transport of contaminants in water would be to construct scenarios that assured safe drinking water limits and ambient water quality criteria were evaluated at all locations potentially impacted by releases from the facility, and to assume conservative values for key parameters controlling contaminant migration. In the analysis presented here, risk and drinking water limits are evaluated with respect to a resident at one location in Bear Creek Valley 460 meters from the facility boundary and generally away from areas that would be more contaminated by releases from the facility. In the application of the models, some parameters key to estimating the future release and migration of radioactive and hazardous constituents have been assigned values that would be considered conservative, as listed on page 82 of Appendix H, but other assumptions and estimates of parameter values lead to lack of conservatism. This appears to result in inconsistent levels of conservatism**,** or lack thereof, for different radioactive and hazardous constituents. If future waste disposal is to be authorized under CERCLA, modeling must be revisited to establish the veracity of the claim made for the analytic pre-WAC and to establish a defensible approach that can be used to develop final waste acceptance criteria. In the CERCLA decision process for authorization of a new on-site disposal facility, TDEC sees two potential roles for assessment of risk to a future resident. An assessment of risk to a receptor drinking from a groundwater source adjacent to the proposed landfill could set limits for waste acceptance that would prevent any further degradation of groundwater in Bear Creek Valley due to future releases from the proposed facility. In addition, an analysis of risk to a resident at some location in Bear Creek Valley that integrates risks from all existing and proposed sources of contamination in the valley would allow an evaluation of the incremental risk that the proposed landfill might add to the risk from the aggregate of sources in the valley. This approach would be consistent with DOE's requirements for performance assessment and composite analysis, which serve similar functions in evaluating the feasibility of radioactive waste disposal at a site. The analysis presented in this RI/FS evaluates risk to a future resident due to contamination from the proposed facility only, but does so at a location where groundwater and surface water are impacted by other sources of contamination in Bear Creek Valley. The risk assessment neglects these additional impacts, and thus serves only as an inadvertent source of confusion rather than as a tool for responsible decision making.	Consideration of risk to human health and water resources resulting from multiple Bear Creek Valley contaminant sources, within the 1000 year post-closure compliance period, will be provided in a Composite Analysis developed to meet the requirements of DOE Order 435.1.
TDEC.S.009	**Page ES-5, Volume Reduction, Paragraph 2, 1st Sentence:** Is a detailed analysis of the claim "*For the On-site Disposal Alternative, VR processing of suitable waste debris was determined to be a net expense; that is, the construction and operation of a VR facility cost more to implement than the savings it would achieve through reducing volume and conserving air space in the EMDF (e.g., building a smaller facility)*" available for review? Also, would not volume reduction be considered a best management practice, as it would ultimately reduce the size of the landfill?	Detailed analysis of VR is included in Appendix B of this document. Many types of VR are discussed in the document, and Appendix B includes explanations of current VR efforts as a best management practice. Most VR efforts are performed, but are performed outside of this CERCLA decision (e.g., performed by demolition contractors, or performed in planning efforts – such as sequencing of waste).
TDEC.S.010	**Page ES5, Paragraph 4:** "*Key assumptions regarding responsibilities of the waste generators are common to both the On- and Off-site Disposal Alternatives. The waste generators are considered to be responsible for removal of waste during cleanup actions; waste characterization and treatment as necessary to meet disposal facility WAC; and local transport to the EMDF (On-site Disposal Alternative) or the ETTP transfer facility (Off-site Disposal Alternative).*"	Costs for characterization for disposal on-site or off-site are dependent on the waste lot, volume of waste, and packaging required to name a few parameters. Ultimately, some facility D&D will require more characterization to dispose of on-site versus off-site, and some may require less. The RI/FS made the assumption that these costs are, overall, similar for on- versus off-site disposal for the program as a whole. This was verified in discussions with the current

	In some cases, this assumption may result in significant errors in total cost comparisons. For example, the K-25 building, which contributed a large volume of waste to the EMWMF, had characterization costs that were of the same order as the disposal costs. Costs for characterization for on-site disposal were driven by the mobility of key contaminants in water and an attempt by the FFA parties to minimize the potential impacts on both EMWMF operations and concentrations of radioactive constituents in ongoing releases of wastewater to Bear Creek, as well as possible impacts from future releases at the facility. Characterization costs were presumably much higher than characterization costs would have been for off-site disposal at a facility in an arid environment. A more holistic approach to cost comparison between off-site and on-site is needed. For example, total cost comparisons that include generator costs for classes of waste with similar contaminants of concern in similar media originating from similar remedial actions would offer more insight than the limited cost analysis performed here.	executing demolition contractor, who reiterated that at the time of demoltion/remediation these costs are re-examined, and if disposal off-site with associated characterization costs are less than characterization costs for on-site disposal (which may be the case for small, individual waste lots) then off-site disposal is selected. Regardless, any differences in characterization costs would be dwarfed by the overall cost of disposing of the estimated waste volume by off-site means versus on-site means. Finally, the granularity of data that would differentiate some of these costs, for small volumes of waste in which it might be more significant, is not available at this time.
TDEC.S.011	**Page ES5, Paragraph 6:** "*Thus VR is included as part of the Off-site Disposal Alternative for Option 1 only (primarily disposal at NNSS). Option 2, Energy Solutions disposal, uses transport containers that are limited by weight rather than volume, thus VR is not cost effective for Option 2.*" This would seem to assume that almost all waste generated in future CERCLA actions on the ORR will be sufficiently dense to be weight limited in transport containers. This statement may be true, but needs more justification, as potential waste types listed in Section 2.1.2 of this document includes waste with highly variable densities (e.g. structural steel versus personal protective equipment).	Waste is only broken down into "debris" and "soil". As such, an average density for debris is assumed that takes into account varying densities of various materials. Wording will be modified to note this.
TDEC.S.012	**Page ES6, Paragraph 1**: "In the CERCLA process, alternatives for remedial action are *assessed against nine evaluation criteria, which include two threshold criteria, five primary balancing criteria, and two modifying criteria. All three alternatives evaluated would meet the two threshold criteria of overall protection of human health and the environment and compliance with ARARs*". TDEC disagrees with the ARAR selection in Appendix G. TDEC also thinks the approach to fate and transport modeling in Appendix H should be revisited. However, the modeling results do suggest that, if the only limits on waste acceptance were determined by fate and transport modeling to the hypothetical receptor identified in section 2.3 of Appendix H, the proposed facility would likely contaminate groundwater above safe drinking water limits over much of the area within a few hundred meters of the waste. These topics will be addressed in more detail in comments on Appendices G and H.	Significant modifications have been made to modeling and PreWAC determination in the revised RI/FS. See responses to specific comments on Appendix H. The D4 RI/FS demonstrates protection of water resources and ecological protection, within the 1000 year compliance period, by comparing predicted surface water concentrations of contaminants to the most limiting Ambient Water Quality Criteria (AWQC), and adjusting calculated preliminary WAC (PreWAC) to maintain SW concentrations at or below the AWQC. Additionally, the RAOs have been updated in the revised document to reflect the goal of meeting AWQC. AWQC are promulgated through the Clean Water Act as given in chapter 0400-40-03 of Tennessee Rules, which is referenced as part of the RAO. The Safe Drinking Water Act (SDWA) is indirectly referenced in the RAO (e.g., "compliance with maximum concentration limits in water that are current or potential sources of drinking water", these MCLs are promulgated through the SDWA). The revised RAO clarifies this. Regarding groundwater concentrations within a few hundred meters of the landfill, ARARs require groundwater monitoring at predetermined Points of Compliance, located upgradient and downgradient of the landfill to monitor for leaking. ARARs associated with this requirement (Subpart F of RCRA) also require statistical analysis of the monitoring results, and corrective action if the need is indicated.
TDEC.S.013	**Page ES6, Paragraph 1:** "*For the On-site Disposal Alternative, two waivers would be requested:*	EPA comments have directed a waiver request to 40 CFR 761.75(b)(3) be a TSCA waiver request, rather than a CERCLA waiver request, with two waivers

	1. A waiver of one hydrologic condition ARAR would be requested on the basis of equivalent protectiveness provided by the landfill design. *2. A waiver from Land Disposal Restrictions prohibition on placement of untreated waste in the landfill for the purpose of treatment would be requested (as an interim measure)."* The information presented in support of the waiver of a TSCA rule 40 CFR 761.75(b)(3) in this document (pages 9 and 10 of Appendix G) is not adequate grounds for a waiver based on equivalent performance as specified in 40 CFR Part 300.430(f)(1)(ii)(C). The portion of the argument relevant to the water table has merit, but the underdrain does not prevent a direct hydraulic connection to surface water, as groundwater from the site can flow directly under gravitational forces through the drain into a tributary to Bear Creek. Limits on waste acceptance determined by the expected life of design features, the anticipated degradation rate of toxic substances in the landfill, and a technically defensible approach to fate and transport would also be necessary to achieve an equivalent protectiveness. The argument for the waiver from land disposal restrictions is also incomplete. As with other chemical species that have relatively high affinity for adsorption to soils, fate and transport modeling of mercury migration through the vadose zone yields travel times to the water table that are thousands to millions of years. Failures in the landfill design that would result in preferential migration pathways into the environment are likely before the times calculated by the model for contaminants to enter either groundwater or surface water. In addition to modeling fate and transport with more realistic estimates of travel times, details on the final waste form are needed to evaluate realistic scenarios of elemental mercury in equipment or concrete debris that could be inadvertently disposed of in the waste cell. These scenarios should be examined, and the costs of characterization and treatment necessary to prevent elemental mercury in debris from entering the proposed facility should be included in the assessment of cost. Based on our review of the regulatory foundation for the preferred alternative (see comments on Appendix G), a number of additional waivers may be required to provide a proper legal framework for on-site disposal of CERCLA waste. This document is itself inconsistent on the issue, with other potential rules that may require waivers listed on page 32 of Appendix D.	requested, (1) to the 50 ft buffer and (2) to the hydraulic connection of site with standing or flowing surface water. More justification for granting these waivers is included in the RI/FS revision, Appendix G, Section 4.1. DOE continues to support that an underdrain will in part fulfill the justification of a waiver to the TSCA requirement that states the site shall not have a hydraulic connection between GW (GW implied in the TSCA requirement) and SW, because both requirements are referring to SW within the landfill footprint/site not outside of the footprint of the landfill. As stated in NUREG 0902 guidance document, this siting criteria is meant to provide and emphasize the need to accommodate longer travel times, to allow for decay of nuclides as well as attenuation within an unsaturated zone. Modeling of the (EBCV) site indicates sufficient travel times are provided for short-lived isotopes to decay in place (e.g., those with half lives under 100 yr). A waiver to LDR placement will not be requested as was proposed in the D3 RI/FS. In the revised RI/FS ICM is discussed as a possibility in Appendix C and appropriate regulatory pathway is designating the facility as a Corrective Action Management Unit (CAMU), also discussed in Appendix C. As requested by EPA and TDEC in-cell macroencapsulation is not presented in this RI/FS as part of an alternative. Elemental mercury will be removed from equipment and from concrete debris to the extent practicable during pre-demolition activities. This will be clarified in the RI/FS revision of Appendix C. All LDRs will be met by waste accepted at an on-site facility Regarding travel times, modifications to parameters in the fate and transport modeling conducted for the East Bear Creek site in the revised document result in reduced travel times for contaminant transport. Final waste form modeling for ICM treated/disposed waste in a realistic fashion would account for a delay in the release of mercury from waste forms in contrast to the current assumption that mercury is available for release at the interface of the waste and vadose zone. This delay is less conservative than the current scenario modeled. The cost of characterization and treatment at the demolition site is a cost that is covered under the D&D project, and not part of the alternative cost. It is a cost common to either on or off-site disposal and is therefore not included. Waivers required for on-site disposal have been consistently stated throughout the revised RI/FS. The only waivers requested are TSCA waivers.
TDEC.S.014	**Page ES7, Paragraph 3:** *"The Off-site Disposal Alternative (Option 2) estimated cost for disposal of the projected volume of CERCLA waste is $824/yd3 (FY 2012 dollars) or $986/yd3 (Present Worth). This is approximately two times the estimated cost for disposing of the waste in the On-site Disposal Alternative ($399/yd3 [FY 2012 dollars] or $447/yd3 [Present Worth])."* Discussion of cost is contingent on volume estimates and the assumption of on-site disposal in a large, contiguous landfill near the current disposal facility. Since such a facility may not be possible due to siting criteria, the cost estimates are premature. In any case, total cost estimates for on-site disposal versus off-site disposal should be emphasized rather than unit cost.	Total cost estimates are presented in the document itself, in detail in Appendix I and summary forms in Chapter 7. Total cost estimates require a great deal of explanation that is not possible in the Executive Summary, therefore only the costs per yd3 of waste are compared. This comparison is made on a basis of waste disposed which does take into account and remove volume that is occupied by fill in the on-site alternative. It is therefore, an apples to apples comparison. Because the revised RI/FS includes multiple on-site options (e.g., three sites - two are large landfill footprints and the third option includes two small footprints, as well an alternative that offers a small landfill footprint along with off-site disposal is also included), a variety of costs (and ranges) are included. All these

		configurations bound the on-site and off-site alternatives in terms of cost.
TDEC.S.015	**Page ES8, Paragraph 3: *"PREFERRED ALTERNATIVE"*** As stated in the comments above, TDEC does not agree that the preferred alternative will necessarily meet the threshold criteria required for a selected remedy under 40 CFR Part 300.430(f)(1)(i)(A). Consequently, TDEC suggest that the following steps should be taken to work toward authorization of on-site waste disposal under the FFA. 1. Establish an agreement between the FFA parties on which rules are applicable or relevant and appropriate requirements (ARARs). 2. Select a site or sites that can either (1) meet all siting requirements specified in ARARs or (2) be cost effectively modified in such a way that any siting requirements that are not met can be waived. 3. Should ARAR compliance indicate significant limitations on volumes that can be legally and cost effectively disposed on-site, have a commitment by DOE to immediately implement aggressive waste minimization practices, including size reduction of debris and sequencing of soils and debris disposal to minimize use of clean soils as structural fill at the on-site facility currently in use. 4. Obtain disposal authorization from DOE for the proposed site(s). 5. Incorporating restrictions imposed by ARARs and the requirements of DOE Orders with information from site characterization studies and design plans, complete a valid risk assessment for the site(s) which can be used to set limits on waste acceptance for the proposed disposal facility or facilities that will protect human health and the environment. 6. Obtain sufficiently detailed information on characteristics of candidate waste streams for a comparison with waste acceptance criteria. Obtain sufficiently precise volume estimates to make cost comparisons between any potentially feasible alternatives that would include various combinations of on-site and off-site disposal consistent with waste acceptance criteria. 7. At this stage, a valid feasibility study could be written and a preferred alternative selected by the FFA parties. The comparison of alternatives should incorporate a comparison of long and short term risks, life cycle and contingency costs, and equity considerations.	Agree, DOE is attempting to follow a similar path.
TDEC.S.016	**Page ES9, Paragraph 1 et seq**: ***"SITE SELECTION AND CHARACTERISTICS"*** As stated elsewhere, TDEC has not seen evidence that any site on the ORR with sufficient footprint to place a contiguous 2 million cubic yard facility for near surface disposal of radioactive, hazardous, and toxic wastes can meet the threshold criteria under CERCLA, protection of human health and the environment and compliance with ARARs. Attachment B provided with these comments, shows candidate areas on the ORR for radioactive and hazardous waste disposal using current property boundaries. Areas underlain by geologic units prone to dissolution and development of karst features or having slopes in excess of 25% have been color coded. Using only these two criteria, potential candidate sites are restricted primarily to Melton Valley and Bear Creek Valley. Sites in Melton Valley and Bear Creek Valley not already filled with legacy waste are dissected by streams and have high water tables. Large sites are unlikely to meet TDEC Division of Radiological Health (DRH) rule 0400-20-11-.17 (1), *Technical Requirements for Land Disposal Facilities*, which specify site suitability requirements for land disposal of radioactive waste, siting criteria under TSCA rules 40 CFR 761.75(b)(3) and (5), or criteria under TN Rule 0400-12-02-.03 (2), *Siting Criteria for New Commercial Hazardous Waste Management Facilities.* In this RI/FS, only the TSCA criteria are considered to be ARARs, but TDEC rules are arguably both relevant and appropriate, and are more or less consistent with the requirements under TSCA. Attachment A evaluates the site	TDEC is correct in noting that a siting requirement under TDEC Division of Radiological Health (DRH) rule 0400-20-11-.17 (1), *Technical Requirements for Land Disposal Facilities* [that is 0400-20-11-.17(1)(h) which requires that there should be no discharge of groundwater to the surface within the disposal site] is not be met pre-construction. However, DOE feels this siting criteria, while relevant in that it regulates disposal of LLW, is not appropriate because it was written to address LLW land disposal facilities (shallow land burial facilities) that are significantly different in construction than the type proposed by DOE. See Appendix H Section 4.3 for the justification of this position. All proposed locations will require TSCA waiver(s) to two parts of 40 CFR 761.75(b)(3) *Hydrologic Conditions*; justification for these waivers has been revised, and is given in Appendix G Section 4.1. The TSCA requirement at 40 CFR 761.75(b)(5) *Topography*, is addressed in Section 4.2, where a waiver is requested for the EBCV Site. The criteria under TN Rule 0400-12-02-.03(2) referenced in the comment has not been included in the ARARs tables; this criteria requires estimated contaminant travel times that are replaced with more rigorous GW modeling, and this

	chosen in this RI/FS against TDEC DRH rules. Site suitability requirements may be waived under CERCLA, but such a demonstration would require limits on waste acceptance as well as engineered features to isolate waste, enhance stability of the landfill, and minimize site erosion. The role of engineering features serves primarily to prevent a significant release. These are mostly barriers that prevent something (usually water) from going somewhere and that route it somewhere else. The site attributes, on the other hand, primarily serve two different, but related, functions. The first is to minimize the long term effort required to maintain the barriers. Requirements for low to moderate slope are of this nature. Buttresses can be constructed, and are proposed for EMDF, but they will never be as cheap or as effective as flat ground. The second is to mitigate the impacts, in the eventuality of a release. This requires a buffer zone around the facility that provides attenuation of the release until it can be detected and evaluated and, if necessary, prevented from spreading by corrective actions. Due to the presence of streams and rapidly migrating shallow groundwater, sites on the ORR will not provide opportunities to effectively mitigate a release of contaminants. Costs for construction of a buffer comparable to that offered by a site that meets the siting criteria in state and federal rules is likely to be prohibitive.	requirement is therefore not relevant or appropriate. Site suitability has been revised in the document; in addition, PreWAC limits have been revised (in D4 version of RI/FS), and are more restrictive (for EBCV site) than reported in the D3 version of the RI/FS, and administrative limits have been added to the document (see Section 6.2.3); and more discussion is given regarding the topography of the EBCV site, and proposed engineered features (buttresses) that mitigate the minor occurrences of steep slopes in the footprint and address erosion and stability challenges. The comment regarding buffer zones around the waste are acknowledged as pertinent, and the D4 document has an enhanced discussion of the buffer zone provided by the site development and engineering features, as well as the increased monitoring and detection capabilities provided by the underdrain, and ability to deploy mitigation measures if needed. DOE disagrees that construction of a buffer is the only way to ensure comparable protectiveness to that of a site meeting siting criteria. See discussion of the ability to monitor the site and provide for corrective actions if necessary in revised Section 7.2.2.6.
TDEC.S.017	**Page 2-4, Paragraph 1**: "*Material types may consist of various forms of soil and debris. Soil includes soil, sediment, and sludge. Debris includes a mixture of various forms of construction and demolition debris, including, but not limited to, the following:* ☐☐*Reinforced concrete, block, brick, and shield walls* ☐☐*Thick plate steel, structural steel, large piping, heavy tanks, and bridge cranes* ☐☐*Glove boxes, fume hoods, ventilation ductwork, small piping, and conduit* ☐☐*Insulation, floor tiles, siding materials, and transite* ☐☐*Small buildings, small cooling towers, wood framing, and interior and exterior finishes* ☐☐*Asphalt shingles, low-slope built-up roofs, vapor barrier, insulation, roof vents, flashing, and felt* ☐☐*Containers, furniture, trash, and personal protective equipment (PPE).*" Some of the waste types defined as debris may contain significant internal contamination. Based on experience at the EMWMF, proper characterization of equipment and other materials that may hold substantial contamination can significantly increase the overall cost of on-site disposal. Another concern is that deposits of contamination held inside equipment may leach at rates that are significantly faster or slower than predicted rates that assume leaching from soil-like materials or rubblized concrete. Consequently, some material types may need to be considered on a case-to-case basis to evaluate their long-term performance in a landfill.	DOE agrees, that different waste types/materials will present different leaching rates of contaminants from that material. The leaching of contaminants from these other materials (e.g., concrete etc.) simply place those contaminants into the surrounding soil within varying amounts of time. The transport modeling completed using PATHRAE is accomplished assuming that contaminants are homogenously dispersed throughout a "soil-like" waste. While this may be nonconservative in some limited cases, overall it represents the highest probability of the condition that will exist in the landfill since soil is used as fill and therefore surrounds the various waste forms. Additionally, the flux of contaminants out of the waste "soil" is assumed to occur at the interface of the bottom of the landfill, without any "depth" of the waste forms/soil being given credit for attenuation. Finally, there is not enough information concerning future waste generation at this time to complete a "case-by-case" evaluation of waste form leaching.

TDEC.S.018	**Page 2-5, Paragraph 4: *"2.2 RI/FS WASTE VOLUME ESTIMATES"*** *"The waste volume estimates included in this RI/FS are limited to future CERCLA waste that will be generated from facility D&D and environmental restoration activities on the ORR. Development of waste volume estimates for this RI/FS relies on waste disposal practices and experiences on the ORR to date and reasonable assumptions about planned future D&D and remedial action activities."* A number of factors might influence the actual volume of waste disposed in a future on-site facility, including waste acceptance restrictions, more aggressive volume reduction, and other disposal practices that are different from those of the recent past. Assessment of the feasibility and cost associated with combined on-site and off-site scenarios evaluated in section 5.4 of the RI/FS indicates that costs associated with on-site disposal are significantly lower than off-site disposal only if at least half of the candidate waste considered in Table 2-2 of this RI/FS is suitable for disposal onsite, and then, only if a single large landfill can be used.	DOE agrees that many factors influence the actual volume of waste that will be generated in the future. To that end, for this analysis DOE has conservatively estimated a volume of waste that will require disposal so as to capture a reasonable prediction of that volume with an associated reasonable contingency. In response to Site Specific Advisory Board recommendations and comments, the estimate is conservative so that an evaluation of management of CERCLA waste will not be required again after this second (EMWMF being the first) evaluation is complete. This comment does not appear to be requesting any modification to the document. DOE notes that a hybrid alternative is now included in the RI/FS that will evaluate the use of a smaller on-site landfill, along with volume reduction, and disposal of the remaining volume of waste off-site.
TDEC.S.019	**Page 2-9, Paragraph 1:** *"A straight 25% uncertainty on waste volumes is assumed in this document."* The assumption of an additional 25% waste volume may create a bias that makes the unit cost of onsite disposal appear cheaper than unit cost estimates based on more realistic assumptions.	Agree, a change in assumed uncertainty would change the $$/yd3, because a different capacity on-site cell would be constructed. Unit cost is inversely proportional to volume capacity, and is not linear. For example, the $$/yd3 for a small landfill (< 1M yd3) would be greater than the $$/yd3 for a larger (>2 M yd3) Thus, the change in unit cost at the volumes involved in this case (going for example from a 2.5 M CY cell to a 2.2 M CY cell) is relatively small (estimating about $14/cy based on recent analysis). Because the cost is used in comparison to off-site, and there is such a large difference between them, this is not a significant differentiator. Additionally, a hybrid alternative has been added to the document that considers a smaller on-site disposal facility in combination with off-site disposal. This alternative results in a much higher $$/yd3 disposal cost for the on-site portion.
TDEC.S.020	**Page 2-9, Paragraph 2:** *"Establish total fill needed using a multiplication factor of 2.26 applied to the as-disposed debris volume. The factor 2.26 is based on a field-determined ratio of total fill density to as-disposed debris density."* This statement implies that about 5/4 the volume of the as disposed debris volume will need to be added as structural fill. As the densities of soil and debris may differ significantly, it is unclear how the volume ratio can be simply extracted from a field determined density ratio. This factor has also changed significantly over time. Better justification should be given for this number.	This value (2.26) is the total fill to as-disposed debris ratio determined for general construction debris as reported in the 2004 CARAR Appendix A based on the previous years of operations at EMWMF. This factor was adjusted to a low of 1.7, and savings in capacity calculated. A full page table has been added to Chapter 2 that evaluates this particular "capacity savings", as well as other non-conservative assumptions (e.g., amount of UEFPC soils that will be generated upon remediation, and Bear Creek Burial Ground remediation waste) to examine how the volume of waste and therefore capacity need might increase and/or decrease to bound the estimate currently used as the basis in the RI/FS. The current basis in the RI/FS is disposal of 1.9 M CY of waste, and a corresponding capacity need of 2.2 M CY. The analysis in Chapter 2 (new Table 2-5) gives a range of 1.4 to 2.5 M CY capacity needed, and demonstrates that the 2.2 M CY capacity needed for an on-site facility is a reasonable assumption.

TDEC.S.021	**Page 2-10, Paragraph 2:** " *Previous waste volume estimates required a facility size of 2.5 M yd3 and as this is only a conceptual design, the difference between 2.2 and 2.5 M yd3 will allow for final design changes (e.g., slope recalculations, cut/fill changes, height of waste, etc.); the conceptual design has not been modified. As explained in Table 2-4, the additional 25% volume uncertainty adds approximately the volume of one cell (Cell 5) to the projected disposal capacity without uncertainty. The additional 15% capacity is approximately equivalent to the size of cell 6, and as discussed, this contingency in capacity will accommodate final design changes. Establish total fill needed using a multiplication factor of 2.26 applied to the as-disposed debris volume. The factor 2.26 is based on a field-determined ratio of total fill density to as-disposed debris density."* The conceptual design for the landfill accommodates 2.5 million cubic yards when the projected waste volume needed for waste disposal is estimated to be about 2/3 of that capacity. As stated in other comments, TDEC currently has seen no evidence that a 2.5 million cubic yard facility can be compliantly sited on the ORR. Better information on the waste volume and characteristics of candidate waste streams will be necessary to provide for more realistic cost estimates of compliant alternatives, such as the combined on and off-site disposal alternatives discussed in section 5.4 of the RI/FS.	The RI/FS conceptual design accommodates a 2.5 M CY landfill; however, the cost (for on-site disposal) is based on only completing five of the six cells and is therefore calculated based on the volume of waste and capacity needed as pointed out in the comment (e.g., the 2/3 capacity). Likewise, the same volume is used in the off-site disposal calculation. The available characterization data for facilities to be demolished/disposed and media to be disposed of is not detailed enough to allow for an accurate estimation of volumes that would require off-site disposal as opposed to on-site disposal. There are/will be waste streams that are known/expected to require off-site disposal, and those volumes are NOT considered within this RI/FS analysis (for example, K-pad waste, 3026 hot cells, 3042 activated components, etc.). They have been excluded from analysis up front, as they carry a cost of "X", that would be the same for either alternative considered [e.g. X added to both sides]. Typically, until a demolition/remediation project is contracted, the characterization data will not be at a sufficient detail to allow for the analysis seemingly requested in this comment. DOE is considering the disposal of waste that will not be generated for as much as 25 years in the future. DOE does believe from the limited data available that the majority of waste to be generated will be low activity waste suitable for disposal in an on-site disposal facility such as EMWMF. Several options for disposal facility locations on the ORR are presented in the revised RI/FS, including a multiple site option, and a hybrid disposal alternative that disposes of waste on-site and off-site. Ultimately, an on-site facility's waste acceptance criteria (among other potential constraints such as physical limits) will determine the size of the landfill in the on-site alternatives, and phased construction of any on-site facility is planned and discussed in the document, such that the final footprint will only provide the capacity that is required.
TDEC.S.022	**Page 2-10, Table 2.3:** From this table it is obvious that the amount of clean fill planned for use nearly equals the combined total of debris + waste soil. Wouldn't further volume reduction of debris be environmentally judicious?	As explained in Appendix B, clean fill is always necessary whether material is size reduced or not. The quantity of clean fill can be reduced when size reduction of debris is performed because the void space is reduced. However, environmental impact is a trade-off because the mass of debris and contaminant load is unchanged, while in fact the contaminant concentration is increased by VR (e.g., a sum of fractions increase as well) thus presenting a higher risk (risk is proportional to contaminant concentration in the landfill). Fill material also provides media which attenuates the contaminants as they move through the waste over long time periods. Less fill means less attenuation. Finally, the activity of conducting VR provides additional risk to workers through exposure by double handling of waste and airborne dust, and generation of dust requires controls (typically watering to suppress dust) which then generate a secondary waste that requires disposal. As Appendix B points out, the quantity of fill material and the required air space for the landfill is reduced when debris is size reduced, however, the cost of implementing VR is significantly greater than cost savings associated with reduced landfill size. Although not addressed in Appendix B, the energy required for size reduction activities is very high, which would likely increase the carbon footprint for landfill operations. Ultimately VR provides some benefits, but also some disadvantages when land disposing of radioactive contaminated waste. A more thorough evaluation of volume reduction against the CERCLA criteria is included in the revised RI/FS.

TDEC.S.023	**Page 2-14, Paragraph 1: "*2.3 RI/FS WASTE CHARACTERIZATION*"** *"This section discusses characterization of future generated CERCLA waste streams. Because detailed characterization data do not exist for many of the individual D&D and remediation projects, characterization of future waste streams is based on available data for waste disposed at EMWMF to establish contaminants of potential concern (COPCs) and estimate contaminant concentrations. This methodology relies on the assumption that available data for waste disposed at EMWMF approximately represent the waste characteristics of future waste streams."* The assumption that waste characteristics of the waste streams that are candidates for future on-site disposal will be sufficiently similar to the waste characteristics of waste disposed at the EMWMF to allow accurate estimates of on-site waste volumes is not well supported by either data or process knowledge. This is only likely to be true if essentially all candidate waste will be acceptable at the proposed facility.	The sentence immediately following the quoted text here states that "Use of characterization data for waste disposed at EMWMF is limited in the RI/FS to serving as a basis for the transportation risk and natural phenomena risk calculations. " Waste profiles based on EMWMF radiological characterization were developed and presented in this section only to allow for transportation risks to be developed. Ultimately these risks are calculated to compare on-site to off-site disposal transportation risk. The absolute difference would be similar regardless of the profiles developed. The same volume of debris/soil waste is used for both on-site and off-site analyses. These volumes have already excluded waste volumes that are known (via process knowledge or data) to require off-site disposal. Additionally, waste radiological characteristics for ONLY those wastes disposed in EMWMF that originated at ORNL and Y-12 were looked at in detail to give an indication if future ORNL and Y12 wastes would be amenable to disposal in an on-site facility.
TDEC.S.024	**Page 2-14, Paragraph 1:** "*Use of characterization data for waste disposed at EMWMF is limited in the RI/FS to serving as a basis for the transportation risk and natural phenomena risk calculations."* Note that the waste inventory that was not accepted for disposal at EMWMF and was consequently shipped off-site included much of the material that would drive exposure risk. Risks due to nonexposure related transportation accidents may increase proportionally with the volume shipped offsite, but exposure risks are unlikely to do so.	The risk of exposure (radiological) during transportation accident scenarios was calculated on the basis of waste compositions similar to those disposed of in EMWMF. Therefore, the risk per accident was based on a source term representative of waste that might be disposed of on-site. This risk is presented on a single shipment basis in Appendix F. The cumulative radiological risk (all shipments) for accident scenarios will be deleted, as will cumulative radiological risk for workers and on-link populations. Cumulative radiological risk for routine exposure for off-link populations is relevant as it is assumed that the off-link (e.g., residents along the route) continue to live there throughout the length of time shipments are conducted.
TDEC.S.025	**Page 3-3, Table 3.1**: It would be helpful if Document numbers were included for any documents in this table that currently lack them (e.g. Hot Garden).	There are no document numbers for the Non-significant ROD change references; these are usually just letters. All other documents have document numbers in the table or have been added as requested.

TDEC.S.026	**Page 3-8, Paragraph 1:** "*No changes are expected to the pre-WAC/risk evaluation through the Proposed Plan and ROD processes.*" In comments submitted on the 1998 EMWMF RI/FS, TDEC expressed concerns that pre-WAC development was based on modeling that did not have adequate foundations in either science or regulations. A decision was made at that time to approve the RI/FS and address waste acceptance uncertainties at a later date. Administrative limits that prevented acceptance of radioactive waste deemed by the Nuclear Regulatory Commission and Tennessee Division of Radiological Health to be unsuitable for shallow land disposal were negotiated after the EMWMF Record of Decision, but improved performance modeling of the site was never initiated. Other than the administrative limits, waste acceptance limits established in the EMWMF RI/FS were never altered. Additional information on groundwater flow in Bear Creek Valley and changes to the size and scope of the waste disposal operations at the EMWMF have since increased concerns over the protectiveness of the EMWMF WAC, and efforts have been made by the FFA parties to limit waste with high concentrations of radionuclides to disposal in more suitable facilities offsite. Consequently, TDEC asked DOE to revisit performance modeling and WAC development prior to submitting CERCLA documentation for a new CERCLA waste disposal facility. DOE has not addressed this concern, and the D3 RI/FS again postpones any changes to the modeling until after key regulatory decisions have been made, stating, at the top of page 3-8, "No changes are expected to the pre-WAC/risk evaluation through the Proposed Plan and ROD processes." In more detailed comments on pre-WAC development in Appendix H, some preconditions necessary for development of a credible pre-WAC are given and some constraints on modeling parameters are suggested.	Significant modifications have been made to the modeling based on concerns discussed in comments, and are incorporated into the D4 RI/FS. Responses to specific concerns are made throughout this response summary. The quote is taken out of context; the quote is aimed at noting that while changes may be implemented in the PreWAC, they would not come about through the PP or ROD developments (as these two documents do not do evaluations/assessments/calculations that would necessitate a change to preliminary WAC limits). Rather, other assessments (such as the intruder analysis to be completed under DOE O 435, or final design calculations and specifications) might have an effect on/modify the PreWAC into their final limits. Additionally, as discussed throughout the RI/FS, other criteria/limits are incorporated into WAC but are not introduced through the fate and transport modeling. However, the revised D4 RI/FS will include some more limits such as those dictated by transuranic waste definitions and greater than Class C limits. Also, as discussed in the RI/FS, a WAC Attainment (Compliance) Plan will be developed that will be the result of tri-party efforts to revise the approach to implementing WAC, and also report the final WAC limits.
TDEC.S.027	**Page 6-6, Paragraph 2, Line 9:** *"An acoustic bat survey conducted by ORNL personnel did not detect any listed bats, such as the endangered Gray or Indiana bats."* It is strongly recommended that a new bat acoustic survey be conducted at the proposed EMDF site. Although the previous ORNL survey did not detect the federally endangered Indiana or Gray bats, this study may have been completed prior to the recent listing of the Northern Long-eared bat as a federally threatened species. Accordingly, acoustic survey information is needed to determine if the Northern Long-eared bat is present onsite or not present. If an acoustic survey detects threatened and endangered bat species at the EMDF proposed site, then DOE may need to enter into a section 7 consultation with the US Fish and Wildlife Service to address the threatened and endangered species at this site.	As recommended by TDEC and EPA, other candidate sites in BCV in addition to the East Bear Creek Valley site have been added to the revised RI/FS. Additional T&E surveys will be postponed until a site is approved by TDEC and EPA.
TDEC.S.028	**Page 6-20, Floor of Landfill, 1st Bullet, Lines 3-5**: "*The purpose of geotextile as separator layers is to provide a filter that restricts finer particles of a material on one side of the textile from traveling through to the other side in order to reduce the potential for clogging.*" Either the reader is misunderstanding something or there is a problem with this statement. It seems that, if a layer restricts the passage of small particles, enough of these particles would accumulate to cause water movement through these to be slowed and then stopped.	Language has been modified..
TDEC.S.029	**Page 6-21, Facility Underdrain discussion:** Are there any case studies or solid examples that the proposed underdrain would function as described? Strong evidence that the underdrain would be successful is needed.	Additional information has been added. See Sections 6.2.2.4.8 and 7.2.2.3.
TDEC.S.030	**Page 6-39, Facility Underdrain discussion**: The arguments made here for a forested landfill cover may not prove valid. Although initially one may be able to establish the desired mix of vegetation, there are no guarantees that these conditions will remain stagnant over time. Establishment of a climax forest does not mean that conditions will remain the same over time.	[Note – this comment actually references the Cap Vegetation Section (not the underdrain)] Comments noted. It is recognized and accepted that the site will be subject to wind damage (and potential damage from forest fires, tree killing pests, or other

	The collapse of individual trees will open that area for a new succession. The vegetation growing in such a disturbed site may not fit the desired type for the climax-forested landfill. Additionally, disturbances, such as those that have already historically occurred at the site could be an extremely important factor in what the eventual climax forest cover looks like. The downburst that seriously impacted the forest cover at the site in the past couple of years could tremendously change any man-made plans for a final vegetative cover.	factors). The potential impacts from wind-throw are summarized in Section 6.2.2.7.3. The engineering specifications for the uppermost cover layer will be addressed during the detailed design and must address the potential for disrupton of the cap materials from the long-term effects of wind-throw and other potential environmental conditions. TDEC will of course be provided the opportunity to review and respond to the adequacy of those design elements. This section is included only as an option to be considered.
TDEC.S.031	**Page 6-55, Last Paragraph, Lines 4-6**: Can materials bound for Energy Solutions in Clive, Utah not be shipped all the way via rail? Is it being indicated here that the material is being trucked from Kingman, Arizona to Clive, Utah.	Corrected. Removed the wording "or to EnergySolutions in Clive, Utah."
TDEC.S.032	**Page 7-7, Paragraph 2, Line 9: "***There are currently no identified federal- or state-listed threatened and endangered species in the proposed EMDF site area."* This sentence should be struck until the presence/non-presence of the federally-threatened Northern Long-eared bat at the proposed EMDF site can be determined.	Agreed. A review of the ORNL acoustic bat survey results from August 2013 (conducted in support of timber recovery at and near Site 5) indicates that the Northern long-eared bat was detected in the survey, but had not been identified as a threatened species. The text has been revised here, and text and tables have been revised in Appendix E to correct this error, and to note that this threatened species was detected.
TDEC.S.033	**Page 7-9, Paragraph 2:** What guarantees are there that the landfill design will not leak for a 100 years much less 200, 1000 or several 1000's years? Are there currently any landfills that have never leaked?	The section does not guarantee no leakage; however, the whole section has been revised. Justification has been provided for longevity of engineered features. As the revision states, no landfill is impervious to leaking, especially in terms of thousands of years.
TDEC.S.034	**Page 7-10, Paragraph 2**: "*Survival of an engineered landfill structure for thousands of years is not unreasonable since, for example, many British earthen hill forts more than 2,000 years old are remain essentially intact. Native American mounds in the Ohio and Tennessee River valleys, many of which are more than 1,000 years old, have also survived with little erosion, as have similar structures built by pre-Columbian civilizations in the much wetter climates of Central and South America. Detailed design calculations will be conducted, in part, to assess the capability of the landfill design to protect from long-term geomorphic and seismic stresses. If final design efforts identify areas needing improvement, these would be incorporated into the final design."* The concern is not whether a relic of the EDMF will remain after 1,000 or more years, but whether engineered barriers can be relied upon to contain radioactive and hazardous contaminants for the period. Prior to approving a LLRW disposal facility, TDEC requires reasonable assurance the facility will meet the performance objectives of TDEC 0400-20-11-.16 for the compliance period and beyond. Any time credit for engineered barriers needs to be justified on case by case basis.	DOE agrees in part with the comment that justification should be directed mainly at engineered barrier longevity in terms of containing contaminants; however, the quoted text is justification of the facility's ability to resist erosion, which translates into longevity of the final cover in reducing infiltration to some degree. This is clarified in this Section, and more justification concerning the longevity of engineered barriers has been added to this Section.
TDEC.S.035	**Page 7-10, 2nd Last Paragraph, Last 2 lines:** Why is erosion caused by wind throw considered unlikely, since a large portion of the area being considered for EMDF has seen considerable wind throw (from a downburst) in recent history?	The wording has been removed.
TDEC.S.036	**Page 7-18, 7.2.2.6 Implementability (On-site) (top of page, first paragraph, 5th line):** *"Should releases to groundwater go undetected, groundwater in the immediate vicinity of EMDF could be contaminated and minor releases to Bear Creek could occur. The actual risk of exposure from such a release would be low."* The discharge to Bear Creek down-valley from the proposed facility footprint will join that of the creek only until that discharge is known to sink into the bed of the creek (TDEC, 2001) near the western limit of the current EMWMF. This has the potential to impact groundwater many	Interactions between surface water and ground water flow along the entire length of Bear Creek are reviewed in detail in Section C.4.5 (p. C4-14) of the Report on the Remedial Investigation of BCV (SAIC March 1997). Section 7.2.2.6, which focuses on implementability of the on-site alternative, does not address those detailed and complex interactions nor the potential fate and transport of releases from the EMDF. Nor is 7.2.2.6 the place for a detailed discussion of these issues. They are addressed to some degree in other sections of the RI/FS (mostly in Appendix E and H). The Composite Analysis will attempt to address fate and

	kilometers away from the sinking point. This is not addressed in the document.	transport over the broader scale at distances further downstream and downgradient of the EMDF along NT-3 and Bear Creek and incorporating other contaminant sources and contaminant flowpaths associated with those other sources. Results of the Composite Analysis will be shared with TDEC and EPA once completed under the DOE O 435 process.
TDEC.S.037	**Page 7-29, Last Paragraph, Lines 1-3**: DOE states "The No Action Alternative may not be supportive of timely remediation of ORR sites due to lack of a coordinated disposal strategy and could result in actions that are less protective and less costly than either of the action alternatives." Is this statement correct?	This statement was modified to read "and could result in actions that are less protective and ~~less~~ more costly (as a whole) than either of the action alternatives due to each project meeting disposal requirements individually.", since the basis for the No Action assumes that each project manages its own waste independently. As explained in Table 7-4, the waste might be managed in place and has the potential therefore to not be as protective as waste managed in a single engineered facility on-site or off-site. Costs would be expected to be more, taken as a whole, with individual projects paying for compliant treatment/disposal on a case-by-case basis, with possibly sending waste off-site by truck as opposed to concerted efforts to rail ship waste.
TDEC.S.038	**Page 7-32, Table 7-4, Implementability, On-site Disposal Alternative Column, Lines 2-4:** Perhaps some examples or case studies of successfully engineered landfills and evidence that they have been protective of the environment can be provided here or elsewhere in the document.	More information has been added to the document. See 7.2.2.6.
TDEC.S.039	**Page B-6, 1. Introduction:** "*Volume reduction (VR) almost always requires additional effort to characterize or process the waste in a manner that reduces volume and cost. Therefore, it is necessary to evaluate VR methods to determine if the additional effort is beneficial.*" The longer the delays on implementing the use of volume reduction equipment, then the lower the cost benefit analysis becomes for the use of volume reduction equipment with each delay. Volume reduction and the associated savings for off-site and onsite disposal was well documented at BNFL's Three Building D&D Project.	See related comment TDEC.G.10 Despite near-term implementation of size reduction, Appendix B indicates such an effort is not cost effective as executed in conjunction with on-site disposal. Revised D4 RI/FS analysis includes the disadvantages that VR implementation includes (e.g. double handling waste, worker exposure, secondary waste). Appendix B also evaluates size reduction for the Off-site Disposal Alternative and found it to be cost effective if a centralized facility is constructed near an ETTP rail terminal. However, as pointed out in the RIFS, off-site disposal (even with the VR facility) is more expensive and presents more risk (because of transportation risk) than on-site disposal at the EMDF.
TDEC.S.040	**Page B-12.5. Volume Reduction Methods and Benefits:** "*Volume reduction methods evaluated in this report include recycling, project sequencing, improved segregation, and physical size reduction. Advantages and disadvantages are discussed along with cost data collected from various sources.*" Are there any total operating costs of waste disposed per cubic yard at EMWMF to compare to costs of off-site disposal to use a basis for the overall cost of the proposed EMDF? If not, then it's difficult to perform an objective evaluation for off-site disposal, transportation, volume reduction, etc.? Since the proposed EMDF is based on the same operating costs as EMWMF, then EMWMF's total (100%) operating costs should be made available for off-site disposal options.	Yes, the EMDF operating costs are based on the EMWMF operating costs. Those operating costs are included as part of the EMDF lifecycle costs. The cost comparison for on-site disposal includes all costs associated with designing, constructing, operating, closing, monitoring, and long-term S&M to compare to off-site transport, VR, and disposal.

TDEC.S.041	**Page B-22, Size Reduction of Equipment and Structural Steel, Paragraph 2, Lines 8-9:** Here it is stated that "*It is assumed that shearing operations will reduce the void volume of equipment and heavy steel components by 50%, doubling the bulk density*." However, on page B-20 under the discussion for the Shearing Machines on Lines 15-18 it is stated that "*Discussions with former BNFL operations supervisors indicated the typical net weight of the sheared material loaded into a 25 ft3 intermodal container was 52,500 lb. giving a bulk density of 2,100 lb. per yd3. This is triple the bulk density normally experienced for large equipment disposed at the EMWMF (per CARAR density data).*" What is the reason for this discrepancy? The difference between a doubling and tripling of the bulk density is quite significant.	In the evaluation summarized in Table B-6 the size reduction of heavy equipment and steel, the overall bulk density of both material types is 957 lb/CY. Reducing the void fraction by 50% using a shear doubles the bulk density to 1,914 lb/CY. This is reasonably close to the BNFL typical bulk density of the processed material.
TDEC.S.042	**Page B-22, Size Reduction of Equipment and Structural Steel, Paragraph 2:** It appears that the discussion here is saying that after use of the supercompactor, the same ratio of clean fill material will be required as without the use of size reduction methods. Somehow, this doesn't seem right.	From page B-22: "Fill material would still be necessary to occupy void space in the material, although the fill requirement would be lower. In the case of equipment debris, it was assumed that the CARAR clean fill requirement would be reduced from a ratio of 9.58:1 (clean fill volume: equipment volume based on the as-disposed debris volume) to the ratio that would normally be required for construction debris or 2.26:1. In the case of structural steel debris, it was assumed that the clean fill requirement would be reduced from a ratio of 6.63:1 (clean fill volume: steel volume based on the as-disposed debris volume) to 2.26:1." This indicates a 76% reduction in clean fill required for equipment and a 66% reduction in clean fill required for heavy steel. Table B-6 provides the data that results in a reduction in the amount of clean fill of 113,455 CY.
TDEC.S.043	**Page B-22, Last Paragraph:** First, based on comments 41 & 42 above, the cost savings calculated here is questionable. Second, reduced landfill space utilized, smaller size for final landfill, reduced S&M costs after closure, reduced likelihood of waste components leaching (i.e., less exposed surface area, less leaching of components) and other considerations should be evaluated before making the final decision on size reduction.	VR does not reduce the mobility or toxicity of the source material, only the volume. Operation of size reduction equipment increases risk to workers and requires substantial amounts of energy. The volume reduction that is realized results in a reduction in fill material. However, fill material can help retard movement of some contaminants. Size reduction actually exposes more surface area and could possibly increase the leaching of some contaminants. [For example, TCLP testing requires crushing of sample to expose more surface area to a leaching environment thus challenging the waste form more.] Size reduction of this nature (shearing/crushing/grinding) would do the same – expose more surface area to leaching.
TDEC.S.044	**Page B-30, Cost Effectiveness of Size Reduction:** Cost should not always be the ultimate decision factor in determining the benefits of size reduction.	Agree; however, size reduction does not accomplish reduction of mobility, nor does it reduce toxicity. It could possibly increase mobility by exposing more surfaces to leaching. The source itself (e.g., radioactivity or toxic material) is not changed, but its concentration is increased, which increases risk (risk is proportional to concentration of contaminant). Appendix B was revised to evaluate VR based on CERCLA criteria (see new Section 5.4.4.).
TDEC.S.045	**Page B-34, Size Reduction Evaluation Conclusions for the On-site Disposal Alternative:** It is clear that the only factor being considered in whether or not size reduction should be implemented is cost. There is some question as to whether the cost differential may be being artificially inflated. Cost should not be allowed to outweigh all the other benefits of size reduction (i.e., environmental, local economy, etc.).	The cost of VR is not being artificially inflated. DOE does not have a reason t to avoid the implementation of VR and has provided an unbiased evaluation. Appendix B was revised to evaluate VR based on CERCLA criteria (see new Section 5.4.4.).

TDEC.S.046	**Page B-43 & Page B-44 7. LESSONS LEARNED**: Interesting that although the waste operations at both Weldon Springs and Fernald involved volume reduction, none of the lessons learned involve the benefits emanating from that volume reduction.	Weldon Springs implemented size reduction activities at the demolition site through the use of shearing attachments for excavators to increase the quantity of debris per transport event. Though not explained in Appendix B, this lessons learned approach is routinely used in Oak Ridge demolition projects. Shearing attachments are routinely used on excavators to reduce transportation costs and to meet EMWMF waste acceptance criteria. As for the Fernald project, the lessons learned regarding the use of waste soil for fill material is implemented for Oak Ridge projects (as explained in Section 5.2) through project sequencing to maximize the use of waste soil as fill material for demolition debris. Appendix B Section 7 was revised to reflect the Oak Ridge response to lessons learned.
TDEC.S.047	**Page B-44, 8. Summary:** It is quite clear from this summary that the only factor given consideration in this analysis is cost. Although, these "costs" for size reduction have been shown to be greater than not size reducing, in terms of the money being spent in Oak Ridge on CERCLA activities the differences are not excessive. More consideration needs to be given to environmental, NEPA, long term monitoring and maintenance, and possibility of landfill failure where size reduction benefits far outweigh the alternative.	DOE agrees. More consideration was given to advantages/disadvantages provided by mechanical volume reduction by size reducing. Appendix B was revised to evaluate VR based on CERCLA criteria (see new Section 5.4.4). Criteria that come into play with VR are worker exposure; double handling of waste; no reduction in toxicity or mobility of waste (perhaps increase in mobility); increase in risk due to higher concentrations with VR; secondary waste generation with VR. These elements of VR were not well addressed in the D3 RI/FS and are more pronounced in the D4 RI/FS through the CERCLA evaluation. In terms of landfill failure, volume reduction offers no reduction in source mass so there would be no less risk involved. In terms of an intruder analysis, VR increases the concentration (same mass in a smaller volume) and therefore offers a higher risk to an intruder accessing waste.
TDEC.S.048	**Page B-44, 8. Summary:** "*The results of this study indicate that volume reduction methods must be evaluated on a case by case basis and are not always cost effective for disposal of CERCLA waste.* Case by case studies should include building reuse/reindustrialization vs. total building disposal to determine the method and equipment used to generate the waste and thus the associated waste size and costs at the point of generation. This must be taken into account for any case by case comparisons for volume reduction. Reindustrialization requires that the structure of the building be protected and D&D equipment such as large track hoes with shears cannot be used. Many of the volume reduction compacter shear comparisons are built upon false comparisons where the intended reuse of the facilities is mixed with total disposal of facilities thus impacting the associated costs, size and equipment used for point of generation.	Evaluation of building reuse/reindustrialization versus total building disposal would be performed prior to a facility being transferred to the DOE Environmental Management program. A building would only be demolished if this evaluation indicated there would be no possible future beneficial use of the building and if the building was not considered historically significant. As is the case at ETTP, those facilities that are suitable for reuse will not be demolished. Y-12 and ORNL DOE landlords (NNSA and Science) have indicated they have no use/reuse plans for the facilities that have been added to the list of IFDP facilities. Any facilities identified for reuse are not included.

TDEC.S.049	**Page B-53, 1st Row:** "*Feed preparation requirements: Used hand-held plasma cutters and air-arc (arc gouge) cutters to prepare materials for 26' feed box. This was the slow step of the process. The shear operators spent a lot of time in stand-by waiting for material to process. Air-arc cutters were much faster than the plasma cutters, but were much louder due to the use of compressed air, and also emitted a large shower of sparks during operation. This was acceptable for cutting converter vessels because sparks were contained within the vessel. Feed box was 26 ft. long and throat width was 5 ft., allowing cut width of 2-5 ft. Longer boxes are available, up to 40 ft.*" This statement is not applicable to the comparison. For BNFL's Three Building D&D Project, K-33 and K-31 were preparation for a final status survey for reindustrialization of the buildings where the integrity of the building structure was to be maintained, thus hand-held plasma cutters and air-arc (arc gouge) cutters were used. This resulted in manual removal of waste material to protect the building structure, not to prepare material for the feed box. Additionally the logistics of moving material east-west without the benefit of the north-south bridge cranes caused higher costs; this would also not be required with the current mode of demolition for a reindustrialization. A 26' feed box would take less preparation with both methods simply do to the fact it's larger than a dump truck. A compactor shear would perform the sizing to minimize the amount of soil brought in, thus reducing operating costs and maximizing the use of space for the intended purpose of waste disposal.	The information quoted is from Appendix B, Attachment A vendor information, consisting of notes taken during a phone call to Harris Equipment Company, manufacturer of the shear used on the BNFL K-33/31 project. The person interviewed was directly involved in K-33/31 project operations. This information was used to estimate operations and maintenance costs for a shear; however, it was not used to estimate the manpower required to operate a volume reduction facility (see Table B-9) where the estimate was built on assumptions regarding operators for the VR equipment/facility. The information provided by the commenter involves activities that would/would not occur in the demolition facility, which is not included in the scope of this RI/FS remedy.
TDEC.S.050	**Page B-53, 3rd Row:** "*Number of operators: To operate the shear requires one person at the controls, one person to provide feed, and 3 persons to manage the product which involves moving the intermodals into place, distributing the product in the intermodal, and managing the filled intermodal. Intermodals were frequently punctured during loading due to the size, weight, and shape of the metal pieces. The intermodals were placed on a stand after filling and patched as necessary. Placing flat sheets of metal (waste material) in the bottom of the intermodals prior to loading helped reduce punctures.*" With the current mode of demolition consisting track hoes, shears and dump trucks for size reduction the beds of dump trucks have also been punctured; this should also be noted for the onsite disposal option with or without volume reduction. Compactor shears are more efficient at reducing the size/weight of material thus reducing the risk of punctures. Punctures happened several times with LATA Sharp during the removal of K-33 building debris. As a corrective action LATA Sharp also used segregated waste material to protect the bottom of dump trucks. It can potentially be assumed this is still an ongoing problem with onsite disposal? How many personnel does it take to load a dump truck including the truck driver, the equipment operator and the Rad Tech? Compacted and sheared material is not restricted to intermodals for transport; dump trucks and various other containers may also be used. BNFL used intermodals loaded on articulated rail cars for offsite shipment of compacted and sheared waste. Each rail car was designed to hold eight intermodals; however only six intermodals were carried on each car due to the fact the compactor shear was so efficient at volume reduction that the addition of more than six intermodals would exceed the weight limit of one rail car. This efficiency would also be effective with onsite disposal and save waste disposal space.	The information quoted is from Appendix B, Attachment A vendor information, consisting of notes taken during a phone call to Harris Equipment Company, manufacturer of the shear used on the BNFL K-33/31 project. The person interviewed was directly involved in K-33/31 project operations. This information was used to estimate operations and maintenance costs for a shear. We agree that punctures of debris containers is probably an ongoing problem for both off-site and on-site disposal. The Appendix B study quantified the benefits of size reduction of heavy steel for both on-site and off-site disposal alternatives. Size reduction does indeed reduce the air space required for on-site disposal, but the evaluation shows it is not cost effective. Additional information has been added to Appendix B to discuss all pro's and con's of on-site VR in terms of the CERCLA criteria (see new Section 5.4.4). However, as Appendix B explains, size reduction is cost effective for the Off-site Disposal Alternative.

TDEC.S.051	**Page B-53, Last Row:** *"Support equipment: Track hoes used to rake/distribute material within intermodals. Intermodals did not have full-open lids, making it difficult to distribute material in the container. System included 4 air-cooled oil coolers mounted on roof about 85 ft. above the shear."* Track hoes are currently used for most loading and distributing of bulk waste for onsite and offsite disposal, especially for loading waste into dump trucks. This should be listed for all bulk waste loading, not just the compactor shear option.	This is an attachment to Appendix B, providing backup information obtained from vendors and is not meant to be all inclusive. Comment noted.
TDEC.S.052	**Page B-58, Table B-22, Row 6, "Operating Hours:"** Why are the estimated operating hours for the excavator twice that of the Crusher and Shredder combined?	Estimated hours for the excavator are doubled because two units are required to support crusher and shredder operations. One is required to manage the feed to the processors and the other to load transport vehicles with the size reduced product.
TDEC.S.053	**Page C-4, Paragraph 3, Line 3:** This discussion seems to exclude treated mercury wastes from the risk assessment. Treatment standards do not protect all water pathways. Treated mercury must be included in the risk assessment. An assessment to ecological and human health risk through fish consumption is most critical. The risk assessment must evaluate the treated mixed waste matrix through the same time scale that its constituent waste radionuclides require. Recognize that Bear Creek is already listed by the state as an impaired stream. Impaired streams are protected more than ones that are not impaired.	Mercury was considered as a contaminant in the risk analysis.
TDEC.S.054	**Page C-5, Paragraph 2, Line 4:** Mercury transport is sensitive to small changes in its partition coefficient (Kd) as when waste is in high pH conditions. The predominant Y-12 waste matrix is concrete and concrete has a high pH (good concrete is pH 9-12.5). Furthermore, mercury migrates out of concrete even without water as a transport agent. The discussion acknowledges some of these difficulties, but does not address the long term effectiveness of the treatment method to protect human health and the environment. Macro encapsulation and flowable fill do nothing to mitigate the fact that the source matrix itself is not treated and is a high pH source that mobilizes mercury. Over time mercury will initially exit the waste disposal facility in a high pH condition through holes and cracks in the encapsulation materials. During this breakthrough single digit Kds best describe mercury waste properties as if in a soil-water solution, not a soil matrix. One way to investigate this is to set up an outdoor test facility similar to the Hill Cut Test Facility at SWSA 6. The test could be run with different treatment technologies and different conditions to test the viability of various treatment methods over the years before WEMA starts. As it is, the state has small confidence that in-cell macro-encapsulation can perform over the long term as required by CERCLA.	Macroencapsulation is an accepted treatment for mercury-contaminated debris and is a technology-based treatment standard as discussed in 40 CFR 268.45 and the corresponding TDEC Rule 0400-12-01-.10, paragraph 3(f), Table 1. Appendix C emphasizes the benefits of including mercury stabilization agents in encasement materials, or the use of specialized, non-cementitious stabilization and solidification materials (e.g. sulfur polymer cement) for debris encasement within a macroencapsulation envelope to enhance long-term effectiveness. Appendix C has been revised to address other treatment methods for mercury, and to discuss pre-demolition activities that will be aimed at removing any free elemental mercury from debris. The assumption that all mercury-contaminated debris is treated to meet LDRs prior to acceptance at the landfill for the on-site alternatives has been added to the document. However, in-cell macroencapsulation is addressed in Appendix C as a possible option, along with the regulatory path required to accomplish in-cell macroencapsulation.
TDEC.S.055	**3Page C-6, Thermal and Chemical:** This brief acknowledgement of thermal separation and retort as an option for WEMA waste treatment is the one the state recognizes as protecting human health and the environment. It is a way to recover and separate mercury from the biosphere. The process also purifies mercury to reduce the chance of it being radiologically contaminated when compared to IAEA standards.	Thermal treatment is acknowledged as a possible treatment option for mercury-contaminated debris in the revised RI/FS. The decision on how to treat mercury-contaminated debris resulting from demolition of mercury-use facilities (via thermal extraction, macroencapsulation, other) is outside the scope of the RI/FS (as explained in the revised document).
TDEC.S.056	**Page D-16, 3.2.5 Proposed SWSA 7 Site (1st paragraph this subsection, last sentence):** *"Groundwater occurs in fractures, and drainage is radial, making monitoring more difficult. There is no karst at this site."* It would seem that if it is known that groundwater drainage is radial, then monitoring could be more straightforward. So, how is it known that drainage is radial?	Agreed. Text was revised. Ground water monitoring would not necessarily be any more difficult than at other sites, but might warrant more monitoring wells around the site perimeter for point of compliance release detection. Figures 30 and 31 in ORNL/TM-9314 (December 1984) illustrate the potentiometric surface configuration for April and November 1983, respectively, based on data from several monitoring wells across the proposed SWSA-7 site. The figures indicate

		that shallow ground water would radiate toward neighboring stream valleys surrounding the upland areas of SWSA-7.
TDEC.S.057	**Page D-30, 4.3.2.1 Sensitive Habitats, Paragraph 2:** A number of factors besides contamination are likely particularly in the headwaters of Bear Creek. Being a headwater stream (especially BCK 12.3), and having limited habitat a diverse fish community would not be expected regardless of any contaminants.	Agreed. No response warranted.
TDEC.S.058	**Page E-1 et seq. General comments on hydrogeology relevant to the discussion in Appendix E:** ☐**Monitoring Wells, Macrofissures, Fissures, Fractures. Channels and Conduits.** It has been published for several decades that there is a low probability of intersecting flow features in the subsurface by drilling boreholes. In the gypsum karst of Ukraine, there are caves systems that comprise the densest conduit networks known on the planet. These are also walking sized passages. The probability of intersecting a conduit in that setting whilst drilling is only 17% (Alexander Klimchouk, personal communication). It should therefore be prudent that during any drilling program that this low probability should be considered after the site investigation has been completed. The way that many problems such as inaccurate groundwater velocities and inaccurate flow vectors are shown is that hydrogeological data from boreholes are significantly different from the results of injected tracer tests done at a given site. It should also be noted that data from boreholes mostly represent flow in small fractures and subsidiary channels and fissures and that these do not carry most of the groundwater flux (Worthington et al., 2000). Although a conduit is often conceptualized as a relatively large, walking-sized opening, for groundwater velocity of 0.001 m.s-1 at the onset of turbulent flow, a diameter of only a few millimeters is needed (Quinlan et al., 1997). With this in mind, groundwater and contaminants may migrate at about 90 m/day (0.001 m/s) in tiny openings not discernible from drilling or from many other site investigation techniques, except tracing. **Hydrogeology, (statistics of finding features remotely).** There are only 5 well clusters being used to evaluate this site. The statistics of finding openings of a certain width in the subsurface are discussed by (Benson and La Fountain, 1987). If a site of 1 acre is being evaluated and an elliptical object (or opening) of 23 meters in diameter is being sought, it would require that at least 10 3-cm drill holes be used to have a 90% probability of finding the object. If the object is 7 meters in diameter, 100 drill holes would be needed, and for a 2.3 meter size 1,000 drill holes would be needed. The point is that 2.3 meters is a very large feature. For an object of 0.25 m it would require more than 80,000 borings. The message is clear, drilling as a method of site evaluation is severely limited. In fact, as many professional have acknowledged the only way to understand groundwater flow and transport in fractured rocks is by tracing and the best way to evaluate transport initially is by injected tracing and analysis of the recovery curve and the inferred hydraulic components. ☐**Groundwater Basin Boundaries.** It is known that topographically-based groundwater basin (catchment) boundaries rarely are consistent with topographic basin boundaries. This is particularly true in carbonate terrains and is also true in fractured-rock terrains involving clastic rocks. ☐**Lithology.** Care should be exercised when making big distinguishing statements about differences between carbonate, shale, and clastic sequences that are close to each other either stratigraphically or geographically. This is particularly true in East Tennessee, where the Nolichucky Shale becomes progressively more of a carbonate rock the further northeast away from the Oak Ridge area. It does not take much carbonate cement or some small amount of calcite in fractures, some very small, to be removed to make a groundwater pathway, and	The commenter points out the difficulties encountered in characterizing a complex hydrogeologic setting. While this complexity is recognized, subsurface investigations and research on the ORR have clearly demonstrated a significant difference between ground water flow and contaminant transport in the predominantly clastic formations of the Conasauga Group in BCV underlying and downgradient of the proposed EMDF sites, versus flow and transport in the carbonate rocks of the Maynardville Limestone further south of the EMDF sites. Appendix E has been expanded to include much more detail describing the results of several tracer test research projects conducted in the fractured clastic rocks typical of the EMDF sites and the results of tracer tests conducted in the karst associated with the Maynardville and Copper Ridge Dolomite. The results indicate that tracer flow rates in the clastic rocks are several orders of magnitude lower than those in the carbonate rocks of BCV and that matrix diffusion in the clastics plays a critical role in attenuating contaminant migration. Relatively rapid flow rates associated with karst environments common to gypsum and limestone rocks have not been documented in the Conasauga clastics. ORR research has also demonstrated that the bulk of ground water flux occurs in the water table interval within saprolite and shallow bedrock, and that fractures and hydraulic characteristics of this interval can be adequately characterized and modeled. DOE believes that the rigorous engineered features (buffer zone, liner systems, and cap) of the EMDF, combined with the attenuating effects of a significant vadose zone and the clastic rock formations surrounding and south of the sites provide a sufficient buffer to contaminant migration that will provide short and long-term protection of human health and the environment. ***Monitoring wells, etc.:*** Comment is acknowledged. DQO sessions are planned for further characterization in support of detailed design with input from TDEC and EPA. ***Hydrogeology:*** While subsurface access by drilling certainly has its limitations, it remains the only practical alternative to access the deeper subsurface. Every site investigation involving taxpayer funds should strike a reasonable balance between data needs and costs. Tracer tests are recognized as a useful method for understanding flow and transport but they are intensive, specialized efforts that in fractured rocks rely on extensive networks of wells/piezometers. The tracer tests conducted at the WBCV site (former LLWWDD site) involved the drilling, installation, and monitoring of over 72 wells/piezometers across an area on the order of only 300 ft long by 80 ft wide (versus the EMDF waste limit footprint ~1800 ftL x ~600-800 ft W) that required 370 days of monitoring to delineate a 100 ppb dye concentration front at 33m (108 ft) from the injection well. Application of tracer tests to any of the EMDF proposed locations must be decided among DOE, TDEC, and EPA employing the DQO process. ***Groundwater basin boundaries:*** The surface water and ground water regimes in

	eventually breakdown the rock thus enlarging the pathway. Examples of this are known where conduits or channels 70 cm high form along a shale bed, where the bed that has been removed is shale and the roof and floor are relatively pure limestone. It is not safe to assume any lithology such as a clay bed or shale is necessarily impermeable, fractures are present especially in geologically older rocks, and where there has been crustal deformation (such as the Valley and Ridge province). These older rocks are not only heavily fractured but many of the fractures are filled with readily soluble minerals such as calcite. Calcite is the most abundant fracture-filling mineral because the components of calcium and the bicarbonate and carbonate ions are common in most waters and it therefore does not exclude filling fractures. ☐**Potentiometric Maps: Assumptions.** The principal assumption made when constructing a potentiometric map is that the site approximates a porous medium. This is not the case for fractured rocks and carbonates because there is convergent flow to channels and conduits. The fundamental assumptions about porous media, function of wells, and validity of potentiometric maps were discussed in comments on the first draft of the RI/FS. These assumptions also apply to any numerical modeling that is performed using porous-media based modeling codes. This means that the fundamental assumptions problem really puts everything in a state of uncertainty. In fact, there is no case that this reviewer has experienced where the assumptions have been tested and not shown to be violated.	BCV (and elsewhere on the ORR) have been extensively characterized, studied, and reported. Results indicate that surface water and ground water regimes from the east end of BCV down to SR 95 are in fact largely restricted to the area between Pine Ridge on the north and Chestnut Ridge on the south. ***Lithology:*** Comment acknowledged. ***Potentiometric Maps:*** See response to comment S.64 below. The uncertainties discussed are recognized, however, available subsurface characterization methods, site conceptual models, and numerical models (EPM or other model types) are all necessary for understanding and simulating ground water flow and fate and transport at any site. The degree to which there is convergent flow to channels or conduits versus non-convergent flow along discrete individual or sets of interconnected fractures to surface water discharge locations is unknown. Many of the seep areas at the EMDF site may be fed by a sponge-like network of closely spaced fractures that do not necessarily converge into master fractures or conduits.
TDEC.S.059	**Page E-15, 2.1 LOCATION AND SETTING, Paragraph 1, Line 4:** Here the expected area permanently occupied by the EMDF is listed as 60-70 acres. In Table D-5 on page D-38 the approximate footprint for the facility is given as 50 acres.	The distinction between the two is, one is the permanently occupied footprint (60-70 acres including cap, monitoring etc.) and the "footprint" of the facility 50 acres (cap only).
TDEC.S.060	**Page E-41 2.3.3 Ground Water Flow (first paragraph in this subsection):** *"…several lines of evidence converge to indicate that flow systems on the ORR are local, not regional."* The Valley and Ridge province in the Oak Ridge area is characterized by folded and faulted Lower Paleozoic sedimentary rocks that unfortunately have a history that predates DOE Operations in the area. Garven et al., (1993) explain the formation of Pb-Zn deposits in the carbonates as being a result of brine migration across the US Midcontinent, mostly in rocks of the Knox Group. This is regional flow of brines driven by physiographic uplift of the Appalachian Mountains and the flow of brines was driven by meteoric waters. A brine (Appalachian type, when plotted) occurs offsite of the ORR, but there are carbonates beneath it with contaminants and fresher water showing that they are certainly not a lower barrier to the groundwater setting. The local flow we see today in any region (in carbonates) is a result of the landscape and geomorphological changes. Just because there is local flow does not mean there is not still active regional flow that is most likely to be deep. This is particularly the case for East Tennessee and the whole mid-continent area. The hydraulic gradients of the shallow profiles are too steep for regional flow, geochemical and isotopic data suggest that the total mass of contaminants is not contained within and does not discharge through the local discharge points. The reference is made to conduits, but there is no definition of a conduit provided. In fact, this was done by Quinlan et al., (1996) where the criteria used were, the minimum velocity for turbulent flow, which resulted in openings of only a few millimeters. In addition there is reference to flow nets based upon water table head measurements. Is it appropriate to draw flow nets, presumably through several different hydrostratigraphic units, that likely have different hydraulic conductivity values? Also, this hydrogeology must be investigated and	Site conceptual models (SCMs) for the EMDF, for BCV (see the BCV RI Report, SAIC 1997) and for the ORR (See the Hydrologic Framework for the ORR – Solomon et al 1992, and various updates and supplements noted in the EMDF SCM) are based on a considerable amount of hydrological and hydrogeological research and related investigations into contaminant fate and transport. The SCMs and supporting data and studies indicate that the majority of ground water and contaminant flux occurs within the topsoil stormflow zone and within the water table interval of the saturated zone. Flux contributions from within the intermediate and deeper intervals of the saturated zone contribute significantly less as fracture density and interconnectivity generally decrease with depth. This is similarly reflected in the ground water and fate and transport models developed for BCV and the site-specific model applied to the EMDF site. The SCMs and modeling suggest that the fate and transport of potential future releases of contaminants from the EMDF would be locally constrained along downgradient flowpaths in BCV, as are existing contaminant releases in BCV. Additional information on the regional scale ground water flow systems and relationships between brine and fresh ground water on the ORR are addressed in the Groundwater Strategy Report for the ORR and in particular in Appendix J to that report "*Hydraulic and Geochemical Boundaries in the Deep Flow System Underlying the ORR*" (See DOE/OR/01-2628/V2&D1, September 2013). This report is referenced for details that may provide an adequate response to concerns raised here. With regard to the final paragraph of the comment, the reference to conduit flow is merely meant to represent the contrast between rapid flow in bedrock conduits well demonstrated within the Maynardville Limestone versus predominant

	properly defined in 3D. Lots of evidence exists in BCV that shows, gradients are downward from the surface, and at depth there are flatter gradients toward the southwest. The simplest explanation for this is recharge and a permeable zone at depth that is influenced by the regional flow in the Valley and Ridge.	bedrock fracture flow within the predominantly clastic sequence between the Maynardville and the Rome at and downgradient of the EMDF site. Plan and cross sectional views illustrating potentiometric surface data (flow nets) can and should be reasonably applied even in complex settings such as those on the ORR.
TDEC.S.061	**Page E-41** ***2.3.3*** **Ground Water Flow (first paragraph in this subsection, 5th line**):*"….and interconnected cavity conduits in the Maynardville Limestone."* What are "cavity conduits?" I think comments were made in previous versions that talk about cavities, and how it is conceptually more difficult to form a cavity, which is probably a conduit albeit small, that a borehole has intersected.	Agreed. The text was modified to simply state conduits, not cavity conduits.
TDEC.S.062	**Page E-41** ***2.3.3*** **Ground Water Flow (first paragraph in this subsection, 8th line):** *"Flow on the flanks of Pine Ridge occurs mainly in fractures, with little contribution by open conduits."* Quinlan et al., (1996) show that for a velocity of 0.001 m/s a conduit a few millimeters in diameter can sustain turbulent flow. Please explain how it is known that conduits this small are not involved.	See response above. The text as revised to clarify distinctions between karst conduit flow in the Maynardville versus fracture dominated flow that is believed to occur in the predominantly clastic formations that subcrop at and near the EMDF. It is agreed that relatively higher flow rates can occur in small aperture interconnected fractures or conduits. The text will be revised and uncertainties discussed.
TDEC.S.063	**Page E-44** ***2.3.3.2.1*** **Shallow Aquifer Zone (3rd paragraph):** *"Vertical gradients are generally upward and flow toward the reduced hydraulic head in the Maynardville Limestone (Dreier et al. 1993). The nitrate plume from the S-3 Ponds (DOE 1997) and chlorinated volatile organic compound (VOC) contaminant plumes from the Boneyard/Burnyard (BY/BY) and BCBG areas (DOE 1997; BNI 1984) have been reported to extend down-dip in the Maynardville and Nolichucky formations, but these are density-driven flows, and not the result of downward vertical ground water flows."* This is an interesting description since in Bear Creek Valley it is known that parts of the creek immediately downstream of the proposed facility sink into its own bed, which would mean, after the water entered the ground, downward (in places vertical) flows.	This comment appears to warrant no response. With regard to the words "immediately downstream", it should be noted that the contact between the Nolichucky Shale and the Maynardville Limestone is located approximately 1300 ft south of the southern limits of the waste footprint. Karst features and flow conditions are known within the Maynardville south of that contact along Bear Creek, but have not been reported north of that contact.
TDEC.S.064	**Page E-46, Figure E-15:** The potentiometric contours, although dashed, where there are few data, have been estimated and drawn so they closely mimic topography. Should this be expected in a fractured rock with such steep dip? The dip is steeper than the slope of Pine Ridge or the slopes of the stream channels. It is often not the case that the water table configuration mimics the topography. For example, it does not appear to in Melton Valley (Webster, 1996). Since the potentiometric surface has been estimated and is inferred to mimic topography, if it actually does not the actual flow system would be significantly different (Haitjema and Mitchell-Bruker, 2005). This could have a significant impact on groundwater movement (and managing groundwater discharges) underneath the proposed facility. Has it been established that it is appropriate to draw the potentiometric surface to mimic the topography?	Potentiometric surface contour maps, particularly those drawn for the water table, are a fundamental and commonly accepted tool used to define hydraulic gradients, generalized flow directions, and areas of recharge and discharge – even for areas such as the EMDF underlain by a clayey/silty residuum, saprolite, and fractured rocks. They have been (and will undoubtedly continue to be) used at sites all across the ORR wherever hydrogeology is a matter of concern. The Phase I results indicate that the water table occurs and fluctuates within unconsolidated overburden regolith clayey residuum and saprolite, above fractured bedrock, everywhere except for the spur ridge area underlying the GW-976(I) location. The porosity and permeability of the regolith materials are more likely to mimic those of an equivalent porous medium than those in the deeper fractured bedrock. It is therefore not unreasonable to map the water table surface bearing in mind that detailed flow paths may and will deviate at local scales from the generalized flow paths that might be suggested by the water table contours. Furthermore, it is clear from the spring and seep locations identified at the site that shallow groundwater discharges to these surface water features along the valley floors of the NT-2/NT-3 tributaries, and that shallow ground water may also provide base flow to the stream channels in areas beyond just those where springs and seeps occur. As noted in the footnotes to the drawing and in Section 7.2.3.2 of the Phase I Report (Attachment A to Appendix E), the water table contours were drawn under the

		assumption that the water table intersects with these surface water features and contours were dictated and constrained by stream channel elevations along the NT valley floors. The close connections between shallow ground water and surface water were established by research and site investigations on the ORR long ago and are well known. Is TDEC suggesting that we abandon these as tools in understanding and interpreting ground water flow? What would TDEC offer as an alternative? The water table contour maps in the Webster document cited by TDEC include eight wells encompassing very small areas that are roughly 30 ft in diameter and do not show surface topography for comparison with the water table configuration. It is unclear how these maps invalidate the use of such contour maps. It is understood that a precise definition of hydraulic gradients and heads is scale dependent, and in fractured media, dependent on the nature and extent of interconnected fractures and how well those are characterized.
TDEC.S.065	**Page E-47 2.3.3.2.2 Intermediate and Deep Aquifer Zones, (last paragraph):** The deeper wells in carbonates in Bear Creek Valley (the ultimate fate of under drain water) show: a relatively flat hydraulic gradient toward the southwest, and, a zone of higher hydraulic conductivity at depth. This strongly suggests a deep system is present and flow is to the southwest along the strike. Uranium-series data and a signature from S-3 Ponds (in picket wells) support this conceptual model.	Comment noted; the comment is very generalized with no specifics to define the terms such as relatively flat gradients, higher zones of hydraulic conductivity or what is meant by a deep system. No response appears warranted.
TDEC.S.066	**Page E-50, *2.3.3.3* Aquiclude (top of page):** The name aquiclude is used here because: "*the extremely high salinity of this water indicates little or no ground water movement occurs*" It is not correct to imply that the existence of brines at moderate depth means no ground water movement associated with them. A single huge contradiction to this is brine *migration* that resulted in the formation of the Mississippi Valley type Pb-Zn deposits (Garven et al., 1993). These brines were driven at depth across the US Page 32 of 79 Midcontinent, beginning about 400 million years ago, from the uplifted Appalachians to Missouri and beyond and from the uplifted Ouachita uplift to the Michigan basin and beyond. During this time the whole of the US mid-continent was characterized by carbonate rocks formed in relatively shallow seas. The results of this topographically driven brine migration was formation of the largest stratabound Pb-Zn ore deposits on Earth (Garven et al., 1993). Again, *brine migration in the subsurface* caused this. The fact there is a brine, does not mean there is no ground water circulation near or beneath it. TDEC has documented, in an offsite well, continuous groundwater discharge (fresher groundwater) including continuous discharge of BTEX compounds, from a thin carbonate bed, nearly 200 m below the water table, and also beneath and decoupled from an Appalachian brine. There are also other examples of brines in contact with fresh water, near the surface and deep beneath the water table, decoupled and moving independently of each other at velocities of kilometers per day (Beddows, 2004; Lindgren et al, 2004). There is also incorrect reference use. Note also that referring to Nativ et al., (1997) as a "report" is not appropriate, it is an independently peer-reviewed paper in a scientific journal. Also, if this paper, Nativ et al., (1997), is to be discussed, the paper, plus any comments made, plus the *responses by the original authors to those comments* also have to be discussed. *This did not happen*, so it appears that the comments successfully refute the original paper. This is	The results of characterization of existing ground water contaminant plumes within BCV are presented in several series of longitudinal and transverse cross sections in the BCV RI Report and more recently in the Ground Water Strategy Report for the ORR. The cross sections illustrate subsurface conditions, sample intervals, and contaminant concentration isochrons that define dissolved contaminant types and concentrations from source areas along downgradient flow paths mostly in the Nolichucky Shale and Maynardville Limestone. A systematic review of these sections indicates that the deepest portions of the plumes downgradient of source areas do not exceed depths of approximately 500 ft below ground surface. The plumes also do not appear to increase in depth along downgradient flowpaths. The cross sections also illustrate locations where ground water contamination resurges from the SS springs along the margins of Bear Creek. The results provide direct evidence that contaminant plumes developed over several decades in BCV with source concentrations and quantities in excess of any that would be allowed at the EMDF have not interacted with deeper brines at relatively greater depths (reported in EBCV starting at depths of 1,150 ft below surface). The cross sections suggest that contaminant plumes are more likely to occur within the shallower and intermediate levels of the fresh ground water regimes and be influenced by surface water/ground water interactions within karst features along the axis of Bear Creek than the very deep ground water regime or the even deeper zone of brine. Regarding the references to Nativ et al (1997), Secion 2.3.3.3 first makes reference to Nativ et al (1997) which is an ORNL report, not a peer reviewed paper in a scientific journal. The second separate reference to Nativ (1997) was intended to actually reference an article by Nativ et al (1997) published in the Journal of Ground Water [i.e - Nativ, R., Halleran, A., and Hunley, A. 1997. "*Evidence for ground water circulation in the brine-filled Aquitard, Oak Ridge,*

	hardly the case, because the original authors respond to the comments, and successfully defend their original position. This must be correctly referenced and correctly stated in the document. The Nativ et al (1997) reference provides evidence of deep circulation of meteoric water, which is what the evidence from the geology, contaminant and geological history support. In terms of how strong this evidence is, the original authors point out that the stable isotope data show a meteoric water signature at depth. This shows that meteoric water circulates deep beneath the ORR and for it to retain this signature, it must have a substantial volume and be connected to recharge and discharge. The response must be reflected in the document. The way the Nativ et al., (1997) reference is misused and misquoted casts doubt on this document and anything that is written in it.	*Tennessee*" Groundwater, v. 35, no. 4: 647-659], to which Moline et al responded. TDEC is correct in noting the counter response by Nativ et al, not described in Section 2.3.3.3. Interested parties should consult all of the original reports and papers for details, conclusions, and interpretations. A recent 2014 article addressing constraints on upward migration of brine is available in Ground Water, Vol. 52, No. 1.
TDEC.S.067	**Page E-66, 2.6.2.2 Aquatic Resource Monitoring in Bear Creek, Paragraph 1, Lines 2-4:** The statement "*The stream habitats of upper Bear Creek and its tributaries are used infrequently by aquatic biota because of headwater contamination originating from waste disposal sites near the Y- 12 Plant (Southworth, et al. 1992)*" is not quite accurate. Despite its inadequacies BCK 12.34 supports small populations of the intolerant to pollution benthic taxa of Pycnopsyche luculenta, Chimarra sp., Neophylax spp. (perhaps 2 species), Optioservus sp., Rheopelopia sp. and Psilotreta sp. Also, although portions of Bear Creek go dry in the summer, portions of the stream support a rather healthy community of benthic macroinvertebrates. Intermittent streams in the Cumberland Plateau region of Tennessee often support a very healthy fauna. In dry periods much of the benthic fauna may migrate to the hyporheic zone of the stream.	Agreed. Text was revised.
TDEC.S.068	**Page E-67, Paragraph 2, Lines 1-3:** The statement "*Benthic fauna appear to be more sensitive to contaminants than the fish communities; species intolerant of pollution (mayflies, stoneflies, and caddisflies) are absent in the upper reaches of Bear Creek and are increasingly more common downstream.*" is not accurate. See comment 65 above.	Comment appears to actually refer back to the preceding comment S.67 (not 65) - Agreed. Text was revised
TDEC.S.069	**Page E-67, Paragraph 3, Lines 3-7:** Regarding the statement "*Fish surveys near the headwaters demonstrate a stressed condition without a stable, resident fish population (Southworth, et al. 1992). A weir located in the creek near Highway 95 acts as a barrier to movement, preventing redistribution of fish species from the lower portions of Bear Creek.*", headwater streams typically don't support very diverse fish fauna. Also, wasn't the weir removed a number of years ago?	Agree. Text was revised. Site reconnaissance indicates that the former weir just upstream of SR 95 has been removed.
TDEC.S.070	**Page E-68, Paragraph 1, Lines 1-3:** Regarding the statement, "*The number of species at BCK 12.4 and NT-3 fish communities is below that of a comparable reference stream (Mill Branch kilometer 1.6), particularly during dry seasons. This has been attributed (DOE 2012) to the greater proportion of stream flow that is provided by contaminated ground water.*" Mill Branch 1.6 is a much larger water body than either BCK 12.4 or NT-3. Regardless of other factors, one would expect the fish fauna to differ considerably.	Text was revised.
TDEC.S.071	**Page E-69, Paragraph 3, Lines 6-9:** Regarding the statement "*These results indicate that conditions in NT-3 become less suitable for invertebrate species that normally inhabit small headwater streams as summer progresses, probably due to poor in-stream habitat quality and poorly developed riparian zone (Peterson, et al. 2009).*", even in pristine headwater streams there is a distinct difference between spring and fall fauna. The majority of the benthic macroinvertebrate fauna emerge as adults in the early to late spring. If there are to be existing populations of these species the following year, they would have to be present in the fall as either eggs or early instar larvae which would be much more difficult to collect and identify.	Comment noted.
TDEC.S.072	**Page E-69, Paragraph 5:** Regarding the aquatic life stream survey, a more extensive survey with more specific identifications would be warranted.	As noted in response above, no additional surveys are warranted until after consensus is reached on a site location among DOE, TDEC, and EPA.

TDEC.S.073	**Page E-70, 2.6.3.1 Terrestrial Flora, Paragraph 1, Lines 7-8:** *Magnolia grandiflora* is mentioned here as part of the understory in the forests of the Oak Ridge Reservation. Although 2 species of magnolia are listed in Kitchings and Mann 1976, neither of them was this species. No mention of *Magnolia grandiflora* was found in the cited document.	Comment noted. Text was revised.
TDEC.S.074	**Page E-71, Paragraph 2:** Along with the whitetail deer, Elk are also occasionally sighted on the Oak Ridge Reservation. See: ORNL/TM-2011/323, *Environmental Survey Report for ORNL: Small Mammal Abundance and Distribution Survey Oak Ridge National Environmental Research Park 2009–2010*, Neil R. Giffen, R. Scott Reasor, Claire A. Campbell. Date Published: September 2011.	Comment noted. Text was revised.
TDEC.S.075	**Page E-71, 2.6.3.3 Avifauna, Paragraph 1, Lines 2-4**: "*Colantes auratus*" should be "*Colaptes auratus*". "*Centurus carolinus*" should be "*Melanerpes carolinus*". "*Dendrocopos villosus*" should be "*Picoides villosus*". "*D. pubescens*" should be "*P. pubescens*".	Text was revised.
TDEC.S.076	**Page E-71, 2.6.3.3 Avifauna, Paragraph 2, Paragraph 3, Lines 1-4, 1:** "*Oporonis formosus*" should be "*Geothlypis formosa*". "*Dendroica pinus*" should be "*Setophaga pinus*". "*Seirus aurocapillus*" should be "*Seirus aurocapilla*". "*Parus cardinensis*" should be "*Poecile carolinensis* ". "*Parus bicolor" should be* "*Baeolophus bicolor"*. "*Buteo lineatus*" should be "*Buteo jamaicensis*"	Text was revised.
TDEC.S.077	**Page E-71, 2.6.4 Results of Recent Surveys at the EMDF Site, Paragraph 1 and Page E-72 :** "*Carpus caroliniana*" should be "*Carpinus caroliniana*". "*C. pallida*" (sand hickory) does not appear to occur on the Oak Ridge Reservation. "*Q. prinus"* (chestnut oak) is not the currently accepted name. Should be "*Q. montana"*. Also, the name "*Q. prinus*" is used twice in paragraph 3 on page E-72.	Text was revised.
TDEC.S.078	**Appendix E – Attachment A., Section 7.2.3.3 Horizontal and Vertical Ground Water Gradients, Page 73, Paragraph 2.** "*It should be noted that the relatively large open hole intervals in the deep wells (and large screened interval in GW-968[I]) result in a composite hydraulic head distributed across the entire interval in each of the deep wells."* There is a transmissive-weighted average of the hydraulic head from the different flow zones in open hole intervals (LeBorgne, 2005). Essentially, the head from the fracture with the greatest yield will control the head in a borehole. Therefore, the uncertainty may not be so undefined.	Agreed.
TDEC.S.079	**Appendix E – Attachment A., North-South Cross Section Through Phase 1 Well Clusters.** It is pretty evident that the model predicted water table [Post Construction, Steady-State Ground Water Flow Conditions] is wrong. There are no engineering changes that would affect the water levels in the Rome formation or upgradient of the proposed EMDF facility, thus this formation will continue to be a source of water above the proposed landfill after construction.	The impacts to existing surface water and ground water conditions following construction, capping, and closure are reviewed in Section 8.2 of the EMDF Phase I Characterization Report (Attachment A to Appendix E), including the remaining recharge zone across the narrow zone along the uppermost part of Pine Ridge underlain by the Rome Formation. A new Section 2.9 has been added to the D4 version of Appendix E to more comprehensively address the anticipated changes to the water table during and after landfill construction. Also, please review Section 8.2 of Attachment A for details supporting the future anticipated water table decline shown on Plate 3. The underdrain system in conjunction with the elevated levels of the geobuffer, liner, and waste above current topography, and the major reduction in infiltration and recharge across the EMDF footprint should result in a significant lowering of the water table surface as shown in Plate 3 and as described in detail in the new Section 2.9. The predicted lowered surface of the water table is reasonable based on current hydrogeological, engineering, and

		modeling insights. The future water table decline should be examined in greater detail during the detailed engineering design process to ensure declines are consistent with design and regulatory requirements.
TDEC.S.080	**Exhibit A.9, Packer Test Documentation, Packer Test Summary Sheet and Table 14 Hydraulic Conductivity Data from Packer Tests, Page 85.** The packer test data looks like a modified Lugeon test for conductivity. No real description was given in the Appendix E for test methodology. However, with a lugeon test there are usually 5 test stages which help determine the lugeon value and its interpretation. If using limited information (which it appears was done), then there should be reporting of the lower and higher conductivity values during the test, rather than representative values.	The packer test methodology is actually presented in Section 4.1.6.2 (p. 14-15) of Attachment A to Appendix E, including the equation on which K values are determined. Results presented in Table 14 are presented for each constant pressure test bracket per tested interval along with the average value for each interval. All values (low/high) are shown in Table 14 with detailed spreadsheet data in Exhibit A.9. References serving as the basis for the testing methodology are provided in Section 4.1.6.2. The tests appear to share some similarities to Lugeon tests but are not directly equivalent.
TDEC.S.081	**Page G-5, Paragraph 2:** *"The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) Section 121(d) (see United States [U.S.] Code Title 42, Chapter 103, Section 9621{d}), as amended, specifies that remedial actions for cleanup of hazardous substances must comply with requirements and standards under federal or more stringent state environmental laws and regulations that are applicable or relevant and appropriate to the hazardous substances or particular circumstances at a site, or obtain a waiver under 40 Code of Federal Regulations (CFR) 300.430 (f)(1)(i)(B) and (C)."* The list of applicable or relevant and appropriate requirements (ARARs) in Appendix G is not complete. If CERCLA is to provide the legal authority for on-site disposal of radioactive, hazardous, and toxic waste on the Oak Ridge Reservation, DOE, EPA, and TDEC should jointly compile a more extensive list ARARs. For example, federal and state rules that implement portions of the Clean Water Act and Safe Drinking Water Act such as water quality criteria that would continue to regulate releases of contaminants to groundwater and surface water from the facility after closure are not listed as chemical specific ARARs in Table G-1. Other examples, discussed on pages G-7 through G- 9 of this appendix, are the substantive portions of TDEC Rule 0400-20-11, *Licensing Requirements for Land Disposal of Radioactive Waste.* See comments on pages G-8 and G-9.	The list of ARARs in Appendix G has been revised with input from both TDEC and EPA, as suggested by this comment. The implementation of SDWA and CWA is addressed through the Remedial Action Objectives (RAOs) in Chapter 4. See corresponding responses to comments on G-8 and G-9.
TDEC.S.082	**Page G-6, Paragraph 6:** *"The On-site Disposal Alternative would comply with all ARARs with the exception of the following two requirements for which waivers would be requested…"* As stated in comments on page G-5, TDEC does not agree that all requirements that are applicable or relevant and appropriate for on-site disposal of CERCLA generated waste in Oak Ridge have been properly identified. Likewise, TDEC does not agree that only two waivers of such requirements would be necessary to legally authorize disposal of radioactive, hazardous, and toxic waste on the Oak Ridge Reservation under CERCLA. One example could be substantive portions of Tennessee Rule 0400-12-02-.03, *Siting Criteria for New Commercial Hazardous Waste Management Facilities*, which are arguably relevant and appropriate. Specifically, part 1 of subparagraph (2) (e) of this rule might require a waiver. TDEC also believes that waivers of some requirements based an equivalent standard of performance (40 CFR 300.430 (f) (ii) (c) (4)) may not be possible, or at least not economically feasible, for the preferred alternative. Examples might include specific siting criteria for radioactive, hazardous, and toxic waste disposal facilities from TDEC rule 0400-20-11-.17, TDEC rule 0400-12-02-.03, and 40 CFR 761.75[b], respectively. In one form or another, these requirements all prescribe that the site provide sufficient buffer to mitigate the impacts of a release from the facility and to implement corrective actions, if needed, to further restrict migration of contaminants. A site constructed over an underdrain that discharges to a stream is unlikely to	Agreement has been reached on including ARARs for NRC-based TDEC rules regulating LLRW as 'relevant and appropriate' and DOE Order (Manual) references as to be considered (TBC) guidance. Justification for waivers proposed, and further evidence for meeting other requirements is given in the revised (D4/D2) document.

	provide such a buffer.	
TDEC.S.083	**Page G-7, Paragraph 4 et seq:** "**3. ROLE OF NUCLEAR REGULATORY COMMISSION REGULATIONS AND DOE ORDERS**" In summary, this section proposes that NRC low-level waste regulations, and more specifically, their analogue in Tennessee Rule 0400-20-11, which contains the licensing requirements for land disposal of radioactive waste, should not be listed as ARARs. The RI/FS argues that these rules are not applicable due to an exemption under the Atomic Energy Act and not appropriate because all requirements of Chapter 0400-20-11 relevant to radioactive waste disposal on DOE facilities have been incorporated into DOE Orders and hence, are redundant. However, the requirements of DOE Orders are not identical to TDEC rules, as acknowledged on page G-8, with TDEC rules offering more prescriptive regulation of site selection and DOE Orders prescribing more detailed guidance for performance assessment. The lines of authority and accountability for enforcement of the requirements written into a Record of Decision (ROD) by the three parties of the Federal Facilities Act (FFA) also differ substantially from those that enforce DOE Orders. If TDEC is to be, jointly with EPA and DOE, responsible for enforcement of the requirements of the ROD, then the ROD should incorporate TDEC rules that state personnel have the experience and training to properly enforce. Disposal of radioactive waste under the authority of DOE Orders could provide an equivalent level of protectiveness to public health and the environment, but it will not provide an equivalent means for TDEC to enforce regulations that assure protection of public health and the environment.	Agreement has been reached on including ARARs for NRC-based TDEC rules regulating LLRW as 'relevant and appropriate' and DOE Order (Manual) references as to be considered (TBC) guidance.
TDEC.S.084	**Page G-8, Paragraph 4, Last Sentence:** "*Conversely, 10 CFR 61 requirements that are not incorporated into DOE O 435.1-1 do not meet the "appropriateness" criteria and, as such, are not regarded as "relevant and appropriate" for DOE environmental restoration sites.*" This is simply a conclusion and not an argument. This text does not provide enough of the background on the process of development of the DOE Order to allow evaluation of this position. Clearly, the state LLW disposal standards are not applicable, but in almost an equally clear fashion they are "relevant and appropriate" in general. Any decisions on specific provisions not being "appropriate" should be made a much higher level of detail.	Agreement has been reached on including ARARs for NRC-based TDEC rules regulating LLRW as 'relevant and appropriate' and DOE Order (Manual) references as to be considered (TBC) guidance.
TDEC.S.085	**Page G-8, Paragraph 5**: "*An example of this process is site selection for a new low-level radioactive waste disposal facility. As discussed in DOE Guide (G) 435.1-1, initial site selection for a new DOE low-level waste (LLW) disposal facility accepting only DOE waste is limited to the DOE reservation, focusing on identifying the best site within the reservation. This is different from the way sites are selected for commercial NRC-licensed LLW disposal facilities, which are selected from large geographic areas where ownership of the land may be under private or public control. Site selection processes for commercial facilities are directed toward identifying sites that meet geographic suitability requirements, considering seismic, hydrogeological, archaeological, and other physical conditions.*" These requirements are to protect health, safety and the environment and are designed to minimize releases to the environment and to mitigate impacts in the event of a release. All these requirements are about managing environmental risk.	Agreement has been reached on including ARARs for NRC-based TDEC rules regulating LLRW as 'relevant and appropriate' and DOE Order (Manual) references as to be considered (TBC) guidance.
TDEC.S.086	**Page G-8, Paragraph 5:** "*While relevant, the suitability criteria are not appropriate since they are not well-suited to the site given the type of facility regulated by the state (a commercial, licensed LLW disposal facility) and the type of facility contemplated by the DOE CERCLA action (a non-commercial, non-licensed LLW disposal facility located on DOE property accepting only DOE waste).*" Refer to the previous comment as well. It is unclear why the performance objectives for a DOE	Agreement has been reached on including ARARs for NRC-based TDEC rules regulating LLRW as 'relevant and appropriate' and DOE Order (Manual) references as to be considered (TBC) guidance.

	site would be different than minimizing the potential for releases and mitigating the impact in the event of any releases. Both public and private wastes are radioactive. Any argument of this nature should involve a comparison of isotopes and characteristics (such as alpha, beta, gamma particles; half-lives, curies, etc.) The commercial/public distinction is irrelevant in and of itself to environment risk.	
TDEC.S.087	**Page G-8, Paragraph 5:** "*This can lead to DOE sites being selected that are located adjacent to or within land previously contaminated.*" The statement referring to site selection on site and in areas of prior disposal leads to the comment that an option not considered would be a site with better hydrogeology that would actually be located in the general area of the Bear Creek Burial Grounds where there have been releases of uranium measured entering the Clinch River. All or parts of this area such as around the S-3 ponds having a remedy not meeting goals in the interim ROD for Bear Creek Valley should be part of the on-site options if this policy were really being applied carefully.	A site that infringed on the Bear Creek Burial Grounds was considered, but was ruled out due to the extent of existing contamination and the extreme cost associated with removing that media and incorporating its remediation in the construction of a new disposal facility.
TDEC.S.088	**Page G-8, Paragraph 5:** "*DOE G 435.1-1 states that "[i]t is not intended that the 435.1 criteria be used as exclusionary conditions to eliminate a site from being considered, but instead provide a measure of evaluation of the site's contribution to performance of the disposal facility. Use of existing facilities on DOE reservations should be considered to the extent practical." (see DOE G 435.1-1, Chapter IV, pp.123–124).*" While Tennessee could accept this argument about 435.1 criteria not being exclusionary in general, many of the specific sites screened in the RI/FS and the ones with the larger capacity are located in areas where there are concerns about depth to water table, karst and perhaps highly-developed karst with conduit flow and very rapid transport in which releases would migrate rapidly and not attenuate. Tennessee would submit that DOE's performance objectives should be to confine the wastes in long-term performance and not just delay the releases or allow the releases to occur gradually because of slow failure of areas of engineering systems that cannot be expected to compensate for a bad site.	DOE recognizes that no disposal facility features, man-made or natural, can contain contaminants in a land disposal facility completely and indefinitely regardless of the intrinsic site characteristics. DOE understands and has stated that East Tennessee is not an ideal area to dispose of mobile waste contaminants. However, DOE further recognizes that engineered disposal facility features can provide a measure of containment that combined with a site's less than ideal features, will maintain risk within an acceptable limit. In terms of the facility DOE is proposing for the ORR, those engineered features, in combination with attaining the CERCLA risk goals through limiting waste entering the facility, will allow compliant and safe disposal of the majority of future CERCLA waste on the ORR. See other responses for descriptions of engineered features.
TDEC.S.089	**Page G-9, Paragraph 1:** "*Since DOE is specifically exempted from NRC regulations and the TDEC rule equivalents, and has equivalent requirements in its internal orders, it is, per EPA's own language, inappropriate and unnecessary to cite these as relevant and appropriate requirements.*" DOE is free to use its internal guidance and develop a site strictly for LLW free from the use of these ARARs, but a lot of material is mixed waste and subject to RCRA jurisdiction and Tennessee is an authorized state having its own hazardous waste program of equivalent stringency. And the DOE Orders themselves should themselves be identified as To Be Considered (TBC). So, in addition to state LLW disposal rules including siting criteria, the DOE Order should either be identified in a table as TBC or could be placed in narrative and could control in circumstances in which the DOE order would be more stringent and more protective of the environment.	Agreement has been reached on including ARARs for NRC-based TDEC rules regulating LLRW as 'relevant and appropriate' and DOE Order (Manual) references as to be considered (TBC) guidance.
TDEC.S.090	**Page G-9, Paragraph 2:** "*CERCLA Section 121(d)(4) allows for waivers of ARARs under certain circumstances for CERCLA actions.* It must be said here that it appears that the obvious reason for the arguments about not identifying state LLW rules as "relevant and appropriate" in the previous section is to take shortcuts for waivers of ARARS without adequate factual support and justification.	State NRC-based radioactive (LLW) rules were not included in the D3 RI/FS because DOE is self-regulated under the AEA, and as pointed out, DOE is specifically called out in the regulations as excluded from their enforcement. The DOE has not here, or ever, made decisions to intentionally avoid federal or state environmental regulations that may apply.
TDEC.S.091	**Page G-9, Paragraph 2:** "*For this On-site Alternative, waivers for two requirements will be requested, as follows:*	The water level issues noted at the EMWMF are believed to be largely the result of not having installed an underdrain network as part of the original EMWMF

	☐*A hydrologic conditions requirement under TSCA specifies that there be no hydraulic connection between the site and standing or flowing surface water and the bottom of the landfill liner system or natural in-place soil barrier of a chemical waste landfill must be at least 50 ft. above the historical high water table (40 CFR 761.75[b][3]). Construction of a disposal facility at the EMDF site evaluated under the On-site Disposal Alternative would not meet this TSCA requirement.* ☐*The RCRA LDRs (40 CFR 268 et seq.) prohibit the placement of untreated hazardous waste in land disposal units. DOE proposes to treat characteristic mercury-contaminated demolition debris by macroencapsulation in specially constructed forms within EMDF cells. Debris would be treated within a short time after placement, and any stormwater or other liquids would be collected and treated so that no contaminants exit the forms. A waiver will be requested to allow this operational approach to be implemented, as an interim action. Once treatment of the waste forms is completed, all applicable and relevant and appropriate requirements will have been met."* The argument made for the waiver of the depth to water table required by 40 CFR 761.75[b][3] is not unreasonable, but has proven not to be true in the case of the EMWMF, where water levels have been and may continue to be near the top of the buffer in some areas under the facility. The argument for waiving the requirement that there shall be no hydraulic connection between the site and standing or flowing surface water would only be valid if the water from the proposed underdrain were permanently prevented from entering NT-3, the discharge point for the underdrain and a tributary to Bear Creek, or any other surface waters, prior to treatment. While the Demolition and Decontamination (D & D) of the West End Mercury Area buildings is not within the scope of this RI/FS, some of the characterization has been referenced in this draft RI/FS. There are concerns that some mercury that can be recovered as free mercury would then need to be subject to recovery as free mercury and treated by RMERC. Although there is precedent for this Page 39 of 79 approach in Hanford, http://pdw.hanford.gov/arpir/pdf.cfm?accession=0090734, the documentation is at much greater level of detail. Specifically, the level of detail in this draft report is inadequate for the state to evaluate either the basis for macro encapsulation effectively under RCRA or the larger issue of whether the proposed off-site cell treatment is protective under CERCA 121(a). The methods used to characterize and demolish the buildings that will generate waste containing mercury at concentrations above LDR, the method of transportation to the disposal facility, and the placement of debris in the facility may all impact the effectiveness of various encapsulation technologies.	design, and subsequent retrofitting of a single underdrain that did not extend up along the entire length and trace of the former NT-4 stream channel/valley floor. This is particularly true for the upper section of the former NT-4 valley where the noted high water levels have been detected (near PP-01) and where no underdrain exists to allow for more active local ground water drainage. With regard to a waiver for hydraulic connections, the underdrain is clearly designed to act as a drain for shallow ground water, not as a drain for surface water. The original stream channels with intermittent seasonal flow will be eliminated during construction and remaining upslope surface water sheet flow runoff and topsoil stormflow zone runoff would be captured and diverted to the sides of the landfill. The underdrain system is within the upper ground water zone, drains ground water from the water table and upper intermediate ground water intervals and is isolated from any surface water runoff. The underdrain is a relatively high permeability subsurface gravel channel that drains ground water flowing mostly laterally below and across the EMDF footprint and is not equivalent to standing or flowing surface water. Ground water drainage below the EMDF would exit at the underdrain outfall locations into existing surface water stream channels along NT-2/NT-3 tributaries and subtributaries *outside of the landfill footprint.* It is not technically feasible or cost effective to eliminate all elemental mercury from Y-12 facility demolition debris. Appendix C revisions emphasize pre-demolition mercury abatement and recovery measures to ensure that mercury content of demolition debris is as low as reasonably achievable. Recovered elemental mercury and secondary wastes associated with mercury abatement will be sent to onsite or off-site facilities for treatment and disposal as necessary. The D4 RI/FS has been modified and in-cell macroencapsulation (ICM) of mercury debris at an on-site facility is presented only as a possibility for consideration in Appendix C; ICM is not part of an alternative in the revised document. Appendix C presents a discussion of the RCRA regulatory path to include ICM for an on-site remedy. See revised Section 5.1.4.
TDEC.S.092	**Page G-10, Paragraph 5: "***The waiver for temporary placement of untreated wastes within one or more landfill cells is justified on the basis that it is an interim action that is a part of a total remedial action that will achieve the LDR requirements at completion, as allowed under CERCLA section 121(d)(4)(A) and 40 CFR 300.430(f)(1)(ii)(C)(1). An April 24, 1991 memorandum from the EPA Office of General Counsel (L. Starfield) to S. Golian, Chief, EPA Remedial Guidance Section, and L. Boornazian, Chief, EPA CERCLA Compliance Division, concurred with a very similar approach at the Wasatch Chemical Superfund site (accessed at www.epa.gov/superfund/policy/remedy/pdfs/memo42491-s.pdf). This waiver request is limited to temporary placement for treatment, and does not affect other aspects of LDR compliance.* Refer to earlier comments about lack of detail in evaluation of this proposal and, more specifically, how it would be equivalent to a CAMU. The website for the ROD is: http://www.epa.gov/superfund/sites/rods/fulltext/r0891048.pdf	The D4 RI/FS has been modified and in-cell macroencapsulation of mercury debris at an on-site facility is presented only as an option for consideration in Appendix C; ICM is not part of an alternative in the revised document. Appendix C presents a discussion of the RCRA regulatory path to include ICM for an on-site remedy. See revised Section 5.1.4.

	And this ROD is not nearly as relevant as the Hanford example discussed above. Here we reiterate our previous concerns regarding both the CAMU- equivalency for placement and the high concentration mercury waste sometimes in free elemental form. Even if an ARAR waiver were granted, concerns remain about the in cell approach for macro encapsulation and protectiveness for the debris waste streams from the WEMA and the concentrations of mercury in this debris. Protectiveness of the remedy is one of two threshold criteria that must be satisfied and cannot be waived like an ARAR, see CERCLA 121(d)(1), 42 USC 9621(d)(1): '*Remedial actions selected under this section or otherwise required or agreed to by the President under this chapter shall attain a degree of cleanup of hazardous substances, pollutants, and contaminants released into the environment and of control of further release at a minimum which assures protection of human health and the environment. Such remedial actions shall be relevant and appropriate under the circumstances presented by the release or threatened release of such substance, pollutant, or contaminant. It must be said here that it appears that the obvious reason for the arguments about not identifying state LLW rules as "relevant and appropriate" in the previous section is to take shortcuts for waivers of ARARS without adequate factual support and justification.*'	
TDEC.S.093	**Page H-8, Paragraph 1:** *"The purpose of this Appendix is to develop preliminary analytic concentration limits for contaminants of potential concern (COPCs), referred to as Preliminary Waste Acceptance Criteria (PreWAC), which would meet the applicable risk and dose criteria specified in the remedial action objectives (RAOs), using fate and transport analysis based on a resident farmer scenario for the proposed Environmental Management Disposal Facility (EMDF)."* TDEC does not agree that the resident farmer scenario used in this document is adequate to provide a basis for demonstrating that the preliminary WAC computed here for the proposed facility will protect human health and the environment. The resident farmer scenario does not consider groundwater impacts except at the point of water extraction 460 meters from and oblique to flow paths from the proposed disposal facility. Impacts to surface water quality are not considered except in the context of their contribution to human health risk via livestock watering and plant irrigation.	The revised PreWAC in the D4 RI/FS have been calculated under the bounding assumption that, within the 1000 year compliance period, appropriate TDEC AWQC are met at the surface water point of exposure in Bear Creek to demonstrate water resource protection and ecological protection.
TDEC.S.094	**Page H-8, Paragraph 1:** *"This analysis provides the basis for demonstrating that the proposed EMDF conceptual design and site would be protective of human health and the environment and be a viable disposal option for most future Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) waste."* Because sites on the Oak Ridge Reservation offer little in the way of environmental buffer to attenuate releases of hazardous or radioactive material, robust facility design and restrictive waste acceptance criteria are the only avenues available for effective protection of human health and the environment in Tennessee. Consequently, a detailed site characterization, detailed design, and final waste acceptance criteria are necessary to show that CERCLA remedial action objectives will be met, and should be completed prior to seeking regulatory agreement for authorization to dispose of future CERCLA generated waste on the ORR.	The revised RI/FS presents more justification of the facility design that demonstrates robustness and longevity of engineered features, which are given credit for maintaining protectiveness of the public and environment. More restrictive PreWAC are the result of incorporating comments by both TDEC and EPA regarding modeling and modeling assumptions. DOE feels the revised RI/FS demonstrates fully that on-site disposal in a new engineered facility is feasible, and meets the CERCLA RAOs. However, as a feasibility study that now includes multiple siting options, and not a decision document, detailed site characterization is not at this time proposed by DOE. Detailed design is not undertaken for a site that may not be approved by all parties. Final WAC will be a tri-party undertaking, to be fully defined in a primary WAC Attainment (Compliance) Plan. It is noted that portions of administrative WAC have been added to the revised RI/FS, as well as a flowchart delineating waste that is excluded from on-site disposal (see Revised Section 6.2.3 for new flowchart and table of administrative WAC limits).

TDEC.S.095	**Page H-8, Paragraph 3:** "*A negotiated waste acceptance criteria (WAC) attainment process was developed for the EMWMF(DOE/OR/01-1909&D3), which involves the designation of four separate types of WAC requirements (DOE 2001a) to define and limit acceptable wastes. Similar triparty negotiations would result in a WAC attainment process for this proposed on-site facility to be documented in a primary Federal Facility Agreement (FFA) document, the WAC Attainment Plan (see Section 1.2 for more information).*" Based on experience at the EMWMF, TDEC does not believe that a negotiated WAC is the best way to protect human health and the environment. TDEC was concerned with the validity of fate and transport modeling to establish analytic WAC for the EMWMF, so negotiations between FFA parties were used for the EMWMF as a means to establish protective WAC. Based on current information, TDEC is not convinced that the resulting WAC will be protective in the long term. WAC should be derived from a credible risk assessment that is consistent with whatever WAC limitations may ultimately be imposed by the requirements of DOE Orders. DOE should obtain a Disposal Authorization Statement for any new radioactive waste disposal facility on the Oak Ridge Reservation prior to finalizing the CERCLA risk assessment and establishing waste acceptance criteria.	DOE will seek a preliminary DAS before ROD approval. The process has begun, and a preliminary/draft Composite Analysis has been completed. Results of reviews by LFRG will be shared with TDEC and EPA. This LFRG involvement will also supersede the establishment of WAC in a primary WAC Attainment (Compliance) Plan. Additionally, see the revised RI/FS for a modified Preliminary WAC (PreWAC) that places more stringent limits on multiple isotopes.
TDEC.S.096	**Page H-9, Paragraph 5:** "*The sum of fractions (SOFs) calculation method is applied to each waste lot to account for the presence of multiple contaminants. To consider incorporation of that waste lot into the entire EMWMF landfill, a volume-based weighting factor is applied to the SOF of each waste lot for all waste lots already in the landfill, waste lots proposed for acceptance in the landfill, and some forecasted future waste lots to determine a "landfill-wide" SOF. This method is referred to as the volume-weighted sum of fractions (VWSF), which allows an evaluation of the acceptance of a waste lot into the disposal facility as a whole.*" TDEC has requested repeatedly that the approach used at the EMWMF to establish waste acceptance criteria (WAC) and implement WAC attainment be changed for any proposed facility for land disposal of CERCLA waste. When waste density is highly variable, as has been the case at EMWMF, the volume weighted sum of fractions method discussed here creates a disconnect between the measure of radioactive or hazardous material in the facility and the actual mass or Curie content in the waste, which is the quantity that drives risk. If the less dense material is cleaner than the more dense material, the facility may be loaded with more contamination than the risk assessment based directly on mass or activity would allow. TDEC experience at the EMWMF has also shown that having no fixed limits (other than administrative WAC) that exclude waste from the facility complicates auditing and validation of compliance with WAC.	DOE agrees that the approach used at EMWMF (VWSF) will be modified, as is written on the next page (H-10) of the document (underlining added for emphasis): "If on-site disposal is the selected remedy as determined by the CERCLA process, final analytic WAC for a new facility will be developed based not only on mobility in the environment and hypothetical receptor exposure, but also on external exposures to inadvertent intruders as required by DOE Order (O) 435.1, and will continue to demonstrate achievement of the RAOs and any applicable or relevant and appropriate requirements. They will be documented in a primary, tri-party-approved FFA document (WAC Attainment Plan). Administrative, ASA-derived, and physical WAC, along with a process to determine attainment of the WAC, will be negotiated and documented in the WAC Attainment Plan. <u>The method or process to determine attainment of the WAC may differ from the attainment process described above (VWSF) for the EMWMF.</u>" The quoted text in this comment was only discussing the current method used at EMWMF, as it states.
TDEC.S.097	**Page H-14, Paragraph 2:** "*An inadvertent intruder (e.g., someone digging through the final cap and being directly exposed to the waste after landfill closure) will be examined as part of the DOE O 435.1 compliance.*" Risk assessment under CERCLA should include sufficient exposure scenarios to be compatible with those mandated under DOE Orders and those prescribed by Tennessee rules for disposal of radioactive waste."	DOE agrees. The risk assessment in the RI/FS is noted clearly as developing Preliminary WAC. DOE O 435.1 requires an intruder analysis, and one will be completed for the selected site within the next year. Results of this analysis will be provided to regulators for review. If any modifications to Preliminary WAC are required upon completion of the intruder analysis, those will be made prior to finalization of the WAC, and documented in the tri-party Primary Document, WAC Attainment (Compliance) Plan.
TDEC.S.098	**Page H-14, Paragraph 3: "***In accordance with current practices in Tennessee, the upper, more active weathered bedrock part of the unconfined aquifer (nominally a 30–50 ft. stratum between the water table and competent bedrock) would not be used for domestic water supplies.*"	The TDEC Rules (0400-45-09-.10) indicate that at least the upper 19 ft of overburden materials are normally isolated from water wells to protect from potential surface contaminants that may impact shallow ground water. TDEC well completion records available for the Bethel Valley and Clinton quadrangles indicate a mean depth of isolation casing of 77 ft below ground surface (median

	What is the basis for this statement? A variety of practices are used in the state. See Tennessee Rule 1200-4-9-.10, Well Construction Standards, for information on compliant well completion in Tennessee."	values closer to 60 ft). At the current (D4) hypothetical water well locations, the assumed well screen interval corresponds to 80 to 160 ft below ground surface, consistent with the local field data. Modifications to the depths and intervals of the water well intake zone may result in higher or lower concentrations depending on relationships between the assumed well location(s), construction details, and the 3D plume concentrations. For the revised groundwater well locations in the D4 RIFS (refer to Appendix H, Figure H-3), sensitivity of the simulated contaminant concentration in drinking water to the choice of well screen interval has been evaluated in Appendix H Section 4.5.1.
TDEC.S.099	**Page H-16, Paragraph 1:** "*A further key assumption in the resident scenario development and risk evaluation is the location of the hypothetical receptor. As this is the location at which the proposed alternative must meet the CERCLA defined risk criteria (e.g., 10-4 to 10-6 Excess Lifetime Cancer Risk [ELCR]), it is appropriate to look to CERCLA guidance on placement of the future hypothetical receptor. Per EPA's Risk Assessment Guidance for Superfund Volume I Human Health Evaluation manual (Part A) [EPA 1989], this placement or location is the "exposure point."* TDEC performed a limited analysis of the sensitivity of the pre-WAC to the receptor location. The goal was to compare the pre-WAC proposed in the RI/FS to a pre-WAC generated if the pathway analysis included a scenario with the receptor using ground water that was much less diluted by clean recharge. The advection-dispersion equation solved by PATHRAE in the saturated zone can be expressed in terms of dimensionless variables, and the analytical solution will depend only on the Peclet number, a Courant number, and time constants that are representative of the time for radioactive decay, the time for release from the source, and the time required for solute to advect to the point where the Peclet number is unity. The latter quantity is a measure of the strength of dispersion. When the time for release of a contaminant from the model boundary into the model domain, which is controlled in PATHRAE by either the release rate from the source or the migration time through the vadose zone, is large enough, and when the time for decay is large compared to the travel time in the saturated zone, the peak concentration will be comparable to that calculated assuming a permanent continuous source. In that case, differences in dilution would account for most of the concentration differences that would result from modeling to a different location of the hypothetical receptor. Consequently, the sensitivity analysis was restricted to examples with longlived radionuclides. Relocating the receptor closer to the source could have much greater impacts on groundwater concentrations of isotopes with shorter half-lives. Pre-WAC for Tc-99, with a half- life substantially longer than the time to peak concentration, is listed as 69,300 pCi/g. If the receptor were assumed to be either immediately downgradient of the facility or near the facility underdrain that is shown in the conceptual design, the dilution factor would be near 0.1, as shown in Figures H-16 and H-17. The proposed underdrain, like the underdrain at the EMWMF, would presumably be able to supply several gallons per minute of water continuously even under drought conditions, and might be a usable water supply even when individual wells were dry. Then Tc-99 at peak concentration should be more or less determined by a ratio of the dilution factor estimated at the new receptor location to that calculated for Bear Creek, or 0.1/.00254. This would result in a concentration in the underdrain or near the facility of slightly less than 40 micro Curies per liter. Since the effective uptake comes primarily from the drinking water pathway, the relocation of the receptor would result in an excess cancer risk of about 2.4E+0 due to Tc-99 exposure The pre-WAC for technetium 99	The assumed location of the groundwater (drinking water) well does have a significant impact on the level of dilution, estimated risk, and resulting PreWAC for a given contaminant. The D4 revision assumes that the groundwater well is located 100 m from the waste facility boundary, along the axis of maximum concentration within the simulated contaminant plume. Additionally, for COPCs that peak after 1000 years post-closure, the groundwater point of exposure remains at 100 m from the waste facility boundary, along the axis of maximum concentration within the simulated contaminant plume.

	calculated using the methodology outline on page H-70 would then be about 25 pCi/g. Another example is U-238. The pre-WAC in Appendix H, Table H-8 includes a pre-WAC of 103,000 pCi/g. With an order of magnitude dilution, then a pre-WAC of 33 pCi/g is calculated. There is about a 4 order of magnitude difference in 33 and 103,000. Therefore, a WAC of 103,000 pCi/g proposed for U-238 in the RI/FS could pose an excess lifetime cancer risk of 3 in 10.	
TDEC.S.100	**Page H-16, Paragraph 1:"***This is the point where MEI contact with the highest contaminant concentration is made "if the site is currently used, if access to the site under current conditions is not restricted or otherwise limited (e.g., by distance), or if contact is possible under an alternate future land use." In this case, the proposed EMDF site is within Zone 3 of Bear Creek with a future land use designation of "DOE-controlled Industrial Use," access is restricted by DOE, and for the foreseeable future will be under DOE control as described in the BCV Phase I ROD (DOE 2000). This future land use designation has been supported and approved by public stakeholders in the End Use Working Group (documented in the Final Report of the Oak Ridge Reservation End Use Working Group, July 1998). Accordingly, the nearest possible exposure point for a future hypothetical resident, and point of highest expected concentration based on ground water and surface water flows, would be the intersection of the "DOE-controlled Industrial Use" Zone 3 boundary with Bear Creek shown in Figure H-3, approximately 1.5 miles to the west of the EMDF.* As stated in comments on Appendix G, water quality rules are not listed as chemical specific ARARs. The risk assessment performed here does use MCLs at the receptor location as an end point for modeling, but does not look at ground water protection more generally, and does not include protection of surface water quality or ecological risk. For the proposed EMDF to meet criteria specified in CERCLA Section 121 (d)(1), future releases from EMDF must assure protection of human health and the environment. In addition to evaluating the risk levels required by CERCLA, we interpret this to mean that future releases cannot cause pollution that violates stream classified uses in Bear Creek or downstream. Bear Creek is a tributary to East Fork Poplar Creek, Poplar Creek and the Clinch River. By evaluating risk for a single, hypothetical receptor, the EMDF RI/FS does not consider the designated uses of Bear Creek, East Fork Poplar Creek, Poplar Creek, and the Clinch River and it does not evaluate the impact of the calculated pre-WAC allowed releases on these surface water uses. The Clinch River, Poplar Creek, East Fork Poplar Creek, and Bear Creek are all classified for fish and aquatic life and recreational use. The Clinch River downstream is also classified for domestic water supply. Certain radioactive, hazardous, and TSCA pollutants pose or may pose a threat to human health through ingestion and/or recreational use (e.g. fishing consumption), or a threat to aquatic life or other ecological risk. These potential pathways are not modeled in the risk assessment and need to be evaluated and included in the development of the pre-WAC. In fact, the pre-WAC should be made to constrain the cumulative impact from any proposed new sources and any existing sources, such as the Bear Creek Burial Grounds and S-3 ponds secondary sources and plume so that the potentially impacted streams or ecosystems will not suffer further degradation. TDEC did some limited modeling with the RESRAD code to evaluate WAC sensitivity to	The D4 RI/FS demonstrates protection of water resources and ecological receptors, within the 1000 year compliance period, by modifying analytical PreWAC if necessary to meet MCLs (or a 4 mrem/yr dose limit) at the groundwater point of exposure, and similarly by limiting predicted surface water contaminant concentrations to Ambient Water Quality Criteria (AWQC), and adjusting calculated PreWAC accordingly. Consideration of risk to human health and water resources resulting from multiple Bear Creek Valley contaminant sources, within the 1000 year post-closure compliance period, will be provided in a Composite Analysis developed to meet the requirements of DOE Order 435.1. Po-210 has a half-life less than 5 yr (specifically it is 0.38 yr half -life), it was therefore excluded from consideration in the D3 RIFS. Review of the decay chains that include Po-210 suggests that parent nuclides are sufficiently limited to address potential risks. In the D3 RIFS, Table H-6 and H-7 contain the predicted SW concentration based on the assumed 1 Ci/m3 waste concentration, and do not reflect the protectiveness provided by the risk-based analytical PreWAC. In the D4 revision of Appendix H these model output data are included in Attachment B, and replaced with the final calculations to derive the final PreWAC (which will take into account AWQC in addition to meeting risk range) to clarify. Antidegradation concerns are being addressed, in part, by deriving risk-based discharge limits for radionuclides as part of the Integrated Water Management Focused Feasibility Study (UCOR 2016).

	water quality driven endpoints, and pathways that might incorporate the effects of progeny. RESRAD modeling based on a source concentration of 103,000 pCi/g uranium-238, the pre-WAC concentration specified in Table H-8 of this Appendix, identified polonium-210 as a progeny and fish consumption as a potentially significant exposure pathway. While a more realistic fate and transport analysis than can be achieved with RESRAD might not reveal an actual risk to a recreational user of Bear Creek, TDEC cannot accept a risk assessment that makes no attempt to incorporate water quality criteria, cumulative effects, and a more detailed analysis of the effects of progeny resulting from radioactive decay. For a number of the contaminants of potential concern modeled in Appendix H, peak concentrations in Bear Creek listed in Tables H-6 and H-7 (pages H-64 through H-69) are above DOE derived concentration standards that limit releases to surface water or ambient water quality criteria. Specifically, any new or expanded discharge to Bear Creek must comply with the Antidegradation Statement of the Tennessee Water Quality Control Act and rules, meaning that no measurable loading is authorized for the parameters causing the stream to be impaired. For now, these parameters include mercury, cadmium, nitrates, and PCBs. Likewise, under Tennessee rule 0400-40-03-.07, groundwater is classified as general use groundwater. Therefore, except for naturally occurring levels, general use ground water: (a) shall not contain constituents that exceed those levels specified in subparagraphs (1)(j) and (k) of Rule 0400-40-03-.03; and (b) shall contain no other constituents at levels and conditions which pose an unreasonable risk to the public health or the environment.	
TDEC.S.101	**Page H-16, Paragraph 2**: "*Ultimately, a much more conservative approach is preferred, and the receptor location was selected based in part on historical records (prior to DOE's land ownership) that indicate several homes were located along Bear Creek in the general area being considered (Tennessee Valley Authority Maps and Surveys Division Quadrangle map 1935, 1941, see Appendix E, Figure E-5 and Section 2.1).*" The implication here is that the receptor location is quite conservative with respect to locations outside of the zone 3 boundary. However, TDEC dye tracing results indicate that groundwater and surface water travel times from the approximate location of the hypothetical receptor to the zone 3 boundary are on the order of only a day. This allows very little additional time for decay or degradation of radioactive or hazardous substances and little opportunity for mass transfer processes to remove solutes from the water. Reasonable dilution factors at hypothetical locations for a receptor along the dominant groundwater flow paths outside the zone 3 boundary in Bear Creek Valley can be estimated from the hydrologic balance over the watershed. Using the optimistic assumption that only 1 centimeter of water infiltrates through the landfill annually, the hydrologic balance still gives dilution of only 103 to 104, less than the 105 determined for the groundwater extraction well. Even though the RI/FS uses less dilution for the surface water pathways, the receptor location used in the RI/FS thus represents more or less a best case scenario rather than a more conservative approach. If modeled with realistic groundwater travel times in the karstic Maynardville limestone, most locations downgradient of the facility outside of zone 3 would yield higher risk than that at the chosen location. The water well location in this RI/FS does not lie along the primary groundwater flow paths that emanate from the landfill footprint, and most of the recharge to the well and the creek is derived from water not impacted by the facility. Perhaps the only less conservative locations would be either upgradient of the proposed facility itself , uphill from the dominant flow paths down Bear Creek Valley, or at the Clinch River.	The assumed location of the groundwater exposure point does have a significant impact on the level of dilution, estimated risk, and resulting PreWAC for a given contaminant. The D4 revision assumes that the groundwater well is located 100 m from the waste facility boundary, along the axis of maximum concentration within the simulated contaminant plume. This new assumed location yields groundwater dilution factors on the order of 10^{-2} to 10^{-1}. Evaluation of model sensitivity to assumed average groundwater velocity is presented in Appendix H, Section 4.5 The Composite Analysis developed to meet the requirements of DOE Order 435.1 will provide assessment of risk at locations farther downstream in BCV within the 1000 year post-closure compliance period, and considers multiple Bear Creek Valley contaminant sources.
TDEC.S.102	**Page H-18, Paragraph 1**: "*DOE performed this analysis of the proposed low-level waste disposal facility using a performance-based approach with little to no reliance on long-term*	Cover system performance assumptions have been modified in the D4 RIFS revision and are summarized in table H-3. For the period exceeding 1,000 years,

	maintenance and the man-made components of the landfill (i.e., geosynthetics) for a performance period of 1,000 years beginning at closure of the landfill." TDEC agrees that long-term performance of the proposed facility should be based on characteristics of the landfill and the site that do not require substantial long-term maintenance. However, the conceptual model used to provide the basis for inputs to the fate and transport model should not assume that either the amended clay barrier layer in the cap or the clay liner will last indefinitely. Note that differential settling of the cap sufficient to create concave upward surfaces at the interface of the drainage layer with the barrier layer that could pool, on average, about 1 centimeter of water over only 10 percent of the barrier surface for one rainfall each month might double the projected infiltration rate. While it may be reasonable to suppose that the geosynthetic materials in the cap and liner will greatly restrict infiltration for decades, or even centuries, performance modeling should allow for degradation of clay layers prior to the one thousand year time frame of the model (or 1 million years in the case of modeling to peak). The time period for which infiltration rates can be assumed to be only one centimeter annually is one of many details in the fate and transport model that needs to be revisited and agreed upon by all FFA parties prior to approval of this RI/FS.	degradation of the amended clay layer is assumed to result in a 2-fold increase in hydraulic conductivity of the layer. Additionally, differential settling is assumed post-1,000 years and is accounted for in modeling by clogging the drainage layer of the cap (decrease in hydraulic conductivity by a factor of 100). These modifications result in an increased infiltration rate of 1.3 in/year after 1,000 years. For COPCs predicted to peak after 1000 years, PATHRAE modeling for PreWAC development conservatively assumes an infiltration rate of 1.3"/yr beginning with geosynthetic liner material failure at 200 years post-closure.
TDEC.S.103	**Page H-18, Paragraph 1**: "*Isotopes that peak beyond 1,000 years are modeled under the recognition that the modeling results for these much greater time lengths have a higher degree of uncertainty."* While TDEC generally agrees that there is a higher degree of uncertainty over time, this would seem to be cause for more conservative assumptions that account for the probable deterioration of all the landfill components over time, not just geosynthetic materials. The only changes made in the modeling in this RI/FS would seem to be a higher target for risk.	The risk target of 10^{-4} ELCR adopted by DOE for the RI/FS analysis past 1,000 years is within the acceptable risk range of CERCLA. However, due to the uncertainties introduced in extrapolating models so far in time, a deviation from the 10^{-6} point-of-departure risk level is warranted past 1,000 years. Modeling in excess of 1,000 years into the future, and then even 10's of thousands of years into the future as is the case here, is fraught with uncertainty. The time steps are necessarily larger, and results become less reliable. With error bars on results that have become extremely large relative to those results, it is necessary to relax goals (e.g. risk or dose targets). DOE recognizes this in limiting the compliance period to 1,000 years for a landfill in Order 435.1, with sensitivity analysis implemented past 1,000 years. The NRC likewise limits the compliance period (in proposed language for 10 CFR 61 – current NRC regulations do not address the time frames) to 1,000 years. After 1,000 years and to 10,000 years, the NRC has proposed a dose goal 20 times higher than that of the proposed 1,000 year compliance period.
TDEC.S.104	**Page H-20, Paragraph 1: "***An overview of the models used, conceptual design and site features provided, and major calculations performed are as follows:"* The description of the models does not include a summary of the equations used or any analytical or numerical techniques used to solve the equations, nor does it address all the consequences of uncertainties in key parameters that are inputs to the models. A description of the key equations and a more detailed sensitivity analysis to certain model inputs should be provided. In the case, of HELP, MT3D, and MODFLOW/MODPATH, the codes and manuals are readily available for download from government web sites. To our knowledge, this is not the case for the latest versions of PATHRAE HAZ and PATHRAE RAD. A more detailed summary of the PATHRAE model is necessary.	The text cited in this comment is from the introductory overview (Section 3.1) The text describing the PATHRAE model in Appendix H Sections 3.2.4 and 4.4 has been revised to provide additional detail and clarity. A more complete set of PATHRAE sensitivity analyses has been added to Appendix H in Section 4.5
TDEC.S.105	**Page H-25, Paragraph 1:** "*The waste layer is assumed to consist of contaminated soil, cement-stabilized soil-like materials, cement-solidified waste, and debris (rubble). These wastes are assumed to be placed in lifts to minimize void spaces within the waste layer. Void*	While there are no requirements for materials having sorptive properties, EMWMF typically uses soil or soil-like material for filling voids within and around non-bulk waste. The fill material is selected based on several parameters,

<table>
<tr>
<td></td>
<td>
spaces are filled with soil or soil-like material to provide structural strength and reduce settling due to waste compaction. For modeling purposes, all waste is conservatively assumed to be soil-like (see Section 4.4 of this Appendix).”
The assumption of soil-like waste may lead to conservatism for many waste forms that may have contamination confined in the interior of inert material. However, definition of the waste types in Section 2.1.2 of the RI/FS includes tanks, piping, glove boxes, and ventilation ductwork. There are no proposed requirements that material having sorptive properties similar to that of soil be used as structural fill around such debris. At the EMWMF, limestone gravel has historically been used around irregular objects rather than soil-like material. Under circumstances where the waste may corrode over time and contain unfilled voids, release rates from the waste may exceed those based on the assumption of equilibria between leachate and a soil-like material. Since the radioactive isotope or chemical is assumed to be adsorbed, this lack of conservatism will be exacerbated when the true chemical form is highly soluble, as in the case of uranyl fluoride deposits in compressors used in the gaseous diffusion process.
</td>
<td>
including function, performance, availability, ease of placement, and cost.
The selected fill, in descending order of preference, is typically:

Soil-like waste – The most cost effective fill, provided it can be placed and compacted in the voids.
Clean soil fill (predominantly clay) – Typically, the least costly non-waste fill, provided it can be placed and compacted in the voids. Also, provides an effective water barrier.
Gravel (typically crushed limestone) – Somewhat flowable and typically used under the haunches of large single debris items where it is difficult to place and compact soil.
CLSM – The most flowable fill material. Typically used where access to the voids is limited. Somewhat difficult to place. Best used for a “campaign” of grouting.
Concrete – Most costly and used only in special situations.

A typical example of the use of fill is illustrated below, in this case for placing the second lift of converters. Note that the interior voids of converters are filled before they are delivered to EMWMF.

Designate an area well away from the in-cell catchments.
Unload converters and place atop the compacted clay layer that is above the first lift of converters.
Position converters in an orderly arrangement with several inches between items to allow filling of voids.
Place crushed gravel (pea gravel size) around the converters so that it fills the voids under the haunches and between the items. Continue placing the stone to about half the depth of the converter.
Place clay from that point upward. Compact the clay between and around the converters.
Place clay over the layer of convertors to achieve a minimum 8-inch final compacted thickness.

Since 2001 the amount of soil and soil-like fill used placed in the EMWMF landfill is:

Waste soil: approximately 250,000 yd3
Clean fill soil: 403,000 yd3
Clean fill stone (including CLSM): 90,000 yd3

Based on these EMWMF operating statistics, soil is the most prevalent fill material used (nearly 90%), and as the best available data point upon which to
</td>
</tr>
</table>

		base an assumption for the future cell, is indicative of the most representative waste form for modeling purposes of the future condition. Furthermore, no attenuation by the soil within the waste matrix is taken.
TDEC.S.106	**Page H-26, Paragraph 6:** "*7. Performance Scenario – The performance of the conceptual design (cover and liner specifically) was assumed to change over time. Three stages were defined as follows:* *A. Stage 1: The best case, short-term performance of the cover/liner systems is assumed. All layers fully function. This stage is assumed to continue through the first 100 years following closure of the landfill. The composite barrier (the compacted and amended clay layers and geosynthetic layers) in conjunction with the overlying lateral drainage layer serve to divert infiltrating water away from the underlying waste and transport the water to the perimeter drainage system, thus minimizing infiltration into the waste. This is a very conservative assumption, supported by research that indicates the service life of HDPE geomembranes exceed 500 years and may reach over 1,000 years at temperatures of 20° C as expected in the case of the EMDF (depth below ground surface ensures temperate conditions); based on the thickness of the proposed geomembrane (40 mil) (antioxidant depletion lifetime in the membrane is extended with thickness); humid environment/moderate rainfall; and protected (depth under overburden) location of the geomembranes. (Benson 2014, Rowe et al. 2009, Needham et al. 2006, Mueller and Jakob 2003, Bonaparte, et al. 2002; Hsuan 2002; Koerner et al. 2001; Giroud 1984)* *B. Stage 2: Gradual failure of the cover/liner systems is assumed. This period is assumed to last for 100 years, extending from year 100 following closure, through year 200 following closure. A linearly increasing infiltration rate is assumed between Stage 1 and Stage 3 results.* *C. Stage 3: The worst case, long-term performance of the cover/liner systems is assumed. It is assumed that all geosynthetic materials degrade and are ineffective at 200 years and beyond. Layers are assumed to be degraded and no longer function (i.e., Layers 5, 11, 12, 13, 14, and 15 are removed from the model). Erosion of the cover is assumed to occur resulting in a decreased thickness of the top soil/rock layer. Layer 1 thickness is reduced by 20%.*" A key component of the Appendix H risk assessment and determination of the pre-WAC (pre-Waste Acceptance Criteria) is how much leachate exits the landfill and enters groundwater or the underdrain after engineering controls fail in a few hundred years. DOE modeled this through the HELP model. DOE's presentation of their HELP modeling shows that, worst case, DOE expects about 0.42 to 0.43 inches of water per year to percolate through the waste and enter groundwater or the underdrain. DOE used this to model whether the peak concentration of pollution for a specific contaminant impacts a receptor living near Bear Creek during the first million years after engineering controls fail. This modeling helps determine which constituents need waste acceptance criteria (WAC). Waste assumed to be placed in EMDF was modeled as a soil-like material and consequently differential settling or differential compaction was not mentioned in Appendix H. Modeling the 50 foot thick waste layer as a soil-like material is inconsistent with many of the materials needing disposal. Further, based on experience with EMWMF, DOE will not perform size reduction of the waste placed in EMDF. Lack of size reduction could result in long term differential compaction/differential settling that disturbs cap drainage layers and causes ponding or micro-fractures in cap layers. Differential compaction/ differential settling could result in DOE's predicted volume of leachate entering groundwater or the underdrain being low by an order or more. If sensitivity analyses were run to evaluate differential compaction and settling, it was not referenced in the RI/FS Appendix H.	Cover system performance assumptions have been modified in the D4 RIFS revision and are summarized in table H-3. For the period exceeding 1,000 years, degradation of the amended clay layer is assumed to result in a 2-fold increase in hydraulic conductivity of the layer. Additionally, differential settling is assumed post-1,000 years and is accounted for in modeling by clogging the drainage layer of the cap (decrease in hydraulic conductivity by a factor of 100). These modifications result in an increased infiltration rate of 1.3 in/year after 1,000 years. For COPCs predicted to peak after 1000 years, PATHRAE modeling for PreWAC development conservatively assumes an infiltration rate of 1.3"/yr beginning with geosynthetic liner material failure at 200 years post-closure. For the D4 RIFS revision, erosion of the protective soil layer is assumed to be 20% after 500 years, and 50% after 1000 years post-closure. It should be noted that the 1mm/100 yr erosion rate identified in the D3 Appendix H, Attachment B does not enter into the PATHRAE calculations for pathway #1 (groundwater to river), so the cap erosion assumption is only relevant in the HELP model analysis. Assuming limited erosion of the protective soil layer is justified in the cover system performance scenario given that natural erosion rates vary widely in space and time as a function of many variables, and severe erosion of the landfill cover is unlikely under anticipated future land use. In the conceptual design, the size gradation of the materials in the protective soil /erosion control layer is specified to limit physical degradation of the cover system, and applying an average soil-loss based erosion rate of 1mm/yr beyond 100 years does not account for the protective effect of including coarse materials in the erosion control layer. Final specification of the surface layer materials could be linked to an estimated maximum long-term erosion rate.

	DOE's worst case scenario (Table H-2) did not assume differential compaction. DOE's worst case scenario did assume the top 48 inch soil layer (Table H-1) erodes 20% or 9.6 inches. However, Table H-2 includes a thickness of 5 feet (60 inches) instead of 38.4 inches. Tennessee Department of Environment and Conservation's Division of Solid Waste Management estimates that a fully closed, grassed, well-maintained landfill should have erosion on the order of two (2) tons of soil per acre per year. Assuming about 120 pounds per cubic foot and that the landfill is completely grassed and well-maintained for the first 100 years after closure (Stage 1, RI/FS page H-26) there may be about 0.233 millimeters (mm) erosion per year or about 0.92 inches erosion in the first 100 years after closure. As opposed to the 1 millimeter erosion per century input to PATHRAE in attachment B of Appendix H, The DOE code RESRAD assumes a default erosion rate of about 1 mm per year. If a 1 mm per year erosion rate is assumed for stages 2 and 3 (Stage 2 and 3, RI/FS page H-26) after maintenance is discontinued, then about 4 inches erosion per 100 years may be expected assuming erosional rills, farming, fires, etc. do not cause an increased erosion rate. Under this scenario, it would take on the order of 240 to 350 years to erode 9.6 inches and it only takes about 1300 years for the initial 48 inch top soil layer to entirely erode away. If the 48 inch soil cover essentially erodes away in the first 1300 years, the clay layer will degrade significantly as an effective hydraulic barrier during the first 1300 years after closure. A more credible "worst case" scenario would allow infiltration rates to increase by an order of magnitude during the first few hundred years, and allow the infiltration rate to increase to the same recharge rate as that assumed for the surrounding area by 1000 years. These increased infiltration rates would not only provide some conservatism, they would reduce the time to peak concentration at a receptor location and allow development of WAC without modeling for time periods that might require consideration of climate change and other long term phenomena.	
TDEC.S.107	**Page H-28, Paragraph 1:** "*Clay layers in the final cover system are below 8 ft. of overburden. The clay layers are assumed to retain their hydraulic conductivity parameters based on the depth below ground surface, which ensures there is no direct exposure to freeze-thaw conditions and no desiccation; no cracking/tunneling due to roots or burrowing animals/insects; little temperature or moisture variation; and the layers are subjected to high pressures (approximately 60 kPa). Research has actually shown decreasing hydraulic conductivities with increased confining stress as is associated with significant overburden pressures (Boynton and Daniel 1985; Albrecht and Benson, 2001).*" This discussion seems to assume that moisture content in the clay liner will not vary significantly even after the geomembrane is degraded. The geomembrane will, at some point, degrade sufficiently at discrete locations to allow significant wetting and drying in the amended clay layer below, leading to desiccation cracks. While the overburden pressure may help to close desiccation cracks, 8 feet of soil and rock overburden (reduced to about 7 feet for stage 3) does not correspond to 60 kPa of effective stress. In fact, Albrecht and Benson, cited above, state in the summary, "Tests at various effective stresses show that an effective stress of at least 60 kPa was needed to close desiccation cracks so that hydraulic conductivity is < 10-7 cm/s. This effective stress is higher than that found in most cover applications, suggesting that desiccation damage to covers will be permanent."	Cover system performance assumptions have been modified in the D4 RIFS revision and are summarized in table H-3. For the period exceeding 1,000 years, degradation of the amended clay layer is assumed to result in a 2-fold increase in hydraulic conductivity of the layer. Additionally, differential settling is assumed post-1,000 years and is accounted for in modeling by clogging the drainage layer of the cap (decrease in hydraulic conductivity by a factor of 100). These modifications result in an increased infiltration rate of 1.3 in/year after 1,000 years. Additional revisions have been made to Chapter 6, section 6.2.2.4.8 to address this concern.
TDEC.S.108	**Page H-36, Paragraph 2:** "*Six distinct hydraulic conductivity zones were used in the UBCV Model to represent the eight geologic units that exist in BCV (Knox Dolomite, Maynardville Limestone, Nolichucky Shale, Maryville-Rogersville-Rutledge formations, Pumpkin Valley shale, and Rome shale/sandstone). Anisotropy ratios (Ky versus Kx [Kz]) of 5:1 (for weathered bedrock zone) and 10:1 (for fractured bedrock zone) were used to represent the preferred fracture/bedding orientation of the geologic units. In this case, Ky represents the conductivity*	DOE agrees that there are significant uncertainties in groundwater modeling related to hydrogeologic heterogeneity

	parallel to strike, Kx is the horizontal conductivity perpendicular to strike, and Kz represents the vertical hydraulic conductivity." Anisotropy values significantly higher than those used here may be necessary to properly simulate groundwater flow paths. Evidence from tracer studies and contaminant migration pathways on the ORR demonstrate that heterogeneity in the subsurface is on a very small scale with respect to hydraulic conductivity perpendicular to bedding (centimeters to decimeters for permeable fracture zones that seem to provide the most transmissive zones in shale rich formations and generally smaller for discrete continuous fractures in carbonate units). Hydraulic conductivity may be much less variable over considerable distance parallel to bedding, creating the effect of stratabound flow. Based on the variability of hydraulic test results on the ORR, the magnitude of local hydraulic conductivity variations is likely to be quite large, particularly in the direction perpendicular to bedding. This heterogeneity is on a scale smaller than the dimensions used for model discretization, and unlikely to be captured by grouping of model cells into only a few zones for purposes of assigning distinct hydraulic conductivities to the subsurface. Consequently, prediction of local hydraulic head values as well as flow direction at specific locations with MODFLOW is questionable. TDEC staff supposes that insufficient data may be available for a more refined model calibration, but cautions that the model results have limited value when used for the purposes of prediction of local flow direction and hydraulic head.	
TDEC.S.109	**Page H-41, Paragraph 1:** "*New ground water monitoring wells installed under Phase I characterization efforts, within the proposed EMDF area, have been used in UBCV Model calibration, and well head values were in general agreement with the model-predicted values.***"** What were the actual and predicted values of hydraulic head for the wells installed under the Phase 1 characterization effort? Were the hydraulic head residuals greater or less than those determined in the regional flow model calibration?	Based on the Phase 1 monitoring data, changes in the assumed groundwater recharge rate were made for the Rome formation to improve prediction of water table elevations on the upslope portion of the EBCV site. Modeled predictions were within a few feet of the measured annual average water table elevations for all shallow well locations, except for the GW-976 well location on the spur ridge.
TDEC.S.110	**Page H-41, Paragraph 3:** "*The water balance conducted for the calibrated current condition UBCV Model compared observed and predicted ground water discharge rates. Ground water sinks (drains cells in the model) discharge to Bear Creek directly and to surface drainage features that also flow into Bear Creek eventually. The model predicted ground water discharge above the Bear Creek/NT-3 junction is 0.31 ft3 per second (cfs). For comparison, the average flow rate measured at the junction location is 0.55 cfs (Appendix E, Section 2.4.3.1), which includes both base flow (ground water discharge) and surface water runoff. The water balance error for the UBCV Model was about 0.34% and is within the typically accepted limit of 1% (EPA 1996).CERCLA process that led to the construction and operation of EMWMF.As a follow-on to that process, this RI/FS utilizes relevant information from the EMWMF RI/FS with revisions and updates to describe and analyze current conditions.***"** TDEC agrees that the recharge rates and hydraulic conductivity values in the calibrated MODFLOW are reasonable for the purposes of computing Darcy flux and a water balance. Consequently, the general relationship between overall dilution computed using MODFLOW results and the steady state MT3D model as a function of distance from the facility footprint (see Figures H-16 and H-17) yields useful information, even if the specific location of any given plume isopleth may not be accurate due underestimation of anisotropy or the scale of heterogeneity in the subsurface.	Requires no response or changes.
TDEC.S.111	**Page H-48, Paragraph 1: 4.3.2 MT3D Model Assumptions.** *"Assumptions made in running the MT3D code are as follows:* *1. Changes in the concentration field will not measurably affect the flow field.*	The MT3D assumptions 3 and 8 have been revised in the RIFS D4 revision.

	2. Transport is modeled as three dimensional and transient until a steady state condition is reached. *3. Only advection is considered; other processes (dispersion and retardation) were not assumed. This is a conservative assumption because other processes will reduce the contaminant peak concentrations, as dispersion and retardation terms represent the contaminant spreading in the environment, thus flattening the peak.* *4. The MOC solution method, best for advection only, was used for the simulation to minimize the potential error from numerical dispersion.* *5. The well pumping rate is 240 gallon/day, based on its use by a family of four.* *6. The well is cased to 70 ft. Water is drawn from model Layers 5–8, corresponding to 70–150 ft below ground surface.* *7. The well was assumed to be located nearby on the BCV floor between the EMDF and Bear Creek (see Section 2.4), at a distance of 460 m from the edge of the landfill. This location is also consistent with topographical and geological features, lithostratigraphic and hydrogeological data, and ground water modeling results.* *8. The landfill is represented by a uniform, constant leaching source (assigned a unit leach rate of 1.0), which is assumed for the duration of the simulation. This represents a conservative approach as in reality the source will be depleted as leaching proceeds. The code is run for a single, non-specific contaminant source.* *9. Steady state is reached at peak leaching, based on a constant, non-depleting contaminant source."* TDEC believes these modeling assumptions provide a reasonable basis for deriving some measure of dilution at various locations in the model domain. Estimation of dilution otherwise may be problematic. Incorporation of dilution effects directly into the differential formulation of the mass balance adds an additional term to the conventional advection/dispersion equation solved analytically in PATHRAE. However, since contaminant transport is being modeled separately but in parallel with the dilution calculations, the claims of conservatism in assumption statements 3 and 8 above are not valid. The attenuation of the peak concentration due to the finite nature of the source and mass transfer processes such as dispersion and adsorption is accounted for in PATHRAE.	
TDEC.S.112	**Page H-49, Paragraph 1:**"*This calculated average ratio of the concentration at the well relative to leachate concentration from the cell, 0.000015, equals the DFwell"* A reasonable bound on dilution factors can be deduced from a water balance over all of zone 3 in Bear Creek Valley. Assuming about half of precipitation is lost to evapotranspiration and 1 centimeter infiltration annually over the 10 to 20 acre footprint of the waste, the resulting bulk dilution factor for the entire upper Bear Creek watershed lies between 0.001 and 0.0001. A more realistic dilution factor near the integration point below the confluence of Bear Creek with NT-8 (where the bulk of groundwater and surface water have already been mixed along the karst pathways) would employ an order of magnitude higher infiltration, based on some expectation of cap degradation, and the dilution factor would be between 0.01 and 0.001. Anything less than this average (for example, the DFwell derived in this Appendix needs some extraordinary justification, and is clearly not conservative, as it is less concentrated than the average value leaving the zone of restricted use. To be somewhat consistent with RCRA LDRs (which typically use a total dilution/attenuation factor of .01 between leachate concentrations and drinking water MCLs), it is hard to justify using a DF less than 0.01. On the other hand, there is some justification for using a dilution factor less than 1, since water infiltrating through the waste will be diluted to some degree even under the facility footprint with groundwater	The MT3D simulated contaminant plume (based on assuming a constant unit leach rate from the cell) provides the three dimensional distribution of relative concentrations used to specify a value of DF_{well}, based on the assumptions for well location and well screen interval. In terms of this MT3D model output, there is no positive lower bound on the relative concentration, i.e. uncontaminated areas along the margins of the plume are present. The D4 revision assumes that the groundwater well is located 100 m from the waste facility boundary, along the axis of maximum concentration within the simulated contaminant plume. This assumed location yields groundwater dilution factors on the order of 10^{-2} to 10^{-1}.

	recharge upgradient of the facility.	
TDEC.S.113	**Page H-49, Footnote:"** *2This assumption is necessary, since the exact contaminant concentrations and placement within the landfill will not be known until after the landfill begins operation. An assumption that contaminants are uniformly distributed is conservative because it allows leaching to be modeled in all the formations underlying the landfill, for the entire footprint."* While the assumption that contaminants are uniformly distributed in the land fill may facilitate computation of the leachate concentrations, it may not always be conservative. The release rate into infiltration will depend locally on the infiltration rate, the concentration of the contaminant in the waste, and the rate at which the contaminant is transferred between solid and liquid phases. If most of the water infiltrates along pathways that are initially cleaner or have slower release rates, the assumptions of uniformity will be lead to conservative values of contaminant concentration in leachate. The opposite situation might occur in a few cases in the EMWMF, where infiltration rates through clean fill may be substantially less than through contaminated demolition debris.	DOE agrees this assumption may not always be conservative, but does believe it represents a conservative assumption in most cases, and is a reasonable and necessary assumption based on the fact that no strategy is planned regarding the placement of waste or waste forms in the landfill. The footnote has been revised to remove the indication that it is a conservative assumption.
TDEC.S.114	**Page H-54, Paragraph 1:"***The contaminant concentration in the landfill is depleted by two mechanisms: (1) decay (for radioactive contaminants; no degradation of hazardous COPCs (chemical compounds) is accounted for as they are all assumed to degrade well within 1,000 years; USGS 2006) and (2) leaching via solid-liquid partitioning."* The reference cited here pertains only to volatile organic compounds, not to pesticides, PCBs, dioxins and furans, or other chemical compounds that are more chemically inert and typically biodegrade to other hazardous chemicals. Reported half-lives of most of these more persistent compounds in soils are reported to be less than 100 years, but the degradation rates under the conditions that may exist in a CERCLA waste landfill, expected to be dryer with less microbial activity, are uncertain. A more conservative approach, that allows modeling of chemicals known to degrade slowly past 1000 years, would add credibility to the risk assessment.	For hazardous chemical compounds predicted to peak within the 1000 year compliance period, no chemical degradation is assumed in PATHRAE modeling for PreWAC development. The D4 text has been revised to note that this is a conservative assumption. This comment indicates that for those persistent organics listed, pesticides, PCBs, dioxins, and furans, the reported half-lives are less than 100 years. 1000 yr modeling results in 10 or more half-lives, indicating that those contaminants are no longer present in their original form. If a safety factor of 2 is used, 5 half-lives occur in the period modeled. Given the low expected concentrations of these types of contaminants, 1000 years is a reasonable time limit for modeling transport of hazardous chemical compounds.
TDEC.S.115	**Page H-54, Paragraph 1:** "*Transport of the contaminant is modeled assuming migration through the vadose zone by soil-water equilibrium partitioning followed by migration in the saturated zone also via soil-water partitioning (with an added level of conservatism introduced by decreasing the partition coefficient by a factor of 10), and a receptor (MEI) exposure to that contaminant via discharge of ground water to surface water."* The PATHRAE code assumes a homogeneous, one-dimensional flow field and chemical equilibria between the fluid and solid phases. For the purposes of modeling solute transport from the fluid phase to the solid phase, the assumption of chemical equilibria allows for the maximum possible transfer of material to the solid phase and may thus create a bias toward long residence times for contaminants. Unrealistically long travel times could lead to lack of conservatism for radionuclides that decay significantly during transport. This is particularly true when contaminants move through very heterogeneous media such as the fractured rock aquifers in Oak Ridge, simulated by the saturated zone in PATHRAE. In such cases, equilibrium is rarely achieved. It is also likely that the assumption of homogeneity will lead to underestimation of peak values of contaminants at the receptor location. Heterogeneity in hydraulic properties typically causes an increase in first arrival times and a shorter time to peak concentrations. For contaminants that will undergo significant decay over the mean time of travel to the receptor, these effects may substantially decrease the computed risk. In addition to the heterogeneity in the aquifer,	The D4 revision includes a set of model sensitivity evaluations in Appendix H Section 4.5. These evaluations include consideration of model parameters that influence the modeled contaminant retardation and travel time, including infiltration rate, Kd, vadose zone thickness, aquifer porosity, and aquifer dispersivity. The effect of these variables on predicted peak concentrations of short-lived radionuclides is provided as part of the evaluation. In addition, because PATHRAE does not include vadose zone dispersion, supplementary modeling has been performed to evaluate the significance of this limitation in the modeling approach for developing PreWAC for radionuclides.

	there is likely to be substantial heterogeneity in the vadose zone, except in engineered materials that have not undergone significant degradation. The effects of dispersion in the vadose zone should be incorporated into the model, as well as use effective porosity and partition coefficients. Tracing studies in very similar Oak Ridge hydrogeologic settings indicate that, to conservatively simulate reactive solute transport with the advection dispersion equation used in PATHRAE, assumed effective porosities should be at least an order of magnitude less than the total porosity, and effective partition coefficients should be near zero.	
TDEC.S.116	**Page H-59, Table 5:** "*Table H-5. Parameters for Use in PATHRAE Modeling and PreWAC Calculations.*" TDEC has found potential discrepancies between tables summarizing model inputs and the model input files in Attachment B. An example would be a vertical groundwater velocity of 0.025 meters per year (from page 16 of attachment B), a 1centimeter per year infiltration rate, and a porosity in the vadose zone of 0.25 (from Table 5 of Appendix H), implying an effective porosity greater than the total porosity.	This inconsistency has been corrected in the D4 RIFS revisions. Assumptions for vadose zone parameters used in PATHRAE are described in Appendix H, Section 4.4
TDEC.S.117	**Page H-60, Paragraph 3:** "*The PATHRAE model also determines the equivalent annual water consumption per year for the creek water for each nuclide based on the surface water exposure routes (via crops and livestock), as stated in Section 2.3. PATHRAE uses EU factors (defined in Section 4.4.1) to represent and quantify the annual amount of nuclide (in terms of water volume) consumed by an individual from all pathways (EU includes the volume of well water ingested as well as volume ingested via surface water pathway) (EPA 1987).*" The document does not state whether the PATHRAE library of parameters such as uptake factors and slope factors used to compute the EU factors has been updated over the past twenty years, and TDEC has not yet been able to get detailed information about the PATHRAE codes. Have changes to the risk analyses for all of the pathways analyzed in the RI/FS since the version of PATHRAE used in the analysis been considered?	Yes, the document does give the library of parameters used. Attachment A to Appendix H lists the most recent slope factors and dose conversion factors, and the accompanying text gives the references (EPA 2014 and ORNL 2015) that were used in the modeling. The tables that contain the numbers will be updated to include the references as well. While the parameters used in the uptake of surface water through livestock and food grown locally are original to PATHRAE, the uptake of surface water through these pathways results in such a low (1% or less) consumption/intake compared to drinking water, the slight changes in these parameters would not affect the overall risk of exposure.
TDEC.S.118	**Page H-62, Paragraph 5:** "*Sensitivity model runs were conducted for mercury, since mercury-contaminated debris will be in a macroencapsulated form(s) within the landfill. The controlling release mechanism of mercury in the macro-form (e.g., the Kd in the waste) and potential localized placement within the cells were analyzed.*" Appendix H assumes that mercury contaminated debris that fails TCLP will be macroencapsulated within the landfill. This material includes demolition debris from the Y-12 West End Mercury Area. It is anticipated some of this building material will be impregnated or saturated with elemental mercury. Section 4.4.3.3 of Appendix H assumes this building material will contain about 625 mg/kg of mercury, but provides little detail on the chemical form. The sensitivity analysis was restricted to changing the partition coefficient of the waste, the waste volume, and, in a final analysis, the partition coefficient of mercury during transport in the vadose zone. PATHRAE model inputs gleaned from Attachment B to this Appendix yield a vertical groundwater velocity of 2.5 centimeters per year and a vadose zone thickness of 7 meters, resulting in a groundwater travel time of 280 years. Since PATHRAE solves the transport equation with constant coefficients and the assumption of linear partitioning between liquid and solid phases, the groundwater velocity cannot be increased over time as the barrier layers in the facility degrade. In the model, solute transport will be retarded with respect to the groundwater velocity by a factor equal to unity plus the product of the bulk density of the vadose zone times the soil-water partition coefficient divided by the porosity. Using the values for density and	Assumptions regarding the treatment and disposal of mercury-contaminated wastes have been modified for the D4 revision. DOE recognizes the uncertainty in modeling contaminant fate and transport beyond the 1000 year compliance period, and the limitations inherent in the modeling approach employed for risk estimation and PreWAC development. Model sensitivity evaluations (Appendix H section 4.5.1) include consideration of climatic changes anticipated within the next few centuries.

	porosity and the units and nomenclature of Appendix H, this is 1+6.4*Kd, so the conclusion that transport through the vadose zone controls the time to peak can be generalized. Using the methodology inherent in PATHRAE, any COPC with an assumed partition coefficient greater than 0.4 ml/g will have a travel time through the vadose zone of greater than 1000 years. Likewise, any COPC with Kd > 560 will have a vadose zone travel time of greater than a million years. Note that the time span for which the model must maintain constant infiltration rates, effective partition coefficients and hydraulic parameters in the subsurface will encompass geological changes that are not addressed in the design. These would include the known, small but relevant climate changes that are documented on cycles during the last few thousand years caused by variation of solar activity, and significantly larger climate change variation on a scale of tens of thousands of years to hundred thousand years, caused by the variations of the Earth's axis wobble during the planet's orbit around the Sun that is well documented over the past two million years.	
TDEC.S.119	**Page H-63, Paragraph 3:** *"A Kd of 580 ml/g is a reasonable assumption for the vadose zone, as discussed in Section 4.4.2.3. These results do indicate, however, that Kd in the vadose zone is the controlling factor."* The partition coefficient of 580 ml/g is a reasonable soil-mercury equilibrium partition coefficient. However, as the geosynthetic liner is ultimately breached and the clay liner begins to degrade, the changes to the hydraulic properties of the liner will not be uniform, and flow through the liner and buffer will not be uniform. The vadose zone beneath the engineered features will have hydraulic properties with significant spatial variation, so after the liner begins to degrade, the assumption that equilibria between the soil and water is achieved everywhere seems unlikely. At this point, flow through the vadose zone should be along preferential paths without enough loss to mass transfer processes to reach equilibrium throughout vadose zone. The sensitivity analysis and implied conclusion that disposal of mercury at concentrations of 625 ppm and higher will not pose a significant risk to human health or the environment is contingent upon slow uniform migration of water through the vadose zone for millennia. The conclusion that mercury can be disposed without limitations on concentration or chemical form is also based on the use of drinking water standards as endpoints for the risk assessment rather than ambient water quality criteria. As noted in other comments, the proposed facility is anticipated to have an extensive underdrain system. The underdrain will provide a direct pathway for future mercury polluted leachate to flow to Bear Creek. The promulgated recreational water quality standard for mercury is 51 ng/L (ppt), resulting from bioaccumulation effects in fish. The allowable TCLP mercury concentration is to 0.2 mg/L (200,000 ppt) in leachate. Concentrations of leachate at the allowable TCLP limit are about 4 orders of magnitude greater than the applicable water quality criteria and so ambient water quality criteria in surface water are likely to control the mercury pre- WAC rather than Maximum Contaminant Levels in ground water. The primary risk from eating fish containing methylmercury include teratogenic (neurodevelopmental effects), mutagenic, or neuro and immunotoxicities, rather than an excess cancer risk Finally, the modeled macro-forms assumed in Appendix H measure 30 feet by 30 feet by 10 feet. It is expected that uncovered macro-forms will contain water due to precipitation. DOE proposed direct dumping large demolition debris into these macro-forms. Dump trucks cannot run on large debris, so it is anticipated smaller material will also be dumped to make a surface that allows dump trucks to fill the cells. Given the potential for elemental mercury to	Expanded model sensitivity exercises have been performed to illustrate the relative importance of vadose zone parameters that influence groundwater travel times (vertical velocity) and mercury transport (Kd).In addition, supplemental modeling has been performed to evaluate the significance of neglecting vadose zone dispersion. The results indicate that vadose dispersion will generally reduce the modeled peak concentration, except for particular radionuclides. Disposal of mercury contaminated waste, including the possibility of in-cell macroencapsulation, has been de-emphasized in the D4 RI/FS. Mercury-focused sensitivity modeling had been removed from Appendix H.

	accumulate in certain areas of the macroform, possibility of inundation of debris, and landfill logistics, TDEC is not convinced that flowable fill can be added in such a way as to assure effective in-cell macroencapsulation.	
TDEC.S.120	**Page H-71, Paragraph 2:** "*Radioactive decay chains in which decay products (daughters) have PreWAC limits were analyzed for cases where the parent isotope may require either establishment of a PreWAC limit (if no limit was determined by the fate-transport modeling of that isotope), or a more stringent limit (if the isotope has an initial fate-transport calculated PreWAC limit). The analysis thus assures that decay of a parent will not result in a daughter concentration exceeding its PreWAC limit. Several decay paths were determined to require this analysis including the following parent - daughter pairs:*" This evaluation of radionuclide progeny addresses only parent-daughter pairs and is incomplete, potentially contributing to inflated pre-WAC values for uranium and transuranic radionuclides. An evaluation of non-cancer toxicity of radionuclides, their progeny, and hazardous substances is also required to evaluate compliance with RAOs and should be included in Appendix H.	There is an evaluation of toxicity (non-cancer) of uranium as well as other hazardous contaminants in the Appendix with appropriate limits determined as necessary. See response to TDEC.S.100, Po-210 was investigated and based on results of that investigation no further requirements to limit parent isotopes were required. Two additional isotopes were added to the modeling: C-113m and Re-187.
TDEC.S.121	**Page H-72, Table 8:** Adjustments to the pre-WAC have expanded the list of radionuclides that have WAC lower than the specific activity of the isotope. However, pre-WAC values for Am 241, Am-243, Cf-249, Cf-250, Cf-251, Cm-244, Cm-245, Cm-246, Cm-247, Cs-137, Ni-63, Pu-238, Pu-239, Pu-240, Pu-241, and Sr-90 all exceed Class C NRC limits at a soil bulk density of 1.6. Since these are limits that are imposed on near surface disposal under even the most favorable siting conditions, the modeling effort in this Appendix appears to give results that are not consistent with an approach that is used widely across the nation.	Agree, there are limits on these isotopes in greater than class C category and in the version of the RI/FS commented on this exclusion was explained (e.g., that waste exceeding class C limits is excluded from disposal in an on-site facility on the ORR).. DOE has modified the D4 RI/FS to address this by including some Administrative WAC in this document, two of those being (1) Greater than Class C limits and (2) TRU waste limits. This change has been incorporated into an extensive revision of Section 6.2.3 of the main document, and see new information contained in Table 6-2 and Figure 6-14.
TDEC.S.122	**Page H-83, Paragraph 1:** "*Table H-11 compares the analytic PreWAC developed for EMDF with the EMWMF analytic WAC. As shown in the table, the analytic PreWAC for EMDF are generally 10 to 100 times higher than the analytic WAC for EMWMF. However, many more isotopes are assigned PreWAC for the proposed EMDF compared to the EMWMF analytic WAC.*" This states the Pre-WAC for EMDF is generally 10 to 100 times higher than the analytic WAC for EMWMF and the higher pre-WAC is based on the distance from the disposal cell to the receptor location, contributing to a smaller dilution factor and increased attenuation due to decay and dispersion modeled in PATHRAE. Another contributing factor to the higher pre-WAC is the underdrain system, which, in the MT3D model, reduces the source of contaminated leachate with respect to clean recharge. A third factor, not mentioned in this discussion, is the use of a 10-4 excess lifetime cancer risk to compute any non-adjusted pre-WAC values of radionuclides.	Revisions to parameters in modeling have resulted in PreWAC that are more restrictive than EMWMF analytic WAC limits. A repositioning of the farmer receptor well, as well as parameter adjustments (resulting in decreased travel times) in PATHRAE have contributed to these changes. This discussion and comparison of EMWMF WAC and EMDF PreWAC has been revised. The third factor mentioned here (reduction of risk after 1,000 years to 10^{-4}) is not a factor, because the same approach was used for EMWMF (e.g., 10-4 at >1,000 yr) and so that does not contribute to differences between EMWMF and EMDF WAC and preWAC.
TDEC.S.123	**Page H-83, Paragraph 7:** "*A hydraulic break will be created by excavating and filling the major existing stream channels within the landfill footprint with highly conductive gravel/cobble sized material. A thinner blanket drain would extend beyond this trench drain to conduct high water seepage to the trench drain. These backfilled existing channels would behave hydraulically as underdrains to allow shallow ground water to move laterally to discharge to surface water outside the landfill. The underdrain system should also help maintain a lower water table under much of the landfill. The underdrain system would act as a preferred migration pathway for contaminant movement under some conditions.*" TDEC agrees that the underdrain will lower concentrations of COPCs in some locations in	DOE has incorporated surface water protection into the D4 RIFS by calculating PreWAC limits that demonstrate surface water AWQC limits are met for those contaminants predicted to peak within the 1000 year compliance period. These results are presented in the revised RI/FS. Conservative mixing assumptions are made in the development of PreWAC in fate and transport analysis. All groundwater discharges to surface water, consequently the mass of contaminants (all) leaching from the landfill are discharged to surface water. Flow identified at the EMWMF underdrain is not necessarily representative of

	groundwater at the expense of surface water. If modeling scenarios were expanded to assure protection of surface water quality, pre-WAC values for some COPCs might be limited by ambient water quality criteria rather than risk to a hypothetical receptor or MCLs in ground water. More realistic scenarios might also look at cumulative effects of all sources on surface water, and would include a more realistic way to incorporate the mixing between surface water and ground water in any carbonate rock formations. With the underdrain at EMWMF, a flow path to carry groundwater and leachate (once engineering controls fail) has already been constructed and is documented to have sufficient flow to be utilized as a future residential water supply. In addition, the MWMF conceptual design and as-built locations shown in EMDF RI/FS, Figure H-26, are not the same and the footprint has expanded significant since the risk evaluation performed for the EMWMF in 1998. The next five year review should revisit the EMWMF risk assessment incorporating relevant potential scenarios and make a determination as to whether groundwater and surface water were evaluated and protected consistent with CERCLA requirements. The updated evaluation should include analysis of what has been put in EMWMF to date and what is proposed to be put in the landfill until closure including constituents for which there is a WAC, constituents for which no WAC was developed, and ingrowth progeny.	flow that might be encountered at another site, in another underdrain. Additionally, this is flow encountered during active operation and open cell faces, and prior to closure of the facility at which time recharge in the footprint will be cut off and underdrain flows should be reduced significantly. The remainder of this comment is not relevant to the RI/FS.