

What the public should know about on-site radioactive and hazardous waste disposal before the next landfill is built on the Department of Energy Oak Ridge Reservation



The Environmental Management Waste Management Facility (EMWMF), the active landfill for radioactive and hazardous waste disposal on the Oak Ridge Reservation



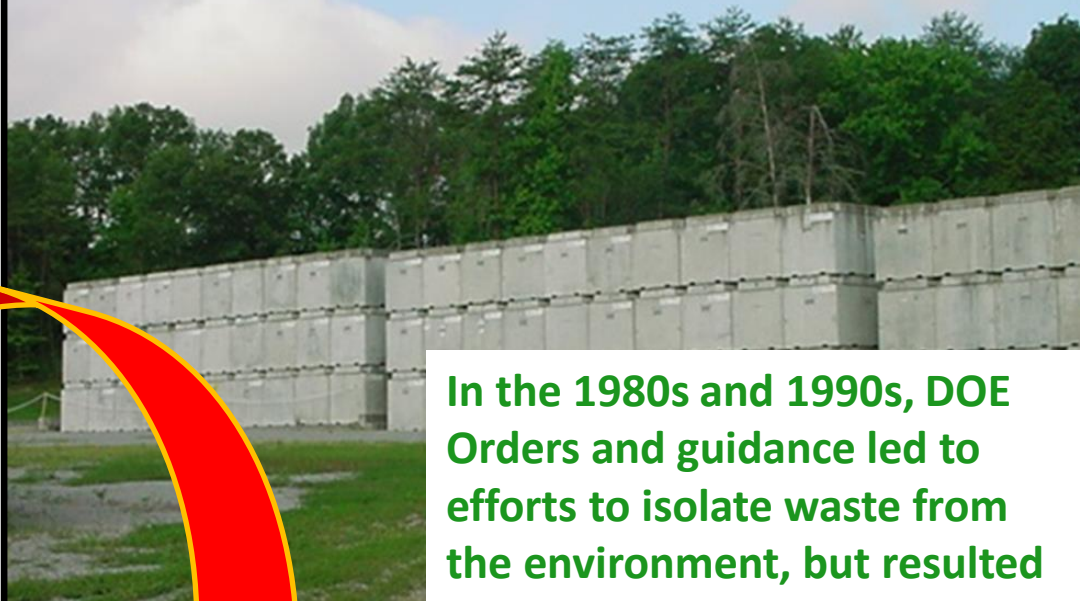
How and why did things go wrong at the EMWMF?
How can mistakes be avoided at a future radioactive and hazardous waste landfill on the Oak Ridge Reservation?

Historically, DOE disposed of waste in Oak Ridge under the authority of the Atomic Energy Act with minimal attention to environmental releases.



Waste dumped into trenches in Bear Creek Valley prior to DOE establishing requirements for disposal

Radioactive waste in vaults in the Interim Waste Management Facility in Melton Valley near highway 95 in the late 1990s



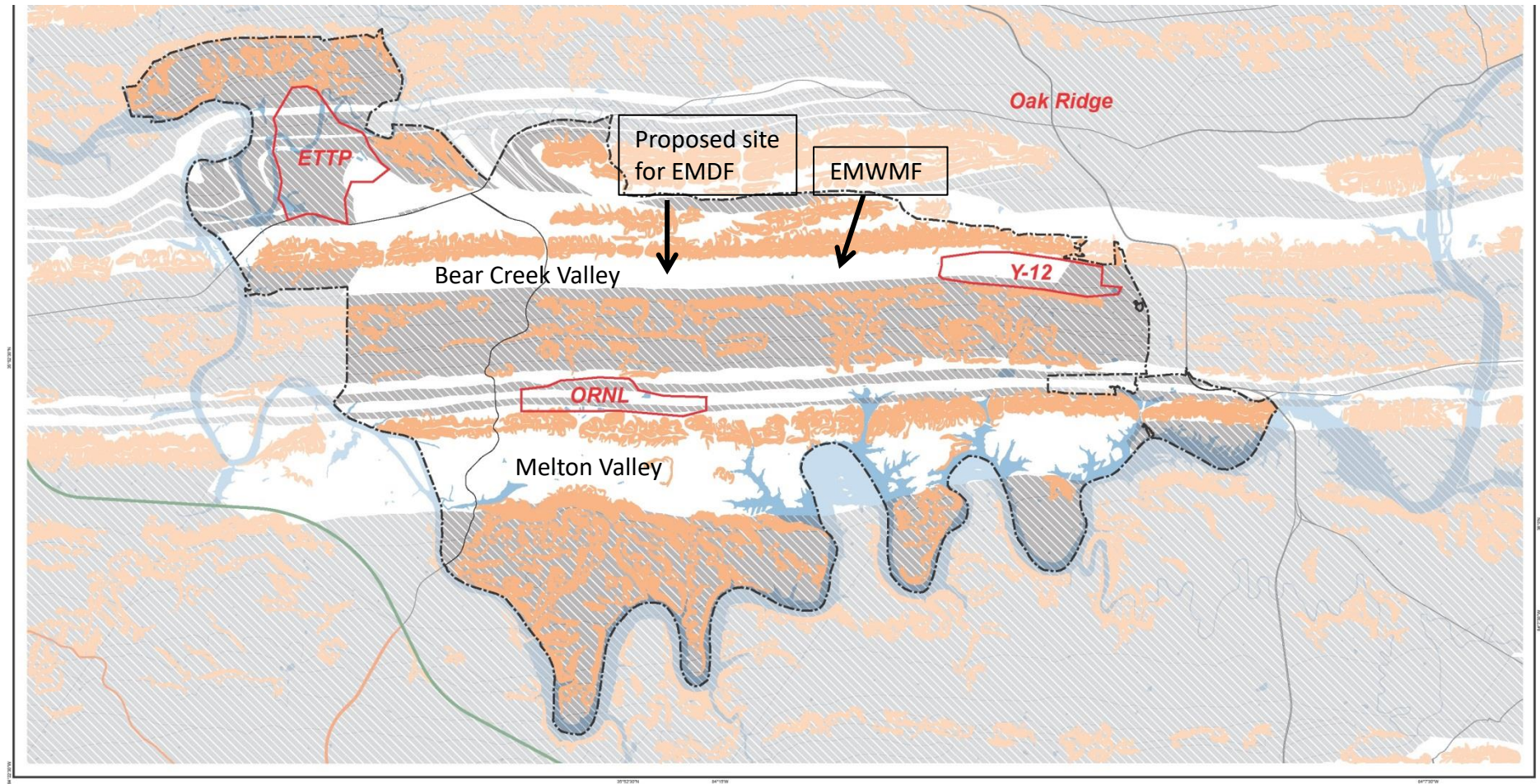
In the 1980s and 1990s, DOE Orders and guidance led to efforts to isolate waste from the environment, but resulted in increased disposal cost



Demolition and remediation waste landfilled in 2002 at the Environmental Management Waste Management Facility (EMWMF)

Radioactive waste generated from plant operations is now shipped off site for disposal, but large volumes of waste generated by cleanup activities in Oak Ridge have been buried on site. Disposal of radioactive and hazardous waste was authorized through an agreement between DOE, EPA, and the State of Tennessee.

ORNL studies as far back as the 1980s identified areas with steep slopes (orange) and areas of carbonate rocks that can develop caves and other karst features (hatched in gray) as poor candidates for radioactive waste disposal. Even the areas that are less problematic for waste disposal (shown in white) have high water tables, many small streams, and are close to roads and property boundaries. Large quantities of radioactive waste were buried in some areas. Wastes disposed in Melton Valley contain millions of Curies of radioactivity. Millions of pounds of uranium are buried near the current disposal facility (EMWMF) in Bear Creek Valley.



Preliminary Geologic Map of the Oak Ridge, Tennessee Area

Radioactive, hazardous, and toxic waste generated by demolition and remediation activities is currently disposed on site at the Environmental Management Waste Management Facility (EMWMF) in Bear Creek Valley. DOE sometimes refers to the EMWMF as a permitted landfill. This may be misleading. Although the EMWMF was authorized by agreement with regulatory agencies, it does not operate under a State or EPA permit for waste disposal. Instead, the authorization is implemented through the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), also known as Superfund, and associated laws and rules. These regulations deal with environmental cleanup rather than waste disposal. When the EMWMF was legally authorized, it was through a CERCLA Record of Decision (ROD) rather than a permit.

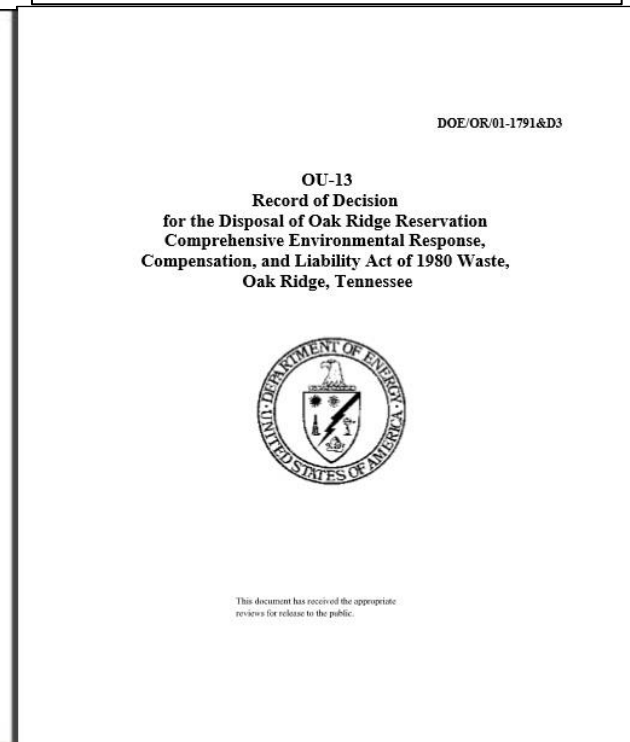
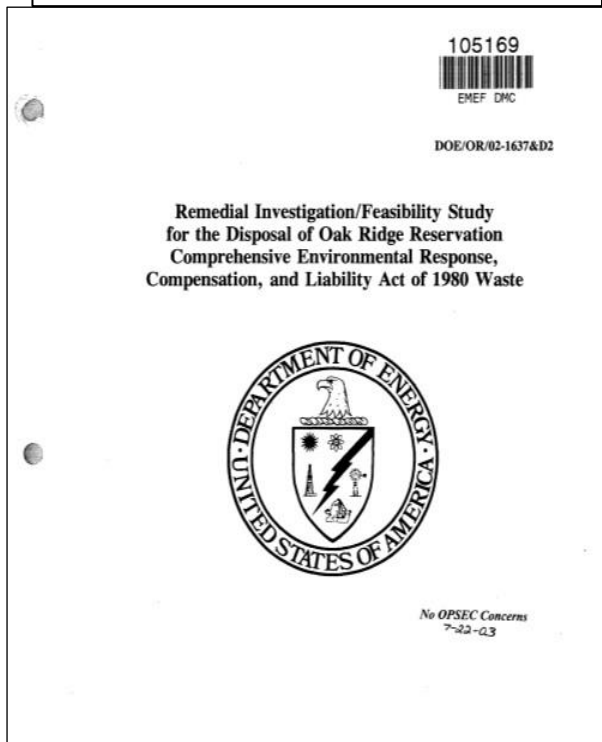


To obtain an actual permit for EMWMF, it would have been necessary to submit a permit application to a regulatory agency that could license the facility. The permit application would have provided information on the characteristics of the waste to be disposed, a detailed characterization of the site, and plans for facility design and closure. The CERCLA documents that should have provided most of the information normally in a permit application are the Remedial Investigation (typically used to report contaminant nature and extent and exposure pathways at a contaminated site) and the Feasibility Study (typically the basis for choosing a cleanup method).

Remedial Investigation Feasibility Study (RI/FS) - evaluates disposal options

Proposed Plan - summarizes the RI/FS information and identifies the preferred option

Record of Decision - presents and describes the alternative chosen by DOE, EPA, and State



CERCLA provides a logical framework for evaluating environmental cleanup but must be adapted when used to authorize waste disposal. The EMWMF ROD was approved before some critical information was available, perhaps because the CERCLA process is not designed for approving a disposal facility. Because regulatory decisions were based on limited information, significant problems arose at EMWMF. Some of these problems have persisted. The most significant include:

- Inadequate information was collected about site hydrogeology before deciding the landfill location, size, layout and design. This has led to groundwater intrusion into the facility buffer and liner.**
- The need to treat large quantities of landfill wastewater was not anticipated, and requirements for wastewater treatment were not included in the ROD. Adequate facilities to manage wastewater were not built at EMWMF.**
- EMWMF risks were evaluated assuming a restricted set of exposure pathways. Contaminant fate and transport modeling in the risk assessment was flawed. As a result, the landfill does not have reasonable limits on the inventory of some radionuclides.**

While Melton Valley and Bear Creek Valley have been considered to be the least problematic locations for radioactive waste disposal on the Oak Ridge Reservation, these areas have high water tables and areas of groundwater discharge that restrict their use for shallow disposal of radioactive waste. The EMWWMF site was not studied enough to identify areas where groundwater is near the ground surface. The landfill was designed as if there was no shallow water table. As a result the facility footprint was moved uphill from its planned location, and a drain was built under the facility to suppress groundwater levels. Prior to construction of the EMWWMF underdrain, modeling suggested that groundwater was in the clay liner beneath the disposal facility. Groundwater levels under some areas of the landfill remain uncertain, and some data indicate that the levels may remain in the buffer below the landfill liner.

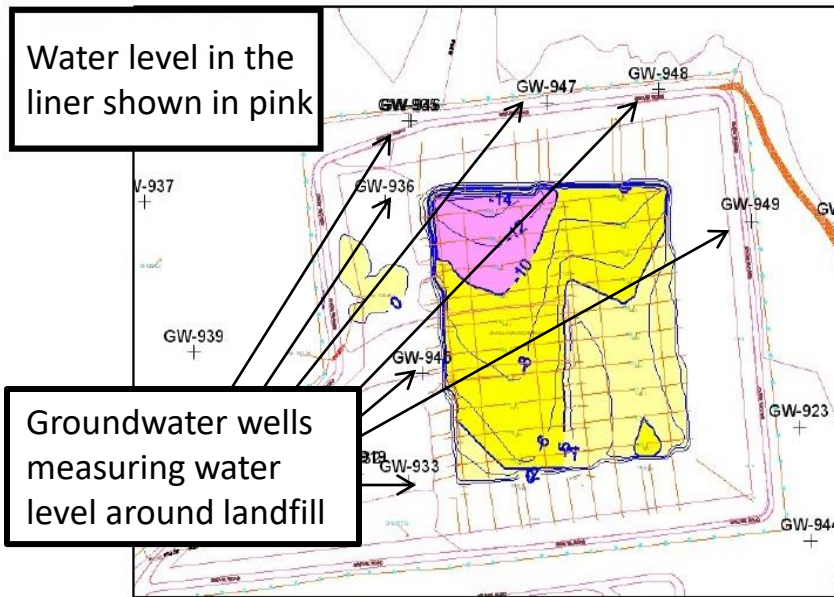


Fig. 9. Modeled hydrogeologic conditions prior to placement of the underdrain.

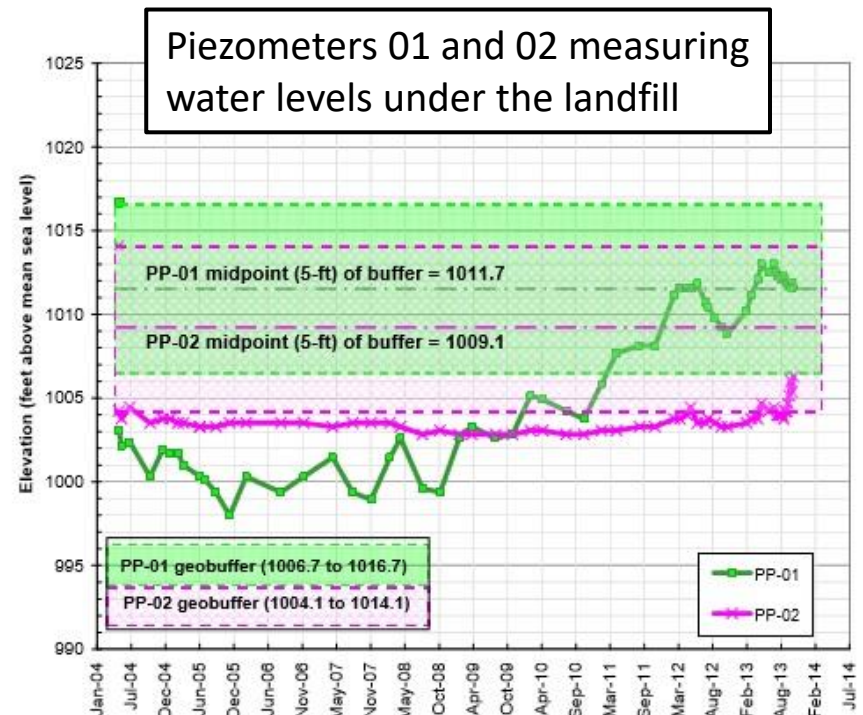
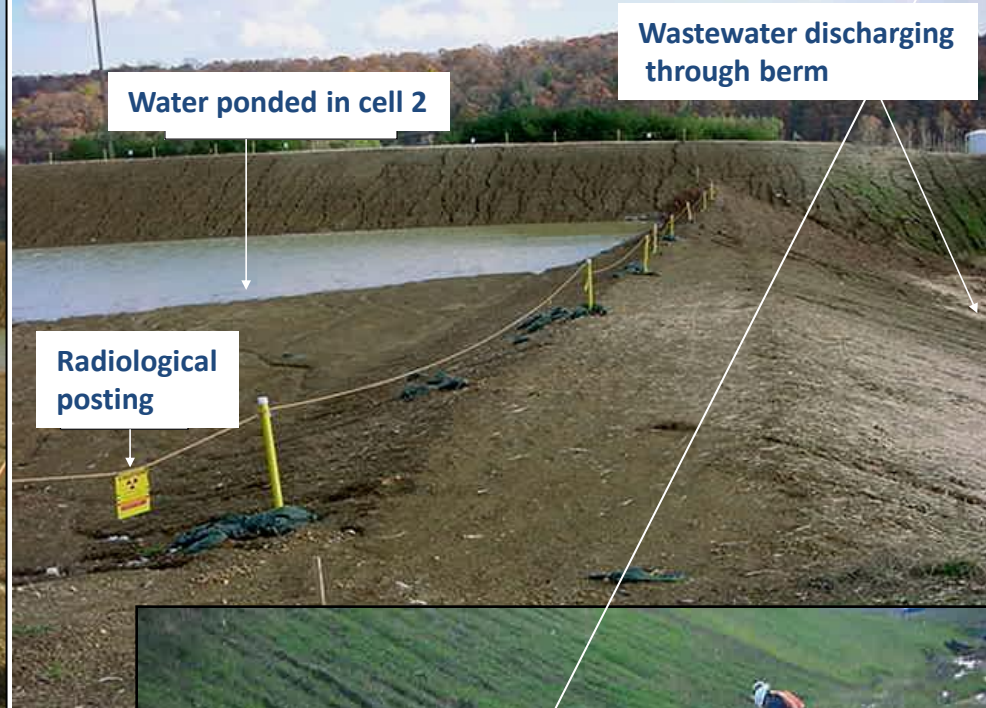
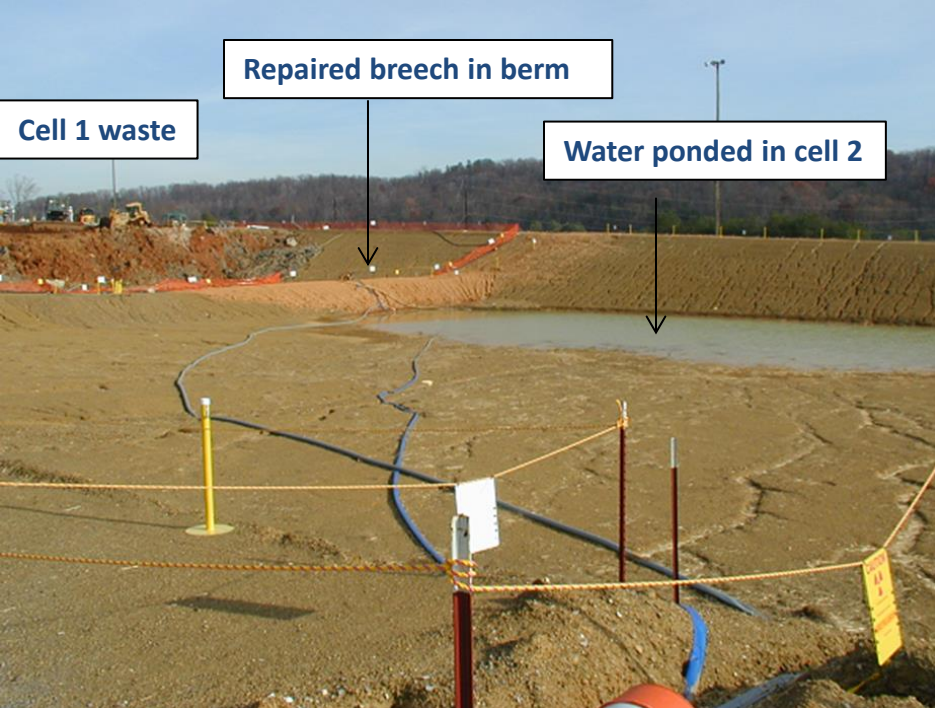


Fig. 6. Groundwater elevations over time for PP-01 and PP-02.



The EMWMF was approved and constructed without adequate planning for wastewater management. In 2002, excessive generation of leachate and contaminated stormwater led to the flooding of Cell 1 and washout of the berm separating Cells 1 and 2. Wastewater pooled in Cell 2 and was directly released to the environment when it ran through a berm around the cell. The landfill operator was ultimately fined for this release, but the ROD that authorized the EMWMF has still not been modified to reflect the current practices of wastewater management at the facility.

The risk assessment for the EMWFM evaluated risks for only a few exposure pathways. In addition, the modeling of contaminant fate and transport was deficient. Consequently, risk assessment imposed no limitations on the amount of most hazardous chemicals and radionuclides that could be buried in the landfill. These results indicate that the EMWFM could be filled with mercury, dioxins and furans, fission products like cesium-137 and strontium-90, and transuranic radionuclides like Americium 241 at any concentration without ever posing risks to human health and the environment.



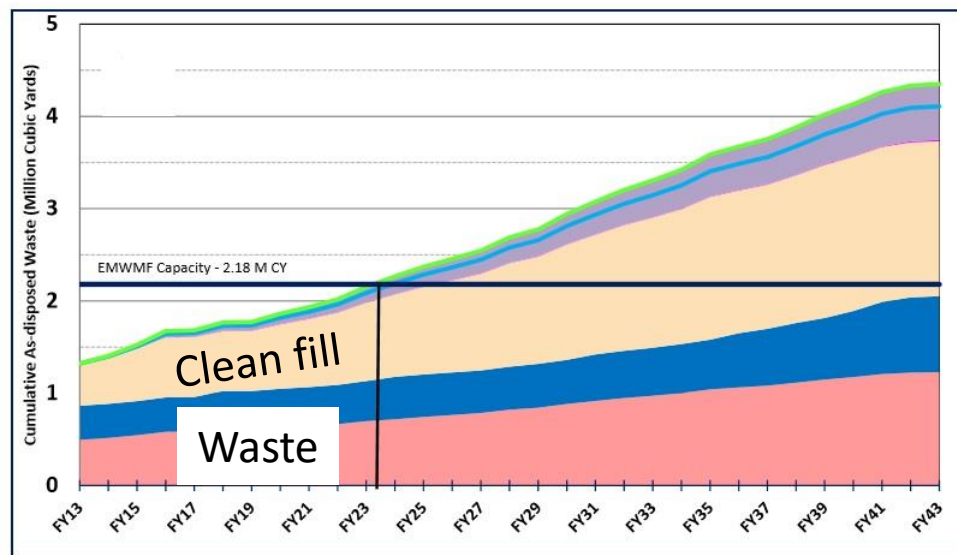
This risk analysis could not pass a reality check. DOE, EPA, and the State negotiated administrative waste limits for some contaminants. However, even these administrative limits would have allowed disposal of billions of Curies of fission products, comparable to the inventory of fission products that could have been disposed at the geologic repository proposed for spent nuclear reactor fuel at Yucca Mountain in Nevada (above) and more than can be disposed at the Energy Solutions disposal facility in Clive, Utah, another arid location.

The failure to develop waste acceptance criteria (WAC) that would clearly protect human health and the environment and the failure to rigorously enforce the EMWMF WAC led to a number of problems, especially during the early years of operation. Examples include:

- Liquid radioactive waste was not properly solidified and leaked onto a public highway during transport to EMWMF.
- High activity waste was apparently buried in EMWMF in Waste Lot 84.4. This should have been disposed in a geologic repository like the one that was proposed at Yucca Mountain.
- Waivers of size requirements led to excessive use of clean soil to fill around large pieces of structural steel, wasting landfill capacity



Radiation survey on Hwy. 95 after liquid waste leaked during transit (DOE/ORO-2183, Type B Accident Investigation Board Report).



Burial of large steel beams from the gaseous diffusion buildings such as K-33 without size reduction to meet the EMWMF physical WAC led to the need for excessive use of clean fill and loss of landfill capacity

Protection of human health and the environment from buried radioactive and hazardous waste depends primarily on:

- **Ability of the site to isolate contaminants from the environment**

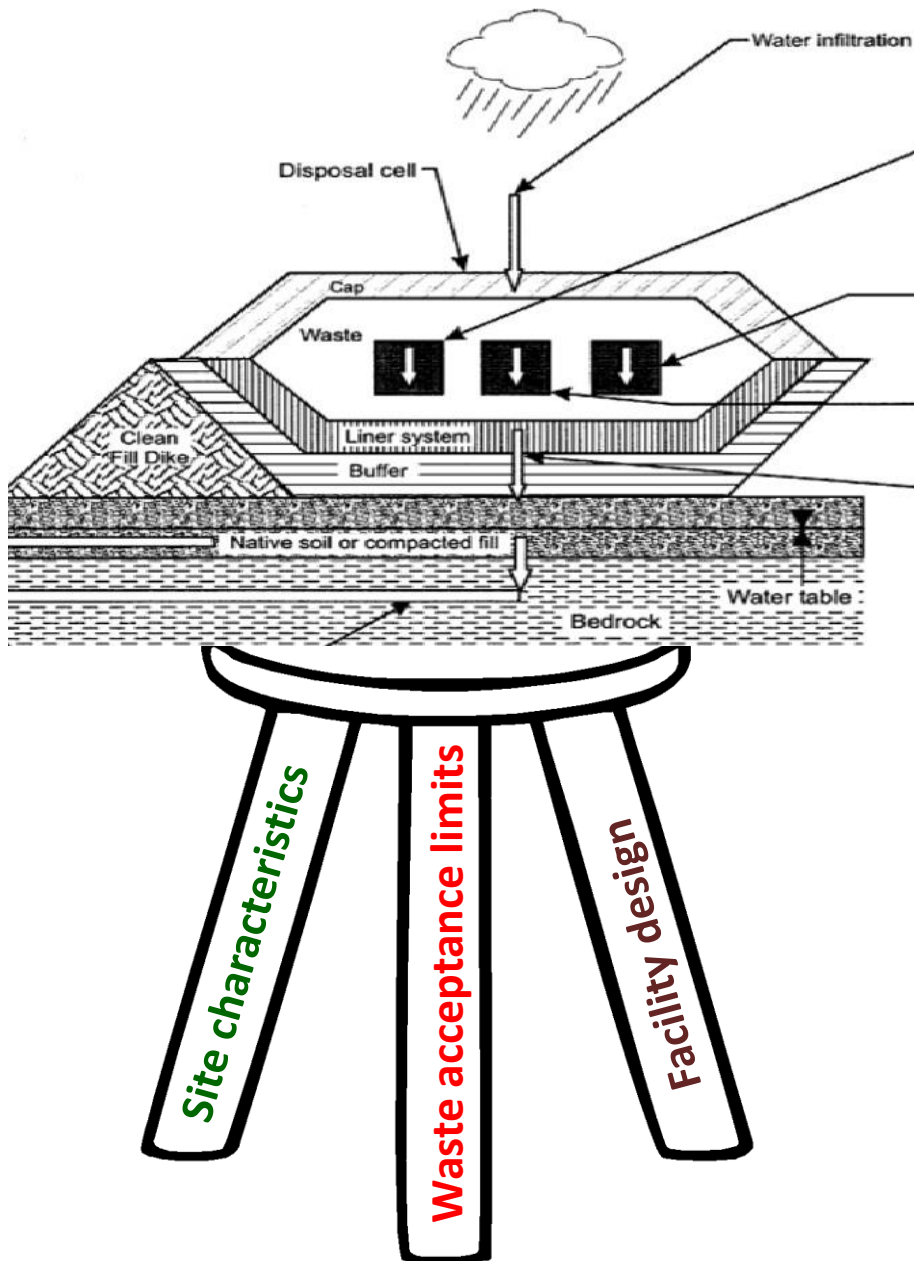
A site with desirable geologic and hydrologic characteristics can minimize the potential for a significant release indefinitely.

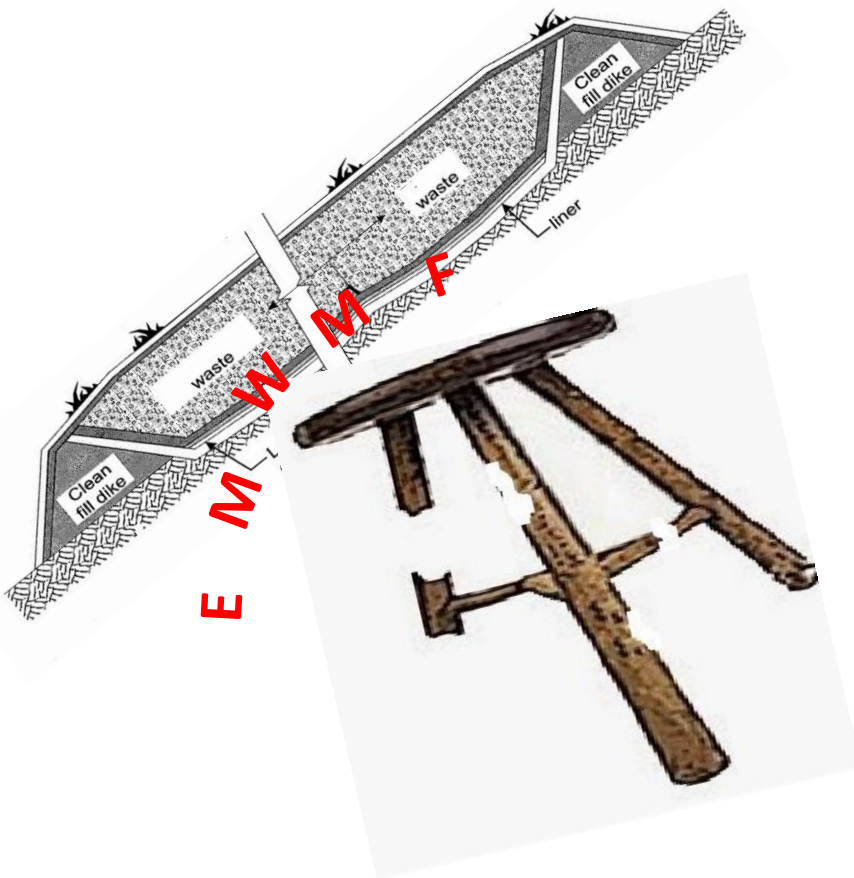
- **Waste limits**

Limits on the amount of radioactive and hazardous material that can be disposed in the landfill will mitigate the effects of any release to the environment or any exposure of humans to contamination over both short and long timeframes.

- **Ability of engineered barriers to isolate contaminants from the environment**

These barriers have proven to be quite effective for time scales of decades, but they may not be effective for longer periods.





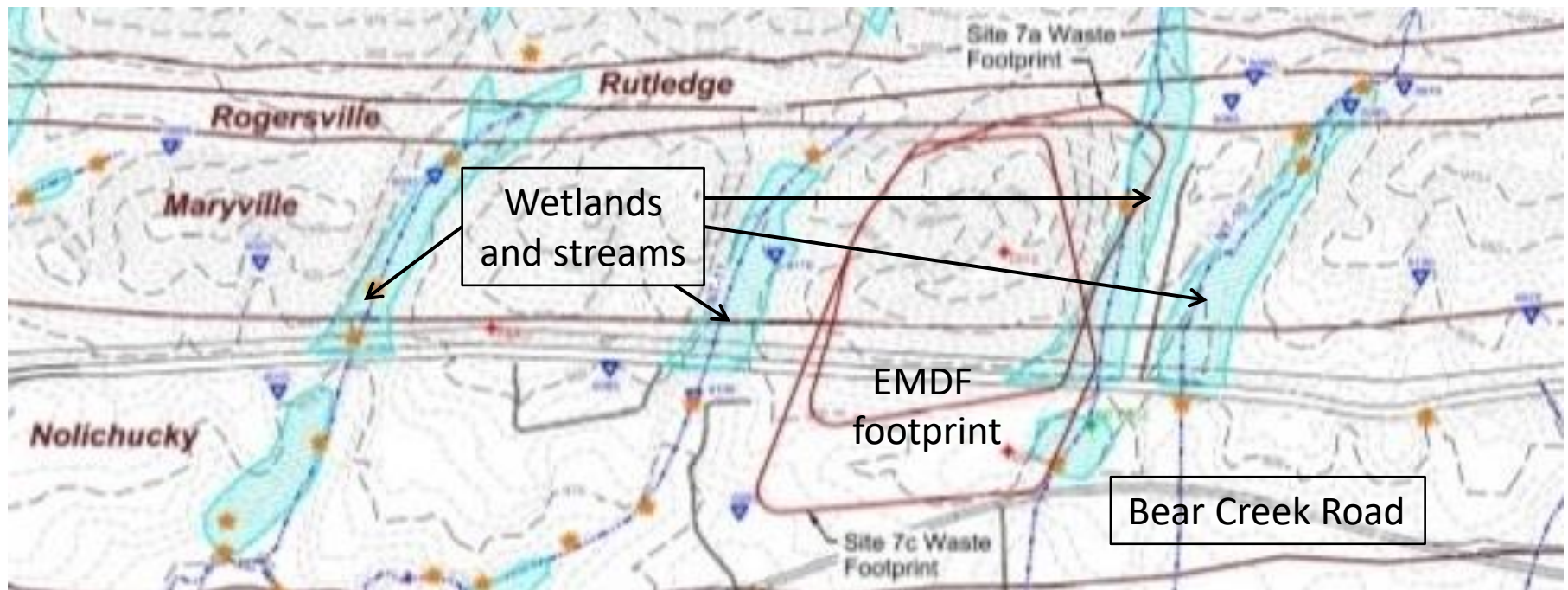
The Oak Ridge Reservation does not provide good sites for radioactive waste disposal due to geologic, hydrologic, and demographic characteristics. Protection of human health and the environment from wastes buried in Oak Ridge must rely on a robust facility design, adequate quality control during construction, and careful operation of the landfill, as well as appropriate restrictions on the waste inventory through development of waste acceptance criteria (WAC).

At EMWMF, the facility design was compromised by inadequate site characterization. The facility was consequently built over, rather than around, areas with streams and shallow groundwater. Waste acceptance criteria were compromised due to limited evaluation of potential exposure pathways and inaccurate assumptions in the contaminant migration models that were fundamental to assessing the potential risks posed by the facility.

Any new radioactive and hazardous waste disposal facility on the Oak Ridge Reservation should not repeat these mistakes!

DOE now plans to build another radioactive and hazardous waste landfill in Bear Creek Valley, the Environment Management Disposal Facility (EMDF), and is asking for regulatory approval:


- Without adequate site characterization to avoid areas where groundwater might intrude into the landfill buffer or liner
- Without waste acceptance limits based on a defensible risk assessment
- Without resolution of wastewater treatment issues
- Using cost savings that presume maximum economy of scale for on-site disposal as justification, despite uncertainties about the facility footprint and waste acceptance limits that may be driven by CERCLA requirements to protect human health and the environment and limit the landfill capacity



How might the same mistakes be avoided?

Regulations used to authorize the EMWMF were meant for cleanup, not waste disposal. The proposed facility (EMDF) would be authorized using the same process. More prescriptive rules and guidance from programs that are meant to regulate disposal of radioactive and hazardous waste should be incorporated into the decision process.

Before a decision about the viability of a new landfill is made, the site to be used for the landfill and the waste to be disposed in the landfill should be characterized well enough to ensure it can be designed to protect human health and the environment.



Otherwise, the problem of contamination has not been solved, just moved to another place and time.

The summary presented here was compiled by staff retired from the Oak Ridge office of the Tennessee Department of Environment and Conservation – Division of Remediation, including:

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Information, photographs, and illustrations were extracted from digital copies of publicly available U.S. Department of Energy (DOE) and Tennessee Department of Environment and Conservation (TDEC) documents and presentations. Conclusions were based on our involvement with radioactive waste management decisions on the Department of Energy Oak Ridge Reservation over the past two decades.

For additional details or specific references
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