

Success of the Melton Valley Watershed Remediation at the ORNL – 12351

David Adler, Laura Wilkerson, DOE, Oak Ridge Operations
Lynn Sims, Richard Ketelle, and Sid Garland, RSI

ABSTRACT

The source remediation of the Melton Valley (MV) Watershed at the U.S. Department of Energy's (DOE's) Oak Ridge National Laboratory was completed 5 years ago (September 2006). Historic operations at the laboratory had resulted in chemical and radionuclide contaminant releases and potential risks or hazards within 175 contaminated units scattered across an area of 430 hectares (1062 acres) within the watershed. Contaminated areas included burial grounds, landfills, underground tanks, surface impoundments, liquid disposal pit/trenches, hydrofracture wells, leak and spill sites, inactive surface structures, and contaminated soil and sediments. The remediation of the watershed was detailed in the MV Interim Action Record of Decision (ROD) and included a combination of actions encompassing containment, isolation, stabilization, removal, and treatment of sources within the watershed and established the monitoring and land use controls that would result in protection of human health. The actions would take place over 5 years with an expenditure of over \$340M. The MV remedial actions left hazardous wastes in-place (e.g., buried wastes beneath hydraulic isolation caps) and cleanup at levels that do not allow for unrestricted access and unlimited exposure. The cleanup with the resultant land use would result in a comprehensive monitoring plan for groundwater, surface water, and biological media, as well as the tracking of the land use controls to assure their completion. This paper includes an overview of select performance measures and monitoring results, as detailed in the annual Remediation Effectiveness Report and the Five-Year Report.

INTRODUCTION

The MV ROD entailed a combination of remedial actions including containment, stabilization, removal and treatment (Figure 1). Upon completion of the actions, a comprehensive monitoring plan was established. The plan entailed assessing the performance of the actions through monitoring and land use controls with yearly reporting in the annual Remediation Effectiveness Report (DOE 2011a). The results of the monitoring over the last 5 years have proven that the remedial actions have been successfully lowering contaminant concentrations to levels that are close to achieving ROD goals.

This paper focuses only on a segment of the MV ROD goals which best illustrate the success of the multiple remedial actions. The MV ROD (DOE 2000) specified surface water quality, surface water risk goals, and groundwater controls to be achieved within specified periods after completion of the RAs. The ROD also included specific performance objectives that would be used as the metrics to evaluate the effectiveness of the remediation. The select RAOs for surface water focused on in this paper includes: the protection of off-site resident users of surface water (at the confluence of White Oak Creek with the Clinch River) to a 10^{-4} to 10^{-6} excess lifetime cancer risk (ELCR). Additionally, the RAO for waste management areas is to meet relevant ambient water quality criteria (AWQC) in a reasonable amount of time and to further mitigate impact to groundwater.

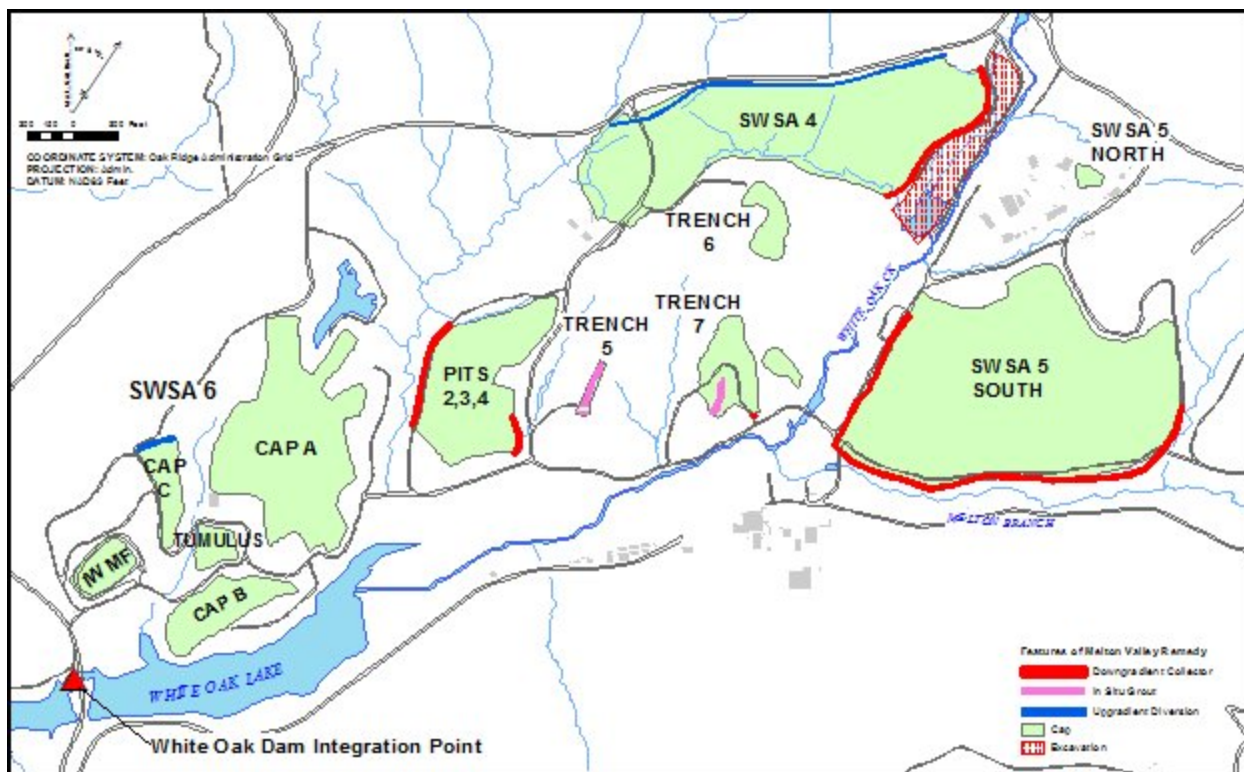


Figure 1. MV surface water monitoring locations.

The MV ROD included specific performance objectives and performance measures that form the basis of remediation effectiveness monitoring. These performance objectives provide a quantitative basis to evaluate the effectiveness of hydrologic isolation at limiting contaminant releases from buried waste by monitoring groundwater fluctuation within hydrologic isolation areas. Additionally, the performance measure for surface water quality is to achieve the AWQC related to contaminant discharges originating from MV areas within two years after completion of remedial actions.

For the hypothetical resident performance measures were identified to reduce contaminant releases to risk levels of 1×10^{-4} for water only at the confluence of White Oak Creek with the Clinch River in ~10 years after completion of ROD actions. For this to occur reductions of Sr-90 and H-3 of 75-80% would be required. The resulting remediation levels equating to a 1×10^{-4} risk at WOD are Co-60 at 250 pCi/l, H-3 at 58,000 pCi/l and Sr-90 at 85 pCi/l, based on a 1×10^{-4} ELCR using general risk assessment protocols for a general household use scenario and apply to single contaminants only. The *2011 Third Annual Reservation Wide CERCLA Five-Year Review for the U.S. DOE Oak Ridge Reservation (DOE 2011)* calculated the excess lifetime cancer risk to a hypothetical resident, this takes into account for the total risk from multiple contaminants and changes in toxicity factors and risk assessment methods since the time of the ROD.

Evaluation of Performance Monitoring Data

IP Monitoring Results

The principal integration point surface water monitoring station in MV is at White Oak Dam where White Oak Creek discharges from White Oak Lake. Continuous, flow-paced sampling is

conducted at WOD to provide an ongoing record of radiological discharges from the watershed. The monitoring integrates measurements of radionuclide activities on samples collected during each month and the flow volume passing through the monitoring station to derive a flux value. Similar monitoring is conducted at three upstream IP surface water monitoring stations in MV.

Comparison of ^{137}Cs , ^{90}Sr , and ^3H activities measured at White Oak Dam with the ROD remediation level is the basis for remedy effectiveness evaluation for protection of the Clinch River. Figure 2 shows the annual average and average plus one standard deviation activities of ^{137}Cs , ^{90}Sr , and tritium at White Oak Dam for FY 2001 through FY 2010. Total annual rainfall at the ORNL site is provided to enable long-term comparison of contaminant activities response to rainfall. The monthly flow-paced sampling provides continuous sampling of surface water at each sample station, thus providing a reliable measure of the time-averaged contaminant activity. During FY 2010, all flow-paced composite sample results from samples collected at White Oak Dam were below the risk-based remediation levels specified in the ROD.

The 2011 Five-Year Review indicated in the ELCR sum of fractions calculation that the sum of fractions is still greater than 1, indicating the overall risk goal has not yet been met. The time frame for meeting this goal in the ROD is 10 years.

Figure 3 shows the annual radionuclide flux for ^{137}Cs , ^{90}Sr , and ^3H measured at White Oak Dam and the ORNL site total annual rainfall from FY 2001 through FY 2010. This analysis is used to evaluate the reductions in contaminant releases that are part of the performance measurement approach for the hydraulic contaminant actions. This analysis indicates significant progress toward meeting the ROD goals by reducing releases by 80%.

Comparison against AWQC criteria, in general, has been met. A few rare pesticide exceedences and infrequent pH and dissolved oxygen noncompliance exceedences are the only issues identified in a comprehensive AWQC check.

Groundwater Monitoring Data

Groundwater-Level Control in Hydrologic Isolation Units

Minimization of surface water infiltration and groundwater inflows into buried waste to reduce contaminant releases is key to the concept of hydrologic isolation. Prior to remediation, groundwater levels were observed to rise into waste burial trenches in many areas of MV. In some areas waste trenches were known to completely fill with water during winter months. Contact of this water with buried waste materials was the source of contaminated leachate that subsequently seeped downward and laterally to adjacent seeps, springs, and streams.

The MV remedy utilizes multilayer caps to prevent vertical infiltration of rainwater into buried waste or other hydrologic isolation units as well as upgradient storm flow interceptor trenches, where necessary, to prevent shallow subsurface seepage from entering the areas laterally. Downgradient seepage collection trenches were constructed in several locations along downgradient perimeters of buried waste units. Seepage that is pumped from these trenches is piped to a process waste treatment center for treatment prior to discharge.

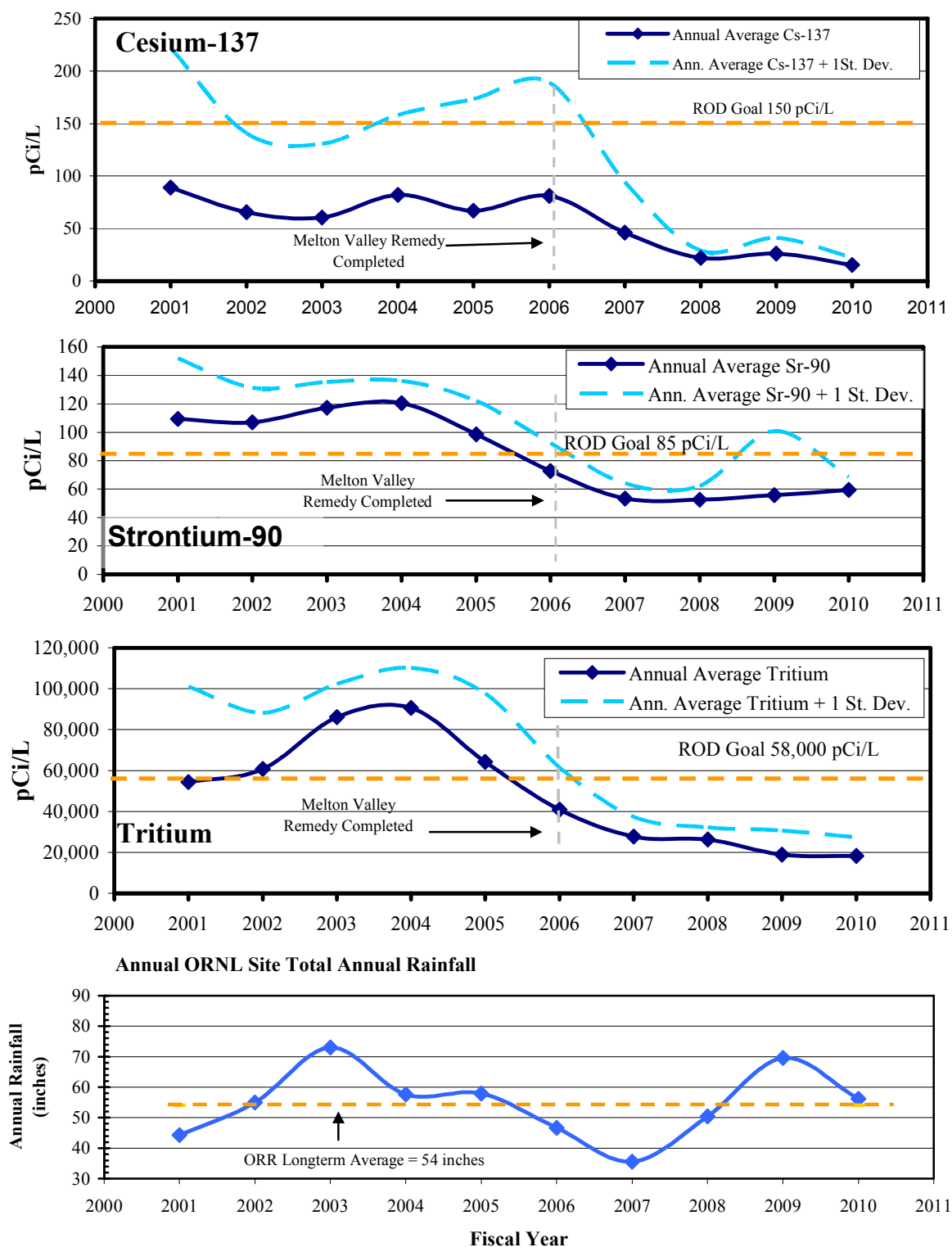


Figure 2. Annual average surface water activities of ^{137}Cs , ^{90}Sr , and tritium at WOD.

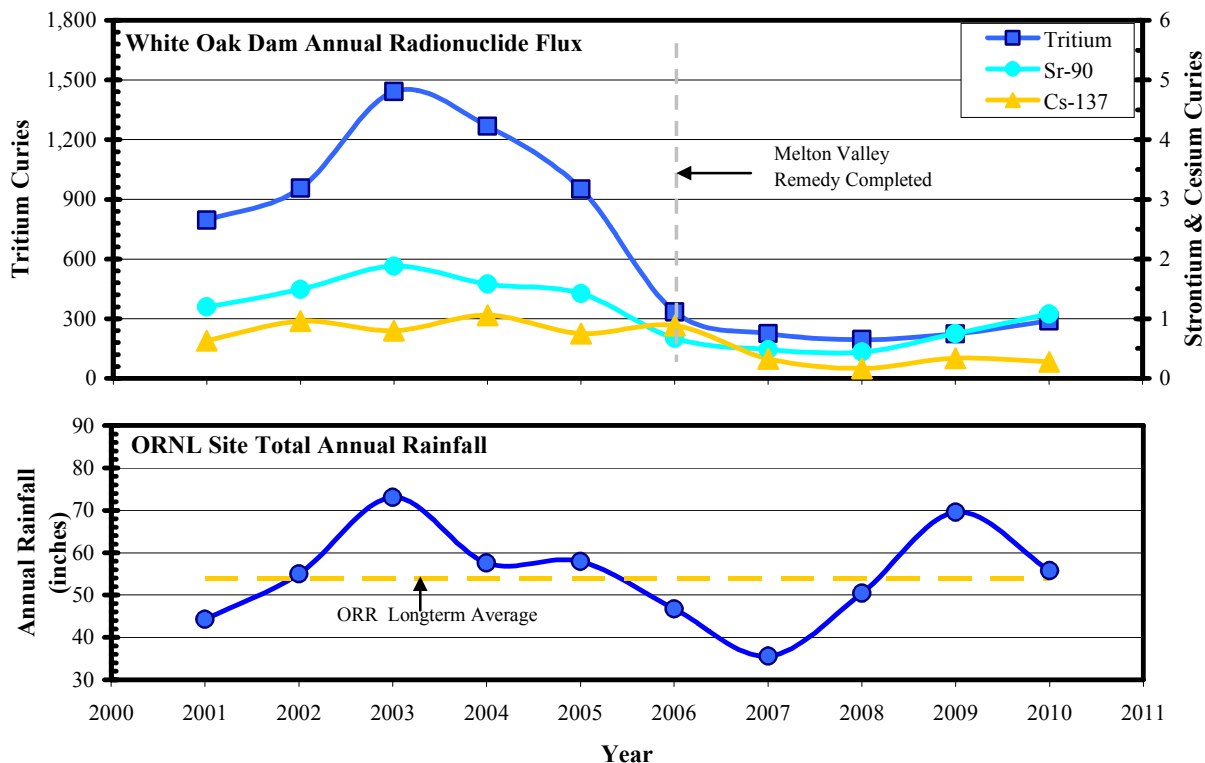


Figure 3. Annual radionuclide fluxes at WOD and annual rainfall at ORNL.

The MV ROD included the performance goal of reducing groundwater-level fluctuations within hydrologically isolated areas by >75% from preconstruction fluctuation ranges. The performance goal of attaining a >75% reduction in groundwater-level fluctuations created a design requirement to minimize, as much as possible, the contact of groundwater with buried waste to reduce the contaminated leachate formation process. As such, the fluctuation range is most relevant in cases where groundwater levels rise into the waste burial elevation zone. Groundwater-level fluctuations at elevations below the contaminant sources have less importance to the overall remedy effectiveness. During the remedial design of each hydrologic isolation area, wells were selected for monitoring the post-remediation groundwater-level fluctuations. Existing baseline fluctuation ranges were evaluated for the wells and target post-remediation groundwater elevations were determined to indicate that groundwater levels had dropped to below the 75% fluctuation range elevation.

REFERENCES

- DOE 2000b. *Record of Decision for Interim Actions for the Melton Valley Watershed, Oak Ridge National Laboratory, Oak Ridge, Tennessee*, DOE/OR/01-1826&D3, U.S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.
- DOE 2011a. *2011 Remediation Effectiveness Report for the U.S. Department of Energy Oak Ridge Reservation, Oak Ridge, Tennessee*, DOE/OR/01-2505&D2, U.S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.

WM2012 Conference, February 26 – March 1, 2012, Phoenix, Arizona, USA

DOE 2011b. *2011 Third Reservation-wide CERCLA Five-Year Review for the U.S. Department of Energy Oak Ridge Reservation, Oak Ridge, Tennessee*, DOE/OR/01-2516&D1, U.S. Department of Energy, Office of Environmental Management, Oak Ridge, TN.