VALUE ENGINEERING REVIEW REPORT

CAP CONSTRUCTION AND FLOOD RETENTION BASIN
HAZARDOUS WASTE CLEANUP
MILLCREEK SUPERFUND SITE
ERIE COUNTY, PENNSYLVANIA

U.S. ARMY CORPS OF ENGINEERS
OMAHA DISTRICT
CONTRACT NO. DACW-45-89-C-D190
MPI PROJECT 0285-33-2

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1.0 INTRODUCTION

1.1 BACKGROUND

The Millcreek site is an 84.5 acre tract of land located in Millcreek Township, Erie County, Pennsylvania (see Figure 1-1). The site was formerly freshwater wetland. Between 1941 and 1981, the majority of the site was filled with foundry sand and industrial and municipal waste. Beginning in the mid-1970s, waste oils containing PCBs were bulk disposed in the fill, along with liquid wastes containing phthalates, phenols, polynuclear aromatic hydrocarbons (PAHs), and heavy metals. The Pennsylvania Department of Environmental Resources (PADER) first advised the landfill operator to cease operations in August 1980. In July 1982, at the request of PADER, five monitoring wells were installed by the Millcreek Township on a four-acre parcel of the site, which was purchased by the Township to build a flood retention basin. A hazard ranking system (HRS) score of 49.31 was determined by the United States Environmental Protection Agency (USEPA) after its Technical Assistance Team performed a site assessment in August 1982. The site was placed on the National Priorities List (NPL) in September 1984 with a relative ranking of 189. USEPA Region III's Remedial Investigation/Feasibility Study (RI/FS), completed in 1985, discovered extensive soil, sediment, and surface water contamination. The major classes of compounds detected included:

- Volatile organic compounds (VOCs) such as vinyl chloride, trichloroethene, 1,2-dichloro-ethene, 1,1,1-trichloroethane, 1,2-dichloroethane, and 1,1-dichlo-roethene in the ground water;
- semi-volatile organic chemicals such as bis (2-ethylhexyl) phthalate, naphthalene and benzo(a)pyrene in on-site fill;
- PCBs in the fill and in some sediment samples, and;
- lead in the fill.

Numerous other metals, PAHs and phthalates were detected in the fill material in addition to the primary contaminants listed.
On May 1, 1986, the USEPA issued a Record of Decision (ROD) which recommended remedial actions for the site based on the RI/FS and the following overall remedial objectives:

- prevent air dispersion and off-site transport of contaminants;
- prevent direct contact with contaminants by humans and wildlife; and
- reduce soil, sediment, surface water and ground water contaminant concentrations to levels acceptable to the USEPA and the PADER.

The selected remedial actions for the site included:

- excavation and consolidation of contaminated soils and sediments under a RCRA cap to meet proposed criteria;
- site grading and placing a vegetated soil cover over remaining low-level contaminated soils not exceeding the proposed criteria;
- construction of surface water management basins and ditches;
- installation and sampling of additional monitoring wells; and
- pumping and treatment of contaminated ground water.

The U.S. Army Corps of Engineers (COE) retained Malcolm Pirnie in October 1987 to perform pre-design studies to determine the design parameters needed to implement these remedial actions. Alternative final cover systems (caps) were evaluated as part of the pre-design studies which were summarized in the Remedial Clean-up Treatability Study Report (Ref-1). The COE subsequently retained Malcolm Pirnie to complete detailed design documents for the construction of a ground water extraction system, a ground water treatment system, a disposal area cap and flood retention basin (FRB). This VER report has been prepared, as part of the detailed design of the cap, to summarize the hydrologic evaluation of alternative final cover systems performed during the pre-design studies.

1.2 SCOPE

Malcolm Pirnie is required to prepare this VER Report to summarize and document the results of the hydrologic evaluations performed as part of the pre-design studies. This VER Report includes an evaluation of alternative caps for the following:
1.3 PURPOSE AND OBJECTIVES

The intent of this VER includes the following:

- draw upon the experience of engineers in previous projects similar in scope and design;
- enable project engineers and designers to submit suggestions on Value Engineering items requiring changes on directed design criteria for evaluation and potential approval;
- form a basis for formal Value Engineering studies; and
- provide a record of approved changes to the design criteria.

The previously completed predesign studies involved the use of an extensive modeling effort to evaluate overall site remedial alternatives including alternative cover or capping systems. Part of the modeling effort involved consideration of infiltrations rates, soil pollutant fate in the vadose zone, solute transport and ground water flow as a function of the various cap alternatives.

Results of the hydrologic evaluations of alternative cap designs are summarized in this VER Report which is intended to provide a formal record of the approved concept for the cap design.

1.4 VALUE ENGINEERING PERSONNEL

Alternative cap designs were identified and evaluated by a VER team with demonstrable and extensive experience in permitting, design, and construction of landfills, and landfill cover systems. VER team members were selected based upon their experience.
which was considered critical for objective technical review of the proposed cap alternatives. Malcolm Pirnie, Inc. personnel who were responsible for identifying and supervising the evaluation of the capping alternatives and in the preparation of this VER Report are as follows:

- Project Officer - Paul H. Werthman, P.E.; and
- Project Manager - Kent R. McManus, P.E.

Resumes of these personnel are provided in Appendix A.
CAP ALTERNATIVE EVALUATION

The remedial cap selected in the Record of Decision (ROD) included selective excavation and consolidation of contaminated fill/soils and sediments under a RCRA cap with grading and vegetative soil covering of "low-level" or uncontaminated fill/soils. The ROD, and the RI/FS upon which it was based, did not define contaminant levels or quantities of fill/soil/sediment to be placed under the cap. As such, the predesign studies involved evaluations of remedial capping alternatives to determine the effectiveness of each cap alternative relative to the overall remedial objectives. The alternatives which were considered were:

- a minimum six-inch topsoil cap with site regrading (referred to herein as the "topsoil cap");
- a topsoil/clay cap consisting of a minimum 6-inch topsoil layer placed over a minimum 18-inch thick clay barrier layer after site regrading (referred to herein as the "topsoil/clay cap"); and
- a RCRA guidance cap consisting of site regrading, a minimum 6-inch topsoil layer, 24-inch soil protective layer, geotextile layer, 12-inch sand drainage layer, 30-mil thick synthetic liner, a 6-inch sand protective layer and a 24-inch recompacted soil barrier layer (referred to herein as the RCRA cap).

Details of the topsoil cap, topsoil/clay cap, and RCRA cap are shown on Figure 2-1. Due to the relatively flat site topography, extensive subgrade preparation is considered necessary in conjunction with any of the capping alternatives to promote adequate surface drainage without adversely impacting drainage on adjacent residential parcels. The subgrade grading plan must also provide for construction of surface water management basins and ditches, as appropriate, and a flood retention basin on property owned by Millcreek Township in accordance with the ROD. The preliminary subgrade grading plan developed during the predesign studies (see Figure 2-2) is common to all capping alternatives and provides an additional physical barrier further separating contaminated fill/soil from potential receptors (i.e. people or animals). The subgrade plan is subject to change during design. The intent of the ROD would be achieved with all of the above capping alternatives, since potential environmental and human health impacts due to air dispersal of contaminated soil, erosion and surface water transport of contaminated soil, and direct contact risk are eliminated by the addition of a topsoil cap.
3.0 FUNCTIONAL EVALUATION

3.1 GENERAL

Functional evaluation of the capping alternatives involved the use of the following computer models:

- the Hydrologic Evaluation of Landfill Performance (HELP) Model to simulate hydrogeologic performance (primarily infiltration rates) of the various alternatives;
- the Seasonal Soil Compartment Model (SESEOIL) which is a mathematical model for a long-term environmental pollutant fate simulations designed to describe chemical migration through the vadose (unsaturated) zone;
- the Prickett-Lonquist Aquifer Simulation Model (PLASM) to simulate steady-state shallow ground water flow; and
- the RANDOM WALK mass transport model to simulate contaminant transport in the shallow ground water.

The models were used in concert to evaluate the performance of the various cap alternatives relative to the objectives of the ROD. Detailed discussions of the models, model inputs and model results are presented in the Remedial Cleanup Treatability Study Report (Ref.1). The following sections present brief summaries of the model results.

3.2 HELP MODEL EVALUATION

The HELP Model was used to simulate the hydrologic performance of the Millcreek site in its existing state and for the three alternative caps. Percolation (infiltration) rates from the base of each alternative cap through underlying fill to ground water were determined on a per-acre basis.

The peak average monthly, average annual, and peak daily percolation rates through the cap and waste fill to the ground water were predicted for the three capping alternates. The existing site condition promotes infiltration of virtually all precipitation and subsequent contact with the waste layer, as there is essentially no runoff. The infiltration either
percolates through the waste fill to ground water or is released to the atmosphere in the form of evapotranspiration.

The HELP model predicts that addition of the topsoil cap will increase runoff slightly. Evapotranspiration increased due to the introduction of a good grass cover which serves to reduce the amount of water available for percolation through the waste fill to the ground water. The top soil/clay cap increased runoff due to the low permeability of the recompacted clay barrier layer. The clay barrier layer also increased the rate of evapotranspiration and served to further reduce the amount of percolation through the waste fill. The RCRA cap decreased the percolation rate to essentially zero due to the addition of the sand drainage layer and the synthetic liner.

3.3 SESOIL MODEL EVALUATION

SESOIL was also used to estimate the contribution of the vadose zone to the ground water in conjunction with various remedial capping alternatives. In general three (3) capping scenarios were evaluated: a topsoil cap; a topsoil clay cap with $1 \times 10^{-7}$ cm/s permeability; and a modified topsoil/clay cap with $5 \times 10^{-6}$ cm/s permeability which was included to evaluate the impact of an anticipated increase in the cap permeability over an extended period of time. Over a period of 30 years, the permeability of a clay cap may increase on or two orders of magnitude due to freeze-thaw impact, root penetration, settlement, and/or desiccation. The three alternatives were simulated by adding an uppermost layer with its associated permeability. The results indicated that the topsoil and topsoil/clay caps provide no significant reduction of pollutant load to ground water. The RCRA cap was not evaluated since no infiltration from the cap to the ground water through the fill would be expected. The RCRA cap would virtually eliminate pollutant load contributions from unsaturated waste fill by eliminating percolation and leaching.

3.4 GROUND WATER EVALUATION

The hydrologic effect of the topsoil/clay cap, was evaluated using the PLASM flow model. With the exception of the infiltration rate, model input parameter values were kept constant to simulate the effect of the cap. The infiltration rate was determined by HELP.
model run simulations discussed previously. The cap simulation was run until steady-state conditions were attained. A comparison of the computer-generated contour maps of the aquifer head distribution for the topsoil/clay cap and existing conditions suggests that in the areas covered by the cap, the expected decline in water levels will be approximately 0.5 to 1.5 feet. The generalized flow patterns for both simulations will remain similar.

Five ground water collection segments or trenches were simulated in conjunction with the topsoil/clay cap in order to evaluate the effect of capping on the ground water collection system. The ground water collection system was simulated using the same input parameter values used to simulate the collection scenario under existing conditions. However, the infiltration rate specified by the HELP model for the topsoil/clay cap simulation was used. Additionally, the RANDOM WALK model was used to visually demonstrate particulate movement along flow lines.

A comparison of the flow lines for the 5 collection segments under existing conditions and a topsoil/clay cap indicate that the effect of placing a topsoil/clay cap over the site coupled with a ground water collection system would not affect the general flow patterns that currently exist (i.e., no cap). The effect of placing a topsoil/clay cap over the site coupled with a five segment ground water collection system would result in a minor (i.e., 12%) reduction of the collected ground water flow rate over that estimated by the model for the same collection system without a cap.

3.5 SUMMARY

SESOIL model results for soil pollutant fate in the unsaturated zone indicate that contaminant loadings to ground water under maximum ("worst-case") and average conditions over a twenty-five year simulation period are not significantly reduced with the placement of a low permeability cover such as the topsoil/clay or RCRA caps even though the infiltration rate is reduced significantly. A RCRA cap over localized areas with high soil contaminant concentrations would virtually eliminate contaminant loading to the ground water. However, based on the solute transport model (RANDOM WALK) predictions, the reduction in contaminant loadings from selectively excavated and capped areas does not significantly alter the need for ground water treatment. Furthermore, selective excavation does not appear to be feasible based upon wide-spread and erratic soil contaminant
distribution. The limiting step to determining the period operation for a ground water collection and treatment system appears to depend upon the time required to recapture the existing contamination in the ground water both on-site and off-site. Consequently, the means of soil remediation (e.g., selective excavation versus capping), the type of cap and the establishment of soil remediation criteria is not important from the perspective of ground water quality, provided that ground water is effectively captured and treated.
4.0 COST EVALUATION

Construction cost estimates in 1989 dollars for the topsoil, topsoil/clay, and RCRA caps are presented in Appendix B as taken from the Remedial Cleanup Treatability Study Report (Ref.1). The total estimated construction costs were determined to be approximately 7.7, 13.8 and 28.8 million dollars for the topsoil, topsoil/clay and RCRA caps, respectively. Unit costs were obtained from a variety of sources, including quarries and earth excavation companies located in Erie, PA, Malcolm Pirnie bid tabulations, and Means' Construction Cost Data 1989. Several assumptions were used when compiling these cost estimates, including:

- a total capped acreage of approximately 50 acres;
- clay, topsoil, protective soil and fill material will be obtained from sources within 30 miles of the site;
- contractor overhead and profit is included in the unit costs, and;
- the estimated quantities for soils which are furnished and delivered, hauled on-site, placed on the landfill, and compacted (viz. clay, off-site fill, on-site cut, and protective soils) were increased by 25 percent to allow for "loose" volume.

The actual construction cost for the landfill closure will not be known until the detailed design is completed and the work is competitively bid. Operating and maintenance costs are expected to be minimal, primarily consisting of maintaining the topsoil cover and vegetation.

Based on the above evaluation, the topsoil cap is clearly the lowest cost remediation alternative. It is approximately 44% and 75% less costly than the topsoil/clay an RCRA caps, respectively. The maintenance costs for each alternative would be virtually the same for all three alternatives.
5.0 IMPLEMENTATION PROBLEMS

Potential implementation problems associated with the three alternative caps are largely a function of the complexity of the individual cover systems. Subgrade preparation, topsoil placement and seeding/landscaping activities are common to each alternative. The topsoil cap presents no unique implementation problems.

Potential implementation problems associated with the topsoil/clay cap include:

- Unavailability of and/or haul distance for the low permeability soil required for construction of the barrier layer;
- Possibility of restrictions by the Township of Erie on the amount of hauling (viz. the number of trucks per day or hauling during specified hours only) allowed; and
- Inability to achieve the required level of compaction due to material quality or weather limitations.

Potential implementation problems associated with the RCRA cap include those associated with topsoil/clay cap plus:

- Unavailability of and/or haul distance for the barrier protection layer material;
- Unavailability of and/or haul distance for the sand drainage layer material;
- Additional restrictions on the amount of hauling by the Township office due to the increased quantities of soil required;
- Inability to achieve the desired seam integrity when placing the synthetic liner; and
- Possibility of puncture of the synthetic liner when placing soil materials on top of the liner

Consequently, the topsoil cap presents the lowest potential for implementation problems, followed by the topsoil/clay cap, with the RCRA cap presenting the highest potential for implementation problems.
6.0 RECOMMENDED REMEDIAL APPROACH

An evaluation of the functional performance economic feasibility and implementability of the cap alternatives for the Millcreek Site indicates that the following remedial capping approach should involve placement of a topsoil cap as follows:

- **Handling of Surface Materials**
  Large metallic debris will be decontaminated and removed from the site for off-site recovery/salvage. Surface debris, drums of slag and non-hazardous solid wastes that were excavated and placed on the eastern portion of the site by the USEPA in 1982, drummed drilling spoils and discarded field supplies at the site, and other such materials should be consolidated for placement under a vegetated soil cap in an area designated for filling in the subgrade grading plan.

- **Regrading**
  The site should be regraded with material cut from the site, including the flood retention basin excavation, on-site debris, and off-site borrow soils. The site regrading plan should include surface drainage improvements along the northern site boundary to convey storm and flood water flows eastward toward Marshall’s Run. The site regrading plan should also address restoration/capping of the areas disturbed during construction of the ground water collection trenches. The subgrade over the site would have 0 to 9 feet of fill material, predominantly composed of clean, off-site soils. Consideration should be given to end uses of the site when developing the subgrade grading plan.

- **Topsoil**
  A minimum of 12-inches of topsoil cover should be place over the regraded portion of the site to establish a vegetative cover.
This remedial approach for the contaminated soil is consistent with the intent of the ROD and recommended approach by PADER. The subgrade and final grading plans will be developed based on the following design criteria:

- Maximum slope of 25% (1:4) to limit erosion;
- Minimum slope of 3% (1:33) to promote runoff and eliminate ponding;
- Minimized volume of cut (subgrade elevations) to minimize waste disturbance and fugitive dust/vapor releases;
- Limits of the landfill established via site inspections and surveys as necessary;
- Minimized disturbance to wetland and matured treed areas;
- A flood retention basin (FRB) along the eastern boundary of the landfill. Marshall's Run will be diverted through the FRB to help control potential flooding along Marshall's Run downstream from the landfill; and
- Minimized volume of clean fill required from off-site borrow sources to reduce overall costs.
- Improved surface drainage along the northern site boundary toward Marshall's Run.

REFERENCES

Figure 2-1

Typical Topsoil/Clay Cover Detail
Not to Scale

Typical RCRA Cover Detail
Not to Scale

Vegetation
Topsoil
Recompacted Soil
Clean Fill (Depth Varies 0 - 6"

18" (k < 1.0 x 10^-2 cm/sec)

Protective Soil Layer
Non-Woven Geotextile
Sand Drainage Layer
30 Mil Synthetic Liner
Sand Protective Layer
Recompacted Soil

24" (k < 1.0 x 10^-2 cm/sec)

Clean Fill (Depth Varies 0 - 6"

6"

Top of Waste

Top of Waste

Typical Topsoil Cover Detail
Not to Scale

U.S. Army Corps of Engineers
Malheur Superfund Project
Typical Cover Details
Not to Scale
FIGURE 1-1

Wetlands (Approx. Location)

Site Boundary

Note: Portion of U.S.G.S. Swanville, PA.

U.S. Army Corps of Engineers
Vicinity Map
Mill Creek Superfund Site
Scale: 1" = 2000'