US Army Corps of Engineers
BUILDING STRONG®

Feasibility Study Addendum

Shallow Land Disposal Area (SLDA)
Parks Township, Pennsylvania

Authorized under the
Formerly Utilized Sites Remedial Action Program
(FUSRAP)

Prepared by:
Department of the Army
U.S. Army Corps of Engineers

December 2014

TABLE OF CONTENTS

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

ARARs	Applicable or Relevant and Appropriate Requirements
ARCO	Atlantic Richfield Company
BWXT	BWX Technologies, Inc.
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
Corps	U.S. Army Corps of Engineers
CSRA	Cost and Schedule Risk Analysis
DA	Department of the Army
DOE	U.S. Department of Energy
FS	Feasibility Study
FSA	Feasibility Study Addendum
FUSRAP	Formerly Utilized Sites Remedial Action Program
MOU	Memorandum of Understanding
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NNSA	National Nuclear Security Administration
NRC	U.S. Nuclear Regulatory Commission
NUMEC	Nuclear Materials and Equipment Corporation
ROD	Record of Decision
SLDA	Shallow Land Disposal Area
USACE	U.S. Army Corps of Engineers

1.0 INTRODUCTION

1.1 Purpose and Scope of this Feasibility Study Addendum

This Feasibility Study Addendum (FSA) was developed to document the reevaluation of the remedial alternatives considered in the Feasibility Study (FS) report (DA, 2006a) as subsequently modified by, and in consideration of, new information gained from the implementation of the selected remedy.

1.2 Background Information

The Shallow Land Disposal Area (SLDA) is located in Parks Township, Armstrong County, Pennsylvania, approximately 23 miles (38 km) east-northeast of Pittsburgh, Pennsylvania. The site is currently owned by BWX Technologies, Inc. (BWXT), and is maintained under U.S. Nuclear Regulatory Commission (NRC) license SNM-2001[1]. The SLDA site occupies approximately 44 acres (17.8 hectares) and is bounded by the community of Kiskimere to the southwest and vacant undeveloped land to the southeast and northeast. The former Parks Nuclear Fabrication Facility site was located adjacent to and northwest of the SLDA. The three buildings that comprised the Parks facility were decommissioned in 2000; the license was terminated and the property released for unrestricted use in 2004. Currently, the Parks site is vacant land owned by BWXT. Land use within the vicinity of the SLDA site is mixed, consisting of small residential communities, individual rural residences, small farms with croplands and pastures, idle farmland, forested areas, and light industrial properties.

In 1957, the Apollo Nuclear Fabrication Facility began operations in Apollo, Pennsylvania, under U.S. Atomic Energy Commission license SNM-145. Between 1961 and 1970, Nuclear Materials and Equipment Corporation (NUMEC), who owned both the Apollo facility and the SLDA, buried process and other wastes from the Apollo plant at the SLDA. According to the available historical documents, these wastes were reportedly buried in accordance with U.S. Atomic Energy Commission regulation Title 10, Part 20, Section 304 of the Code of Federal Regulations (10 CFR 20.304), Disposal by Burial in Soil, which was subsequently rescinded in 1981. In 1967, NUMEC stock was bought by Atlantic Richfield Company (ARCO) and the use of the SLDA for radioactive waste disposal was discontinued in 1970. In 1971, the Babcock & Wilcox Company acquired NUMEC. In 1997, BWXT assumed ownership of the SLDA.

Based on reports prepared by ARCO/BWXT, and discussions with individuals familiar with disposal operations at the SLDA, the waste materials were placed into a series of pits that were constructed adjacent to one another. From geophysical surveys performed at the site, these pits appear as linear trenches and are depicted on site drawings as trenches. These geophysical anomalies were labeled as “trenches 1 through 10”. This numbering scheme was based partially on the sequential construction and use of each trench (1 being the oldest trench and 9 being the most recently constructed trench in the upper trench area). Trench 3 was historically referred to as a settling pond used during the exhumation of trenches 2, 4, and 5 in 1965. Trench 10 is

[1] The NRC issued a Confirmatory Order suspending the license on August 5, 2011, to enable the U.S. Army Corps of Engineers to commence waste excavation and disposal activities.

located in another part of the site and was used for disposal purposes throughout the 1960s and during 1970. Disposal activities at the SLDA were reportedly terminated in 1970.

The authority for this response action is found in Section 8143 of the Fiscal Year 2002 Defense Appropriations Act, Public Law 107-117, which, subject to subsections (b) through (e) of section 611 of Public Law 106-60 (113 Stat. 502; 10 U.S.C. 2701 note), directs the Secretary of the Army, acting through the Chief of Engineers, "to clean up radioactive waste at the [SLDA] consistent with the Memorandum of Understanding Between the United States Nuclear Regulatory Commission and the United States Army Corps of Engineers for Coordination on Cleanup and Decommissioning of the Formerly Utilized Sites Remedial Action Program (FUSRAP) Sites with NRC-Licensed Facilities, dated July 5, 2001." Any chemical contamination that is not co-mingled with radioactive waste cannot be addressed by the U.S. Army Corps of Engineers (Corps) under FUSRAP by the authority provided in Section 8143 of Public Law 107-117.

1.3 Pre-Remediation Activities

To date, the Corps has completed a Preliminary Assessment, a Remedial Investigation (DA, 2005), a Feasibility Study (DA, 2006a), a Proposed Plan (DA, 2006b), and a Record of Decision (ROD) (DA, 2007) for the SLDA. The FS developed and evaluated alternatives for addressing the radionuclides of concern requiring remediation on the site. The FS Report included five remedial alternatives: 1) No Action, 2) Limited Action, 3) Containment, 4) Excavation, Treatment, and On-site Disposal, and 5) Excavation, Treatment, and Off-site Disposal. Based on a comparative analysis of the relative performance of each alternative against the nine criteria specified in 40 CFR 300.430(f), the Corps selected Alternative 5 as the preferred alternative, which was presented to the public in the 2006 Proposed Plan. On September 6, 2007, the Corps issued the ROD for the SLDA. At that time, the Corps' selected remedy was Alternative 5 – Excavation, Treatment and Off-site Disposal. The estimated cost of the selected remedy presented in the ROD was $44,500,000.

1.4 Remediation Activities

From 2009 to 2011, the Corps coordinated with NRC pursuant to the requirement in the 2001 Memorandum of Understanding (MOU) for the NRC to place the license in abeyance. Through this coordination, both the Corps and NRC were satisfied with the proposed work plans for remediation and the NRC placed the license in abeyance on August 5, 2011. Immediately following license abeyance, the Corps began implementation of the selected remedy which involved the excavation of radiologically contaminated soil and debris, sorting of this material, packaging for off-site transportation, and disposal at an appropriately permitted, licensed disposal facility. Between August and September of 2011, the Corps excavated approximately 3,300 tons of radiologically contaminated soil and debris which was subsequently disposed off-site. Excavation activities were suspended on September 30, 2011, and remediation activities have not resumed at the site to date.

During the remediation the Corps encountered materials that were difficult to characterize, which caused an unanticipated and immediate need for fundamental changes to site operations, project work plans, waste disposal options, and site infrastructure. The Corps coordinated with the NRC

and the U.S. Department of Energy (DOE) to further characterize these materials. The resulting information has refined the Corps' understanding of the nature of the contamination in the trenches. Specifically, the information gained from remediation emphasized the uncertainty associated with the reported trench waste materials referenced in the FS report (DA, 2006a). In light of this information and the significant uncertainty surrounding the waste materials, the Corps, in consultation with the NRC and DOE, devoted the greater part of the last two years considering best methods and practices for the excavation, characterization, handling, storage, and disposal of trench materials associated with future onsite activities. The Corps recognized early in 2012 that these methods differed substantially from those previously considered during the evaluation of remedial alternatives in the FS (DA, 2006a). This understanding has been formalized in a site-specific MOU entered into by the Corps, NRC, DOE, and the National Nuclear Security Administration (NNSA) to address the roles of each party to facilitate comprehensive and timely remediation.

The Corps updates FUSRAP project cost estimates annually to reflect the most current information available from actual field experience during the prior year's activities (USACE, 2010). Information obtained during the remedial construction activities in 2011, and expected changes in methodology and procedures for implementing the selected remedy, were considered in the 2013 cost estimate. As a result of the refined understanding of site conditions, the estimate indicated a substantial increase in the cost to complete the remedy, nearly ten times greater than originally estimated in the ROD. As a result of the magnitude of the cost increase, and the changes to the methodology and procedures to implement the remedy, the Corps determined that an Amendment to the ROD was required pursuant to 40 CFR 300.435(c)(2)(ii). To provide the decision maker with relevant information needed to decide how to most effectively and appropriately modify the ROD, this evaluation of potential alternatives, substantially consistent with 40 CFR 300.430(f), was completed.

2.0 EVALUATION OF REMEDIAL ALTERNATIVES

2.1 Development and Screening of Remedial Alternatives

Five preliminary remedial alternatives were identified in the FS as follows:

- Alternative 1: No Action – Required by the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) and provides a baseline for comparing other alternatives because no remedial activities would be implemented.
- Alternative 2: Limited Action – Existing NRC license remains in effect for the entire performance period and the licensee continues existing land-use controls and environmental monitoring.
- Alternative 3: Containment – Existing NRC license remains in effect for the entire performance period and modifications are implemented to reduce the potential for migration of the radionuclides from the trenches, including: drainage improvements, an engineered cover, slurry walls, grout curtains, and grout mine stabilization.
- Alternative 4: Excavation, Treatment, and On-site Disposal – Radiological wastes are removed from the trenches and placed in an engineered disposal cell constructed on site away from potential impacts of the abandoned underground mine workings. Concentrations of radionuclides of concern in remaining soil meet criteria for restricted use as defined in 10 CFR 20.1403.
- Alternative 5 – Excavation, Treatment, and Off-site Disposal – Radiological wastes are removed from the trenches and transported to an off-site disposal facility for long-term isolation, and concentrations of radionuclides of concern in remaining soil meet criteria for unrestricted use as defined in 10 CFR 20.1402.

The FS screened the five preliminary remedial alternatives on the basis of their relative effectiveness in meeting the remedial action objectives identified for the site, implementability, and cost. The performance period used to demonstrate compliance with the applicable or relevant and appropriate requirements (ARARs) is 1,000 years, which is consistent with the time frame identified in 10 CFR 20.1401(d). This time period was also used in developing the exposure scenarios for future uses of the site in the human health Baseline Risk Assessment.

During the screening of remedial alternatives in the FS, and upon reevaluation for this FSA, the Corps determined that Alternatives 2 and 3 still did not meet the threshold criteria and, therefore, were not included in the detailed evaluation. Specifically, neither alternative could be assured to provide protection of human health and the environment over the 1,000-year performance period due to the uncertain stability of the abandoned mine workings beneath the upper trench area as shown in Figure 1.4 of the FS report (DA, 2006a). If mine subsidence were to occur underneath the disposal trenches, the radioactive wastes could be mobilized in the groundwater, and an individual drinking this water could be exposed to unacceptable levels of contaminants. A review of available information regarding the abandoned mines and current technology related to mine stabilization was conducted for this FSA. To date, no scientific consensus exists on an accurate method to predict when and where sinkhole subsidence and trough subsidence will

occur for a shallow mine with remnant coal pillars. Estimating the likelihood of subsidence in the next 1,000 years is impossible and leaves great statistically significant uncertainty.

A grouting program to stabilize the mine workings beneath the trenches could be developed with the use of existing mine maps, additional subsurface surveying, and an extensive exploratory drilling program. The technology of grouting mine openings is proven, and has been used successfully by the U.S. Department of the Interior, Office of Surface Mining. Grouting the mine openings beneath and adjacent to the footprints of the trenches would stabilize the ground and would reduce the probability of future subsidence for the next 1,000 years. However, extensive grouting of the mine entries, and potentially the caved rock, may cause heave of ground and would most likely change the groundwater levels and flow regime in the rock strata. Due to the high degree of uncertainty with trying to predict impacts to groundwater flow from grouting of the mine openings, protection of human health and the environment cannot be assured over the performance period for Alternatives 2 and 3. Therefore, Alternatives 2 and 3 did not, and still do not, meet the threshold criteria and were not included in the detailed evaluation in the FS or this reevaluation.

2.2 Summary of Final Alternatives

The remedial alternatives that were subjected to detailed analysis in the FS are summarized in this section. Alternatives discussed in this section, except the No Action alternative, require excavation of radiologically contaminated soil and debris from the trenches, and disposal of this material in an engineered repository. The Corps considered the new information and updated cost estimates for each alternative considered in this reevaluation. Additionally, the Corps performed this reevaluation to ensure the assumptions related to the various alternatives used in the FS were still valid and the ARARs had not been modified, changed or rescinded. The information in the FS report remains largely unchanged. The cost estimates for Alternative 4 and Alternative 5 increased substantially as a result of the new methodologies and procedures for excavation and characterization of the waste within the trenches. These new methodologies and procedures were developed for the most part because of new information on trench contents and lessons learned obtained during initial remediation efforts in 2011. The knowledge gained reduced some of the uncertainty with excavation of the trench contents and the new methods and procedures increased the short term effectiveness of Alternative 4 and Alternative 5 by further mitigating the risk to workers during excavation. These methods and procedures further mitigate risk during sorting and packaging of excavated materials associated with Alternative 5. In light of the foregoing the Corps' evaluation of the Short Term Effectiveness improved from "low/medium" favorability to "medium" favorability for that evaluation criteria.

The capital costs presented for each alternative include expenses related to labor, equipment, material costs of construction, treatment, transport, and disposal. Operation and maintenance costs refer to the annual cost of labor, maintenance, materials, energy, and administrative activities required to ensure the effectiveness of the alternative over the 1,000-year performance period. Present value, also known as net present worth, provides an analysis of the current value of all costs. The estimated present value is calculated based on a predetermined interest rate and the time period over which the remedy will be completed. In order to enable an objective reevaluation of the alternatives, cost estimates for both Alternatives 4 and 5 were updated to reflect the most current information available. That information included actual field experience during the remediation activities in 2011, anticipated changes to the methodologies and

procedures for excavation and characterization of the waste materials in the trenches, and current pricing levels for labor, equipment, and materials. Risk-based contingencies specific to each alternative were determined through the Cost and Schedule Risk Analysis (CSRA) process (USACE, 2010), which is explained in greater detail in section 2.4.7.

2.2.1 Alternative 1 – No Action

Estimated Capital Cost:	$0
Operation and Maintenance Cost:	$0
Estimated Present Value:	$0

This alternative is included to provide a baseline for evaluation of other alternatives in accordance with the NCP and the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) requirements. Under the No Action alternative, no additional remedial action by the Corps would be taken to reduce the toxicity, mobility or volume of radiologically contaminated waste at the SLDA.

2.2.2 Alternative 4 – Excavation, Treatment and On-site Disposal

Estimated Capital Cost:	$259,300,000
Operation and Maintenance Cost:	$ 50,656,000
Estimated Present Value:	$309,956,000

Alternative 4 consists of the excavation, treatment and on-site disposal of radiologically contaminated soil and debris. Treatment processes could include physical separation, size reduction, radiological sorting, and, if necessary, stabilization of excavated material with cement-like grout to reduce its leaching capabilities prior to placement in the disposal cell. The radioactively contaminated soil and debris would be removed from the disposal trenches and placed into an on-site engineered disposal cell. Uncontaminated soils identified during handling and treatment activities would be stockpiled on site, sampled, characterized, and re-used as backfill. Access to the completed disposal cell would be restricted through the use of land-use controls, which would include both engineering and administrative controls, and a permanent monitoring and maintenance program would be implemented to demonstrate this alternative's effectiveness over the 1,000-year performance period.

The new disposal cell would be constructed in the northern corner of the site, clear of the abandoned mine workings to minimize any potential effects of long-term mine subsidence. It was assumed for Alternative 4 that radiologically contaminated soils and debris would be managed such that only the engineered disposal cell, and an appropriately sized buffer zone immediately surrounding it, would require land-use controls. Any residual concentrations of the radionuclides of concern remaining outside this area would meet the 25 millirem/year dose rate limit in 10 CFR 20.1403. Excavated soils and debris found to be radiologically contaminated would be treated on site as necessary and disposed of in the disposal cell. If hazardous substances, as defined by CERCLA, are encountered that are not comingled with radiologically contaminated soil or debris, the material will be managed in an appropriate manner consistent with the Corps' authority for conducting remedial actions at the site. However, the Corps did not encounter any CERCLA hazardous substances that were not comingled with FUSRAP contaminants during the remediation activities in 2011.

2.2.3 Alternative 5 – Excavation, Treatment and Off-site Disposal

Estimated Capital Cost:	$350,187,000
Operation and Maintenance Cost:	$0
Estimated Present Value:	$350,187,000

Alternative 5 consists of the excavation, treatment and off-site disposal of radiologically contaminated soils and debris. Treatment processes could include physical separation, size reduction, and radiological sorting. The radioactively contaminated soils, sediments, and debris would be removed from the disposal trenches, subjected to treatment, and transported off-site for disposal in an appropriately permitted, licensed facility. Any residual contamination would meet the 25millirem/year dose pursuant to 10 CFR 20.1402. If hazardous substances, as defined by CERCLA, are encountered that are not comingled with radiologically contaminated soil or debris, the material will be managed in an appropriate manner consistent with the Corps' authority for conducting remedial actions at the site. However, the Corps did not encounter any CERCLA hazardous substances that were not comingled with FUSRAP contaminants during the remediation activities in 2011.

Although several of the tasks associated with this Alternative were completed in 2011, significant effort is required to mobilize for a new remediation contract, and to develop new work plans that will guide the remedial action. The scope of this Alternative also reflects the uncertainty regarding the types and quantities of waste materials in the trenches, and the difficulty in characterizing these materials. Previous experience has resulted in an increased awareness of the level of effort required to ensure nuclear criticality safety concerns are addressed, as well as addressing non-radiological safety concerns such as those related to beryllium exposure. As a result, the level of effort related to radiological monitoring, sampling, and analysis has increased significantly, as well as activities related to beryllium monitoring.

2.3 Evaluation Criteria

When performing a feasibility study, the NCP directs the use of nine criteria to evaluate the remedial alternatives individually, and directs a comparative analysis of relative performance of each alternative against the nine criteria. Those criteria are specified in 40 CFR 300.430(f) and are grouped into three categories: Threshold Criteria, Primary Balancing Criteria, and Modifying Criteria. Each group and its applicable criteria are presented below.

Threshold Criteria are requirements that each alternative must meet in order to be eligible for selection as the preferred alternative. The threshold criteria are:

- Overall Protection of Human Health and the Environment – Addresses whether or not a remedy provides adequate protection and describes how risks posed through each pathway are eliminated, reduced, or controlled.
- Compliance with ARARs – addresses whether or not a remedy will meet cleanup levels or criteria found in appropriate federal and state environmental requirements or provide justification for a waiver.

Primary Balancing Criteria are criteria used to illustrate major differences or "trade offs" between alternatives. The primary balancing criteria are:

- Long-term Effectiveness and Permanence – Refers to the ability of a remedy to provide reliable protection of human health and the environment over time.
- Reduction of Toxicity, Mobility, or Volume of Contaminants through Treatment – Refers to the preference for a remedy that reduces health hazards, the movement of contaminants, or the quantity of contaminants at the site through treatment.
- Short-term Effectiveness – Addresses the period of time needed to complete the remedy and any adverse effects to human health and the environment that may be caused during the construction and implementation of the remedy.
- Implementability – Refers to the technical and administrative feasibility of the remedy, including the availability of materials and services needed to carry out the remedy and coordination of federal, state, and local governments to work together to clean up the site.
- Cost – Evaluates the estimated capital and operation and maintenance costs of each alternative in comparison to other, equally protective measures.

Modifying Criteria may be considered to the extent that information is available during the FS, but can be fully considered only after public comment is received on the proposed plan. The modifying criteria are:

- State Acceptance – Indicates whether the State of Pennsylvania accepts or rejects the preferred alternative.
- Community Acceptance – Indicates whether the public and town or county governments accept or reject the preferred alternative.

2.4 Comparative Analysis of Final Alternatives

This section of the FSA summarizes the relative performance of each alternative against the nine CERCLA criteria. A detailed analysis of alternatives can be found in the Feasibility Study report (DA, 2006a) and the Proposed Plan (DA, 2006b). Other than cost, short-term effectiveness, and implementability, that analysis still applies and is used to inform the discussion below. Tables 1 and 3 present a summary of the remedial alternatives evaluation discussed below, and Table 4 presents a comparative analysis of the alternatives with the updated cost information.

2.4.1 Overall Protection of Human Health and the Environment

Alternative 1 was not and is not considered protective of human health and the environment because it does not include any actions to reduce exposure to radiological contamination. Both Alternatives 4 and 5 would provide protection to human health and the environment, but present greater short-term risk to remediation workers and the general public during the excavation and handling of the radiological wastes. Those short-term risks are offset by the fact that Alternatives 4 and 5 both significantly reduce the potential for future human contact with the contaminants. Alternatives 4 and 5 introduce greater risk to the general public from transporting bulk materials for disposal cell construction or waste to the disposal facility, respectively, on public roads. However, Alternative 5 is determined to provide a higher degree of effectiveness

to protect human health and the environment because of the complete removal of all radioactive contamination above cleanup levels to an appropriately permitted, licensed, off-site disposal facility that has been optimally sited to minimize the potential for future human exposure and release to the environment.

2.4.2 Compliance with ARARs

Alternative 1 does not meet ARARs. Alternative 4 would comply with the ARAR identified for restricted conditions (10 CFR 20.1403) through the use of land-use controls to limit exposure to contaminated wastes. Alternative 5 would comply with the ARAR identified for unrestricted use (10 CFR 20.1402) because the radiological contaminants above cleanup levels would be permanently removed from the site.

2.4.3 Long-term Effectiveness and Permanence

Implementation of Alternative 1 would not achieve long-term effectiveness or permanence because no actions would be taken to reduce exposure to radiological contamination. Alternatives 4 and 5 would achieve both long-term effectiveness and permanence. Both alternatives involve removal of radiologically contaminated wastes above cleanup levels from the disposal trench areas. Alternative 4 would permanently restrict all future land use for the parcel upon which the disposal cell is located. Alternative 5 would achieve a higher degree of long-term effectiveness and permanence since the radiologically contaminated soil and debris would be permanently removed from the site to an appropriately permitted, licensed disposal facility suitable for receiving such wastes, and optimally sited to prevent future exposure. Alternative 5 also eliminates the need for the long-term operation and maintenance program, and required CERCLA five-year reviews, that would have to be implemented to ensure and monitor the effectiveness of Alternative 4 over the 1,000-year performance period.

2.4.4 Reduction of Toxicity, Mobility, or Volume through Treatment

There are no effective treatment technologies for reducing the toxicity of radionuclides. Radionuclides lose their toxicity over time only through radioactive decay. Under Alternative 1, there would be no reduction of contaminant mobility or volume. Both Alternatives 4 and 5 will include a high degree of physical separation and radiological sorting during and after excavation. This may result in classifying some soils with radioactivity levels below the derived concentration guideline levels as acceptable for re-use on site, which would reduce the volume of excavated materials that require disposal. In addition, Alternatives 4 and 5 would both reduce the mobility of radiological contaminants by placing them in engineered disposal cells to isolate them from the environment. As a result, both of these alternatives are ranked equally for achieving this criterion.

2.4.5 Short-term Effectiveness

Although Alternative 1 would not be effective in achieving the remedial action objectives (either in the short or long term), there would be no increase in worker and public exposure to contaminants during implementation since no remedial activities would occur. Alternatives 4 and 5 would involve excavation, loading, sorting, and transportation activities, all of which would involve significant soil disturbance. There would be increased short-term risk and the

potential for elevated dose rates to workers and the public from these activities; however, implementing the new methods and procedures, and engineering controls developed largely as a result of the information gained from the 2011 remedial activities, will likely mitigate these risks more than previous methods considered in the original FS report (DA, 2006a). There are also risks associated with transportation of both radiologically contaminated wastes from the site and bulk materials to the site on public roads. Alternative 4 would result in a greater number of total truckloads on local roads in the vicinity of the site due to the amount and location of materials needed to construct the on-site disposal cell. Alternative 5 involves transportation of radiologically contaminated materials in approved shipping containers from the site to a loading or disposal facility, but results in fewer total truckloads than for Alternative 4. However, since the bulk materials being transported for Alternative 4 are uncontaminated, the transportation risk for both alternatives is considered effectively the same. Risks of potential exposure to radiologically contaminated wastes during transport would be mitigated through proper containerization, labeling, and the utilization of qualified transporters.

2.4.6 Implementability

Alternative 1 would be the easiest alternative to implement since it involves no remedial action yet it does not meet the threshold criteria. Both Alternatives 4 and 5 employ common and proven methods, such as excavation and physical treatment activities. The availability of licensed commercial disposal facilities and the available expertise for design, construction, closure, and maintenance of an on-site disposal cell make both of these alternatives technically feasible as confirmed by the remedial effort in 2011. The administrative feasibility of implementing Alternative 5 will be more efficient than anticipated in the original FS Report (DA, 2006a) due to processes for interaction and assistance articulated in the 2014 site-specific MOU between the Corps, NRC, DOE, and NNSA. Alternative 4 has a higher degree of technical complexity associated with the design and construction of the on-site disposal cell. In addition, the administrative feasibility of siting an on-site disposal cell, and developing the required long-term operations and maintenance program, is considered low. Alternative 4 presents significant administrative challenges as it presumes that the property owner would be amenable to having a disposal cell constructed along with the appropriate land use controls and would be willing to implement, or consent to, the long-term operation, management and monitoring program at its facility. It also presumes that the appropriate real estate interests are obtained expeditiously without undue delay to the project, which if realized could increase the cost estimate for Alternative 4. In the event the property owner could not fulfill or refused to fulfill the operation, maintenance and monitoring obligations it is expected that these obligations would continue through governmental regulatory oversight. Prior to implementation of Alternative 4, a new Memorandum of Understanding (MOU) between the Corps and NRC would have to be developed to address the use of 10 CFR 20.1403 as the ARAR at this licensed site. Based upon the foregoing, and the fact that there are commercial disposal facilities available to accept the radioactive waste as confirmed by the 2011 remedial action, Alternative 5 is the most administratively feasible.

2.4.7 Cost

Table 2 presents a breakdown of the current estimated costs for each alternative. Since 2009, the Corps Great Lakes and Ohio River Division has utilized a risk-based approach for estimating

FUSRAP remedial action project costs and schedules known as the CSRA process (USACE, 2008). Both Alternatives 4 and 5 were estimated using this CSRA process and the new information now known about the site obtained by the work efforts to date. The CSRA process includes a software-based statistical analysis of project risks to identify, analyze, and account for a wide range of uncertainties that can affect a project's cost and schedule. The CSRA results in a range of estimated project costs and durations associated with varying confidence levels. For example, a 50% confidence level means there is a 50% probability that the project will be accomplished within that estimated cost and schedule. The 80% confidence level is the contingency value most commonly reported for programming and management purposes within the Corps. The CSRA estimates are updated annually to reflect the most current information available from actual field experience during the prior year's activities (USACE, 2010). The remedial alternative cost estimates include contingency determined through the CSRA process at the 80% confidence level.

The cost estimates for Alternatives 4 and 5 were updated in 2013 to reflect the most current information obtained during the remedial construction activities in 2011. With the exception of the *Disposal Cell Construction* and *Operation and Maintenance* activities in Alternative 4 and the *Waste Transportation and Disposal* activity in Alternative 5, and the differences discussed below, all other activities for both alternatives are similar in scope and cost. The estimated costs for each of the similar activities in Alternative 4 are due to the longer project duration associated with construction of the disposal cell. Alternative 4 has a longer project duration because excavation of trench wastes cannot begin until the disposal cell construction is completed, whereas trench waste excavation can begin almost immediately with Alternative 5. Additionally, the costs for the *Environmental Sampling and Analysis* activity in Alternative 4 are greater because all of the construction materials utilized for disposal cell construction must be sampled and analyzed prior to use.

The 2013 cost estimates also include two activities that were omitted from the FS cost estimates for both Alternatives 4 and 5, namely *Oversight and Physical Security* and *Post-Remedial Action Closeout*. The scope of the *Oversight and Physical Security* activity includes all labor, equipment and materials associated with Corps supervision, administration, and construction management during implementation of the remedial action, as well as all physical security measures employed at the SLDA, for the duration of the project, not including the 1,000 year operation and maintenance period. The *Post-Remedial Action Closeout* activity includes Corps' labor and contracts for post-remedial action physical, financial, and legal closeout activities. A detailed explanation of the scope of the remaining project activities can be found in Appendix B of the FS (DA, 2006a).

The estimated cost for Alternative 1 remains $0 since no remedial action would occur. Alternatives 4 and 5 are estimated to cost approximately $310 million and $350 million, respectively. Even though the estimated cost of Alternative 5 is 13% greater than Alternative 4, the uncertainties in the cost estimate for Alternative 4, as discussed in section 2.4.6 above, substantially undercut this difference. There is some uncertainty about who will bear the operation and maintenance costs for 1,000 years as required by Alternative 4. The FS presumed that the NRC would maintain the license for the owner for the required operation and maintenance period, but did not identify who would bear the costs of such operation and maintenance. Additionally, the costs of the operation and maintenance were included in the cost

estimate for Alternative 4 in the FS. Because the operation and maintenance is required for Alternative 4 to be a viable remedy, and to remain consistent with the original assumptions in the FS, the Corps chose to include costs for such maintenance and operation in the cost estimate of Alternative 4. Over 74% of the difference in base costs for Alternatives 4 and 5 is due to operation and maintenance over the 1,000 year performance period. Additionally, the contingency costs for both alternatives are more than three times greater than the difference between their total costs, which differ by 11% or 13%, respectively. While it goes without saying that the approximately $40 million differential between the two alternatives is large, to enable comparison, that amount must be viewed as a percentage of the overall costs of each alternative.

It should be noted that the Corps has spent $62.2 million through September 30, 2014 to implement the remedy selected in the ROD. These expenditures, also referred to as "sunk costs", were not included in any of the alternatives' cost estimates presented herein. However, these sunk costs must be included upon completion of remediation to calculate the total cost of the selected remedy.

2.4.8 State and Community Acceptance

The preferred alternative put forth in the Proposed Plan (DA, 2006b) was Alternative 5 and after receiving comments from the State of Pennsylvania and other stakeholders during the public comment period, Alternative 5 became the selected remedy. The responses to comments were documented in the Responsiveness Summary which can be found in Appendix A of the ROD (DA, 2007). The State of Pennsylvania, in their comments to the Proposed Plan, agreed that Alternative 5 was protective of human health and the environment. None of the comments received on the Proposed Plan expressed support for Alternative 4. There has been a record of documented public support for Alternative 5 including the community group that organized and lobbied Congress to get the special legislation and comments made throughout the years in various public forums. There has not been similar public support for Alternative 4.

Table 1: Summary of Remedial Alternatives Evaluation for Threshold Criteria

Threshold Criteria	Alternative 1 No Action	Alternative 4 Excavation, Treatment and On-site Disposal	Alternative 5 Excavation, Treatment and Off-site Disposal
Overall Protection of Human Health and the Environment	Not considered protective of human health and the environment.	Meets the remedial objectives for protection of human health and the environment.	Meets the remedial objectives for protection of human health and the environment.
Compliance with ARARs	Does not satisfy the ARARs established for the site.	Satisfies the ARARs established for the alternative.	Satisfies the ARARs established for the alternative.

Table 2: Summary of Estimated Present Worth Costs[2] for Remedial Alternatives

Activity	Alternative 1 No Action	Alternative 4 Excavation, Treatment and On-site Disposal	Alternative 5 Excavation, Treatment and Off-site Disposal
Site Preparation	N/A[3]	$1,954,437	$1,860,673
Site Supervision and Support Facilities	N/A	$22,648,336	$21,422,206
Remediation Activities	N/A	$48,898,487	$47,475,832
Environmental Sampling and Analysis	N/A	$37,518,107	$34,961,204
Disposal Cell Construction	N/A	$7,388,366	N/A
Operation and Maintenance	N/A	$28,028,399	N/A
Waste Transportation and Disposal	N/A	N/A	$80,721,622
Oversight and Physical Security	N/A	$40,980,000	$39,000,000
Post-Remedial Action Closeout Costs	N/A	$2,000,000	$2,000,000
Alternative Subtotal	**$0**	**$189,774,000**	**$227,442,000**
Contingency (80% Confidence Level)	$0	$120,182,000	$122,745,000
Alternative Total[4,5]	**$0**	**$309,956,000**	**$350,187,000**

[2] All costs are in 2013 dollars
[3] N/A = Not Applicable
[4] This cost estimate does not include the $62.2 million that was expended through September 30, 2014 to execute the selected remedy
[5] Total costs are rounded to the nearest $1,000

Table 3: Summary of Remedial Alternatives Evaluation for Balancing Criteria

Primary Balancing Criteria	Alternative 1 No Action	Alternative 4 Excavation, Treatment and On-site Disposal	Alternative 5 Excavation, Treatment and Off-site Disposal
Long-term Effectiveness and Permanence	Does not provide long-term effectiveness and permanence.	Provides long-term effectiveness and permanence by placing contaminated soil and debris into an on-site engineered disposal cell.	Provides long-term effectiveness and permanence by removing contaminated soil and debris from the SLDA, and disposing of it in an appropriately licensed off-site disposal facility.
Reduction of Toxicity, Mobility, or Volume of Contaminants through Treatment	Achieves no reduction of toxicity, mobility, or volume of radionuclides of concern.	Achieves no reduction of toxicity. Reduces mobility of contaminants through isolation into an on-site engineered disposal cell. May achieve small reduction of disposal volume.	Achieves no reduction of toxicity. Reduces mobility of contaminants through removal and isolation into an optimally sited disposal facility distant from the community. May achieve small reduction of disposal volume.
Short-term Effectiveness	There would be no short-term hazards to site workers and the community since no remedial actions would be implemented.	Low to moderate risk of adverse effects to remedial workers, the community, and the environment during implementation. Moderate risk to the general public associated with transportation of bulk materials to the site.	Low risk of adverse effects to remedial workers, the community, and the environment during implementation due to development of new methods and procedures. Moderate risk to the general public associated with off-site transportation of contaminated wastes.
Implementability	No technical or administrative issues with implementability since no remedial actions would be implemented.	Implementation is technically feasible; services and materials are readily available. Administrative feasibility related to construction of an on-site disposal facility could significantly impact implementability.	Implementation is technically and administratively feasible; services and materials are readily available.
Cost[6]	$0	$309,956,000	$350,187,000

[6] All costs are in 2013 dollars

Table 4: Comparative Evaluation of Remedial Alternatives

Evaluation Criteria	Alternative 1 No Action	Alternative 4 Excavation, Treatment and On-site Disposal	Alternative 5 Excavation, Treatment and Off-site Disposal
Threshold Criteria			
Overall Protection of Human Health and the Environment	Not Protective	Protective	Protective
Compliance with ARARs	Not Compliant	Compliant	Compliant
Balancing Criteria	**Ranking**[7]	**Ranking**	**Ranking**
Long-term Effectiveness and Permanence	Low	Medium/High	High
Reduction of Toxicity, Mobility, or Volume of Contaminants through Treatment	Low	Low/Medium	Low/Medium
Short-term Effectiveness	High	Medium	Medium
Implementability	High	Low	Medium/High
Cost[8]	$0	$309,956,000	$350,187,000

[7] Rankings: High = most favorable ranking; Medium = average favorable ranking; Low = least favorable ranking.
[8] All costs are in 2013 dollars

3.0 CONCLUSIONS

The purpose of this FSA was to document the Corps' reevaluation of the remedial alternatives considered in the FS report (DA, 2006a) as subsequently modified by, and in consideration of, new information gained from implementation of the selected remedy. To achieve this objective, the five preliminary alternatives from the FS were re-screened to confirm that the assumptions applied in the FS are still valid. In addition, updated cost estimates were used that reflect current pricing levels, risk-based contingencies, and lessons learned from the initial remediation phase to assist in determining whether the preferred alternative chosen in 2007 is cost effective in comparison to the other alternatives. Based on the screening evaluation in this FSA, Alternatives 2 and 3 were eliminated from further consideration because neither alternative could be assured to provide protection of human health and the environment over the 1,000-year performance period due to the uncertain stability of the abandoned mine workings beneath the upper trench area. Alternatives 4 and 5 were retained for detailed analysis because they would be protective and meet the criteria set forth in 10 CFR 20.1403 and 10 CFR 20.1402, respectively. The No Action alternative (Alternative 1) was retained for further analysis consistent with EPA guidance and the NCP.

Alternatives 1, 4, and 5 were subsequently subjected to detailed reanalysis. This reanalysis primarily consisted of a comparison against the nine CERCLA criteria, grouped into three categories: Threshold, Balancing, and Modifying criteria. Threshold criteria had to be satisfied for a remedial alternative to be considered a viable remedy. The five balancing criteria represented the primary criteria upon which the detailed analysis was based. Modifying criteria were evaluated following public comment on the Proposed Plan (DA, 2006b), and were addressed in the Responsiveness Summary for the ROD (DA, 2007).

The results of the detailed reanalysis indicate that Alternative 1 still will not meet the CERCLA threshold criteria. Both Alternatives 4 and 5 are still protective of human health and the environment over the performance period and will satisfy the ARARs identified for the site. Alternative 4's cost estimate continues to be less than Alternative 5; however, this perceived benefit is offset by the determination of lesser effectiveness and permanence, lower implementability, and the uncertainty in obtaining regulatory concurrence for, and community and owner acceptance of, construction of an on-site disposal cell, and by the uncertainty and potential delay in obtaining real estate interests and long-term operation and maintenance requirements for 1,000 years. The current estimated cost of Alternative 5 is 13% greater than Alternative 4, but this difference has decreased significantly from the ROD where the estimated cost of Alternative 5 was more than twice that of Alternative 4. Alternative 5 has the advantage that once the remediation work is completed, the radiological contamination will be permanently removed from the community, and the site would be suitable for unrestricted use. Alternative 5 remains cost effective. None of the comments received on the Proposed Plan from the State of Pennsylvania or other stakeholders expressed support for Alternative 4.

Upon reevaluation of the remedial alternatives identified in the FS Report (DA, 2006a), when considered in light of the new information gained from the implementation of the selected remedy, the preferred alternative continues to be Alternative 5. The Proposed ROD Amendment will document all of the post-ROD changes in compliance with CERCLA and 40 CFR 300.435(c)(2)(ii).

4.0 REFERENCES

Department of the Army (DA), 2007. *Record of Decision for the Shallow Land Disposal Site, Parks Township, Armstrong County, Pennsylvania*, U.S. Army Corps of Engineers (USACE), August 2007.

DA, 2006b. *Proposed Plan for the Shallow Land Disposal Area Site, Parks Township, Armstrong County, Pennsylvania*, USACE, September 2006.

DA, 2006a. *Final Feasibility Study for the Shallow Land Disposal Area Site, Parks Township, Armstrong County, Pennsylvania*, USACE, September 2006.

DA, 2005. *Shallow Land Disposal Area, Remedial Investigation Report, Final*, USACE, October 2005.

USACE, 2010. *08621 LRB – Cost & Schedule Risk Analysis*, LRD Regional Business Process Manual (Doc ID: 5826), USACE, July 26, 2010.

USACE, 2008. *Engineering and Design – Civil Works Cost Engineering*, Engineer Regulation ER 1110-2-1302, U.S. Army Corps of Engineers, September 15, 2008