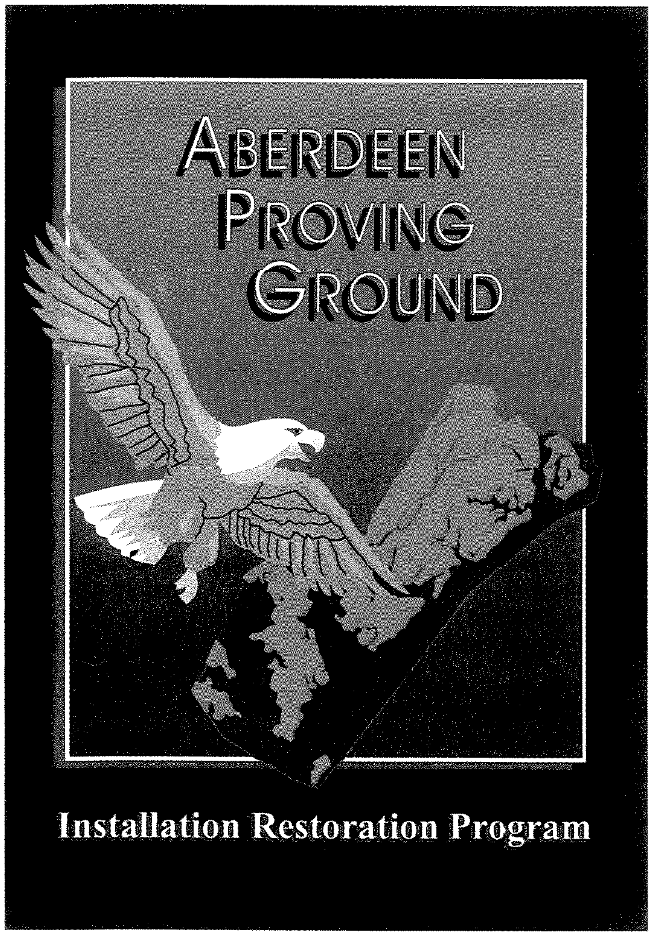

BUSH RIVER STUDY AREA

Engineering Evaluation / Cost Analysis
Radioactive Waste Management Facility

February 2003

U.S. Army Garrison
Aberdeen Proving Ground, Maryland

Engineering Evaluation/Cost Analysis For Bush River Study Area Radioactive Waste Management Facility Aberdeen Proving Ground, Maryland

Prepared for

U.S. Army Garrison, Aberdeen Proving Ground
Directorate of Safety, Health and Environment
Aberdeen Proving Ground, Maryland

Contract DAAD05-97-D-7003

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This Engineering Evaluation/Cost Analysis evaluates removal action alternatives for the Rad Yard in the Bush River Study Area of Aberdeen Proving Ground. The alternatives evaluated include “No Action,” and “Excavation and Disposal”. The recommended removal alternative is “Excavation and Disposal”.

14. SUBJECT TERMS
Aberdeen Proving Ground, Bush River, radioactive waste, cesium-137, strontium-90, UXO, ordnance and explosive waste, Operable Unit 3, Rad Yard

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U.S. Army Garrison Aberdeen Proving Ground
Directorate of Safety, Health and Environment
Aberdeen Proving Ground, Maryland

Engineering Evaluation/Cost Analysis
For
Bush River Study Area

February 2003

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EXECUTIVE SUMMARY

This Engineering Evaluation/Cost Analysis (EE/CA) presents a comparative analysis and selection of non-time-critical removal options proposed at the Radioactive Waste Management Facility (as known as the "Rad Yard") within the Bush River Study Area of Aberdeen Proving Ground. The EE/CA develops, evaluates and selects alternatives that will provide an effective interim remedy consistent with anticipated final remediation goals under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA).

The removal action is proposed to manage wastes generated by historic consolidation, repackaging and shipment of waste from the 1930's through the year 2002. Storage of radioactive wastes no longer occurs at the facility, but the residual contamination presents a potential threat to human and ecological receptors exposed to the soil. At present, the calculated total radiation dose to hypothetical workers at the Rad Yard is 2,661 mrem/yr. Based on the previously conducted Human Health Radiological Risk Assessment, remedial goals corresponding to 5 pCi/g (picocuries per gram) for Cs-137, 0.5 pCi/g for Co-60 and 10 mg/Kg (milligrams per Kilogram) are proposed as final unrestricted use remedial levels for soil in the Rad Yard. These proposed remedial goals are consistent with both Nuclear Regulatory Commission (NRC) criteria (for removal from the NRC license) and Environmental Protection Agency's CERCLA guidance and do not require site restrictions. Remediation to less stringent levels would not meet Nuclear Regulatory Commission requirements for remediation to "as low as reasonably achievable" levels (an "applicable, relevant and appropriate requirement"), even if a cap were to be placed on the site. Hence this is not viewed as being a viable option and is not considered further.

Two alternatives, "no action" and "excavation and disposal" were evaluated. The "excavation and disposal" alternative is recommended as the preferred alternative, because it would be protective of human health and the environment, meet the risk-based remediation goals, meet long-term and short-term goals, and reduce the quantity of radioactive wastes on site. It is technically and administratively feasible, and can be implemented with readily available equipment and materials. It involves a greater 'upfront' capital cost, but would not require ongoing land use controls and/or operation and maintenance to maintain effectiveness.

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1 SITE CHARACTERIZATION

1.1 Site Description and Background

The "Rad Yard" is the former Radioactive Material Disposal Facility located in the Bush River Study area at Aberdeen Proving Ground (APG), Maryland (Figure 1) [Defense Site Environmental Tracking System (DSERTS) #EABR11-I]. The facility is approximately five acres in size. It is a part of Operable Unit 3 in the Bush River Study Area. The site includes an open storage yard, several associated buildings (E2360, E2362, E2364 and E2354), and a former Ton-Container Steamout Site (Structures E2368 and E2366). The former Adamsite Storage Pit (former Building E2370) [DSERTS #EABR11-H] is located within the boundaries of the Rad Yard. The layout of the Rad Yard is shown in Figure 2.

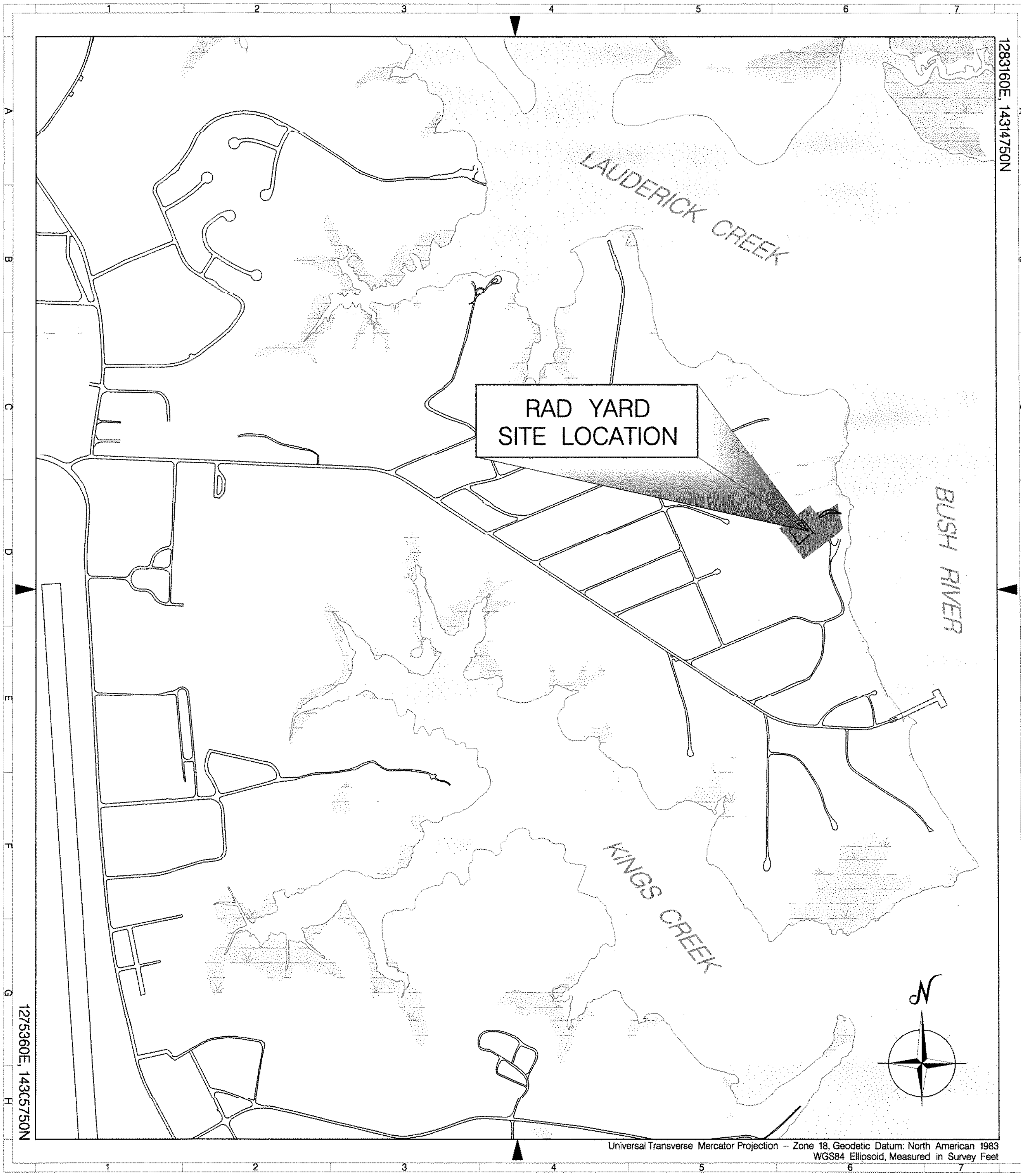
The Rad Yard was originally constructed in 1931 as a storage facility for chemical warfare agents and ordnance, and was referred to as the Toxic Gas Yard (TGY). The Ton-Container Steamout Facility was constructed during the late 1930s and operated until the 1950s or early 1960s. Operations at this facility included the decontamination of one-ton containers used to store mustard, chloropicrin, Lewisite and other chemical agents. The facility was used for management of radioactive waste from the early 1960s until the year 2002. Prior to 1985, wastes were received from a large portion of the eastern United States for processing. After 1985, only small quantities of waste generated on APG were stored at the site. After October 2002, no wastes have been stored at this site and the site is currently unused. No actual disposal occurred at the site during the period that it was in operation.

1.1.1 Topography & Geology

The project site lies within the Coastal Plain Physiographic Province. The province is low-lying with gently rolling to flat terrain. Elevations over most of the project site are 10 feet Mean Sea Level (MSL). Tidal wetlands are located east of the site along the river and west and north of the site along a stream.

The geology of the site and surrounding area is characterized by bands of Coastal Plain sediments that parallel the fall line, or geologic boundary, that runs north of the site. The fall line represents the boundary between the older crystalline rocks of the Piedmont Plateau and the younger sediments of the Coastal Plain physiographic provinces. These sediments, which date to the Cretaceous and Quaternary periods, consist of sedimentary beds of clay, silt, sand, and scattered gravel lenses. The beds and lenses dip to the southeast at an angle of less than one degree; thickness of the bed varies. Crystalline rocks underlying the Coastal Plain sediments are Precambrian to lower Paleozoic in age and consist of schist, gneiss, gabbro, granite, marble, and quartzite.

Coastal Plain sediments underlying the site are divided into the following formations, starting with the oldest and progressing to the youngest: the Potomac Group, the Talbot Formation, and recent alluvium. The Potomac Group sediments are the continental



1200 900 600 300 0 600 1200 2400

GRAPHICAL SCALE
IN FEET (1" = 1200')
1:14400

L E G E N D

Water — Tidal Wetland
Road — Non-tidal Wetland

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TITLE:

LOCATION OF THE RAD YARD IN THE BUSH RIVER STUDY AREA

CARTOGRAPHER:	APPROVED BY:	DATE:	FIGURE:
B. JOYCE	G. NEMETH	02-11-03	1

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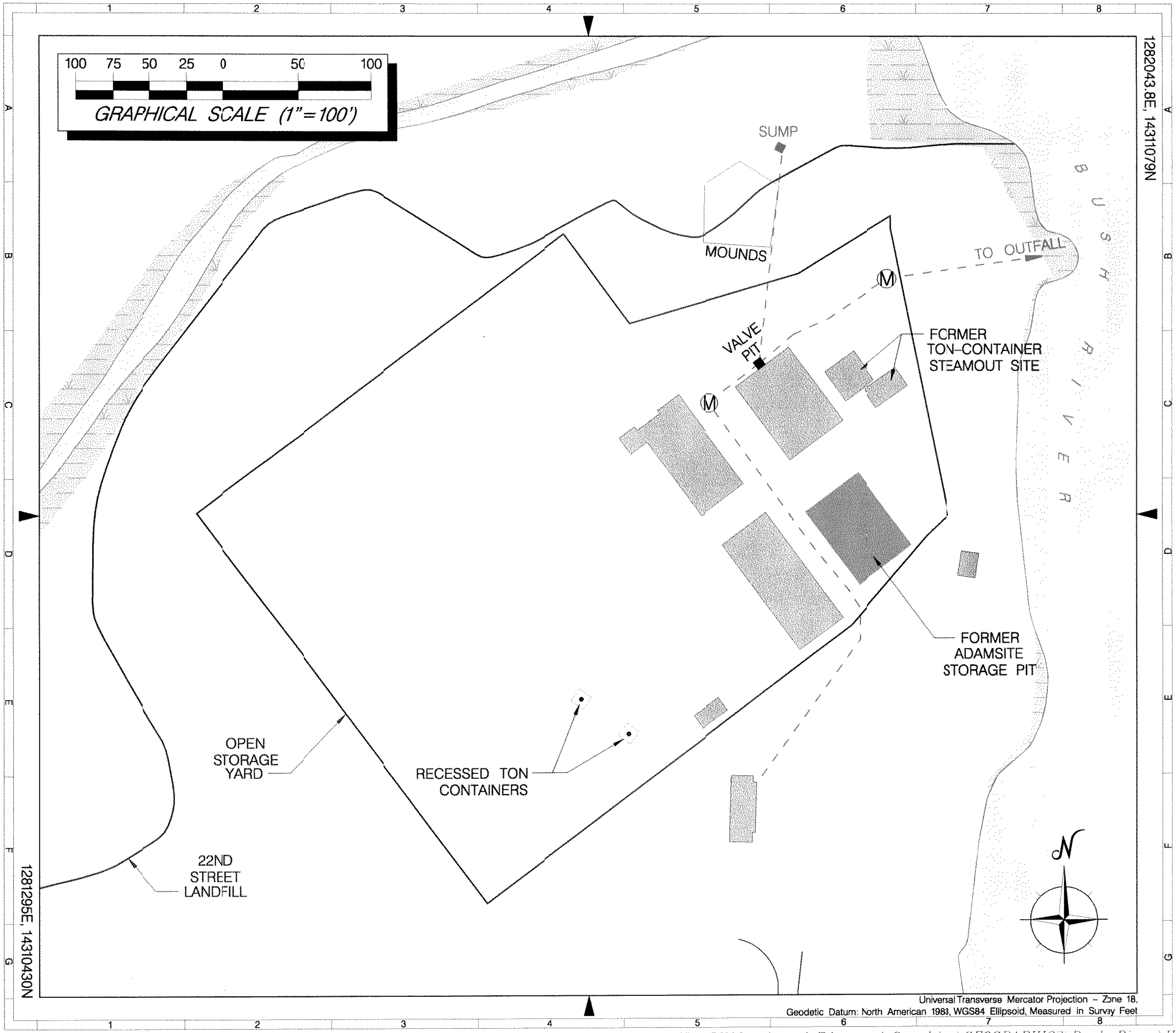

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GENERAL PHYSICS

TITLE:

LAYOUT OF THE RAD YARD

CARTOGRAPHER:	APPROVED BY:
B. JOYCE	G. NEMETH
DATE:	FIGURE:
02-11-03	2

\\NAEDGSRV001\shared\Edgewood Graphics\GEOGRAPHICS\Bush River\HHRRA-Radyard\site@1001a3.dgn deposits of rivers, lakes, and swamp floodplains. The Potomac Group is subdivided into the Patuxent, Arundel, and Patapsco Formations. The Talbot Formation was deposited during the Pleistocene epoch. It consists of a series of gravel, sand, and silt river terraces occurring between 10 and 35 feet above sea level. Erosion has stripped away most of the Talbot Formation deposits, and what is left is primarily silty sands. The recent alluvium consists of silts and clays and is found at lower elevations in topographic lows and drainage ways.

1.2 Previous Removal Actions

The sand, soil, concrete and water in the former Adamsite Storage Pit (Building E2370, located within the boundary of the Rad Yard) were investigated in 1996, following which all contaminated materials were removed and the vaults were filled with concrete. Surface waste material from the area was also removed at this time.

1.3 Source, Nature and Extent of Contamination

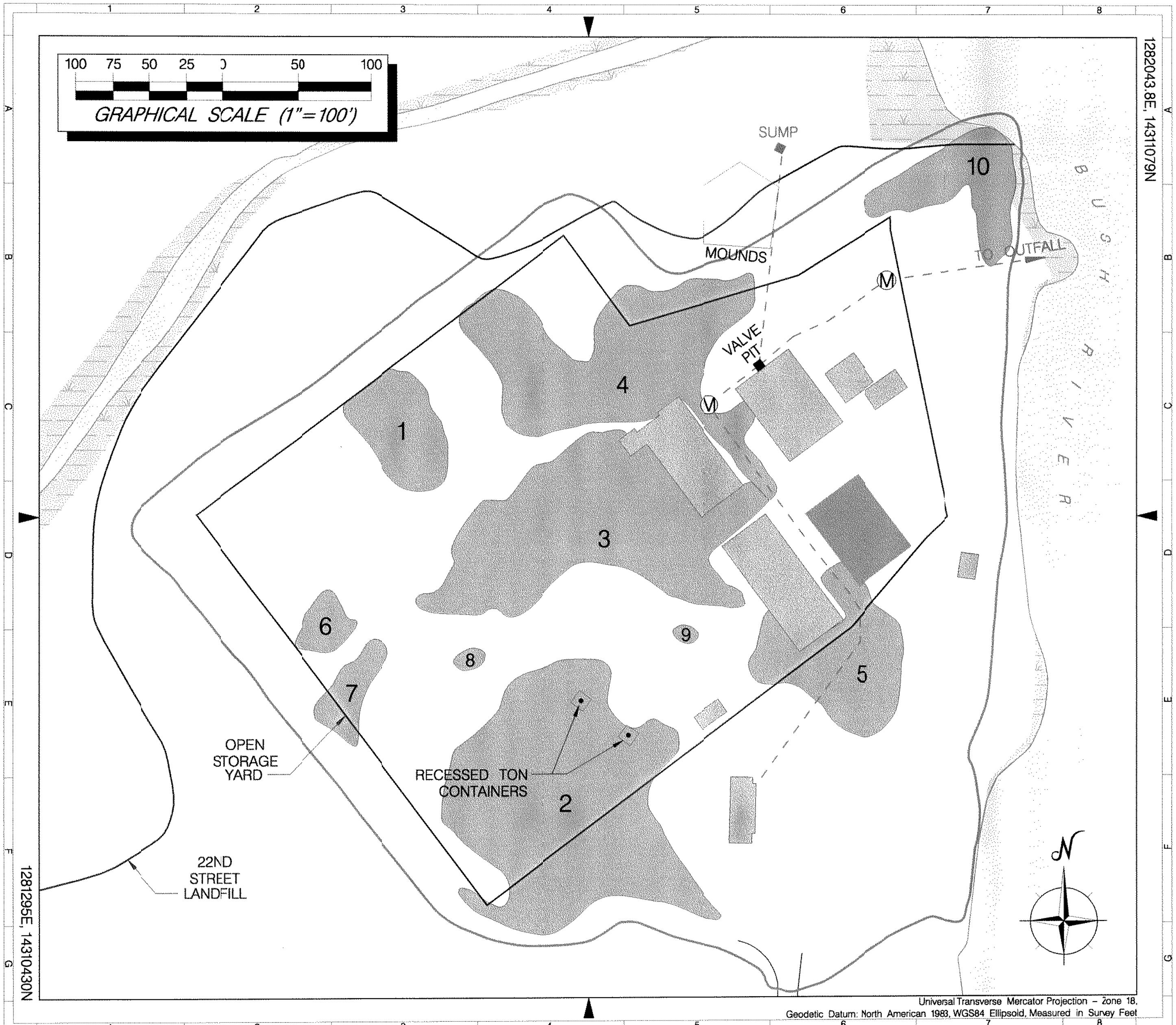
1.3.1 Soil

The areas of soil contamination by radionuclides within the Rad Yard are shown in Figure 3. The areas identified in this figure are based on field radiation survey results and on soil sampling data. Most of the Cs-137 and Co-60 contamination is within the top 12 to 18 inches of soil. The maximum activities of Cs-137 and Co-60 in soil samples were 4,620 pCi/g and 4.47 pCi/g, respectively. The estimated cancer risk to industrial workers if the site is not remediated is 3.8×10^{-2}. Calculated areas and volumes of the contaminated hot spot areas are presented in Table 1.

The estimated total area of contamination is 1.6 acres, and the soil volume, based on an 18-inch depth and certain assumptions regarding the fraction of soil contaminated (see Table 1) is approximately 3,800 yards^3. A more conservative soil volume estimate with the assumption of all topsoil contaminated (i.e., fraction contaminated of 100% for all hot spots) to a depth of 2 feet is approximately 5,200 yards^3. These estimated volumes do not include contaminated soil that may be associated with sewer lines (see Section 1.3.3).

There is some uncertainty concerning the contamination in Hot Spot #10 (Figure 1). This hot spot was identified by the field survey, and no surface soil samples were collected in the area to provide supporting data. The presence of contamination in this area was also noted in a 1995 radiological assessment of the Adamsite storage vaults (i.e., former Building E2370) (Foster Wheeler, 1995). Surface water ponding in this general area has been noted in historical aerial photographs. Overflow of the E2364 wastewater tanks would provide a possible explanation, but documentation of such overflow is not available.

While the soil sample data are roughly correlated with the field survey results (i.e., highest sample results in areas of highest survey results), there is considerable variability in soil data within contaminated areas. This is likely due to the nature of releases, primarily involving small quantities of liquid waste material stored and handled in the



LEGEND

- Structure
- Former Structure
- Road
- Water
- Wetland
- Site Boundary
- Rad Sewer Line
- Manhole
- Area of Required Soil Remerdiation

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GENERAL PHYSICS

TITLE:

ESTIMATED REMEDIAL AREAS FOR RADIONUCLIDES IN SOIL

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DATE:	FIGURE:
02-11-03	3

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Table 1. Estimated Areas and Volumes of Contaminated Soil

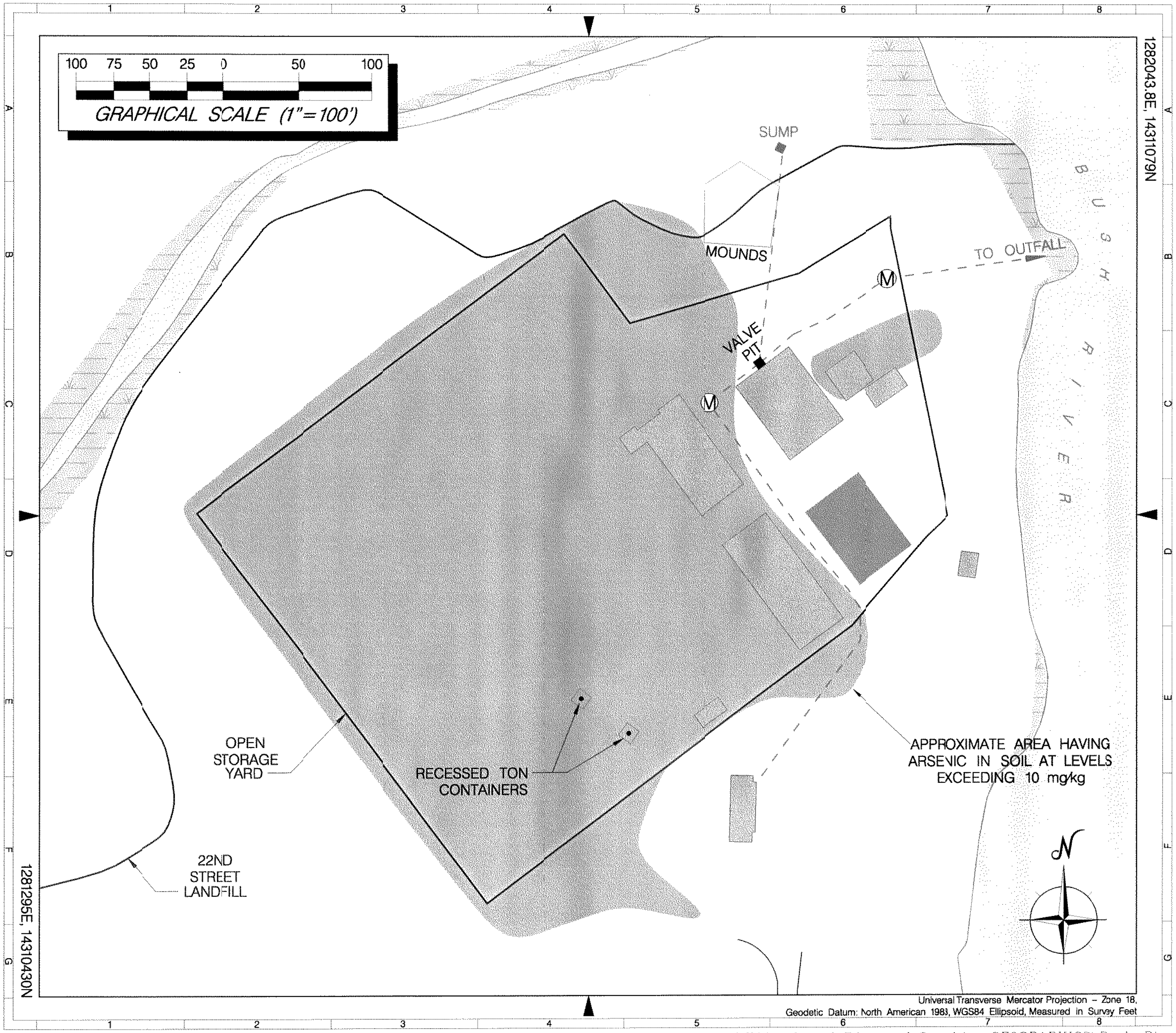
			Area (sq ft)	Area (acres)	Depth of Contamination (ft)	Assumed Portion of Soil Contaminated	Volume of Contaminated Soil (cu yd)
Radionuclides	CONTAMINATED AREAS						
	HS1		3,840	0.088	1.5	100%	213
	HS2	80%	21,180	0.486	1.5	80%	941
	HS3	70%	16,230	0.373	1.5	70%	631
	HS4	85%	14,140	0.325	1.5	85%	668
	HS5	70%	6,710	0.154	1.5	70%	261
	HS6		1,110	0.025	1.5	100%	62
	HS7		1,610	0.037	1.5	100%	89
	HS8		240	0.006	1.5	100%	13
	HS9		160	0.004	1.5	100%	9
	HS10	70%	4,380	0.101	1.5	70%	170
	Total (in place)		**69,600**	**1.60**			**3,058**
	Total (excavated)				Expansion Factor = 25%		**3,823**
Arsenic	CONTAMINATED AREAS						
	Storage Yard		130,200	2.989	1.5	100%	7,233
	Ton-Container Steamout Site		3,000	0.069	1.5	100%	167
	Total (in place)		**133,200**	**3.06**			**7,400**
	Total (excavated)				Expansion Factor = 25%		**9,250**
	ESTIMATED RADIONUCLIDE/ARSENIC OVERLAP AREA		**65,220**	**1.50**	1.5	100%	3,623
	ENTIRE RAD YARD		**235,100**	**5.40**			

open yard and buildings. The soil data do not allow precise contouring differentiating between areas and volumes at varying low levels of contamination. That is, the volume of soil with a Cs-137 level exceeding 5 pCi/g is not expected to be significantly different from the volume exceeding 15 pCi/g. This implies that the cost associated with remediation by excavation and offsite disposal is relatively insensitive to the remedial level, as long as the remedial level is reasonably higher than the anthropogenic background level (0.04 pCi/g to 0.73 pCi/g range in activity level in reference background samples, with a mean of 0.30 pCi/g)[1].

The estimated area of soil with arsenic exceeding the recommended remedial level of 10 mg/kg for unrestricted use is shown in Figure 4. This area consists of the fenced open storage yard, plus runoff areas at the north, east and south corners of the yard. There is also a small area of arsenic contamination at the ton-container steamout facility. The size of these areas is approximately 133,200 feet^2 (3.1 acres). There is some uncertainty associated with the lateral extent of arsenic-contaminated soil in areas outside the boundary of the open storage yard to the northwest, southwest and southeast. While the storage of arsenicals, and historical releases to soil, were within the storage yard, it is possible that there has been transport, via precipitation runoff, to areas outside the yard boundary. Soil sampling and analysis data indicate that such migration did occur in the vicinity of E2360 and at the southern corner of the open storage yard. These are the same areas in which there was Cs-137 transport. With the Cs-137, the uncertainty concerning transport and lateral extent is low because the field radiological survey extended beyond the fence line. If the transport of arsenic has occurred only in those areas where Cs-137 transport has occurred, then the extent of elevated arsenic in soil outside the open storage yard is as shown in Figure 4. Most of the arsenic is within surface and near surface soil. Assuming that the average depth of arsenic exceeding the recommended 10 mg/kg remedial level for unrestricted use is 18 inches, the volume of arsenic-contaminated soil is estimated to be 9,250 yards^3. All but one of the Cs-137 hot spot areas are located within the area of arsenic contamination. Remediation of the Cs-137 alone would remove approximately 65,000 feet^2 and 4,500 yards^3 of the arsenic-contaminated soil, including all of the areas with the highest levels of arsenic. The mean arsenic concentration in soil following remediation of Cs-137 would be roughly 15 to 20 mg/kg.

The highest levels of total arsenic in soil in the Rad Yard exceed the 40 CFR 261 arsenic toxicity characteristic limit (5 mg/L in test leachate) by a ratio of more than 20:1. However, the highest levels are found in relatively small areas, and the mean arsenic level in soil is only 56.2 mg/kg. This indicates that it is unlikely that waste characterization for soil containing Cs-137 will exceed the toxicity characteristic limit, which if it did, would classify the soil as a hazardous and a mixed waste.

[1] The anthropogenic background levels on APG may be slightly higher in areas with surface soil having relatively high clay content. The off-post reference samples were collected from off-post locations upon both sand-rich and clay-rich soils (IT, 2002). The Bush River Area surface soils are generally fine-grained, and may have a higher clay content, with correspondingly slightly higher anthropogenic levels of Cs-137.



L E G E N D

- Structure
- Former Structure
- Road
- Water
- Wetland
- Site Boundary
- Rad Sewer Line
- (M) Manhole
- Estimated Area of Regional Soil Remediation for Arsenic to Allow Unrestricted Use

Note: No Areas exceed Recommnded Human Health Based Remedial Goals for restricted use. Actions may be neccessary to protect Ecological Receptors.

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GENERAL PHYSICS

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ESTIMATED REMEDIAL AREAS FOR ARSENIC IN SOIL

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1.3.2 Buildings

The building surveys showed maximum dose equivalent rates less than 50 μrem/hr and no significant removable contamination. Fixed contamination levels were as high as 200,000 dpm per 100 cm^2 in E2362.These findings indicate that most of the above-ground building materials were either not substantially contaminated, or were decontaminated in the past. The higher fixed contamination levels are likely due to the spillage of liquid radioactive waste on the floor in certain areas, with seepage into and contamination of the concrete. Much of the floor material will require management as radioactive waste at the time of site remediation.

The estimated volume of building structural material is presented in Table 2. The volume estimates are based on facility drawings, and assume ratios of shipping volume to in-place volume of 2 for concrete, 1 for wastewater/sludge, and 1.25 for soil/sand. The superstructure material is mostly uncontaminated, and not included in this table.

1.3.3 Radioactive Wastewater System

The wastewater in the concrete pit tanks in the northwest end of Building E2364 contained 2,100 pCi/L of Cs-137. The water in the valve pit adjacent to the building also contained this radionuclide, at a lower level activity of 480 pCi/L. Small amounts of Sr-90 and Tc-99 were also detected in the wastewater. The small amount of sludge in the concrete tanks is contaminated primarily with Cs-137 (168 and 2,880 pCi/g in samples Sl-02 and SL-03, respectively). Sludge in these tanks also contains a small amount of Co-60 (11.6 pCi/g). Sludge in the marsh sump that received drainage from the valve pit also contains Cs-137 (98.8 pCi/g). Sludge from the small wastewater sump in E2354 also contains small amounts of Cs-137 and Co-60, 36.3 and 1.06 pCi/g, respectively. These FS data are generally consistent with the findings of a 1995 survey (R&R, 1995).

It is likely that there was some leakage from sewer lines, sumps and concrete floor tanks to surrounding and underlying soil. The extent of this contamination is uncertain. The E2364 concrete pit tanks are full of water. These tanks have been emptied in the past, and have subsequently filled up with water from an unknown source (Nemeth, 1989). It is unlikely that groundwater seepage contributes to this flow, because the bottom depth of the pits is near or slightly above the level of groundwater. The likely source of seepage is from the former pits under the floor in the southern portion of the building. It is likely that this former white phosphorus storage pit was filled with soil or sand at the time the concrete floor was constructed during the 1960s conversion to a radioactive waste processing facility. This sub-floor pit area has not been sampled, but could be contaminated with radionuclides.

The E2354 concrete pit tanks and the drum pit are filled with wastewater and a small amount of sludge. Piping in the valve pit was leaking at the time of sampling, and the valve pit contained several feet of water. The water level is likely variable and dependant on the rate of leakage. The sump at the end of the line that drains the valve pit did not contain water at the time of sampling, suggesting that the drain line is plugged. The sump has an earthen bottom to allow seepage. The sub-floor pit in the southern end of

Table 2. Structures and Debris/Waste Volumes

Building	Feature	Year of Const	Material	# of Items	Dimensions (ft) Length	Width/ Height/ Diameter	Average Thickness	Estimated Volume Ratio	Estimated Shipping Volume (yd^3)	Volume (gal)
E2354	Wastewater sump and pump	1961	40-gallon stoneware tank w/steel cover and sump pump	1	4	3		1	1	
E2356	Concrete Slab	?	Concrete.	1	21	11.67	0.5	2	9	
E2360	Original Floor (based on E2362 drawings)	1936	Concrete (StR?), 6-in thickness	1	76	35	0.5	2	99	
E2360	Concrete Apron	1936	Concrete (StR?), 4-in thickness	1	76	24	0.33	2	45	
E2360	Original structural columns (based on E2362 drawings)	1936	Concrete (StR?), 18 in sq	7	8	1.5	1.5	2	9	
E2360	Original structural columns (based on E2362 drawings)	1936	Concrete (StR?), 12 in sq	14	6	1	1	2	6	
E2362	Original Floor	1936	Concrete (StR?), 6-in thickness	1	76	35	0.5	2	99	
E2362	Concrete Apron	1936	Concrete (StR?), 4-in thickness	1	130	24	0.33	2	76	
E2362	Original structural columns	1936	Concrete (StR?), 18 in sq	7	8	1.5	1.5	2	9	
E2362	Original structural columns	1936	Concrete (StR?), 12 in sq	14	6	1	1	2	6	
E2362	Entry Ramp	1961	Concrete with wire mesh reinforcing	1	76	3	0.25	2	4	
E2362	Sloping floor topping, slope to middle wastewater trench	1961	Concrete with wire mesh reinforcing	1	76	35	0.25	2	49	
E2362	Wastewater Trench running length of building, 12 in sq inside, 18 in sq structure	1961	Concrete (with wire mesh reinforcing?)	1	76	3	0.25	2	4	
E2364	Floor of original pits	1941	Concrete (StR), 16in thick, except center of 2 pit areas 12in thick. Bottom elev 4.17 (GS = 12.17).	1	62.0	45.0	1.33	2	275	
E2364	Walls, lengthwise outside walls	1941	Concrete (StR), 12in thick, 7.5 ft top portion	2	60	7.5	1.00	2	67	
E2364	Walls, lengthwise outside walls	1941	Concrete (StR), 12in thick, 2.5 ft bottom portion	2	60	2.5	1.33	2	30	
E2364	Dividing wall, lengthwise in bldg	1941	Concrete (StR), 12in thick	1	60	10	1.00	2	44	
E2364	Walls, outside ends	1941	Concrete (StR), 12in thick, 7.5 ft top portion	2	43	7.5	1.00	2	48	
E2364	Walls, outside ends	1941	Concrete (StR), 12in thick, 2.5 ft bottom portion	2	43	2.5	1.33	2	21	
E2364	Platform at north end of building	1941	Concrete (StR)	1	39	6	1.50	2	26	
E2364	Platform at north end of building (support beams)	1941	Concrete (StR)	4	7.5	0.83	0.83	2	2	
E2364	Platform at north end of building (stairs)	1941	Concrete (StR)	1	7	6	1.50	2	5	
E2364	Divider walls to create holding tanks	1961	Concrete (StR?), 12-inch thick	2	20	5	1.00	2	15	
E2364	Walls of drum pit (side)	1961	Concrete (StR?)	1	16	5	1	2	6	
E2364	Walls of drum pit (end)	1961	Concrete (StR?)	1	9	5	1	2	3	
E2364	Drum pit stairway	1961	Concrete (StR?) (estimated dimensions)	1	9	6	4	2	16	
E2364	Floor over old WP pit (southwest)	1961	Concrete (StR?)	1	45	20	0.67	2	45	
E2364	Floor over old WP pit (southeast)	1961	Concrete (StR?)	1	45	20	0.67	2	45	
E2364	Valve pit (bottom)	1961	Concrete (StR), 12-inch thick	1	8	8	1	2	5	
E2364	Valve pit (sidewalls)	1961	Concrete Block, 8-inch, asphaltum coating	4	8	6.7	0.67	2	11	
E2364	Sump at end of valve pit drain line into marsh	1961	Concrete (cinder) block with earthen bottom (estimated dimensions)	4	5	4	0.67	2	4	
E2364	Holding tank in discharge line (bottom)	1983	Concrete (StR), 10-inch thick	1	14	10	0.83	2	9	
E2364	Holding tank in discharge line (top)	1983	Concrete (StR), 8-inch thick	1	13.33	9.33	0.67	2	6	
E2364	Holding tank in discharge line (sides)	1983	Concrete (StR), 8-inch thick	2	13.33	8	0.67	2	11	
E2364	Holding tank in discharge line (ends)	1983	Concrete (StR), 8-inch thick	2	8	8	0.67	2	6	
E2364	Holding tank misc (manway cover, vent, etc.)	1983	Misc						2	
E2364	Headwall in discharge line at Bush River shoreline	1961	Concrete (estimated dimensions)	1	4	4	0.67	2	1	
E2364	Contents of holding tank (northwest) contents		Wastewater and sludge	1	20	15	5	1	56	11220
E2364	Contents of holding tank (northeast) contents		Wastewater and sludge	1	20	15	5	1	56	11220
E2364	Contents of drum pit		Wastewater and sludge	1	16	9	5	1	27	5386
E2364	Contents of valve pit		Wastewater and sludge	1	8	8	*3.2*	1	8	1532
E2364	Contents of sump at end of valve pit drain line into marsh		Soil. The sump has an earthen bottom, and at the time of sampling contained no water.	1	5	4	*3*	1.25	3	561
E2364	Contents of wastewater holding tank in discharge line		Wastewater and sludge	1	12	8	8	1	28	5745
E2364	Contents of southwest subfloor pit in southern portion of building		Sand or soil	1	45	20	5	1.25	208	
E2364	Contents of southwest subfloor pit in southern portion of building		Wastewater	1	45	20	5	1	167	33660
E2364	Contents of southeast subfloor pit in southern portion of building		Sand or soil	1	45	20	5	1.25	208	
E2364	Contents of southeast subfloor pit in southern portion of building		Wastewater	1	45	20	5	1	167	33660
E2364	Miscellaneous equipment		Evaporator, hoods, etc.						30	
							TOTALS		**2,074**	**102,983**

Notes: - All volumes of solids (yd3) are estimates of shipping volume following demolition. The estimated volume ratio is the ratio of shipping volume to inplace volume of materials.
- The 3.2-foot depth of wastewater in the valve pit was at the time of sampling in 1998. The inflow pipe was noted to be leaking at the time of sampling.
- The thickness of contaminated soil in the bottom of the valve pit drain sump is assumed to be 3 feet.

Table 3. Sewer Lines of Radioactive Wastewater System

Building #	Sewer Line Section	Year of Const	Material	# of Items	Dimensions (ft) Length	Diameter	Estimated Pipe Shipping Volume (yd^3)	Max Content Volume (gal)	Estimated Soil Volume (yd^3)[a]
E2354	Wastewater line from E2354 to E2362/E2364 system	1961	4-inch black pipe	1	345	0.33	4.3	221	144
E2362	Wastewater line from floor trench to E2364 valve pit	1961	6-inch black pipe	1	100	0.5	2.1	147	42
E2364	Drain line from E2364 valve pit to sump in marsh	1961	4-inch TC	1	100	0.33	1.2	64	42
E2364	Discharge line from valve pit to 5000-gallon holding tank	1961	8-inch TC	1	40	0.67	1.3	105	17
E2364	Former discharge line downgradient from 5000-gallon holding tank	1961	8-inch TC (reported to be abandoned, method unknown)	1	128	0.67	4.0	338	53
E2364	Former discharge line into Bush River from concrete headwall	1961	8-inch black pipe	1	15	0.67	0.5	40	6
			TOTALS		**728**		**13**	**914**	**303**

[a] Assumes soil in a 3 foot square cross section along 50% of sewer line length is contaminated and assumes an expansion factor of 25% for excavation.

E2364 was likely filled with a fill material such as sand or soil at the time the building was modified for radioactive waste handling in 1961. This fill material may be saturated with water, and both water and fill may be contaminated. The estimated volume of wastewater and sludge in tanks, pits and sumps is presented in Table 3. The sump that received drainage from the valve pit was originally located at the edge of a marsh area, and landfilling was subsequently performed around the sump. Wastes containing the chemical agent mustard were also historically released to this marsh area. This sump has an earthen floor, and the extent of contamination is uncertain. It is likely that only limited excavation will be technically feasible because of the hazards associated with mustard wastes and subsequently landfilled wastes that likely include ordnance and hazardous waste.

The total length of sewer lines is approximately 730 feet. It is anticipated that remediation will involve excavation of all sewer lines, sumps and floors, possibly including the concrete pit tanks. The estimated volume of waste associated with the sewer line is presented in Table 3. Portions of the wastewater lines may also contain contaminated wastewater. Those most likely to contain water are those up-line of E2364 that run to E2362 and E2354.

It is expected that soil verification sampling and analysis will be conducted at the time of remediation, with soil being removed as necessary from beneath sewer lines to achieve the cleanup levels. If it is assumed that soil along 50% of the sewer line is contaminated due to leakage, and that the contaminated soil is in a 3-foot square cross section, then the total volume of contaminated soil associated with the sewer lines would be approximately 300 yards^3. This estimate may be high for the sewers up-line of E2364, because the black steel pipe line was unlikely to leak except at joints. The terra cotta discharge line between E2364 and the Bush River would most probably have leaked, but the wastewater in this line would have contained low levels of radionuclides, and the extent of soil contamination may be small.

1.4 Risk Assessment Summary

A risk assessment focusing on the risks posed by radionuclides has previously been performed. Details may be found in the (draft) document titled "Bush River Study Area, Human Health Radiological Risk Assessment, Radioactive Waste Management Facility" dated September 2002. This document also addresses risks associated with arsenic in soil. Other non-radionuclide constituents such as chlorinated solvents in the groundwater, are being addressed by an ongoing CERCLA feasibility study and are not within the scope of this removal action.

The area is not open for public use, and is currently protected by a variety of physical security measures including fences, military patrols, and other security countermeasures to prevent trespass. Current and future use of the site is 'industrial' (labeled by the APG Master Plan as supply/storage). Workers, security guards, military police, maintenance workers/groundskeepers and environmental workers have access to the site.

Radionuclides in the soil present a human health risk to industrial workers through inhalation exposures to dust and radon, ingestion of radionuclides in soil, and external gamma exposure to workers. Radionuclide constituents also could be released from the soil in the future via erosion during precipitation runoff, windblown dust and vegetative uptake. There is no evidence that these processes have been significant in the past and that radionuclides have been transported from points of release in the Rad Yard, (with the exception of possible transport by surface runoff in the vicinity of E2360 and the southern corner of the yard). There is also no evidence that radionuclides have migrated or will migrate to groundwater.

The health effects from radiation exposure were evaluated using the NRC dose assessment approach. Radiation dose is calculated by multiplying a dose conversion factor (DCF), expressed in terms of unit dose/unit intake, for a given radionuclide by the total intake/exposure to that radionuclide (i.e., external radiation, ingestion or inhalation). The health effects were also evaluated by using a cancer risk assessment approach (i.e., slope factor approach) that is used by the United States Environmental Protection Agency (EPA). Using this approach, risk is calculated directly by multiplying the total exposure by a risk coefficient, also termed a cancer slope factor (i.e., probability of cancer/pCi). The risk assessment for both methods was preformed using the Department of Energy (DOE) Residual Radioactivity (RESRAD) model, Version 6.2.

At present, the calculated total radiation dose and risk to hypothetical workers at the Rad Yard is 2,661 mrem/yr and 3.83×10^{-2}, respectively. The arsenic in soil further contributes to cancer risk. The dose is significantly higher than the radiological criteria for NRC license termination (or removal of a site from a license) in 10 CFR 20 Subpart E, i.e., either 25 mrem/yr or 100 mrem/yr, or the risk levels considered to be protective under CERCLA.

2 IDENTIFICATION OF REMOVAL ACTION OBJECTIVES

The Rad Yard is currently regulated under an NRC license. The radiological criteria for NRC license termination (or removal of a site from a license) are put forth in 10 CFR 20 Subpart E, Radiological Criteria for License Termination. The radiological criteria for unrestricted use are: "*A site will be considered acceptable for unrestricted use if the residual radioactivity that is distinguishable from background radiation results in a TEDE to an average member of the critical group that does not exceed 25 mrem (0.25 mSv) per year, including that from groundwater sources of drinking water, and the residual radioactivity has been reduced to levels that are as low as reasonable achievable (ALARA). Determination of the levels which are ALARA must take into account consideration of any detriments, such as deaths from transportation accidents, expected to potentially result from decontamination and waste disposal.*"

The 25 mrem/yr dose limit as a criteria for license termination is set lower than the 100 mrem/yr exposure limit for the public to protect against the possibility of a persons exposure to multiple sources.

Removal of the Rad Yard from the license under restricted conditions is allowed under 10 CFR 20 Subpart E. However, the ALARA requirement still applies, and remediation must still be to a level that would result in no more than 100 mrem/year exposure in the absence of land use controls.

The Rad Yard is also a CERCLA site and is on the National Priorities List. As such, it is subject to USEPA remedial requirements. The USEPA often uses applicable or relevant and appropriate requirements (ARARs) in establishing cleanup levels at CERCLA sites. However, where ARARs are not available or are not sufficiently protective, EPA generally sets site-specific remediation levels. For carcinogens, including radionuclides, remediation levels are established at a level that represents an excess upper bound lifetime cancer risk to an individual of between 10^{-6} and 10^{-4}. The USEPA has indicated that the upper boundary of the risk range is not a discrete line at 1×10^{-4}, although EPA generally uses 1×10^{-4} in making risk management decisions. A specific risk estimate around 10^{-4} may be considered acceptable if justified based on site-specific conditions. Cancer risk from both radiological and non-radiological contaminants should be summed to provide risk estimates for persons exposed to both types of carcinogenic contaminants.

The NRC Radiological Criteria for License Termination (10 CFR 20 Subpart E) are not based on the 10^{-6} and 10^{-4} risk range, but are based on a different framework for risk management recommended by the International Commission on Radiological Protection and the National Council on Radiation Protection and Measurements. The 25 mrem/yr effective dose equivalent of 10 CFR 20 Subpart E is approximately equivalent to a risk of 5×10^{-4} for external gamma radiation. The USEPA has also indicated that guidance that provides for cleanups outside the risk range (in general, cleanup levels exceeding 15 millirem per year which equates to approximately 3×10^{-4} increased lifetime risk) is not protective under CERCLA and generally should not be used to establish cleanup levels (USEPA, 1997c).

The risk assessment for the Rad Yard recommended remedial goals (i.e., cleanup levels) based on NRC and USEPA requirements. Remedial goal options for removal of the Rad Yard from the NRC license were calculated using RESRAD. The procedures and equations presented by the U.S. Environmental Protection Agency's *Soil Screening Guidance for Radionuclides: Users Guide and Soil Screening Guidance for Radionuclides: Technical Background Document* were used to develop risk-based remedial goal options for radionuclides and arsenic under the Comprehensive Environmental Response, Compensation and Liability Act.

Proposed remedial goals for soil with unrestricted site usage are 5 pCi/g for cesium-137, 0.5 pCi/g for cobalt-60 and 10 mg/kg for arsenic. These proposed remedial goals are consistent with both U.S. Nuclear Regulatory Commission criteria for removal from the license, and also the U.S. Environmental Protection Agency requirements for remediation under CERCLA. Because the NRC requirements for cleanup are for total dose from all radionuclides and the USEPA requirements are for total risk from all radionuclides plus chemical carcinogens, the cleanup levels for all three constituents are lower than what would be required for a single constituent alone.

While the focus of the risk assessment was on human health, discussion of potential impacts on ecological receptors was also presented, indicating that final cleanup levels for radionuclides that are protective of human health will also be protective of ecological receptors. A final cleanup level for arsenic that would allow unrestricted use of the site would also be protective of ecological receptors.

The Rad Yard could be removed from the NRC license without site restrictions if the residual radioactivity is reduced to levels that are as low as reasonably achievable (ALARA) and does not exceed 25mrem/yr. The NRC license could also be terminated under restricted conditions if residual levels meet the ALARA requirement, exposure does not exceed 25 mrem/yr under institutional controls, and does not exceed 100 mrem/yr if institutional controls are not in effect. Under the restricted use alternative, soil would be removed from Cs-137 hot spots, and the site would be capped to control future erosion and leaching. However, this alternative (NRC restricted use levels) would not meet the NRC ALARA requirements, and hence is not viewed as being a viable option and is not considered further.

The mean level of constituents in soil would be less than the remedial levels following remediation. It is expected that an unrestricted use remedy for soil would involve excavation with offsite disposal at a radiological waste disposal facility. Any subsequent backfilling or grading would be for site restoration purposes, and not as a cap or cover to manage risk.

Remediation to the above levels will achieve the following objectives:

- Eliminate the threat to health and safety associated with exposure to radioactive materials, eliminate the potential for release of radioactive wastes to soil, sediment and surface water, and protect ecological receptors, without requiring a cap

- Allow the site to be removed from the NRC license with unrestricted use, while also meeting CERCLA guidance

- Facilitate the future remediation of non-radioactive contaminants being addressed by the ongoing CERCLA feasibility study.

2.1 Statutory Limits on Removal Actions

Removal actions are generally limited by statute to a maximum cost of 2 million dollars and a maximum duration of 12 months, except as provided for under 2 types of exemptions available (emergency and consistency). CERCLA Section 104(b) (1) governs the 12-month time limit and the 2 million dollar statutory limit. As described in this engineering evaluation/cost analysis (EE/CA), the proposed removal will be accomplished with a cost less than 2 million dollars and within a period of less than 12 months, subject to factors such as weather and availability of resources.

2.2 Determination of Removal Scope

The removal action will include the excavation and removal of soil contaminated with radioactive materials and arsenic such that residual soils have contaminant levels below cleanup goals. It will also include demolition and removal of fencing, concrete slabs, drum-handling rails, and the wastewater system (i.e., pits, tanks, sewer lines and sumps). An attempt will be made to segregate uncontaminated structural materials such as steel beams. Only contaminated materials will be shipped off-site to a permitted disposal facility. Any subsequent backfilling or grading would be for site restoration purposes only, and would not constitute a cap or a cover to manage risk

Incidental to and prior to this removal action, UXO will be cleared from the site, since it is possible that unexploded ordnance is present within the boundaries of the Rad Yard. With the exception of radionuclides and arsenic in soil, which will be removed as part of the removal of radioactive wastes, there are no other contaminants in soil at levels that require any remediation. Contaminants in ground water (e.g., chlorinated compounds) are being addressed by an ongoing CERCLA feasibility study and are not within the scope of this removal action.

2.3 Determination of Removal Schedule

The response being considered is a non-time critical removal action as defined under CERCLA. While the action is technically non-time critical by CERCLA definition, it is expected that the removal would be accomplished in an expedited manner, subject to factors such as weather and availability of resources. The one-year statutory restriction on removal actions under CERCLA is not applicable at PRP-lead sites.

3 IDENTIFICATION AND ANALYSIS OF REMOVAL ACTION ALTERNATIVES

Two alternatives have been identified for the purposes of this analysis: "No Action," and "Excavation and Disposal." These alternatives are described and evaluated against the criteria of effectiveness, implementability and cost.

3.1 Alternative 1 – No Action

The "No Action" alternative would involve no actions specifically intended to address the radioactive wastes in the Rad Yard. No actions would be taken to control or monitor release of radioactive contaminants from the site. No engineering measures would be implemented to prevent contact with wastes. However, access controls would exist with continuance of the existing physical security measures, to include random patrols by law enforcement personnel. Even with a "No Action" decision for removal, the Rad Yard would be evaluated and addressed by the ongoing feasibility study and remedial decision process for the Bush River Study Area, to be accomplished during the next few years.

The "No Action" alternative is not protective of human health or the environment; exposure to radioactive wastes or arsenic would not be controlled or prevented. At present, the calculated total radiation dose to hypothetical workers at the Rad Yard is 2,661 mrem/yr. Under the "No Action" alternative, site workers in the Rad Yard will continue to be exposed to external gamma radiation, primarily from Cs-137. Site workers could also contact surface soil, with incidental ingestion of soil. All future receptors could also be exposed to radionuclides in soil via external radiation and ingestion. In addition, radionuclides could eventually migrate to sediment and surface water and pose risk to human health via exposure pathways including these media.

The "No Action" alternative is easily implemented. No capital cost is associated with this alternative. If a future "No Action" decision was again made with the CERCLA record of decision (ROD), the only long-term costs would be for 5-year remedy reviews, which would have a present worth cost of approximately $50,000 for a 30-year period.[2]

3.2 Alternative 2 – Removal and Disposal

Alternative 2 consists of the following:

- Clearance of UXO from the site
- Excavation of soil contaminated with radioactive materials
- Temporary storage of material in segregated storage piles
- Screening of excavated soil and loading into 20 cubic yard roll-off containers for shipment to off-site disposal facilities
- Removal of fencing, drum-handling rails, and concrete slabs in and around Building E2356
- Demolition of wastewater system including wastewater pits, tanks, sewer lines and sumps
- Demolition of Buildings E2360, E2362, E2364, E2366 and E2368
- Segregation of uncontaminated building materials, e.g., superstructure
- Backfilling of excavated pits and tanks
- Soil verification sampling and analysis to confirm that remediation goals have been met.
- Site restoration and landscaping

[2] The EPA guidance for cost estimates under CERCLA is to estimate the present worth cost for 30 years of operations and maintenance.

Table 4
Removal Action Cost Estimate
Rad Yard

Line	Item #	Item	Quantity	Units	Safety Level	Unit Cost	Direct Cost	Markup	Marked Up Cost[a]	Basis[b]
		Capital Costs								
		Planning								
A1	1	Remedial Design/Workplan	1	ea	E	$23,398	$23,398	210%	$72,616	R
A2	2	Health & Safety Plan	1	ea	E	$3,500	$3,500	208%	$10,766	U
A3	3	Soil Erosion & Sediment Control Plan	1	ea	E	$3,676	$3,676	177%	$10,168	U
		Site Preparation & Equipment								
B1	1	Topographic Survey	6	acres	D	$517	$3,101	102%	$6,271	U
B2	2	UXO Clearance (Remedial & Support Area)	5	acre	D	$27,282	$136,409	20%	$163,989	R
B3	3	Install Silt Fence	1,000	lin ft	D	$1.53	$1,533	112%	$3,249	U
B4	4	Decontamination Facilities	1	ea	D	$18,181	$18,181	40%	$25,471	R
B5	5	Bulk Material Storage (excavated soil awaiting screening)	1,000	cy	D	$31.69	$31,689	44%	$45,778	R
B6	6	Bulk Material Storage (rad contaminated soil)	3,800	cy	D	$9.97	$37,879	46%	$55,161	R
B7	7	Bulk Material Storage (arsenic only contaminated soil)	5,600	cy	D	$8.43	$47,214	46%	$68,772	R
B8	8	Bulk Material Storage (uncontaminated soil)	1,000	cy	D	$7.33	$7,326	40%	$10,276	R
B9	9	Bulk Material Storage (demolition debris awaiting screening)	500	cy	D	$26.41	$13,205	45%	$19,199	R
B10	10	Bulk Material Storage (contaminated demolition debris)	775	cy	D	$21.20	$16,427	45%	$23,893	R
B11	11	Bulk Material Storage (uncontaminated demolition debris)	1,000	cy	D	$7.33	$7,326	40%	$10,276	R
B12	12	Intermodal Containers, 21.5 cy, closed top	10	ea	D	$4,695	$46,946	29%	$60,436	R
B13	13	Tanker Trailers (6000-gal) for Temporary Storage of Wastewater	5	ea	D	$31,710	$158,551	29%	$204,111	R
		Storage Yard Soil Remediation								
C1	1	Remove Fence	1,520	lin ft	D	$1.57	$2,390	59%	$3,812	R
C2	2	Remove Concrete Slabs (E2356 + Nearby Unnamed)	350	sf	C	$1.17	$411	51%	$622	R
C3	3	Remove Recessed Ton-Containers	1	ea	C	$380	$380	51%	$574	R
C4	4	Remove Remnants of Drum-Handling Rails	500	lin ft	C	$3.76	$1,878	52%	$2,853	R
C5	5	Surface Soil Excavation (Cs-137), Verification Sampling & Backfilling	3,872	cy	C	$26.42	$102,283	33%	$135,787	R
C6	6	Surface Soil Excavation (As only), Verification Sampling & Backfilling	3,623	cy	C	$25.36	$91,877	33%	$122,122	R
		Demolition of Wastewater System								
D1	1	Excavate E2354 Wastewater Line (4-inch black pipe)	345	ft	C	$13.18	$4,547	49%	$6,782	R
D2	2	Excavate E2362 to Valve Pit Line (6-inch black pipe)	100	ft	C	$13.86	$1,386	49%	$2,067	R
D3	3	Excavate Drain Line from Valve Pit to Marsh Sump (4-inch TC)	100	ft	C	$13.21	$1,321	49%	$1,968	R
D4	4	Excavate Discharge Line from Valve Pit to Holding Tank (8-inch TC)	40	ft	C	$14.85	$594	49%	$887	R
D5	5	Excavate Discharge Line downflow of Holding Tank (8-inch TC)	128	ft	C	$14.86	$1,902	49%	$2,838	R
D6	6	Demolition of Manholes in Sewer Line	2	ea	C	$380	$760	49%	$1,132	R
D7	7	Demolition of Marsh Sump	1	ea	C	$380	$380	49%	$566	R
D8	8	Demolition of Valve Pit	1	ea	C	$380	$380	49%	$566	R
D9	9	Excavation/Demolition of 5000 gal Holding Tank	1	ea	C	$7,001	$7,001	51%	$11,795	R
D10	10	Demolition of E2354 Wastewater Sump	1	ea	C	$196	$196	47%	$289	R
D11	11	EOD Support for Wastewater System Excavation	10	days	C	$1,131	$11,307	48%	$16,708	U
D12	12	Wastewater System Verification Sampling	1	ea	C	$40,620	$40,620	44%	$58,471	R
		Demolition of Buildings								
E1	1	Demolition of E2360 Roof	1	ea	D	$7,891	$7,891	30%	$10,261	R
E2	2	Demolition of E2362 Roof	1	ea	D	$7,891	$7,891	30%	$10,261	R
E3	3	Demolition of E2360 Slab, Columns and Walls	1	ea	C	$40,350	$40,350	43%	$57,731	R
E4	4	Demolition of E2362 Slab, Columns and Walls	1	ea	C	$41,820	$41,820	43%	$59,625	R
E5	5	Temporary Cover of E2364 Wastewater Pits	1	ea	C	$383	$383	57%	$603	U
E6	6	Removal of E2364 Abandonned Equipment (evaporator, hoods, etc.)	1	ea	C	$1,125	$1,125	36%	$1,526	U
E7	7	Demolition of E2364 Roof and Upper Walls	1	ea	C	$11,796	$11,796	32%	$15,527	R
E8	8	Demolition of E2364 Floor (southern portion of bldg)	1	ea	C	$25,484	$25,484	41%	$35,917	R
E9	9	Excavation of E2364 Backfill (southern portion of bldg)	1	ea	C	$14,358	$14,358	38%	$19,860	R
E10	10	Removal of Wastewater & Sludge from Floor Tanks and Pits	1	ea	C	$26,827	$26,827	39%	$37,229	U
E11	11	Treatment of Wastewater from E2364 Tanks	103,000	gal	D	$0.47	$48,064	38%	$66,116	R
E12	12	Demolition of E2364 Concrete Structure	1	ea	C	$37,439	$37,439	43%	$53,549	R
E13	13	Excavation of Contaminated subsurface soil	200	cy	C	$22.40	$4,479	37%	$6,135	R
E14	14	E2360, E2362 & E2364 Subfloor Verification S&A	1	ea	D	$30,571	$30,571	43%	$43,669	R
E15	15	Backfill E2364 Pit Tanks	1	ea	D	$500	$500	48%	$741	U
		Site Restoration								
F1	1	Cleanup and Landscaping	10	acre	D	$969	$9,691	40%	$13,542	R
		Project/Construction Management								
G1	1	Professional Labor Management	1	ea	E	$105,349	$105,349	202%	$318,051	R
		TOTAL					$1,240,792	54%	**$1,910,614**	

[a] Markups include a 5% owner cost. All markups for Racer-derived estimates are system defaults.
[b] "R" = Racer estimate, "U" = User-defined estimate in Racer.

Details of items included in the removal action are shown in Table 4, along with the corresponding cost estimate.

This alternative would be effective in protecting human health and the environment, would meet removal action objectives, and could be readily implemented. The cost of this alternative is estimated to be $1,910,164, and consists entirely of capital cost with negligible long-term operations and maintenance cost.

4 COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES

4.1 General

This section presents a description and analysis of each of the removal action alternatives identified for the project area. The following alternatives are considered:

- Alternative 1: No Action
- Alternative 2: Excavation and Removal

Each alternative is evaluated based on three major categories:

1. Effectiveness
2. Implementability
3. Cost

Effectiveness is evaluated based upon the following factors:

- Overall protection of public health and safety
- Compliance with ARARs or other requirements
- Long-term effectiveness and permanence
- Short-term effectiveness
- Reduction in toxicity, mobility and volume

Implementability is based on:

- Technical feasibility
- Availability of services and materials
- Administrative feasibility
- State & Community Acceptance

Cost includes:

- Direct Capital Costs, e.g., construction, equipment, material, treatment & operating costs, analytical costs, and contingency allowances.
- Indirect Capital Costs, e.g., engineering and design expenses.
- Annual Post-Removal Site Control, e.g., operational and maintenance, and monitoring costs.

Effectiveness: Only the excavation and removal alternative (Alternative 2) would be protective of human health and the environment, meet the risk-based remediation goals, meet long-term and short-term goals, and reduce the quantity of radioactive wastes on site. The No Action alternative would involve no actions to protect either human health or the environment, and would not meet remedial action objectives.

Implementability: The excavation and disposal alternative is technically and administratively feasible, and can be implemented with readily available equipment and materials. State and community acceptance issues will be incorporated into the Action Memorandum after review and comment.

Cost: The excavation and disposal alternative involves a greater 'upfront' capital cost, but long-term operation and maintenance costs would be negligible. The No Action alternative would involve costs only for 5-year remedy reviews if the no action decision was carried forward as a long-term remedy in the ROD. The estimated costs of the two alternatives are:

No Action	$50,000
Excavation and Disposal	$1,910,164

The two alternatives have also been evaluated for environmental considerations under the National Environmental Policy Act (NEPA). Table 5 presents a discussion of potential environmental impacts and satisfies NEPA requirements.

5 RECOMMENDED REMOVAL ACTION ALTERNATIVE

The Excavation and Disposal alternative is recommended because it offers the highest degree of protectiveness, and is a permanent remedy that does not depend on long-term site restrictions, operation and maintenance.

Table 5. Environmental Considerations for Removal Action Alternatives

	Alternative 1 **No Action**	**Alternative 2** **Excavation and Disposal**
WETLANDS	No impacts	Valve pit sump was located in a wetland area, subsequently filled in around sump. Only limited excavation will be feasible because of presence of ordnance, chemical agent and hazardous waste. Precautions will have to be taken to minimize potential impacts on any adjacent wetlands.
ARCHEOLOGICAL RESOURCES	No impacts	No impacts
THREATENED / ENDANGERED SPECIES	No impacts	The waste removal activities would be of short duration and limited to a small area, with no significant impacts to threatened or endangered species
SEDIMENT AND EROSION CONTROL	No impacts	Will probably require an approved sediment and erosion control plan, depending on the size of the area to be disturbed by excavation and supporting activities
NOISE POLLUTION	No impacts	Noise control measures may need to be implemented to minimize impacts during any necessary onsite detonation of unexploded ordnance
HAZARDOUS WASTE	No actions would be taken to mitigate threats associated with explosive wastes possibly present at the site	The excavation and disposal of waste would eliminate any possible threats associated with direct human contact with explosive (reactive) wastes possibly present at the site. Excavated wastes would be managed in accordance with Federal and State regulations
AIR POLLUTION	No impacts	Proper procedures would need to be implemented to control fugitive emissions of dust during excavation operations

APPENDIX A

REFERENCES

1. Nemeth, Gary, "RCRA Facility Assessment Report, Edgewood Area, Aberdeen Proving Ground, Project No. 38-26-0490-90," Waste Disposal Engineering Division, US Army Environmental Hygiene Agency, Aberdeen Proving Ground, Maryland, November 1989.
2. US Army Corps of Engineers, Baltimore District, October 1998, "Final Technical Report for the Removal Action at the Bush River 26th Street Disposal Site."
3. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, "Guidance on Conducting Non-Time-Critical Removal Actions Under CERCLA," EPA 540-R-93-057, August 1993.
4. USAPG, "Bush River Study Area Feasibility Study 26th Street Disposal Site," Draft, November 2002.
5. USAPG, "Nothern Bush River Remedial Investigation Report, Volume I and II," Draft, June 2002.
6. USAPG, "Bush River Study Area, Human Health Radiological Risk Assessment, Radioactive Waste Management Facility" (Draft), September 2002.

APPENDIX B

GLOSSARY

APG	Aberdeen Proving Ground
ARAR	Applicable or Relevant and Appropriate Requirement
ALARA	As Low As Reasonably Achievable
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
EE/CA	Engineering Evaluation/Cost Analysis
NEPA	National Environmental Policy Act
UXO	Unexploded Ordnance