4.2.2 DEDICATION STRATEGY (NO REMOVAL OF WASTE AT EXISTING WASTE SITES, AND IMPLEMENTATION OF COST-EFFECTIVE REMEDIAL AND CLOSURE ACTIONS AS REQUIRED)

This section describes modifications at existing waste sites that include closure and could include further remedial actions, consistent with the Dedication strategy in which waste is not removed at any of the existing waste sites, and the sites, with buffer zones, are dedicated for waste management purposes.

Closure would be applied to inactive waste sites to reduce infiltration, control surface-water runoff, and reduce erosion and leachate generation. Closure techniques include capping, grading, and revegetation; runoff diversion and collection; and leachate control systems. Although individual site remediation requirements would be determined by interactions with regulatory agencies, for this EIS, remedial actions refer to measures that are applied in addition to closure to control past or continuing releases of contaminants. Remedial actions include in situ treatment, groundwater pumping and treatment, and containment or diversion. Appendix C presents more information on remedial, treatment, and closure techniques.

TC Intermedia exchange or transfer of contaminants from corrective or remedial actions applied to contaminated groundwater may result in transfer of quantities of contaminants to other environmental media. For example, air stripping of groundwater contaminanted with volatile organic chemicals results in airborne releases of these compounds. While there is no impact to nearby soils, vegetation, or surface streams, close coordination with regulatory agencies is necessary for proper permitting and approval of these practices. Similar conditions would apply in the case of reinjection of treated groundwater to local aquifers or disposal of groundwater through NPDES outfalls, disposal of sludges from liquid effluent treatment facilities, and disposal of spent ion exchange media or carbon filters contaminated with radioactivity or hazardous organic compounds. Incineration of organic solvents presents still another form of intermedia transfer when halogenated solvents, nitrogen, or sulfur-containing materials are converted to acidic off-gases that could be released to the atmosphere, or are combined in air scrubber sludges as a result of neutralization or other absorbent mechanisms in stack scrubber systems. End products from hazardous or radioactive waste pretreatments pose similar concerns that must be evaluated before process selections are finalized.

Under the Dedication strategy, all existing basins that had not been filled previously would be backfilled after any water has been removed. Table 4-17 lists the basins containing water and methods of disposal for the contained liquids. Bottom sediments or sludges would be stabilized before backfilling.

Low-permeability infiltration barriers would be installed to cap selected waste sites (Table 4-18) to minimize the migration of material remaining in the ground into the groundwater. These selections are based on projections of constituent migration made for the No-Action strategy (Section 4.2.1) to provide a basis for preliminary cost estimates for this EIS.

Table 4-17. Basin Liquid Disposal Methods

Site			
Number	Name	Building	Method
1-4	Metallurgical laboratory basin	904-110G	Batch neutralization and discharge to stream
1-8	SRL seepage basin	904-53G	Move to basin 904-55G
1-9	SRL seepage basin	904-53G	Move to basin 904-55G
1-10	SRL seepage basin	904-54G	Move to basin 904-55G
1-11	SRL seepage basin	904-55G	Allow to drain and dry
1-12	M-Area settling basin[a]	904-51G	Decant to Lost Lake
1-13	Lost Lake[a]	904-112G	Allow to drain
2-1	F-Area acid/caustic basin	904-74G	Neutralize and discharge to stream
2-2	H-Area acid/caustic basin	904-75G	Neutralize and discharge to stream
2-5	H-Area retention basin	281-3H	Disposed to operating H-Area retention basin
2-10	F-Area seepage basin[a]	904-41G	Allow to drain and dry
2-11	F-Area seepage basin[a]	904-42G	Allow to drain and dry
2-12	F-Area seepage basin[a]	904-43G	Allow to drain and dry
2-13	F-Area seepage basin (old)	904-49G	Allow to drain and dry
2-14	H-Area seepage basin[a]	904-44G	Allow to drain and dry
2-15	H-Area seepage basin[a]	904-45G	Allow to drain and dry
2-16	H-Area seepage basin[a]	904-46G	Allow to drain and dry
2-17	H-Area seepage basin[a]	904-56G	Allow to drain and dry
3-3	R-Area acid/caustic basin	904-77G	Neutralize and discharge to stream
5-5	TNX seepage basin (new)	904-102G	Transfer to TNX effluent treatment plant
8-2	K-Area acid/caustic basin	904-80G	Neutralize and discharge to stream
8-4	K-Area reactor seepage basin	904-65G	Allow to dry
9-2	L-Area acid/caustic basin	904-79G	Neutralize and discharge to stream
9-12	L-Area oil and chemical basin	904-83G	Remove water to storage/ disposal facility
10-2	P-Area acid/caustic basin	904-78G	Neutralize and discharge to stream

[a]Closure plans have been prepared or filed for these basins.

TC TC TC TC TC

Remedial actions would be performed as needed to conform to groundwater protection requirements resulting from interactions with regulatory agencies and on detailed site-specific information. Additional groundwater monitoring wells would be installed and existing and new wells would be monitored in conformance with post-closure care requirements.

Table 4-18. Waste Sites Assumed To Be Capped with Low-Permeability Barriers

A- and M-Areas	
1-2	Metals burning pit
1-3	Silverton Road waste site
1-4	Metallurgical Lab. basin
1-5	Miscellaneous chemical basin
1-8	Through 1-11 SRL seepage basins
1-12	M-Area settling basin
F- and H-Areas	
2-5	H-Area retention basin
2-6	F-Area retention basin
2-7	Radioactive waste burial ground
2-8	Mixed-waste management facility
2-9	Radioactive waste burial ground
2-10	F-Area seepage basin
2-11	F-Area seepage basin
2-12	F-Area seepage basin
2-13	F-Area seepage basin (old)
2-14	H-Area seepage basin
2-15	H-Area seepage basin
2-16	H-Area seepage basin
2-17	H-Area seepage basin
R-Area	
3-7	R-Area reactor seepage basin
3-8	R-Area reactor seepage basin
3-9	R-Area reactor seepage basin
3-10	R-Area reactor seepage basin
3-11	R-Area reactor seepage basin
3-12	R-Area reactor seepage basin
TNX-Area	
5-3	TNX burying ground
5-4	TNX seepage basin (old)
5-5	TNX seepage basin (new)
Road A Area	
7-1	Road A chemical basin
K-Area	
8-4	K-Area reactor seepage basin
L-Area	
9-12	L-Area oil and chemical basin
Miscellaneous Areas	
11-1	SRL oil test site

TC

Fences, pylons, and signs would be erected at appropriate sites as needed. Inspection and maintenance (mowing, etc.) would be performed routinely as part of overall good housekeeping practices.

4.2.2.1 Groundwater Impacts

The following paragraphs describe groundwater impacts from implementation of no-removal-and-closure actions at the various waste sites in each geographic group.

The results of the model analyses indicate that remedial actions might be required at some sites to reduce the predicted concentration of certain constituents in the groundwater to within the applicable standards. A number of actions could provide remediation (see Appendix C). One corrective action would be groundwater extraction and treatment to remove constituents, such as volatile organic compounds. Such a system is now in operation in M-Area. For this EIS, the feasibility of groundwater extraction at appropriate sites is assumed at the waste sites discussed in the sections that follow. However, TE the choice of actual remedial action would depend on the results of site-specific investigations and regulatory agency agreement.

Groundwater pumping is an accepted method for the extraction of contaminants and, in certain cases, is also a cost-effective method for the limitation of contaminant transport into surrounding water bodies. However, such pumping can affect groundwater extraction at other wells.

A beneficial impact realized in the M-Area groundwater remedial action is the removal of more than 99 percent of volatile organic compounds (VOCs) from the TC recovered groundwater. After one year of operation, more than 55,000 pounds of VOCs were removed from the groundwater.

Another impact that could result from groundwater extraction is ground surface subsidence; that is, the elevation of the ground surface could be reduced measurably as the water table is lowered or as the pressure in a confined aquifer is reduced. However, due to the limited drawdown expected, such effects are considered to be insignificant.

Hydraulic effects of groundwater pumping could be limited through the use of reinjection in conjunction with the pumping. Extracted and treated groundwater meeting applicable National Pollutant Discharge Elimination System (NPDES) requirements also could be discharged to nearby surface streams.

The potential need for groundwater corrective action in a geographic group TE following the implementation of the Dedication strategy is indicated when peak constituent concentrations in the 1- and 100-meter wells are predicted to exceed MCLs or comparable criteria. This differs from no action, which protects the offsite environment but does not necessarily meet criteria for the protection of onsite groundwater. Further, because these exceedances can occur at either a 1-meter or a 100-meter well, individual site contributions are not added to determine if there is a potential for cumulative effects in a geographic grouping. Actual monitoring data and more detailed site-specific modeling would be required to determine the extent and nature of groundwater corrective actions in an area.

The predicted peak concentrations for the acid/caustic basins and the burning/rubble pits are from PATHRAE modeling for the site in each of these two functional groups that has the largest inventory of contaminants. These upper-bound impact predictions are for the L-Area acid/caustic basin and the C-Area burning/rubble pit. Actual peak concentrations for the other acid/caustic basins and burning/rubble pits would depend on site-specific inventories, which could be considerably lower.

Table 4-19 lists constituents in A- and M-Areas that are predicted to exceed MCLs and that could require remedial action under the Dedication strategy. The predominant contaminants are trichloroethylene and tetrachloroethylene. Others that exceed MCLs are tetrachloromethane, 1,1,1-trichloroethylene, TC arsenic, barium, cadmium, nickel, nitrate, and tritium.

Five chemical and 13 radionuclide constituents are predicted to exceed MCLs and require remedial actions in F- and H-Areas for the Dedication strategy, as indicated in Table 4-20. The chemical constituents are lead, mercury, nitrate, trichloroethylene, and tetrachloroethylene. The radionuclides are TC strontium-90, yttrium-90, nickel-63, cobalt-60, technetium-99, cesium-134 and 137, uranium-238, plutonium-238 and -239, iodine-129, neptunium-237, and tritium.

Groundwater pumped from recovery wells would be processed to achieve concentrations within MCLs. Treated groundwater could be discharged to Four Mile Creek or Upper Three Runs Creek, the natural discharge locations for the water-table aquifer, or could be injected to recharge that aquifer. Discharge TC to streams would conform to NPDES and RCRA requirements and would not impact these water bodies. Reinjection would essentially increase the travel time of constituents in the groundwater, which could be an effective method of reducing the concentration of short half-life isotopes such as tritium. Groundwater withdrawal with discharge to surface waters would have an insignificant effect on water-table elevations in F- and H-Areas.

Table 4-21 lists lead, trichloroethylene, tetrachloroethylene, cesium-137, tritium, strontium-90, and yttrium-90 as the constituents predicted to exceed MCLs in R-Area under the Dedication strategy. The R-Area reactor seepage basins are the only sources of radionuclides that are predicted to exceed TC standards. Potentially all of the contaminants predicted to exceed standards in the R-Area could be treated. If groundwater pumping were employed, the drawdown effects would probably be localized and transitory. If drawdown were found to be a problem, the treated water would be reinjected into the aquifer from which it was withdrawn. Otherwise, the treated water would be discharged to nearby onsite streams in compliance with NPDES requirements.

Chromium, trichloroethylene, and tritium are the only constituents in C- and CS-Areas predicted to exceed MCLs under the Dedication strategy (Table 4-22). All the contaminants identified as exceeding standards potentially could require treatment to meet regulatory standards. The considerations of drawdown effects, reinjection, or surface discharge resulting from any groundwater extraction would be the same as those described above for R-Area.

Table 4-23 lists the constituents in TNX-Area that are predicted to exceed TC MCLs under the Dedication strategy (barium, chromium, lead, nitrate, trichloroethylene, and tetrachloromethane). Groundwater would be pumped from recovery wells and processed to reduce contaminant levels to within MCLs or requirements established through regulatory interactions. Treated groundwater would be discharged to the Savannah River swamp, the natural location of outcropping for the water-table aquifer. Drawdown of the water-table due to groundwater withdrawal is expected to be local and insignificant.

The D-Area oil seepage basin (Building 631-G) is the only waste management unit in D-Area. PATHRAE simulations project that the concentration of tetrachloroethylene at the 1-meter well (0.02 milligrams per liter) exceeded its health-based standard (0.0007 milligrams per liter) in 1977 for all actions including the Dedication strategy. As in the nearby TNX-Area, the TC direction of groundwater flow in D-Area is toward the Savannah River. Likewise, because of higher head in the Middendorf/Black Creek, contamination of this aquifer is unlikely.

The constituent concentrations in the miscellaneous waste sites grouping did not meet the threshold selection criteria for PATHRAE modeling. All constituents at these sites would be expected to be within MCLs under the Dedication strategy. Therefore, groundwater corrective actions are not considered likely in those areas. Under the Dedication strategy, the concentration of uranium-238 at the Road A chemical basin is predicted to be 270 picocuries per liter in the year 2985, which is above its MCL (24 TC picocuries per liter).

Four constituents predicted to exceed MCLs in K-Area under the Dedication strategy are lead, chromium, trichloroethylene, tetrachloroethylene, and tritium (Table 4-24). Additional corrective actions, such as contaminated groundwater withdrawal and treatment, could be employed to meet regulatory standards and protect human health and the environment.

The considerations of drawdown effects, reinjection, or surface discharge resulting from any groundwater extraction would be the same as those described for R-Area above.

Table 4-25 identifies 10 chemical and five radioactive constituents in L-Area that are predicted to exceed MCLs under the Dedication strategy. Most of the chemical constituents are organics, issued to originate primarily from the CMP pits; these are 2,4,5-TP (silvex), 2,4-D, endrin, toxaphene, benzene, trichloroethylene, tetrachloroethylene, dichloromethane, and chloroethylene. The other chemical constituent that exceeds MCLs in L-Area is lead. Radioactive constituents include tritium, cobalt-60, strontium-90, yttrium-90, and americium-241. TC

Additional corrective actions, such as the installation of a groundwater extraction system to reduce the levels of listed contaminants, could result in intermedia impacts both individually at each site and cumulatively, as discussed above.

Lead, trichloroethylene and tetrachloroethylene are predicted to exceed MCLs in P-Area under the Dedication strategy (Table 4-26). TC

If an action such as groundwater extraction and treatment is undertaken to meet regulatory standards, the drawdown effects are expected to be localized and transitory. If drawdown were found to be a problem, the treated water would be reinjected into the aquifer from which it was withdrawn. Otherwise, the treated water would be discharged to nearby onsite streams, probably to the natural aquifer outcrop. Such discharges would be in compliance with all pertinent standards.

Summary of Groundwater Effects Under Dedication Strategy

This analysis indicates that groundwater corrective action could be required at 9 of the 11 geographic groups because of constituent concentrations in groundwater that exceed MCLs or comparable criteria. The predominant constituents predicted by PATHRAE code to exceed MCLs are nitrate, lead, trichloroethylene, tetrachloroethylene, tritium, and strontium-90. TC

4.2.2.2 Surface-Water Impacts

As a result of closure and groundwater remedial actions to be conducted under this strategy, the concentrations of tritium, tetrachloroethylene, and nitrate which are calculated to exceed MCLs in surface water for no action would be brought into compliance. Corrective action could consist of groundwater withdrawal and treatment, with subsequent discharge of treated groundwater to onsite streams in compliance with applicable NPDES permits. TE

Table 4-24. Peak Concentrations for Dedication Strategy, K-Area

			PATHRAE - Peak concentrations[a]			
			Chemicals (mg/L)		Radionuclides (pCi/L)	
	Waste Management facility	Site number	Pb	Trichloro-ethylene	Tetrachloro-ethylene	H-3
TC	K-Area burning/ rubble pit	8-1	(b)	1.9 (1978)	(b)	(b)
TC	K-Area acid/ caustic basin	8-2	0.054 (1971)	(b) (1971)	0.094 (1971)	(b)
TE	K-Area reactor seepage basin	8-4	(b)	(b)	(b) (1960)	7.2×10^6
TC	Standard[c]		0.05	0.005	0.0007	8.7×10^4

[a]Year of occurrence in parentheses. Only the constituents with peak concentrations that exceed standards at one or more waste sites are given.
[b]Constituent did not meet threshold selection criteria for PATHRAE modeling or peak concentration is within regulatory standard.
TE [c]Sources: EPA, 1985a, 1985b (tetrachloroethylene), and EPA, 1987. ICRP Publication 30 (ICRP, 1978) methodology was used to determine concentrations that yield an annual effective whole-body dose of 4 millirem.

4.2.2.3 Radiological Doses

TC For the Dedication strategy, Table 4-27 lists peak annual doses to the maximally exposed individual from the 21 low-level radioactive and mixed-waste sites, and their years of occurrence. These doses assume that the maximally exposed individual resides on the SRP after institutional control is relinquished in 100 years. The groundwater-well pathway is the most significant, contributing more than 95 percent of the total dose at those sites with peak annual doses of 0.10 millirem or more, with the exception of the old TNX seepage basin. At that site, resuspension of contaminated dust from the unvegetated outfall delta results in a first year dose of 12.3 millirem. The reclaimed-farm pathway contributes all the 0.071-millirem and 1.4×10^{-4} millirem doses from the SRL seepage basins and the TNX burying ground, respectively.

TC The R-Area seepage basins are predicted to exceed the 4-millirem EPA annual drinking-water dose limit and the 100-millirem DOE annual dose limit for all pathways via water consumption from the 1-meter well under the Dedication strategy (630 millirem in 2111). Six additional sites predicted to exceed the 4-millirem EPA annual drinking-water limit after closure only (no groundwater

Table 4-26. Peak Concentrations for Dedication Strategy, P-Area

		PATHRAE - Peak Concentration[a]		
		Chemicals, mg/L		
Waste management facility	Site number	Pb	Trichloro-ethylene	Tetrachloro-ethylene
P-Area burning/ rubble pit	10-1	(b)	1.9 (1978)	(b)
P-Area acid caustic basin	10-2	0.054 (1971)	(b)	0.094 (1971)
Standard[c]		0.05	0.005	0.0007

TC

[a]Year of occurrence in parentheses. Only the constituents with peak concentrations that exceed standards at one or more waste sites are given.
[b]Constituent did not meet threshold selection criteria for PATHRAE modeling or peak concentration is within regulatory standard.
[c]Sources: EPA, 1985a, 1985b (tetrachloroethylene), and EPA, 1987. ICRP Publication 30 (ICRP, 1978) methodology was used to determine concentrations that yield an annual effective whole-body dose of 4 millirem per year. TE

remediation), are the H-Area retention basin (81 millirem from the 1-meter well in 2085), the radioactive waste burial grounds (14 millirem from the 100-meter well in 2085), the F-Area seepage basins (5.7 millirem from the 1-meter well in 2985), the old F-Area seepage basin (34 millirem from the 1-meter well in 2370), the Road A chemical basin (4.3 millirem from the 1-meter well in 2985), and the L-Area oil and chemical basin (6.1 millirem from the 1-meter well in 2185). The complete Dedication strategy (i.e., closure and remedial action as required) would reduce these doses to below the 4-millirem annual EPA drinking-water dose limit. All sites comply individually with the 25-millirem DOE annual dose limit for the atmospheric pathway. TC

The annual doses received from all pathways by the maximally exposed individual residing at the SRP boundary during the year of closure and onsite during the peak exposure year (2111) are 12.3 and 6.4×10^2 millirem, respectively. TC The latter dose neglects the implementation of postclosure groundwater remedial actions, which would reduce that dose to less than 10 millirem per year (including about 8.7 millirem from direct exposure to the unreclaimed outfall delta). TC

The annual collective doses received by the population during the first year and 100 years (2085) from the time of implementation of the Dedication strategy are 3.9 and 3.0 person-rem, respectively, of which the atmospheric TC

Table 4-27. Peak Annual Doses to the Maximally Exposed Individual from Radiological Releases for the Dedication Strategy

Low-level and mixed waste sites	Maximum individual dose (mrem)	Year of Peak dose
H-Area retention basin	81	2085
F-Area retention basin	0.057	2318
R-Area Bingham pump outage pits	0.20	2085
R-Area reactor seepage basins	630	2111
Ford Building waste site	0	
TNX burying ground	1.4×10^{-4}	2085
K-Area Bingham pump outage pit	0.20	2085
K-Area reactor seepage basin	0.22	2085
L-Area Bingham pump outage pits	0.20	2085
P-Area Bingham pump outage pit	0.20	2085
SRL seepage basins	0.071	2085
TC M-Area settling basin and Lost Lake	0.0072	2085
Radioactive waste burial ground, mixed waste management facility (new), and radioactive waste burial ground (old)	14.0	2085
F-Area seepage basins	5.7	2985
F-Area seepage basin (old)	34	2370
H-Area seepage basins	1.3	2185
Ford Building seepage basin	0.57	2393
TNX seepage basin (old)	12.3	1985
TNX seepage basin (new)	1.4	2614
Road A chemical basin	4.3	2985
L-Area oil and chemical basin	6.1	2185

TC pathway of the old TNX seepage basin releases alone contributes more than 65 percent. Appropriate remedial actions could reduce these doses further.

4.2.2.4 Health Effects

Radiological

The health effects presented in this section are based on the Dedication strategy doses without further groundwater remedial action. Table 4-28 lists lifetime health risks to the maximally exposed individual resulting from peak annual radioactive releases from 21 low-level and mixed waste sites.

TC The fatal health risks to the maximally exposed individual residing at the SRP boundary from exposures during the year of closure (1985 assumed) and residing onsite during the peak year (2111), are 3.4×10^{-6} and 1.8×10^{-4}, respectively. The corresponding maximum lifetime risks would be 1.7×10^{-4} and 9.0×10^{-3}, respectively, assuming a 50-year exposure at the peak annual rate.

Table 4-28. Radiological Health Risks to Maximally Exposed Individual from the Peak Annual Doses for the Dedication Strategy

Low-level and mixed waste sites	Maximum individual risk (HE for peak year dose)	Lifetime exposure risk[a]
H-Area retention basin	2.3×10^{-5}	1.2×10^{-3}
F-Area retention basin	5.6×10^{-8}	8.0×10^{-7}
R-Area Bingham pump outage pits	3.4×10^{-8}	2.8×10^{-6}
R-Area reactor seepage basins	1.8×10^{-4}	9.0×10^{-3}
Ford Building waste site	0	0
TNX burying ground	3.9×10^{-9}	2.0×10^{-9}
K-Area Bingham pump outage pit	5.6×10^{-8}	2.8×10^{-6}
K-Area reactor seepage basin	6.2×10^{-8}	3.1×10^{-6}
L-Area Bingham pump outage pits	5.6×10^{-8}	2.8×10^{-6}
P-Area Bingham pump outage pit	5.6×10^{-8}	2.8×10^{-6}
SRL seepage basins	2.0×10^{-8}	1.0×10^{-6}
M-Area settling basin and Lost Lake	2.0×10^{-9}	1.0×10^{-7}
Radioactive waste burial ground, mixed waste management facility (new), and radioactive waste burial ground (old)	3.9×10^{-7}	2.0×10^{-4}
F-Area seepage basins	1.6×10^{-6}	8.0×10^{-5}
F-Area seepage basin (old)	9.5×10^{-6}	4.8×10^{-4}
H-Area seepage basins	3.6×10^{-7}	1.8×10^{-5}
Ford Building seepage basin	1.6×10^{-7}	8.0×10^{-6}
TNX seepage basin (old)	3.4×10^{-6}	1.7×10^{-4}
TNX seepage basin (new)	3.9×10^{-7}	2.0×10^{-5}
Road A chemical basin	1.2×10^{-6}	6.0×10^{-5}
L-Area oil and chemical basin	1.7×10^{-6}	8.5×10^{-5}

[a]Assumes a 50-year exposure at peak year dose.

TC

The number of fatal health effects predicted for the population in the SRP region as a result of exposures during the year of closure and during the one-hundredth year (2085) are 1.1×10^{-3} and 8.4×10^{-4}, respectively. Lifetime effects of exposures at the same rate would total 5.5×10^{-2} and 4.2×10^{-2} cancer deaths, respectively. TC

Appropriate remedial actions could reduce the doses and health effects further.

Chemical

Groundwater/Surface-Water Pathway

Tables 4-29 and 4-30 summarize the risks posed under the Dedication strategy in each geographic region via the groundwater/surface-water pathway.

For the A- and M-Area geographic grouping, the highest total carcinogenic risk for 50-year exposures following 2085 is 1.2×10^{-2}, presented by the M-Area TC settling basin at the 100-meter well. The peak risk is 1.3×10^{-1}, due to tetrachloroethylene at the miscellaneous chemical basin 1-meter well and 100-meter well from exposures peaking in 2024 and 2033, respectively.

The M-Area settling basin also presents the highest noncarcinogenic risks for exposures in 2085, with hazard indexes of 2.1 at the 100-meter well and 2.9×10^{-1} at the 1-meter well. Maximum chemical-specific, noncarcinogenic hazard indexes are also posed by nitrate in these wells: 2.1×10^{2} in the 1-meter and 100-meter wells for exposures in 2052.

TC In the F- and H-Area geographic grouping, the highest total carcinogenic risk from 50-year exposures following 2085 presented under the Dedication strategy by the 100-meter well is insignificant. However, the peak risk for the dominant carcinogenic chemical (1.7×10^{-4}) was presented by trichloroethylene from hypothetical exposures peaking at the 1-meter well in 1978.

The mixed-waste management facility and old radioactive waste burial grounds present the highest noncarcinogenic risks from exposures in 2085, with hazard indexes of 1.1 in the 1-meter well and 5.5 in the 100-meter well. The dominant noncarcinogenic chemicals are nitrates, presenting an ADI fraction of 6.9×10^{1} in 1987 at both the 1- and 100-meter wells at the F-Area seepage basins.

All four strategies present the same carcinogenic and noncarcinogenic risks for the groundwater/surface-water pathway for the R-, C-, CS-, TNX-, Road A, K-, and P-Area geographic groupings. The carcinogenic risks are the same under all strategies for the L-Area geographic grouping. See Section 4.2.1.4.

TC The total noncarcinogenic risks for exposures in 2085 under the Dedication strategy are greatest for the 1-meter well at the L-Area oil and chemical basin (hazard index of 3.8×10^{-1}). As under the No-Action strategy, the dominant noncarcinogenic chemical risk of 4.8 is posed by silvex at the CMP pits 1-meter well in 2012.

Atmospheric Pathway

Table 4-31 lists risks to the maximally exposed individual and to the population for the Dedication strategy due to carcinogenic atmospheric releases. Risks due to noncarcinogenic releases are not considered significant for the three selected years. Major contributors to total risk due to carcinogenic releases are from burning/rubble pits and the M-Area air stripper. The major chemical contributors to the risk are trichloroethylene and chromium-VI. Risks are generally higher for 2085 than for 1985 because the maximally exposed individual is assumed to be much closer to the waste site. This results in higher exposures, even though the source strength might have decreased due to leaching over the previous 100 years.

4.2.2.5 Ecological Impacts

TC Potential impacts of the Dedication strategy on aquatic ecosystems would be similar to those discussed in Section 4.2.1.5. This is true since in most cases the diluted concentrations of contaminants subjected to PATHRAE analysis did not significantly change under any of the closure actions. It is likely that the wastes evaluated on the basis of contaminant concentrations of downgradient wells and stream dilution would also not change since many wastes have already leached to the groundwater and would continue to outcrop for years. TC

The Dedication strategy would eliminate potential impacts to wildlife resulting from the consumption of contaminated standing water and biointrusion, as described in Section 4.2.1.5. All open basins would be drained, backfilled, and revegetated. Thus, none of the waste sites would have open basins to retain water, and the contaminated soils would be buried. If the roots of the vegetation do not penetrate into the contaminated layer, biointrusion should not be a problem. Proper site maintenance would prevent establishment of deep-rooted plants. This strategy would not eliminate potential impacts to wildlife from consuming undiluted groundwater at the outcrop. The potential impacts related to the consumption of undiluted groundwater would be similar to those described in Section 4.2.1.5. TC

Noise and habitat disturbance related to the Dedication strategy could adversely impact wildlife. These impacts could eliminate use of the sites by some animals; however, impacts would be short-term. Current information does not permit an accurate determination of potential impacts from borrow pit activities, although these are not expected to be significant in the context of overall site land uses. As indicated in Section 4.2.1.5, some endangered and threatened species, including a candidate species, exist on the SRP. Based on surveys conducted on the SRP, none of these species have been found to reside within the immediate vicinity of any of the waste sites with the exception of the candidate species, the sand burrowing mayfly, located within 200 meters of the Old F-Area Seepage Basin, and an American alligator residing in the M-Area Settling Basin. As noted in Section 4.2.1.5, bald eagles have been sighted flying in the vicinity of a number of waste sites, but there are no active nest sites that have been located near any of these sites. Impacts should not occur to the sand burrowing mayfly if erosion control measures are closely followed. The American alligator residing in the M-Area Settling Basin would be displaced due to closure. Eagle flights near sites could be temporarily affected due to noise and disturbance; however, no adverse long-term impacts would occur. TC

The Dedication strategy would eliminate the potential impacts to wetlands from contaminated basin overflow, but would not eliminate potential impacts from contaminated groundwater; sedimentation impacts are also possible. Because all open basins would be drained, backfilled, and revegetated, the potential for basin overflow would be removed. The discussion of contaminated groundwater affecting wetlands is presented in Section 4.2.1.5. As mentioned above, levels of groundwater contaminants are not expected to change significantly under any closure actions; thus, impacts to wetlands and their associated wildlife could occur. Impacts to wetlands located near waste sites could arise due to erosion from closure activities. However, proper erosion control measures could prevent or reduce such impacts. Most sites, however, are sufficiently removed from wetlands that sedimentation impacts would not likely occur. TC

TC TE TE TE TE TE TC TE

4.2.2.6 Other Impacts

Occupational Risk

TC Carcinogenic and noncarcinogenic risks have been estimated for workers at one site under the Dedication strategy: the M-Area settling basin and associated areas (overflow ditch and seepage area and Lost Lake), which are to be drained prior to closure. For protected workers at this site, the total carcinogenic risk would be 7.1×10^{-10} and the total noncarcinogenic risk would be 7.9×10^{-4} from airborne materials.

TE Archaeological/Historical Impacts

The Dedication strategy would not affect any archaeological and/or historic resources. A survey in the existing waste site areas located no significant sites requiring impact mitigation (see Section 4.2.1.6).

TE Socioeconomic Impacts

Socioeconomic impacts for this strategy would be insignificant because the projected peak construction workforce would not exceed 200 persons and would be drawn from the existing construction workforce employed on the Plant. Because these workers already reside in the SRP area, no additional impacts to local communities and services due to inmigrating workers are expected to occur.

4.2.3 ELIMINATION STRATEGY (REMOVAL OF WASTE TO THE EXTENT PRACTICABLE FROM EXISTING WASTE SITES, AND IMPLEMENTATION OF COST-EFFECTIVE REMEDIAL AND CLOSURE ACTIONS AS REQUIRED)

Under the Elimination strategy, buried waste and contaminated soil at all existing waste sites would be excavated, packaged, and transported to one of five SRP storage/disposal facilities: the existing sanitary landfill, a new low-level radioactive waste facility, a new hazardous waste facility, a new mixed waste facility, or the cement/flyash matrix (CFM) facility in Y-Area. TE Table 4-32 lists the estimated volumes of waste and contaminated soil in each existing waste site. Recovery of this waste would require slightly greater volumes to be excavated and transported to a suitable storage/disposal facility. Table 4-32 also lists the volumes of backfill required, the distance from each waste site to the storage/disposal facility, and the facility utilized. TE The volumes and distances are preliminary values used in this EIS only to describe the likely range of impacts of the proposed actions.

TE Any liquids in the open basins would be managed as indicated in Table 4-17 before any excavation is begun. Low-permeability infiltration barriers would be installed to cap the excavated waste sites listed in Table 4-33.

Following waste removal and closure, additional groundwater monitoring wells would be installed as required, and existing and new wells would be monitored TC in accordance with requirements. As in the case of the Dedication strategy, remedial actions would be performed as required (see Section 4.2.2).

TE Good housekeeping practices would continue, including the installation of new fences and pylons.

Table 4-33. Excavated Waste Sites Assumed to be Capped with Low Permeability Barrier

A- and M-Areas		R-Area		
1-3	Silverton Road waste site	3-7	R-Area reactor seepage basin	
1-8	SRL seepage basin	3-8	R-Area reactor seepage basin	
1-9	SRL seepage basin	3-9	R-Area reactor seepage basin	
1-10	SRL seepage basin	3-10	R-Area reactor seepage basin	
1-11	SRL seepage basin	3-11	R-Area reactor seepage basin	
		3-12	R-Area reactor seepage basin	
F- and H-Areas				
2-5	H-Area retention basin	TNX Area		TC
2-6	F-Area retention basin	5-3	TNX burying ground	
2-7	Radioactive waste burial ground			
2-8	Mixed-waste management facility			
2-9	Radioactive waste burial ground	Road A Area		
2-10	F-Area seepage basin	7-1	Road A chemical basin	
2-11	F-Area seepage basin			
2-12	F-Area seepage basin	K-Area		
2-13	F-Area seepage basin (old)	8-4	K-Area reactor seepage basin	
2-14	H-Area seepage basin			
2-15	H-Area seepage basin	L-Area		
2-16	H-Area seepage basin	9-12	L-Area oil and chemical basin	
2-17	H-Area seepage basin			

4.2.3.1 Groundwater Impacts

The following paragraphs discuss groundwater impacts from waste constituents released from the various waste sites in each geographic group. They also present peak constituent concentrations predicted by the PATHRAE computer code to exceed MCLs or comparable criteria in each geographic group following implementation of the Elimination strategy. Corrective actions could be required to bring these constituent levels to within health-based concentration limits. TE

Table 4-34 lists constituents in A- and M-Areas predicted to exceed MCLs or comparable criteria under the Elimination strategy. The primary constituents are trichloroethylene and tetrachloroethylene. Others are tetrachloromethane, 1,1,1-trichloroethylene, arsenic, barium, cadmium, lead, nickel, nitrate, and tritium. Groundwater remediation would follow the same general pattern described in Section 4.2.2.1. TC

Implementation of the Elimination strategy at all existing waste sites in F- and H-Areas is not predicted to change the concentration of chemical contaminants in the groundwater from that calculated in the Dedication strategy, as indicated in Table 4-20. Table 4-35 lists the radioactive constituents predicted to exceed MCLs or comparable criteria in F- and H-Areas. Potential groundwater impacts are similar to those described in Section 4.2.2.1. Groundwater remedial action would be implemented as required to reduce the concentration of constituents to below applicable standards. TE

Table 4-36 lists lead, trichloroethylene, tetrachloroethylene, cesium-137, tritium, strontium-90, and yttrium-90 as the constituents predicted to exceed MCLs or comparable criteria in R-Area under the Elimination strategy. The R-Area reactor seepage basins are the sources of radionuclides that exceed standards. Strontium-90 and yttrium-90 would be the only substances reduced by this strategy, compared to the No-Action strategy.

Remedial action, such as contaminated groundwater withdrawal and treatment to meet regulatory standards, could be implemented for all the contaminants determined to exceed standards.

The Elimination strategy in C- and CS-Areas results in predictions of the same peak concentrations as those under no action (see Table 4-22), with the exception of chromium from the Ford Building seepage basin, which is reduced to below its MCL. This strategy could require contaminated groundwater withdrawal and treatment or some other action after closure to meet regulatory standards for those contaminants determined to exceed standards.

The Elimination strategy at existing waste sites in the TNX, K- and P-Areas is not predicted to reduce the peak concentrations of contaminants in the groundwater below those presented for the Dedication strategy in Tables 4-23, 4-24, and 4-26, respectively. The Elimination strategy in D-, Road A and L-Areas also leaves peak concentrations unchanged with the exception of americium-241 in L-Area, which is reduced to below its MCL (see Table 4-25). Groundwater remedial action could be required to reduce the concentration of constituents listed to below applicable standards.

PATHRAE predicts the peak constituent concentrations in the miscellaneous waste site grouping to be within MCLs or comparable criteria. Groundwater corrective action is not expected to be required in these areas under any strategy.

Summary of Groundwater Effects

Groundwater corrective action could be required at 9 of the 11 geographic groups, because the constituent concentrations exceed MCLs or comparable criteria. The number of groups is unchanged from that estimated for the Dedication strategy, but the extent of required remedial actions is expected to be less under the elimination strategy. The predominant constituents predicted by PATHRAE to exceed MCLs or comparable criteria under the Elimination strategy are nitrate, lead, trichloroethylene, tetrachloroethylene, tritium, and strontium-90.

4.2.3.2 Surface-Water Impacts

The closure and remedial actions to be conducted under this strategy would result in surface-water quality improvements similar to those identified in Section 4.2.2.2.

4.2.3.3 Radiological Doses

For the Elimination strategy, Table 4-37 lists peak annual doses to the maximally exposed individual from 21 low-level radioactive and mixed waste sites, and their years of occurrence. These doses assume that the maximally exposed

Table 4-36. Peak Concentrations for Elimination Strategy, R-Area

		PATHRAE - Peak concentration[a]						
		Chemicals (mg/L)		Radionuclides (pCi/L)				
Waste management facility	Site number	Pb	Trichloro-ethylene	Tetrachloro-ethylene	Cs-137	H-3	Sr-90	Y-90
R-Area burning/ rubble pits	3-1 3-2	(b)	1.9 (1978)	(b)	(b)	(b)	(b)	(b)
R-Area acid/ caustic basin	3-3	0.054 (1971)	(b)	0.094 (1971)	(b)	(b)	(b)	(b)
R-Area reactor seepage basins	3-7 through 3-12	(b)	(b)	(b)	3300 (1965)	1.5×10^8 (1963)	93[c] (2111)	93[c] (2111)
Standard[d]		0.05	0.005	0.0007	110	8.7×10^4	42	550

TC

[a]Year of occurrence in parentheses. Only the constituents with peak concentrations that exceed standards at one or more waste sites are given.
[b]Constituent did not meet threshold selection criteria for PATHRAE modeling or peak concentration is within regulatory standard.
[c]The facilitated transport peak for Sr-90 and Y-90 is predicted to have been 720 pCi/L in 1965. The listed value is the predicted future peak, which is affected by waste removal and closure.
[d]Sources: EPA, 1985a, 1985b (tetrachloroethylene), and EPA, 1987. ICRP Publication 30 (ICRP, 1978) methodology was used to determine concentrations that yield an annual effective whole-body dose of 4 millirem per year.

Table 4-37. Peak Annual Doses to Maximally Exposed Individual and Years of Occurrence for Elimination Strategy

Low-level and mixed waste site	Maximum individual dose (mrem)	Year of peak dose
H-Area retention basin	47	2085
F-Area retention basin	0.0006	2318
R-Area Bingham pump outage pits	0.0058	2115
R-Area reactor seepage basins	6.3	2111
Ford Building waste site	0	
TNX burying ground	1.4×10^{-4}	2085
K-Area Bingham pump outage pit	0.0058	2115
K-Area reactor seepage basin	0.22	2085
L-Area Bingham pump outage pits	0.0058	2115
P-Area Bingham pump outage pit	0.0058	2115
SRL seepage basins	0.053	2085
M-Area settling basin and Lost Lake	0.0073	1985
TC Radioactive waste burial ground, mixed waste management facility (new), and radioactive waste burial ground (old)	14.0	2085
F-Area seepage basins	0.45	2685
F-Area seepage basin (old)	0.48	2085
H-Area seepage basins	1.0	2185
Ford Building seepage basin	0.22	2393
TNX seepage basin (old)	12.3	1985
TNX seepage basin (new)	0.014	2614
Road A chemical basin	0.043	2985
L-Area oil and chemical basin	1.4	2085

individual resides on the SRP after institutional control is relinquished in 2085. The groundwater-well pathway is the most significant, and is responsible for the dose at all sites with peak annual doses of 0.10 millirem or more, except at the old TNX seepage basin, where resuspension of contaminated dust from the unclosed outfall delta results in a first-year (1985) dose of 12.3 millirem. The atmospheric pathway is responsible for doses in the M-Area settling basin and its vicinity. At the TNX burying ground and the SRL seepage basin, the reclaimed farm pathway is responsible. TC

All sites comply with the 100-millirem DOE annual dose limit for all pathways. Three sites are predicted to exceed the 4-millirem EPA annual drinking-water limit after the implementation of the Elimination strategy (but with no groundwater remediation): the radioactive waste burial grounds (14 millirem from the 100-meter well in 2085), the R-Area seepage basins (6.3 millirem from the 1-meter well in 2111) and the H-Area retention basin (47 millirem from the 1-meter well in 2085). All sites comply individually with the 25-millirem DOE annual dose limit for the atmospheric pathway. TC

The complete implementation of this strategy (i.e., closure and remedial action as required) would reduce the peak annual drinking-water dose to below the 4-millirem EPA annual limit.

The annual doses received from all pathways by the maximally exposed individual residing at the SRP boundary during the year of closure and onsite during the peak exposure year (2085) are 13 and 57 millirem, respectively. TC

The annual collective doses received by the population during the first year and 100 years (2085), from the time of implementation of the elimination option, are 30 and 3.0 person-rem, respectively. More than 95 percent of the dose during each of these years arises from the atmospheric pathway. TC

4.2.3.4 Health Effects

Radiological

The health effects presented in this section are based on the Elimination strategy without further remedial action. Table 4-38 lists lifetime health risks to the maximally exposed individual resulting from peak annual radioactive releases from 21 low-level and mixed waste sites.

The fatal health risks to the maximally exposed individual residing on the SRP boundary from exposures during the year of closure and residing onsite during the peak year (2085) would be 3.7×10^{-6} and 1.6×10^{-5}, respectively. The corresponding maximum lifetime risks would be 1.8×10^{-4} and 8.0×10^{-4}, respectively, assuming a 50-year exposure at the peak annual rate. TC

The number of fatal health effects that would be predicted in the population in the SRP region from exposures during the year of waste removal and closure, and in 2085, are 8.5×10^{-3} and 8.3×10^{-4}, respectively. TC

Chemical

Groundwater and Surface-Water Pathway

Tables 4-39 and 4-40 summarize the risks under the Elimination strategy in each geographic grouping via the groundwater/surface-water pathway.

For the A- and M-Area geographic grouping, the highest total carcinogenic risk for 2085 would occur at the M-Area settling basin 100-meter well (3.5×10^{-4}). The peak carcinogenic risk for tetrachloroethylene (2.9×10^{-1}) would occur at both the 1- and 100-meter wells of the miscellaneous chemical basin in 1990 and 1999. TC

The M-Area settling basin would present the highest noncarcinogenic risk in 2085 at the 100-meter well (5.0×10^{-2}). The peak noncarcinogenic risks are also presented by this site. Nitrate would peak in the 1-meter well at 5.4×10^{-2} in 1995, and in the 100-meter well in 1994. TC

In the F- and H-Area geographic grouping, the highest total carcinogenic risk in 2085 is presented by the F-Area burning/rubble pit; it is not significant. Trichloroethylene created the peak carcinogenic risk at the 1-meter well of

Table 4-38. Radiological Health Risks to Maximally Exposed Individual from the Peak Annual Dose for Elimination Strategy

Low-level and mixed waste sites	Maximum individual risk (HE for peak year dose)	Lifetime exposure risk[a]
H-Area retention basin	1.3×10^{-5}	6.5×10^{-4}
F-Area retention basin	1.7×10^{-10}	8.5×10^{-9}
R-Area Bingham pump outage pits	1.6×10^{-9}	8.0×10^{-7}
R-Area reactor seepage basins	1.8×10^{-6}	9.0×10^{-5}
Ford Building waste site	0	0
TNX burying ground	3.9×10^{-11}	2.0×10^{-9}
K-Area Bingham pump outage pit	1.6×10^{-9}	8.0×10^{-8}
K-Area reactor seepage basin	6.2×10^{-8}	3.1×10^{-6}
L-Area Bingham pump outage pits	1.6×10^{-9}	8.0×10^{-8}
P-Area Bingham pump outage pit	1.6×10^{-9}	8.0×10^{-8}
SRL seepage basins	1.5×10^{-8}	7.5×10^{-7}
TC M-Area settling basin and Lost Lake	2.0×10^{-9}	1.0×10^{-7}
Radioactive waste burial ground, mixed waste management facility (new), and radioactive waste burial ground (old)	3.9×10^{-6}	2.0×10^{-4}
F-Area seepage basins	1.3×10^{-7}	6.5×10^{-6}
F-Area seepage basin (old)	1.3×10^{-7}	6.5×10^{-6}
H-Area seepage basins	2.8×10^{-7}	1.4×10^{-5}
Ford Building seepage basin	6.2×10^{-8}	3.1×10^{-6}
TNX seepage basin (old)	3.4×10^{-6}	1.7×10^{-4}
TNX seepage basin (new)	3.9×10^{-9}	2.0×10^{-7}
Road A chemical basin	1.2×10^{-8}	6.0×10^{-7}
L-Area oil and chemical basin	3.9×10^{-7}	2.0×10^{-5}

[a]Assumes a 50-year exposure at peak year dose.

TC the F-Area burning/rubble pit (1.7×10^{-4}) in 1978. A similar risk (1.6×10^{-4}) was presented at the 100-meter well in 1983.

The mixed waste management facility and old radioactive waste burial grounds present the highest noncarcinogenic risks. In 2085, the 100-meter well would present a hazard of 5.3. Nitrate is the dominant noncarcinogenic chemical, TC creating a peak hazard index of 6.9×10^{1} in 1987 for both the 1- and 100-meter wells of the F-Area seepage basins.

In the R-Area and the C- and CS-Area geographic grouping, all four strategies present the same carcinogenic and noncarcinogenic risks (see Section 4.2.1.4).

In the TNX-Area geographic grouping, the total carcinogenic risks from 50-year exposures following 2085 are highest at the D-Area oil basin 100-meter well TC (4.8×10^{-8}). The risk for the dominant carcinogen, trichloroethylene, peaked at the D-Area burning/rubble pit 1-meter well in 1978 (1.7×10^{-4}), and at the 100-meter well in 1983 (1.6×10^{-4}).

Noncarcinogenic risks presented under this alternative are the same as those presented under no action (see the discussion in Section 4.2.1.4).

In the Road A and the K-Area geographic groupings, carcinogenic and noncarcinogenic risks are the same for all four strategies (see Section 4.2.1.4).

In the L-Area geographic grouping, carcinogenic risks are the same for all four strategies (see Section 4.2.1.4). The L-Area oil and chemical basin poses the highest noncarcinogenic risk in 2085 at the 1-meter well (hazard index = 2.8×10^{-1}). The peak risk for the dominant noncarcinogenic chemical is the same for all strategies (see Section 4.2.1.4).

In the P-Area geographic grouping, the carcinogenic and noncarcinogenic risks are the same for all options (see the discussion of these risks in Section 4.2.1.4).

Atmospheric Pathway

Table 4-41 lists risks to the maximally exposed individual and to the population for the Elimination strategy due to carcinogenic atmospheric releases. Risks due to noncarcinogenic releases are considered not significant for the three selected years. Major contributors to total risk due to carcinogenic releases are those from the M-Area air stripper; the chemical contributor to the risk is trichloroethylene. TE

4.2.3.5 Ecological Impacts

Potential impacts to aquatic ecosystems resulting from the Elimination strategy are similar to those discussed in Section 4.2.2.5.

TC

Potential impacts to terrestrial ecosystems resulting from the Elimination strategy are similar to those discussed in Section 4.2.2.5. Removal of wastes would eliminate potential impacts from biointrusion. Potential impacts at borrow pit areas would increase due to the greater amount of backfill required for closure.

As discussed in Section 4.2.2.5, only the American alligator residing in the M-Area settling basin is likely to be directly impacted by closure activities. Proper erosion control measures should prevent impacts to the sand burrowing mayfly, a candidate species found within 200 meters of the old F-Area seepage basin. Bald eagles which have been sighted flying near some waste sites should not be seriously affected by closure activities.

Potential impacts to wetlands and their associated wildlife would be similar to those discussed in Section 4.2.2.5. Proper erosion control would reduce the potential for impacts where wetlands are close to waste sites.

4.2.3.6 Other Impacts

Occupational Risk

Individual and collective occupational risks to protected workers due to atmospheric releases of nonradioactive materials from waste removal and closure of sites are very low and are considered to be insignificant. Specifically:

- The total individual occupational carcinogenic risk (i.e., incremental lifetime probability of death from cancer) to an average worker is 1.6×10^{-7} for waste removal and closure of hazardous and mixed waste sites. This risk conservatively assumes that the average worker is involved in the cleanup of all the sites. The total collective occupational carcinogenic risk to all workers involved in these activities (i.e., a crew of nine persons) is 1.4×10^{-6}.

- The total individual occupational noncarcinogenic risk (i.e., hazard index) to an average worker is 3.9×10^{-1} for waste removal and closure of hazardous and mixed waste sites. This risk conservatively assumes that the average worker is involved in the cleanup of all the sites.

For occupational risks to cleanup workers and transportation workers attributed to direct gamma exposure and to atmospheric releases of radioactive materials due to waste removal and closure of waste sites, the highest total doses and associated carcinogenic risks are as follows:

- Radioactive waste burial ground, mixed waste management facility, and radioactive waste burial ground - 4200 millirem total dose to cleanup worker (1.2×10^{-3} risk) and 2200 millirem total dose to transportation worker (6.2×10^{-4}); the collective dose to all workers involved in these activities is 31.5 person-rem with a group risk of 8.8×10^{-3}.

- F-, H-, and R-Area seepage basins - 940 to 4200 millirem total dose to cleanup worker (2.6×10^{-4} to 1.2×10^{-3} risk) and 300 to 340 millirem total dose to transportation worker (8.4×10^{-5} to 9.5×10^{-5} risk); the collective dose to all workers involved in these activities is 6.7 to 26.0 person-rem with a group risk of 1.9×10^{-3} to 7.3×10^{-3}.

- H-Area retention basins - 600 millirem total dose to cleanup worker (1.7×10^{-4} risk) and 240 millirem total dose to transportation worker (6.7×10^{-5} risk); the collective dose to all workers involved in these activities is 4.3 person-rem with a group risk of 1.2×10^{-3}.

- M-Area settling basin and vicinity - 46.5 millirem total dose to the cleanup work (1.3×10^{-5} risk) and 23.3 millirem total dose to the transportation worker (6.5×10^{-6} risk); the collective dose to all workers involved in these activities is 0.35 person-rem with a group risk of 9.9×10^{-5}.

- L-Area oil and chemical basin - 24 millirem total dose to the cleanup worker (6.7×10^{-6} risk) and 12 millirem total dose to the transportation worker (3.4×10^{-6} risk); the collective dose to all workers involved in these activities is 0.18 person-rem with a group risk of 5.0×10^{-5}.

Archaeological Impacts | TE

No significant archaeological and/or historic resources have been identified; therefore, no impacts would be observed (see Section 4.2.1.6).

Socioeconomic Impacts | TE

Socioeconomic impacts for this strategy would be insignificant, because the projected peak construction workforce would not exceed 200 persons and would be drawn from the existing construction workforce employed on the Plant. Because these workers already reside in the SRP area, no additional impacts to local communities and services due to inmigrating workers are expected to occur.

Air Emissions Due to Transportation

The transportation of hazardous, mixed, and low-level waste from existing sites to new sites would result in the emission of small quantities of carbon monoxide and hydrocarbons from engine exhausts and truck traffic, and suspended particulates and dust from ground-surface disturbances. The effects of these emissions would be small and limited to short distances from the vehicles due to the nature of the sources, which are near-ground releases. All applicable emission standards would be met during construction.

4.2.4 COMBINATION STRATEGY (REMOVAL OF WASTE TO THE EXTENT PRACTICABLE FROM SELECTED EXISTING WASTE SITES, AND IMPLEMENTATION OF COST-EFFECTIVE REMEDIAL AND CLOSURE ACTIONS AS REQUIRED)

Under this strategy, waste would be removed from selected existing waste sites (see Section 4.2.4.1), all sites would be closed, and remedial actions would be implemented as required. As indicated in the preceding section, the removal of waste from all existing sites (the Elimination strategy) does not always result in a reduction of peak concentrations of waste constituents in groundwater and in consequent groundwater remedial action requirements. At the same time, the removal process introduces a degree of occupational risk not present in the Dedication strategy that should not be undertaken without a balancing benefit. | TE

Section 4.1 indicates that decisions on specific actions at particular sites would be adopted following interactions with regulatory agencies based on detailed site-specific information and studies. To provide a basis for comparison of alternative strategies, this EIS assumes that waste removal before closure would be instituted at those sites where the predicted concentration of at least one constituent substantially exceeds its applicable standard if the site is closed without waste removal and when closure with waste removal significantly reduces predicted peak groundwater concentration of the constituent. | TC | TE

Because this strategy combines the Dedication - including dewatering, backfilling, capping, revegetation, runoff diversion, and leachate controls (i.e., closure without removal) - and the Elimination (i.e., waste removal) strategies, it is called the Combination strategy.

4.2.4.1 Groundwater Impacts

For the purposes of this EIS, concentration reductions were judged to be significant if the peak groundwater concentration under the Dedication strategy was at least three times greater than the peak concentration under the Elimination strategy, and the peak concentration under the Dedication strategy exceeded its standard by at least a factor of three. These are believed to be reasonable (but very preliminary) indications that post-closure groundwater cleanup would be required under the Dedication strategy and that waste removal before closure would significantly reduce the extent of or eliminate the need for groundwater cleanup. The final waste removal decision at specific waste sites would be determined through regulatory interactions and further modeling and monitoring efforts.

TC

One waste site in the F- and H-Areas (the old F-Area seepage basin) and six waste sites in the R-Area (the R-Area reactor seepage basins) satisfy the criteria described above. These sites, the affected constituents, and their predicted peak concentrations for closure with and without waste removal are presented in Table 4-42.

In the F- and H-Area geographic grouping, removal of waste to the extent practicable from the old F-Area seepage basin is predicted to reduce significantly the release of uranium-238, resulting in groundwater concentrations that are calculated to be less than applicable standards (see Appendix F). Contaminant releases to the groundwater at other waste sites in F- and H-Areas would not be affected by this action (see Section 4.2.2.1).

In the R-Area geographic grouping, the six inactive reactor seepage basins would be selected for waste removal. Such an action would decrease peak strontium-90 (and yttrium-90) concentrations by a factor of 100 from those that would exist if closure was the only action taken (Section 4.2.2.1). Groundwater remedial actions would be provided as necessary to reduce contaminant (e.g., strontium-90) concentrations further to values established through regulatory interactions.

Because no waste sites would be selected for waste removal in the A and M, C and CS, TNX, D, Road A, K, L, P, and miscellaneous areas, discussions for the Dedication strategy in Section 4.2.2.1 apply.

4.2.4.2 Surface-Water Impacts

The closure and remedial actions to be conducted under this strategy would result in surface-water quality improvements similar to those identified in Section 4.2.2.2 for the Dedication strategy (no waste removal and closure).

4.2.4.3 Radiological Doses

TC

Peak annual doses to the maximally exposed individual from the 21 low-level radioactive and mixed waste sites and their years of occurrence are the same for the Combination strategy as for the Dedication strategy (see Table 4-27), except for the R-Area reactor seepage basins and the old F-Area seepage basin from which waste would be removed under this strategy. The doses for the latter sites are the same as those under the Elimination strategy (see Table 4-27). The groundwater-well pathway is the most significant, contributing

Table 4-42. Combination Strategy - Sites Selected for Waste Removal

	Peak groundwater concentration (Year of peak in parentheses)			
	Applicable standard (pCi/L)[a]	(Dedication) No removal and closure (pCi/L)	(Elimination) Removal and closure (pCi/L)	Ratio[b]
F- and H-Areas				
F-Area seepage basin (old)				
Uranium-238	24	310 (2370)	3.1[c,d] (2370)	100
R-Area				
R-Area reactor seepage basins				
Strontium-90	42	9300 (2111)	93 (2111)	100
Yttrium-90	550	9300 (2111)	93[c] (2111)	100

[a]ICRP Publication 30 (ICRP, 1978) methodology was used to calculate the radionuclide concentrations that yield an annual effective whole-body dose of 4 mrem. TE

[b]No removal concentration divided by removal concentration.

[c]Below applicable standard.

[d]Peak concentration for facilitated transport fraction is 21 picocuries per liter for year 1956. TC

more than 95 percent of the total dose at those sites with peak annual doses of 0.10 millirem or more, with the exception of the old TNX seepage basin, where resuspension of contaminated dust from the unclosed outfall delta results in a first-year dose of 12.3 millirem. The reclaimed farm pathway is responsible for the entire dose from the SRL seepage basins and from the TNX burying ground. TC TC

All sites comply individually with the DOE annual dose limits of 100 millirem for all pathways and 25 millirem for the atmospheric pathway (40 CFR 61). Without remedial action, 6 sites are each predicted to exceed the 4-millirem EPA annual drinking-water limit after implementation of the Combination strategy; they are the R-Area reactor seepage basins (6.3 millirem from the 1-meter well in 2111), the F-Area seepage basins (5.7 millirem from the 1-meter well in 2985), the H-Area retention basin (81 millirem from the 1-meter well in 2085), the Road A chemical basin (4.3 millirem from the 1-meter well in 2985), the L-Area oil and chemical basin (6.1 millirem from the 1-meter well in 2185), and the radioactive waste burial grounds (14.0 millirem from the 100-meter well in 2085). TC TC

The complete implementation of this strategy, including remedial action as required, would reduce the peak annual drinking water dose to below the EPA annual 4-millirem limit.

The annual doses received from all pathways by the maximally exposed individual residing at the SRP boundary during the year of closure and onsite during the peak exposure year (2085) would be 12.3 and 91 millirem, respectively. The annual collective doses received by the population during the first year, and 100 years (2085) after implementation of the Combination strategy, would be 4.2 and 3.0 person-rem, respectively, of which the atmospheric pathway would contribute more than 65 percent.

TC

4.2.4.4 Health Effects

Radiological

TC The lifetime health risks from peak annual releases for the Combination strategy are the same as those for the Dedication strategy (see Section 4.2.2.4) for all sites except the R-Area seepage basins and the old F-Area seepage basin which produce the same risks as in Section 4.2.3.4.

The fatal health risks to the maximally exposed individual residing at the SRP boundary from exposures during the year of closure and residing onsite during the peak year (2085) are 3.4×10^{-6} and 2.5×10^{-5}, respectively. The corresponding maximum lifetime risks would be 1.7×10^{-4} and 1.3×10^{-3}, respectively, assuming a 50-year exposure at the peak annual rate.

TC

The number of fatal health effects that would be predicted in the population in the SRP region from exposures during the year of waste removal and closure and 100 years from that time (2085) are 1.2×10^{-3} and 8.3×10^{-4}, respectively.

TC

Chemical

The only waste site selected for removal of waste under the Combination strategy that would have chemical-related health effects different than those of the Dedication strategy (Section 4.2.2.4) is the old F-Area seepage basin. The health effects for this site under the Combination strategy would be the same as those presented for the Elimination strategy (Section 4.2.3.4). The only differences in these chemical-related health effects is a reduction of the peak noncarcinogenic health risks from the reclaimed farm pathway and a minimal increase in health risks to individuals due to atmospherically released carcinogens.

TE The peak noncarcinogenic hazard index for the reclaimed farm pathway under the Dedication strategy is 7.1×10^{-7}, which is reduced to 7.1×10^{-9} under the Combination or Elimination strategies. The health risk from atmospherically released carcinogens to the maximally exposed individual is zero in 1986 under the Dedication strategy and 8.4×10^{-15} under the Combination or Elimination strategies. This health risk, like all health risks due to atmospherically released carcinogens, is not considered significant.