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NUREG-1888

Environmental Impact Statement for the Reclamation of the Sequoyah Fuels Corporation Site in Gore, Oklahoma

Final Report

Office of Federal and State Materials and Environmental Management Programs

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ABSTRACT

Sequoyah Fuels Corporation (SFC) is proposing to conduct reclamation activities at its 243-hectare (600-acre) former uranium conversion site in Gore, Oklahoma, in accordance with Title 10, "Energy," of the U.S. Code of Federal Regulations (CFR), Part 40 (10 CFR Part 40), Appendix A (which includes criteria for the disposition of uranium mill tailings or wastes). In its *Reclamation Plan* submitted to the U.S. Nuclear Regulatory Commission (NRC), SFC proposes to consolidate contaminated sludges and soils, demolish existing structures (with the exception of the administration building and the electrical substation), and construct an above-grade, on-site engineered disposal cell for the permanent disposal of all contaminated materials. SFC also would implement its proposed groundwater *Corrective Action Plan* to restore the groundwater using the "hydraulic containment and pump back" method. Following the completion of surface reclamation and groundwater corrective actions, SFC would seek termination of its NRC license. As part of that future license termination process, SFC proposes the transfer of approximately 131 hectares (324 acres) of the site, including the land area encompassing the disposal cell and a surrounding buffer, to the custody of the United States or the State of Oklahoma for long-term control. SFC proposes that the remaining 112 hectares (276 acres) of the site be released for unrestricted use by members of the public.

This Environmental Impact Statement (EIS) was prepared in compliance with the National Environmental Policy Act (NEPA) of 1969 and NRC's regulations for implementing the Act, found at 10 CFR Part 51. This EIS evaluates the potential environmental impacts of the proposed action and its reasonable alternatives. This EIS also describes the environment potentially affected by SFC's proposed site reclamation activities, presents and compares the potential environmental impacts resulting from the proposed action and its alternatives, and describes SFC's environmental monitoring program and proposed mitigation measures.

Paperwork Reduction Act Statement

This EIS covers information about only one site, does not contain information collection requirements and, therefore, is not subject to the requirements of the Paperwork Reduction Act of 1995 (44 U.S.C. 3501 et seq.).

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BACKGROUND

The U.S. Nuclear Regulatory Commission (NRC) is evaluating the potential environmental impacts of the reclamation activities proposed by Sequoyah Fuels Corporation (SFC) for its former uranium conversion site in Gore, Oklahoma. The NRC has determined that approval of SFC's proposal for on-site disposal of the radioactive waste from its previous operations, along with land use restrictions or other institutional controls to prevent inadvertent disturbance of waste, constitutes a major federal action. Therefore, preparation of an Environmental Impact Statement (EIS) is warranted, in accordance with the National Environmental Policy Act (NEPA) of 1969 and NRC's regulations implementing NEPA, found at Title 10, "Energy," of the U.S. Code of Federal Regulations (CFR), Part 51 (10 CFR Part 51).

THE PROPOSED ACTION

The proposed action considered in this EIS is the implementation of SFC's proposed reclamation activities for the 243-hectare (600-acre) Gore, Oklahoma, site. SFC's *Reclamation Plan* identifies the activities that would be undertaken by SFC to accomplish surface reclamation of the site in accordance with 10 CFR Part 40, Appendix A (which includes criteria for the disposition of uranium mill tailings or wastes). SFC proposes to consolidate contaminated sludges and soils, demolish existing structures (with the exception of the administration building and the electrical substation), and construct an above-grade, on-site disposal cell for the permanent disposal of all contaminated materials. SFC would also implement its proposed groundwater *Corrective Action Plan*, using the "hydraulic containment and pump back" method to restore groundwater impacted by past site operations.

Following the completion of surface reclamation and groundwater corrective actions, SFC would seek termination of its NRC license. As part of that future license termination process, SFC proposes the transfer of approximately 131 hectares (324 acres) of the site, including the land area encompassing the disposal cell and a surrounding buffer, to the custody of the United States or the State of Oklahoma for long-term control. SFC proposes that the remaining 112 hectares (276 acres) of the site be released for unrestricted use by members of the public.

PURPOSE OF AND NEED FOR THE PROPOSED ACTION

Background

In November 1992, SFC notified the NRC that it had permanently ceased production at its Gore, Oklahoma, uranium conversion facility and would terminate its depleted uranium hexafluoride-tetrafluoride operations by the end of July 1993. Information available to the NRC at the time of the SFC notification indicated that at least some of the identified waste and contamination at the site was known to exceed the NRC's radiological criteria for decommissioning. Consequently, the NRC required that the site be remediated to meet the radiological criteria contained in Subpart E of 10 CFR Part 20 (Standards for Protection Against Radiation). In July 2002, NRC granted a request by SFC to reclassify some of the waste at the site as "byproduct material," as defined in section 11e.(2) of the Atomic Energy Act (AEA) of 1954, as amended. Because of the reclassification, Appendix A to 10 CFR Part 40 (which contains criteria for disposition of mill tailings or wastes) became the appropriate regulatory regime for site reclamation. As a result, SFC submitted a site *Reclamation Plan*, and also a groundwater *Corrective Action Plan* to NRC in 2003. Both plans have since been revised in response to NRC staff reviews.

Purpose and Need

Under the AEA, the NRC has licensing and regulatory authority for nuclear energy uses within the commercial sector. This includes the responsibility to ensure the safe and timely decommissioning of nuclear facilities that are regulated by the NRC. Decommissioning means to "remove a site safely from service and reduce residual radioactivity [through remediation or reclamation of the site by the licensee] to a level that permits: (1) release of the property for unrestricted future use and ultimate termination of the license; or (2) release of the property under restricted conditions and ultimate termination of the license" (10 CFR 40.4). The proposed action is intended to satisfy the need to protect public health and safety and ensure that any potential long-term radiological and nonradiological hazards or other impacts on the environment are minimized.

The purpose of the proposed action is the reclamation of SFC's Gore, Oklahoma, uranium conversion site in accordance with the NRC performance standards contained in 10 CFR Part 40, Appendix A. These standards require, in part: (1) isolation of the waste materials in a manner that protects human health and the environment; (2) reduction in the rate of radon emanating from the disposal cell cover to an average of 20 picocuries (pCi) per square meter-second or less; (3) a level of stabilization and containment of contaminated materials for a long period of time (200 to 1,000 years); (4) minimal reliance on active maintenance of the disposal cell; (5) protection and restoration, as needed, of groundwater; and (6) clean up of the site and structures outside of the disposal cell to the applicable radiation standards.

Following the completion of surface reclamation activities and groundwater restoration, the NRC license for the site would be terminated. The disposal cell and a buffer area surrounding the cell, delineated by an institutional control boundary (ICB), would be transferred to a long-term custodian for perpetual care. The U.S. Department of Energy, another federal agency so designated by the President, or the State of Oklahoma would be this custodian and licensed under an NRC general license (10 CFR 40.28). The purpose of this general license is to ensure that the SFC site will be cared for in such a manner as to protect public health and safety and the environment after closure of the disposal cell.

ALTERNATIVES

This EIS evaluates the potential environmental impacts of several alternatives to the proposed action, including the no-action alternative. Under the no-action alternative, consideration of which is required by the Council on Environmental Quality's (CEQ's) regulations implementing NEPA (at 40 CFR 1502.14), SFC would not implement its proposed *Reclamation Plan*, but it would continue its current programs to clean up the existing groundwater contamination. The SFC site buildings and waste materials would remain in their current condition and configuration.

The NRC staff considered a range of alternatives that would fulfill the underlying need and purpose for the proposed action. From this analysis, a set of reasonable alternatives was developed, and the impacts of the proposed action were compared with the impacts that would result if a given alternative were implemented. These alternatives include:

- Off-site disposal of all contaminated materials to off-site licensed disposal locations where the SFC waste materials met waste acceptance criteria, including the Energy*Solutions* site in Clive, Utah, and the Waste Control Specialists site near Andrews, Texas; and

- Shipment of specific contaminated materials (the dewatered raffinate sludge and other sludges and sediments from the North Ditch, Emergency Basin, and Sanitary Lagoon) to an appropriate off-site location. This alternative reflects provisions of the Settlement Agreement reached between SFC, the State of Oklahoma, and the Cherokee Nation in 2004. Potential off-site options considered were: (1) Use of the raffinate sludge and other sludges and sediments as an alternate feed stock at a conventional uranium mill, (2) Disposal of the contaminated materials at an existing uranium mill tailings impoundment, and (3) Disposal of the contaminated materials at a licensed disposal facility. The remaining site contaminated materials would be placed in a disposal cell that SFC would construct on-site.

The NRC staff also considered other alternatives to the surface reclamation and groundwater corrective actions proposed by SFC, including: (1) On-site Retrievable Storage; and (2) Alternative Treatment Technologies. These alternatives were eliminated from further analysis due to economic, environmental, or maturity reasons.

POTENTIAL ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

This EIS evaluates the potential environmental impacts of SFC's proposed action (Alternative 1) and two alternatives. The environmental impacts of the proposed action are generally SMALL, although they could be as high as MODERATE in the area of land use. Methods for mitigating the potential impacts are described in Chapter 5. Environmental monitoring methods are described in Chapter 6.

Determination of the Significance of Potential Environmental Impacts

A standard of significance has been established by the NRC for assessing environmental impacts. With standards based on the Council on Environmental Quality's regulations, each impact should be assigned one of the following three significance levels:

Small. The environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource.

Moderate. The environmental effects are sufficient to alter noticeably but not to destabilize important attributes of the resource.

Large. The environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

Source: NRC, 2003 (see Chapter 4)

Land Use

MODERATE IMPACT. The licensee proposes to construct a disposal cell in the former Process Area in the northern portion of the SFC site and demolish process buildings and equipment on the site. The only exceptions to this planned demolition would be the administration building, which would be available for potential reuse, and the electrical substation. Following completion of proposed site reclamation activities, SFC proposes the transfer of 131 hectares (324 acres) of the site to a long-term custodian for perpetual care and 112 hectares (276 acres) for unrestricted use by members of the public.

SMALL IMPACT. Because the 131-hectare portion of the SFC site would be held by a nontaxable government entity (i.e., the long-term custodian), local property taxes may be reduced slightly.

Surface Water Resources

SMALL IMPACT. Wastewater generated by SFC during site reclamation (e.g., water from existing ponds and impoundments, storm water runoff from work areas, water used for decontamination and reclamation processes, and recovered groundwater) would be collected and treated using an existing wastewater treatment system to remove uranium before discharge of the treated water to permitted Outfall 001. SFC would backfill soil excavation areas with on-site rock and soil (with concentrations of constituents of concern [COCs] below cleanup criteria), and the areas would be graded with a slight slope to provide adequate storm water drainage. The cap would be covered with topsoil and planted with native vegetation to minimize runoff and erosion. In addition, the majority of pavement and buildings on the site would be removed, thus decreasing site runoff and minimizing long-term effects on surface water quality.

Groundwater Resources

SMALL IMPACT. Implementation of SFC's proposed surface reclamation and groundwater corrective actions would result in concentrations of hazardous constituents in the groundwater being returned to levels that would be protective of public health and safety and the environment. Groundwater would be monitored by the long-term custodian responsible for perpetual care of the disposal cell and surrounding buffer zone to assess the performance of the proposed disposal cell.

Public and Occupational Health

SMALL IMPACT. The estimated off-site public dose during SFC's reclamation activities would be 0.005 millisievert (0.5 millirem) per year, and the long-term public dose in the unrestricted area surrounding the proposed ICB would be 0.095 millisievert (9.5 millirem) per year. These values are below the regulatory limit of 1 millisievert (100 millirem) per year from all sources. The estimated average worker dose during reclamation would be 2.2 millisieverts (220 millirem) per year, and the worker dose during the custodial care period would be 0.002 millisievert (2 millirem) per year. These values are below the NRC occupational worker regulatory limit of 50 millisieverts (5,000 millirem) per year. If there were a loss of institutional controls within the proposed ICB following reclamation, the estimated dose to the public would be 0.54 millisievert (54 millirem) per year (residential farmer scenario). The estimate of latent cancer fatalities to the public and workers due to radiation exposure are less than one in all of the above cases (range: 3.0×10^{-7} to 1.3×10^{-2}). There would be no chemical exposures to workers or the public during reclamation due to the implementation of mitigation procedures (dust suppression). There would be a maximum of five occupational injuries per year during the construction period, and a fatality would be unlikely (the probability of a fatality is less than one fatality per year).

Transportation

SMALL IMPACT. The increased numbers of commuting workers and construction deliveries to the SFC site would be below the design capacity of State Highway 10. While the increased traffic volume would be noticeable to users of State Highway 10, and minor traffic slowdowns or delays might occur at the entrance to the SFC site and at the intersection of State Highway 10 and U.S. Highway 64 about 1.6 kilometers (km) (1 mile) north of the SFC facility, this would have a small impact on the quality of traffic flow in the area. Following SFC's completion of site reclamation, traffic conditions would return to normal.

SMALL NONRADIOLOGICAL IMPACT. The predicted risk of fatalities from traffic accidents would be less than one; therefore, no truck-related fatalities are likely to occur as a result of SFC's reclamation activities. There would be no long-term direct or indirect traffic-accident-related effects following completion of site reclamation activities. The additional vehicle use during SFC's site reclamation would result in a predicted additional latent cancer fatality of 0.00055 (a probability of 1 in 2,000) for inhalation exposure to vehicle-related emissions, which is a very small fraction of the fatalities expected from all causes (1,500) within the population in proximity to the SFC site. Long-term indirect effects of inhalation of vehicular-generated particulates would not occur because there would be little to no activity conducted at the restricted portions of the SFC site following completion of reclamation activities.

SMALL RADIOLOGICAL IMPACT. Under the proposed action, no waste materials would be transported off-site; therefore, no off-site transportation-related radiological impacts or accidents would occur under this alternative.

Cultural Resources

SMALL IMPACT. Consultation with the Oklahoma Historical Society, the Oklahoma Archaeological Survey, and the Cherokee Nation has determined that there are no prehistoric or historic cultural resources currently known on the SFC site. If cultural materials were identified during site reclamation, SFC has indicated that construction activities would be halted, the appropriate NRC official would be notified, and the Oklahoma Historical Society would be consulted. Similarly, if Native American human remains or funerary objects are discovered during reclamation, all construction activities in the area of the discovery would be halted for up to 30 days, the appropriate NRC official would be notified, and steps would be initiated to comply with the requirements of the Native American Graves Protection and Repatriation Act.

Visual and Scenic Resources

SMALL IMPACT. During demolition and construction at the SFC site, the movement of heavy equipment on the site would temporarily generate dust, noise, and open earth that might be visible to travelers on State Highway 10, U.S. Route 64, and I-40. Following completion of reclamation activities, the only structures that would remain on the SFC site would be the administration building and the electrical substation. The licensee's disposal cell would be a rise of about 12 meters (40 feet) above the existing grade. The top of the disposal cell would slope at 1% and the sides would slope at 20%. The cap of the cell would be covered in topsoil and planted with native grassy vegetation. Although the disposal cell may be visible from State Highway 10, U.S. Route 64, and the I-40 bridge, overall the SFC site would contain fewer structures and all exterior equipment and tanks would be removed. The revegetated and grassy disposal cell would blend into the existing natural landscape, although the surrounding fence would be visible to passersby.

Geology and Soils

SMALL IMPACT. SFC would excavate soils under the footprint of the disposal cell that exceed 560 picocuries per gram (pCi/g) uranium and soils outside the footprint that contain uranium, radium, or thorium in excess of the following:

- Uranium – 100 pCi/g;
- Radium – 5 pCi/g; and
- Thorium – 14 pCi/g.

Suitable clayey soils from the southern portion of the SFC site would be used as a liner in both the base and cover layers of the disposal cell. In addition, SFC would place soils collected and stored on-site from prior cleanup activities into the disposal cell. To reduce the potential for soil erosion, SFC would employ mitigation measures in the form of best management practices (e.g., the use of earthen berms, dikes, and silt fences) to minimize this impact. The excavation areas would be backfilled as necessary, graded, and planted with native grasses, which would mitigate any long-term impacts associated with soil erosion. In addition, NRC staff evaluated the effects of potential geologic hazards on the long-term integrity of the proposed disposal cell and determined that the design adequately protects public safety.

Climate, Meteorology, and Air Quality

SMALL IMPACT. Air concentrations of the criteria pollutants predicted for vehicle emissions and emissions of particulates of less than 10 microns (PM_{10}) from fugitive dust emissions would be below the National Ambient Air Quality Standards. Fugitive dust would be temporary and localized. Activities associated with the proposed action also have the potential to release radiological air emissions. Based on the results of data collected during and after remediation of a similar site (Department of Energy's Weldon Spring uranium conversion facility in east-central Missouri that was decommissioned in the late 1990s), it can be concluded that radiological emissions during site reclamation would be below the annual National Emission Standards for Hazardous Air Pollutants (NESHAPSs) of 0.1 millisievert (10 millirem).

Ecological Resources

SMALL IMPACT. Construction of the engineered disposal cell by SFC would remove approximately 0.8 hectare (2 acres) of open field habitat from the industrial area. In addition, approximately 6.1 hectares (15 acres) of upland woodland in the southern part of the site would be disturbed and altered due to use as a clay borrow area. Based on the disturbed nature of the

SFC site, the overall number of wildlife species and diversity are low. Any wildlife disturbed by construction activity and noise would likely return to the area following cessation of the disturbance, which would be temporary. The American burying beetle (a listed endangered species) could be present at the proposed clay borrow area on the SFC site. Because the proposed action has the potential to affect the American burying beetle, the NRC has engaged in informal consultation with the U.S. Fish and Wildlife Service (USFWS) under Section 7 of the Endangered Species Act. As a result of this consultation, the USFWS has recommended that a survey for the American burying beetle be conducted at the clay borrow area prior to initiating any reclamation activities. If it is determined that the American burying beetle is present, SFC will follow standard mitigation practices under USFWS Conservation Approach 1 (e.g., bait away and trap and relocation protocols). No other threatened or endangered species are likely to be adversely affected by the proposed action.

Another recommendation by the USFWS concerns compliance with the Migratory Bird Treaty Act (MBTA). To comply with the “no take” provisions (i.e., no bird mortalities) of the MBTA, SFC has agreed that the upland woodlands in the clay borrow area would not be cleared during the nesting season for migratory bird species.

No jurisdictional wetlands are located on the SFC site.

Socioeconomic Conditions

SMALL IMPACT. The local workforce required by SFC for site reclamation would increase by an average of 72 workers during the peak level of activity, which would primarily be the first two years of reclamation activities. This workforce would include the management team, cell closure workers, health and safety technicians, equipment operators, truck drivers, welders and riggers, and general laborers. The overall number of short-term workers that would be needed is small compared with the total labor force available in the region.

Environmental Justice

SMALL IMPACT. Four census tracts within a 25-mile radius of the SFC site have a higher percentage of minority populations than their respective counties, and one census tract has a higher rate of low-income residents than its county. However, all of these census tracts are greater than 32 km (20 miles) from the SFC site. Since the environmental impacts associated with the SFC’s site reclamation activities would be localized and temporary, these census tracts are too distant from the site to experience any adverse impacts. Therefore, based upon the NRC guidelines for evaluating environmental justice impacts, there would be no disproportionately high or adverse human health or environmental effects on these populations.

Noise

SMALL IMPACT. Reclamation activities would be limited to normal daytime working hours. The maximum noise level calculated for the nearest residence, 0.73 km (0.5 mile) to the northeast of the site boundary, was 54 decibels (A weighted), or dBA. This noise level would not exceed the United States Environmental Protection Agency’s (EPA’s) day-night level of 55 dB(A), which is recommended for protecting the public from interference with indoor and outdoor activities.

SUMMARY OF THE COSTS AND BENEFITS OF THE PROPOSED ACTION

The cost benefit analysis conducted on the proposed action and alternatives compares the full resource costs of each site reclamation alternative over the entire project lifetime to the anticipated benefits. The analysis conforms to the guidance contained in NUREG-1748, *Environmental Guidance for Licensing Actions Associated with NMSS Programs*, Section 5.7, and reference documents contained therein. In addition, the cost benefit analysis was conducted using procedures outlined in NUREG-1757 Vol. 2, Rev. 1, Appendix N.

The direct costs of the site reclamation activities associated with the proposed action would amount to approximately $32.6 million (in 2007 dollars). These direct costs represent site remediation and restoration costs, construction of an on-site disposal cell, and groundwater remediation and treatment. The total costs considered in the cost benefit analysis for the proposed action also included regulatory costs and the opportunity cost of land (see Table 7-6).

The main benefits measured in the cost benefit analysis consisted of the monetized direct health and safety benefits associated with removing residual radioactivity, referred to as the "collective radiation dose averted." The collective radiation dose averted would no longer be experienced by relevant population(s) at the site. The net monetized collective radiation dose averted for the proposed action totaled $191 million. Benefits also included regulatory costs avoided and the capitalized value of net agricultural income from unrestricted release of a portion of the land. The total net benefits of the proposed action (net benefits = total benefits less total costs) amounted to $171.5 million.

The expenditures associated with these remediation activities and costs noted above would mainly be spent locally for goods, services, and wages. These expenditures would have a one-time additional economic indirect impact by creating temporary additional employment and economic activity. Because the 131-hectare (324-acre) portion of the SFC site would be held in permanent custody of a nontaxable government entity, the county tax base would be reduced since SFC currently makes an annual property tax payment to Sequoyah County at the same rate it paid when its facility was in operation.

COMPARISON OF ALTERNATIVES

No-Action Alternative

Under the no-action alternative, SFC would not implement its proposed *Reclamation Plan* and the site would remain in its current condition and configuration. SFC would not remove potential sources of additional groundwater contamination but would continue its current programs to clean up the existing groundwater contamination and perform associated monitoring. This alternative would have SMALL impacts with respect to transportation, cultural resources, air quality, ecological resources, socioeconomic conditions, environmental justice, and noise. For land use, the LARGE adverse impact would be the restricted use of the site in perpetuity. There would be no possibility of the site being productively reused for another purpose.

If reclamation of the site is not conducted, the potential exists for the manifestation of broader contamination across the site in the long term, with MODERATE to LARGE adverse environmental effects on surface water and groundwater resources, public and occupational health, and geology and soils. The existing structures on the SFC site would continue to deteriorate and result in MODERATE adverse impacts on the visual quality of the site.

Alternative 2 (Off-site Disposal of All Contaminated Materials)

Under this alternative, SFC would remove all contaminated soils, sludges, and structures from the site and restore the groundwater under an NRC-approved groundwater *Corrective Action Plan*. In the short-term, there would be SMALL impacts on land use, surface water, and groundwater resources, public and occupational health, cultural resources, geology and soils, air quality, ecological resources, socioeconomic conditions, environmental justice, and noise. There would be a short-term MODERATE impact on transportation due to the combined effects of the increased number of community workers, the construction and use of a rail spur to connect to the main railroad line, and construction deliveries to the site. In the long-term, this alternative would have a MODERATE positive impact on land use in that the entire site would be released for unrestricted use. For all other resource areas, the long-term impacts would be SMALL.

Alternative 3 (Partial Off-site Disposal of Contaminated Materials)

Partial off-site disposal of contaminated materials would result in the most contaminated materials being removed from the SFC site (the dewatered raffinate sludge and the sediments from the Emergency Basin, North Ditch, and Sanitary Lagoon). In the short-term, there would be SMALL impacts on land use, surface water, and groundwater resources, public and occupational health, cultural resources, geology and soils, air quality, ecological resources, socioeconomic conditions, environmental justice, and noise. There would be a short-term MODERATE impact on transportation due to the movement of contaminated materials off-site on local and regional highways. In the long-term, this alternative would have MODERATE impacts on land use in that a portion of the site would be released for unrestricted use. For all other resource areas, the long-term impacts would be SMALL.

Comparison of No-Action and Alternatives 2 and 3 with the Proposed Action

In comparison to the no-action alternative, the proposed action (Alternative 1, On-site Disposal of Contaminated Materials) and Alternatives 2 and 3 would almost all have SMALL impacts, with the exceptions of land use and transportation. Alternatives 1, 2, and 3 would all have MODERATE land use impacts, differing only in the amount of the site acreage that is proposed for release as unrestricted use. Alternatives 2 and 3 would have MODERATE transportation impacts because, in combination with commuting workers and construction activities, either railcars or trucks would be used for transporting contaminated materials off-site. For all other resource areas, the magnitude of potential impacts among Alternatives 1, 2, and 3 would be SMALL.

LIST OF ACRONYMS AND ABBREVIATIONS

ACHP	Advisory Council on Historic Preservation
ACL	alternate concentration limit
AEA	Atomic Energy Act
AES	AES Corporation
ALARA	as low as reasonably achievable
amsl	above mean sea level
bgs	below ground surface
Bq/g	becquerels per gram
Bq/L	becquerels per liter
CDC	Centers for Disease Control and Prevention
CDPHE	Colorado Department of Public Health and Environment
CEDE	committed effective dose equivalent
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	U.S. Code of Federal Regulations
CL	cleanup level
COC	constituent of concern
DAC	derived air concentration
DCGL	derived concentration guideline level
DEIS	Draft Environmental Impact Statement
DOE	U.S. Department of Energy
DOI	U.S. Department of the Interior
DOL	U.S. Department of Labor
DUF_4	depleted uranium tetrafluoride

DUF_6	depleted uranium hexafluoride
E & E	Ecology and Environment, Inc.
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FRTR	Federal Remediation Technologies Roundtable
g	gram
GEIS	Generic Environmental Impact Statement
gpm	gallons per minute
HCM	Highway Capacity Manual
HDPE	high-density polyethylene
HEPA	high-efficiency particulate air
ICB	institutional control boundary
ICRP	International Commission on Radiological Protection
IUC	International Uranium Corporation
kg	kilogram
km	kilometer
LCF	latent cancer fatality
LLRW	low-level radioactive waste
lpm	liters per minute
MCL	maximum contaminant level
MEI	maximally exposed individual
mg	milligram
mg/L	milligrams per liter

mrem	millirem
mSv	millisievert
MW	megawatts
NAAQS	National Ambient Air Quality Standards
NAIP	National Agricultural Imagery Program
NCHS	National Center for Health Statistics
NCI	National Cancer Institute
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NRC	U.S. Nuclear Regulatory Commission
NRHP	National Register of Historic Places
NWI	National Wetlands Inventory
NWR	National Wildlife Refuge
OAS	Oklahoma Archaeological Survey
OCES	Oklahoma Cooperative Extension Service
ODEQ	Oklahoma Department of Environmental Quality
OESFO	Oklahoma Ecological Services Field Office
OG&E	Oklahoma Gas & Electric
OHS	Oklahoma Historical Society
OMB	Office of Management and Budget
OPDES	Oklahoma Pollutant Discharge Elimination System
OSDH	Oklahoma State Department of Health
OSHA	Occupational Safety and Health Administration

OWRB	Oklahoma Water Resources Board
pCi	picocuries
pCi/g	picocuries per gram
pCi/L	picocuries per liter
PMC	Pathfinder Mines Corporation
ppm	parts per million
RAI	Request for Additional Information
RCRA	Resource Conservation and Recovery Act
RIS	Regulatory Information Summary
ROW	right-of-way
SARA	Superfund Amendments and Reauthorization Act
SER	Safety Evaluation Report
SFC	Sequoyah Fuels Corporation
SHPO	State Historic Preservation Officer
Sv	sievert
TEDE	total effective dose equivalent
TER	Technical Evaluation Report
TI	transport index
TRB	Transportation Research Board
UDEQ	Utah Department of Environmental Quality
UF_6	uranium hexafluoride
µg/L	micrograms per liter
UMTRCA	Uranium Mill Tailings Radiation Control Act of 1978
U.S.C.	United States Code
USACE	U.S. Army Corps of Engineers

USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WCS	Waste Control Specialists
yr	year

1. INTRODUCTION

1.1 Background

The U.S. Nuclear Regulatory Commission (NRC) staff and its contractor, Ecology and Environment, Inc., prepared this Environmental Impact Statement (EIS) to evaluate the potential environmental impacts of the reclamation activities proposed by Sequoyah Fuels Corporation (SFC) for its former uranium conversion site in Gore, Oklahoma. These reclamation activities include both surface reclamation and groundwater corrective actions. The SFC Gore site is located in Sequoyah County in eastern Oklahoma (see Figure 1.1-1).

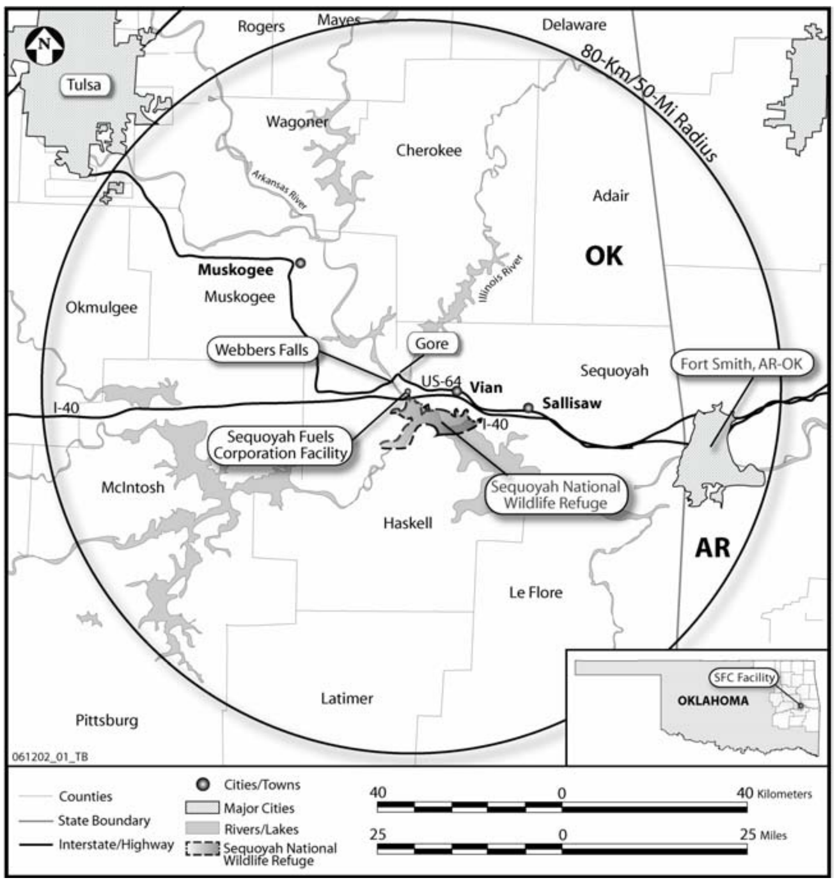


Figure 1.1-1 Location of Sequoyah Fuels Corporation Facility, Gore, Oklahoma

The NRC has determined that approval of SFC's proposal for on-site disposal of the radioactive waste from its previous operations, along with land use restrictions or other institutional controls to prevent inadvertent disturbance of the waste, constitutes a major federal action and, therefore, warrants the preparation of an EIS in accordance with the National Environmental Policy Act (NEPA) of 1969, as amended. This EIS meets the requirements of the NRC regulations implementing the NEPA, found at Title 10, "Energy," of the U.S. Code of Federal Regulations (CFR), Part 51 (10 CFR Part 51).

The SFC site is licensed under NRC license SUB-0110. In accordance with conditions in that license, SFC submitted its proposed site *Reclamation Plan* and its proposed groundwater *Corrective Action Plan* in 2003 for NRC approval. Both plans have since been revised in response to NRC staff reviews and requests for additional information. The NRC staff's review of SFC's plans against the requirements in Appendix A to Part 40 are contained in two separate reports, a Safety Evaluation Report (SER) for the *Reclamation Plan* and a Technical Evaluation Report (TER) for the groundwater *Corrective Action Plan*.

Before SFC can proceed with its proposed surface reclamation activities and groundwater corrective actions, these activities must be approved by the NRC. This approval would come in the form of NRC-issued amendments to SFC's license, which would require SFC to conduct surface reclamation and groundwater corrective actions in accordance with the approved plans. To approve SFC's proposed plans, the NRC must determine that they meet the requirements of Appendix A to 10 CFR Part 40 and that the environmental impacts of such plans have been evaluated and appropriately considered.

The role of the NRC as a regulator is to assess the licensee's proposed action with respect to protection of public health and safety and the environment. As lead agency, NRC retains final responsibility for the content of all documents, which include the Sequoyah Fuels Draft EIS and the Final EIS. NRC's responsibilities include determining the purpose of and need for the EIS; selecting alternatives for analysis; identifying impacts of the proposed alternatives; making a recommendation on the proposed action; and evaluating appropriate mitigation measures. Under NEPA, the EIS must consider reasonable alternatives to the licensee's proposed action to define the issues and provide a clear basis for choice among options by the decision maker and the public (40 CFR Part 1502.14). In this EIS, the NRC staff has reviewed and evaluateed the impacts of the licensee's proposed action and two alternatives. However, as a regulator, the NRC does not choose a preferred alternative in the EIS.

1.2 The Licensee's Proposed Action (Alternative 1)

The proposed action considered in this EIS is the implementation of SFC's proposed reclamation activities for the 243-hectare (600-acre) Gore site. SFC's *Reclamation Plan* (SFC, 2006a) identifies the activities that would be undertaken by SFC to accomplish surface reclamation of the site in accordance with 10 CFR Part 40, Appendix A (which includes criteria for the disposition of uranium mill tailings or wastes). SFC proposes to consolidate contaminated sludges and soils, demolish existing structures (with the exception of the administration building and the electrical substation), and construct an above-grade, on-site engineered disposal cell for the permanent disposal of all contaminated materials. In accordance with 10 CFR Part 40, Appendix A, the NRC can allow the reclamation of the SFC site such that the SFC waste can be isolated in an on-site disposal cell.

SFC has also submitted a groundwater *Corrective Action Plan* (SFC, 2003) that identified activities to address groundwater contamination at the site. SFC subsequently modified its groundwater *Corrective Action Plan* in response to NRC staff reviews and requests for additional information (SFC, 2005).

Following the completion of surface reclamation and groundwater corrective actions, SFC would seek termination of its NRC license. As part of that future license termination process, SFC proposes to transfer approximately 131 hectares (324 acres) of the site, including the land area encompassing the disposal cell and a surrounding buffer, to the United States government or the State of Oklahoma for long-term control (the final size of the area to be transferred is subject to negotiation between SFC and the long-term custodian). The State of Oklahoma would have the first option to take responsibility for long-term custodial care of the site. If the State declines this role, the U.S. Department of Energy (DOE) (or other federal agency) would take custody of the site under the provisions of Section 83 of the Atomic Energy Act (AEA) of 1954, as amended by the Uranium Mill Tailings Radiation Control Act of 1978. The remaining 112 hectares (276 acres) of the site would be released for unrestricted use.

1.3 Purpose and Need for the Proposed Action

This section of the EIS describes the regulatory history of the site and the relevant NRC hearing history in the context of the purpose and need for the proposed action.

1.3.1 Regulatory History

In November 1992, following a release of nitrous oxide, SFC notified the NRC that it had permanently ceased production of uranium hexafluoride (UF_6) and would terminate the depleted uranium hexafluoride-tetrafluoride (DUF_6-DUF_4) operation by the end of July 1993. Accordingly, SFC notified NRC by letter that all production activities at its Gore, Oklahoma, uranium conversion facility had ceased on July 6, 1993, and that SFC was seeking termination of its license in compliance with the requirements of 10 CFR 40.42(e) (License Termination and Decommissioning of Sites).

The information available to the NRC at the time of the SFC notification indicated that at least some of the identified waste and contamination at the facility was known to exceed the NRC's radiological criteria for decommissioning. In the vicinity of the process buildings, process impoundments, and uranium handling areas, concentrations of uranium in the soils were found to exceed background levels. Consequently, the NRC required that the site be remediated to meet the radiological criteria contained in Subpart E of 10 CFR Part 20 (Standards for Protection Against Radiation). SFC subsequently submitted a *Site Characterization Report* and a study of remediation alternatives (SFC 1998) to the NRC. In a *Decommissioning Plan* submitted to the NRC staff in March 1999 (SFC, 1999), SFC proposed the construction of an on-site disposal cell for the disposal of contaminated materials, including consolidated waste and soils.

> **Byproduct Material** means . . . (2) the tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content." 42 U.S.C. § 2014(e)(2).

In July 2002, the NRC granted a request by SFC to reclassify some of the waste at the site as AEA Section 11e.(2) "byproduct material" (42 U.S. Code [U.S.C.] 2014(e)(2)) and in December 2002 issued a license amendment to authorize SFC's possession of this reclassified material. With the reclassification of some of the contaminated waste and soils, the applicable regulatory regime was transferred from Subpart E of 10 CFR Part 20 (Standards for Protection Against Radiation) to Appendix A to 10 CFR Part 40 (which includes Criteria for the Disposition of Mill Tailings or Wastes). This shift required SFC to withdraw its 1999 *Decommissioning Plan* and to prepare a *Reclamation Plan*, which was submitted to the NRC staff in January 2003, with further revisions being submitted in May 2005 and December 2006 (SFC, 2006a). In addition, SFC submitted a groundwater *Corrective Action Plan* to NRC in June 2003 (SFC, 2003), which was subsequently revised (SFC, 2005).

In its *Reclamation Plan*, SFC proposes to conduct many of the same types of activities to achieve surface reclamation of its Gore, Oklahoma site as it proposed under its previous *Decommissioning Plan*. Implementation of these activities would result in many of the same environmental issues—disturbance of surface soils, control of surface runoff, groundwater corrective actions, and ultimately the release of at least a portion of the site for future use.

1.3.2 Relevant Hearing History

In 2003, the State of Oklahoma and the Cherokee Nation submitted hearing requests to the NRC's Atomic Licensing Board regarding SFC's plan for reclamation of their Gore, Oklahoma, site. The licensing board withheld action on the hearing requests because negotiations were in progress and, in December 2004, a Settlement Agreement was entered into by SFC, the State of Oklahoma, and the Cherokee Nation (NRC, 2004). The topics addressed by the Settlement Agreement included, among others, the disposition of contaminated sludges and sediments, as well as PCBs and asbestos. It is important to note that the terms of the Settlement Agreement do not fall within the scope of the NRC's enforcement authority. In response to the requests of cooperating agencies, the NRC acknowledged that a Settlement Agreement was entered into by the State of Oklahoma, the Cherokee Nation, and SFC. In this regard, the Settlement Agreement and any discussion of its terms must not be construed as a supplement or substitution whatsoever for any Commission regulation or staff review of the information submitted by SFC.

In the Settlement Agreement, the parties agreed that SFC would revise the *Reclamation Plan* to state that the raffinate sludge, North Ditch sediment, Emergency Basin sediment, and Sanitary Lagoon sediment would be disposed at an appropriate off-site location and that SFC would spend up to $3.5 million for off-site disposal of this material. The parties acknowledged that off-site disposal of this material would be given high priority but that complete off-site disposal may not be economically possible due to circumstances outside the control of SFC.

To date, the *Reclamation Plan* has not been revised to provide for any off-site disposal of raffinate sludge, North Ditch sediment, Emergency Basin sediment, and Sanitary Lagoon sediment as described in the terms of the Settlement Agreement. However, as per the Settlement Agreement, two months after the publication of the SER by the NRC staff, SFC is required to prepare and submit an updated assessment of off-site disposal locations, SFC's financial resources, and the estimated costs of such off-site disposal. The NRC staff has not yet completed its SER for the SFC proposed action. Once the SER is completed, it is SFC's responsibility to either revise the *Reclamation Plan* according to the Settlement Agreement or reach consensus with the State of Oklahoma and the Cherokee Nation on other disposal options or modifications to the plan. If SFC changes the *Reclamation Plan* to provide for off-site disposal as described in the Settlement Agreement, SFC would be obligated to submit a license amendment to the *Reclamation Plan* to the NRC for approval. At that time, the NRC staff would make a determination as to whether a supplement to the EIS would be necessary.

1.3.3 Purpose and Need

Under the AEA of 1954, as amended, the NRC has licensing and regulatory authority for nuclear energy uses within the commercial sector. One part of this licensing responsibility is to ensure the safe and timely decommissioning of nuclear facilities that are regulated by the NRC. Decommissioning means to "remove a site safely from service and reduce residual radioactivity [through remediation or reclamation of the site by the licensee] to a level that permits: (1) release of the property for unrestricted future use and ultimate termination of the license; or (2) release of the property under restricted conditions and ultimate termination of the license" (10 CFR 40.4). The proposed reclamation, including construction and maintenance of the disposal cell at the SFC site, are being evaluated by the NRC with respect to conformance with the criteria for decontamination, decommissioning, and reclamation specified in Appendix A to 10 CFR Part 40. This evaluation is documented in the NRC's Safety Evaluation Report (SER). The proposed action is intended to satisfy the need to protect public health and safety and ensure that any potential long-term radiological and nonradiological hazards or other impacts on the environment are minimized. Satisfying this need would be consistent with NRC's statutory mission under the AEA.

The purpose of the proposed action is the reclamation of SFC's Gore, Oklahoma, uranium conversion site in accordance with the NRC performance standards contained in 10 CFR Part 40, Appendix A. These standards require, in part: (1) isolation of the waste materials in a manner that protects human health and the environment; (2) reduction in the rate of radon emanating from the disposal cell cover to an average of 20 picocuries (pCi) per square meter-second or less; (3) a level of stabilization and containment of contaminated materials for a long period of time; (4) minimal reliance on active maintenance of the disposal cell; and (5) protection and restoration, as needed, of groundwater, and (6) clean up of the site and structures outside of the disposal cell to the applicable radiation standards.

The Appendix A criteria were established to provide reasonable assurance of control of radiological hazards for 1,000 years, to the extent reasonably achievable, and in any case, for at least 200 years. This requirement conforms to the standard established by EPA in 40 CFR Part 192. The Uranium Mill Tailings Radiation Control Act (UMTRCA) required EPA to establish standards for reclamation of 11e.(2) byproduct material and NRC to conform its regulations to the EPA standards. For performance beyond 1,000 years, the low-profile of the cell is designed such that any future releases of uranium-238, thorium-230, or radium-226 would be incrementally slow (erosion of a low-relief feature over geologic time), hence minimizing risks to the public health, safety, or the environment.

Following the completion of surface reclamation activities and groundwater restoration, the NRC license for the site would be terminated. The disposal cell and a buffer area surrounding the cell, delineated by an institutional control boundary (ICB), would be transferred to a long-term custodian for perpetual care. The DOE, another federal agency so designated by the President, or the State of Oklahoma would be this custodian and licensed under an NRC general license at 10 CFR 40.28. The purpose of this general license is to ensure that the SFC site will be cared for in such a manner as to protect public health and safety and the environment after closure of the disposal cell.

1.4 Scope of the Environmental Analysis

To fulfill its responsibilities under NEPA, the NRC has prepared this EIS to analyze the potential environmental impacts (i.e., direct, indirect, and cumulative impacts) of the reclamation activities proposed by SFC for its Gore, Oklahoma site, as well as reasonable alternatives to the proposed action. The scope of this EIS includes consideration of both radiological and nonradiological (including chemical) impacts associated with the proposed action and the reasonable alternatives. The EIS also addresses potential environmental impacts relevant to transportation.

In addition, this EIS addresses cumulative impacts to physical, biological, economic, and social parameters. This EIS also identifies resource uses, monitoring, potential mitigation measures, unavoidable adverse environmental impacts, the relationship between short-term uses of the environment and long-term productivity, and irreversible and irretrievable commitments of resources.

The development of this EIS is the result of the NRC staff's review of the SFC *Reclamation Plan* (SFC, 2006a), its supporting *Environmental Report* (SFC, 2006b), and the SFC groundwater *Corrective Action Plan* (SFC, 2003, as amended). This EIS review has been closely coordinated with the development of the SER and TER prepared by the NRC staff to evaluate, among other aspects, the health and safety impacts of the proposed action. The SER and TER are the outcomes of the NRC safety and technical reviews of SFC's *Reclamation Plan* and the groundwater *Corrective Action Plan*.

1.4.1 Scoping Process and Public Participation Activities

The NRC's NEPA implementing regulations in 10 CFR Part 51 contain requirements for conducting a scoping process prior to the preparation of an EIS. Scoping was used to help identify those issues to be addressed in detail and those issues that are either beyond the scope of the EIS or are not directly relevant to the assessment of potential impacts from the proposed action and reasonable alternatives.

On October 20, 1995, the NRC published a Notice of Intent (NOI) in the Federal Register (60 FR 54260) to prepare an EIS for the proposed decommissioning of the SFC facility. Following reclassification of the waste at the SFC site by the NRC, an NOI to Conduct a Public Rescoping Meeting was published in the Federal Register on April 23, 2003 (68 FR 20033). The public rescoping meeting was held on May 13, 2003, in Gore, Oklahoma. The purposes of the rescoping meeting were threefold: (1) to inform the public about the *Reclamation Plan* and the groundwater *Corrective Action Plan*; (2) to explain how these plans would be used to reassess the potential impacts of the proposed action; and (3) to solicit additional public input on the Draft Environmental Impact Statement (DEIS).

On September 21, 2007, the NRC staff published a Notice of Availability for the DEIS in the Federal Register (72 FR 54080). In the notice, the NRC staff provided information regarding the public meeting and the public comment period and how to obtain a free copy of the DEIS. On October 16, 2007, in Gore, Oklahoma, the NRC staff conducted a public meeting to receive oral comments on the DEIS from members of the public. The NRC staff received both oral and written comments on the DEIS during the comment period. The NRC staff identified 58 comments from the oral comments and the five letters received during the public comment period. Appendix H to this EIS contains a more detailed summary of the public participation process, all of the public comments, and the NRC staff's responses to the public comments, including an indication of whether the comment resulted in a modification to this EIS.

1.4.2 Issues Studied in Detail

In the 2003 NOI, the NRC identified the issues to be studied in detail as they relate to implementation of the proposed action. During the subsequent scoping process, the public identified additional issues. The following issues identified by the NRC and the public could result in short- or long-term impacts on resources during SFC's proposed reclamation of their Gore, Oklahoma, site:

- **Land Use and Tax Revenues.** SFC is proposing that the radioactive waste at the site be consolidated and placed in an on-site disposal cell. In addition, long-term control by the state or federal government would be required in perpetuity to protect the disposal cell and surrounding contaminated areas from inadvertent intrusion by the public. As a result, the proposed site reclamation would make portions of the site unavailable for future unrestricted use. The public has commented that restricted use of the SFC site would have significant societal and economic impacts. Section 4.2, Land Use, discusses land use and tax revenue impacts related to the alternatives assessed in this EIS.

- **Water Resources.** There are both surface water and groundwater issues associated with SFC's proposed plan for site reclamation.

  - ***Surface Water Resources.*** The public has expressed concern that, even after the completion of site reclamation, drainage from and erosion of the site could result in suspended radionuclide-contaminated soils being washed into nearby rivers. The public also is concerned about ingesting fish products from a river or reservoir that has been contaminated with radionuclides by surface runoff or groundwater from the site. The potential for surface water contamination during and after surface reclamation of the site is discussed in detail in Section 4.3, Impacts on Water Resources, of this EIS.

  - ***Groundwater Resources.*** During operations, SFC inadvertently released radioactive materials into the ground, contaminating the surrounding soil and groundwater. Elevated concentrations of uranium have been identified in the upper levels of groundwater in the vicinity of the main process building. There also are groundwater plumes from the storage ponds with uranium concentrations exceeding the drinking water standard contained in 40 CFR 141.66 (30 milligrams per liter [mg/L]).

    The public is concerned that contaminated groundwater plumes could reach underlying aquifers and believes the groundwater should be cleaned up before such plumes reach local rivers or the Robert S. Kerr Reservoir. The public also is concerned that, even after the completion of surface reclamation, seepage from the on-site disposal cell could still be directed downward to the groundwater and ultimately reach surface water resources.

    Under SFC's proposed action, approximately 112 hectares (276 acres) would be made available to the public for unrestricted use. An alternative to SFC's proposed action would make the entire site (243 hectares [600 acres]) available for unrestricted use. Of concern, then, is the potential for future residents to use the groundwater for drinking or other domestic uses. The potential impacts on groundwater resources are discussed in detail in Section 4.4, Water Resources, of this EIS.

- **Public and Occupational Health.** Public and occupational health and safety issues are of concern to the public, including the potential for adverse effects on human health related to chronic and acute exposures to ionizing radiation and hazardous chemicals present on the site, as well as from physical safety hazards. The public has indicated that effects on human health might occur during and after site reclamation and during transportation of any contaminated wastes under off-site disposal alternatives. The potential impacts on public and worker safety and health are discussed in detail in Section 4.4, Public and Occupational Health, of this EIS.

- **Transportation.** As a result of surface reclamation activities proposed by SFC, there would be an increase in traffic operating on the SFC site and accessing the site from public highways. This increase in traffic would include construction workers commuting in private vehicles, earthmoving equipment operating on-site, and large trucks delivering equipment and materials to and removing waste from the site. The public is concerned with the consequences of increased traffic, such as accidents and exposure of local residents to transportation-related radiological doses. The potential for impacts due to transportation issues is discussed in detail in Section 4.5, Transportation Impacts, of this EIS.

1.4.3 Issues Eliminated from Detailed Study

The NRC has determined that detailed analysis of several issues is unnecessary because, after examination, they were found to have small to no impacts and thus are not considered potential discriminators among the proposed action and the reasonable alternatives. These issues and any associated impacts are briefly described below and are further discussed in Appendix B, Issues Eliminated from Detailed Study, of this EIS.

- **Geology and Soils.** Reclamation of the SFC site would disturb surface soils during excavation and grading activities to remove and consolidate contaminated materials prior to disposal and during construction of the disposal cell, including its closure and capping. At completion of the *Reclamation Plan*, contaminated soils would be isolated within the on-site disposal cell. Excavated areas would be regraded and reseeded. Therefore, impacts on geology and soils would be small.

- **Cultural Resources.** Consultation conducted with the Oklahoma State Historic Preservation Officer (SHPO) revealed that no historic properties would be affected by implementation of SFC's proposed reclamation activities (OHS, 2006). The Oklahoma Archaeological Survey (OAS) identified only one archaeological site in the area, to the west of the SFC site boundary (OAS, 2000). This site would not be disturbed during the proposed SFC reclamation activities. Therefore, there would be no impacts on cultural resources from on-site reclamation activities. Consultations regarding construction of a rail spur east of the site for another reasonable alternative would be pursued if needed.

- **Visual and Scenic Resources.** Visual and scenic resources comprise those features that relate to the overall impression a viewer receives of an area. The value of the affected setting is highly dependent on existing land use. The SFC site is an industrial facility located in a rural area and is surrounded by a mix of forest and pastureland with rolling hills. The waterways adjacent to or near the site (the Illinois and Arkansas rivers, including the Robert S. Kerr Reservoir) are used by the public for recreation. The SFC facility currently contrasts with the rural and natural character of the surrounding area.

  This contrast would continue to be evident during the licensee's construction of the disposal cell and related reclamation activities. Travelers on Interstate 40, U.S. Route 64, and State Highway 10 would be able to observe dust and construction equipment on the site and increased traffic on the roads leading to the SFC site. Following reclamation, the only structures that would remain on the SFC site would be the administration building and the electrical substation. After revegetation, the disposal cell would blend into the existing natural landscape, although the surrounding fence would be visible to passersby. In summary, following SFC's completion of the reclamation activities, the overall visual and scenic impacts would be small.

- **Air Quality.** Air quality and visibility could be temporarily affected by site reclamation activities. Demolition or earthmoving activities during removal of structures and consolidation of contaminated soils and sludges would result in fugitive dust and vehicular emissions, causing local, short-term degradation of air quality. SFC would implement standard dust-suppression practices and maintain appropriate emission controls on diesel and gasoline engines during the reclamation activities. Therefore, the action will not exceed any National Ambient Air Quality Standards (NAAQS). Applicable radiological air quality standards are not expected to be exceeded as evidenced by experience from decommissioning of the former uranium conversion facility at Weldon Spring, Missouri. The concentration ranges of contaminants at that site and at the SFC site are comparable, and decommissioning at the former site included removal and temporary storage of contaminated soil and other material as well as permanent disposal in an on-site earthen cell. In addition, the results of the dose assessment study conducted for this EIS indicate that the radiological dose from all potential pathways, including air emissions, would be within regulatory limits. Therefore, the impact would be small. In summary, any air quality impacts would be small since they would be temporary and occur only as reclamation activities were being conducted.

- **Ecological Resources.** As proposed in its *Reclamation Plan*, the licensee would raze all of the former process buildings (with the exception of the administration building and the electrical substation) and construct an on-site disposal cell for the disposal of the contaminated materials consolidated from different areas of the site. Following capping of the disposal cell, it and the former Process and Industrial Areas would be graded and seeded with grasses to prevent erosion. As a result, the amount of wildlife habitat on the site would increase. In addition, the potential risks to wildlife from exposure to radiological and nonradiological contaminants would be reduced. While the construction phase of the proposed action would result in short-term, moderate disturbance to wildlife, in the long-term, implementation of SFC's proposed reclamation activities would improve the quality of local wildlife habitat. The American burying beetle (a listed endangered species) could be present at the proposed clay borrow area on the SFC site. Because the proposed action has the potential to affect the American burying beetle, the NRC has engaged in informal consultation with the U.S. Fish and Wildlife Service (USFWS) under Section 7 of the Endangered Species Act. As a result of this consultation, the USFWS has recommended that a survey for the American burying beetle be conducted at the clay borrow area prior to initiating any reclamation activities. If it is determined that the American burying beetle is present, SFC will implement standard mitigation practices prior to construction activities. No other threatened or endangered species are likely to be adversely affected by the proposed action. Therefore, overall potential impacts on ecological resources would be small.

- **Noise.** Reclamation activities at the SFC site would result in temporarily increased noise levels from the operation of heavy trucks, jackhammers, bulldozers, loaders, and other equipment that would be used to dismantle and demolish structures and to conduct other activities necessary to remediate the site. Noise levels in the immediate vicinity of the equipment could reach 110 decibels or more if there are multiple nearby sources, but noise levels at the nearest receptor would be about 55 decibels, which would be comparable to residential construction. Appropriate controls to limit worker exposure to noise would be implemented by SFC in accordance with regulations of the Occupational Safety and Health Administration (OSHA) (29 CFR 1910.95). Noise impacts would be small since they would occur only during the construction phase of SFC's reclamation efforts at the site and would not adversely affect nearby residents.

- **Socioeconomic Impacts.** SFC has indicated that implementation of the proposed *Reclamation Plan* would likely involve the hiring of 72 to 78 on-site workers, most of whom would be local. As a result, short-term construction-related impacts on regional housing, public infrastructure, and economic resources would be small. Under the Proposed Action, SFC is proposing to "restrict use" of more than 50% of the site in the long-term, with additional long-term restrictions on the use of groundwater at the site. The remaining portion of the site will be released for unrestricted use. Following reclamation and until reuse of the unrestricted portion of the property, there would be no commercial activity and the impacts would be small. In the long-term, the unrestricted portion of the site could potentially be developed for commercial or industrial use and yield positive economic and tax benefits.

- **Environmental Justice.** Executive Order 12898 directs federal agencies to address disproportionately high and adverse human health or environmental effects of proposed actions on minority and low-income populations. Appendix B of this EIS describes the distributions of minority and low-income populations in the vicinity of the SFC site. This analysis shows that there are four census tracts where the percentage of minority populations within 40 kilometers (km) (25 miles) of the SFC facility exceed the percentage of these populations in the region as a whole. In addition, there was one census tract within 32 kilometers (20 miles) of the SFC site where the low-income population exceeded that of the region. Since the environmental impacts associated with SFC's proposed site reclamation activities would be localized and temporary, these census tracts are too distant from the SFC site to experience adverse impacts. Based upon NRC environmental justice guidelines and further analysis, it was determined that the implementation of SFC's proposed action would not have disproportionately high and adverse human health or environmental effects on minority or low-income populations.

- **Mineral Resources.** Minerals mined in the area include coal, limestone, sandstone, sand/gravel from the Arkansas River floodplain, clay, and shale. No coal mining operations, oil or gas fields, or other mineral resources in the immediate area of the SFC site would be affected by implementation of SFC's proposed *Reclamation Plan*.

- **Cost.** SFC provided cost estimates to support the alternatives, and the NRC obtained quotes from transporters and off-site facilities licensed to accept the contaminated materials. These were used to develop a cost benefit analysis based on the guidance contained in NUREG-1748, *Environmental Guidance for Licensing Actions Associated with NMSS Programs*, Section 5.7 (NRC, 2003), and reference documents contained therein. In addition, the cost benefit analysis was conducted using procedures outlined in NUREG-1757 Vol. 2, Rev. 1, Appendix N. The results of the cost benefit analysis indicated Alternative 1 (Licensee's Proposed Action) would yield the greatest net benefits.

1.4.4 Issues Outside the Scope of the EIS

The following issues were identified in the public scoping process to be outside the scope of the EIS:

- Impacts of past exposures to radioactive materials.

- Legal actions.

- Siting of low-level radioactive waste (LLRW) disposal facilities.

A summary of the scoping process is presented in Appendix A.

1.4.5 Related NEPA and Other Relevant Documents

The following NEPA documents were reviewed as part of the development of this EIS to obtain information relevant to the issues raised:

- **Final EIS (FEIS) for Operation of the SFC Facility (NRC, 1975).** In 1975, the NRC published an FEIS regarding the operation of the SFC facility. This document did not discuss the environmental impacts associated with decommissioning because a detailed description of decommissioning was not expected until just before SFC's license would be terminated.

- **Environmental Assessment for SFC License Renewal (NRC, 1985).** In 1985, the NRC published an Environmental Assessment for renewal of SFC's license. This document noted that SFC had submitted a decommissioning plan and cost estimate, but that the plan did not review the environmental impacts of decommissioning.

- **NUREG-0586, Final Generic Environmental Impact Statement (GEIS) on Decommissioning of Nuclear Facilities (NRC, 1988).** This GEIS describes and evaluates the generic impacts associated with the decommissioning process for various nuclear fuel cycle facilities, including a uranium conversion plant, and concludes that the environmental consequences of decommissioning a uranium conversion plant are small. The impacts of decontaminating building structures and areas of contaminated soils also are discussed in the document.

- **NUREG-1496, Generic Environmental Impact Statement in Support of Rulemaking on Radiological Criteria for License Termination of NRC-Licensed Nuclear Facilities (NRC, 1997).** This GEIS focuses on the costs and environmental effects of the activities required to achieve the residual dose criteria contained in 10 CFR Part 20 and evaluates the environmental impacts associated with the remediation of several types of NRC-licensed facilities. The analysis encompasses many of the likely impacts that would in situations where the licensee proposes to release a decommissioned site for unrestricted use.

- **NRC Safety and Technical Evaluation Reports.** The NRC staff is preparing an SER for the reclamation of the SFC site and a TER for groundwater restoration. In the SER, the NRC staff evaluates whether the licensee's proposed action can be accomplished in accordance with the criteria in 10 CFR Part 40, Appendix A. The SER evaluates the licensee's *Reclamation Plan.* The TER evaluates the groundwater *Corrective Action Plan.* Together, these reports include reviews of the extent of contamination at the facility, the radiation protection program, the design of the disposal cell and proposed groundwater corrective actions, potential for accidents, and the funding needed to complete site reclamation.

1.5 Applicable Regulatory Requirements and Permits

This section provides a summary assessment of major environmental requirements, agreements, Executive Orders, and permits relevant to the performance of proposed reclamation activities at the SFC site.

1.5.1 Federal Laws and Regulations

1.5.1.1 National Environmental Policy Act of 1969, as amended (42 U.S.C. §4321 et seq.)

NEPA establishes national environmental policy and goals for the protection, maintenance, and enhancement of the environment to ensure for all Americans a safe, healthful, productive, and aesthetically and culturally pleasing environment. The Act provides a process for implementing these specific goals within the federal agencies responsible for the action. This EIS has been prepared in accordance with NEPA requirements and the NRC's regulations for implementing NEPA (10 CFR Part 51).

1.5.1.2 Atomic Energy Act of 1954, as amended (42 U.S.C. §2011 et seq.)

The AEA and the Energy Reorganization Act of 1974 (42 U.S.C. §5801 et seq.) give the NRC the licensing and regulatory authority for nuclear energy uses within the commercial sector. The NRC staff's environmental and safety reviews of the licensee's proposed *Reclamation Plan* and groundwater *Corrective Action Plan* ensure that the surface reclamation of the SFC site and groundwater corrective actions are conducted such that public health and safety are protected and that any long-term radiological and nonradiological hazards or other impacts on the environment are minimized.

1.5.1.3 Uranium Mill Tailings Radiation Control Act of 1978

The Uranium Mill Tailings Radiation Control Act of 1978 (UMTRCA) was enacted to provide for the disposal, long-term stabilization, and control of uranium mill tailings in a safe and environmentally sound manner and to minimize or eliminate radiation health hazards to the public. Regulatory oversight for the SFC site falls under the UMTRCA Title II program, which provides NRC the authority to control radiological and nonradiological hazards, gives the U.S. Environmental Protection Agency (EPA) the authority to set generally applicable standards for both radiological and nonradiological hazards, and provides for eventual State of Oklahoma or federal ownership of the disposal site (disposal cell and area within the ICB).

1.5.1.4 Clean Air Act, as amended (42 U.S.C. §7401 et seq.)

The Clean Air Act establishes regulations to ensure air quality and authorizes individual states to manage permits. The Clean Air Act requires: (1) the EPA to establish NAAQS as necessary to protect the public health, with an adequate margin of safety, from any known or anticipated adverse effects of a regulated pollutant (42 U.S.C. §7409 et seq.); (2) establishment of national standards of performance for new or modified stationary sources of atmospheric pollutants (42 U.S.C. §7411); (3) specific emission increases to be evaluated so as to prevent a significant deterioration in air quality (42 U.S.C. §7470 et seq.); and (4) specific standards for releases of hazardous air pollutants (including radionuclides) (42 U.S.C. §7412). These standards are implemented through plans developed by each state with EPA approval. The Clean Air Act requires sources to meet air quality standards and obtain permits to satisfy those standards.

1.5.1.5 Clean Water Act, as amended (33 U.S.C. §1251 et seq.)

The Clean Water Act requires the EPA to set national effluent limitations and water quality standards and establishes a regulatory program for enforcement. Specifically, Section 402(a) of the Act establishes water-quality standards for contaminants in surface waters. The Clean Water Act requires that a National Pollutant Discharge Elimination System (NPDES) permit be obtained before discharging any point source pollutant into U.S. waters. In 1996, the Oklahoma Department of Environmental Quality (ODEQ) assumed NPDES permitting authority from the EPA, with the exceptions of Agricultural (e.g., feedlots), General Permits, Indian Lands, and Oil, Gas, and Pipeline Facilities (Standard Industrial Classification code 1300s, with the exception of both 1321 and 1389 where the discharges are not associated with an exploration or production-site). Similarly, ODEQ has the authority to issue storm water permits for industries operating in Oklahoma and has primacy in enforcement actions. SFC currently holds Oklahoma Pollutant Discharge Elimination System (OPDES) storm water permits.

Section 404 of the Clean Water Act specifically establishes the program that regulates the discharge of dredged and fill material into waters of the United States, including wetlands. Activities in waters of the United States that are regulated under this program include fills for development, water resource projects (such as dams and levees), infrastructure development (such as highways and airports), and conversion of wetlands to uplands for farming and forestry. The licensee’s proposed on-site reclamation activities would not involve the discharge of dredged or fill materials into waters of the United States. Applicants requesting a Section 404 permit for any activity that may result in a discharge into waters of the U.S. must first obtain a

State 401 water quality certification. Construction of the rail spur under the off-site disposal alternative would require a Section 404 CWA permit from the U.S. Army Corps of Engineers (USACE), Tulsa District, for disturbance to two intermittent tributaries of Salt Branch, which is an intermittent tributary of the lower Illinois River. It is expected that both stream crossings would qualify for coverage under a Section 404 Nationwide Permit. An accompanying Section 401 water quality certification from the ODEQ also would be required for the stream crossings.

1.5.1.6 Resource Conservation and Recovery Act, as amended (42 U.S.C. §6901 et seq.)

The Resource Conservation and Recovery Act (RCRA) requires the EPA to define and identify hazardous waste; establish standards for its transportation, treatment, storage, and disposal; and require permits for persons engaged in hazardous waste activities. Section 3006 of RCRA (42 U.S.C. §6926) allows states to establish and administer these permit programs with EPA approval. The EPA has delegated regulatory jurisdiction to the ODEQ, acting under the Oklahoma Hazardous Waste Management Act, for nearly all aspects of RCRA permitting. The EPA, however, retains its authority under RCRA sections 3007, 3008, 3013, and 7003, which include, among others, authority to: (1) conduct inspections, and require monitoring, tests, analyses or reports; (2) enforce RCRA requirements and suspend or revoke permits; and, (3) take enforcement actions regardless of whether the state has taken its own actions. In a letter dated May 24, 2006, the ODEQ stated its determination that the non-11e.(2) byproduct materials proposed for disposal in the on-site disposal cell was the calcium fluoride sludge. Following review of sludge analytical results, ODEQ stated that they would not assert their jurisdiction to regulate any of the SFC non-11e.(2) byproduct material as hazardous waste.

1.5.1.7 Emergency Planning and Community Right-to-Know Act of 1986 (42 U.S.C. §11001 et seq.) (also known as Superfund Amendments and Reauthorization Act (SARA) Title III)

The Emergency Planning and Community Right-to-Know Act of 1986, which is the major amendment to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (42 U.S.C. §9601*)*, establishes the requirements for federal, state, and local governments; Indian tribes; and industry regarding emergency planning and “Community Right-to-Know” reporting on hazardous and toxic chemicals. The “Community Right-to-Know” provisions increase the public’s knowledge and access to information on chemicals at individual facilities, their uses, and releases into the environment. States and communities working with facilities can use the information to improve chemical safety and protect public health and the environment. This Act requires emergency planning and notice to communities and government agencies concerning the presence and release of specific chemicals. EPA Region VI has deferred to RCRA and NRC reviews with respect to this Act.

1.5.1.8 Safe Drinking Water Act, as amended (42 U.S.C. § 300f et seq.)

The Safe Drinking Water Act was enacted to protect the quality of public water supplies and sources of drinking water. Under the Act, Oklahoma has primary enforcement responsibility (or “primacy”) over its water supply systems. Other programs established by the Safe Drinking Water Act include the Sole Source Aquifer Program (there are no designated sole source aquifers in eastern Oklahoma), the Wellhead Protection Program, and the Underground Injection Control

Program. In addition, the Act provides underground sources of drinking water with protection from contaminated releases and spills (e.g., requiring the implementation of a Spill Prevention Control and Countermeasure Plan). SFC would not use on-site groundwater or surface water supplies in conducting on-site reclamation activities. Remediation of existing groundwater contamination at the SFC site is the focus of the groundwater *Corrective Action Plan* and is addressed in this EIS.

1.5.1.9 Noise Control Act of 1972, as amended (42 U.S.C. § 4901 et seq.)

The Noise Control Act delegates the responsibility of noise control to State and local governments. Commercial facilities are required to comply with federal, state, interstate, and local requirements regarding noise control. The SFC site is located in Sequoyah County, which does not have a noise control ordinance.

1.5.1.10 National Historic Preservation Act of 1966, as amended (16 U.S.C. § 470 et seq.)

The National Historic Preservation Act (NHPA) was enacted to create a national historic preservation program, including the National Register of Historic Places and the Advisory Council on Historic Preservation (ACHP). Section 106 of the NHPA requires federal agencies to take into account the effects of their undertakings on historic properties. The ACHP regulations implementing Section 106, found in 36 CFR Part 800, were revised and became effective on August 5, 2004. These regulations call for public involvement in the Section 106 consultation process, including Indian tribes and other interested members of the public, as applicable. The NRC staff has completed the Section 106 consultation process addressing the potential historic and archaeological sites that have been identified on and in the vicinity of the SFC site.

1.5.1.11 Endangered Species Act of 1973, as amended (16 U.S.C. § 1531 et seq.)

The Endangered Species Act was enacted to prevent the further decline of endangered and threatened species and to restore those species and their critical habitats. Section 7 of the Act requires consultation with either or both the USFWS of the U.S. Department of the Interior (DOI) and the National Marine Fisheries Service of the U.S. Department of Commerce to determine whether endangered and threatened species or their critical habitats are known to be in the vicinity of the proposed action. The NRC has engaged in informal consultation with the USFWS under Section 7 of the Endangered Species Act regarding the potential presence of the American burying beetle in the proposed clay borrow area at the southern end of the SFC site.

1.5.1.12 Occupational Safety and Health Act of 1970, as amended (29 U.S.C. § 651 et seq.)

The Occupational Safety and Health Act establishes standards to enhance safe and healthy working conditions in places of employment throughout the United States. The Act is administered and enforced by OSHA, a DOL agency. The identification, classification, and regulation of potential occupational carcinogens are found in 29 CFR §1910.101, while the standards pertaining to hazardous materials are listed in 29 CFR §1910.120. The OSHA regulates mitigation requirements and mandates proper training and equipment for workers. SFC would be required to comply with the requirements of these regulations during site reclamation activities.

1.5.1.13 Hazardous Materials Transportation Act (49 U.S.C. § 1801 et seq.)

The Hazardous Materials Transportation Act regulates the transportation of hazardous material (including radioactive material) in and between states. According to the Act, states may regulate the transport of hazardous material as long as they are consistent with the Act or the U.S. Department of Transportation regulations provided in 49 CFR Parts 171-177. Title 49 CFR Part 173, Subpart I, contains other regulations regarding packaging for transportation of radionuclides. Transportation of contaminated materials from the SFC site would require compliance with the U.S. Department of Transportation regulations.

1.5.2 Applicable Executive Orders

Executive Order 11988 (Floodplain Management) directs federal agencies to establish procedures to ensure that the potential effects of flood hazards and floodplain management are considered for any action undertaken in a floodplain and that floodplain impacts be avoided to the extent practicable.

Executive Order 12898 (Environmental Justice) requires federal agencies to address environmental justice in minority and low-income populations (59 FR 7629) and directs federal agencies to identify and address, as appropriate, disproportionately high and adverse health or environmental effects of their programs, policies, and activities on minority and low-income populations.

1.5.3 Applicable State of Oklahoma Laws and Regulations

Certain environmental requirements, including those discussed earlier, have been delegated to state authorities for implementation, enforcement, or oversight. Table 1.5-1 provides a list of applicable State of Oklahoma laws, regulations, and agreements. Any changes to SFC's permits issued under Oklahoma statutes and administrative codes would require a permit modification and in some cases a closure plan, which would be independent of any NRC authority or jurisdiction.

Table 1.5-1 Applicable State of Oklahoma Laws, Regulations, and Agreements

Law/Regulation/ Agreement	Citation	Requirements
Oklahoma Clean Air Act	**Oklahoma Statutes**, Title 27A, Chapter 2, Article 5 **Oklahoma Administrative Code**, Title 252, Ch. 100, Air Pollution Control	Establish air quality standards and require permits for construction/ modification of an air contaminant source; require operating permits for pollutant producers; impose hazardous air pollutant emission standards.

Table 1.5-1 Applicable State of Oklahoma Laws, Regulations, and Agreements

Law/Regulation/ Agreement	Citation	Requirements
Oklahoma Radiation Management Act	**Oklahoma Statutes**, Title 27A, Chapter 2, Article 9, Section 2-9-103 **Oklahoma Administrative Code**, Title 252, Ch. 410 Radiation Management	Establish radiation protection standards; records maintenance; prevention and control of hazards; reporting; inspections; permitting and licensing.
Oklahoma Water Quality Act (Oklahoma Pollutant Discharge Elimination System Act)	**Oklahoma Statutes**, Title 27A, Chapter 2, Article 6, Section 2-6-101 *et seq*. **Oklahoma Administrative Code**, Title 252, Chapters 606, 616, and 690	Establish and implement water quality standards, discharge permitting and requirements, industrial wastewater permitting procedures and standards, and review of impacts on water quality from various activities.
Oklahoma Groundwater Law	**Oklahoma Administrative Code**, Title 785, Ch. 45, Subchapter 7, Groundwater Quality Standards	Rules to protect beneficial uses and classifications of groundwater, to ensure that degradation of the existing quality of groundwater does not occur, and to provide minimum standards for remediation.
Oklahoma Solid Waste Management Act	**Oklahoma Statutes**, Title 27A, Chapter 2, Article 10 **Oklahoma Administrative Code**, Title 252, Chapter 515, Management of Solid Waste	Establish State standards for the management of solid wastes.
Oklahoma Hazardous Waste Management Act	**Oklahoma Statutes**, Title 27A, Chapter 2, Article 7 **Oklahoma Administrative Code**, Title 252, Chapter 205	Establish State standards for the management of hazardous wastes.
Oklahoma Hazardous Materials Planning and Notification Act	**Oklahoma Statutes**, Title 27A, Chapter 5, Article 3 **Oklahoma Administrative Code**, Title 252, Chapter 20, Emergency Planning and Community Right-to-Know	Administer and enforce the reporting requirements of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA Title III).
Oklahoma Wildlife Conservation Code	**Oklahoma Statutes**, Title 29, Game and Fish, Chapter 1 **Oklahoma Administrative Code**, Title 800, Ch. 25, Wildlife Rules	Encourage habitat conservation on private lands.

Table 1.5-1 Applicable State of Oklahoma Laws, Regulations, and Agreements

Law/Regulation/ Agreement	Citation	Requirements
Wildlife Rules (Raptors)	**Oklahoma Statutes**, Title 29, Game and Fish, Chapter 1, Article 5, Section 5-410**, Hawks, Falcons, Owls,** Eagles **Oklahoma Administrative Code**, Title 800, Ch. 25, Subchapter 7, General Hunting Seasons, Part 7, Falconry	Unlawful to molest, injure or kill any species of hawk, falcon, owl or eagle, their nests, eggs or young.
Threatened/ Endangered Animal Species - List	**Oklahoma Administrative Code**, Title 800, Ch. 25, Subchapter 19, Oklahoma Endangered Species	Establishes the list of threatened and endangered animal species.
Oklahoma 401 Water Quality Certification	**Oklahoma Administrative Code,** 252:610-1-1, and 252:610-3-1 through 252:610-3-10 pursuant to 28A Oklahoma Statute, Section 2-6-103(i)(2)	Section 401 Water Quality Certification is required for projects receiving authorization under Section 404 of the CWA.
Transportation and Highway	**Oklahoma Statutes**, Title 69, Chapter 1, Oklahoma Highway Code of 1968 **Oklahoma Administrative Code**, Title 730, Ch. 35, Maintenance and Control of State Highway System	Establishes state highway management requirements.
State Trust Lands/Land Exchanges	**Oklahoma Statutes**, Title 64, Ch. 1, Section 1.3, **Manner of Acquiring Property for Utilizing Trust Lands for Development of Commercial Lease** **Oklahoma Administrative Code**, Title 385, Ch. 25, Section 385:25-1-41, Procedure for Exchanging Land	Establishes State standards and procedures for exchanges of lands held in trust.
Cultural Properties	**Oklahoma Statutes**, Title 53, Chapter 20, Section 361, **Oklahoma Historical Societies and Associations**	Establishes State Register of Historical Places and permitting requirements.

1.5.4 Permits and Approval Status

Several construction and operating permit applications would be prepared and submitted, and regulator approval and/or permits would be received prior to implementation of reclamation activities. Table 1.5-2 lists the required federal and state authorizations and their status.

Table 1.5-2 Federal and State Authorizations

Agency	Authority	Activity Covered	Status
Authorizations			
U.S. Nuclear Regulatory Commission	AEA/UMTRCA 10 CFR Part 40	Licensing authority	Amendment applications currently under review
U.S. Army Corp of Engineers	Section 404 of the Clean Water Act	Wetland Delineation	Reported that no jurisdictional wetlands are on the site.
Oklahoma Department of Environmental Quality	Oklahoma Statutes Title 27 A, Chapter 2, Article 6, Section 2-6-101 *et seq.* Oklahoma Administrative Code, Title 252, Chapters 606, 616, and 690	Oklahoma Pollutant Discharge Elimination System (OPDES) Permits	Currently active: OPDES Permit No. OK0000191 and OPDES Storm Water Industrial General Permit Authorization No. OKGP00046

1.6 Cooperating Agencies and Required Consultations

This section of the EIS provides details on the Cooperating Agencies for this document and the status of consultations required under Section 7 of the Endangered Species Act and under Section 106 of the NHPA.

1.6.1 Cooperating Agencies

The Council on Environmental Quality (CEQ) in 10 CFR 1508.5 defines a cooperating agency as a federal, state, or local agency or tribal government that has jurisdiction by law or special expertise with respect to any environmental impact involved in a proposal. The NRC, the EPA, USACE, the U.S. Geological Survey (USGS), the ODEQ, and the Cherokee Nation have an interest in the proposed reclamation of the SFC site. Because the interests of these agencies are interrelated on this project, and these agencies have jurisdiction by law or special expertise pertinent to potential environmental impacts associated with the proposed reclamation of the SFC site, the EPA, USACE, USGS, ODEQ, and the Cherokee Nation have agreed to cooperate with the NRC in the preparation of this EIS. The NRC is the lead agency for the EIS, and all the cooperating agencies are involved in or supporting its development and review. To the fullest extent consistent with its responsibility as lead agency, NRC will utilize the comments, recommendations, data, and/or analyses provided by the Cooperating Agencies in the Sequoyah Fuels EIS process, giving particular weight to those topics on which Cooperating Agencies are acknowledged to possess special expertise. Each cooperating agency's special expertise/interest in the EIS is described as follows:

- **Cherokee Nation.** The Cherokee Nation formally requested to become a cooperating agency for a variety of reasons. Issues related to environmental contamination are important to the Cherokee Nation because historical, cultural, and religious issues mandate the tribe's symbiotic relationship with a clean, healthy environment. As a result, appropriate reclamation of the SFC site is of interest and concern to the tribe. In addition, the Cherokee

Nation owns land next to and near the site. Potential development of these lands and of the SFC site is of interest to the tribe.

- **EPA.** The EPA is exercising its right to review state actions because Oklahoma has been authorized under both RCRA and CERCLA. The EPA lead in this project is Region VI.

- **USACE.** It is the policy of the Secretary of the Army, acting through the Chief of Engineers, to provide the public with safe and healthful recreation as well as commercial and industrial opportunities within and along the McClellan-Kerr Navigation System and, more specifically, within Robert S. Kerr Reservoir and its tributaries. The USACE manages public lands on Robert S. Kerr Reservoir immediately next to the SFC facility on the north, west, and south.

- **USGS.** The USGS collects water quality and related natural resource data for the State of Oklahoma, and its staff has written several hundred reports related to environmental issues in the state. In addition, the USGS staff has attended meetings and reviewed documents related to environmental investigations and determinations at the SFC site. The USGS staff will assist the NRC in the review of the EIS and will participate in investigations at the site, as needed.

- **ODEQ.** The ODEQ has committed to working with the NRC as a cooperating agency in identifying information needs, reviewing relevant data, and participating in the determination of required remediation activities at the SFC site. The ODEQ represents the interests of the citizens of Oklahoma. The SFC may hold or be required to obtain ODEQ permits relating to air and water quality issues.

In addition to the cooperating agencies listed above, other governmental agencies and organizations (see Table 1.5-3) have been consulted to gather the information needed to produce an informed EIS.

Table 1.5-3 Cooperating and Other Agencies and Organizations Contacted

Federal Agencies
U.S. Department of Transportation U.S. Fish and Wildlife Service
Oklahoma Agencies
Archaeological Survey Department of Agriculture Department of Commerce Department of Transportation Department of Wildlife Conservation Office of the Attorney General State Historic Preservation Officer State Parks and Resorts University of Oklahoma Natural Heritage Inventory Water Resources Board

Table 1.5-3 Cooperating and Other Agencies and Organizations Contacted

Local and County Governments Contacted
Cherokee County, Oklahoma
Eastern Oklahoma Development Commission
Gore, Oklahoma
Haskell County, Oklahoma
Indian Nations Council of Governments
McIntosh County, Oklahoma
Muskogee County, Oklahoma
Salisaw, Oklahoma
Sequoyah County, Oklahoma
Sequoyah County I-40 Industrial Park and Port Trust
Tahlequah, Oklahoma
Vian, Oklahoma
Webbers Falls, Oklahoma

1.6.2 Consultations

1.6.2.1 Endangered Species Act of 1973 Consultation

The NRC staff has engaged in informal consultation with the USFWS to comply with the requirements of Section 7 of the Endangered Species Act of 1973 (see Appendix C). On November 28, 2006, the NRC staff sent a letter to the USFWS Oklahoma Ecological Services Field Office (OESFO) in Tulsa, Oklahoma, briefly describing the proposed action and providing its determination and requesting concurrence that consultation under Section 7 was not required, because the proposed action would not adversely affect threatened or endangered species or critical habitat within the area of potential effect (see Appendix C). Following the publication of the DEIS, USFWS provided comments regarding the American burying beetle and its potential presence on undisturbed areas of the site. On February 27, 2008, the NRC met with the USFWS regarding this issue. As a result of this consultation, the USFWS has recommended that a survey for the American burying beetle be conducted at the clay borrow area prior to initiating any reclamation activities. If it is determined that the American burying beetle is present, SFC will follow standard mitigation practices under USFWS Conservation Approach 1 (e.g., bait away and trap and relocation protocols).

1.6.2.2 National Historic Preservation Act of 1966 Consultation

The NRC staff has offered state agencies, federally recognized Indian tribes, and other organizations that may be concerned with the possible effects of the proposed action on historic properties an opportunity to participate in the consultation process required by Section 106 of the NHPA (see Appendix C). The following sections provide a summary of the consultation performed.

The Cherokee Nation

In 2001, the NRC staff initiated the Section 106 consultation process with the Cherokee Nation, a federally recognized Indian tribe with interest in the area of the SFC site. By a letter dated

August 29, 2001, the Cherokee Nation indicated that the tribe did not have objections to SFC's proposed site reclamation and that the tribe was unaware of any significant prehistoric or historic sites at or in the vicinity of the SFC site (Rabon, 2001). The Cherokee Nation did request that they be contacted if buried archaeological materials such as chipped stone tools, pottery, and building materials are discovered during site reclamation. By a letter dated March 19, 2007, the NRC staff requested of the Cherokee Nation a re-confirmation of the tribe's 2001 determination (see Appendix C).

If Native American human remains or funerary objects are discovered during site reclamation, SFC would halt all ground disturbance in the area of the discovery for up to 30 days, notify the appropriate NRC official and the Cherokee Nation, and take steps to comply with the Native American Graves Protection and Repatriation Act. If any ground-disturbing site reclamation activities were conducted off the SFC site, the SHPO and OAS would be consulted prior to any ground disturbance in compliance with the NHPA (SFC, 2006a).

Oklahoma State Historic Preservation Officer

By letters dated November 28, 2006, and November 27, 2006, respectively, the NRC initiated consultations with the Oklahoma SHPO and the OAS under Section 106 of the NHPA of 1966. These letters described the potentially affected area and requested the views of the SHPO on further actions required to identify historic properties that may be affected. The Oklahoma SHPO and OAS have confirmed that there would be no effect on historic or prehistoric properties on or near the SFC site as a result of SFC's proposed reclamation activities (see Appendix C).

If historic or prehistoric cultural materials were identified during site reclamation activities, SFC would halt ground disturbance in the area of the discovery and notify the appropriate NRC official, and treatment of the discovery would be determined in consultation with the SHPO (SFC, 2006a).

1.7 Organizations Involved in the Proposed Action

Two organizations have specific roles in the implementation of the proposed action:

- SFC is the NRC licensee. SFC owns and maintains the site under NRC License Number SUB-1010, Docket Number 40-8027. General Atomics, a privately held high-technology company, is the parent company of SFC, having purchased the SFC subsidiary from Kerr-McGee in 1988.

- The NRC is the licensing agency. The NRC has the responsibility to conduct an evaluation of the safety and environmental aspects of the licensee's proposed *Reclamation Plan* and groundwater *Corrective Action Plan* for compliance with NRC regulations associated with the reclamation of uranium mill facilities. These regulations include 10 CFR Part 40, including Appendix A. To fulfill the NRC's responsibilities under NEPA, the environmental impacts of the proposed action and its alternatives are evaluated in accordance with the requirements of 10 CFR Part 51 and documented in this EIS.

References

(NRC, 1975) U.S. Nuclear Regulatory Commission. *Final Environmental Statement Related to the Sequoyah Uranium Hexafluoride Plant.* NUREG-75/007. February 1975.

(NRC, 1985) U.S. Nuclear Regulatory Commission. *Environmental Assessment for Renewal of Source Nuclear Material License No. SUB-1010, Docket No. 40-8027, Sequoyah Fuels*. NUREG-1157.

(NRC, 1988) U.S. Nuclear Regulatory Commission. *Final Generic Environmental Impact State (GEIS) on Decommissioning of Nuclear Facilities*. NUREG-0586.

(NRC, 1997) U.S. Nuclear Regulatory Commission. *Generic Environmental Impact Statement in Support of Rulemaking on Radiological Criteria for License Termination of NRC-Licensed Nuclear Facilities*. NUREG-1496.

(NRC, 2003) U.S. Nuclear Regulatory Commission. *Environmental Review Guidance for Licensing Actions Associated with NMSS Programs*. NUREG-1748. August 2003.

(NRC, 2004) U.S. Nuclear Regulatory Commission. Atomic Safety and Licensing Board Panel. Memorandum and Order, Docket No. 40-8027-MLA-6 and Docket No. 40-8027-MLA-9. Appendix, Settlement Agreement. December 2004.

(OAS, 2000) Oklahoma Archeolgical Survey. Letter from Robert Brooks, Oklahoma State Archeologist, to Thomas Essig, U.S. Nuclear Regulatory Commission, regarding the results of a site file review for the Sequoyah Fuels Crporation Facility near Gore, Oklahoma. June 20, 2000.

(ODEQ, 2006) Oklahoma Department of Environmental Quality. Letter from Scott A. Thompson, Director, Land Protection Division, to Myron Fliegel, Senior Project Manager, U.S. Nuclear Regulatory Commission, Fuel Cycle Facilities Branch, regarding disposal of non-11e.(2) byproduct materials (non-hazardous calcium fluoride sludge) on-site at the Sequoyah Fuels Corporation site in Gore, Oklahoma. May 24, 2004.

(OHS, 2000) Oklahoma Historical Society. Letter from Melvena Heisch, Preservation Officer, to Thomas Essig, U.S. Nuclear Regulatory Commission, regarding File #1933-00; Sequoyah Fuels Corp. Proposed Decommission Project near Gore, Oklahoma. June 27, 2000.

(OHS, 2006) Oklahoma Historical Society. Letter from Melvena Heisch, Preservation Officer, to Jennifer Davis, U.S. Nuclear Regulatory Commission, regarding File #0426-07; Sequoyah Fuels Reclamation Project in Gore, Oklahoma. December 20, 2006.

(Rabon, 2001) Rabon, David (Cherokee Nation). Letter to Phyllis Sobel, Project Manager, U.S. Regulatory Commission, regarding the Proposed Decommissioning of Sequoyah Fuels Site in Sequoyah County, OK. August 29, 2001.

(SFC, 1998) Sequoyah Fuels Corporation. *Site Characterization Report*. Gore, Oklahoma. December 15, 1998.

(SFC, 1999) Sequoyah Fuels Corporation. *Decommissioning Plan*. March 26, 1999.

(SFC, 2003) Sequoyah Fuels Corporation. (Groundwater) *Corrective Action Plan*. June 2003.

(SFC, 2005) Sequoyah Fuels Corporation. Response to Request for Additional Information: Groundwater Information: (Groundwater) Corrective Action Plan Review. December 2005.

(SFC, 2006a) Sequoyah Fuels Corporation. *Reclamation Plan: Sequoyah Facility*. Rev. 2. December 2006.

(SFC, 2006b) Sequoyah Fuels Corporation. *Environmental Report* [for the] *Reclamation Plan*. October 13, 2006.

2. ALTERNATIVES

This chapter describes SFC's proposed reclamation activities at its Gore, Oklahoma, site and other reasonable alternatives to these activities. As required by NEPA, this chapter also presents a no-action alternative. Under the no-action alternative, SFC would conduct neither the surface reclamation activities nor implement the groundwater corrective actions it has proposed for its Gore, Oklahoma, site. The no-action alternative provides a basis from which to compare and evaluate the potential environmental impacts of the licensee's proposed action and the other reasonable alternatives.

2.1 Past Operations at the SFC Site

From 1970 until 1993, SFC operated a uranium conversion facility at Gore, Oklahoma, under the authority of NRC Materials License SUB-1010, issued pursuant to 10 CFR Part 40 (Domestic Licensing of Source Material). During this 23-year period, two major operations were conducted at the facility:

- Conversion of uranium oxide (yellowcake) to UF_6, which is an important step in the nuclear fuel cycle leading to the production of fuel elements for nuclear reactors. During this conversion, impurities in the yellowcake are removed through the use of strong acids and alkalis and the uranium is combined with fluorine to create the UF_6 gas, which is cooled and solidified in cylinders and shipped to a uranium enrichment plant. SFC began these operations in 1970.

- Conversion of DUF_6 to depleted uranium tetrafluoride (DUF_4). SFC began these operations in 1987. SFC conducted this conversion process under a subcontract to a defense contractor for use in the defense armament industry.

> **Source Material** means (1) uranium, thorium, or any other material which is determined by the NRC pursuant to the provisions of section 61 of the Atomic Energy Act of 1954, as amended, to be source material; or (2) ores containing one or more of the foregoing materials, in such concentration as the NRC may by regulation determine from time to time.
>
> **Yellowcake:** A uranium mill is a chemical plant that extracts uranium from mined ore. The product is a powder-like substance that is a mixture of uranium oxides. It is called yellowcake due to its color.
>
> **Uranium and Depleted Uranium:** Naturally occurring uranium consists of uranium-238 (99.27%), uranium-235 (0.72%), and uranium-234 (0.01%), which are called isotopes of uranium. Depleted uranium results from processes that separate the isotopes of uranium such that the remaining residue contains a lower percentage of U-235 than shown above.

When active, production processes at the SFC facility were largely confined to an 81-hectare (200-acre) Industrial Area. The Industrial Area, shown in Figure 2.1-1, generally bounds the overall area on the SFC site that has been directly and indirectly affected by past uranium conversion industrial activities. Within this Industrial Area is a smaller Process Area (34 hectares [85 acres]) where the buildings and related facilities are located and where uranium processing operations were conducted. The remaining 47 hectares (115 acres) of the Industrial Area were used by the licensee for storm water management and process material storage. SFC's proposed *Reclamation Plan* focuses on the Process and Industrial Areas.

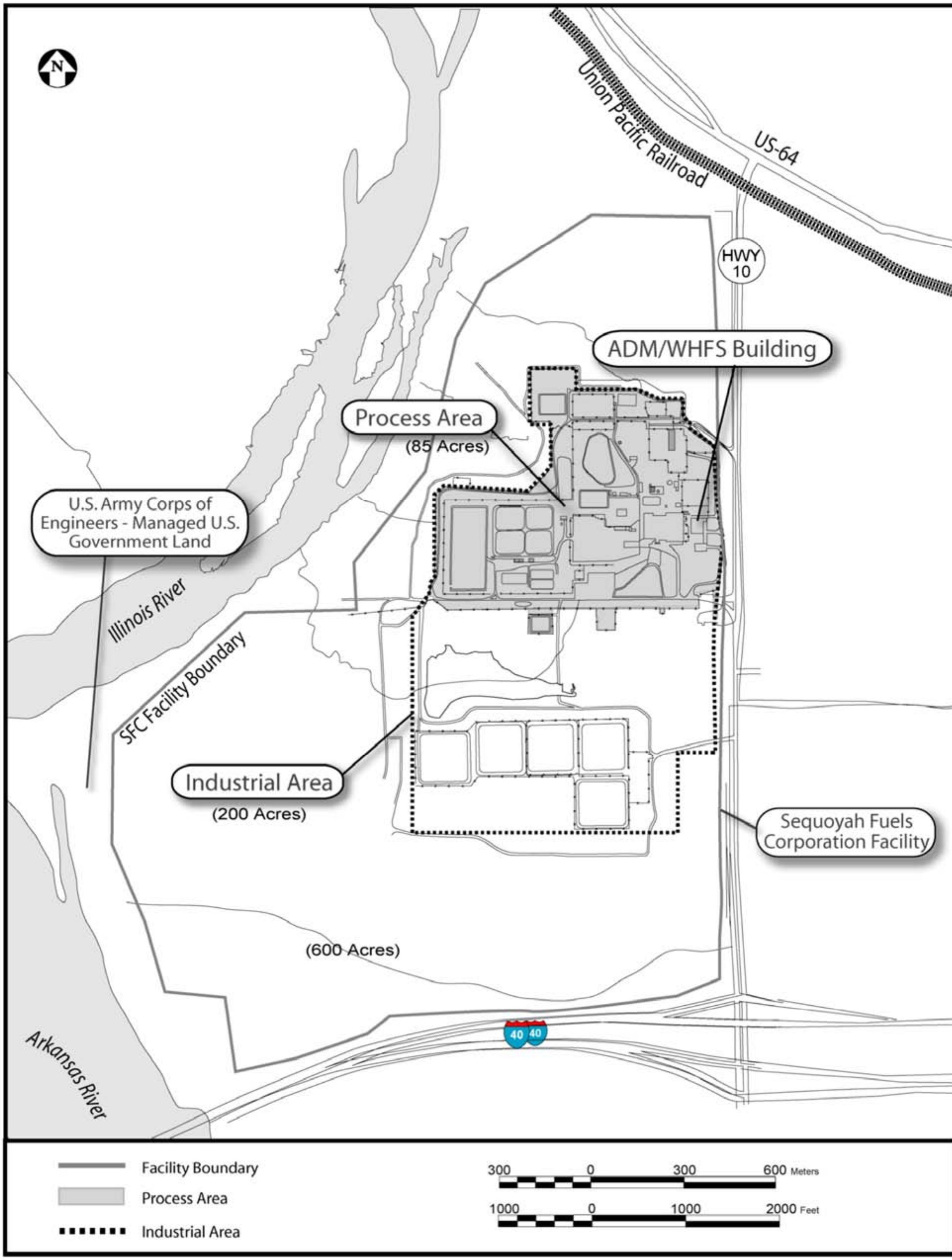


Figure 2.1-1 SFC Site Layout During Active Operations

Contaminated materials are present throughout the Process Area of the SFC site. These contaminated materials include scrap materials and debris, soils, and groundwater; buried wastes; ponds containing sludges; surfaces of equipment; and some surfaces and interiors of the process buildings (SFC, 2006a). Contamination of the exterior and interior of each of the buildings, including equipment and surrounding concrete pads, is dependent upon the original use of each building. Within the Process Area, the main process building, the miscellaneous-digestion building, and the solvent extraction building were all used in the uranium conversion process (see Figure 2.1-2). Feed material consisted of ore concentrates (i.e., yellowcake) that were stored on a storage pad southwest of the Main Process building. Cylinders containing high purity UF_6 were stored on a cylinder storage pad north of the Main Process building. Uranium has been detected at concentrations above 35 picocuries per gram (pCi/g) in soil below the Process Area to a maximum depth of about 9 meters (31 feet).

Processing of the raffinate was primarily conducted in clarifiers (settling basins) west of the yellowcake storage pad (SFC, 2006a). The raffinate liquid was treated with anhydrous ammonia to neutralize the nitric acid and precipitate radioactive and heavy metals. The resulting ammonium nitrate solution and the precipitated material were separated. The precipitate was referred to as raffinate sludge. SFC impounded the treated ammonium nitrate solution in storage ponds on the southern end of the site. This solution was used for beneficial reuse as part of SFC's land application program (SFC, 2006b).

Raffinate: A liquid acid solution resulting from the solvent extraction process and containing impurities such as nitric acid, metallic salts, and small quantities of uranium, thorium-230, and radium-226.

Dewatered raffinate sludge: Sludge from the bottom of the ponds that has gone through a dewatering process such that the sludge volume has been reduced to approximately one-third of the original volume. The sludge is currently stored on-site in covered, 1-cubic-yard-capacity packages known as "super sacks."

In 2005, SFC removed and dewatered the raffinate sludge remaining from treatment of the raffinate liquid from three lined impoundments on-site. The liquid (filtrate) removed from the sludge was returned to the lined impoundments. The dewatered raffinate sludge, which comprises the 11e.(2) material, totals approximately 6,995 cubic meters (9,150 cubic yards) in volume. The sludge is now being stored on a concrete pad in the central portion of the site (the former yellowcake storage pad) in covered, approximately 0.76-cubic-meter (1-cubic-yard) capacity polypropylene bags (approximately 0.91 meter by 0.91 meter by 1.2 meter [3 feet by 3 feet by 4 feet]) known as "super sacks." The raffinate sludge contains a significant fraction of the radionuclides presently on the SFC site (34% of the uranium [41.5 curies], 76% of the thorium-230 [156 curies], and 38% of the radium-226 [1.1 curies]). The sludge also contains various other metals.

In 2004 and 2005, PCB-impacted concrete, sand, and soil located along the east wall of the Main Process building were remediated in accordance with 40 CFR 761.61(a). The excavation area was associated with the operation of electrical rectifiers and transformers that leaked PCB-contaminated oil (Aroclor 1260) in the late 1970s. Site characterization and concrete slab removal were conducted in August 2004 (SFC, 2004), and soil excavation activities were conducted in December 2004 and January 2005 (SFC, 2005a). Confirmation sampling results were all below the target cleanup level of 25 ppm. A total of 115.6 tons of concrete and

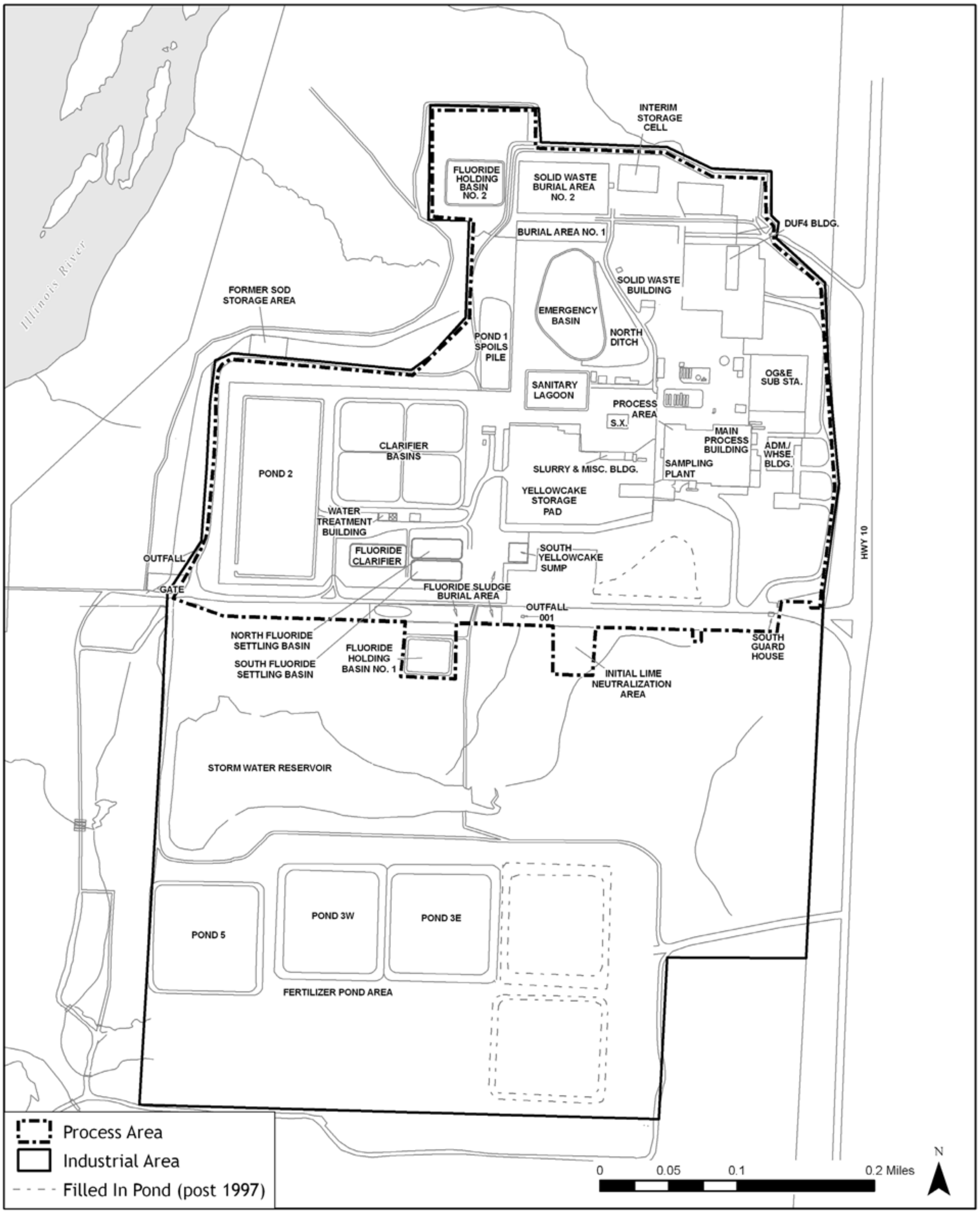


Figure 2.1-2 SFC General Site Layout

sand and 712.3 tons of soil were shipped off-site to a facility licensed to accept such waste. (The management and disposal of these wastes is not considered further in this EIS.)

In the northern portion of the Process Area in a building known as the DUF4 building, SFC produced DUF_4 using DUF_6 as feed material. The approximately one thousand 208-liter (55-gallon) drums of depleted uranium that had been stored on-site were removed by the U.S. Army as required by the provisions of the John Warner National Defense Authorization Act for Fiscal Year 2007 §316. (The management and disposal of these wastes is not considered further in this EIS.)

At two areas to the north and west of the DUF4 building but within the Process Area, solid waste was buried by the licensee in the 1970s and 1980s (SFC 2006a). These areas are known as Solid Waste Burial Areas No. 1 and No. 2. LLRW materials buried at these locations consist of contaminated drums, equipment, and other solid waste.

Surface and groundwater at the site were affected by the operations at the SFC uranium conversion facility. Liquid wastes containing traces of radioactivity were treated by the licensee and released to the lower Illinois River. As a result, a natural drainage course between the Process Area buildings and the river was contaminated (SFC 2006a). Groundwater beneath portions of the SFC site is contaminated by uranium from past leaks and spills at the uranium conversion facility. The vertical extent of the affected groundwater is controlled, in part, by a low-permeability sandstone layer underlying most of the site, which inhibits downward migration of contamination (SFC, 2003a).

In October 1982, the Oklahoma Department of Health, Industrial Waste Division issued a permit for operation of a deep-injection well at the SFC site for the disposal of treated liquid raffinate into the Arbuckle Formation (between 493 and 952 meters [1,619 and 3,122 feet] below ground surface [bgs]). The NRC amended the site license to authorize the injection of treated raffinate liquid (radium levels less than 0.18 becquerel/liter [5 picocuries/liter]) subject to an initial volume limit of 18.9 million liters (5 million gallons) followed by monitoring tests of formation performance. The test results were submitted to Oklahoma and the NRC for permission for continued injection. However, due to public opposition, the injection well was abandoned and plugged in 1985. The history of the deep injection well at the SFC site is included in Appendix G.

Uranium has been found at elevated concentrations throughout the Process Area. SFC has identified the areas of uranium soil contamination that exceed the proposed cleanup levels (CLs) (see Figures 2.1-3 and 2.1-4). Uranium contamination can be found at depths up to 6 meters (20 feet), although the majority of the contamination is present within the first 15 centimeters (6 inches). Thorium-230 and radium-226 are generally associated with the uranium contamination and have been found in similar areas (SFC, 1998). The concentration ranges of these radionuclides in the soils and sediments at the SFC site are summarized in Table 2.1-1. Chemical contaminants present on-site that exceed background concentrations and health-based screening criteria in soil and sediment include fluoride, arsenic, lead, antimony, and several other metals (see Section 4.4).

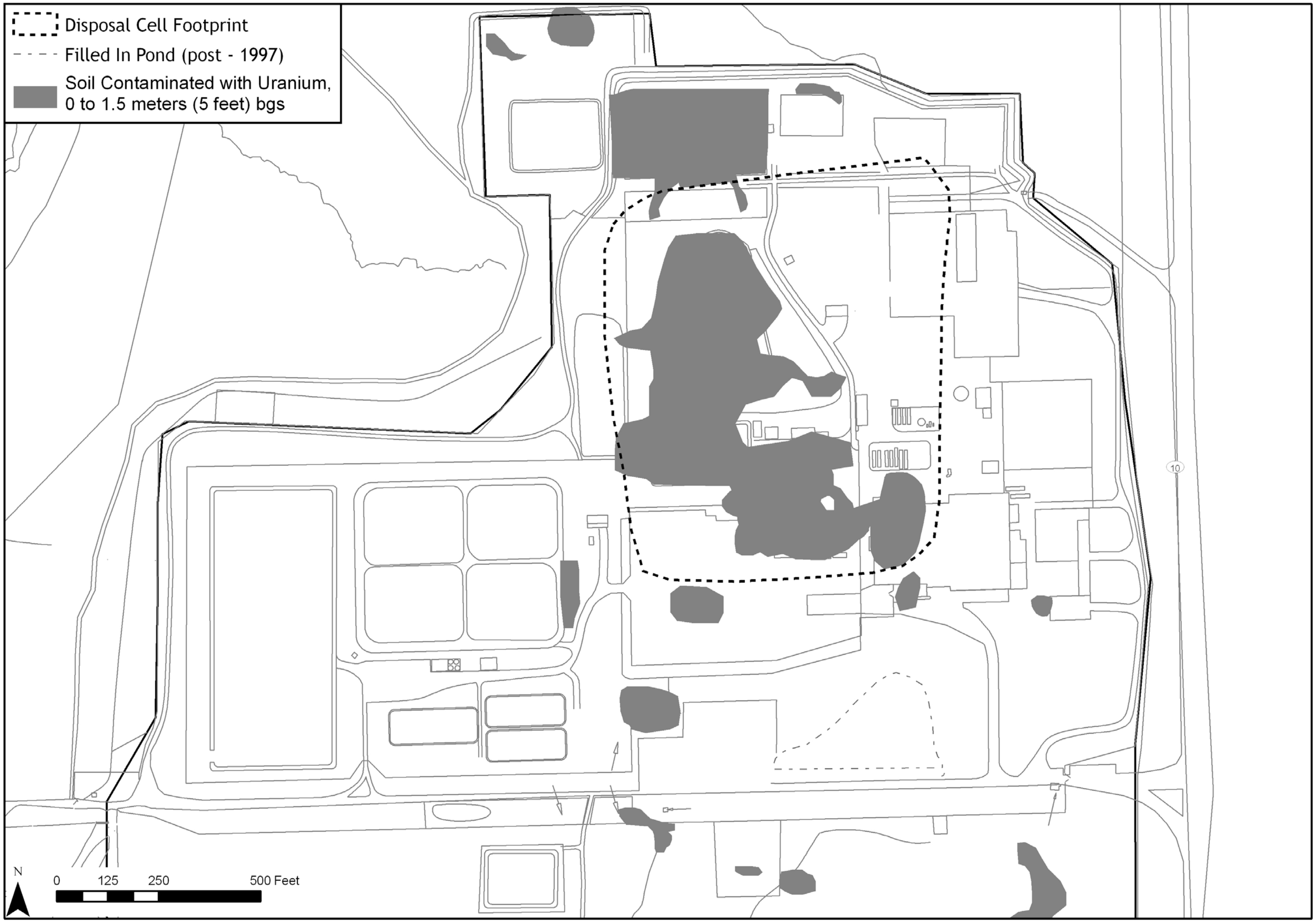


Figure 2.1-3 Area of Uranium Contamination at SFC, Depths 0 to 1.5 meters (5 feet)

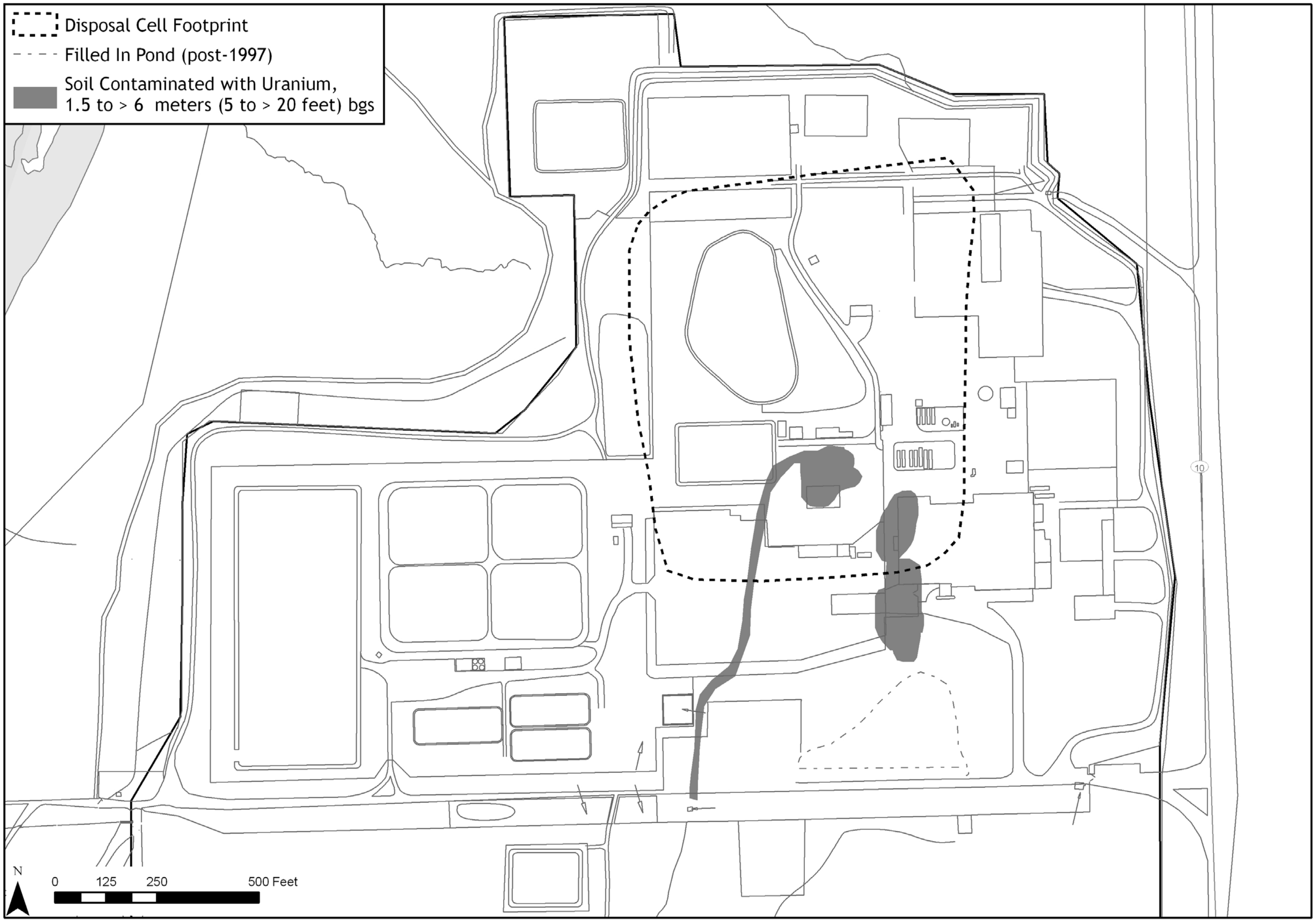


Figure 2.1-4 Area of Uranium Contamination at SFC, Depths 1.5 to >6 meters (5 to >20 feet)

Table 2.1-1 Maximum Radionuclide Concentrations Measured in Soils and Sediments

Contaminant	Concentrations Bq/g			
	Minimum Bq/g (pCi/g)	Maximum Bq/g (pCi/g)	Mean Bq/g (pCi/g)	Median Bq/g (pCi/g)
Total Uranium	0.03 (0.81)	1,726 (46,602)	18 (486)	0.52 (14.0)
Radium-226	0.002 (0.05)	8.5 (230)	0.30 (0.81)	0.05 (1.35)
Thorium-230	0.004 (1.08)	216 (5,832)	6.9 (186)	0.10 (2.7)

Source: (SFC, 1999).

2.2 Alternative 1: On-site Disposal of Contaminated Materials (the Licensee's Proposed Action)

The proposed action is the implementation of SFC's proposed surface reclamation and groundwater restoration activities for its 243-hectare (600-acre) Gore, Oklahoma, site. SFC's *Reclamation Plan* (SFC 2006c) forms the basis for how SFC would undertake the proposed surface reclamation activities at the site to meet the requirements of 10 CFR Part 40, Appendix A (which includes criteria for the disposition of uranium mill tailings or wastes).

Implementation of SFC's *Reclamation Plan* would involve the following activities:

- Demolition of existing structures, equipment, and concrete floors and pads; excavation of underground utilities; and compaction of debris. The administration building and Oklahoma Gas & Electric (OG&E) electrical substation would remain intact for future reuse.

- Removal and consolidation of contaminated sludges and sediments from the ponds and lagoons and excavation of buried wastes and contaminated soils on the site. The storm water impoundment would remain intact for future use.

- Construction of an on-site, above-grade, engineered disposal cell for the permanent disposal of all contaminated material.

- Placement of demolition debris and contaminated sludges and soils within the disposal cell followed by closure, capping, regrading, and revegetation of the completed disposal cell.

- Management and treatment of produced groundwater and storm water during construction activities.

SFC would also implement a groundwater *Corrective Action Plan* to clean up existing groundwater contamination that resulted from previous site operations (SFC, 2003a). The goal of the cleanup is to reduce the concentrations of the identified hazardous constituents in the groundwater to levels that are either less than the maximum concentration limits for each constituent or to less than the background levels for each constituent, whichever is greater. The NRC staff is currently reviewing SFC's groundwater *Corrective Action Plan*, submitted by SFC on June 30, 2003 (SFC, 2003a). The results of this review will be documented in a TER.

After completion of these surface reclamation and groundwater corrective actions, and following the final site survey and monitoring of site conditions, SFC would seek termination of its NRC license. As part of that future termination process, SFC proposes to turn over approximately 131 hectares (324 acres) of the site, including the land area encompassing the disposal cell and a surrounding buffer, to the United States government or the State of Oklahoma for long-term control. The State of Oklahoma would have the first option to take responsibility for long-term custodial care of the site. If the state declines this role, the Department of Energy (or other federal agency) would take custody of the site under the provisions of Section 83 of the AEA of 1954, as amended by the UMTRCA. The remaining 112 hectares (276 acres) of the SFC site would be released for unrestricted use.

2.2.1 Site Reclamation in Accordance with the Proposed Reclamation Plan and Groundwater Corrective Action Plan

This section describes how SFC proposes to conduct surface reclamation and groundwater restoration in accordance with its proposed *Reclamation Plan* and groundwater *Corrective Action Plan*. By doing so, SFC would remove potential sources of additional groundwater contamination. Among the areas to be reclaimed are the underground utility trenches in the Process Area and the granular backfill material near the Main Processing Building. These trenches and associated backfill provided preferential drainage routes for shallow subsurface water, and spills of uranium-contaminated liquids tended to seep into these trenches and the backfill (SFC, 2003a).

SFC would sequence activities to avoid stockpiling and double-handling of contaminated materials. Thus, the following discussion is not in the order that SFC might undertake the proposed surface reclamation activities. The licensee's proposed sequence for disposal cell construction and placement of contaminated materials within the cell is described in Section 2.2.1.3. SFC's proposed groundwater restoration activities are discussed in Section 2.2.1.6.

The licensee estimates that the workforce needed to accomplish all the activities required under the proposed *Reclamation Plan* would range from a minimum of 26 to a maximum of 72 employees. Only one employee would be required after these activities were completed.

2.2.1.1 Excavation and Consolidation of Contaminated Sludges, Sediments, and Soils

SFC would undertake excavation and removal of contaminated sludges, sediments, and soils from various locations within the Industrial and Process Areas for placement in the disposal cell. These contaminated materials would include:

- Dewatered sludges and sediments from the ponds and lagoons, with the exception of the storm water impoundment, which would remain intact for future use.

- Buried solid waste materials in Solid Waste Burial Areas No. 1 and No. 2.

- Soils outside of the footprint of the proposed disposal cell and soils and clay liners beneath the ponds and lagoons that contain uranium, radium, or thorium in excess of the proposed site-specific cleanup criteria. Materials with concentrations above the release criteria would be disposed of in the disposal cell. The derived concentration guideline level (DCGL) would be applied to materials under the intended cell footprint, and CLs would be applied elsewhere (see Table 2.2-1). (SFC has already excavated and consolidated some of the contaminated soils on the site. These soils are covered and stored on a concrete pad on the northern portion of the site.)

Derived Concentration Guideline Levels (DCGLs) are the derived, radionuclide-specific, activity concentrations that correspond to the release criterion. DCGLs are derived from activity-to-dose relationships as determined through modeling of radiation exposure pathway scenarios.

In addition, as previously discussed, SFC has already dewatered and consolidated the raffinate sludge. This material is packaged, covered, and staged for disposal on the former yellowcake storage pad in the central portion of the Process Area.

Table 2.2-1 DCGLs and CLs

Condition	Natural Uranium Bq/g (pCi/g)	Thorium-230 Bq/g (pCi/g)	Radium-226 Bq/g (pCi/g)[a]
DCGL	21 (570)	2.4 (66)	0.18/0.56 (5.0/15)
CL	3.7 (100)	≤0.52/1.6 (14/43)	≤0.18/0.56 (5.0/15)

Source: SFC, 2006c.

[a] As stated in 10 CFR 40, Appendix A, Criterion 6(6), the concentration of radium in the first 15-centimeter (5.9-inch) layer below the surface/followed by the concentration in subsequent 15-centimeter layers more than 15 centimeters below the surface. CLs for thorium-230 also to be applied at same incremental depths.

The dewatered calcium fluoride sludge, sediments (Emergency Basin, North Ditch, and Sanitary Lagoon), and Pond 2 sediments would be solidified and stabilized to improve their structural properties prior to placement in the disposal cell. The materials would be solidified using fly ash and other additives to increase the compressive strength of these various materials (SFC, 1999). The fly ash would be obtained from a coal-fired power plant in Poteau, Oklahoma, about 82 km (51 miles) southeast of the SFC site (SFC, 2006a).

2.2.1.2 Demolition of Structures, Equipment, and Management of Other On-Site Materials

As described in the site history, existing buildings, including equipment, concrete floors, pads, and underground utilities, have been contaminated by the licensee's uranium conversion operations at the site. SFC has already removed, decontaminated (where necessary), and recycled the majority of salvageable equipment and materials from the site. All remaining structures, equipment, and piping will be dismantled, and the debris will be crushed into manageable pieces and compacted in preparation for placement in the disposal cell. Other materials on-site, including scrap metal, empty drums, packaged wastes, wooden pallets, etc., would also be crushed and compacted. Underground utilities, including contaminated sand backfill from utility trenches and building foundation areas, would be excavated. The only structures that would remain on-site following demolition activities would be the administration building and the OG&E electrical substation. These structures would remain intact for future reuse.

SFC would complete certain pre-demolition activities prior to undertaking the actual demolition of structures and buildings. These activities would include removing any product, reagents, residues, and other fluids from equipment, buildings, or other structures and disconnecting utilities on a building-by-building basis. In addition, as required by the terms of the Settlement Agreement with the Cherokee Nation and the State of Oklahoma (NRC, 2004; see Section 1.5), SFC would have the asbestos from the SFC buildings removed and packaged by a contractor that is licensed to conduct such activities in Oklahoma and in accordance with the applicable requirements in 40 CFR Parts 61.145 and 61.150 and Oklahoma law. The State of Oklahoma has agreed to the use of the on-site disposal cell for disposal of the asbestos currently on the SFC site.

SFC would then conduct the actual demolition activities in four stages: (1) demolition of above-ground structures such as piping and tanks, then buildings and enclosed structures; (2) removal of concrete, including structure floor slabs, belowground walls, and footings; (3) removal of underground utilities (may be concurrent with concrete removal); and (4) excavation and removal of contaminated soils beneath structures. SFC proposes using mechanized demolition equipment to minimize manual labor. Specific demolition equipment proposed for use by the licensee is identified in Table 2.2-2.

Table 2.2-2 Proposed Demolition Equipment

Hydraulic Shear	Trucks
Grapple	Scraper
Backhoe Excavator	Soil Ripper
Front-end Loader	Water Truck
Concrete Shear	Grader
Concrete Impactor	

Because of the wide variety of shapes and sizes of equipment and structural materials, SFC would cut or dismantle large pieces so that they could be safely lifted or carried with the demolition equipment. SFC would use a backhoe or front-end loader to crush or compact compressible materials, and void spaces would be minimized. Debris with voids that cannot be eliminated through crushing or compacting would be filled with sand or other materials prior to disposal in the disposal cell.

2.2.1.3 Construction of an Engineered Disposal Cell

SFC proposes to construct an on-site engineered disposal cell for disposition of the contaminated waste that would result from the consolidation of sludges, sediments, and soils and the debris and rubble that would result from demolition activities.

Location of the Disposal Cell. Based on the results of a siting evaluation conducted by SFC and appended to the SFC *Reclamation Plan* (SFC, 2006c) as Appendix H, the proposed location for the disposal cell would be in the central portion of the SFC Process Area (see Figure 2.2-1). This is the current location of the Emergency Basin, solid waste building, solvent extraction building, and the western half of the main processing building. SFC evaluated four potential sites for the disposal cell using a qualitative ranking system. The Process Area was selected by the licensee as the preferred site for the disposal cell since it met all of the ranked environmental factors and had the following advantages:

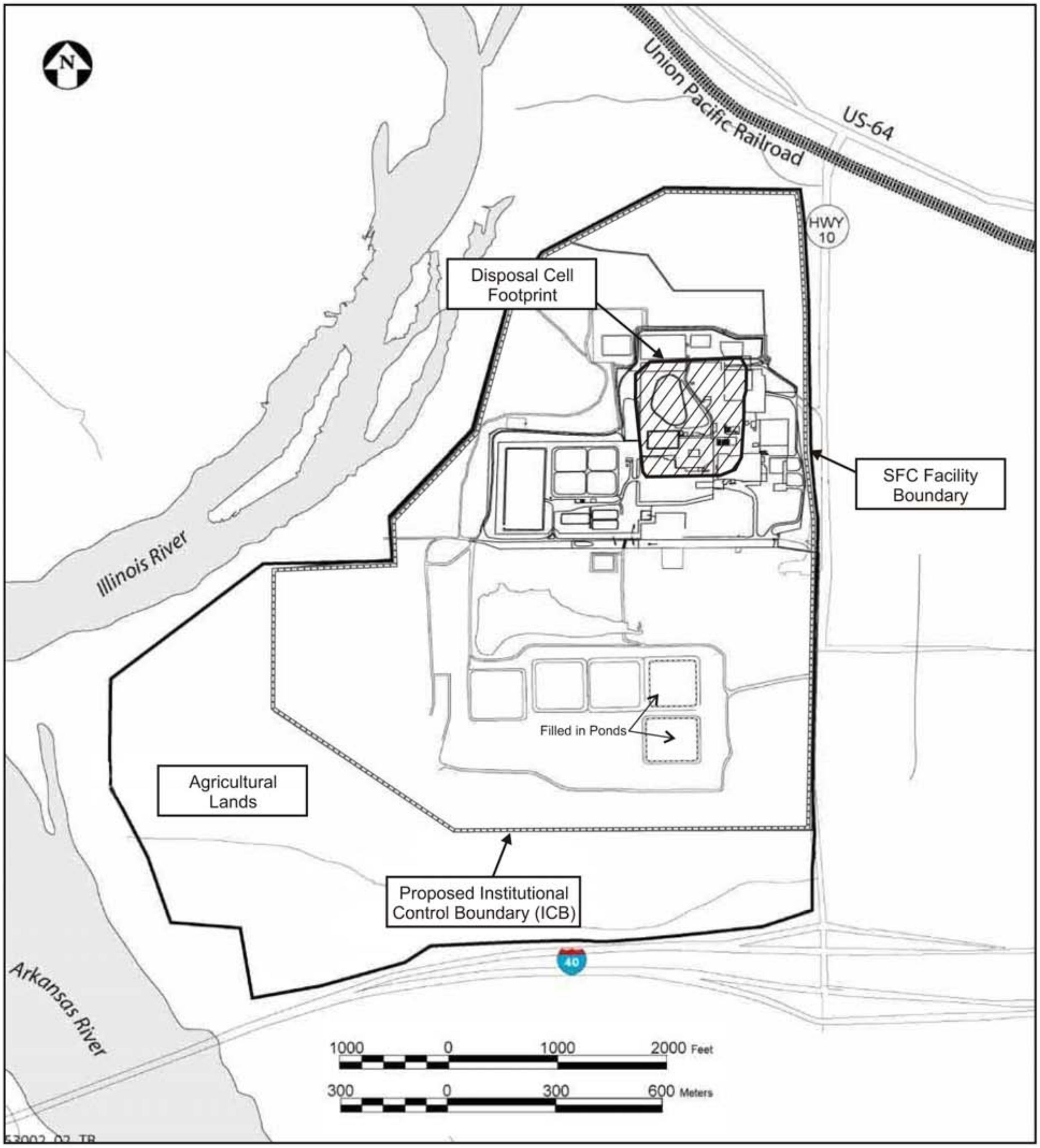


Figure 2.2-1 SFC Proposed Disposal Area Footprint

- The Process Area is already contaminated with uranium, radium-226, thorium-230, arsenic, nitrates, and fluoride. Therefore, use of this location for the disposal cell would minimize the amount of property that would be restricted for future reuse.

- The geometry of the area surrounding the Process Area would allow for the disposal cell footprint to be expanded, if required;

- Leachate management with respect to leachate transfer, treatment, and discharge would be less complex at this location;

- The upstream rainfall catchment area would be very small; and

- The proximity and lateral extent of competent sandstone bedrock would limit the potential for long-term erosion to undercut the disposal cell.

Based on the above summary, the NRC staff has determined that the site selection process for the SFC on-site disposal cell was rational and objective and appears reasonable. None of the candidate sites were obviously superior to the SFC preferred site in the Process Area; therefore, no other site was selected for further analysis.

Disposal Cell Design. SFC has designed the proposed disposal cell to meet the NRC performance standards specified in 10 CFR Part 40, Appendix A. The disposal cell would be capable of accommodating approximately 254,850 cubic meters (9 million cubic feet) of waste, but SFC would be able to adjust its capacity, as needed, for the disposal of between approximately 141,600 to 339,800 cubic meters (5 million to 12 million cubic feet) of waste.

The NRC staff is reviewing the proposed design against the performance standards contained in 10 CFR Part 40, Appendix A, with respect to the geologic, seismic, geotechnical, and surface erosional aspects of long-term stability, groundwater standards, and radiation protection. Once the review is complete, NRC staff will present a conclusion in the final SER on the suitability and adequacy of the proposed *Reclamation Plan*.

Cell Base Liner System. SFC has proposed a multi-layered cell base and liner system to underlie the contaminated materials that would be placed in the cell. The components of this system are shown on Figures 2.2-2 and 2.2-3 and are listed below (from bottom to top):

- **Subsurface Fill.** SFC proposes to construct the cell base from a combination of weathered sedimentary rock surfaces, undisturbed surfaces of native soil, and the concrete pads that already exist within the area of the proposed cell footprint. SFC would establish the required base grade by backfilling any areas within the disposal footprint that would be excavated prior to disposal cell construction for the purposes of remediating soil and the terrace-shale 1 groundwater system. To facilitate leachate collection and liner leak detection, SFC proposes to slope the base of the disposal cell to drain to the west.

- **Compacted Clay Layer.** SFC would place a 0.9-meter (3-foot) -thick compacted clay layer on the subsurface fill or foundation surface to form the lower liner system. The licensee would obtain this clay from a borrow area at the extreme southern end of the SFC site (see Figure 2.2-4). In the draft SER, the NRC staff concluded that this source of clayey soils is

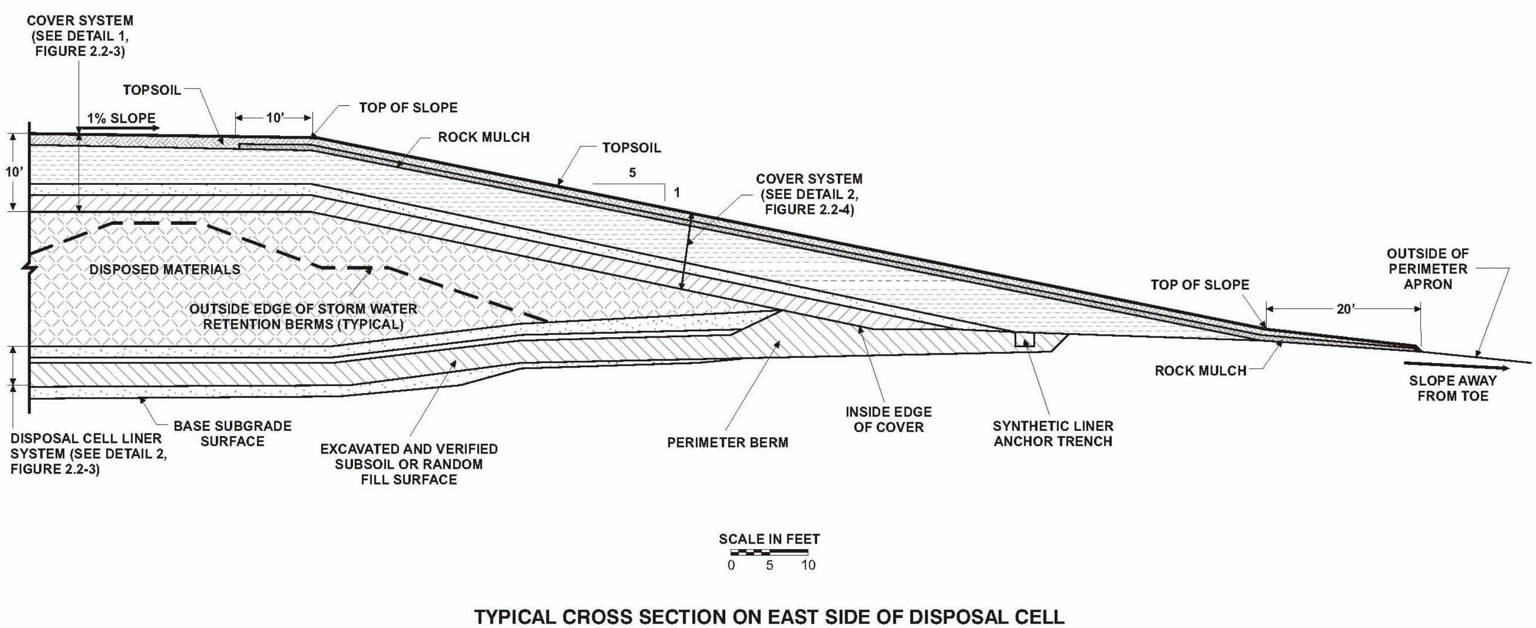


Figure 2.2-2 SFC Disposal Cell Cross Section

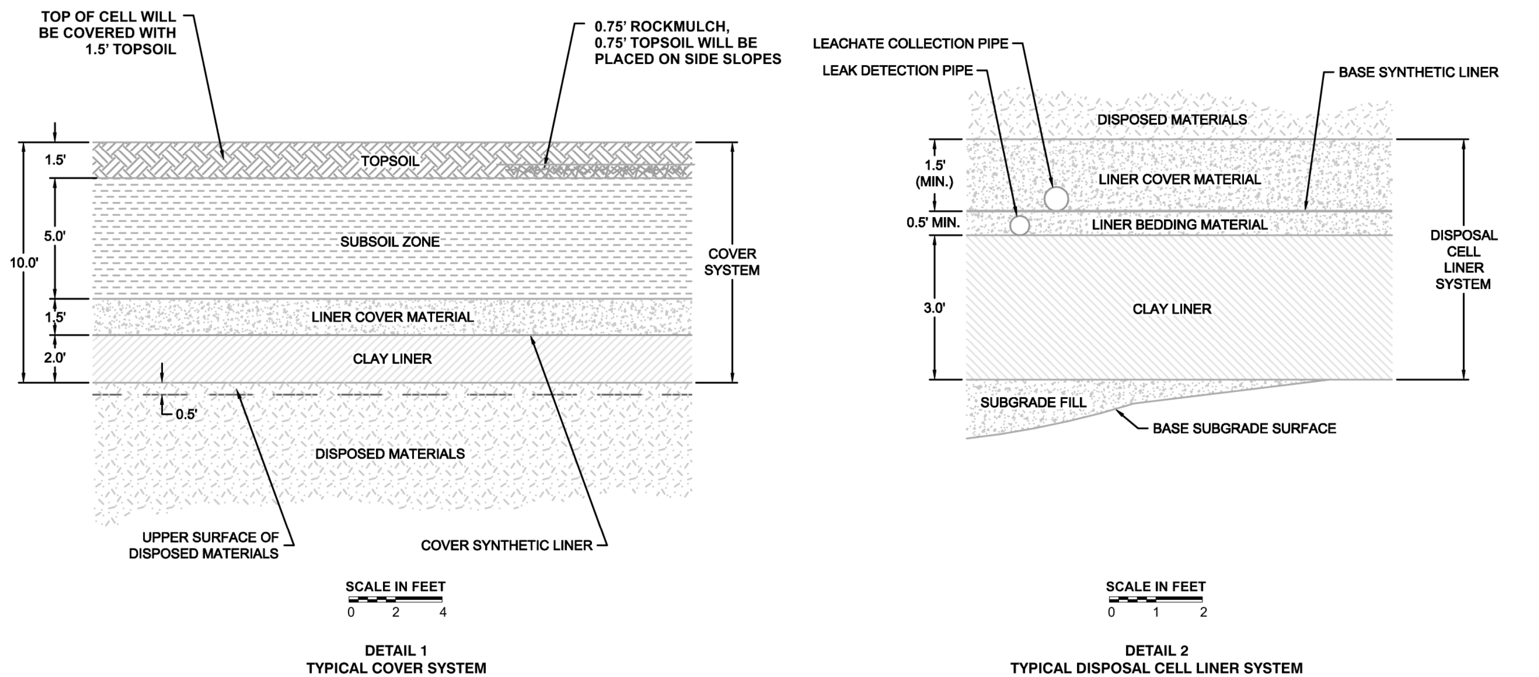


Figure 2.2-3 SFC Disposal Cell Cover and Liner Details

Figure 2.2-4 SFC Disposal Area Footprint and Clay Borrow Area

suitable for use in disposal cell construction and sufficient quantities are present to complete the proposed disposal cell design (NRC, 2005a).

- **Sand Bedding Layer Containing a Leak Detection System.** On top of the clay liner, SFC would place a 15-centimeter (6-inch) -thick gravelly sand bedding layer. This bedding material would be obtained by SFC from an off-site commercial source (SFC, 2003b). This would form a free-draining bedding layer for the synthetic (upper) liner and provide a leak detection zone above the clay layer (should leakage through the upper liner occur). SFC's proposed leak detection system would consist of a series of 10-centimeter (4-inch) -diameter slotted pipes installed in the bedding layer. SFC would test, remove, and dispose of any leachate collected in the sumps connected to this system. For the period of future institutional control, the leak detection system and point of compliance wells required by the Appendix A criteria would provide for the earliest practical warning of any future release of hazardous constituents from the cell. Such a release could be expected to be gradual, providing ample time to implement any mitigation measures necessary to control the release.

- **Synthetic Liner.** A synthetic liner consisting of 60-mil high-density polyethylene (HDPE) or similar material of appropriate low permeability, puncture resistance, and resistance to oxidation would be placed by SFC on top of the bedding layer surface. The licensee's purpose in using a synthetic liner is to provide a hydraulic barrier between the waste and the clay liner to prevent dissolved hazardous constituents from accumulating in the clay liner.

- **Sand Cover Layer with Leachate Collection System.** On top of the synthetic liner, SFC would place a 46-centimeter (18-inch) -thick sand cover layer that would protect the synthetic liner from puncture during waste placement and act as a drainage layer for the leachate collection system. The leachate collection system would consist of a series of 15-centimeter (6-inch) -diameter slotted pipes installed in the cover layer. This material would be obtained from the TM Gravel and Souter Quarry in Gore, which is approximately 11 km (7 miles) away.

Waste Materials. The waste materials would be placed on top of the sand cover layer. Section 2.2.1.4 describes the placement of waste materials within the cell.

Cover System. SFC proposes a disposal cell cover system over the waste designed to promote long-term vegetative growth. The licensee's proposed design is for a multi-layered cover system with a thickness of 3 meters (10 feet) (see Figure 2.2-3). The cover system would consist of the following layers, beginning at the top of the waste (bottom layer of the disposal cell cover) to the surface (top and sides) of the disposal cell.

- **Compacted Clay Layer.** SFC proposes to place 61 centimeters (2 feet) of compacted clay directly on top of the waste. SFC's source for this clay layer would be the same as described for the clay liner in the cell base liner system.

- **Liner Cover Material.** SFC proposes to place 46 centimeters (18 inches) of liner cover materials between the compacted clay layer and the synthetic liner (see below). This material would be obtained by SFC from the clay borrow area at the southern end of the SFC site.

- **Synthetic Liner.** SFC proposes to place a synthetic liner on the surface of the compacted clay layer. The liner would be made of 60-mil HDPE or similar material of appropriate low permeability, puncture resistance, and resistance to oxidation.

- **Subsoil Layer.** SFC proposes to place a 1.5-meter (5-foot) -thick layer of soil on top of the synthetic liner. The licensee contends that any infiltrating water would be contained within this subsoil layer and above the synthetic liner and drain to the sides of the cell. The material for this layer would be obtained by the licensee from the tornado berm and settling pond berm materials on the SFC site (SFC, 2003b).

- **Rock Mulch.** SFC proposes to place a 23-centimeter (9-inch) -thick rock mulch layer on the sides of the disposal cell but not on the top of the disposal cell. This material would be obtained from the TM Gravel and Souter Quarry. The purpose of the rock mulch would be to form an erosion protection zone on the side slopes and perimeter apron of the disposal cell.

- **Topsoil.** SFC proposes to use a layer of topsoil as the final layer of the disposal cell cover system. This layer of topsoil would enhance erosion protection and allow for vegetative growth, which would minimize rainfall infiltration into the disposal cell. The licensee would place 61 centimeters (18 inches) of topsoil on the top of the disposal cell and 23 centimeters (9 inches) on the sides. This material would be obtained by the licensee from the agricultural land on the western side of the SFC site.

- **Vegetation.** SFC proposes to plant the cover surface with native grasses, wildflowers, and brush (proposed species are identified in Table 2.2-3). SFC proposes that the grass be mowed approximately six times per year to prevent the growth of trees on the cover of the disposal cell.

Table 2.2-3 Proposed Seed Mix

Species		Pounds of Pure Live Seed per Acre
Common Name	**Latin Name**	
Big bluestem	*Andropogon gerardii*	6
Little bluestem	*Schizachyrium scoparium*	3
Switchgrass	*Panicum virgatum*	2
Indiangrass	*Sorghastrum nutans*	2
Hairy wildrye	*Elymus villosus*	2
High plains goldenrod	*Solidago altiplanities*	1.5
Prairie sunflower	*Helianthus petiolaris*	1.5
Compassplant	*Silphium laciniatum*	0.5
Blazing star	*Liatris Gaertn. Ex Schreb.*	0.5
Littleleaf sumac	*Rhus microphylla*	2

SFC proposes that the top of the disposal cell will have a final elevation of 9 to 15 meters (30 to 50 feet) above the surrounding ground elevation, depending on the volume of waste placed within the disposal cell (SFC, 2006c). The maximum elevation would be approximately 180 meters (590 feet) above mean sea level. The licensee proposes that the finished side slopes of the disposal cell would have a slope of 5:1 (horizontal face to vertical face) or less, and the corners of the disposal cell would be rounded to create a four-sided dome or rolling hillside to blend in with the surrounding topography. Outside the bottom of the side slopes, SFC proposes to construct a 6-meter (20-foot) -wide perimeter apron to provide protection against the potential migration of gullies toward the disposal cell. The apron would consist of the same topsoil and rock mulch layers that would be placed on the side slopes of the disposal cell (SFC, 2006c). The structure's top surface would drain to the southeast at a 1% slope.

In addition to placing a rock apron at the side slopes of the disposal cell, SFC would install rock armor in the 005 drainage outlet to the west of the proposed disposal cell (see Figure 3.3-1). The rock would be obtained from the TM Gravel and Souter Quarry.

Disposal Cell Construction Sequence. The licensee would construct the disposal cell in three phases (see Figure 2.2-5), which would allow SFC to prepare one area of the disposal cell base for receipt of materials excavated from another area of the cell. After all three base areas of the cell have been constructed, SFC would be able to place materials from outside the disposal cell footprint throughout the cell. By sequencing site reclamation activities, the licensee would avoid stockpiling and double-handling of contaminated materials.

During Phase I, SFC would empty and clean the clarifier ponds (for storm water storage) and initiate building demolition in the Phase I cell area. The licensee would then initiate cell construction on top of the concrete pad or asphalt pads, with the liner system and 0.9-meter (3-foot)-high perimeter berm on the outside edges of the cell (SFC, 2006c). In addition, SFC would construct a 0.9-meter (3-foot)-high internal berm on the inside edges of the cell to tie into the adjoining cell base. The purpose of the perimeter and internal berms is to aid in leachate collection during each cell phase.

Water management during disposal cell construction will be based on containing within the cell any water that is affected by disposed materials, and discharging storm water that is unaffected by disposed materials. SFC will construct interior berms or embankments primarily with compacted contaminated site soils, other soils to be disposed in the cell, and minor amounts of concrete. The berms will be constructed within the cell (on top of the cell base and liner) and will be covered by the cell cover. The inside slopes of the berms will be covered with synthetic material during the filling activities, which will minimize contact with the collected storm water and aid in retention until the water is processed. Clean soil will be used on the outside slopes of the berm in areas that require clean storm water discharge. The licensee would maintain the elevation of the retention berms at a minimum of 1.5 meters (5 feet) above the top surface elevation of the interior materials (SFC, 2006c).

Once the cell base for Phase I is constructed, SFC would place contaminated soils from the Phase II area (Emergency Basin, North Ditch, and Sanitary Lagoon) in the completed disposal cell. The dewatered sludges (with the exception of the already packaged raffinate sludge) and pond residues could be pumped to the disposal cell for placement by the licensee as backfill around large construction debris and equipment. SFC would then raise the storm water retention berm as soils are available and as needed. Contaminated materials from the Phase III disposal cell area would be placed by the licensee in the completed Phase II cell area, and contaminated materials from outside the footprint of the disposal cell would then be placed in various locations of the cell.

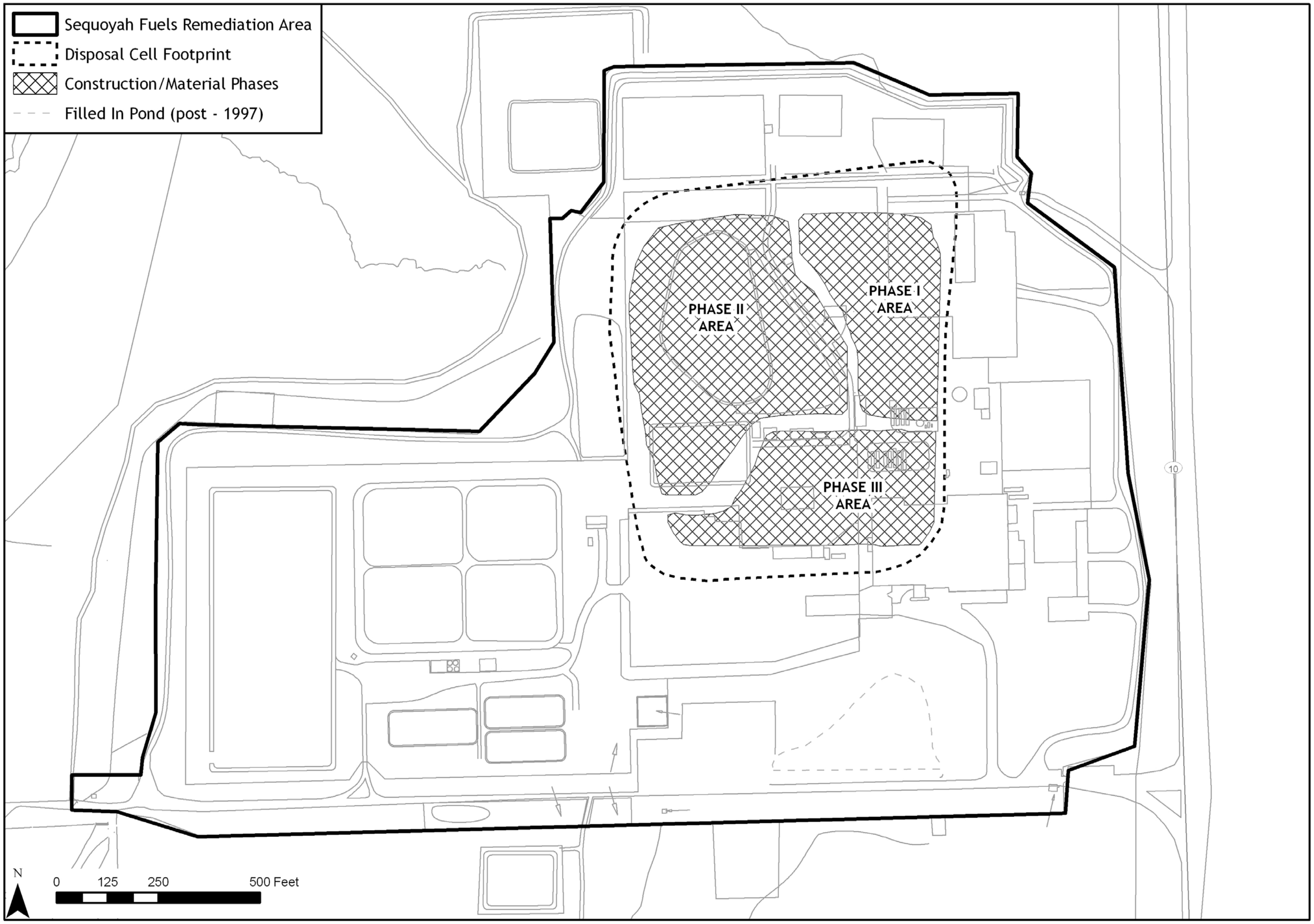


Figure 2.2-5 SFC Disposal Cell Construction/Material Placement Phases

During disposal cell construction, SFC would apply the same controls to the construction site as identified in Section 2.2.1.2 (Demolition of Structures, Equipment, and Management of Other On-site Materials) to protect human health and safety, control dust, manage residues, control contamination, and protect surface and groundwater resources. In addition, to reduce the generation of fugitive dust, SFC would transport clay, soils, rock mulch, and rock armor from source areas to stockpiles (as needed) or to the disposal cell along existing roads as much as possible. The licensee would use haul trucks for long distances and loaders for short distances.

Following completion of the disposal cell, SFC would ensure that materials to be disposed in the disposal cell have been so disposed and that all contaminated soils outside the disposal cell footprint have been excavated and placed in the disposal cell. SFC proposes to restore the site by backfilling where necessary, grading approximately 34 hectares (83 acres) in the Process Area, applying 15 centimeters (6 inches) of topsoil, and reestablishing vegetation by seeding approximately 50 hectares (124 acres) of the site.

2.2.1.4 Placement of Materials Inside the Disposal Cell

SFC would place waste materials into the disposal cell in layers to minimize leaching and optimize shielding. The layers would be identified alphabetically from A to D, proceeding from the cell bottom layer upward:

- **Layer A materials.** In the lowest layer in the disposal cell, SFC proposes to place those waste materials that contain higher activity radionuclides. Therefore, the Layer A materials would consist of the Pond 2 residual materials, dewatered raffinate sludge, and sediments from the Emergency Basin, North Ditch, and Sanitary Lagoon. The already packaged raffinate sludge would remain in the super sacks.

- **Layer B materials.** SFC proposes to place subsoil materials, including soil, clay, and synthetic liner materials excavated from beneath the clarifier, the calcium fluoride basins, Pond 3E, the Emergency Basin, the North Ditch, and the Sanitary Lagoon, as well as the Pond 1 spoils pile, in Layer B.

- **Layer C materials.** In Layer C, SFC proposes to place structural debris such as concrete and asphalt, calcium fluoride basin materials and sediments, and on-site buried materials from Solid Waste Burial Areas Nos. 1 and 2. SFC could also place these Layer C materials with Level B materials.

- **Layer D materials.** In Layer D, SFC proposes to place on-site contaminated soils and sedimentary rock excavated from areas of the site other than the retention ponds, basins, and lagoon described for Level B materials.

The estimated volumes of materials assigned by SFC to each disposal cell layer are provided in Table 2.2-4.

The licensee would spread out incompressible structural materials or lay them out in lifts, the longest dimension laid out horizontally. For large incompressible materials exceeding 0.61 m (2 feet) in vertical dimension (e.g., thick-walled tanks or vessels), SFC would fill interior void spaces with sand or grout. SFC would place soil and soil-like materials around and within the demolition materials to reduce pore spaces.

Table 2.2-4 Disposal Material Summary

Layer	Estimated Volume		Fraction of Total Volume (%)	Natural Uranium (Bq/g)	Radium-226 (Bq/g)	Thorium-230 (Bq/g)
	cubic meters	cubic feet				
A	31,362	1,107,543	22	13.2-448	0.22-12.3	7.81-604
B	33,256	1,174,441	23	0.19-3.52	0.02-0.08	1.74-2.59
C	58,045	2,049,840	40	6.22-19.3	0.01-0.03	0.08-0.18
D	22,984	811,685	16	–	9.26	–
Total	145,647	5,143,509	100	–	–	–

To convert becquerels to picocuries, multiply by 27.

2.2.1.5 Management and Treatment of Produced Groundwater and Storm Water During Construction Activities

As reclamation activities are conducted at the site, SFC would collect storm water and recovered groundwater and leachate and treat it using the on-site wastewater treatment system, located south of the clarifier basins. The SFC wastewater treatment system is designed for batch treatment of wastewater and uses precipitation, filtration, and ion exchange processes to remove uranium prior to release of the water. SFC would sample and analyze treated water for uranium prior to discharge through SFC's permitted Outfall 001. If the treated water met the SFC discharge permit limits, it would be released to the Lower Illinois River through permitted Outfall 001. If the water still contained concentrations of nitrates above 32 mg/L after treatment, the water would be applied to the land application areas at the south end of the SFC site for beneficial reuse at agronomic rates in compliance with the DEQ issued OPDES permit pursuant to 27A O.S. Section 2-6-501 and Oklahoma Administrative Code (OAC) 252:616-11-1 and 616-11-2. At least 180 days prior to the use of or changes to the wastewater treatment system and prior to the discharge through permitted Outfall 001, SFC would need to submit a detailed proposal to the Water Quality Division of the DEQ to modify their current OPDES permit.

As necessary, the sand filter and polishing filter used in the water treatment would be backwashed by the licensee to the precipitate settling tank. SFC would periodically flush uranium-bearing sludge from the precipitate settling tank for dewatering using a small vacuum drum filter. The filtrate would be shipped off-site via truck for disposal or uranium recovery. Options for disposal or use as alternative feed would be the same as identified in Sections 2.3.2 and 2.3.3.

2.2.1.6 Implementation of Groundwater Corrective Action Plan Activities

SFC's proposal to restore the groundwater would use the "hydraulic containment and pump back" method (SFC, 2003a). This method involves the interception of site-impacted groundwater before it reaches the surface or enters surface waters and the containment and treatment of recovered groundwater. Under this approach, SFC is currently recovering groundwater contaminated by past operations using three drainage collection trenches: one is located at the head of the 005 drainage, another is located between Pond 2 and monitoring well MW095A, and the third is in the swale area just north of the former Decorative Pond (see Figure 3.3-1). Groundwater recovered at these trenches is pumped to the clarifier basins, where it is stored prior to treatment in the Water Treatment Plant to reduce arsenic, nitrate, and uranium concentrations to levels suitable for land application. After treatment, the treated water would be pumped to Pond 5, further diluted, and stored for eventual beneficial reuse as part of SFC's land application program at the southern end of the site (SFC, 2003a).

In addition to these three trenches, SFC is proposing to install two groundwater extraction wells in the northwest section of the facility in response to a plume of uranium-contaminated groundwater in that area. One of the wells would be installed in the northwest corner of Fluoride Holding Basin No. 2, and the other well would be installed just to the east, in the southwest corner of Solid Waste Burial Area No. 2. Groundwater recovered using these wells would be handled in the same fashion as that recovered from the three drainage collection trenches.

All water recovered in the corrective action areas would be treated by SFC to meet the land application standards included in SFC's existing materials license. The NRC staff approved a *Groundwater Monitoring Plan* for the SFC site on August 22, 2005 (NRC, 2005b). This plan addresses identification of (1) hazardous constituents in the groundwater that result from licensed site operations; (2) groundwater protection standards for the hazardous constituents; and (3) monitoring locations, frequency, and parameters. For the purposes of groundwater monitoring, SFC identified antimony, arsenic, barium, beryllium, cadmium, chromium, fluorides, lead, mercury, molybdenum, nickel, nitrates, radium-226, selenium, silver, thallium, thorium-230, and uranium as constituents of concern (COCs) or hazardous constituents (SFC, 2005b). However, the main constituents with sizable groundwater contaminant plumes are arsenic, nitrates, fluoride, and uranium. For each of these COCs, a groundwater protection standard was set in accordance with concentration limits found in 10 CFR Part 40, Appendix A, or in the U.S. EPA's National Primary Drinking Water Regulations. The standards in 10 CFR Part 40 and in the U.S. EPA's regulations have been determined to be protective of public health and safety.

Under the approved *Groundwater Monitoring Plan*, SFC would collect and analyze samples from the groundwater, drainages and seeps, and surface water. On an annual basis, SFC would collect and analyze samples from 64 groundwater monitoring wells (see Figure 2.2-6) located around the site. The samples would be collected from different levels (i.e., different shale units) beneath the site. SFC could abandon and plug up to 24 of these wells as surface reclamation proceeds. On a quarterly basis, SFC would collect samples from the three drainage collection trenches and associated monitoring wells and from six drainage and seep locations on the site. SFC would also collect surface waters samples on an annual basis from two locations on the Illinois River and two locations on the Arkansas River. SFC is required under its NRC license to submit, by April 1 of each year, the results of its monitoring analyses in a groundwater compliance monitoring summary report (NRC, 2005b). Additional information about the monitoring plan is provided in Chapter 6, Environmental Measurement and Monitoring Programs.

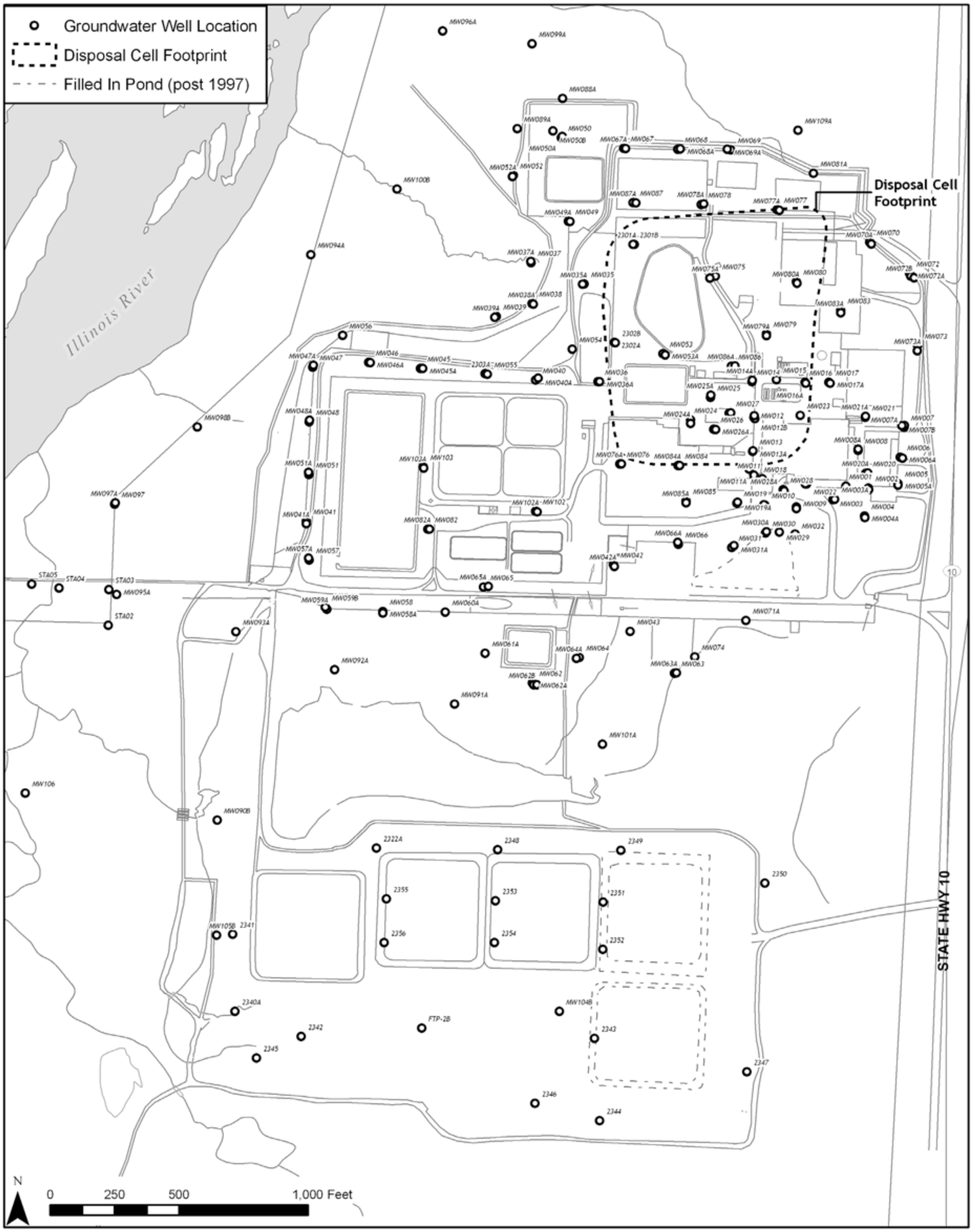


Figure 2.2-6 SFC Groundwater Monitoring Well Locations

2.2.1.7 Release of the SFC Site

After completion of surface reclamation activities and construction of the on-site disposal cell, SFC would perform final status surveys in accordance with the guidance provided in NUREG 1575, *Multi-Agency Radiation Survey and Site Investigation Manual* (NRC, 2002) and the requirements of 10 CFR 40, Appendix A, Criterion 6. The survey methodology would be designed to demonstrate that residual radioactivity levels meet the established cleanup criteria identified in Table 2.2-1. The NRC staff would perform a follow-on verification radiation survey to confirm SFC's findings. If the radiation surveys confirm that residual radioactivity levels meet the cleanup criteria and groundwater corrective actions are completed, SFC would seek termination of its NRC license. As part of that future termination process, SFC proposes to turn over approximately 131 hectares (324 acres) of the site, including the land area encompassing the disposal cell and a surrounding buffer (the ICB; see Figure 2.2-1), to the United States government or the State of Oklahoma for long-term control. The State of Oklahoma would have the first option to take responsibility for long-term custodial care of the site. If the state declines this role, the Department of Energy (or other federal agency) would take custody of the site under the provisions of Section 83 of the AEA of 1954, as amended by the UMTRCA.

The 131-hectares (324-acres) of SFC's proposed ICB would be enclosed by fencing. The entity assuming responsibility for long-term custodial care of this area would restrict access to authorized individuals for monitoring or maintenance activities. The remaining 112 hectares (276 acres) of the SFC site would be released for unrestricted use. Future users of this portion of the site would be allowed access to groundwater for domestic or other uses.

2.3 Alternatives to the Proposed Action

This section examines alternatives to the proposed action described in Section 2.2. The range of alternatives was determined by considering the underlying need and purpose for the proposed action. From this analysis, a set of reasonable alternatives was developed and the impacts of the proposed action were compared with the impacts that would result if a given alternative were implemented. These alternatives include:

- A no-action alternative under which reclamation of the SFC site would not be conducted.
- Off-site disposal of all contaminated materials and groundwater restoration; and
- Partial off-site disposal of a portion of the contaminated materials, construction of an on-site disposal cell for the remaining materials (as in the proposed action), and groundwater restoration.

2.3.1 No-Action Alternative

The CEQ's regulations implementing NEPA require an analysis of the no-action alternative (see 40 CFR 1502.14(d)). Under the no-action alternative, SFC would not implement its proposed *Reclamation Plan.* The SFC site, including all on-site buildings and contaminated materials, would remain in their current condition and configuration. SFC would take corrective measures only in the event of degradation of containment structures, release of contaminated materials, or intrusion. This means that there would be no decontamination (other than for routine maintenance), dismantlement, or removal of equipment or structures. Over the long-term, SFC would be required to maintain the entire 243-hectare (600-acre) site indefinitely under restricted conditions and perform site surveillance and maintenance to ensure that the facility is maintained in a safe condition and that contaminated materials are controlled (SFC 2006a).

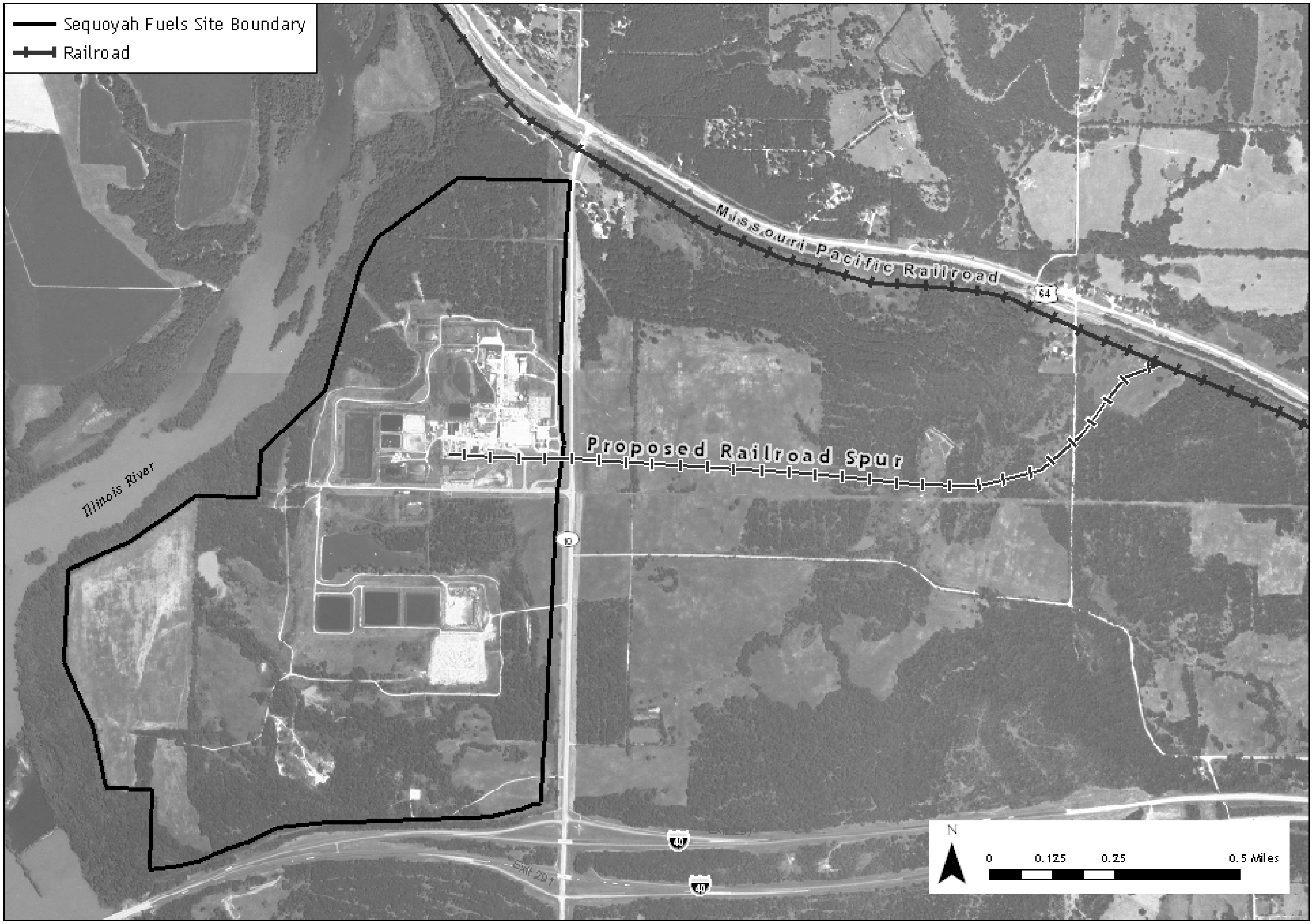
Under the no-action alternative, SFC would not remove potential sources of additional groundwater contamination. However, SFC would continue its current programs to clean up the existing groundwater contamination and perform associated monitoring through its NRC-approved *Groundwater Monitoring Plan*.

Maintaining the SFC site in its current condition and configuration would provide negligible, if any, environmental benefit and would reduce options for future use of the property. Furthermore, the no-action alternative is not acceptable because it would not allow for the surface reclamation and ultimate decommissioning of the SFC site in accordance with the requirements of 10 CFR Part 40, Appendix A (Criteria Relating to the Operation of Uranium Mills and the Disposition of Tailings or Wastes).

2.3.2 Off-Site Disposal of All Contaminated Materials (Alternative 2)

Under this alternative, SFC would excavate, compact, and stage all contaminated soils, sludges, residues, equipment, structures, and any other material contaminated above the cleanup levels identified in Table 2.2-1 for removal from the SFC site. Asbestos would be removed from the structures prior to demolition and packaged by a licensed contractor for disposal at a licensed disposal facility. As contaminated material is excavated, SFC would characterize it for radioactive content. Groundwater encountered by SFC during excavation or extracted from existing wells would be collected, processed, and disposed using the existing on-site wastewater treatment system (described in Section 2.2.1.5) (SFC, 2006a). SFC would arrange for transport of all contaminated materials to a licensed off-site disposal facility (SFC, 2006a) instead of constructing and placing the materials in an on-site disposal cell. The licensee has estimated that the work force needed to accomplish all the activities required under the proposed *Reclamation Plan* would range from a minimum of 25 to a maximum of 73 employees. Only one employee would be required after these activities were completed.

Because the volume of material to be transported to an off-site disposal facility could be as much as 254,850 cubic meters (9 million cubic feet), SFC has determined that transportation by rail would be more economical than by truck (SFC, 2006a). Therefore, under this alternative, SFC proposes to construct an on-site intermodal facility for loading all contaminated materials (e.g., soils, sludges, sediments, and construction debris) into hard top railroad gondola cars. SFC would also construct a rail spur (2.6 km [1.6 miles]) to junction with the Union Pacific Railroad line. SFC's proposed route for the rail spur is shown on Figure 2.3-1. Alternatively, the intermodal facility could be located next to the Union Pacific Railroad line to the north of the SFC site, which would require SFC to load the material on trucks with construction equipment and haul it to the intermodal facility for loading onto the rail cars. The potential environmental impacts of locating the intermodal facility either on- or off-site would not be significantly different; therefore, only the on-site intermodal facility is considered in this alternative.



Source: 2003 NAIP Imagery.

Figure 2.3-1 SFC Proposed Rail Spur for Alternative 2

Before rail cars loaded with contaminated materials left the SFC site to move along the rail spur, SFC would decontaminate the outside of the cars and place a hard top cover on each car. The disposal facility would be responsible for decontaminating the gondola cars before their return to SFC for reuse.

SFC could consider the following off-site disposal locations, provided the SFC waste materials meet the disposal facility's waste acceptance criteria:

- **Energy*Solutions*, Clive, Utah (2,424 km [1,505 miles] by rail from the SFC site)** Energy*Solutions* provides waste management, treatment, and disposal services for low-level and naturally occurring radioactive wastes, byproduct material from uranium mills (AEA Section 11e.(2) wastes), and mixed radioactive and RCRA hazardous waste. Energy*Solutions* is licensed and permitted to receive Class A LLRW, asbestos-contaminated waste, mixed waste (i.e., both radioactive and hazardous), and 11e.(2) byproduct material.

  Furthermore, Energy*Solutions* receives radioactive waste in all forms, including, but not limited to, soil, sludges, resins, large reactor components, dry active waste, and other radioactively contaminated debris. The facility is accessible by rail and truck and is capable of receiving both bulk (e.g., intermodals, gondolas) and non-bulk (e.g., drums, boxes) containers.

- **Waste Control Specialists (WCS), Andrews, Texas (1,221 km [759 miles] by rail from the SFC Site)** This facility, which is accessible by truck or rail, is located in southwest Texas near the New Mexico border. Currently, the WCS Andrews facility is not permitted to accept and dispose of the type of waste materials present at the SFC site. Potentially, WCS will be able to accept the SFC materials for disposal in the proposed WCS 11e.(2) tailings impoundment. This, however, is contingent upon the following: (1) WCS must first receive license approval (issuance expected in the next year or two), (2) SFC would need to get Texas Compact (Texas and Vermont) approval to dispose of the materials with a LLRW component in the proposed tailings impoundment (per Regulatory Information Summary (RIS) 200-23), and (3) DOE would need to make a commitment to take over custody of the impoundment with some LLRW in it. Therefore, in the short-term, SFC would be unable to dispose of waste materials at this facility.

Under this alternative, SFC would not construct an on-site disposal cell. After removal of the structures, equipment, concrete pads and floors, contaminated sludges and sediments from the ponds and lagoons, buried wastes, and contaminated soils from the site, all excavations would be backfilled, graded, covered with topsoil, and seeded with grass or native vegetation. The sources of clean topsoil would be from the same on-site borrow areas identified under Alternative 1. In addition, clean up of the existing groundwater contamination would be accomplished by SFC through the NRC-approved groundwater *Corrective Action Plan* and *Groundwater Monitoring Plan* as discussed for Alternative 1.

SFC would conduct final status surveys to demonstrate that the cleanup criteria identified in Table 2.2-1 had been met. The NRC staff would perform a follow-on verification radiation survey to confirm SFC's findings. If the radiation surveys confirmed that residual radioactivity levels met the cleanup criteria, SFC would seek termination of its NRC license. As part of that future termination process, SFC would release the entire 243-hectare (600-acre) site for unrestricted use. The rail spur would be left in place for potential future use with redevelopment of the SFC site. Future users of the site would be allowed to access groundwater for domestic or other uses.

2.3.3 Partial Off-Site Disposal of Contaminated Materials (Alternative 3)

Under this alternative, SFC would construct an on-site disposal cell in the same location based on the same design described for Alternative 1 (the licensee's proposed action). However, the dewatered raffinate sludge (11e.(2) byproduct material) and the sludges and sediments from the North Ditch, Emergency Basin, and Sanitary Lagoon (non 11e.(2) byproduct material) would be shipped off-site to a facility or facilities licensed to accept such material. This alternative is based on the provisions of the Settlement Agreement (NRC 2004), which requires SFC to explore options for disposition of these materials with the understanding that SFC would spend up to $3.5 million for this action (see Section 1.3.2). There are approximately 6,995 cubic meters (9,150 cubic yards) of dewatered raffinate sludge already packaged in super sacks and approximately 1,292 cubic meters (1,690 cubic yards) of other sludges and sediments that would be packaged in super sacks to be shipped off-site.

Under Alternative 3, SFC would excavate and consolidate soils, sludges, and other contaminated material on-site and demolish/dismantle all structures and equipment on-site. Asbestos would be removed from the structures prior to demolition and packaged by a licensed contractor for disposal in the on-site disposal cell. As with Alternative 1, the licensee would not demolish the administration building, the OG&E electrical substation, or the storm water impoundment. SFC would place all of the consolidated waste materials (with the exception of the dewatered raffinate sludge and sludges and sediments from the Emergency Basin, the North Ditch, and the Sanitary Lagoon) with the residual sediments from Pond 2 and the materials previously identified for Layer B as the first layer placed in the on-site disposal cell. The height of the south side of the cell would be adjusted by SFC to conform to the reduced capacity of the disposal cell.

The dewatered raffinate sludge is already packaged in 0.76-cubic-meter (1-cubic-yard) super sacks. The consolidated materials from the Emergency Basin, North Ditch, and Sanitary Lagoon also would be packaged in super sacks. Using forklifts and loaders, SFC would load the packaged waste material into appropriate vehicles such as trailer vans or trucks. Each truckload would weigh approximately 36 metric tons (40 tons). These wastes would then be transported by SFC to a licensed off-site disposal or recovery facility.

The licensee estimates that the work force needed to accomplish all the activities required would be a maximum of 96 employees, including the on-site workers (78) and off-site truck drivers. Approximately one employee would be required after these activities were completed.

Following the off-site shipment of waste materials, SFC would complete surface reclamation activities and cleanup of the existing groundwater contamination through the NRC-approved groundwater *Corrective Action Plan* and *Groundwater Monitoring Plan* as discussed for Alternative 1. A final radiation survey would be conducted by the NRC staff to verify complete decontamination of the SFC site. Following the final site survey and monitoring of site conditions, SFC would seek termination of its NRC license. As part of that future termination process, SFC would be able to turn over approximately 131 hectares (324 acres) of the site, including the land area encompassing the disposal cell and a surrounding buffer area (see Figure 2.2-1), to the United States government or the State of Oklahoma for long-term control. The State of Oklahoma would have the first option to take responsibility for long-term custodial care of the site. If the state declines this role, the Department of Energy (or other federal agency) would take custody of the site under the provisions of Section 83 of the AEA of 1954, as amended by the UMTRCA.

The 131-hectares (324-acres) of SFC's proposed ICB would be enclosed by fencing. The entity assuming responsibility for long-term custodial care of this area would restrict access to authorized individuals for monitoring or maintenance activities. The remaining 112 hectares (276 acres) of the SFC site would be released for unrestricted use.

Potential off-site options for disposition of the dewatered raffinate sludge and residual materials and sludges and sediments from the Emergency Basin, North Ditch, and Sanitary Lagoon that could be considered by SFC are:

- Use of the raffinate sludge as an alternate feed stock,
- Use of the other sludges and sediments as alternate feed stock,
- Disposal of the waste materials at an existing uranium mill tailings impoundment, or
- Disposal of the waste materials at a licensed disposal facility.

2.3.3.1 Use of the Raffinate Sludge and Other Sludges and Sediments as Alternate Feed Stock

The dewatered raffinate sludge is estimated to contain 43,200 kilogram (kg) (95,232 lbs) of natural uranium. The other sludges and sediments from the Emergency Basin, North Ditch, and Sanitary Lagoon are estimated to contain 3,862 kg (8,496 lbs) of natural uranium. The NRC staff estimated that with a 75% recovery, a total of approximately 34,696 kg (77,809 lbs) of uranium could be recovered from the materials through processing (i.e., 31,800 kg [71,424 lbs] from the raffinate sludge and 2,896 kg [6,385 lbs] from the other sludges and sediments), alone or together with other metals, at a licensed uranium mill. Following processing, the residual materials (tailings) would be permanently disposed in the mill's tailings impoundment. SFC has considered the possibility of transporting the raffinate sludge to two potential candidate uranium mills for use as alternate feed stock: Cotter Corporation's uranium mill near Canon City, Colorado, and International Uranium Corporation's (IUC's) White Mesa uranium mill near Blanding, Utah. In addition, the NRC staff has evaluated the possibility of transporting the other sludges and sediments to IUC's White Mesa uranium mill for use as an alternate feed stock.

The Cotter uranium mill is licensed by the State of Colorado. While the facility's current license (Colorado License No. 369-01, Amendment 42) allows it to accept, receive, possess, and handle ores and other Department of Health-approved classified materials for the commercial processing and recovery of uranium, there are strict limits on the source and quantity of materials that may be processed. SFC is not currently an approved source. For the Cotter uranium mill to obtain approval from the Colorado Department of Health to process the SFC waste, Cotter

Corporation would have to obtain an amendment to its license. In January 2006, Cotter Corporation requested approval from the Colorado Department of Public Health and Environment (CDPHE) to process the SFC raffinate sludge as an alternate feedstock (Cotter, 2006). Following an exchange of correspondence on the request, Cotter Corporation and the CDPHE agreed in August 2006 to table the request until operations at the Cotter mill were more clearly defined and a readiness review process for restart of the mill had been completed (CDPHE, 2006). Because this review process could take months to years to complete, this alternative uranium processing location has not been further considered in this EIS.

IUC's White Mesa uranium mill, which is located approximately 1,607 km (998 miles) by truck from the SFC site, is licensed by the State of Utah. Under the terms of the license (Utah License No. UT1900479 Amendment No. 2), IUC is required to first apply for and obtain approval from the State of Utah for a license amendment before receiving or processing any alternate feed material. Processing of the raffinate sludge at the White Mesa mill would require such an amendment. The State of Utah's review would address the appropriateness of the raffinate sludge and other sludges and sediments as an alternate feedstock and the strict limits on the amount of byproduct materials that the mill can receive for processing, which is based on the tailings cell disposal capacity. In June 2006, the State of Utah approved a license amendment for the White Mesa uranium mill, allowing it to accept alternate feed materials from the Fansteel site in Muskogee, Oklahoma, for processing (UDEQ, 2007). This approval was upheld in February 2007 by the Utah Radiation Control Board in response to a petition filed by the Glen Canyon Sierra Club challenging the 2006 license decision. It is possible that this same situation and corresponding delay in final approval of a license amendment could occur if the White Mesa uranium mill sought the approval of the State of Utah to process the raffinate sludge and other sludges and sediments from the SFC site. However, this alternative would still remain a reasonable alternative for disposal of this material and is carried through this EIS for analysis of potential environmental impacts.

If the sediments and sludges from the Emergency Basin, North Ditch, and Sanitary Lagoon are determined not to be suitable for processing as alternate feed stock, they would require disposal at an off-site, licensed disposal facility.

2.3.3.2 Disposal at Existing Uranium Mill Tailings Impoundments

It is also possible that the dewatered raffinate sludge and the sludges and sediments from the Emergency Basin, North Ditch, and Sanitary Lagoon could be disposed in an existing uranium mill tailings impoundment. Potential candidate uranium mill tailing impoundments include the Pathfinder-Shirley Basin mill tailings impoundment in Mills, Wyoming, and the Rio Algom-Ambrosia Lake mill tailings impoundment in Grants, New Mexico.

The former Shirley Basin uranium mill is owned by the Pathfinder Mines Corporation (PMC). The site, which is located approximately 1,675 km (1,040 miles) from the SFC site, has two solid tailings impoundments, the largest covering approximately 64 hectares (158 acres), and the smaller 55 hectares (135 acres) (NRC, 2007). A solution pond, which is also the disposal location for 11e.(2) byproduct material from in situ leach uranium mines, covers approximately 12 hectares (30 acres). PMC intends to operate its in situ leach disposal area for the foreseeable future under NRC License No. SUA-442, Amendment 59 (NRC, 2007). Under its NRC license, PMC is authorized to dispose of up to a total of 7,646 cubic meters (10,000 cubic yards) of byproduct material per year from all generators other than in situ leach facilities, once NRC approval is granted for each generator. Disposal of the raffinate sludge from SFC in the PMC-Shirley Basin tailings impoundment would require such a prior NRC approval. PMC would also have to acquire an amendment to their waste disposal settlement agreement with the State of Wyoming Department of Environmental Quality to significantly expand the overall permitted volume of material allowed to be disposed at Shirley Basin. In addition, disposal of the non-11e.(2) byproduct material wastes (in the sludges and sediments from the Emergency Basin, North Ditch, and Sanitary Lagoon) at the Shirley Basin site would require prior NRC approval. This approval would require demonstration to the NRC of the acceptability of disposing of non-11e.(2) materials with the 11e.(2) materials in the Shirley Basin tailings impoundment, as required by NRC Regulatory Issue Summary (RIS) 2000-23 (NRC, 2000). SFC has indicated that it would need to dispose of approximately 6,995 cubic meters (9,150 cubic yards) of raffinate sludge (i.e., 11e.(2) byproduct material) and a total of approximately 1,292 cubic meters (1,690 cubic yards) of sludges and sediments from the Emergency Basin, North Ditch, and Sanitary Lagoon (i.e., a mix of 11e.(2) and non-11e.(2) byproduct materials). Therefore, disposal of the raffinate sludge alone or with the other sludges and sediments at this location would take at least two years provided SFC was the only generator disposing of byproduct material at this site. However, the annual limitation on byproduct material disposal at this site could be increased with NRC approval.

The Rio Algom-Ambrosia Lake uranium mill site is located in McKinley County, New Mexico, approximately 1,215 km (754 miles) by truck from the SFC site. The tailings impoundment contains 30 million metric tons (33 million tons) of uranium ore and covers an area of approximately 150 hectares (370 acres). A portion of the tailings impoundment remains open for disposal of Section 11e.(2) byproduct material under NRC License No. SUA-1473, Amendment 57 (NRC, 2006). As 11e.(2) byproduct material, SFC's dewatered raffinate sludge is expected to be found acceptable for disposal at the Rio Algom-Ambrosia Lake site. The site is limited by license condition to a total annual receipt and disposal of Section 11e.(2) byproduct material not to exceed 76,456 cubic meters (100,000 cubic yards) from all generators. As with the Shirley Basin site, the disposal of non-11e.(2) materials (sludges and sediments from the Emergency Basin, North Ditch, and Sanitary Lagoon) at the Rio-Algom Ambrosia Lake site would require demonstration to the NRC of the acceptability of disposing of non-11e.(2) materials with the 11e.(2) materials in the tailings impoundment, as required by NRC RIS 2000-23. SFC would need to dispose of approximately 6,995 cubic meters (9,150 cubic yards) of raffinate sludge (i.e., 11e.(2) byproduct material) and approximately 1,292 cubic meters (1,690 cubic yards) of sludges and sediments from the Emergency Basin, North Ditch, and Sanitary Lagoon (i.e., a mix of 11e.(2) and non-11e.(2) byproduct materials). It is expected that the Rio Algom-Ambrosia Lake tailings impoundment could accommodate this amount of material for disposal.

Because both the Shirley Basin and the Rio Algom-Ambrosia Lake tailings impoundments could potentially accept for disposal the SFC raffinate sludge and the Emergency Basin, North Ditch, and Sanitary Lagoon sediments, disposal at both sites is carried through this EIS for analysis of potential environmental impacts.

2.3.3.3 Disposal at a Licensed Disposal Facility

The SFC raffinate sludge and the sediments from the Emergency Basin, North Ditch, and Sanitary Lagoon could be accepted by Energy*Solutions* of Clive, Utah, and potentially by WCS of Andrews, Texas.

- **Energy*Solutions*, Clive, Utah (2,424 km [1,505 miles] by rail from the SFC Site).** Energy*Solutions* provides waste management, treatment, and disposal services for low-level and naturally occurring radioactive wastes, byproduct material from uranium mills (AEA Section 11e.(2) wastes), and mixed radioactive and RCRA hazardous waste. Energy*Solutions* is licensed and permitted to receive Class A LLRW, asbestos-contaminated waste, mixed waste (i.e., both radioactive and hazardous), and 11e.(2) byproduct material. Furthermore, Energy*Solutions* receives radioactive waste in all forms, including, but not limited to, soil, sludges, resins, large reactor components, dry active waste, and other radioactively contaminated debris. The facility is accessible by rail and truck and is capable of receiving both bulk (e.g., intermodals, gondolas) and non-bulk (e.g., drums, boxes) containers.

- **WCS, Andrews, Texas (1,221 km [759 miles] by rail from the SFC Site).** This facility, which is accessible by truck or rail, is located in southwest Texas near the New Mexico border. Currently, the WCS Andrews facility is not permitted to accept and dispose of the type of waste materials present at the SFC site. Potentially, WCS will be able to accept the SFC materials for disposal in the proposed WCS 11e.(2) tailings impoundment. This, however, is contingent on the following: (1) WCS must first receive license approval (issuance expected in the next year or two), (2) SFC would need to get Texas Compact (Texas and Vermont) approval to dispose of the materials with a LLRW component in the proposed tailings impoundment (per RIS 200-23), and (3) DOE would need to make a commitment to take over custody of the impoundment with some LLRW in it. Therefore, in the short-term, SFC would be unable to dispose of waste materials at this facility.

Because both Energy*Solutions* and WCS could potentially accept the raffinate sludges and the sediments from the Emergency Basin, North Ditch, and Sanitary Lagoon for disposal, disposition at both sites is carried through this EIS for analysis of potential environmental impacts.

2.4 Alternatives Considered but Eliminated

As required by NRC regulations, the NRC staff has considered other alternatives to the surface reclamation and groundwater corrective actions proposed by SFC, the licensee. These alternatives were considered but eliminated from further analysis due to economic, environmental, national security, or maturity reasons. This section discusses these alternatives and the reasons the NRC staff eliminated them from further consideration. These alternatives can be categorized as (1) On-site Retrievable Storage and (2) Alternative Treatment Technologies.

2.4.1 On-site Retrievable Storage

Under this alternative, SFC would package, stack, and cover the on-site waste materials in a manner designed to facilitate subsequent retrieval for either reuse or eventual disposal. SFC would place the waste materials in above-grade storage cells, and a surface-grade pad would be used as the base for the storage area. Alternatively, SFC could use a below-grade cell similar to the disposal cell to store packaged materials. The licensee would surround the cell with an interceptor trench and a groundwater treatment system and cover it with a weather-proof cap that also would impede access. SFC also would establish a monitoring program and security to prevent unauthorized access to the site.

An on-site retrievable storage facility would need to meet the criteria established in Appendix A to 10 CFR Part 40. These design criteria are focused on an objective of permanent isolation of tailings and associated contaminants, and transfer of the site to a government custodian. Furthermore, the final disposition of the contaminated materials should be such that ongoing active maintenance is not necessary to preserve isolation. While licensees may propose alternatives such as retrievable storage, the alternative design must provide a level of protection that is equivalent to or more stringent than that required by the Appendix A criteria. To meet that level of protection and allow for retrievability of the materials would be economically prohibitive, especially since less than 3% of the volume of materials to be disposed (i.e., the raffinate sludge and other sludges and sediments from the North Ditch, Emergency Basin, and Sanitary Lagoon) could have any commercial value. Therefore, this alternative has not been further considered in this EIS.

2.4.2 Alternative Treatment Technologies

SFC conducted a literature search and technical evaluation of various treatment technologies available and appropriate for remediation of soils containing radionuclides and for groundwater remediation of arsenic. The Treatment Technologies Screening Matrix available on the Federal Remediation Technologies Roundtable (FRTR) internet Web site (http://www.frtr.gov/) was used to select candidate treatment technologies for further study. The FRTR is a consortium of cleanup managers at the federal government level. Members include the EPA, the Department of Defense, Department of Energy, Department of the Interior, and the National Aeronautics and Space Administration. The FRTR has rated three treatment technologies as “average” or “better” for treatment of radionuclides:

- **Electrokinetic Remediation.** This process applies low-voltage direct current electrical power to contaminated soil. The electrical power causes the movement of certain types of contaminants (negatively charged), such as heavy metals, to migrate to a collection point where they can be removed. This technology is most applicable in low permeability soils such as saturated and partially saturated clays and silt-clay mixtures that are not readily drained. In addition, there have been few, if any, commercial applications of electrokinetic remediation in the U.S. A recent study estimated full-scale costs at $117 per cubic meter ($153 per cubic yard). For the contaminated soil at the SFC site, the cost to implement this technology would be approximately $4.5 million.

- **In situ Vitrification.** This process uses electrical power to heat and melt contaminated soil in place. The molten material cools to form a solid glassy block trapping the inorganic compounds and heavy metals from the contaminated soil. The organic contaminants are vaporized and migrate to the surface of the treated soil, where they are oxidized under a collection hood. Residual emissions are captured in an off-gas treatment system. Depth of contaminants may limit some types of application processes. Disadvantages of in situ vitrification include the fact that there could be a significant increase in the volume of treated material (up to double the original volume), and the solidified material may hinder future site use. In addition, there have been few, if any, commercial applications of this technology worldwide. One study for a site in the Midwest estimated vitrification costs at $204 per cubic meter ($267 per cubic yard), or approximately $8 million for the contaminated soil at the SFC site.

- **Chemical Extraction.** In this process, soil and contaminants are extracted and dissolved into solution, separated, treated, and reused. Acids or solvents are the chemicals used for extraction. Some soil types and moisture content levels can adversely impact process performance, with higher clay content acting to reduce extraction efficiency and requiring longer contact times. Traces of solvent also may remain in the treated solids. The process may be more economical at larger sites.

In summary, all of these technologies have been, at least for test and demonstration purposes, proven successful in treating soils contaminated with radionuclides. However, widespread commercial-scale application of these technologies has not yet been achieved in the U.S. Coupled with the disadvantages identified in the above discussion, these technologies were not deemed to be sufficiently advanced for further consideration in this EIS.

2.5 Comparison of the Predicted Environmental Impacts

Table 2.5-1 provides a summary of the potential environmental impacts of the proposed action and other alternatives. As indicated in the table, the proposed action and Alternatives 2 and 3 would almost all have SMALL impacts, with the exceptions of land use and transportation. Alternatives 1, 2, and 3 would all have MODERATE land use impacts, differing only in the amount of the site acreage that is proposed for release for unrestricted use. Alternatives 2 and 3 would have MODERATE transportation impacts because either railcars or trucks would be used for transporting contaminated materials off-site. For all other resource areas, the magnitude of potential impacts among Alternatives 1, 2, and 3 is SMALL. In comparison, the no-action alternative would have a LARGE impact on land use and MODERATE to LARGE impacts on surface water and groundwater resources, public and occupational health, geology and soils, and visual quality of the site.

2.6 NRC Staff Final Recommendation Regarding the Proposed Action

After weighing the impacts of the proposed action and comparing the alternatives, the NRC staff, in accordance with 10 CFR § 51.91(d), sets forth its NEPA recommendation regarding the proposed action. The NRC staff recommends that, unless safety issues mandate otherwise, to approve SFC's proposed action. The NRC staff has concluded that the applicable environmental monitoring program described in Chapter 6 and the proposed mitigation measures discussed in Chapter 5 would eliminate or substantially lessen any potential adverse environmental impacts associated with the proposed action.

The NRC staff has concluded the overall benefits of the proposed surface reclamation and groundwater corrective actions outweigh the environmental disadvantages and costs based on consideration of the following:

- The need to protect public health and safety and ensure that any potential long-term radiological and nonradiological hazards or other impacts on the environment are minimized.

- The impacts on the physical environment and human communities would be small.

- Portions of the site would be made available for future unrestricted use.

Table 2.5-1 Comparison of Predicted Environmental Impacts

Resource Area	Alternative 1 On-site Disposal Cell (Proposed Action)	Alternative 2 Off-site Disposal	Alternative 3 Partial Off-site Disposal	No-Action Alternative
Land Use	MODERATE: Future use of about 131 hectares (324 acres) of the site would be restricted, including the disposal cell area; 112 hectares (276 acres) would be released for unrestricted use. SMALL: If the 131-hectare (324-acre) restricted-use portion of the SFC site is held by a nontaxable, government entity, local property taxes may be reduced slightly.	SMALL: During reclamation, there would be a small impact on land use due to land disturbance. MODERATE: After reclamation is completed, the entire 243-hectare (600-acre) site would be available for unrestricted use, which is a moderate positive impact on land use. SMALL: Construction/operation of the rail spur would affect and/or replace up to 3 hectares (7 acres) of forest and 5 hectares (12 acres) of agricultural uses with an industrial use.	MODERATE: Future use of about 131 hectares (324 acres) of the site would be restricted including the disposal cell); 112 hectares (276 acres) would be released for unrestricted use. SMALL: If the 131-hectare (324-acre) restricted-use portion of the SFC site is held by a nontaxable, government entity, local property taxes may be reduced slightly.	LARGE: SFC would not undertake site reclamation; future use of the entire site would be restricted. SMALL: SFC will continue to be responsible for paying property taxes for the site.
Water Resources (Surface)	SMALL: Collection and treatment of surface runoff by SFC using the existing wastewater treatment system to remove uranium would result in small, short-term direct and indirect impacts on water resources while the licensee conducts site reclamation activities. SFC would test the collected water before discharging it to ensure compliance with drinking water standards. SMALL: The design of the disposal cell and SFC's revegetation of the top cover following completion of site reclamation would minimize	SMALL: Collection and treatment of surface runoff by SFC using the existing wastewater treatment system to remove uranium would result in small, short-term direct and indirect impacts on water resources while the licensee conducts site reclamation activities. SFC would test the collected water before discharging it to ensure compliance with drinking water standards. SMALL: Following completion of site reclamation activities, which would consolidate and remove contaminated materials, there would be a small impact on	SMALL: Collection and treatment of surface runoff by SFC using the existing wastewater treatment system to remove uranium would result in small, short-term direct and indirect impacts on water resources while the licensee conducts site reclamation activities. SFC would test the collected water before discharging it to ensure compliance with drinking water standards. SMALL: The design of the disposal cell and revegetation of the top cover following completion of site reclamation would minimize surface water	MODERATE: Measurements of surface water quality in the vicinity of the SFC site exceeded OPDES discharge limits for nitrates and ammonia in 2007 due to a breach in the liner of Pond 2. Pending remediation, the current situation may result in additional exceedances. Under the current uncontained conditions at the site, measurements of contaminant levels in the river have not exceeded drinking water standards. MODERATE: In the long term, without removal of

Table 2.5-1 Comparison of Predicted Environmental Impacts

Resource Area	Alternative 1 On-site Disposal Cell (Proposed Action)	Alternative 2 Off-site Disposal	Alternative 3 Partial Off-site Disposal	No-Action Alternative
	surface water runoff and erosion.	surface water. SMALL: The implementation of best management practices to control run-on and runoff at the construction area for the rail spur would result in small impacts on surface water on the SFC site.	runoff and erosion.	existing site contamination, there is a potential for site contaminants to affect surface water resources on the SFC site.
Water Resources (Groundwater)	SMALL: The consolidation of contaminated materials and their placement in the disposal cell would reduce the source of future contamination. Implementation of the groundwater *Corrective Action Plan*, *Groundwater Monitoring Plan*, and long-term surveillance plan would result in the remediation of groundwater contamination.	SMALL: The consolidation of contaminated materials and removal from the SFC site would reduce the source of future contamination. Implementation of the groundwater *Corrective Action Plan*, *Groundwater Monitoring Plan*, and long-term surveillance plan would result in the remediation of groundwater contamination.	SMALL: The consolidation of contaminated materials and their placement in the disposal cell would reduce the source of future contamination. Implementation of the groundwater *Corrective Action Plan*, *Groundwater Monitoring Plan*, and long-term surveillance plan would result in the remediation of groundwater contamination.	MODERATE: Contamination of the groundwater resources at the SFC would likely continue because the source of such contamination would not be addressed.
Public and Occupational Health	SMALL: The annual radiation dose to members of the public or workers associated with reclamation of the SFC site, long-term public doses in the unrestricted area, and loss of institutional controls within the ICB would be within regulatory limits, and the estimated probabilities of LCFs would be low. SMALL: Implementation of mitigation measures would reduce exposure to chemicals during reclamation. The disposal cell cap would prevent human	SMALL: The annual radiation dose to members of the public or workers associated with reclamation of the SFC site would be within regulatory limits, and the estimated probabilities of LCFs would be low. SMALL: Implementation of mitigation measures would reduce exposure to chemicals during reclamation. Following completion of site reclamation activities, SFC would release the 243-hectare (600-acre) site for unrestricted reuse. The overall risk of the public coming into	SMALL: The annual radiation dose to members of the public or workers associated with reclamation of the SFC site, long-term public doses in the unrestricted area, and loss of institutional controls within the ICB would be within regulatory limits, and the estimated probabilities of LCFs would be low. SMALL: Implementation of mitigation measures would reduce exposure to chemicals during reclamation. The disposal cell cap would prevent human	SMALL: The annual radiation dose to SFC workers and the public associated with ongoing activities at the SFC site would be within regulatory limits and the estimated probabilities of LCFs would be low. LARGE: The annual radiation dose to the public (in this case the residential farmer) if there were no license controls would be far in excess of the regulatory limits, and the estimated probabilities of LCFs would

Table 2.5-1 Comparison of Predicted Environmental Impacts

Resource Area	Alternative 1 On-site Disposal Cell (Proposed Action)	Alternative 2 Off-site Disposal	Alternative 3 Partial Off-site Disposal	No-Action Alternative
	exposure to the chemical contamination within the disposal cell, and the impact on the occupational worker and the public following the licensee's completion of site reclamation activities would be small. SMALL: During construction activities, a maximum of five occupational injuries per year would be expected, and no fatalities would be expected (probability less than one).	contact with any radionuclides or chemicals remaining on-site would be low. SMALL: During construction activities, a maximum of five occupational injuries per year would be expected, and no fatalities would be expected (probability less than one).	exposure to the chemical contamination within the disposal cell, and the impact on the occupational worker and the public following the licensee's completion of site reclamation activities would be small. SMALL: During construction activities, a maximum of five occupational injuries per year would be expected, and no fatalities would be expected (probability less than one).	be higher than any of the other three alternatives. SMALL: Exposure to chemicals in the short-term would be small because there would be no disturbance of chemical contaminants. LARGE: If, in the long-term, site contaminants are disturbed due to a loss of license controls, there would be a risk of potential chemical exposure to the public and occupational workers.
Transportation	SMALL: The increased numbers of commuting workers and construction deliveries to the SFC site would have a small impact on the quality of traffic flow in the area. SMALL: The increased risk of fatality from vehicular accidents resulting from licensee's site reclamation activities would be small during the year of most intensive site reclamation activities, after which the impact would be the same as baseline conditions. SMALL: The increased risk of fatality resulting from vehicle emissions from activities at the	MODERATE: The increased numbers of commuting workers, construction and use of the rail spur, and construction deliveries to the SFC site would have a moderate impact on the quality of traffic flow in the vicinity of the site. SMALL: The increased risk of fatality from vehicular and rail accidents resulting from licensee's site reclamation activities would be small during the year of most intensive site reclamation activities, after which the impact would be the same as baseline conditions. SMALL: The increased risk of	MODERATE: The increased numbers of commuting workers and construction deliveries to the SFC site, in combination with the use of trucks for off-site shipment of contaminated materials, would have moderate impacts on the quality of traffic flow in the vicinity of the site. SMALL: The increased risk of fatality from vehicular accidents resulting from licensee's site reclamation activities would be small for the year of most intensive site reclamation activities, after which the impact would be the same as baseline conditions.	SMALL: There would be no change in the quality of traffic flow for roads in the vicinity of the SFC site. SMALL: The increased risk of fatality resulting from vehicle emissions from activities at the SFC site would be the same as baseline conditions. SMALL: There would be no radiological impact from the transportation of waste because the radiological contaminated waste would not be removed from the site.

Table 2.5-1 Comparison of Predicted Environmental Impacts

Resource Area	Alternative 1 On-site Disposal Cell (Proposed Action)	Alternative 2 Off-site Disposal	Alternative 3 Partial Off-site Disposal	No-Action Alternative
	SFC site would be small for the year of most intensive site reclamation activities, after which the impact would be the same as baseline conditions.	fatality resulting from vehicle emissions from activities at the SFC site would be small for the year of most intensive site reclamation activities, after which the impact would be the same as baseline conditions. SMALL: There would be a small risk of exposure to radiological waste during off-site transport of contaminated materials.	SMALL: The increased risk of fatality resulting from vehicle emissions from activities at the SFC site would be small during the year of most intensive site reclamation activities, after which the impact would be the same as baseline conditions. SMALL: There would be a small risk of exposure to radiological waste during off-site transport of contaminated materials.	
Historic and Cultural Resources*	SMALL: Consultation with the Oklahoma Historical Society has determined there are no prehistoric or historic sites currently known at the SFC site.	SMALL: Consultation with the Oklahoma Historical Society has determined there are no prehistoric or historic sites currently known at the SFC site. (Note: An archaeological survey must be performed on the proposed rail spur route.)	SMALL: Consultation with the Oklahoma Historical Society has determined there are no prehistoric or historic sites currently known at the SFC site.	SMALL: Consultation with the Oklahoma Historical Society has determined there are no prehistoric or historic sites currently known at the SFC site.
Visual and Scenic Resources*	SMALL: During reclamation, increased traffic, dust, and noise associated with the consolidation of waste materials, including building demolition, and construction of the disposal cell would be visible to travelers along local roadways. SMALL: Following SFC's completion of site reclamation, the disposal cell would be visible; however, the surface would be revegetated to resemble the local topography. There also would be	SMALL: During reclamation, increased traffic, dust, and noise associated with the consolidation of waste materials, including building demolition, and construction of the disposal cell would be visible to travelers along local roadways. SMALL: With the exception of the rail spur, which would not intrude into the landscape, and the administration building, SFC would restore the site to near natural conditions.	SMALL: During reclamation, increased traffic, dust, and noise associated with the consolidation of waste materials, including building demolition, and construction of the disposal cell would be visible to travelers along local roadways. SMALL: Following SFC's completion of site reclamation, the disposal cell would be visible; however, the surface would be revegetated to resemble the local topography. There also would be	MODERATE: The SFC site facilities and related equipment would not be removed and further deterioration of the site would likely result in a continued reduction in the visual quality of the site.

Table 2.5-1 Comparison of Predicted Environmental Impacts

Resource Area	Alternative 1 On-site Disposal Cell (Proposed Action)	Alternative 2 Off-site Disposal	Alternative 3 Partial Off-site Disposal	No-Action Alternative
	fewer structures and tanks, improving the overall visual quality of the site.		fewer structures and tanks, improving the overall visual quality of the site.	
Geology and Soils*	SMALL: Implementation of best management practices during site reclamation activities would minimize any potential erosion impacts at the SFC site. SMALL: The licensee's excavation of on-site clay for liners would be a necessary component of the site reclamation process. SMALL: To minimize soil compaction, existing on-site roadways would be used during reclamation activities. Given the total size of the SFC site, the area where potential compaction of soils could occur is expected to be small. SMALL: The disposal cell is designed to withstand the maximum intensity earthquake likely to occur at the SFC site.	SMALL: Implementation of best management practices during site reclamation activities would minimize any potential erosion impacts at the SFC site. SMALL: The licensee's excavation of on-site clay for liners would be a necessary component of the site reclamation process. SMALL: To minimize soil compaction, existing on-site roadways would be used during reclamation activities. Given the total size of the SFC site, the area where potential compaction of soils could occur is expected to be small.	SMALL: Implementation of best management practices during site reclamation activities would minimize any potential erosion impacts at the SFC site. SMALL: The licensee's excavation of on-site clay for liners would be a necessary component of the site reclamation process. SMALL: To minimize soil compaction, existing on-site roadways would be used during reclamation activities. Given the total size of the SFC site, the area where potential compaction of soils could occur is expected to be small. SMALL: The disposal cell is designed to withstand the maximum intensity earthquake likely to occur at the SFC site.	MODERATE TO LARGE: Contaminated soils and structures would remain indefinitely at the SFC site. Deterioration and potential leaching into the surface or groundwater resources could result in further contamination of site soils.
Climate, Meteorology, and Air Quality*	SMALL: Projected construction emissions are projected to be small and short term. SMALL: Additional vehicular traffic on local highways would have a small, indirect impact on local air quality.	SMALL: Projected construction emissions are projected to be small and short term. SMALL: Additional mobile-source emissions would be generated by trucks making deliveries and railcars	SMALL: Projected construction emissions are projected to be small and short term. SMALL: Additional mobile-source emissions would be generated by trucks transporting contaminated materials from the	SMALL: Monitoring and maintenance activities at the SFC site would continue with small direct impacts on air quality.

Table 2.5-1 Comparison of Predicted Environmental Impacts

Resource Area	Alternative 1 On-site Disposal Cell (Proposed Action)	Alternative 2 Off-site Disposal	Alternative 3 Partial Off-site Disposal	No-Action Alternative
	SMALL: Demolition of facilities on the SFC site would be conducted in compliance with applicable regulatory requirements with respect to potential asbestos-containing materials. SMALL: Based on studies of similar sites and activities, the radiological air emissions during site reclamation by SFC would have a small, direct impact on local air quality. SMALL: The disposal cell cover and revegetated surface would limit soil erosion; thus, air transport of contaminated soil is not expected.	transporting contaminated wastes from the SFC site. Vehicles would be decontaminated before leaving the site to reduce the potential for fugitive radiological dust being transported from the site. SMALL: Demolition of facilities on the SFC site would be conducted in compliance with applicable regulatory requirements with respect to potential asbestos-containing materials. SMALL: Based on studies of similar sites and activities, the radiological air emissions during site reclamation by SFC would have a small, direct impact on local air quality.	SFC site. The material would be shipped in super sacks, truckbeds would be covered with tarps, and trucks would be decontaminated before leaving the site to reduce the potential for fugitive radiological dust being transported from the site. SMALL: Demolition of facilities on the SFC site would be conducted in compliance with applicable regulatory requirements with respect to potential asbestos-containing materials. SMALL: Based on studies of similar sites and activities, the radiological air emissions during site reclamation by SFC would have a small, direct impact on local air quality. SMALL: The disposal cell cover and revegetated surface would limit soil erosion; thus, air transport of contaminated soil is not expected.	
Ecological Resources*	SMALL: Due to previous disturbance of the SFC site for industrial use, there is limited diversity. Small impacts due to the small area of ecological communities and open field habitat affected.	SMALL: Due to previous disturbance of the SFC site for industrial use, there is limited diversity. Small impacts due to the small area of ecological communities and open field habitat affected.	SMALL: Due to previous disturbance of the SFC site for industrial use, there is limited diversity. Small impacts due to the small area of ecological communities and open field habitat affected.	SMALL: There would be no change in the current level of disturbance to ecological resources as there would be no construction or excavation activities on the site.

Table 2.5-1 Comparison of Predicted Environmental Impacts

Resource Area	Alternative 1 On-site Disposal Cell (Proposed Action)	Alternative 2 Off-site Disposal	Alternative 3 Partial Off-site Disposal	No-Action Alternative
	SMALL: Site reclamation activities would incorporate best management practices to control erosion and manage storm water runoff such that impacts on aquatic habitats would be small. SMALL: No jurisdictional wetlands are located on the SFC site; thus, there would be no impacts on wetlands. SMALL: Overall wildlife species numbers and diversity are low, and existing wildlife has already acclimated to a certain amount of disturbance over the years of industrial operations. Mobile species would relocate. The potential direct impact on less mobile species is considered small. SMALL: Increased noise during site reclamation would have a small impact on wildlife. SMALL: No federally or state-listed species are known to occur at the SFC site or at a distance that may experience adverse impacts from SFC's site reclamation activities. SMALL: Although not known to	SMALL: Site reclamation activities would incorporate best management practices to control erosion and manage storm water runoff such that impacts on aquatic habitats would be small. SMALL: No jurisdictional wetlands are located on the SFC site or along the route of the proposed railroad spur; thus, there would be no impacts on wetlands. SMALL: Overall wildlife species numbers and diversity are low, and existing wildlife has already acclimated to a certain amount of disturbance over the years of industrial operations. Mobile species would relocate. The potential direct impact on less mobile species is considered small. SMALL: Increased noise during site reclamation would have a small impact on wildlife. SMALL: The proposed railroad spur would traverse a previously undeveloped area, primarily consisting of pastureland, hayfields, and forestland. These ecological communities are common throughout the area and	SMALL: Site reclamation activities would incorporate best management practices to control erosion and manage storm water runoff such that impacts on aquatic habitats would be small. SMALL: No jurisdictional wetlands are located on the SFC site; thus, there would be no impacts on wetlands. SMALL: Overall wildlife species numbers and diversity are low, and existing wildlife has already acclimated to a certain amount of disturbance over the years of industrial operations. Mobile species would relocate. The potential direct impact on less mobile species is considered small. SMALL: Increased noise during site reclamation would have a small impact on wildlife. SMALL: No federally or state-listed species are known to occur at the SFC site or at a distance that may experience adverse impacts from reclamation activities. SMALL: Although not known to	

Table 2.5-1 Comparison of Predicted Environmental Impacts

Resource Area	Alternative 1 On-site Disposal Cell (Proposed Action)	Alternative 2 Off-site Disposal	Alternative 3 Partial Off-site Disposal	No-Action Alternative
	be present, suitable habitat for the endangered American burying beetle exists within the proposed clay borrow area at the SFC site. Based on informal Section 7 consultation, if surveys find the burying beetle to be present, SFC would implement mitigation measures to avoid adversely affecting the beetle. SMALL: Proposed site reclamation activities would occur 5 km (3 miles) from the Sequoyah National Wildlife Refuge (NWR). This distance would provide a suitable buffer between site reclamation activities and the wildlife and visitors on the refuge.	are currently traversed by numerous existing roadways and railroad lines; thus, any additional impact from the proposed railroad spur would be small. SMALL: Construction of the railroad spur would cross two intermittent tributaries. The small area potentially affected and lack of aquatic diversity would result in a small impact. SMALL: No federally or state-listed species are known to occur at the SFC site or at a distance that may experience adverse impacts from SFC's site reclamation activities. SMALL: Although not known to be present, suitable habitat for the endangered American burying beetle exists within the proposed clay borrow area at the SFC site. Based on informal Section 7 consultation, if surveys find the burying beetle to be present, SFC would implement mitigation measures to avoid adversely affecting the beetle. SMALL: Much of the proposed railroad spur corridor would cross lands considered potentially suitable habitat for the	be present, suitable habitat for the endangered American burying beetle exists within the proposed clay borrow area at the SFC site. Based on informal Section 7 consultation, if surveys find the burying beetle to be present, SFC would implement mitigation measures to avoid adversely affecting the beetle. SMALL: Reclamation activities at the SFC site would occur 5 km (3 miles) from the Sequoyah NWR. This distance would provide a suitable buffer between site reclamation activities and the wildlife and visitors on the refuge	

Table 2.5-1 Comparison of Predicted Environmental Impacts

Resource Area	Alternative 1 On-site Disposal Cell (Proposed Action)	Alternative 2 Off-site Disposal	Alternative 3 Partial Off-site Disposal	No-Action Alternative
		endangered American burying beetle, and a project evaluation would be completed with USFWS prior to construction to evaluate whether the species is present. If present, SFC would implement mitigation measures to avoid adversely affecting the beetle. SMALL: Reclamation and construction activities at the SFC site would occur 5 km (3 miles) from the Sequoyah NWR. This distance would provide a suitable buffer between site reclamation activities and the wildlife and visitors on the refuge.		
Socioeconomic Conditions*	SMALL: SFC's site reclamation activities would require only a short-term increase of approximately 72 workers. SMALL: Following reclamation and until reuse of the property released for unrestricted use (131 hectares [324 acres]), there would be no commercial activity. Positive impacts could be expected in the long-term with commercial or industrial use.	SMALL: SFC's site reclamation activities would only require a short-term increase of approximately 73 workers. SMALL: Following reclamation and until reuse of the property released for unrestricted use (243 hectares [600 acres]), there would be no commercial activity. Positive impacts could be expected in the long-term with commercial or industrial use.	SMALL: SFC's site reclamation activities would require only a short-term increase of approximately 78 workers on-site and an additional 18 off-site truck drivers. SMALL: Following reclamation and until reuse of the property released for unrestricted use (131 hectares [324 acres]), there would be no commercial activity. Positive impacts could be expected in the long-term with commercial or industrial use.	SMALL: There would be no change in management or employment at the SFC site, and there would be no socioeconomic implications.
Environmental Justice*	SMALL: No disproportionately high or adverse human health or environmental effects on minority	SMALL: No disproportionately high or adverse human health or environmental effects on minority	SMALL: No disproportionately high or adverse human health or environmental effects on minority	SMALL: There would be no change in management or facility maintenance at the

Table 2.5-1 Comparison of Predicted Environmental Impacts

Resource Area	Alternative 1 On-site Disposal Cell (Proposed Action)	Alternative 2 Off-site Disposal	Alternative 3 Partial Off-site Disposal	No-Action Alternative
	or low-income populations were identified. Impacts on plants and animal resources used as subsistence food sources and for religious purposes, which are found in proximity to the SFC site and the Lower Illinois River, and that are used by minority or low-income populations, would be small and not disproportionately high or adverse with the reclamation of the SFC site.	or low-income populations were identified. Impacts on plants and animal resources used as subsistence food sources and for religious purposes, which are found in proximity to the SFC site and the Lower Illinois River, and that are used by minority or low-income populations, would be small and not disproportionately high or adverse with the reclamation of the SFC site.	or low income populations were identified. Impacts on plants and animal resources used as subsistence food sources and for religious purposes, which are found in proximity to the SFC site and the Lower Illinois River, and that are used by minority or low-income populations, would be small and not disproportionately high or adverse with the reclamation of the SFC site.	SFC site, and there would be no disproportionately high or adverse human health or environmental effects on these populations with this alternative.
Noise*	SMALL: Reclamation activities, would result in small, direct noise impacts on the nearest noise receptor. SMALL: Noise from vehicles used by workers commuting to the SFC site would have a small impact on highway noise.	SMALL: Reclamation activities, would result in small, direct noise impacts on the nearest noise receptor. SMALL: Noise from vehicles used by workers commuting to and from the SFC site would have a small impact on highway noise. SMALL: Transportation of contaminated materials via railcar would add only a very minor noise component to the existing daytime noise level in the vicinity of the SFC site.	SMALL: Reclamation activities, would result in small, direct noise impacts on the nearest noise receptor. SMALL: Noise from vehicles used by workers commuting to the SFC site would have a small impact on highway noise. SMALL: Noise from trucks transporting contaminated materials off-site would generate short-duration noise events that would add little to the average noise levels at the receptors.	SMALL: As SFC would not undertake any construction-related activities, there would be no noise impacts.
Cost**	15% (Least Impact)	100% (Greatest Impact)	17% (Second Least Impact)	Not Applicable**

*These resource areas were determined to have small to no impacts and were eliminated from the detailed study. Their associated analysis can be found in Appendix B. In addition, there are no mineral resources actively mined or exploited in the vicinity of the SFC site.

** Cost impacts are expressed in relative terms by indexing them or scaling them to the highest cost option (Alternative 2 = 100%). The no-action alternative does not comply with NRC regulations for license termination and the costs are not comparable using this scaling impact metric.

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3. AFFECTED ENVIRONMENT

3.1 Introduction

This chapter describes the existing conditions at and near the SFC facility in Gore, Oklahoma. These data and information form the basis for assessing the potential impacts of the proposed action and other alternatives, including the no-action alternative, that are evaluated in Chapter 4. This chapter describes the environment in and around the site with emphasis on those resource areas most likely to be affected by the reclamation process (i.e., land use, water resources, public and occupational health, and transportation). As discussed in Section 1.4.3, NRC has identified SMALL impacts for additional resources that could potentially be affected by reclamation activities. These resource areas are discussed in Appendix B of this EIS, which presents information on cultural resources, visual and scenic resources, geology and soils, air quality, ecological resources, socioeconomic conditions, environmental justice, and noise.

3.2 Land Use

The SFC site is located in an unincorporated area of western Sequoyah County in eastern Oklahoma. Sequoyah County has not adopted a land use plan, nor does the county control land use development through zoning.

The SFC site is about 4 km (2.5 miles) southeast of the town of Gore, Oklahoma, and about 3 km (2 miles) east of the town of Webbers Falls, Oklahoma. Gore and Webbers Falls are both considered rural areas (USCB, 2000). The nearest urbanized areas are the cities of Muskogee, Oklahoma (40 km [25 miles] northwest), and Fort Smith, Arkansas (64 km [40 miles] east). The Sequoyah National Wildlife Refuge (NWR) is located 1.6 km (1 mile) from the SFC site. Existing land uses on the SFC site are also described in the context of Haskell and Muskogee counties, which are adjacent to Sequoyah County.

3.2.1 Land Uses at the Sequoyah Fuels Corporation Site

The SFC site is a former industrial site situated on an approximately 243-hectare (600-acre) parcel. The site is in a rural area with forested land to the north and south and agricultural land to the east. The Arkansas and Illinois rivers are to the west. The Robert S. Kerr Reservoir is located to the southeast on the Arkansas River. The reservoir is owned by the federal government and is administered by the USACE. The location of the site in relation to these resources is shown on Figure 3.2-1.

When the SFC site was active, site operations were concentrated within the 81-hectare (200-acre) Industrial Area. Existing structures are located within the smaller Process Area (see Section 2 for a more complete discussion of site history and configuration). Surrounding the Industrial Area are approximately 81 hectares (200 acres) of pastureland that have been used for forage production in conjunction with a land application program operated by SFC. In 2005 and 2006, SFC applied ammonium nitrate solution (a byproduct of the liquid portion of the former raffinate process stream) to an on-site control plot located within the 243-hectare (600-acre) site boundary in the agricultural lands to the south and southwest of the Industrial Area (see Figure 1.2-1). SFC monitors this control plot as specified in Source Materials License SUB-1010 in order to

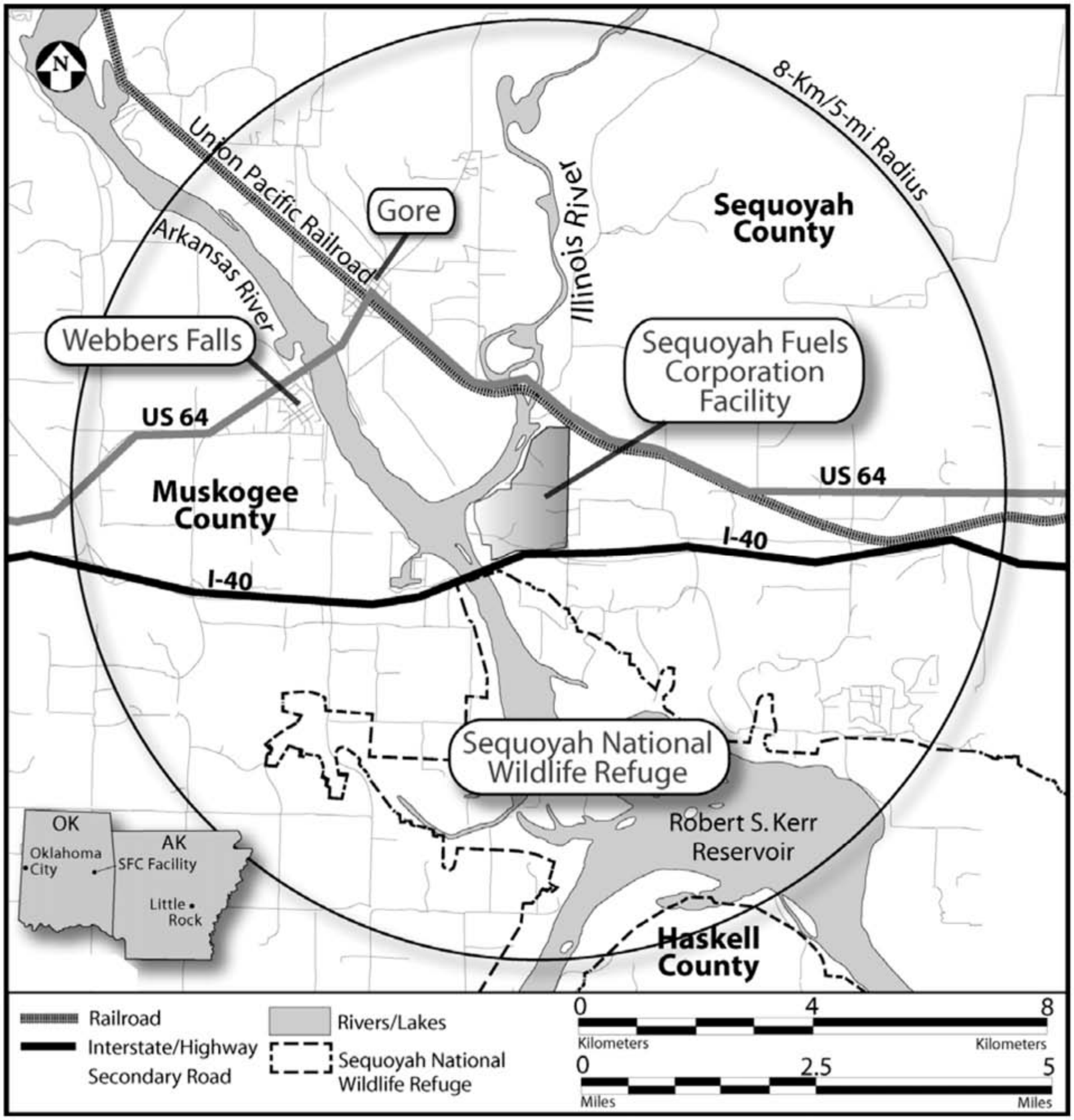


Figure 3.2-1 Land Uses Within an 8-kilometer (5-mile) Radius of the SFC Site

implement good programmatic control and ensure that the program is being operated in accordance with best agricultural practices (SFC, 2006a). The control plot encompasses about 37 hectares (91 acres), of which approximately 24 hectares (60 acres) were used for the application. The ammonium nitrate solution also was applied to an approximately 3-hectare (8-acre) field located immediately south of the control plot and an 8-hectare (20-acre) portion located immediately east of the control plot.

3.2.2 Regional Land Use

As shown below in Table 3.2-1, agricultural uses and recreational uses represent more than 60% of the land uses found within a 16-km (10-mile) radius of the SFC site. Prior to the construction of railroads in this region of Oklahoma, cattle range was a dominant land use. After the railroads were constructed, corn and cotton became the main agricultural products. In the last several decades, however, there has been a return to cattle grazing in the region and to the production of other food crops, mainly corn and soybeans. Areas currently in cultivation are primarily located in the bottomlands along the Arkansas River. High-quality forestland has been largely eliminated from the area due to heavy cutting, fires, and uncontrolled grazing (SFC, 2001). Recreation is represented largely by the federally owned land and water areas along the Arkansas and Illinois rivers, including the 8,948-hectare (21,000-acre) Sequoyah NWR.

Table 3.2-1 Land Use within a 16-Kilometer (10-Mile) Radius of the SFC Site

Land Use Category	Percent *
Agricultural (mostly pasture)	30
Recreation	35
Residential	20
Commercial and Industrial	15
Unused Rough Terrain	25

Source: SFC, 1998.
* Due to multiple usage of some areas, the total exceeds 100%

Residential, industrial, and commercial development constitutes about one-third of the land use within 16 km (10 miles) of the SFC site, including 7 schools, 11 churches, and 32 cemeteries. No hospitals or prisons are located within a 16-km (10-mile) radius of the site. Figure 3.2-2 shows all the public facilities within a 16-km (10-mile) radius of the site.

Sequoyah County encompasses 1,852 square km (715 square miles). A majority of the county is undeveloped and consists of rangeland, pasture, and forest. As of 1997, the most recent year for which statistics are available, Sequoyah County contained 3,201 hectares (7,909 acres) of publicly and privately owned land that fell under the jurisdiction of the Bureau of Indian Affairs (DOI, 1997; SFC, 2006b). Nearly 70,000 members of the more than 200,000-member Cherokee Nation reside in this 18,130-square-km (7,000-square-mile) jurisdictional service area, which includes all of eight counties and portions of six others in northeastern Oklahoma (see Figure 3.2-3).

Approximately 26,709 hectares (66,000 acres) of Cherokee Nation tribal trust land and 155 km (96 miles) of the Arkansas riverbed are tribal assets. As a federally recognized tribe, the

Figure 3.2-2 Public Facilities within a 16-kilometer (10-mile) Radius of the SFC Site

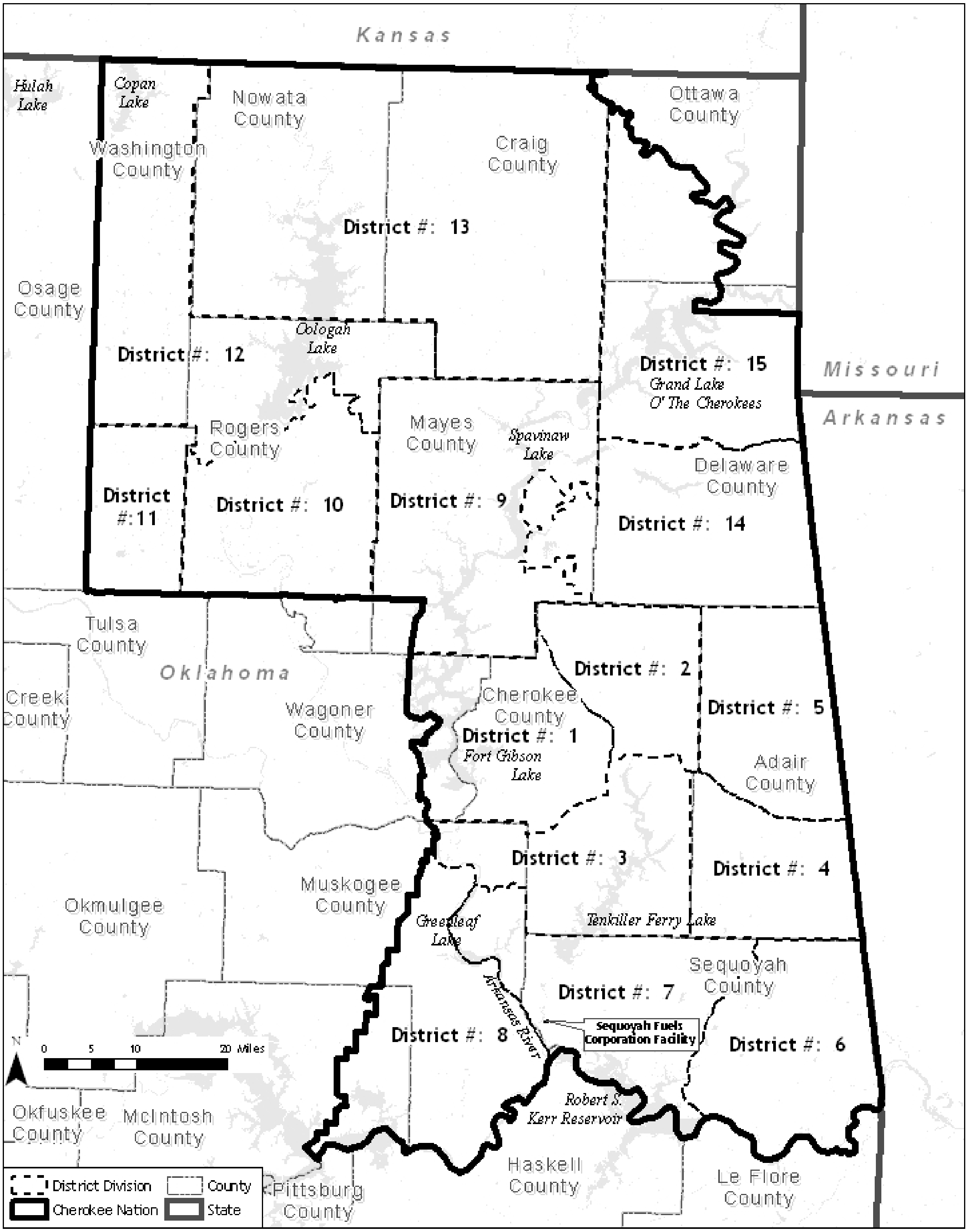


Figure 3.2-3 Cherokee Nation and Districts in Eastern Oklahoma

Cherokee Nation has both the opportunity and the sovereign right to exercise control and development over their tribal assets. All transactions with respect to tribal trust lands must be approved by the Cherokee Nation. Although the SFC site lies within the jurisdictional boundary that defines the Cherokee Nation, it is not located on tribal lands. However, the site is adjacent to the Cherokee Nation's tribal trust riverbed lands.

Haskell County's 1,590 square km (614 square miles) are primarily undeveloped pasture, rangelands, and forest. Muskogee County encompasses 2,178 square km (841 square miles), and a large percentage of the county consists of pasture, rangeland, and cropland. Table 3.2-2 summarizes the overall land uses in the three counties surrounding the SFC site.

Table 3.2-2 Land Use in Project Area Counties

Land Use	**Sequoyah** (%)*	**Haskell** (%)*	**Muskogee** (%)
Cropland	9	1	30
Range and Pasture	41	56	47
Forest	44	33	-
Urban	2	1	9
Water	5	8	4
Mined	-	3	< 1
Recreation	-	< 1	< 1
Other	-	< 1	< 1

Source: USDA, 1999a, 1999b, and 1999c.
* Due to multiple usage of some areas, the total exceeds 100%
\- Data unavailable

3.2.3 Recreational Resources Near the SFC Site

Five recreational facilities in the area are used by residents and visitors: Gore Landing, the Gore Summers Ferry Landing boat launch, the Webbers Falls boat launch, the Sequoyah National NWR, and the Cherokee Courthouse. Trout fishing and camping also are popular activities in the area.

Gore Landing is currently leased to and administered by the Town of Gore. The area includes 24 campsites and a boat launch. No fees are charged and there is no counter at the boat launch; thus, a precise count of visitors is unavailable, though it is estimated that approximately 15 boats are launched per day during the summer months. The average visit is 8 to 10 hours for boaters. The 24 campsites are full during some periods in the summer, and it is estimated that the average stay is three days for campers (SFC, 2001).

Gore Summers Ferry Landing boat launch on the Kerr-McClellan waterway does not charge fees for camping or boat launching and no specific count is taken. It is estimated that 20 to 25 boats are launched per day on the weekends during the summer and that there are approximately 15 campers per day. The average visit is 8 to 10 hours for boaters and three days for campers (SFC, 2001).

Webbers Falls boat launch does not charge fees and no specific count is taken. It is estimated that 25 to 30 boats are launched per day during the summer months. The average visit is 8 to 10 hours (SFC, 2001).

The entrance to the Sequoyah NWR is about 5 km (3 miles) south of Vian, Oklahoma, and about 21 kilometers (13 miles) from the SFC site. Access to the refuge also can be obtained from the waterway along the Robert S. Kerr Reservoir. The refuge is a day-use area, and no campsites are available. The average stay is 6 to 8 hours. Approximately 80,000 visitors annually enter the refuge through the main entrance (SFC, 2001).

The Cherokee Courthouse is a museum and historical site to the north of the SFC facility, along U.S. Route 64. It includes picnic tables and a gift shop. A guest book is maintained, but a precise count of visitors is not taken. During the summer months an estimated 50 to 100 people per day visit the museum. The average stay is typically 1 to 2 hours (SFC, 2001).

The 12.9-km (8-mile) stretch of the Lower Illinois River from Lake Tenkiller Dam to the Highway 64 bridge between Gore and Vian has become a destination for trout fishing and camping. Lake Tenkiller is about 11.2 km (7 miles) from the SFC site. In 1965, the Lower Illinois River was established as Oklahoma's first year-round designated trout stream. The SFC site is downstream of the designated portion of the stream. The trout stream is stocked weekly throughout the year in four locations by the Fisheries Division of the Oklahoma Department of Wildlife. Stocked species include rainbow trout and brown trout. Numerous camping facilities are located from Lake Tenkiller to the confluence of the Lower Illinois and Arkansas rivers. Two of these are state parks (Tenkiller and Cherokee Landing), and others are privately owned or managed by the USACE.

3.2.4 Taxes and Revenue

As a private entity, SFC pays annual property taxes to Sequoyah County. It is estimated that from 1995 to 2006, SFC paid between $123,950 and $205,286 annually to Sequoyah County in property taxes. However, portions of this annual amount were paid under protest and are being disputed with the overall valuation of the SFC property due to the fact that there were no longer operations at the facility. SFC estimated that, since the facility was not operating, the annual amount due to the county from 1995 to the present should have been $27,376.

In 2004, Sequoyah County collected approximately $1,078,483 in real property taxes (OCES, 2005). The estimated $27,376 that SFC states it is responsible for paying following stoppage of operations equates to approximately 2.5% of the total property tax revenue collected for Sequoyah County annually. These property tax revenues support county operations and the school system.

The economic benefits of trout fishing on the economy of the region surrounding the Lower Illinois River has been studied by Oklahoma State University (Prado, 2006). This study found that the Lower Illinois River trout fishery generates an estimated $2.1 million in revenue per year, assuming that the 18,391 single-purpose visitors to the region in 2006 were anglers.

3.3 Water Resources

3.3.1 Surface Water Features

The SFC facility is located on the east bank of the lower Illinois River. The river flows in a southwesterly direction for about 1.6 km (1 mile) along the SFC property boundary before joining the Arkansas River to form the headwaters of the Robert S. Kerr Reservoir. Flow into the Illinois River is regulated by releases from Lake Tenkiller, which is a reservoir located approximately 11.2 km (7 miles) upstream of the SFC site. The annual flow rate of the Illinois River near the SFC facility averages 45.3 cubic meters (1,600 cubic feet) per second (OWRB, 1995). The SFC Process Area is nearly 30.5 meters (100 feet) higher than the surface of the Robert S. Kerr Reservoir, with steep slopes separating the Process Area, the Robert S. Kerr Reservoir, and the floodplain area on the southwestern portion of the facility property (SFC, 2006a).

There are 11 surface water impoundments on the SFC property (DEQ, 2005). The raffinate sludge clarifier impoundments and recovered groundwater and storm water discharge to fertilizer pond 5. The fertilizer ponds are designed for total retention, evaporation, and land application. Pond 2 and the fluoride holding basins are out of service but still hold storm water. Storm water from all of these impoundments and all other surface water from the site is directed to Outfall 008 or Outfall 001 on the south side of the property. The Emergency Basin and North Ditch are primarily storm water runoff impoundments for the property, and are connected to Outfall 001 by a combination stream, which also collects storm water runoff from uncontaminated areas (see Figure 3.3-1).

The storm water reservoir, located outside of the Process Area, originally received runoff from non-process areas located on the southern and eastern portions of the property via Outfall 001, however, this discharge is now rerouted by the 001 pipeline to the Illinois River through Outfall 01F. In addition, eight man-made farm ponds are located within the SFC property but outside the Process Area; these ponds do not receive runoff or discharge water. The former Decorative Pond and Sanitary Lagoon have been filled and are no longer in use.

On July 1, 2005, SFC was issued an Oklahoma pollutant discharge elimination system (OPDES) permit (No. OK0000191) by the Oklahoma Department of Environmental Quality (DEQ) that authorizes discharge from Outfalls 01F, 008, and 001 (DEQ, 2005). This permit establishes monitoring requirements and effluent limitations for the internal Outfalls 008 and 001, as well as conditions for the operation of five total retention surface impoundments, 11 flow-through surface impoundments, and the land application of treated wastewater. SFC also has a multi-sector general permit OKR050549 that was issued on May 3, 2006.

In addition to the impoundments identified above, several small intermittent streams (001, 004, 005, 007, 008, 009, and the drainage associated with the storm water reservoir) had historically drained out from the Process Area toward the Illinois River. Storm water and groundwater have been collected and re-routed away from these streams to Outfalls 008 and 001 as part of the groundwater *Corrective Action Plan* (SFC, 2005b).

3.3.1.1 Surface Water Quality

The rugged nature of its watershed and the spring-fed streams that flow into the Illinois River are the sources of its relatively clear water. The Arkansas River has more suspended material than the Illinois River because it courses through agricultural areas in Colorado, Kansas, and Oklahoma. Surface water samples are collected annually from surrounding surface water locations, including The Salt Branch stream, a farm pond east of the site, and at upstream and

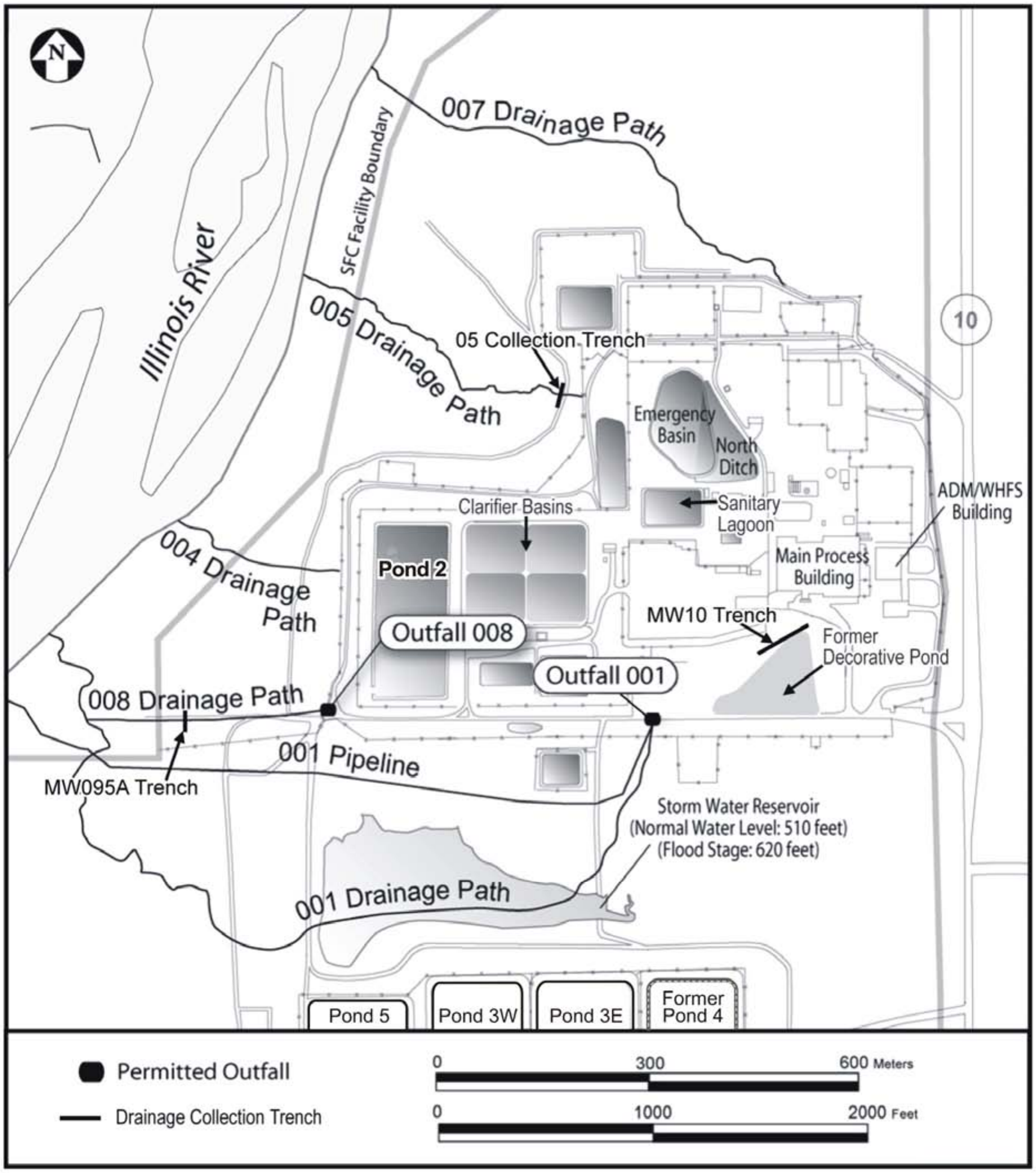


Figure 3.3-1 SFC Surface Water Impoundments and Drainage

downstream locations of the Illinois and Arkansas rivers. Other samples are collected more frequently at on-site locations such as the storm water reservoir and groundwater collection basins, seeps, and drainages, which have very low flow. To assess surface water that is leaving the site, storm water event samples are collected in accordance with the OPDES permit from Outfalls 008 and 001. Samples for the years 2000 to 2007 from all of these locations are summarized in Table 3.3-1. Flow rate and concentration data collected from the Arkansas and Illinois rivers are detailed in Table 3.3-2.

As shown in the table, the concentrations of uranium and radium-226 were generally higher upstream of the SFC site rather than downstream on both the Illinois and Arkansas rivers, while nitrate levels were about the same at upstream and downstream locations. Samples collected in 1991 and 1992 indicated elevated concentrations of uranium in the Illinois River, but these levels were less than the environmental action level for uranium (SFC, 1998). Elevated levels of uranium, however, have not been detected since 1993.

SFC operated from 2000 to 2006 without exceedances of OPDES discharge limits. However, in 2007, SFC recorded seven exceedances of nitrate discharge limits and two exceedances of ammonia discharge limits at Outfall 008. The first of these exceedances occurred on May 8, 2007, and was reported to the DEQ on June 11, 2007 (DEQ, 2007). SFC submitted a report to DEQ on June 14, 2007, identifying holes in the liner of Pond 2 as the cause for the exceedances (SFC, 2007a). Subsequent exceedances occurred in June, July, and September 2007. A Notice of Violation (NOV) was issued by DEQ to SFC on December 19, 2007, stating that SFC was in violation of the permit as a result of exceedances in Outfall 008 and that SFC had provided an insufficient plan to repair the impaired impoundment (DEQ, 2007). In a series of letters between July 2007 and January 2008, SFC and DEQ discussed the exceedances and need for remediation at Pond 2 to prevent future exceedances (SFC 2007a, SFC 2007b, DEQ 2007, SFC 2008a). As of February 2008, SFC is awaiting modification of their OPDES permit to go forward with remediation of Pond 2.

The contribution from the outfalls to the rivers would be minimal due to these exceedances because the quantity of water and flow rates in the rivers are very large when compared to the flow rates from the outfalls. The Illinois River averages a total flow of 1,427 billion liters (377 billion gallons) per year (OWRB, 1995), while the SFC site produced 2.1 billion liters (0.55 billion gallons) from permitted outfalls in 2007 (SFC, 2008b). Under the current uncontained conditions at the site, measurements of contaminant levels in the river have not exceeded drinking water standards.

3.3.1.2 Surface Water Uses

The Illinois River is an important water body for recreational fishing. Species sought include largemouth and smallmouth bass, rainbow and brown trout, crappies, catfish, striped bass, bream, and walleye. Game animals in nearby habitat include whitetail deer, quail, geese, duck, rabbit, and squirrel. Rural District No. 5 in Gore, Oklahoma, supplies most residents and the SFC facility with water from the lower Illinois River. The Sequoyah County Water Association, Gore Utility Authority, and the East Central Oklahoma Water Authority (Webbers Falls) all supply water to the area from Lake Tenkiller, which is located approximately 11 km (7 miles) upstream of the SFC site. The cities of Vian and Sallisaw have their own water systems. The

Table 3.3-1 Surface Water Sampling Summary, 2000-2007

Parameter	Illinois River – Upstream (Loc ID 2201) 29Jun2000 – 31Dec2007						Illinois River – Downstream (Loc ID 2202) 29Jun2000 – 31Dec2007					
	n	Min	Max	Median	Mean	Std Dev	n	Min	Max	Median	Mean	Std Dev
Uranium, µg/L	7	<1.0	8.64	1.0	2.14	2.87	7	<1.0	1.55	1.0	1.08	0.21
Radium-226, pCi/L	7	0	0.255	0.084	0.119	0.104	7	0	0.303	0.043	0.092	0.118
Radium-228, pCi/L	2	0	0.415	0.208	0.208	0.293	2	0	0	0	0	0
Thorium-230, pCi/L	1	0	0	0	0	N/A	1	0	0	0	0	N/A
Nitrate (as N), mg/L	4	<1.0	1.6	1.2	1.2	0.3	4	<1.0	1.4	1.1	1.2	0.2
Ammonia (as N), mg/l	–	–	–	–	–	–	–	–	–	–	–	–
Fluoride, mg/L	2	<0.2	<0.2	0.2	0.2	0	2	<0.2	0.3	0.3	0.3	0.1
TSS, mg/L	1	0.4	0.4	0.4	0.4	N/A	1	14	14	14	14	N/A
Antimony, mg/L	1	0.012	0.012	0.012	0.012	N/A	1	0.011	0.011	0.011	0.011	N/A
Arsenic, mg/L	4	0.005	0.010	0.010	0.009	0.002	4	<0.005	0.010	0.010	0.009	0.002
Barium, mg/L	1	0.046	0.046	0.046	0.046	N/A	1	0.075	0.075	0.075	0.075	N/A
Beryllium, mg/L	1	<0.001	<0.001	0.001	0.001	N/A	1	<0.001	<0.001	0.001	0.001	N/A
Cadmium, mg/L	1	<0.001	<0.001	0.001	0.001	N/A	1	<0.001	<0.001	0.001	0.001	N/A
Chromium, mg/L	1	0.005	0.005	0.005	0.005	N/A	1	0.006	0.006	0.006	0.006	N/A
Lead, mg/L	1	0.009	0.009	0.009	0.009	N/A	1	0.022	0.022	0.022	0.022	N/A
Molybdenum, mg/L	1	<0.005	<0.005	0.005	0.005	N/A	1	<0.005	<0.005	0.005	0.005	N/A
Nickel, mg/L	1	0.032	0.032	0.032	0.032	N/A	1	0.049	0.049	0.049	0.049	N/A
Selenium, mg/L	1	<0.005	<0.005	0.005	0.005	N/A	1	<0.005	<0.005	0.005	0.005	N/A
Thallium, mg/L	1	<0.002	<0.002	0.002	0.002	N/A	1	<0.002	<0.002	0.002	0.002	N/A
COD, mg/L	–	–	–	–	–	–	–	–	–	–	–	–
TOC, mg/L	–	–	–	–	–	–	–	–	–	–	–	–
TDS, mg/L	1	130	130	130	130	N/A	1	343	343	343	343	N/A
Sulfate, mg/L	1	20	20	20	20	N/A	1	78.7	78.7	78.7	78.7	N/A
Chloride, mg/L	1	9.5	9.5	9.5	9.5	N/A	1	100	100	100	100	N/A

Table 3.3-1 Surface Water Sampling Summary, 2000-2007

Parameter	Arkansas River – Upstream (Loc ID 2203) 29Jun2000 – 31Dec2007						Arkansas River – Downstream (Loc ID 2204) 29Jun2000 – 31Dec2007					
	n	Min	Max	Median	Mean	Std Dev	n	Min	Max	Median	Mean	Std Dev
Uranium, µg/L	7	<1.0	2.15	1.0	1.3	0.45	7	0.1	1.65	1.0	0.96	0.45
Radium-226, pCi/L	7	0.116	0.414	0.199	0.196	0.105	7	0	0.285	0.104	0.119	0.098
Radium-228, pCi/L	2	0	0.192	0.096	0.096	0.136	2	0.004	0.214	0.109	0.109	0.148
Thorium-230, pCi/L	1	0	0	0	0	N/A	1	0	0	0	0	N/A
Nitrate (as N), mg/L	4	<1.0	1.3	1.0	1.1	0.2	4	<1.0	1.3	1.0	1.1	0.2
Ammonia (as N), mg/L	–	–	–	–	–	–	–	–	–	–	–	–
Fluoride, mg/L	2	0.2	0.3	0.3	0.3	0.1	2	0.2	0.2	0.2	0.2	0
TSS, mg/L	1	7.6	7.6	7.6	7.6	N/A	1	9.6	9.6	9.6	9.6	N/A
Antimony, mg/L	1	0.010	0.010	0.010	0.010	N/A	1	0.011	0.011	0.011	0.011	N/A
Arsenic, mg/L	4	0.007	0.010	0.009	0.009	0.001	4	<0.009	0.010	0.010	0.010	0.001
Barium, mg/L	1	0.093	0.093	0.093	0.093	N/A	1	0.085	0.085	0.085	0.085	N/A
Beryllium, mg/L	1	<0.001	<0.001	0.001	0.001	N/A	1	<0.001	<0.001	0.001	0.001	N/A
Cadmium, mg/L	1	<0.001	<0.001	0.001	0.001	N/A	1	<0.001	<0.001	0.001	0.001	N/A
Chromium, mg/L	1	0.006	0.006	0.006	0.006	N/A	1	0.005	0.005	0.005	0.005	N/A
Lead, mg/L	1	0.007	0.007	0.007	0.007	N/A	1	0.005	0.005	0.005	0.005	N/A
Molybdenum, mg/L	1	<0.005	<0.005	0.005	0.005	N/A	1	<0.005	<0.005	0.005	0.005	N/A
Nickel, mg/L	1	0.006	0.006	0.006	0.006	N/A	1	0.031	0.031	0.031	0.031	N/A
Selenium, mg/L	1	<0.005	<0.005	0.005	0.005	N/A	1	<0.005	<0.005	0.005	0.005	N/A
Thallium, mg/L	1	<0.002	<0.002	0.002	0.002	N/A	1	<0.002	<0.002	0.002	0.002	N/A
COD, mg/L	–	–	–	–	–	–	–	–	–	–	–	–
TOC, mg/L	–	–	–	–	–	–	–	–	–	–	–	–
TDS, mg/L	1	376	376	376	376	N/A	1	369	369	369	369	N/A
Sulfate, mg/L	1	85.2	85.2	85.2	85.2	N/A	1	78.7	78.7	78.7	78.7	N/A
Chloride, mg/L	1	114	114	114	114	114	1	116	116	116	116	N/A

Table 3.3-1 Surface Water Sampling Summary, 2000-2007

Parameter	Farm Pond East of Hwy 10 (Loc ID 2205)						Salt Branch (Loc ID 2209)					
	28Jun2000 – 31Dec2007						28Jun2000 – 31Dec2007					
	n	Min	Max	Median	Mean	Std Dev	n	Min	Max	Median	Mean	Std Dev
Uranium, µg/L	8	<1.0	10.9	1.0	2.46	3.43	6	<1.0	<1.0	1.0	1.0	0
Radium-226, pCi/L	8	0	3.74	0.285	0.788	1.24	6	0	0.328	0.029	0.092	0.131
Radium-228, pCi/L	2	0	0	0	0	0	2	0	0.133	0.067	0.067	0.094
Thorium-230, pCi/L	1	0	0	0	0	N/A	1	0	0	0	0	N/A
Nitrate (as N), mg/L	1	<1.0	<1.0	1.0	1.0	N/A	1	<1.0	<1.0	1.0	1.0	N/A
Ammonia (as N), mg/L	–	–	–	–	–	–	–	–	–	–	–	–
Fluoride, mg/L	1	<1.0	<1.0	1.0	1.0	N/A	1	<0.2	<0.2	0.2	0.2	N/A
TSS, mg/L	–	–	–	–	–	–	–	–	–	–	–	–
Antimony, mg/L	1	0.039	0.039	0.039	0.039	N/A	1	<0.030	<0.030	0.030	0.030	N/A
Arsenic, mg/L	1	0.007	0.007	0.007	0.007	N/A	1	0.004	0.004	0.004	0.004	N/A
Barium, mg/L	1	0.053	0.053	0.053	0.053	N/A	1	0.028	0.028	0.028	0.028	N/A
Beryllium, mg/L	1	0.011	0.011	0.011	0.011	N/A	1	0.011	0.011	0.011	0.011	N/A
Cadmium, mg/L	1	<0.002	<0.002	0.002	0.002	N/A	1	<0.002	<0.002	0.002	0.002	N/A
Chromium, mg/L	1	0.003	0.003	0.003	0.003	N/A	1	0.002	0.002	0.002	0.002	N/A
Lead, mg/L	1	0.006	0.006	0.006	0.006	N/A	1	0.006	0.006	0.006	0.006	N/A
Molybdenum, mg/L	1	0.011	0.011	0.011	0.011	N/A	1	0.008	0.008	0.008	0.008	N/A
Nickel, mg/L	1	0.017	0.017	0.017	0.017	N/A	1	0.012	0.012	0.012	0.012	N/A
Selenium, mg/L	1	<0.005	<0.005	0.005	0.005	N/A	1	<0.005	<0.005	0.005	0.005	N/A
Thallium, mg/L	1	<0.013	<0.013	0.013	0.013	N/A	1	<0.013	<0.013	0.013	0.013	N/A
COD, mg/L	–	–	–	–	–	–	–	–	–	–	–	–
TOC, mg/L	–	–	–	–	–	–	–	–	–	–	–	–
TDS, mg/L	–	–	–	–	–	–	–	–	–	–	–	–
Sulfate, mg/L	–	–	–	–	–	–	–	–	–	–	–	–
Chloride, mg/L	–	–	–	–	–	–	–	–	–	–	–	–

Table 3.3-1 Surface Water Sampling Summary, 2000-2007

Parameter	OPDES Outfall 001 (Combination Stream discharge) (Loc ID 2207)						OPDES Permitted Outfall 008 (Loc ID 2216)					
	03Jan2000 – 31Dec2007						03Jan2000 – 31Dec2007					
	n	Min	Max	Median	Mean	Std Dev	n	Min	Max	Median	Mean	Std Dev
Uranium, µg/L	1471	0.21	255	15.8	24.7	27.8	213	<1.0	180	17.9	25.5	27.4
Radium-226, pCi/L	463	0	1.79	0.062	0.135	0.239	170	0	3.00	0.146	0.231	0.349
Radium-228, pCi/L	–	–	–	–	–	–	–	–	–	–	–	–
Thorium-230, pCi/L	167	0	1.73	0.352	0.371	0.383	26	0	4.4	0.445	0.777	1
Nitrate (as N), mg/L	1187	0.1	8.6	0.6	0.8	0.6	224	<0.2	107	3.3	7.0	11.7
Ammonia (as N), mg/L	340	0	2.2	0.2	0.2	0.2	170	<0.2	23.3	0.2	0.6	2.2
Fluoride, mg/L	1183	0.1	2.0	0.2	0.2	0.1	223	<0.2	1.9	0.3	0.4	0.2
TSS, mg/L	1057	0	58.4	1.6	2.3	3.4	221	0.4	34.0	6.8	8.1	6.1
Antimony, mg/L	–	–	–	–	–	–	2	0	0.007	0.004	0.004	0.005
Arsenic, mg/L	–	–	–	–	–	–	2	<0.005	0.007	0.006	0.006	0.001
Barium, mg/L	–	–	–	–	–	–	1	0.040	0.040	0.040	0.040	N/A
Beryllium, mg/L	–	–	–	–	–	–	1	0.004	0.004	0.004	0.004	N/A
Cadmium, mg/L	–	–	–	–	–	–	2	<0.001	0.001	0.001	0.001	0
Chromium, mg/L	–	–	–	–	–	–	2	<0.007	0.010	0.009	0.009	0.002
Lead, mg/L	–	–	–	–	–	–	2	<0.005	0.005	0.005	0.005	0
Molybdenum, mg/L	–	–	–	–	–	–	2	<0.007	0.009	0.008	0.008	0.001
Nickel, mg/L	–	–	–	–	–	–	2	<0.005	0.014	0.010	0.010	0.006
Selenium, mg/L	–	–	–	–	–	–	27	<0.005	0.045	0.009	0.011	0.008
Thallium, mg/L	–	–	–	–	–	–	1	<0.010	<0.010	0.010	0.010	N/A
COD, mg/L	–	–	–	–	–	–	24	5	67.4	26.6	26.2	15.1
TOC, mg/L	–	–	–	–	–	–	1	9.4	9.4	9.4	9.4	N/A
TDS, mg/L	–	–	–	–	–	–	–	–	–	–	–	–
Sulfate, mg/L	–	–	–	–	–	–	–	–	–	–	–	–
Chloride, mg/L	–	–	–	–	–	–	–	–	–	–	–	–

Table 3.3-1 Surface Water Sampling Summary, 2000-2007

Parameter	Illinois River, Downstream OPDES Outfall 01F (Loc ID 2238)						005 Drainage at COE Property Line (Loc ID 2241)					
	25Jan2000 – 31Dec2007						06Mar2000 – 31Dec2007					
	n	**Min**	**Max**	**Median**	**Mean**	**Std Dev**	**n**	**Min**	**Max**	**Median**	**Mean**	**Std Dev**
Uranium, µg/L	4	<1	3.14	1.0	1.54	1.07	35	19.2	1490	67.9	146.0	300
Radium-226, pCi/L	4	0	0.186	0.027	0.060	0.088	1	0.132	0.132	0.132	0.132	N/A
Radium-228, pCi/L	1	0.315	0.315	0.315	0.315	N/A	–	–	–	–	–	–
Thorium-230, pCi/L	2	0	0.875	0.438	0.438	0.619	1	1.83	1.83	1.83	1.83	N/A
Nitrate (as N), mg/L	3	<1	1.4	1.0	1.1	0.2	35	<1.0	42.3	5.8	8.4	9.4
Ammonia (as N), mg/L	–	–	–	–	–	–	–	–	–	–	–	–
Fluoride, mg/L	1	<0.2	<0.2	0.2	0.2	N/A	1	0.3	0.3	0.3	0.3	N/A
TSS, mg/L	–	–	–	–	–	–	–	–	–	–	–	–
Antimony, mg/L	1	0.015	0.015	0.015	0.015	N/A	9	<0.002	0.013	0.009	0.008	0.004
Arsenic, mg/L	3	<0.009	0.010	0.009	0.009	0.001	35	<0.004	0.019	0.007	0.008	0.004
Barium, mg/L	1	0.078	0.078	0.078	0.078	N/A	1	0.060	0.060	0.060	0.060	N/A
Beryllium, mg/L	1	<0.001	<0.001	0.001	0.001	N/A	1	<0.001	<0.001	0.001	0.001	N/A
Cadmium, mg/L	1	<0.001	<0.001	0.001	0.001	N/A	1	0.001	0.001	0.001	0.001	N/A
Chromium, mg/L	1	0.007	0.007	0.007	0.007	N/A	1	0.006	0.006	0.006	0.006	N/A
Lead, mg/L	1	0.019	0.019	0.019	0.019	N/A	9	<0.005	0.017	0.007	0.008	0.004
Molybdenum, mg/L	1	<0.005	<0.005	0.005	0.005	N/A	1	0.006	0.006	0.006	0.006	N/A
Nickel, mg/L	1	0.009	0.009	0.009	0.009	N/A	1	0.015	0.015	0.015	0.015	N/A
Selenium, mg/L	1	<0.005	<0.005	0.005	0.005	N/A	1	<0.005	<0.005	0.005	0.005	N/A
Thallium, mg/L	1	<0.002	<0.002	0.002	0.002	N/A	9	<0.002	0.012	0.004	0.005	0.003
COD, mg/L	–	–	–	–	–	–	–	–	–	–	–	–
TOC, mg/L	–	–	–	–	–	–	–	–	–	–	–	–
TDS, mg/L	–	–	–	–	–	–	–	–	–	–	–	–
Sulfate, mg/L	–	–	–	–	–	–	–	–	–	–	–	–
Chloride, mg/L	–	–	–	–	–	–	–	–	–	–	–	–

Table 3.3-1 Surface Water Sampling Summary, 2000-2007

Parameter	005 Drainage at MW100B (Loc ID 2242) 06Mar2002 – 31Dec2007						007 Drainage N. F_2 Holding Basin (Loc ID 2243) 06Mar2002 – 31Dec2007					
	n	Min	Max	Median	Mean	Std Dev	n	Min	Max	Median	Mean	Std Dev
Uranium, µg/L	51	16.3	814	65.8	145	203	40	<1.0	16.9	4.0	4.9	3.6
Radium-226, pCi/L	1	0.214	0.214	0.214	0.214	N/A	1	0.073	0.073	0.073	0.073	N/A
Radium-228, pCi/L	–	–	–	–	–	–	–	–	–	–	–	–
Thorium-230, pCi/L	1	0	0	0	0	N/A	1	0.356	0.356	0.356	0.356	N/A
Nitrate (as N), mg/L	51	<1.0	262	5.4	15.7	38.5	40	<1.0	8.5	1.0	1.5	1.3
Ammonia (as N), mg/L	–	–	–	–	–	–	–	–	–	–	–	–
Fluoride, mg/L	2	0	0.3	0.2	0.2	0.2	1	<0.2	<0.2	0.2	0.2	N/A
TSS, mg/L	–	–	–	–	–	–	–	–	–	–	–	–
Antimony, mg/L	10	<0.002	0.015	0.009	0.008	0.004	9	<0.005	0.011	0.008	0.008	0.004
Arsenic, mg/L	51	<0.004	0.052	0.007	0.009	0.008	40	<0.004	0.017	0.005	0.007	0.003
Barium, mg/L	1	0.08	0.08	0.08	0.08	N/A	1	0.038	0.038	0.038	0.038	N/A
Beryllium, mg/L	1	<0.001	<0.001	0.001	0.001	N/A	1	0.001	0.001	0.001	0.001	N/A
Cadmium, mg/L	1	<0.001	<0.001	0.001	0.001	N/A	1	0.003	0.003	0.003	0.003	N/A
Chromium, mg/L	1	0.003	0.003	0.003	0.003	N/A	1	0.006	0.006	0.006	0.006	N/A
Lead, mg/L	10	<0.004	0.011	0.006	0.007	0.003	9	<0.005	0.027	0.007	0.010	0.007
Molybdenum, mg/L	1	0.002	0.002	0.002	0.002	N/A	1	0.004	0.004	0.004	0.004	N/A
Nickel, mg/L	1	0.019	0.019	0.019	0.019	N/A	1	0.017	0.017	0.017	0.017	N/A
Selenium, mg/L	1	<0.005	<0.005	0.005	0.005	N/A	1	<0.005	<0.005	0.005	0.005	N/A
Thallium, mg/L	10	<0.002	0.011	0.005	0.005	0.003	9	<0.002	0.009	0.006	0.005	0.002
COD, mg/L	–	–	–	–	–	–	–	–	–	–	–	–
TOC, mg/L	–	–	–	–	–	–	–	–	–	–	–	–
TDS, mg/L	–	–	–	–	–	–	–	–	–	–	–	–
Sulfate, mg/L	–	–	–	–	–	–	–	–	–	–	–	–
Chloride, mg/L	–	–	–	–	–	–	–	–	–	–	–	–

Table 3.3-1 Surface Water Sampling Summary, 2000-2007

Parameter	004 Drainage East of COE Property (Loc ID 2244) 06Mar2002 – 31Dec2007						Seep North of Port Road Bridge (Loc ID 2245) 06Mar2002 – 31Dec2007					
	n	Min	Max	Median	Mean	Std Dev	n	Min	Max	Median	Mean	Std Dev
Uranium, µg/L	44	<1.0	15.6	2.7	3.8	3.5	40	<1.0	8.06	1.0	1.85	1.59
Radium-226, pCi/L	1	0.022	0.022	0.022	0.022	N/A	1	0.080	0.080	0.080	0.080	N/A
Radium-228, pCi/L	–	–	–	–	–	–	–	–	–	–	–	–
Thorium-230, pCi/L	1	0.662	0.662	0.662	0.662	N/A	1	0	0	0	0	N/A
Nitrate (as N), mg/L	45	<1.0	104	26.2	29.4	25.4	40	<1.0	990	106	238	249
Ammonia (as N), mg/L	–	–	–	–	–	–	–	–	–	–	–	–
Fluoride, mg/L	1	0.3	0.3	0.3	0.3	N/A	7	<0.2	0.5	0.2	0.3	0.1
TSS, mg/L	–	–	–	–	–	–	–	–	–	–	–	–
Antimony, mg/L	9	<0.002	0.053	0.007	0.012	0.016	7	<0.002	0.011	0.005	0.006	0.003
Arsenic, mg/L	45	<0.004	0.082	0.008	0.012	0.013	40	<0.004	0.074	0.010	0.020	0.020
Barium, mg/L	1	0.080	0.080	0.080	0.080	N/A	1	0.072	0.072	0.072	0.072	N/A
Beryllium, mg/L	1	0.001	0.001	0.001	0.001	N/A	1	0.001	0.001	0.001	0.001	N/A
Cadmium, mg/L	1	<0.001	<0.001	0.001	0.001	N/A	1	0.001	0.001	0.001	0.001	N/A
Chromium, mg/L	1	0.006	0.006	0.006	0.006	N/A	1	0.004	0.004	0.004	0.004	N/A
Lead, mg/L	9	<0.004	0.010	0.007	0.007	0.002	7	<0.004	0.026	0.007	0.010	0.008
Molybdenum, mg/L	1	<0.002	<0.002	0.002	0.002	N/A	1	0.004	0.004	0.004	0.004	N/A
Nickel, mg/L	1	0.008	0.008	0.008	0.008	N/A	1	0.026	0.026	0.026	0.026	N/A
Selenium, mg/L	1	<0.005	<0.005	0.005	0.005	N/A	1	0.008	0.008	0.008	0.008	N/A
Thallium, mg/L	9	<0.002	0.007	0.005	0.005	0.002	7	<0.002	0.007	0.004	0.004	0.002
COD, mg/L	–	–	–	–	–	–	–	–	–	–	–	–
TOC, mg/L	–	–	–	–	–	–	–	–	–	–	–	–
TDS, mg/L	–	–	–	–	–	–	–	–	–	–	–	–
Sulfate, mg/L	–	–	–	–	–	–	–	–	–	–	–	–
Chloride, mg/L	–	–	–	–	–	–	–	–	–	–	–	–

Table 3.3-1 Surface Water Sampling Summary, 2000-2007

Parameter	005 Drainage at MW100B (Loc ID 2242) 06Mar2002 – 31Dec2007						007 Drainage N. F_2 Holding Basin (Loc ID 2243) 06Mar2002 – 31Dec2007					
	n	Min	Max	Median	Mean	Std Dev	n	Min	Max	Median	Mean	Std Dev
Uranium, µg/L	51	16.3	814	65.8	145	203	40	<1.0	16.9	4.0	4.9	3.6
Radium-226, pCi/L	1	0.214	0.214	0.214	0.214	N/A	1	0.073	0.073	0.073	0.073	N/A
Radium-228, pCi/L	–	–	–	–	–	–	–	–	–	–	–	–
Thorium-230, pCi/L	1	0	0	0	0	N/A	1	0.356	0.356	0.356	0.356	N/A
Nitrate (as N), mg/L	51	<1.0	262	5.4	15.7	38.5	40	<1.0	8.5	1.0	1.5	1.3
Ammonia (as N), mg/L	–	–	–	–	–	–	–	–	–	–	–	–
Fluoride, mg/L	2	0	0.3	0.2	0.2	0.2	1	<0.2	<0.2	0.2	0.2	N/A
TSS, mg/L	–	–	–	–	–	–	–	–	–	–	–	–
Antimony, mg/L	10	<0.002	0.015	0.009	0.008	0.004	9	<0.005	0.011	0.008	0.008	0.004
Arsenic, mg/L	51	<0.004	0.052	0.007	0.009	0.008	40	<0.004	0.017	0.005	0.007	0.003
Barium, mg/L	1	0.08	0.08	0.08	0.08	N/A	1	0.038	0.038	0.038	0.038	N/A
Beryllium, mg/L	1	<0.001	<0.001	0.001	0.001	N/A	1	0.001	0.001	0.001	0.001	N/A
Cadmium, mg/L	1	<0.001	<0.001	0.001	0.001	N/A	1	0.003	0.003	0.003	0.003	N/A
Chromium, mg/L	1	0.003	0.003	0.003	0.003	N/A	1	0.006	0.006	0.006	0.006	N/A
Lead, mg/L	10	<0.004	0.011	0.006	0.007	0.003	9	<0.005	0.027	0.007	0.010	0.007
Molybdenum, mg/L	1	0.002	0.002	0.002	0.002	N/A	1	0.004	0.004	0.004	0.004	N/A
Nickel, mg/L	1	0.019	0.019	0.019	0.019	N/A	1	0.017	0.017	0.017	0.017	N/A
Selenium, mg/L	1	<0.005	<0.005	0.005	0.005	N/A	1	<0.005	<0.005	0.005	0.005	N/A
Thallium, mg/L	10	<0.002	0.011	0.005	0.005	0.003	9	<0.002	0.009	0.006	0.005	0.002
COD, mg/L	–	–	–	–	–	–	–	–	–	–	–	–
TOC, mg/L	–	–	–	–	–	–	–	–	–	–	–	–
TDS, mg/L	–	–	–	–	–	–	–	–	–	–	–	–
Sulfate, mg/L	–	–	–	–	–	–	–	–	–	–	–	–
Chloride, mg/L	–	–	–	–	–	–	–	–	–	–	–	–

Table 3.3-1 Surface Water Sampling Summary, 2000-2007

Parameter	001 Drainage North of Port Road Bridge (Loc ID 2246) 06Mar2002 – 31Dec2007						Storm Water Reservoir (Loc ID 2236) 24Jan2000 – 31Dec2007					
	n	Min	Max	Median	Mean	Std Dev	n	Min	Max	Median	Mean	Std Dev
Uranium, µg/L	50	<1.0	229	25.4	32.4	41.4	11	<1	10.0	1.4	2.85	2.81
Radium-226, pCi/L	1	0.117	0.117	0.117	0.117	N/A	3	0	0.148	0.039	0.062	0.077
Radium-228, pCi/L	–	–	–	–	–	–	–	–	–	–	–	–
Thorium-230, pCi/L	1	0	0	0	0	N/A	1	0	0	0	0	N/A
Nitrate (as N), mg/L	50	<1.0	484	6.9	27.8	80.5	10	<1.0	3.7	1.0	1.3	0.8
Ammonia (as N), mg/L	–	–	–	–	–	–	–	–	–	–	–	–
Fluoride, mg/L	5	<0.2	0.5	0.2	0.3	0.1	1	0.4	0.4	0.4	0.4	N/A
TSS, mg/L	–	–	–	–	–	–	–	–	–	–	–	–
Antimony, mg/L	12	<0.003	0.011	0.007	0.007	0.003	1	<0.030	<0.030	0.030	0.030	N/A
Arsenic, mg/L	50	<0.004	0.194	0.006	0.012	0.027	1	0.005	0.005	0.005	0.005	N/A
Barium, mg/L	1	0.026	0.026	0.026	0.026	N/A	1	0.008	0.008	0.008	0.008	N/A
Beryllium, mg/L	1	<0.001	<0.001	0.001	0.001	N/A	1	0.011	0.011	0.011	0.011	N/A
Cadmium, mg/L	1	<0.001	<0.001	0.001	0.001	N/A	1	<0.002	<0.002	0.002	0.002	N/A
Chromium, mg/L	1	0.004	0.004	0.004	0.004	N/A	1	0.003	0.003	0.003	0.003	N/A
Lead, mg/L	12	<0.004	0.017	0.007	0.008	0.004	1	<0.004	<0.004	0.004	0.004	N/A
Molybdenum, mg/L	1	<0.002	<0.002	0.002	0.002	N/A	1	<0.002	<0.002	0.002	0.002	N/A
Nickel, mg/L	1	0.007	0.007	0.007	0.007	N/A	1	0.005	0.005	0.005	0.005	N/A
Selenium, mg/L	1	<0.005	<0.005	0.005	0.005	N/A	1	<0.005	<0.005	0.005	0.005	N/A
Thallium, mg/L	12	<0.002	0.013	0.005	0.005	0.003	1	<0.013	<0.013	0.013	0.013	N/A
COD, mg/L	–	–	–	–	–	–	–	–	–	–	–	–
TOC, mg/L	–	–	–	–	–	–	–	–	–	–	–	–
TDS, mg/L	–	–	–	–	–	–	–	–	–	–	–	–
Sulfate, mg/L	–	–	–	–	–	–	–	–	–	–	–	–
Chloride, mg/L	–	–	–	–	–	–	–	–	–	–	–	–

Source: SFC 2008b

Table 3.3-2 Sampling Data from Arkansas and Illinois Rivers, 2000-2007

Uranium levels (µg/L) in the Arkansas and Illinois Rivers, 2000-2007						
	Arkansas River			Illinois River		
Date	Flow rate (cfs)[1]	Upstream	Downstream	Flow rate (cfs)[2]	Upstream	Downstream
6/29/2000	no data	< 1.00	< 1.00	12900	1.36	< 1.00
7/30/2002	no data	1.30	< 1.00	372	1.00	< 1.00
7/30/2003	5770	2.15	< 1.00	747	1.00	< 1.00
6/25/2004	16600	< 1.00	0.10	1320	1.00	< 1.00
6/29/2005	76900	< 1.00	< 1.00	925	1.00	< 1.00
6/14/2006	6700	< 1.00	< 1.00	278	8.64	< 1.00
9/27/2007	9510	1.65	1.65	77	<1.00	1.55
Radium-226 levels (pCi/L) in the Arkansas and Illinois Rivers, 2000-2007						
	Arkansas River			Illinois River		
Date	Flow rate (cfs)[1]	Upstream	Downstream	Flow rate (cfs)[2]	Upstream	Downstream
6/29/2000	no data	0.203	-0.001[3]	12900	0.252	-0.001[3]
7/30/2002	no data	0.119	0.069	372	0.255	-0.001[3]
7/30/2003	5770	0.117	0.104	747	0.084	0.081
6/25/2004	16600	0.116	0.042	1320	0.076	0.208
6/29/2005	76900	0.199	0.285	925	0.150	0.014
6/14/2006	6700	0.203	0.135	278	0.000	0.303
9/27/2007	9510	0.414	0.202	77	0.015	0.043
Nitrate levels (mg/L) in the Arkansas and Illinois Rivers, 2000-2007						
	Arkansas River			Illinois River		
Date	Flow rate (cfs)[1]	Upstream	Downstream	Flow rate (cfs)[2]	Upstream	Downstream
7/30/2002	no data	<1.00	<1.00	372	1.30	<1.00
6/25/2004	16600	1.30	1.30	1320	1.60	1.40
6/14/2006	6700	<1.00	<1.00	278	<1.00	<1.00
9/27/2007	9510	<1.00	<1.00	77	1.00	1.20

Source: SFC 2008c

1 Arkansas River Flow–USGS Gauging Station 07194500 (Arkansas River near Muskogee, OK) Data obtained from USGS website: http://waterdata.usgs.gov/ok/nwis/current/?type=flow&group_key=county_cd

2 Illinois River Flow – USGS Gauging Station 07198000 (Illinois River near Gore, OK) Data obtained from USGS website: http://waterdata.usgs.gov/ok/nwis/current/?type=flow&group_key=county_cd

3 Negative value denotes below background levels.

Robert S. Kerr Reservoir, downstream of the site, is not used as a public water supply (SFC, 2006b). Two permitted stream water diversions in the area are indicated on Figure 3.3-2.

3.3.1.3 Floodplains

Floodplains are described as areas near streams or rivers that are likely to be inundated with water during times of elevated water levels. The SFC facility has not been affected by flooding of the Illinois River or the Arkansas River. The highest recorded water level—145.9 meters (479 feet) above mean sea level (amsl)—occurred in 1943. The Federal Emergency Management

Agency (FEMA) Flood Insurance Rate Map indicates that a 100-year flood would elevate water levels near the SFC site to 155.4 meters (510 feet) amsl (FEMA, 1991a; FEMA, 1991b). The elevation of the SFC facility is about 173.7 meters (570 feet) amsl, well above the reservoir's lock and dam at 147.4 meters (483.5 feet) amsl. Therefore, a catastrophic flooding event at the site is unlikely (RSA, 1997a; 1997b). Figure 3.3-2 illustrates the additive expansion of flood levels from a breach of the Webber Fall's dam, to the 100-year flood level, to a breach of the Lake Tenkiller dam.

3.3.2 Groundwater

3.3.2.1 Regional Groundwater

> An aquifer is a geologic formation, series of formations, or part of a formation capable of yielding a significant amount of groundwater to wells or springs.
> (10 CFR Part 40, Appendix A)

Groundwater in the region flows westward toward the Arkansas and Illinois Rivers, which are potential discharge locations for shallow groundwater (SFC, 1996). Regional groundwater can be found primarily in the unconsolidated deposits of sand, silt, clay, and gravel that occur along or adjacent to the Arkansas, Illinois, and Canadian Rivers. The only major bedrock aquifer (found in the Keokuk and Reed Springs formations) is located approximately 16 km (10 miles) northeast and upgradient of the SFC site. This aquifer produces between 11 and 190 liters per minute (lpm) [3 to 50 gallons per minute (gpm)] of good-quality water (SFC, 1996).

The only significant freshwater aquifer in the immediate area of the SFC facility is in the alluvial deposits along the Arkansas and Illinois rivers. The lower part of the alluvium consists of a maximum of 4.9 meters (15 feet) of coarse sand and gravel capable of producing up to 3,402 lpm (900 gpm), and the water quality of the alluvium aquifer is hard to very hard (180 mg/L calcium carbonate), suitable for irrigation and stock watering (SFC, 1996).

> "Permeability" is the capacity of a porous rock, sediment, or soil for transmitting a fluid (e.g., water). (Bates and Jackson, 1984).

The alternating sandstones and shales of the Atoka Formation that underlie the SFC site have low permeabilities, which yield only a few gallons per minute of fair- to poor-quality water (SMI, 2001). Groundwater in the vicinity of the site also can discharge to springs or recharge other deeper rock layers. For example, shallow groundwater discharges to the Salt Branch to the north of the SFC site and a tributary of the Salt Branch to the east of the site (SFC, 2003). The Carlile School Fault lies to the east of the SFC facility (see Figure 3.3-3). Any groundwater that encounters the fault is expected to flow down-drainage, away from the facility.

Flow across the fault is not anticipated due to the discontinuity of rock strata across the fault and a near-vertical dip of rock layers adjacent to the fault (SMI, 2001).

Groundwater Usage

In 1991, SFC and the Oklahoma State Department of Health (OSDH) initiated a survey to identify any water wells within a 3-km (2-mile) radius of the SFC site (SFC, 1991). The locations of the wells that were identified are indicated on Figure 3.3-4, and Table 3.3-3

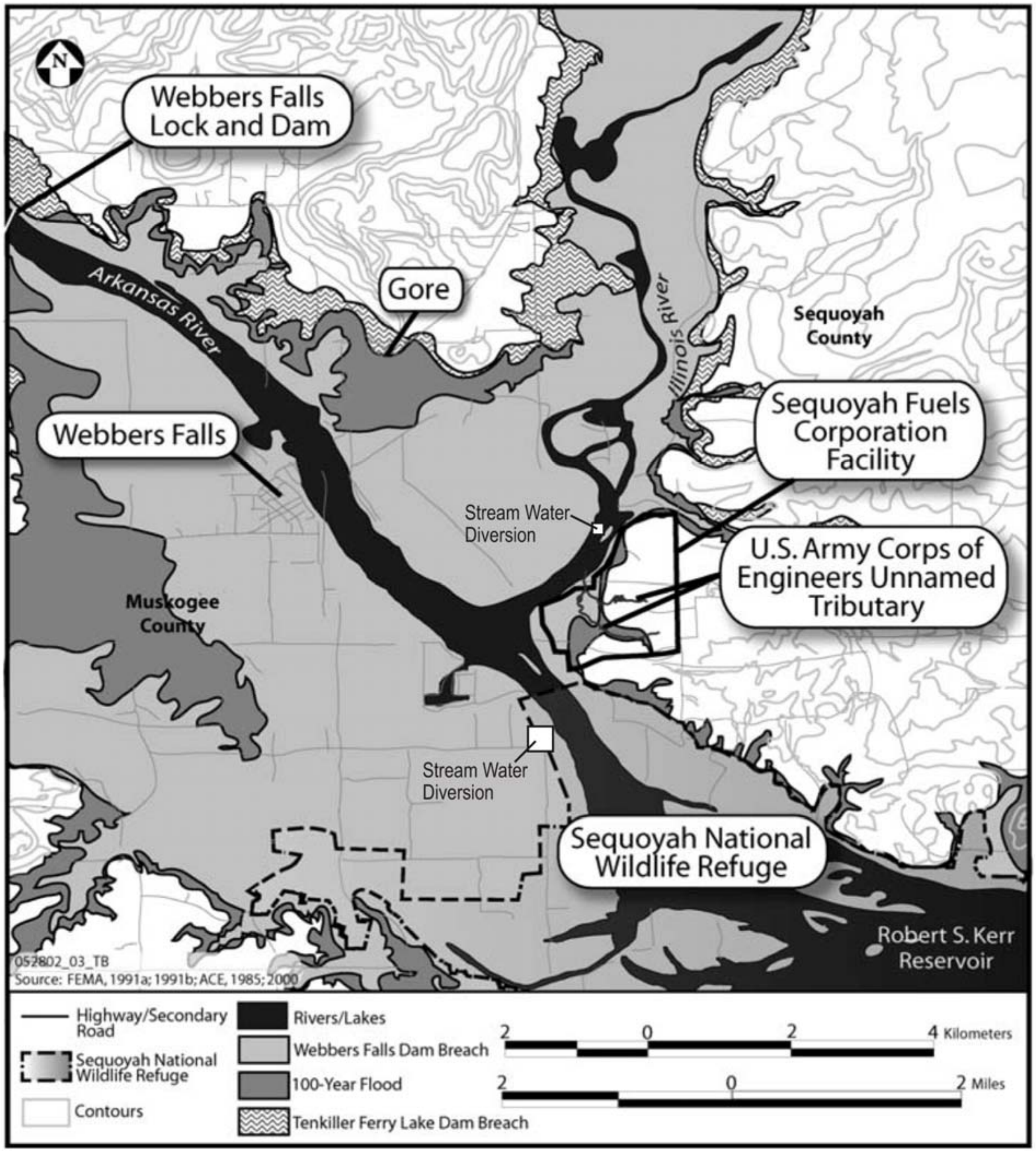
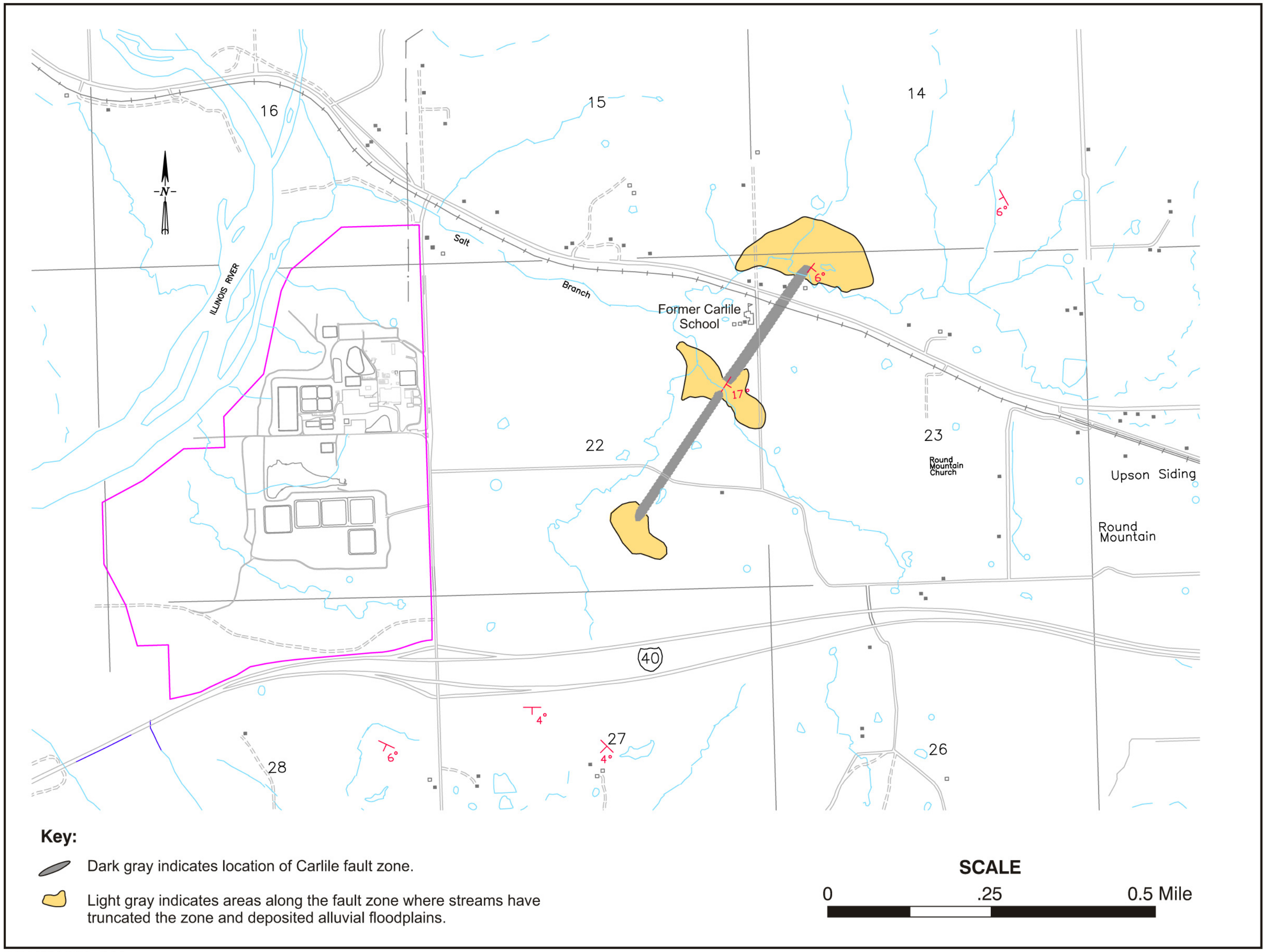


Figure 3.3-2 SFC Floodplains and 100-Year Flood



SOURCE: SFC 1998

Figure 3.3-3 Location of Carlile School Fault Relative to the SFC Site

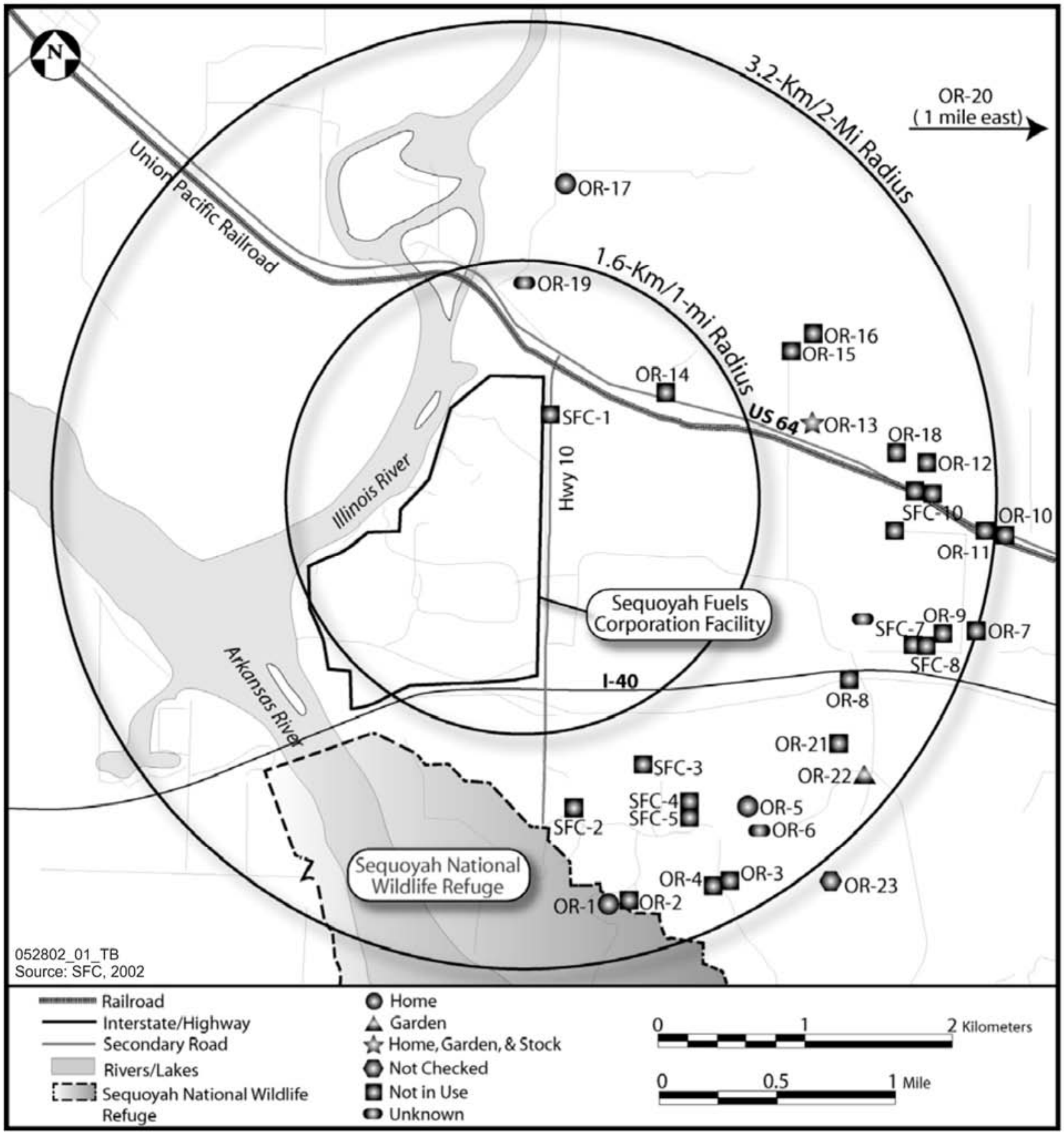


Figure 3.3-4 Groundwater Wells within 3 Kilometers (2 Miles) of the SFC Site (identified during 1991 survey by SFC and OSDH)

Table 3.3-3 Groundwater Usage Based on 1991 Survey of Wells within 3 Kilometers (2 Miles) of the SFC Site

Location	Use	Number of Wells
On-site *	Irrigation (lawn watering)	1
On-site *	Not in use	9
Off-site	Domestic/Livestock	10
Off-site	Not in use	7
Off-site	Unknown	1

Source: SFC, 1991.
* On the SFC site or on nearby property owned by Sequoyah Fuels International Corporation

summarizes the uses of the wells. Based on the 1991 survey, no groundwater users were identified in the hydraulically down-gradient area between the SFC site and the Arkansas and Illinois rivers (SFC, 1991).

In September 1990 and in May 1991, the OSDH and SFC sampled a total of 23 off-site groundwater supply wells in the site vicinity. The analytical results indicated that none of the wells exceeded drinking water standards for gross alpha, gross beta, or radium-226. In addition, uranium was not detected and fluoride concentrations were at or near background levels and did not exceed EPA drinking water limits. Nitrate concentrations were elevated in samples from several wells, but these results were likely due to landowner septic tanks and/or barnyard animals. These sampling results indicated that site operations had not impacted off-site groundwater users (SFC, 1991).

In April 2001, SFC performed a follow-up check that indicated that four wells within the 3-km (2-mile) radius of the facility were being used for home, stock, and/or garden use (SFC, 2002). No off-site groundwater users were located downgradient of the site (i.e., west and south of the site). Within 3 km (2 mile) downstream of the site, the Oklahoma Water Resources Board identified two stream water diversions, both used for irrigation purposes (SFC, 2005a).

3.3.2.2 Local Groundwater

In the alternating sandstones and shales of the Atoka Formation beneath the site, SFC has identified and characterized three groundwater systems that underlie most of the facility process and industrial areas. These systems are (from the ground surface down): the terrace, the shallow bedrock, and the deep bedrock systems (see Figures 3.3-5 and 3.3-6). In addition to these three systems, an alluvial aquifer system is found on the western portion of the site, along the Robert S. Kerr Reservoir (SFC, 1998).

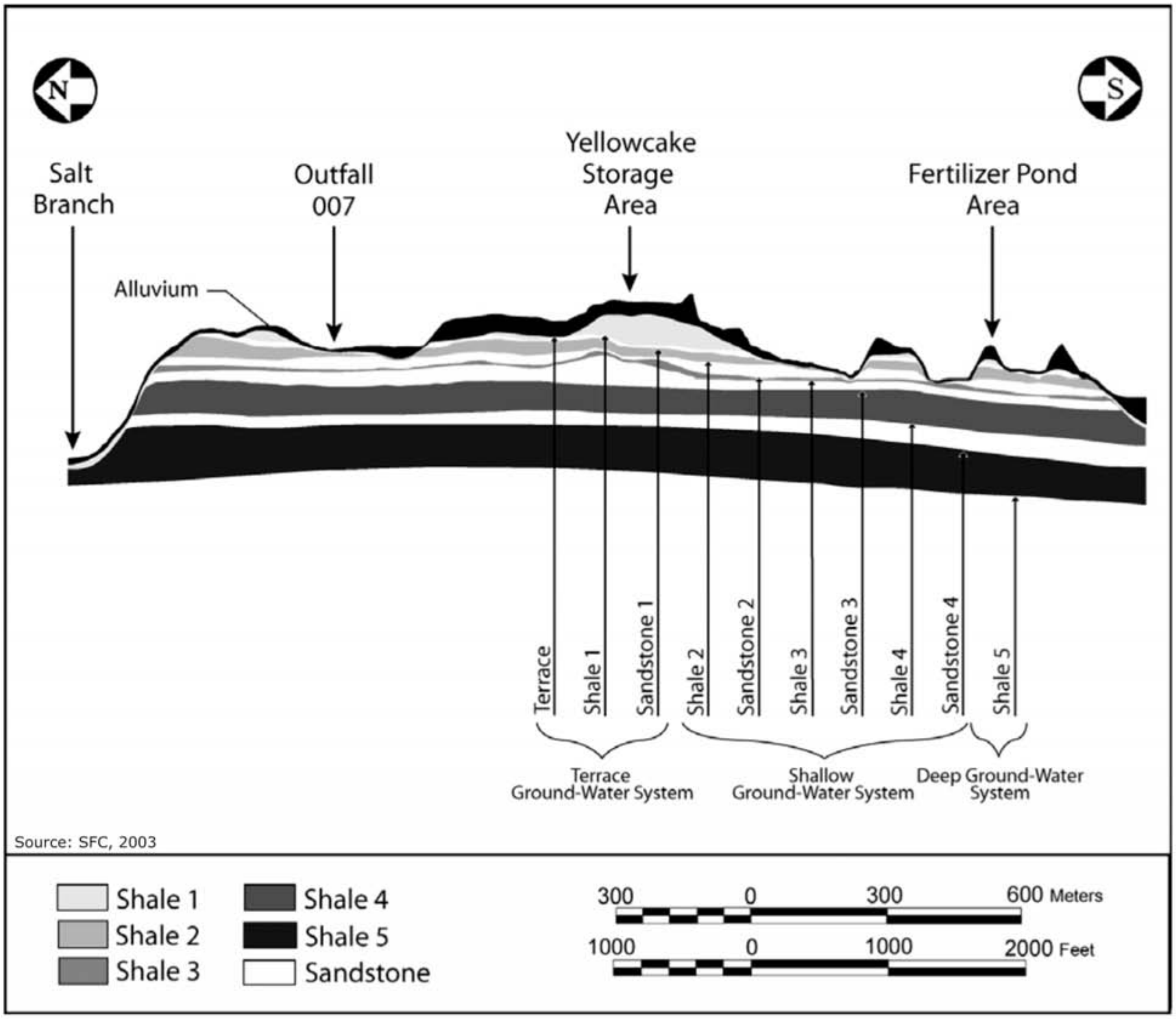


Figure 3.3-5 Schematic of Terrace, Shallow Bedrock, and Deep Bedrock Aquifers Beneath the SFC Site (North-South Orientation)

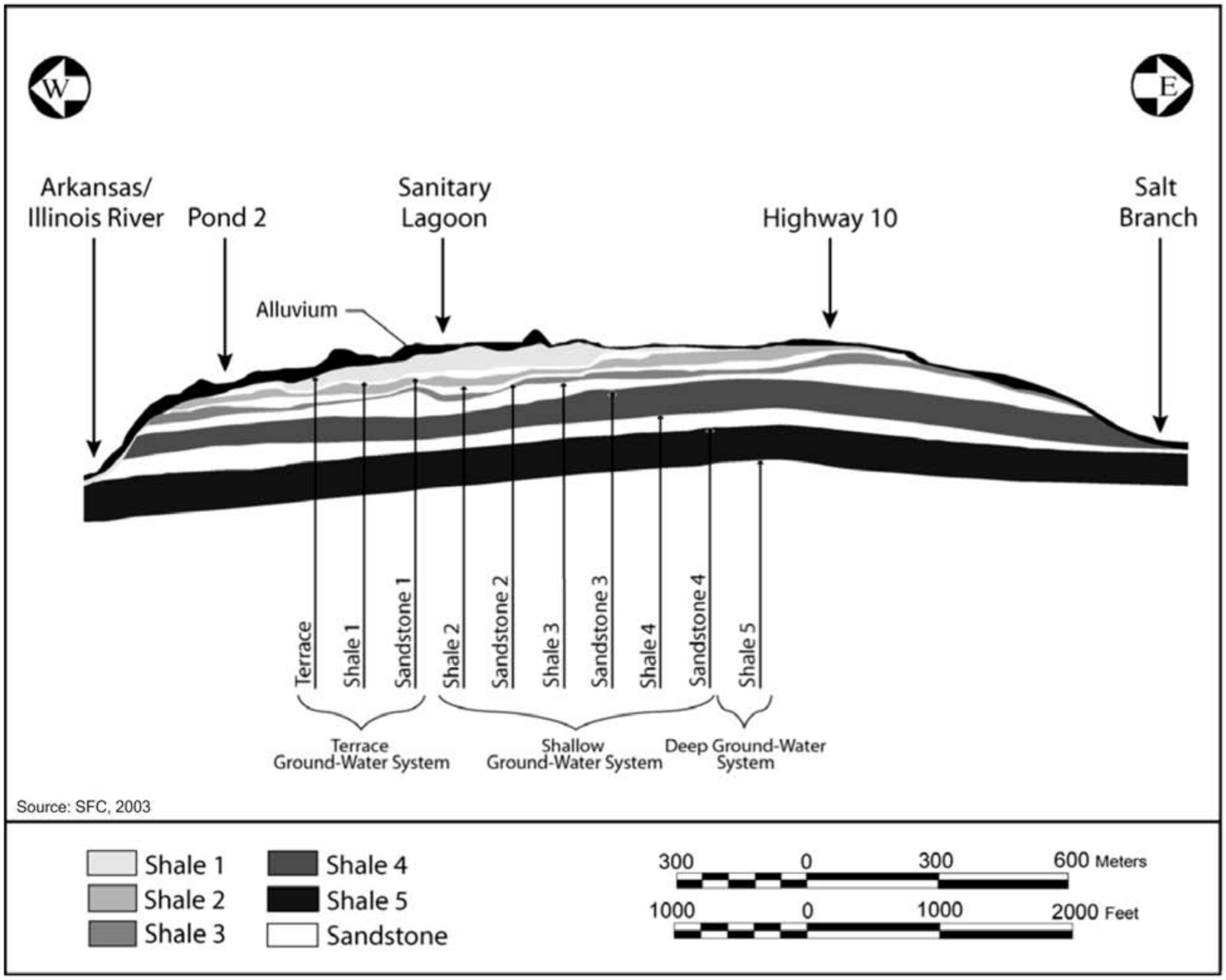


Figure 3.3-6 Schematic of Terrace, Shallow Bedrock, and Deep Bedrock Aquifers Beneath the SFC Site (East-West Orientation)

Alluvial Aquifer System

The alluvial aquifer system is found in the clay and silt deposits, with lesser amounts of sand and gravel, which exist in the westernmost portion of the site. These materials were deposited by the Arkansas and Illinois rivers and range from 0 to 11.5 meters (0 to 35 feet) in thickness (SFC, 2003). Figure 3.3-7 depicts the potentiometric surface of this system. As can be seen, groundwater in the alluvial aquifer system flows to the west and south, toward the Illinois and Arkansas rivers, respectively. This system is the only significant freshwater aquifer in the facility area (SFC, 1996). In the vicinity of the SFC site, groundwater yields from this aquifer likely range from 3.8 to 38 lpm (1 to 10 gpm) (SFC, 1998). However, there are no known users of groundwater from the alluvial deposits in the SFC facility area.

> The "potentiometric surface" for an aquifer provides an indication of the directions of groundwater flow in the aquifer. Groundwater flow is in the direction from higher water-level elevations to lower water-level elevations (Freeze and Cherry, 1979).

Terrace-Shale 1 Groundwater System

The uppermost groundwater system at the facility is the terrace-shale system. This system is unconfined and occurs in the site terrace deposits and the uppermost site shale (the "Unit 1 shale") of the Atoka Formation. This formation is first encountered at depths of 0 to 6 meters (0 to 20 feet). With calculated yields of less than 0.38 lpm (0.1 gpm), the terrace system yields little groundwater (MFG, 2002). Groundwater in this system flows radially away from the main process building, as shown on Figure 3.3-8.

> A "confined aquifer" is bounded above and below by impermeable or distinctly less permeable rock strata. (Bates and Jackson, 1984)
>
> An "unconfined aquifer" has the water table as its upper boundary.
> (Freeze and Cherry, 1979)

Shallow Bedrock Groundwater System

Beneath the terrace groundwater system lies the interbedded shale and sandstone sequence of the shallow bedrock groundwater system. This system, which is confined and first encountered at depths of 3 to 12 meters (10 to 40 feet), extends downward from the bottom of the sandstone underlying the Unit 1 shale through the Unit 2 and 3 shales and sandstones to the bottom of the Unit 4 shale. Figure 3.3-9 depicts the potentiometric surface of the Unit 4 shale. This figure illustrates that the flow in this system is towards the southwest, west, and northwest in the Process Area and becomes more westerly as it leaves this area (SFC, 2003). Calculated yields from the Unit 2 and 3 shales are less than 0.38 lpm (0.1 gpm). The Unit 4 shale may have a limited potential to yield groundwater at slightly greater than 0.38 lpm (0.1 gpm), but the background groundwater quality of the shale is poor, with a measured sulfate concentration of 1,750 mg/L and a total dissolved solids concentration of over 3,100 mg/L (MFG, 2002).

Deep Bedrock Groundwater System

The Unit 5 water-bearing shale, which lies stratigraphically below the Unit 4 sandstone, is referred to as the deep bedrock groundwater system. This system is found at depths of 1.5 to

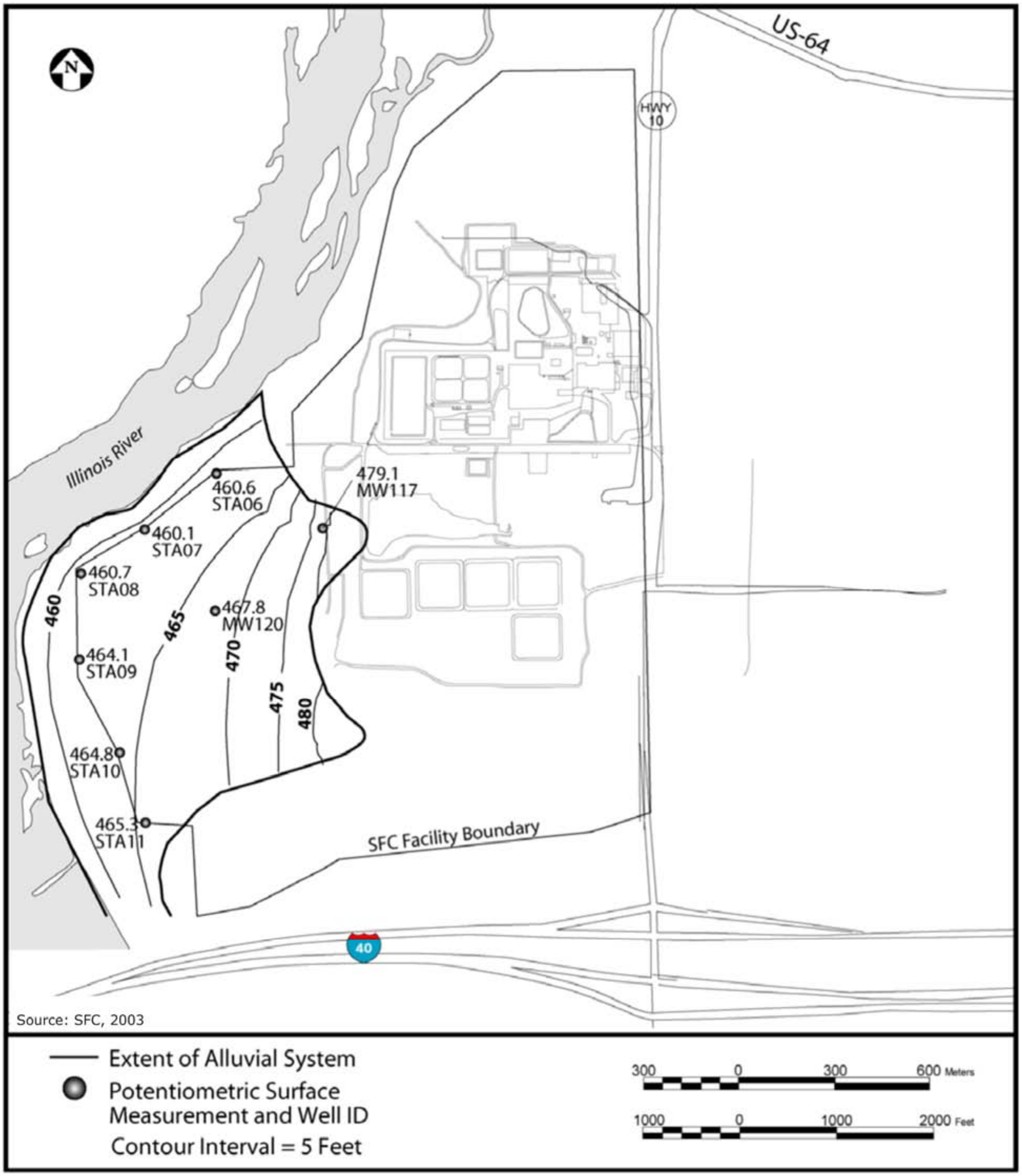


Figure 3.3-7 The Potentiometric Surface of the Alluvial Aquifer System

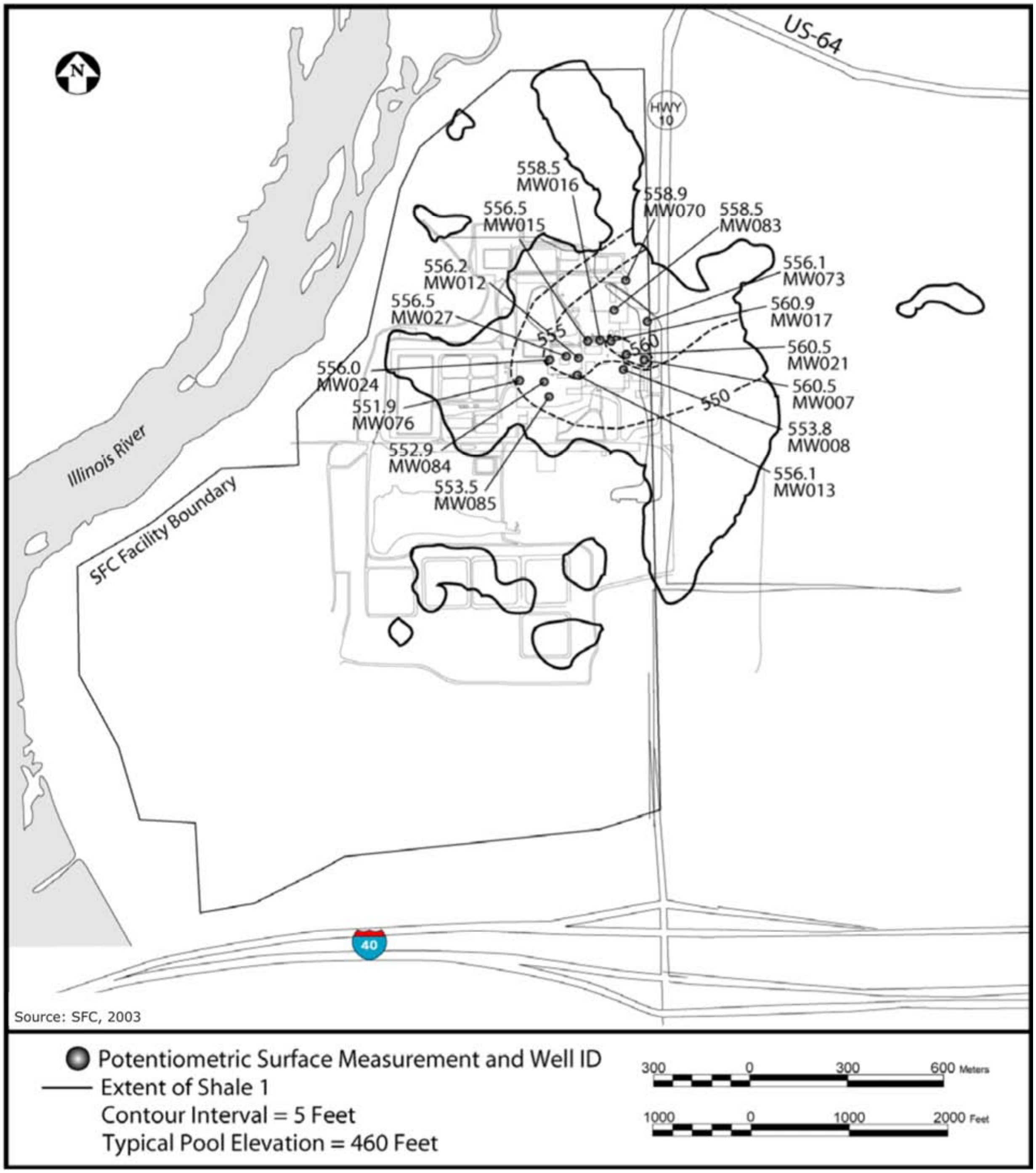


Figure 3.3-8 The Potentiometric Surface of the Terrace– Shale 1 Groundwater System

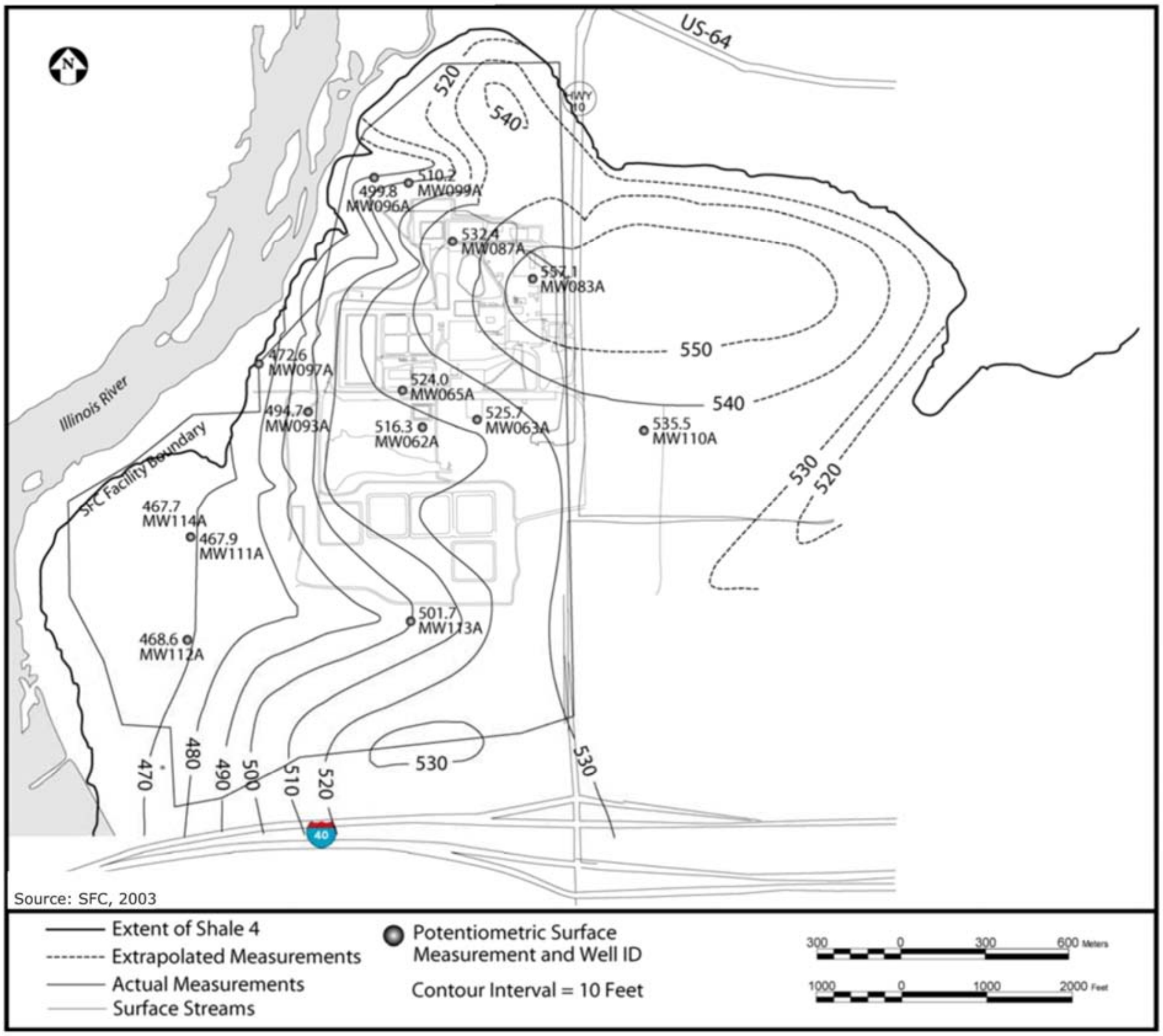


Figure 3.3-9 The Potentiometric Surface of the Unit 4 Shale (of the shallow bedrock system)

18 meters (5 to 60 feet) below the ground surface, depending on location at the site, and has a thickness of up to 10 meters (33 feet) (SFC, 1998).

Groundwater Flow

A conceptualized diagram of the site hydrogeology is presented on Figure 3.3-10. Lateral flow beneath the SFC site generally occurs in the shales, which are fissile (i.e., they split easily along closely spaced planes). The shales also exhibit a wide range (three orders of magnitude) in hydraulic conductivity (i.e., the rate at which water can flow through a cross section of the rock). The sandstone units, while fractured, are highly cemented and thus do not conduct water as freely as the shales. Groundwater flow through these sandstone units is considered to be primarily vertical. In general, the shale units are the primary water-bearing units in the area of the facility, while the sandstone units act as barriers to groundwater movement between the shales (SMI, 2001).

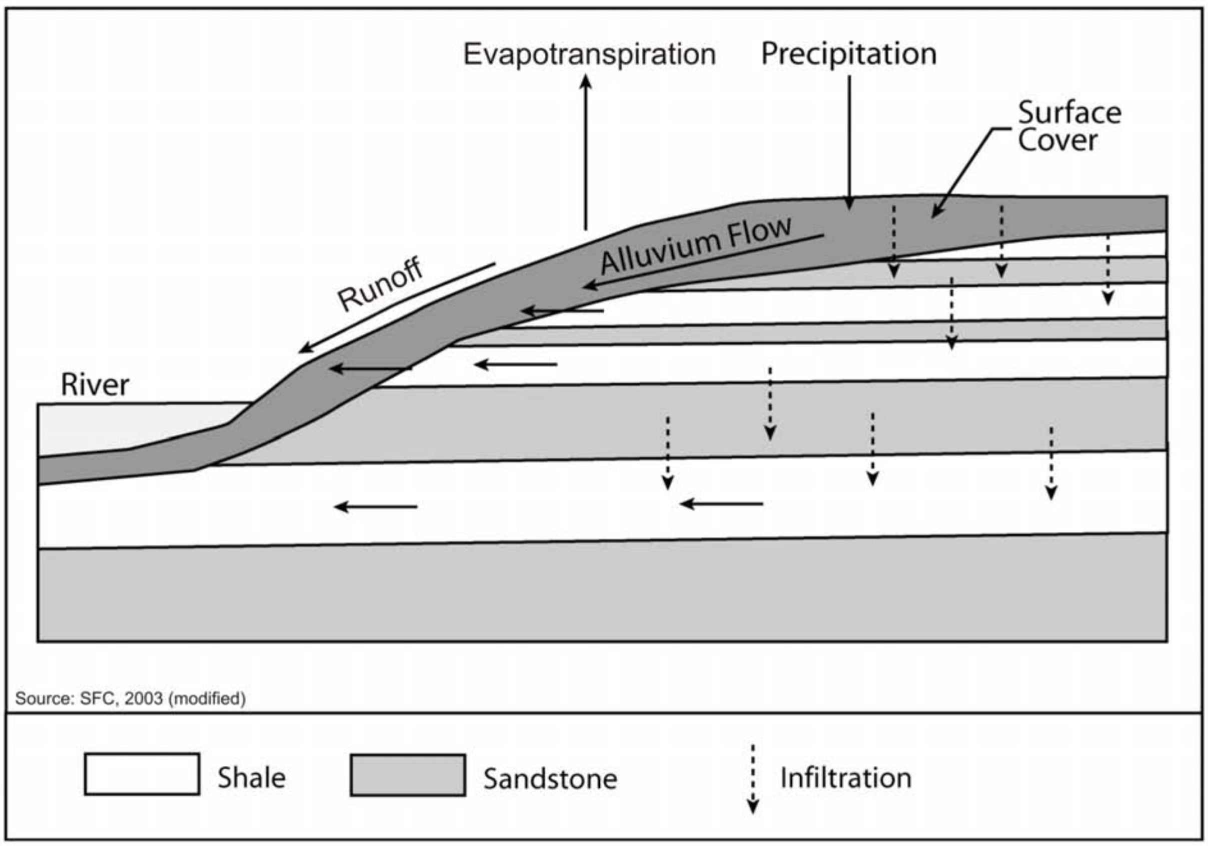


Figure 3.3-10 Conceptualized Diagram of the SFC Site Hydrogeology

Groundwater in the various shale units discharges laterally to streams that flow to the Robert S. Kerr Reservoir, hillside colluvium, and/or to Arkansas/Illinois river alluvium (MFG, 2002). ("Colluvium" is the unconsolidated sediments at the site, composed typically of silts, clays, and/or sands, with varying amounts of gravel.) In addition, the Unit 4 shale, which is continuous beneath the Salt Branch tributary to the east of the SFC site, also discharges to the Illinois River (SMI, 2001). The Unit 5 shale is partially continuous across the Salt Branch and probably discharges to it, and hydrologic modeling of the site indicates that this shale discharges directly to the Robert S. Kerr Reservoir at the north end of the SFC site (SMI, 2001).

The EIS discusses the impacts of contaminant transport across the site and into the Illinois River via surface water and groundwater in the terrace, shallow bedrock, and deep bedrock systems, since they are the principal units in which contaminants could migrate. Although there are some briny solutions that discharge as seeps along the Salt Branch tributary, they represent upward flow of natural formation waters from the deeper Arbuckle Formation (below the Atoka Formation). This type of artesian flow hampers the migration of site contaminants to deeper levels below the Atoka Formation and thus is not a factor affecting contaminant transport across the site.

Potentiometric surface maps for the alluvial aquifer and the terrace and shallow bedrock groundwater systems are presented on Figures 3.3-7, 3.3-8, and 3.3-9, respectively. These maps clearly indicate that groundwater flows away from the main process building (SFC, 2003).

Groundwater Quality

Background Groundwater Quality. As part of its *Groundwater Monitoring Plan* (SFC, 2005a), SFC selected nine groundwater monitoring wells (MW005, MW005A, MW007, MW007A, MW007B, MW072, MW072A, MW072B, and MW110A) from which to determine background groundwater quality for the site. SFC chose these nine wells, which are located upgradient of the facility, from the three groundwater systems beneath the site (i.e., the terrace, shallow bedrock, and deep bedrock systems). The locations of these wells are indicated on Figure 3.3-11.

SFC installed these wells after facility operations had begun; thus, samples from these wells do not provide true background concentrations. However, concentration levels for the various constituents suggest that site operations have had little to no impact on the quality of water from these wells.

The results of SFC's analysis of samples from these nine wells for the major COCs (i.e., uranium, nitrate, fluoride, and arsenic) are provided in Table 3.3-4. The results reflect SFC's removal of certain data due to (1) the change in minimum detection limits for uranium and arsenic, (2) an evaluation of outliers, and (3) impacts on the initial analyses from the installation of a new well. SFC attributed the elevated fluoride levels in the deep bedrock aquifer (elevated relative to levels in the other two systems) to a naturally occurring constituent in the Unit 5 shale (SFC, 2005b).

Classification for Potential Use. SFC has classified the groundwater at the site using the EPA's draft final guidelines for such classification (EPA, 1986). These EPA guidelines established a three-tiered system that recognizes that different groundwater systems require different levels of protection (see text box below). Based on this classification scheme, SFC concurred with the EPA that the groundwater system for the site could be classified as Class IIB, signifying a potential source of drinking water (SFC, 1997). A Class IIB designation means that the groundwater can be obtained in sufficient quantity to meet the needs of an average family by

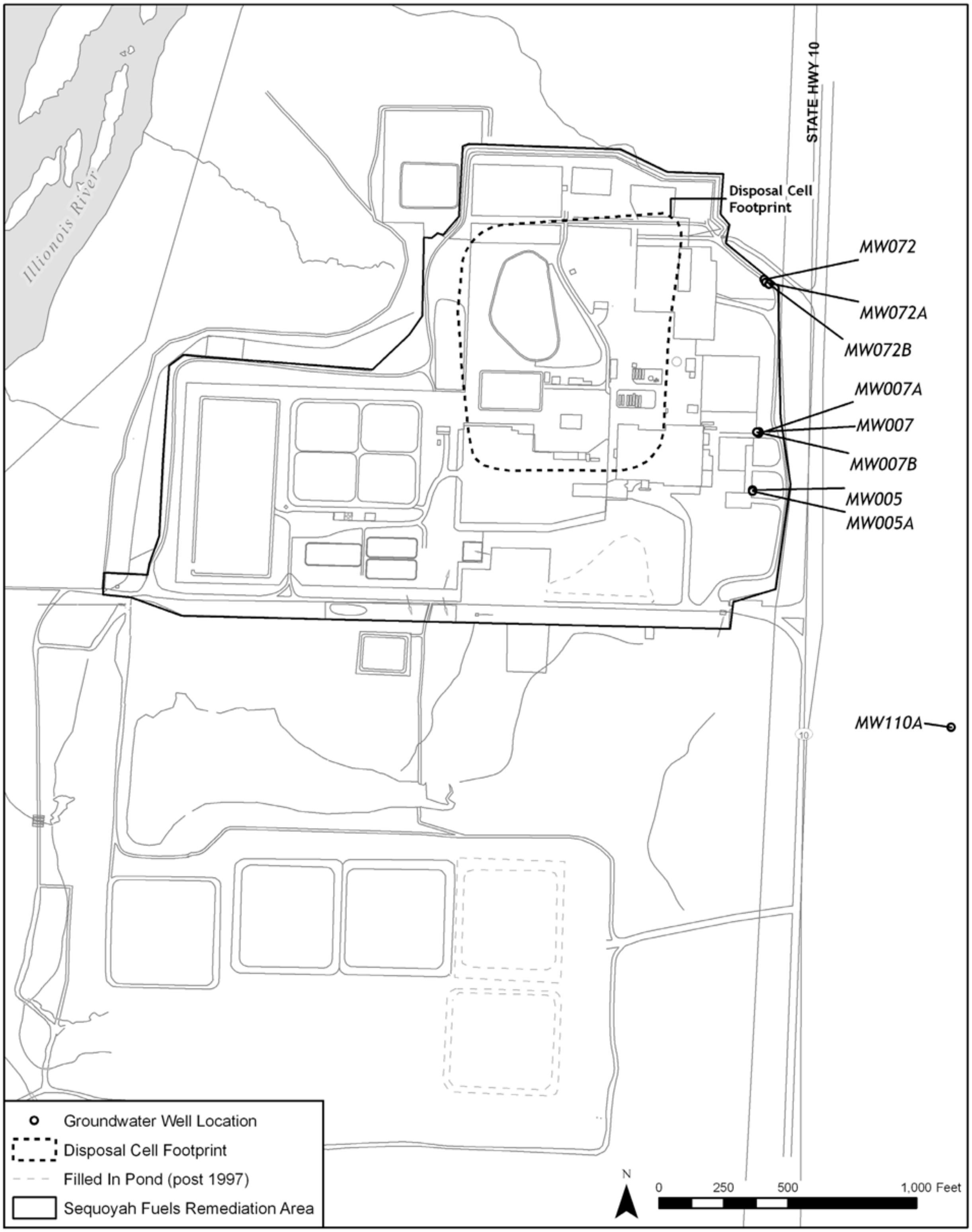


Figure 3.3-11 SFC Background Monitoring Well Locations

providing approximately 568 liters (150 gallons) per day and has total dissolved solids (TDS) of less than 10,000 mg/L. Such water is considered suitable for drinking or amenable to methods reasonably employed by public water systems (EPA, 1986).

Table 3.3-4 SFC Site Background Groundwater Quality

Aquifer System	Mean	Standard Deviation	No. of Wells	No. of Samples
Uranium in µg/L (MCL = 30 µg/L)				
Terrace	1.07	0.41	3	21
Shallow Bedrock	1.0	0.24	4	27
Deep Bedrock	1.15	0.56	2	14
Nitrate (as Nitrogen) in mg/L (MCL = 10 mg/L)				
Terrace	1.28	0.67	3	41
Shallow Bedrock	2.16	1.27	4	46
Deep Bedrock	0.96	0.43	2	19
Fluoride in mg/L (MCL = 4.0 mg/L)				
Terrace	0.61	0.27	3	28
Shallow Bedrock	0.63	0.24	4	32
Deep Bedrock	2.25	0.61	2	15
Arsenic in mg/L (MCL = 0.01 mg/L)				
Terrace	0.006	0.003	3	30
Shallow Bedrock	0.006	0.003	4	29
Deep Bedrock	0.006	0.002	2	21

Source: SFC, 2005b.
MCL = maximum contaminant level, per EPA's National Primary Drinking Water standards.

Classification of the SFC site groundwater as Class IIB was based on sustained yields from the alluvial aquifer of between 3.8 and 37.8 liters (1 and 10 gallons) per minute. Therefore, although SFC classified the other groundwater systems at the site (i.e., the terrace, shallow bedrock, and deep bedrock systems) as Class IIIA due to their insufficient yield, the overall classification of groundwater at the site is Class IIB (SFC, 1997).

EPA Classification of Groundwater

Class I Resources of unusually high value. They are highly vulnerable to contamination and are either irreplaceable as a drinking water source to substantial populations or ecologically vital.

Class IIA Current source of drinking water.

Class IIB Potential source of drinking water: sufficient to yield 568 liters (150 gallons)/day with a TDS <10,000 mg/L, which can be used without treatment or with reasonably employed treatment methods.

Class IIIA Not a potential source of drinking water: intermediate-to-high interconnection and >10,000 mg/L TDS, or untreatable, or not a source of drinking water due to insufficient yield.

Class IIIB Not a source of drinking water: low interconnection and >10,000 mg/L TDS or untreatable.

Source: EPA, 1986

Existing Site Contamination. Groundwater at the facility has been contaminated by past site operations. A comprehensive well monitoring program, installed as part of a facility environmental investigation conducted in 1990 and 1991 (SFC, 1991), determined that uranium, fluoride, nitrate, and arsenic are present at concentrations above background levels. SFC has indicated that uranium contamination is chiefly centered near the main process and solvent extraction buildings (see Figures 2.1-3 and 2.1-4). Elevated levels of nitrate, arsenic, and fluoride are found throughout the process area; elevated levels of nitrate also are present in the alluvial aquifer in the western portion of the site as a result of SFC's nitrate application program. The extent and distribution of modeled current and future nitrate concentrations are shown in Figures 108 through 112 in SFC's responses to a request for additional information (SFC, 2005c). Elevated levels of barium also have been found in a localized area north of the clarifier basins.

Groundwater treatment and recovery is required until the contaminant levels stipulated in an NRC-approved groundwater *Corrective Action Plan* are attained. Groundwater monitoring by the long-term custodian would continue indefinitely under the Long-Term Surveillance Program. The groundwater *Corrective Action Plan* submitted by SFC is still under NRC review. SFC identified 18 constituents and proposed standards for them—four background, six maximum contaminant levels (MCLs) (EPA drinking water standard), and eight alternate concentration limits.

SFC's remedial strategy for the nitrates in the northern portion of the site is the same as that for the other contaminants. They have installed interceptor trenches and will install extraction wells to remove contaminant mass from the aquifer systems. Despite the current remedial actions, some nitrate contamination will migrate off-site, and these remedial structures will not draw back contamination that has already flowed past.

Regarding the southern portion of the site, no remedial actions are planned where nitrate contamination is present. As a result, nitrates will migrate unabated into the Illinois River. This type of remedial action is essentially natural flushing, which is permitted by the DOE for long-term site control under Title I of UMTRCA. Under Title II of UMTRCA, however, the SFC site can be transferred to the DOE for long-term site control only after the groundwater standards have been met. NRC will require SFC to address this issue in a revision to the groundwater *Corrective Action Plan.*

By license amendment 31 to SFC's NRC license, the NRC staff approved SFC's groundwater compliance monitoring plan (NRC, 2005b). The NRC staff reviewed SFC's monitoring plan in accordance with the provisions of 10 CFR Part 40, Appendix A, Criteria 5 and 7, which outline the requirements for groundwater compliance monitoring for 10 CFR Part 40 licensees, such as SFC. With that approval, hazardous constituents present in the groundwater as a result of SFC's licensed activities were identified; groundwater protection standards for those hazardous constituents were set; and the locations, frequency, and parameters for compliance monitoring were determined (NRC, 2005b).

The hazardous constituents for the SFC site and the protection standards for each of these constituents are identified in Table 3.3-5. SFC's *Groundwater Monitoring Plan* is described in greater detail in Chapter 6.

As indicated in Table 3.3-6, uranium concentrations have been found to be elevated above the MCL in both the terrace and shallow bedrock aquifer systems. A closer look at the results from the shallow bedrock aquifer system show that the MCL was not exceeded in the lower unit of the aquifer system (i.e., the Unit 4 shale) (SFC, 2006b). In addition, concentrations above the MCL were not recorded in samples from the deep bedrock aquifer.

Table 3.3-5 Hazardous Constituents in Groundwater at the SFC Site and Associated Protection Standards

Hazardous Constituent	Groundwater Standard	Type of Standard
Antimony (mg/L)	0.006	ACL
Arsenic (mg/L)	0.01	MCL
Barium (mg/L)	1.0	ACL
Beryllium (mg/L)	0.004	ACL
Cadmium (mg/L)	0.01	MCL
Chromium (mg/L)	0.05	MCL
Fluoride (mg/L)	4.0	ACL
Lead (mg/L)	0.05	ACL
Mercury (mg/L)	0.002	MCL
Molybdenum (mg/L)	0.012	Background
Nickel (mg/L)	0.023	Background
Nitrate (mg/L)	10	ACL
Combined Radium-226 and 228 (ρCi/L)	5	MCL
Selenium (mg/L)	0.01	ACL
Silver (mg/L)	0.05	MCL
Thallium (mg/L)	0.005	ACL
Thorium-230 (ρCi/L)	1.2	Background
Uranium (μg/L)	30	ACL

Source: SFC 2005a.
ACL = Alternate concentration limit (derived from EPA National Primary Drinking Water regulations).
MCL = Maximum contaminant level (from EPA National Primary Drinking Water regulations).

Table 3.3-6 Summary of Groundwater Compliance Monitoring Results for 2005 and 2006

Aquifer System	Minimum Value	Maximum Value	No. of Samples Over the MCL	No. of Samples
2005 Results				
Uranium (MCL = 30 μg/L)				
Terrace	< 1	48,400	7	23
Shallow Bedrock	< 1	3,100	6	29
Deep Bedrock	< 1	< 1	0	6
Nitrate (as Nitrogen) (MCL = 10 mg/L)				
Terrace	< 1	829	9	22
Shallow Bedrock	2	6,000	16	27
Deep Bedrock	< 1	2.9	0	6
Fluoride (MCL = 4.0 mg/L)				
Terrace	0.2	6	2	20
Shallow Bedrock	0.3	5.2	1	26
Deep Bedrock	0.5	2.5	0	6

Table 3.3-6 Summary of Groundwater Compliance Monitoring Results for 2005 and 2006

Aquifer System	Minimum Value	Maximum Value	No. of Samples Over the MCL	No. of Samples
Arsenic (MCL = 0.01 mg/L)				
Terrace	< 0.005	2.01	10	20
Shallow Bedrock	0.007	2.54	18	27
Deep Bedrock	< 0.004	0.009	0	6
2006 Results				
Uranium (MCL = 30 µg/L)				
Terrace	< 1	28,000	5	19
Shallow Bedrock	< 1	2,670	5	51
Deep Bedrock	< 1	19	0	12
Nitrate (as Nitrogen) (MCL = 10 mg/L)				
Terrace	< 1	877	6	19
Shallow Bedrock	8	6,190	27	51
Deep Bedrock	< 1	7	0	12
Fluoride (MCL = 4.0 mg/L)				
Terrace	0.2	4.5	1	19
Shallow Bedrock	0.3	4.9	1	51
Deep Bedrock	0.5	2.3	0	12
Arsenic (MCL = 0.01 mg/L)				
Terrace	< 0.005	1.09	7	19
Shallow Bedrock	< 0.005	2.95	21	51
Deep Bedrock	< 0.005	0.041	1	12

Source: SFC, 2006b.

Regarding any eventual releases of uranium, the total groundwater flux from the SFC site into the Kerr Reservoir averages 7,680 ft^3/day, whereas the flow down the Illinois River varies between 8,035,000 ft^3/day (low flow) and 133,480,00 ft^3/day (average flow). To exceed the uranium drinking water standard of 30 µg/L in the Illinois River, all of the groundwater crossing the site would have to have a uranium concentration of greater than 31,200 µg/L. Modeling of groundwater contamination at the SFC site indicates that the maximum uranium concentration in groundwater at the site boundary could reach approximately 135 µg/L. The effects of groundwater input would result in uranium concentrations increasing in the Illinois River by 1.3 µg/L. Radium-226 is less mobile than uranium and is present in lower concentrations than uranium at the SFC site. Under present site conditions, radium-226 concentrations in both groundwater and surface water remain below the drinking water standard of 5 pCi/L. Placing the contaminated soils in an engineered disposal cell would further isolate contaminants from the environment.

Nitrate, fluoride, and arsenic concentrations were found to be above their respective MCLs in the terrace and shallow bedrock aquifer systems. In 2006, the MCL for arsenic was exceeded in one sample collected from the deep bedrock groundwater system. In addition, as noted previously, nitrate contamination has been found in the agricultural lands to the south, and this is attributed to its beneficial reuse as a part of SFC's land application program. The effects of nitrate loading to the Illinois River can be approximated by calculating the expected increase in nitrate loads using weighted averages. Because flows in the Illinois River far exceed the groundwater flow from the site into the river, the actual increase in concentration would likely be low. From information provided in SFC's groundwater *Corrective Action Plan* response to a Request for Additional Information (RAI) (SFC, 2005c), NRC staff calculated the concentration increase in the Illinois River using flow as a weighting factor. NRC staff estimates the nitrate increase in the Illinois River to be relatively small, at 0.02 mg/L.

Under its NRC license, SFC is required to submit an annual groundwater report that summarizes the results of its compliance monitoring. The report is required to contain a table of results, groundwater contour maps, and groundwater isoconcentration maps for arsenic, fluoride, nitrate, and uranium (NRC, 2005b). The results of groundwater compliance monitoring for 2005 and 2006 are summarized in Table 3.3-6.

3.4 Public and Occupational Health

This section describes the radiological and chemical background in terms of public and occupational exposure and health and historical exposure levels from SFC's previous industrial operations. This section also summarizes public health studies performed in the region, which were used to establish the baseline information necessary for the analysis of impacts on public and worker health that may result from the implementation of the proposed action and its alternatives (see Chapter 4).

3.4.1 Background Radiological Exposure

Humans are exposed to ionizing radiation from many sources in the environment. One source is cosmic radiation, or charged particles, primarily protons, from extra-terrestrial sources that are incident on the earth's atmosphere. Cosmic rays directly account for a proportion of the naturally occurring radiation present in the environment. Radioactivity is also present in soil, rocks, and in living organisms from naturally occurring elements in the environment.

The average exposure from naturally occurring radionuclides in the soil in the United States has been estimated to range from 0.28 millisieverts (28 millirem) per year (NCRP 1987) to 0.60 millisieverts (60 millirem) per year (NRC, 2004). A major proportion of natural background radiation comes from naturally occurring radon in the air, which contributes about 2 millisieverts (200 millirem) per year and is related to radioactivity in the soil and rocks (NCRP, 1987). These natural radiation sources contribute to the annual background dose received by individuals.

Man-made sources of radiation also contribute to the background dose. These sources include X-rays for medical purposes, nuclear medicine, and consumer products. The current average dose to a person living in the United States from both natural and man-made radiation sources is about 3.6 millisieverts (360 millirem) per year. Figure 3.4-1 shows the relative contribution of each of these sources to the dose received by an average member of the public residing in the United States (Kathren, 1984).

The major radioactive impurities in yellowcake are radium-226 and thorium-230. The SFC site has been monitored for these radioactive elements in addition to uranium. Background radiological characteristics of the SFC site have been determined from 31 soil samples taken from outside the facility boundary. These samples were analyzed for uranium, radium-226, and thorium-230, and the results are shown in Table 3.4-1 (SFC, 2001).

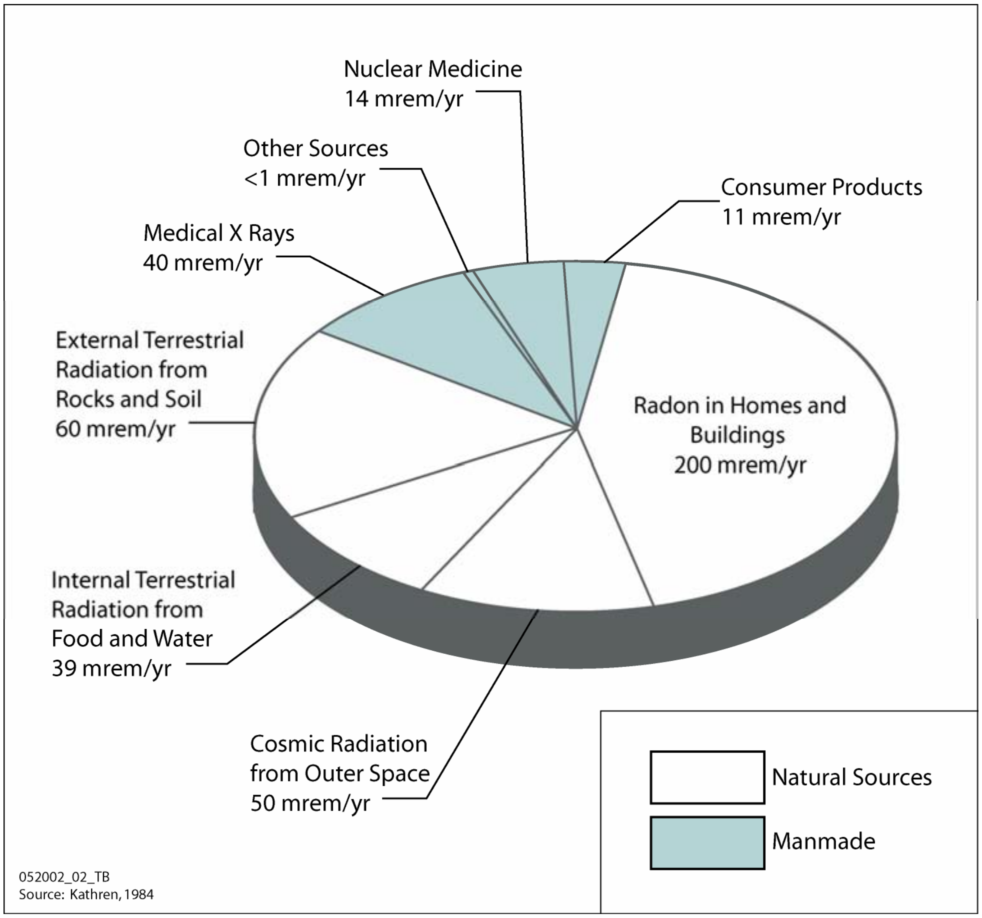


Figure 3.4-1 The Relative Contribution of Background Sources of Radiation in the United States

Table 3.4-1 Concentrations of Radionuclides in Background Soil Samples

Value	Concentration in Soil		
	Natural Uranium Bq/g (pCi/g)	Radium-226 Bq/g (pCi/g)	Thorium-230 Bq/g (pCi/g)
Minimum	<0.025 (<0.684)	0.004 (0.1)	0.015 (0.4)
Maximum	0.063 (1.71)	0.059 (1.6)	0.067 (1.8)
Average	0.037 (0.99)	0.034 (0.91)	0.033 (0.9)
Median	0.036 (0.96)	0.033 (0.9)	0.028 (0.75)

Source: SFC, 2001.

Groundwater samples collected from the background monitoring wells shown on Figure 3.3-11 were also analyzed for background radioactivity levels. Table 3.4-2 provides concentrations of radionuclides at the SFC site for terrace, shallow, and deep groundwater. These background groundwater wells were installed after plant operations began. Therefore, the levels are not "true" background levels, since it is not possible to know whether the levels have been affected by SFC's operations at the site. However, the results from wells located upgradient of the SFC site show little or no contamination.

Table 3.4-2 Concentrations of Radionuclides in Background Groundwater Samples from July 1993 to 2001

Constituent	Minimum	Maximum	Mean	Median	No. of Samples
Terrace Groundwater					
Total Uranium (mg/L)	0.57	12.40	2.92	1	24
Total Uranium (Bq/L)	0.014	0.314	0.074	0.025	24
Radium-226 (Bq/L)	0.004	0.022	0.013	0.013	2
Thorium (Bq/L)	0.019	0.337	0.129	0.030	3
Shallow Groundwater					
Total Uranium (mg/L)	0.57	500	2.11	1	27
Total Uranium (Bq/L)	0.014	0.127	0.053	0.025	27
Radium-226 (Bq/L)	0	0.004	0.003	0.004	3
Thorium (Bq/L)	0.011	0.022	0.017	0.017	2
Deep Groundwater					
Total Uranium (mg/L)	0.97	10.00	2.88	1.50	18
Total Uranium (Bq/L)	0.024	0.253	0.073	0.038	18
Radium-226 (Bq/L)	0.007	0.052	0.030	0.030	2
Thorium (Bq/L)	0.011	0.048	0.030	0.030	2

Source: SMI 2001.
To convert becquerels to picocuries, multiply by 27.

3.4.2 Background Chemical Exposure

In order to characterize the background soil metal concentrations in the area surrounding the site, soil samples were collected during the RCRA Facility Investigation (RFI; SFC, 1996). Four off-site locations within 8 km (5 miles) of the site were selected to represent the three main soil series that are encountered in the Industrial Area. Sample locations were selected such that influences from human activities were minimized and drainage ways, paved surfaces, railroads, and agricultural (cropland) areas were avoided. Each borehole was advanced to a maximum depth of 1.2 meters (4 feet), and samples were collected and analyzed for metals.

The analytical results for background samples were compiled for each parameter, and calculations were performed to determine the mean and standard deviation. A background "prediction interval" was established for each metal at the 99% confidence level; the upper prediction interval is the arithmetic mean plus three standard deviations. The results of this statistical analysis are included in Table 3.4-3.

Background concentrations for fluoride and nitrate in soils were presented in the SFC Site Characterization Report (SFC, 1998). Data presented in this report indicated that nitrate analysis was performed on four soil samples collected at background locations HA270, HA272, HA307, and HA308. The concentration of nitrate detected in these samples ranged from 3 to 7 mg/kg

Table 3.4-3 Calculation of the Upper Prediction Interval Values for Background Soil Samples

Location		Ag	Al	As	Ba	Be	Ca	Cd	Co	Cr	Cu	Fe	Hg	K	Li	Mg
HA223	BKG-1-B	0.6	11900	5.0	69.5	1.12	1920	4.8	6.6	20.6	14.1	33400	0.020	427	4.7	1240
HA223	BKG-1-C	0.6	9090	11.5	129.0	1.07	1950	5.0	15.3	19.5	9.7	36200	0.020	411	5.8	13.50
HA224	BKG-2-B	0.6	6000	5.0	63.3	0.78	756	3.6	13.3	16.8	5.0	25300	0.005	331	4.2	611
HA224	BKG-2-C	0.6	11400	17.2	116.0	1.25	1780	5.0	8.8	23.5	15.3	36600	0.010	585	8.7	1230
HA225	BKG-3B	0.6	10200	26.1	52.6	0.90	884	6.5	8.2	27.2	9.9	44400	0.020	435	8.5	849
HA226	BKG-4												0.030			
Mean		0.6	9718	13.0	86.1	1.0	1458	5.0	10.4	21.5	10.8	35180	0.018	438	6.4	1056
Std Dev		0.0	2347	8.9	34.1	0.2	588	1.0	3.7	4.0	4.1	6871	0.009	92	2.1	280
Mean + 3 Std Dev		0.6	16760	39.8	188.4	1.6	3221	8.1	21.5	33.5	23.1	55793	0.044	714	12.7	1895
Location		**Mn**	**Mo**	**Na**	**Ni**	**P**	**Pb**	**Sb**	**Se**	**Sr**	**Ti**	**V**	**Zn**			
HA223	BKG-1-B	203	1.2	1160.0	8.2	75.6	26.2	10.0	10.0	16.70	5.0	34.2	24.9			
HA223	BKG-1-C	504	1.2	1240.0	10.2	104.0	23.6	10.0	10.0	17.80	16.3	26.6	40.8			
HA224	BKG-2-B	347	1.2	126.0	8.9	117.0	20.6	10.0	10.0	6.27	11.9	27.2	20.0			
HA224	BKG-2-C	157	1.2	232.0	16.4	91.1	27.8	10.0	10.0	13.00	5.0	36.5	33.1			
HA225	BKG-3B	178	1.2	89.7	13.1	235.0	24.1	10.0	10.0	7.69	5.0	31.3	38.4			
HA226	BKG-4															
Mean		278	1.2	569.5	11.4	124.5	24.5	10.0	10.0	12.3	8.6	31.2	31.4			
Std Dev		147	0.0	578.6	3.4	63.6	2.7	0.0	0.0	5.2	5.2	4.3	8.8			
Mean + 3 Std Dev		718	1.2	2305.3	21.5	315.4	32.7	10.0	10.0	27.9	24.3	44.1	58.0			

Notes:

1. Less than values were not deleted from the analysis. When data sets included a mixture of values that are less than a limit of detection and actual concentration measurements, less than values were analyzed at half their reported value. (This was required for As, Hg and Tl.)
2. The actual less than values were used during analysis for Ag, Mo, Sb and Se because all reported values were less than detection limits. (Data set did not include a mixture of values.)
3. Mercury analysis for BKG-4 (HA226) was not requested; however, since the laboratory ran analysis the results are included.

nitrate. Fluoride analysis was performed on two background samples (HA270 and HA272). Fluoride concentrations of 134 mg/kg and 146 mg/kg were detected.

3.4.3 Public Health Studies

The National Vital Statistics System public-use data file includes both national and state death rate statistics. These data were calculated by the National Cancer Institute. The death rates are age-adjusted to the 2000 U.S. standard population by 5-year age groups. The new cancer data compiled for this EIS are shown in Table 3.4-4. These data show that Sequoyah County is similar to the rest of Oklahoma and the U.S. in terms of overall cancer mortality.

Table 3.4-4 Death Rate/Trend Comparisons, All Cancers, Death Years Through 2003

Area	Death Rate Compared to US Rate[1]	Annual Death Rate Over Rate Period	Lower 95% Confidence Interval for Death Rate	Upper 95% Confidence Interval for Death Rate	Rate Period	Rate Ratio (County to U.S.)[2]	Recent Annual Percent Change in Death Rates[3]	Recent Trend[4]	Recent Trend Period[3,4]
United States	-	164.3	164	164.5	1999-2003	-	-0.9	Falling	1994-2003
Oklahoma	Similar	168.5	166	171.1	1999-2003	1.0	0.0	Stable	1999-2003
Sequoyah County	Similar	179.8	156.0	206.4	1999-2003	1.1	0.3	Stable	1979-2003

Notes: All rates are per 100,000 persons. When the population size for a denominator is small, the rates may be unstable. A rate is unstable when a small change in the numerator (e.g., only one or two additional cases) has a dramatic effect on the calculated rate. Suppression is used to avoid misinterpretation when rates are unstable.

1 Rate Comparison
  "above" = when 95% confident the rate is above rate ratio > 1.10.
  "similar" = when unable to conclude above or below with confidence.
  "below" = when 95% confident the rate is below and rate ratio < 0.90.

2 The rate ratio is the county rate divided by the U.S. rate.

3 Recent trends in death rates were calculated using the Joinpoint Regression Program and are expressed as the annual percent change over the recent trend period. Recent trend period is the period since last change in trend as determined by Joinpoint.

4 Trend
  "rising" = when 95% confidence interval of annual percent change is above 0.
  "stable" = when 95% confidence interval of annual percent change is below 0.
  "falling" = when 95% confidence interval of annual percent change is below).

Source: Death data provided by the National Vital Statistics System public-use data file. Death rates calculated by the National Cancer Institute (NCI) using SEER*Stat. Death rates are age-adjusted to the 2000 U.S. standard population by 5-year age groups. Population counts for denominators are based on census populations, as modified by NCI.

New cancer data also were compiled for mortality due to renal (kidney) failure, a health endpoint of interest due to the renal toxicity of uranium. These data are summarized in Table 3.4-5. Data for the U.S. cover the period 1991 through 2003, while the data for Oklahoma cover the period 1979 through 2003 (data only available for Cherokee and Muskogee counties). Data for Sequoyah and other surrounding counties are suppressed to ensure confidentiality and stability of rate and trend estimates. When the population size for a denominator is small, the rates may be unstable; that is, a small change in the numerator (only one or two additional cases) has a dramatic effect on the calculated rate. Suppression is used to avoid misinterpretation when rates are unstable.

Table 3.4-5 Age-Adjusted Mortality Rates for Renal Failure

Year Range	United States	Oklahoma	Sequoyah County	Cherokee County	Muskogee County
1991-2003	4.2	–	–	–	–
1979-2003	–	5.2	–	8.2	5.3

Source: Death data provided by the National Vital Statistics System public-use data file. Death rates calculated by the National Cancer Institute using SEER*Stat.

3.5 Transportation

This section describes the transportation routes and modes of transportation available to the SFC site.

3.5.1 Roads

U.S. Interstate 40 (I-40) runs immediately south of and adjacent to the SFC property. It is a principal east-west highway and extends from North Carolina to California.

The gates to the SFC site are on State Highway 10, which runs in a north-south direction and connects I-40 and U.S. Highway 64. U.S. Highway 64 runs just north of the SFC property in a path parallel to I-40. The primary road between Tulsa and the Gore area is the Muskogee Turnpike, a four-lane highway that extends from Webbers Falls to Tulsa, a distance of approximately 70 miles. The average daily traffic for the highways most affected by the proposed action and alternatives is provided below in Table 3.5-1.

Table 3.5-1 Average Daily Traffic on Local Highways (2005 Data, both directions)

Highway	Location	Traffic Count
Oklahoma Highway 10	Between Interstate 40 and U.S. Route 64	810
U.S. Route 64	2.4 km (1.5 miles) east of Highway 10	1,600
U.S. Route 64	Just east of Gore, Oklahoma	2,000
Interstate 40	Interstate 40 just west of Arkansas River bridge	17,100
Muskogee Turnpike (10 miles west of site)	Between Webber Falls and Tulsa	21,300

Source: OTCIS 2005; OHS 2005.

3.5.2 Rail

The only railroad in the vicinity of the SFC site is the Union Pacific Railroad, which parallels U.S. Route 64 to the west of Gore but then heads north to a major junction at Wagoner, where connections can be made north to Kansas City and south to Fort Worth. The railroad is almost adjacent to the SFC property on the north, and its principal cargo is grain and coal.

3.5.3 Water

The McClellan-Kerr Arkansas River Navigation System is a series of dams and locks used by large vessels along the Arkansas River. This river links Oklahoma to a 19,312-km (12,000-mile) inland waterway and both domestic and foreign ports (via New Orleans). The headwaters of the waterway is at the Port of Catoosa in Tulsa, Oklahoma, which contains a full intermodal terminal. The Illinois River is not navigable.

3.5.4 Air

Tulsa International Airport and the airport at Fort Smith, Arkansas, would facilitate air travel to the SFC site. Both airports are serviced by major U.S. airlines. The overland drive to Gore is approximately 129 km (80 miles) from Tulsa and 72 kilometers (45 miles) from Fort Smith. An airport and a helicopter landing pad are located within 16 km (10 miles) of the SFC site (see Table 3.5-2).

Table 3.5-2 Airports, Landing Strips, and Helicopter Landing Pads within 10 Miles of the SFC Site

Location of Airport	Airport Name	Distance and Direction from SFC Site	Airport ID
Gore, Oklahoma	Fin & Feather Resort Heliport	12.2 km (7.6 mi) NNE	25OK
Pickens, Oklahoma	Little River Ranch Airport	15.4 km (9.6 mi) SSW	79OK

Source: www.Airnav.com.

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Section 3.1

None

Section 3.2

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4. ENVIRONMENTAL IMPACTS

4.1 Introduction

This chapter provides an evaluation of the potential environmental impacts of the proposed action and its alternatives, including the no-action alternative. The chapter is organized by the environmentally affected areas presented in Chapter 3 (i.e., land use, water resources, public and occupational health, and transportation). Other nondiscriminating environmental resource areas for which the potential impacts were determined to be small are discussed in Appendix B. The potential environmental impacts are assigned a significance level, as defined below. This chapter also discusses the potential cumulative impacts associated the proposed action and other past, present, and reasonably foreseeable actions (Section 4.6).

Determination of the Significance of Potential Environmental Impacts

A standard of significance has been established by the NRC for assessing environmental impacts. With standards based on the Council on Environmental Quality's regulations, each impact should be assigned one of the following three significance levels:

Small. The environmental effects are not detectable or are so minor that they will neither destabilize or noticeably alter any important attribute of the resource.

Moderate. The environmental effects are sufficient to alter noticeably but not to destabilize important attributes of the resource.

Large. The environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

Source: NRC, 2003

4.2 Land Use Impacts

This section presents the potential direct and indirect impacts on land use and the associated tax revenue resulting from implementation of each of the alternatives.

4.2.1 Alternative 1: On-site Disposal of Contaminated Materials (the Licensee's Proposed Action)

The land use changes that would occur under the licensee's proposed action involve the construction of a disposal cell in the former Process Area in the northern portion of the SFC site, the dismantlement/demolition of the process buildings and equipment on the site, and placement of these materials in the disposal cell. The only exceptions to this dismantlement would be the administration building, which would be available for potential reuse, and the electrical substation. In addition, SFC would consolidate other materials such as contaminated soils, sludges, pond residues and sediments, and previously buried waste for placement in the disposal cell (see Chapter 2).

Following completion of surface reclamation, SFC has proposed that a 131-hectare (324-acre) fenced ICB be established around the disposal cell. This buffer zone surrounding the disposal cell would encompass areas that had detectable impacts from past site operations. At license termination, the disposal cell and area within the ICB would be transferred to a long-term custodian (either the State of Oklahoma or the DOE) for perpetual care. The ICB would be restricted in perpetuity from excavation, construction, and production water-well drilling. Authorized personnel would be able to access the ICB for the purposes of monitoring and maintenance.

The licensee would release the remaining 112 hectares (276 acres) of the original 243-hectare (600-acre) SFC site (46% of the SFC site) for unrestricted use. The released land could be appropriate for agricultural or residential development or be maintained as open space or park land, land uses that would be compatible with existing adjacent land uses.

The potential land use impacts of the licensee's proposed action would primarily affect the immediate vicinity of the SFC site rather than the regional area. These land use impacts could be characterized as MODERATE, in that the removal of the process facility and subsequent restrictions to and change in land use following reclamation will be noticeable but not sufficient to destabilize important attributes of the resource.

Implementation of this alternative would have indirect effects on the Sequoyah County tax base as a result of property ownership changes. Depending on future land ownership decision making, the area of the site within the ICB would remain in a custodial care status. If the DOE or another nontaxable governmental entity would assume ownership, the county tax base would be reduced since SFC currently makes an annual property tax payment to Sequoyah County at the same rate it paid when its facility was in operation. In 2004, Sequoyah County collected approximately $1,078,483 in real property taxes and, based on the estimation presented in Section 3.2 following the stoppage of operations at the site, SFC would be responsible for approximately $27,346 in property taxes, which represents about 2.5% of the county's tax revenue. When reclamation of the site is complete, SFC has estimated that $13,620 in property taxes would be due, equating to an overall loss of $13,756 in property tax revenue for the 131 hectares (324 acres) within the proposed ICB. The loss of this property tax revenue is considered a SMALL impact on the Sequoyah County tax base.

The parcels of land outside the ICB that would be released for unrestricted reuse would be subject to property taxes according to the type of reuse and the assessed value. Property tax assessments take into account property location, soil type, and land ownership classification (i.e., agricultural, commercial, residential, etc.). Agricultural land is taxed at a lower rate than commercial or residential uses. Therefore, future property tax revenues to Sequoyah County may be positively or negatively affected by an increase or reduction in future landowner payments. Given the lack of certainty in how and when the property would be redeveloped, the potential impact on the county's tax base cannot be determined at this time.

4.2.2 Alternative 2: Off-site Disposal of All Contaminated Materials

Under this alternative, the licensee would consolidate all contaminated soils, sludges, equipment, structures, and any other contaminated material and transport them via rail to a licensed off-site disposal facility. A 2.6-km (1.6-mile) railroad spur would be constructed to connect to the major railroad line north and east of the site. The railroad spur would traverse a combination of agricultural (pastureland/hayfield) and forestland. A review of recent aerial photographs (NAIP, 2003) indicates that agricultural land covers about 1.6 km (1 mile), or 63%, of the route, while forestland covers about 1 km (0.6 mile), or 27%, of the route. The forestland along the proposed route is contiguous with the forestland on the main SFC site and so is expected to be characterized as secondary growth oak-hickory forest.

The rail spur would be constructed within an approximately 30-meter (100-foot) -wide construction right-of-way (ROW). Establishment of this ROW would result in temporary disturbance of about 5 hectares (12 acres) of agricultural land and temporary removal of about 3 hectares (7 acres) of forestland. Following completion of the rail spur construction, the impacted forestland would be allowed to naturally revegetate. The rail spur would occupy an approximately 12-meter (40-foot) -wide permanently maintained ROW. Establishment of this ROW would result in the permanent removal of about 2 hectares (5 acres) of agricultural land and 1 hectare (3 acres) of forestland. Both of these land uses are common throughout the local area, and the land is currently traversed by numerous roads and existing railroad lines. In addition, the rail spur would require an at-grade crossing of State Highway 10, requiring a traffic stop. A permit would be required for this at-grade road crossing. The temporary and permanent impacts on agricultural and forested land uses associated with construction and operation of the rail spur under Alternative 2 would be considered SMALL.

After off-site transport of the contaminated materials, SFC would conduct further reclamation activities at the site such that the entire 243-hectare (600-acre) property (100% of the SFC site), including the administrative building, could be released for unrestricted future use. Future reuse of the site would likely be consistent with regional trends, which would mean that the land would be used for agricultural, industrial, residential, or recreational development, or open space or park land. The railroad spur would be left intact and could potentially be utilized by future uses on the site. The siting of the spur could be adjusted as necessary to place it outside the controlled area so that it could service the southern, unaffected area of the site for industrial development. All of these uses would be compatible with existing surrounding land uses. The potential for reuse of the site is discussed further in Section 4.7 (Cumulative Impacts).

Under this alternative, direct on-site land use impacts due to land disturbance during restoration would be SMALL. Following removal of the process facility and contaminated materials, the entire site would be available for unrestricted use, which is a MODERATE positive impact on land use.

Impacts on the tax base of Sequoyah County would depend on future land ownership and uses. Therefore, future property tax revenues to Sequoyah County may be positively or negatively affected by an increase or reduction in future landowner payments. Given the lack of certainty in how and when the property would be redeveloped, the potential impact on the county’s tax base cannot be determined at this time.

4.2.3 Alternative 3: Partial Off-site Disposal of Contaminated Materials

Under Alternative 3, only the raffinate sludge and the sludges and soils from the Emergency Basin, North Ditch, and Sanitary Lagoon would be consolidated by the licensee and transported off-site for reuse (raffinate sludge) or to a licensed disposal facility. The remaining contaminated materials would be disposed of by the licensee in an on-site disposal cell, which would be constructed in the same location as the disposal cell under the proposed action. SFC proposes to establish a fenced 131-hectare (324-acre) ICB surrounding the cell and buffer area, which would be restricted in perpetuity from future reuse, including excavation, construction, and production water-well drilling. The proposed ICB and the disposal cell would be transferred to the long-term custody of the State of Oklahoma or the United States.

SFC would release the remaining land (112 hectares [276 acres]), including the administration building, for unrestricted future reuse (46% of the SFC site). The released land could be appropriate for agricultural or residential development, or it could be maintained as open space or park land.

The potential land use impacts resulting from implementation of this alternative would primarily affect the immediate vicinity of the SFC site rather than the regional area. These land use impacts could be characterized as MODERATE.

Implementation of this alternative would have indirect effects on the Sequoyah County tax base as a result of property ownership changes. Depending on future land ownership decision making for the ICB and disposal cell, the tax base of Sequoyah County could be reduced as discussed under Alternative 1, but the impacts would be SMALL.

The parcels of land outside the final ICB would be released for unrestricted reuse, they would be subject to property taxes according to the type of reuse and the assessed value. In this case, as previously stated in Alternative 1, future property tax revenues to Sequoyah County may be positively or negatively affected by an increase or reduction in future landowner payments. Given the lack of certainty in how and when the property would be redeveloped, the potential impact on the county’s tax base cannot be determined at this time.

4.2.4 No-Action Alternative

Under the no-action alternative, SFC would remain responsible for control and maintenance of the entire 243-hectare (600-acre) site indefinitely. There would be no decontamination (other than for purposes of routine maintenance), dismantlement, or removal of equipment or structures, and no soils would be remediated. SFC would be able to continue its current programs of groundwater remediation and monitor the groundwater under the NRC-approved *Groundwater Monitoring Plan*. With the existing levels of contamination in the soil and groundwater, the site would not be suitable for release for redevelopment now or in the foreseeable future. SFC would continue to be responsible for allocating resources to ensure control over the site and to continue some level of maintenance of the site’s infrastructure in perpetuity. Therefore, direct impacts on local or regional land use under the no-action alternative would be LARGE because the unremediated SFC site could potentially result in a wider area of off-site contamination from uncontained sources of radioactive material, thus limiting reuse of surrounding areas for the foreseeable future.

Under the no-action alternative, there would be no change in the annual property taxes paid by SFC relating to this alternatives analysis. However, one ongoing tax base issue may have an indirect fiscal effect on the local county. SFC currently makes an annual property tax payment to Sequoyah County at the same rate it paid when at full operation, and they are negotiating a property tax reduction with the county. SFC believes that the property assessment should take into account the fact that the idle facility no longer generates revenue, which should reduce its assessed value. The potential impact on the county's tax base if conditions do not change would be SMALL. Given the lack of certainty regarding the outcome of negotiations, further assessment cannot be made at this time.

4.3 Impacts on Water Resources

4.3.1 Surface Water Impacts

This section describes potential impacts on surface water that could occur during and following reclamation activities.

4.3.1.1 Alternative 1: On-site Disposal of Contaminated Materials (the Licensee's Proposed Action)

Wastewater generated by SFC during site reclamation (e.g., water from existing ponds and impoundments, storm water runoff from work areas, water used for decontamination and reclamation processes, and recovered groundwater) would be transferred to the on-site wastewater treatment system (SFC, 2006a). This wastewater treatment system, which is located south of the clarifier basins, would be designed for batch treatment of wastewater to remove uranium. The system would remove uranium through precipitation, filtration, and ion-exchange processes before discharging the water to permitted Outfall 001. The water would be tested before discharge to ensure that the uranium concentrations comply with the drinking water standards (SFC, 2005). At least 180 days prior to the use of or changes to the on-site wastewater treatment system and prior to the discharge through permitted Outfall 001, SFC would need to submit a detailed proposal to the Water Quality Division of the DEQ to modify their current OPDES permit. The direct and indirect impacts on surface water on the SFC site during reclamation activities and construction of the disposal cell would be short-term and SMALL.

Areas where SFC has excavated contaminated soil would be backfilled with on-site rock and soil (with concentrations of COCs below cleanup criteria). These areas also would be graded with a slight slope to provide adequate storm water drainage. The disposal cell cap would be covered with topsoil and planted with native vegetation to minimize runoff and erosion (SFC, 2006b). In addition, the majority of pavement and buildings on the site would be removed, thus decreasing site runoff and minimizing long-term effects on surface water quality. The direct and indirect impacts on surface water on the SFC site following reclamation would be SMALL.

4.3.1.2 Alternative 2: Off-site Disposal of All Contaminated Materials

The wastewater generated by SFC during site reclamation would be transferred to a wastewater treatment system (SFC, 2006a) as discussed above under Alternative 1. The treatment system would remove uranium before discharging the water to permitted Outfall 001. The water would be tested before discharge to ensure that the uranium concentrations comply with the drinking water standards (SFC, 2005). At least 180 days prior to the use of or changes to the on-site wastewater treatment system and prior to the discharge through permitted Outfall 001, SFC would need to submit a detailed proposal to the Water Quality Division of the DEQ to modify their current OPDES permit. The direct and indirect impacts on surface water on the SFC site during implementation of Alternative 2 would be short-term and SMALL.

SFC proposes to build a railroad spur that would cross two streams that are intermittent tributaries to Salt Branch (Salt Branch is an intermittent tributary of the Lower Illinois River). During construction, these streams would be directly affected by increased erosion and sedimentation; however, this impact would be minimized through the use of various best management practices (see Chapter 5). Culverts would be installed in both streams to maintain the flow of water following installation of the railroad spur. Impacts would be SMALL.

Areas where SFC has excavated contaminated soil would be backfilled with on-site rock and soil. These areas also would be graded with a slight slope to provide adequate storm water drainage. In addition, contaminated pavement and buildings on the site would be removed, thus decreasing site runoff and minimizing long-term effects on surface water quality. Off-site disposal of soil would not impact the surface water or create any additional surface water waste streams. The direct and indirect impacts on surface water on the SFC site following completion of the licensee's site reclamation activities would be SMALL.

4.3.1.3 Alternative 3: Partial Off-site Disposal of Contaminated Materials

The wastewater generated by SFC during site reclamation would be transferred to a wastewater treatment system (SFC, 2006a), as discussed above under Alternative 1. The treatment system would remove uranium before discharging the water to permitted Outfall 001. The water would be tested before discharge to ensure that the uranium concentrations comply with the drinking water standards (SFC, 2005). At least 180 days prior to the use of or changes to the on-site wastewater treatment system and prior to the discharge through permitted Outfall 001, SFC would need to submit a detailed proposal to the Water Quality Division of the DEQ to modify their current OPDES permit. The direct and indirect impacts on surface water during implementation of Alternative 3 would be short-term and SMALL.

Areas where SFC has excavated contaminated soil would be backfilled with on-site rock and soil. These areas also would be graded with a slight slope to provide adequate storm water drainage. The disposal cell cap would be graded with a slight slope to provide adequate storm water drainage. The cap would be covered with topsoil and planted with native vegetation to minimize runoff and erosion (SFC, 1998). In addition, the majority of contaminated pavement and buildings on the site would be removed, thus decreasing site runoff and minimizing long-term effects on surface water quality. Off-site disposal of soil would not impact the surface water or create any additional surface water waste streams. The direct and indirect impacts on surface water on the SFC site following completion of the licensee's site reclamation activities would be SMALL.

4.3.1.4 No-Action Alternative

As of 2006, measurements of surface water quality on-site and in the vicinity of the site indicated that there had been no significant surface water quality impacts as a result of contamination from the SFC facility since operations ceased in 1993. The contribution from the outfalls to the rivers is minimal due to the flow rates in the rivers when compared to the flow rates from the outfalls. The Illinois River averages a total flow of 1,427 billion liters (377 billion gallons) per year (OWRB, 1995), while the SFC site produced only 2.1 billion liters (0.55 billion gallons) from permitted outfalls in 2007 (SFC, 2008).

In 2007, damage to the liner of Pond 2 caused exceedances of nitrate and ammonia limits specified in the DEQ OPDES permit, leading to a Notice of Violation from the DEQ (DEQ, 2007). The problems associated with these violations have not been resolved as of February 2008; therefore, the potential for future exceedances remains high. Given this potential for future OPDES exceedances, direct and indirect impacts on surface water resources would be MODERATE.

In the long term, as evidenced by the 2007 exceedances, there is the potential for existing contamination to affect surface water resources on and off the SFC site. Therefore, long-term direct and indirect impacts on surface water resources from the SFC site from implementation of the no-action alternative would be MODERATE.

4.3.2 Groundwater Impacts

No groundwater users are located downgradient of the site (i.e., between the site and the Arkansas and Illinois rivers). The levels of groundwater contamination found beneath the SFC site are included in SFC's annual groundwater reports from 2005 (SFC, 2006c) and 2006 (SFC, 2007). These reports provide information on the concentrations and distribution of COCs (uranium, arsenic, nitrate, and fluoride) in the different groundwater systems beneath the site. The results from the annual groundwater reports are summarized in Table 3.3-6. In the deep bedrock groundwater system (Unit 5 shale), only arsenic has been detected above the MCL in one sample. Nitrate and arsenic (at levels of >500 mg/L and 0.1 to 0.5 mg/L, respectively) have been detected at one location at the site boundary (MW095A) (SFC, 2003).

Potential future uses of the site could include agricultural, pasture, residential, or commercial/industrial uses. Therefore, there is a possibility that such future users could access the site groundwater. However, the Atoka Formation, which underlies the SFC site, has limited potential as a groundwater source. Calculated yield rates are low (only a few gallons per minute), and the predominant shales contribute to high sulfate levels (1,750 mg/L) and total dissolved solids concentrations of greater than 3,100 mg/L. For future domestic water consumption, the existing rural water distribution system, which draws water from Lake Tenkiller, would be a more likely source of water due to its better quality and reliability. Water needs associated with future development around the site would be covered under Sequoyah County Rural Water District No. 5 infrastructure provisions. Any water used locally for irrigation or livestock would likely come from the Illinois River due to its better quality and predictable yields. Of the existing wells located within 3 kilometers (2 miles) of the site, none are hydraulically downgradient of the site, i.e., groundwater in the vicinity of the site flows away from the wells.

This section presents the potential impacts on groundwater resources from the proposed action and the alternatives to that action.

4.3.2.1 Alternative 1: On-site Disposal of Contaminated Materials (the Licensee's Proposed Action)

Alternative 1 would involve (1) cleanup of contaminated soils and sediments to the cleanup levels (unrestricted release levels) identified for areas outside the proposed ICB and DCGLs identified for areas within the proposed ICB (see Table 2.2-1), and (2) construction of a disposal cell to hold these materials. In addition, during surface reclamation and disposal cell construction, SFC anticipates encountering groundwater in the terrace and shallow aquifers that has been contaminated by previous site operations. SFC would employ its existing wastewater treatment system to treat any affected groundwater that is recovered during its site reclamation activities. Removal of the contaminated soil and remediation of part of the groundwater systems would reduce the source for further groundwater contamination resulting from past operations. With respect to monitoring the integrity of the disposal cell, the cell liner would be equipped with a leak detection system that would be separate from the groundwater monitoring program. This monitoring system is designed strictly to detect leakage from the cell and would serve as an important safety and environmental protection aspect of the site reclamation.

To address the existing contamination of the site groundwater, SFC has proposed a groundwater *Corrective Action Plan* (SFC, 2003), which is currently under review by the NRC staff. As discussed in Section 2.2.1.6, the purpose of the proposed groundwater *Corrective Action Plan* is to clean up existing groundwater contamination that resulted from previous SFC industrial operations. The goal of the cleanup is to reduce the concentrations of the identified hazardous constituents in the groundwater to the approved concentration limits for each constituent, which are protective of public health and safety and the environment. The hazardous constituents of interest and their respective cleanup standards are provided in Table 3.3-5. The NRC staff's technical and safety review of SFC's proposed groundwater *Corrective Action Plan* will be documented in a TER.

SFC would monitor the progress of groundwater corrective actions under its NRC-approved *Groundwater Monitoring Plan*, as discussed in Chapter 6. SFC's approved monitoring plan addresses identification of (1) hazardous constituents in the groundwater that resulted from licensed site operations; (2) groundwater protection standards for the hazardous constituents; and (3) monitoring locations, frequency, and parameters. SFC would collect and analyze samples from the groundwater, drainages and seeps, and surface water; the frequency of these sampling events is discussed in Chapter 6. SFC is required under its NRC license to submit by April 1 of each year the results of its monitoring analyses in a groundwater compliance monitoring summary report (NRC, 2005).

Following the completion of surface reclamation (including construction of the proposed disposal cell) and groundwater corrective actions, SFC proposes that a portion of the site within the proposed ICB be released to the State of Oklahoma or the United States for long-term restricted use. The long-term custodian would continue the groundwater monitoring program as part of its procedures to assess the performance of the proposed disposal cell. Such a groundwater monitoring program would be part of the custodian's Long-Term Surveillance Plan approved by the NRC.

Land outside the proposed ICB would be released for unrestricted use. Future land uses could involve agricultural, pasture, residential, or commercial/industrial uses; however, the availability and quality of site groundwater is limited (MFG, 2002). It is expected that future users of the site would make use of other water sources (e.g., directly from the adjacent Illinois River or from the established drinking water distribution system within Sequoyah County Rural Water District No. 5).

In summary, as a result of SFC's proposed surface reclamation and groundwater corrective activities, the concentrations of hazardous constituents in the groundwater would be returned to levels that would be protective of public health and safety and the environment. In addition, the potential future use of site groundwater is limited, and future users would be expected to obtain their water from easily obtainable, nearby sources. Therefore, the impact of Alternative 1 on groundwater resources would be SMALL.

4.3.2.2 Alternative 2: Off-site Disposal of All Contaminated Materials

Under this alternative, SFC would conduct reclamation of contaminated soils and sediments at the site, along with other process-related sludges and sediments and building materials, and transport those materials off-site to a licensed disposal facility for permanent disposal or, for selected materials, use as an alternate feed at a uranium recovery mill. An on-site disposal cell would not be constructed. Contaminated soils would be cleaned up to the unrestricted release cleanup levels identified in Table 2.2-1. Contaminated groundwater in the terrace and shallow aquifers that is encountered during surface reclamation would be treated in SFC's existing wastewater treatment system. These actions would reduce the source term for further contamination of site groundwater. To address the existing contamination, groundwater corrective actions and groundwater monitoring would be performed in accordance with plans approved by the NRC.

Following the completion of surface reclamation and groundwater corrective actions, SFC proposes to release the entire 243-hectare (600-acre) site for unrestricted future use. Future land uses could involve agricultural, pasture, residential, or commercial/industrial uses; however, the availability and quality of site groundwater is limited. It is expected that future users of the site would make use of other water sources (e.g., directly from the adjacent Illinois River or from the established drinking water distribution system within Sequoyah County Rural Water District No. 5).

In summary, as a result of SFC's proposed surface reclamation and groundwater corrective activities, concentrations of hazardous constituents in the groundwater would be returned to levels that would be protective of public health and safety and the environment. In addition, the potential future use of site groundwater is limited, and future users would be expected to obtain their water from easily obtainable, nearby sources. Therefore, the impact of Alternative 2 on groundwater resources would be SMALL.

4.3.2.3 Alternative 3: Partial Off-site Disposal of Contaminated Materials

The potential environmental impacts associated with the partial off-site disposal alternative would be similar to those of the Proposed Action (On-site Disposal of Contaminated Materials). Under this alternative, SFC could transport the raffinate sludges and the sludges and sediments from the Emergency Basin, North Ditch, and Sanitary Lagoon to a uranium mill for processing as an alternate feed material, or it could transport these sludges and sediments to an off-site uranium mill tailings impoundment or a licensed disposal facility for permanent disposal. Other contaminated soils, sludges, and sediments removed during surface reclamation would be consolidated, along with building materials, in an on-site disposal cell. SFC would apply the DCGLs and cleanup levels identified in Table 2.2-1 during surface reclamation.

Contaminated groundwater in the terrace and shallow aquifers that is encountered during surface reclamation would be treated in SFC's wastewater treatment system. These actions would reduce the source term for further contamination of site groundwater. To address the existing contamination, groundwater corrective actions and groundwater monitoring would be performed in accordance with NRC-approved plans.

Following the completion of reclamation activities and groundwater corrective actions, the portion of the site within the proposed ICB would be transferred to a long-term custodian for perpetual care. The long-term custodian would implement a groundwater monitoring program as part of its procedures to assess the performance of the proposed disposal cell. Such a groundwater monitoring program would be part of the custodian's Long-Term Surveillance Plan approved by the NRC.

SFC proposes that land outside the proposed ICB be released for unrestricted use. Future land uses could involve agricultural, pasture, residential, or commercial/industrial uses; however, the availability and quality of site groundwater is limited due to low yields and poor natural water quality. Future users of the site would likely make use of other water sources (e.g., directly from the adjacent Illinois River or from the established drinking water distribution system within Sequoyah County Rural Water District No. 5).

In summary, as a result of SFC's proposed surface reclamation and groundwater corrective activities, concentrations of hazardous constituents in the groundwater would be returned to levels that would be protective of public health and safety and the environment. In addition, the potential future use of site groundwater is limited, and future users are expected to obtain their water from easily obtainable, nearby sources. Therefore, the impact of Alternative 3 on groundwater resources would be SMALL.

4.3.2.4 No-Action Alternative

Under the no-action alternative, SFC would not conduct remediation of existing soil contamination. Instead, SFC would continue to conduct its current program of site surveillance, groundwater remediation, and monitoring. Progress toward eventual license termination would not occur, and no portion of the SFC site would be released for restricted or unrestricted use. SFC is currently conducting groundwater corrective actions and monitoring, and these actions would continue under this alternative. The results of SFC's groundwater monitoring program during 2005 and 2006 are provided in Table 3.3-6.

Because excavation of contaminated soils and treatment of affected near-surface groundwater would not occur, contamination of the site groundwater would likely continue because the source for such contamination would not be addressed. As a result, while current groundwater corrective actions and associated monitoring would continue, contamination of site groundwater would likely continue for an extended period of time. Therefore, the impacts of the no-action alternative on groundwater would be MODERATE.

4.4 Public and Occupational Health Impacts

This section discusses potential health impacts of the proposed alternatives (with the exception of transportation impacts, which are discussed in Section 4.5) on the surrounding population and the proposed SFC reclamation workforce. The analysis considered the following radiological impacts (radiation doses and risks) and nonradiological impacts (industrial accidents and exposures to hazardous chemicals) on public health and occupational workers:

- Radiation doses and risks for members of the public during reclamation. The NRC staff considered the affected population to be that within 80 km (50 miles) of the SFC facility. The primary exposures would be from radioactive material suspended in the atmosphere by reclamation operations.

- Long-term doses and risks for individuals who inhabit the site. Because of the long half-lives of the radioactive materials at the SFC site, should there be a loss of institutional controls or license conditions, it may be possible that individuals could come to inhabit both the unrestricted and restricted portions of the site in the future.

- Potential radiological impacts on workers during site reclamation activities.

- Radiological impacts for average exposed workers during the period of custodial care.

- Exposures to hazardous chemicals.

- Injuries and fatalities in the workforce during reclamation activities.

Radiological Dose Assessment. Because there would be no high-energy sources (e.g., explosives or nuclear fuel) that could lead to accidents involving radioactive material during site reclamation, there would be little potential for off-site radiological consequences from accidents. This analysis did not include exposure of off-site members of the public to radiation from any on-site accidents because it was determined that the impacts from transportation of the waste off-site exceeded those from any on-site accident. For exposure to ionizing radiation, the impacts are expressed in terms of dose. The following fundamental definitions apply:

- **Dose Equivalent.** The product of the absorbed dose in tissue, quality factor (to account for different types of ionizing radiation), and all other necessary modifying factors at the location (organ) of interest. The units of dose equivalent are sievert and rem.

- **Deep Dose Equivalent.** The dose equivalent at a tissue depth of 1 cm for whole body exposure to ionizing radiation sources external to the body.

- **Committed Effective Dose Equivalent (CEDE).** The internal dose to the body over 50 years from sources internal to the body after inhalation or ingestion of radioactive material.

- **Total Effective Dose Equivalent.** The sum of the deep dose equivalent received for radiation from sources external to the body and the CEDE.

- **Annual Dose.** The radiation dose received in one year.

- **Lifetime Dose.** The radiation dose received in a lifetime.

- **Collective Dose.** The total radiation dose received by a population. Collective dose is expressed in units of person-sievert or person-rem. Note that the annual collective dose is the dose to a population in one year, and the collective lifetime dose is the dose to a population over their lifetimes.

Title 10, "Energy," of CFR Part 20 contains the regulations related to radiation doses during reclamation of the SFC site. This regulation provides the regulatory limits for occupational (worker) doses and radiation dose for individual members of the off-site public. For occupational doses, 10 CFR § 20.1201 states that licensees must limit the occupational dose to individual adults to an annual limit based on the more limiting of:

- The total effective dose equivalent (TEDE) being equal to 0.05 sievert (5 rem), or

- The sum of the deep dose equivalent and the committed dose equivalent to any individual organ or tissue, other than the lens of the eye, being equal to 0.5 sievert (50 rem).

The annual limits to the lens of the eye, to the skin of the whole body, and to the skin of the extremities are:

- A lens dose equivalent of 0.15 sievert (15 rem).

- A shallow-dose equivalent of 0.5 sievert (50 rem) to the skin of the whole body.

- A shallow-dose equivalent of 0.5 sievert (50 rem) to the skin of any extremity.

For members of the public during reclamation, and for industrial workers during long-term maintenance periods (who also are assumed to be members of the public), the regulation provides an explicit TEDE limit of 1.0 millisievert (100 millirem) per year from all sources. This limit includes both internal and external doses through all pathways, including food, as required by specific exposure scenarios. External dose rates cannot exceed 0.02 millisievert (2 millirem) in any 1 hour. Further, the standards in 10 CFR § 20.1101 and 40 CFR Part 190 would be generally applicable during reclamation: 40 CFR Part 190 requires that routine releases from uranium fuel-cycle facilities to the general environment do not result in annual doses above 0.25 millisievert (25 millirem) to the whole body, 0.75 millisievert (75 millirem) to the thyroid, and 0.25 millisievert (25 millirem) to any other organ.

For alternatives that would result in unrestricted release of the site, doses to members of the public are limited by determining the CLs using the benchmark dose approach in 10 CFR Part 40, Appendix A (see Section 4.4.1.1). Appendix D of this EIS presents the detailed calculations applicable to radiation dose and risk assessment for the radiological impact analysis. As described in Appendix D, Section D.2.1.3, the analysis based the CLs on a fraction of the benchmark dose for radium of 0.54 millisievert (54 millirem) per year.

Chemical Screening-Level Risk Analysis. The NRC staff performed a screening-level risk analysis in order to assess potential adverse health effects associated with chemical (nonradiological) contamination in soils and sediments at the SFC site. Soil and sediment data from previously conducted investigations were compared to background soil concentrations and human health-based, medium-specific screening levels for residential use. Data presented in the following reports served as the basis for this comparison:

- *Sequoyah Fuels Corporation Site Characterization Report* (SFC, 1998);
- *Sequoyah Fuels Corporation Facility Environmental Investigation Findings Report*, Volumes 1-5 (SFC, 1991);
- *Sequoyah Fuels Corporation Final RCRA Facility Investigation Report* (SFC, 1996).

Soil data from these reports were compared to U.S. EPA Region 6 Human Health Medium-Specific Screening Levels for residential use (EPA, 2007a). The Region 6 values consider exposure through incidental ingestion of soil, dermal (skin) contact with soil, and inhalation of soil particulates. These values were developed using equations from EPA guidance and commonly used EPA default exposure factors. Toxicity information and other chemical factors used to develop screening levels are published by the EPA or academic sources. The Region 6 soil screening values (EPA, 2007a) are based on a noncancer hazard index of 1 and a total excess cancer risk of 1E-06 (1 in a million, or 1×10^{-6}). If the concentrations of nonradiological contaminants at a site do not exceed the applicable screening levels, there would be no expectation of adverse health effects resulting from exposure to site contamination screened using this method. In addition to comparing site data to Region 6 screening values, concentrations of chemicals detected in soils and sediment were compared to background concentrations.

The analysis indicated that fluoride levels in soil and sediment exceeded background and Region 6 health-based screening criteria at many locations throughout the site. Exceedances of Region 6 health-based screening criteria and background levels also were noted for arsenic (five locations), lead (three locations), antimony (two locations), and lithium, molybdenum, nickel, vanadium, copper, and chromium (one location each). Appendix D provides the details of this screening-level analysis.

The following sections describe potential public and occupational health impacts associated with SFC's proposed alternative and other alternatives.

4.4.1 Alternative 1: On-site Disposal of Contaminated Materials (the Licensee's Proposed Action)

This section describes the potential health radiological and nonradiological impacts on the surrounding population and the proposed SFC reclamation workforce during implementation of the licensee's proposed action.

4.4.1.1 Public and Worker Radiation Doses and Risks

Table 4.4-1 summarizes the estimated potential public and worker radiation doses for Alternative 1. The results are for individual annual radiation doses, individual lifetime doses (i.e., the total dose to an individual over their lifetime from Alternative 1), and collective lifetime doses (i.e., the total lifetime radiation dose to the affected population). The individual annual doses are within the regulatory dose limits (100 mrem/yr public, 5,000 mrem/yr worker). The resultant individual lifetime doses and collective lifetime doses are used to estimate the lifetime risk to workers and members of the public, and these populations as a whole. The estimated maximum collective lifetime dose to members of the public during reclamation would be 0.005 person-sievert (0.5 person-rem). The average collective lifetime dose to workers for Alternative 1 would be 0.33 person-sievert (33 person-rem).

Table 4.4-1 Public and Worker Radiation Doses Under Alternative 1

Dose Receptor	Individual Annual Dose mSv/yr (mrem/yr)	Individual Lifetime Dose mSv (mrem)	Collective Lifetime Dose person-Sv (person-rem)
Off-site Public Doses during Reclamation	0.005 (0.5)	0.02 (2.0)	0.005 (0.5)
Average Worker Doses during Reclamation	2.2 (220)	8.8 (880)	0.33 (33)
Maximum Annual Worker Doses during Reclamation	7.4 (740)	N/A	N/A
Long-term Public Doses in the Restricted Area if Custodial Care of the ICB is Lost (Residential Farmer Scenario)	0.54 (54)	38 (3,800)	N/A
Long-term Public Doses in the Unrestricted Area	0.095 (9.5)	6.6 (660)	N/A
Worker Doses during the Custodial Care Period	0.002 (2)	0.6 (60)	N/A

mSv – millisievert
yr – year
mrem – millirem
Sv – sievert
N/A – Not Applicable.

To account for the long half-lives of the radionuclides within the ICB at the SFC site, SFC used the residential farmer scenario as the basis for estimating the DCGLs beyond the period of long-term custodial care.

DCGLs are residual radionuclide concentrations in soil that result in the appropriate dose limit using a computer-modeled radiation pathway analysis. The scenario that was modeled by SFC and was accepted by NRC was of a hypothetical residential farmer residing within the restricted area of the ICB (SFC, 2006). This scenario included the following radiation exposure pathways:

- External exposure from soil.
- Inhalation of suspended soil.
- Ingestion of soil.
- Ingestion of plant products grown in contaminated soil and using potentially contaminated surface water to supply irrigation.
- Ingestion of animal products grown on the site using feed and surface water from potentially contaminated sources.
- Ingestion of fish from potentially contaminated surface water on the site.

SFC indicated that it did not consider two potential exposure pathways:

- **Groundwater usage:** SFC indicated that there are no existing active water wells near or downgradient from the facility that migrating contaminants could affect. The only active wells in the nearby region are either upgradient or so far removed that future impacts are not possible. The shallow aquifers cannot produce sufficient water to qualify as potential drinking water sources or are of such poor quality that well water would not be a suitable source for domestic purposes (MFG, 2002). Because of limited groundwater in this region of Oklahoma, there are extensive potable water distribution systems that use surface-water sources (SFC, 2006). Specifically, the Sequoyah County Rural Water District No. 5 is the designated district for supplying future water needs for the SFC site.

- **Radon inhalation:** SFC indicated that it did not consider radon inhalation because, consistent with EPA guidance, it applied the DCGLs in soil for radium found in the regulations (10 CFR Part 40, Appendix A). When the default regulatory limits are used, radon calculations are not required.

In addition, SFC indicated that it did not consider scenarios that involved the inadvertent construction of a house with a basement over the disposal cell during the licensed or custodial care periods. SFC eliminated these scenarios because basement construction is not a common

> **Sum-of-Ratio Method:** When a mixture of radionuclides is present, the ratio of the concentration of each radionuclide to its calculated DCGL is determined first. These ratios are then summed over all of the radionuclides. If this sum is less than or equal to 1, then the resulting dose for the mixture is within the dose criterion.

feature of homes in northeast Oklahoma. Further, the SFC cell design, including the application of an outer covering of riprap to the disposal cell, would prevent human intrusion (SFC, 2006).

SFC based its development of the DCGLs on a radiation exposure scenario analysis using the RESRAD computer program (Yu et. al., 2001) and applying the benchmark dose approach in 10 CFR Part 40, Appendix A. This approach is described in Appendix D of this EIS. In summary, benchmark doses result from a radiation pathway scenario modeling analysis of the radium soil contamination at the accepted regulatory level of 0.18 becquerel (5 pCi) per gram in surface soil (see Table 4.4-2). SFC then used the benchmark doses to define the residual contamination levels for other radionuclides that might be present. SFC then applied the sum-of-ratios requirement to ensure that the total dose for the residual mixture of radionuclides would not exceed the benchmark dose.

SFC determined that the benchmark dose for radium would be 0.54 millisievert (54 millirem) per year, which is within the public radiation protection limit of 1 millisievert (100 millirem) per year. The individual lifetime dose, assuming the residential farmer lived within the ICB for 70 years, would then be 38 millisievert (3,800 millirem).

SFC developed CLs for uranium and thorium-230 that are lower than their DCGLs to ensure application of the "as low as reasonably achievable (ALARA)" principle. The CL for radium is equal to the regulatory limit. Table 4.4-2 summarizes the DCGLs and CLs developed by SFC.

Table 4.4-2 DCGLs and CLs

Condition	Natural Uranium Bq/g (pCi/g)	Thorium-230 Bq/g (pCi/g)	Radium-226 Bq/g (pCi/g)[a]
DCGL	21 (570)	2.4 (66)	0.18/0.56 (5.0/15)
CL	3.7 (100)	≤0.52/1.6 (14/43)	≤0.18/0.56 (5.0/15)

Source: SFC, 2006.

[a] As stated in 10 CFR 40, Appendix A, Criterion 6(6), the concentration of radium in the first 15-centimeter (5.9-inch) layer below surface, followed by the concentrations in subsequent 15-centimeter layers more than 15 centimeters below the surface. CLs for thorium-230 also to be applied at same incremental depths.

The resulting estimated annual radiation dose to a member of the public in the unrestricted area of the site would be 0.095 millisievert (9.5 millirem) per year. The analysis estimated this annual dose by multiplying the ratio of the CL to the DCGL for natural uranium by the benchmark dose. This dose would be well within the public radiation protection limit of 1 millisievert (100 millirem) per year. If this individual resided in the unrestricted area for 70 years, the lifetime dose for the unrestricted area would be about 6.6 millisievert (660 millirem).

The analysis estimated worker radiation doses during the custodial care period. An industrial worker employed by or under contract to the long-term custodian would perform maintenance tasks. The applicable regulatory dose limit would be 1 millisievert (100 millirem) per year to a member of the public. SFC assumed that the concentration of residual radioactive material would be equivalent to the DCGLs. The exposure pathways include (SFC, 2006):

- External exposure to penetrating radiation from radionuclides in soil.
- Inhalation of suspended soil.

- Ingestion of soil.

SFC did not consider additional pathways because the industrial workers would not be involved in farming activities, use groundwater or surface water, or be exposed to indoor radon. SFC assumed the worker would perform maintenance activities within the proposed ICB for a total of 130 hours per year: 32 hours sampling on-site wells and 98 hours mowing (SFC, 2006). The result of the SFC dose assessment was about 0.02 millisievert (2 millirem) per year to this industrial worker. The analysis assumed that the same individual would work at the site for 30 years conducting maintenance activities. The resulting lifetime dose would be about 0.6 millisievert (60 millirem).

The NRC staff considers the estimated radiation doses after reclamation activities to be conservative bounding estimates because the land, either within the ICB or in the unrestricted area, would contain radionuclide concentrations in surface soil that would be much lower than the DCGLs or CLs. This is because SFC proposes to use clean soil to cover the contaminated areas after moving the contaminated soil to the disposal cell within the ICB. Further, facility operations have left the unrestricted areas largely unaffected; therefore, radionuclide concentrations in those unrestricted areas reflect background levels.

Table 4.4-3 summarizes public and worker radiation risks for Alternative 1 in terms of the probability of latent cancer fatalities (LCFs). The estimated probabilities of LCFs use dose-to-risk conversion factors of 4×10^{-5} (4 in 10,000) per millisievert (4×10^{-7} [4 in 10 million] per millirem) for the reclamation for industrial workers (ICRP, 1990) and 6×10^{-5} (6 in 10,000) per millisievert (6×10^{-7} [6 in 10 million] per millirem) for members of the public based on current EPA information (Eckerman et al., 1999).

Latent cancer fatalities (LCFs) are potential cancer deaths caused by exposure to ionizing radiation. They are derived and based on scientific evaluation of exposed populations, including survivors of nuclear weapons detonations. Multiplying the annual or lifetime radiation dose to an individual or population by a dose-to-risk conversion factor results in the estimate of LCF probability.

Table 4.4-3 Public and Worker Estimated Probabilities of LCFs Under Alternative 1

Risk Receptor	Individual Annual Risk (LCF)	Individual Lifetime Risk (LCF)	Collective Lifetime Risk (LCF)
Off-site Public Risks during Reclamation	3.0×10^{-7}	1.2×10^{-6}	1.2×10^{-3}
Average Worker Risks during Reclamation	8.8×10^{-5}	3.5×10^{-4}	1.3×10^{-2}
Maximum Annual Worker Risks During Reclamation	3.0×10^{-4}	N/A	N/A
Long-term Public Risks if Custodial Care of the ICB is Lost	3.2×10^{-5}	2.3×10^{-3}	N/A
Long-term Public Risks in the Unrestricted Area	5.7×10^{-6}	4.0×10^{-4}	N/A
Worker Risks during Custodial Care Period	8.0×10^{-7}	2.4×10^{-5}	N/A

N/A – Not Applicable.

The estimated annual radiation doses, either to members of the public or to workers, are within the regulatory limits, and the estimated individual lifetime probabilities of LCFs are low (10^{-6} to 10^{-3}); therefore, the impacts on occupational workers and the public from exposure to radiation would be SMALL.

4.4.1.2 Exposures to Hazardous Chemicals

SFC's proposed reclamation activities would remove the vast majority of chemical (nonradiological) contamination present on the SFC site outside of the disposal cell area. As indicated on Figure 4.4-1, the chemical contamination identified during various site investigations (see Appendix D.3) is either under the disposal cell footprint or within the SFC site ponds and lagoons that will be remediated during the implementation of Alternative 1. Table 4.4-4 and Figure 4.4-2 identify the only sampling location that would have contaminant concentrations exceeding a screening criterion outside of the remediation areas. Fluoride was detected above a screening criterion (3,700 mg/kg fluoride, residential [EPA 2007b]) in sample BH093, which was collected from subsurface soil located northwest of Fluoride Holding Basin No. 2 (SFC, 1998). Fluoride concentrations in the 0 to 6.7-meter (0 to 22-foot) bgs interval did not exceed the screening criterion, but the concentrations in the 6.7- to 7.9-meter (22- to 26-foot) bgs interval did exceed the screening criterion. It is unlikely that future receptors would contact soil at this depth; therefore, this area is not of concern for adverse health effects resulting from direct contact.

Table 4.4-4 Sample Locations Exceeding a Screening Criterion after Implementation of the Proposed Action

Sample ID	Analyte	Concentration (mg/kg)	Sample Depth meters (feet)	Sample Date
BH093	Fluoride	7,480	6.1 to 6.7 (20.00) (22.00)	3/15/1991
BH093	Fluoride	21,400	6.7 to 7.3 (22.00) (24.00)	3/15/1991
BH093	Fluoride	10,000	7.3 to 7.9 (24.00) (26.00)	3/15/1991

Source: SFC, 1998.

During site reclamation activities, SFC proposes to conduct mitigation procedures to protect workers from inhalation of dust that may be contaminated with chemical or radiological contaminants (see Section 5).

As described in Chapter 2, the disposal cell would be capped, and a perimeter fence would be constructed around the ICB. For contamination to pose a human health risk, there must be a complete pathway of exposure from the contamination to human receptors. The disposal cell cap would prevent human exposure to the chemical contamination in the disposal cell and the impact on the occupational worker and the public following reclamation would be SMALL.

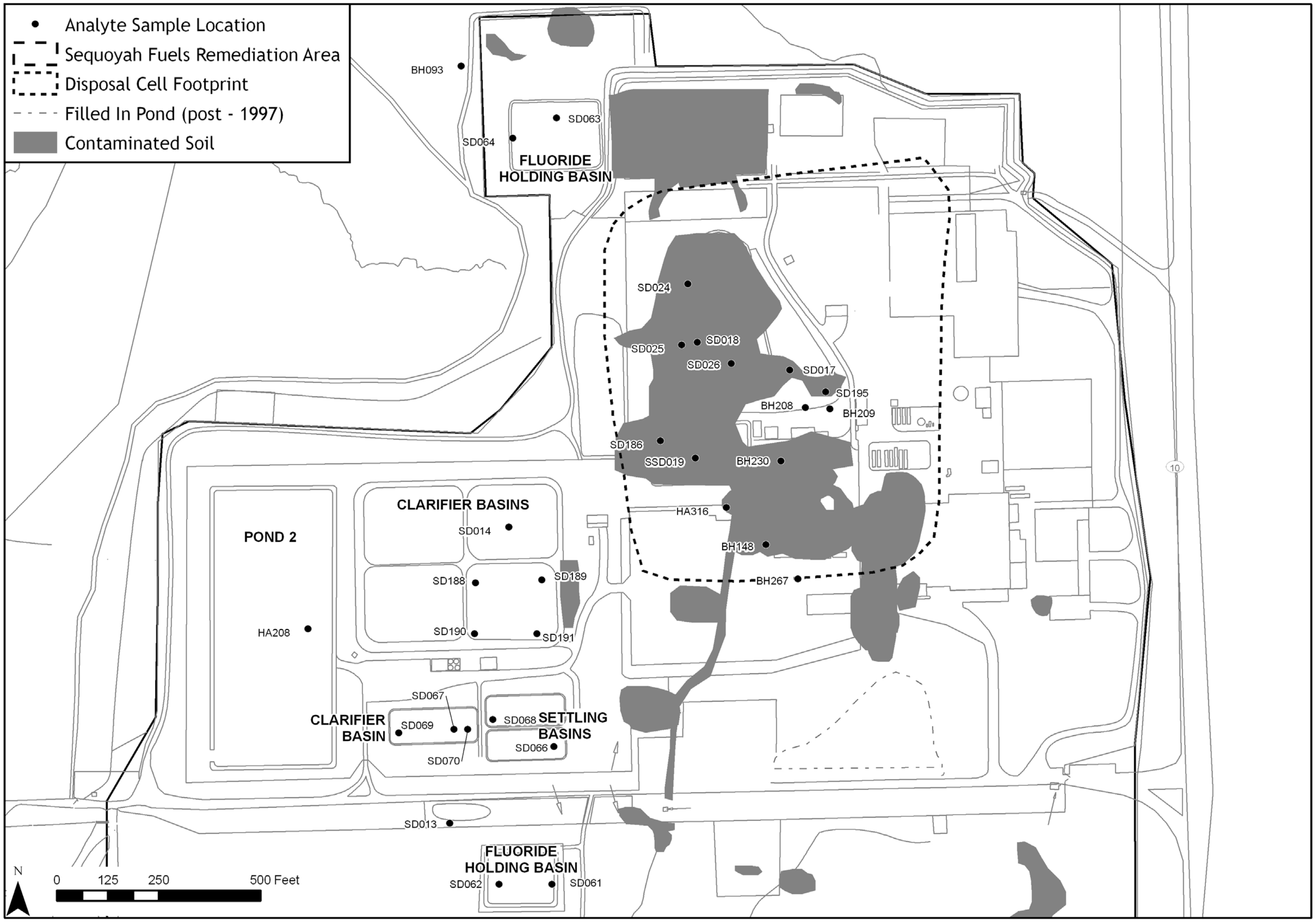

Figure 4.4-1 Sample Locations that Currently Exceed Screening Criteria at SFC Site

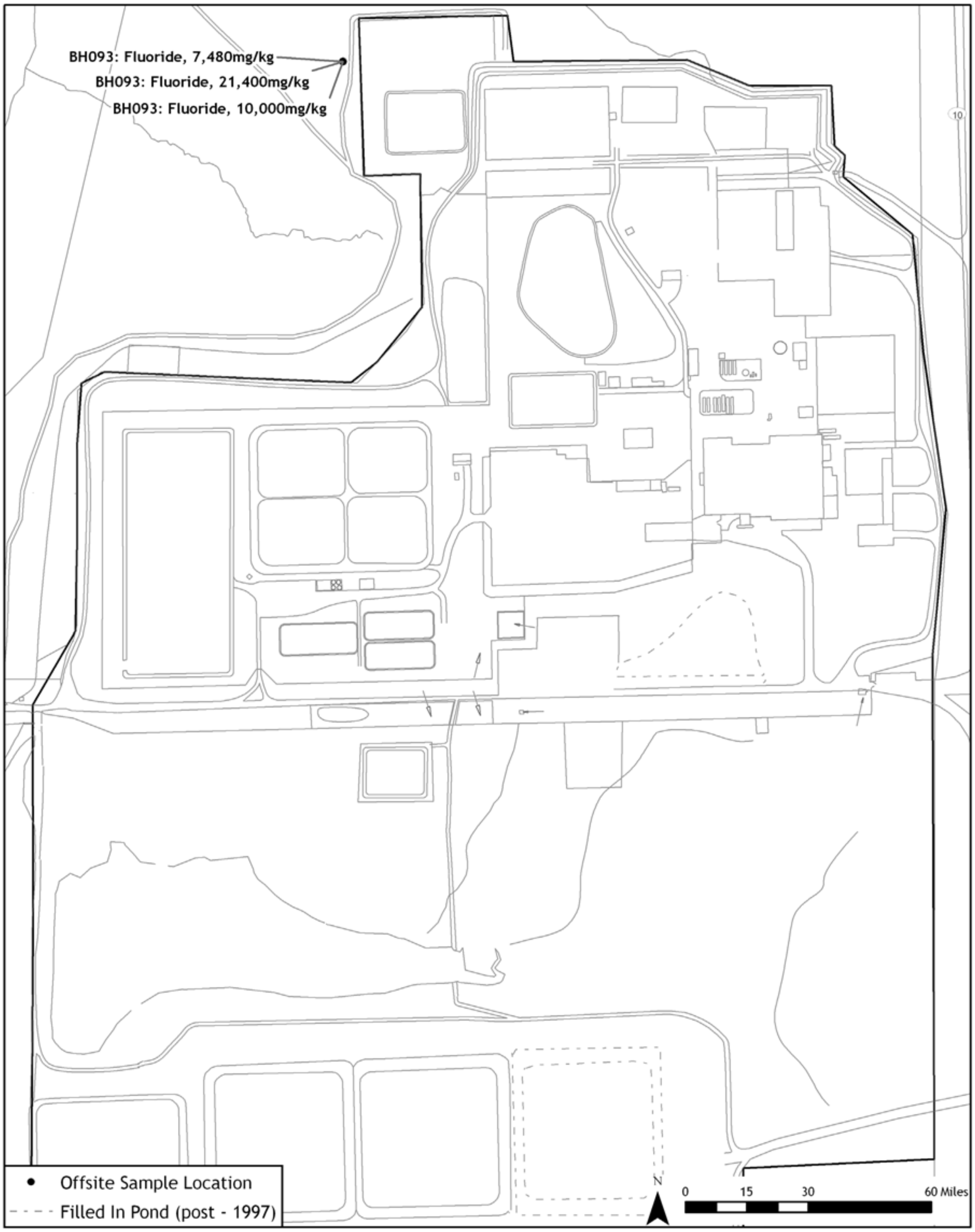

Figure 4.4-2 Soil Sample Location Outside Soil Removal Areas and Depth of Alternative 1

4.4.1.3 Potential Nonfatal and Fatal Occupational Injuries

SFC's proposed action involves major construction activities (construction, excavation, and demolition) with the potential for industrial accidents related to construction and demolition vehicle accidents, material-handling accidents, falls, etc. These accidents could result in temporary injuries, long-term injuries and/or disabilities, and even fatalities. The NRC does not anticipate any of the proposed activities to be any more hazardous than expected for a major industrial construction or demolition project.

To estimate the number of potential nonfatal and fatal occupational injuries that would result from implementation of Alternative 1, data on nonfatal and fatal occupational injuries per year were collected from the DOL, Bureau of Labor Statistics. Nonfatal occupational injury rates specific to Oklahoma for the year 2005 and national fatal occupational injury rates for the year 2005 for the construction industry were used to estimate the potential nonfatal and fatal injuries that could occur during implementation of Alternative 1. The expected nonfatal and fatal injuries presented in Table 4.4-5 were based on SFC's estimated peak labor force of 72 employees and a total workforce of 207.5 man-years performing construction, demolition, excavation, and recovery work over a 4-year period. An estimated 6.6% of the workforce is expected to experience nonfatal injuries, which would result in approximately five injuries during the peak period of construction and 14 injuries over the 4-year period. The number of fatalities that would be expected to occur over the 4-year period is estimated to be less than 1 (0.02). Thus, the impact from nonfatal and fatal injuries would be SMALL.

Table 4.4-5 Expected Occupational Injuries for On-site Workers Under Alternative 1

Category	Injury Rate	Peak Year	Total for 4 Years
Nonfatal Injuries	0.066	5	14
Fatal Injuries	0.00011	0.008	0.02

Source: DOL, 2005.

The NRC also has considered impacts from criteria pollutants. Criteria pollutants would be generated at the site by combustion engines used in heavy equipment. As discussed in Section 1.4.6 and Appendix B, the impacts on human health and safety from air pollutants are expected to be SMALL and, therefore, are excluded from detailed analysis.

4.4.2 Alternative 2: Off-site Disposal of All Contaminated Materials

This section describes the potential radiological and nonradiological health impacts on the surrounding population and the proposed SFC reclamation workforce during implementation of Alternative 2.

4.4.2.1 Public and Worker Radiation Doses and Risks

Table 4.4-6 summarizes the estimated potential public and worker radiation doses for Alternative 2. The analysis estimated these radiation doses using the same methods as those used for Alternative 1, with modified input for the numbers of exposed individuals, hours of labor, and duration of reclamation activities. The public and worker doses would be well within the appropriate regulatory dose limits. The estimated maximum collective lifetime dose to members of the public during reclamation would be 0.02 person-sievert (2.0 person-rem). The average collective lifetime dose to reclamation workers for Alternative 2 would be 0.34 person-sievert (34 person-rem). The doses shown in Table 4.4-6 are the same as those of the relevant dose receptors identified in Alternative 1 (shown in Table 4.4-1). The major differences between Alternatives 1 and 2 are the inclusion in Alternative 1 of long-term public doses (assuming loss of custodial care) and worker doses during the custodial care period.

Table 4.4-6 Public and Worker Radiation Doses Under Alternative 2

Dose Receptor	Individual Annual Dose mSv/yr (mrem/yr)	Individual Lifetime Dose mSv (mrem)	Collective Lifetime Dose person-Sv (person-rem)
Off-site Public Doses during Reclamation	0.005 (0.5)	0.02 (2.0)	0.02 (2.0)
Average Worker Doses During Reclamation	2.2 (220)	8.8 (880)	0.34 (34)
Maximum Annual Worker Doses during Reclamation	7.4 (740)	N/A	N/A
Long-term Public Doses Following Reclamation	0.095 (9.5)	6.6 (660)	N/A

N/A– Not Applicable.

Using the benchmark dose approach and the unrestricted CLs described for Alternative 1, the analysis determined that the estimated dose to a member of the public after unrestricted release of the site would be about 0.095 millisievert (9.5 millirem) per year. This dose would be within the public radiation protection limit of 1 millisievert (100 millirem) per year. The estimated individual lifetime dose for the unrestricted area, assuming 70 years of site residency, would be 6.6 millisievert (660 millirem).

Table 4.4-7 summarizes the estimated public and worker radiation risks for Alternative 2. The estimated public and worker radiation risks for Alternative 2 are the same as those estimated for the relevant risk receptors of Alternative 1. The major difference between Alternative 1 and Alternative 2 is the inclusion in Alternative 1 of long-term public risks if custodial care of the ICB is lost. Annual radiation doses, either to members of the public or to workers, would be within regulatory limits, and all the estimated individual lifetime probabilities of LCFs would be low (10^{-6} to 10^{-4}); therefore, the significance levels of all worker or public radiation doses and risks under Alternative 2 would be SMALL. There would be no long-term public or maintenance worker doses or risks because there would be no custodial care period under Alternative 2.

Table 4.4-7 Public and Worker Estimated Probabilities of LCFs Under Alternative 2

Risk Receptor	Individual Annual Risk (LCF)	Individual Lifetime Risk (LCF)	Collective Lifetime Risk (LCF)
Off-site Public Risks during Reclamation	3.0×10^{-7}	1.2×10^{-6}	1.2×10^{-3}
Average Worker Risks during Reclamation	8.8×10^{-5}	3.5×10^{-4}	1.4×10^{-2}
Maximum Annual Worker Risks during Reclamation	3.0×10^{-4}	NA	NA
Public Risks from the Potential Use of the Unrestricted Area	5.7×10^{-6}	4.0×10^{-4}	N/A

N/A – Not Applicable

4.4.2.2 Exposures to Hazardous Chemicals

SFC's proposed reclamation activities would remove the vast majority of chemical (nonradiological) contamination present on the SFC site. The contaminated materials would be removed from the site and there would be no disposal cell.

Table 4.4-8 and Figure 4.4-3 identify the sampling locations that would have contaminant concentrations exceeding a screening criterion outside of the remediation areas following implementation of Alternative 2. Fluoride was detected above a screening criterion (3,700 mg/kg fluoride, residential [EPA 2007b]) in sample BH093, which was collected from subsurface soil located northwest of Fluoride Holding Basin No. 2 (SFC, 1998). Fluoride concentrations in the 0 to 6.7-meter (0 to 22-foot) bgs interval did not exceed the screening criterion, but the concentrations in the 6.7- to 7.9-meter (22- to 26-foot) bgs interval did exceed the screening criterion. It is unlikely that future receptors would contact soil at this depth; therefore, this area is not of concern for adverse health effects resulting from direct contact.

Table 4.4-8 Sampling Locations Exceeding a Screening Criterion that Will Not be Removed in Alternative 2 Cleanup Implementation

Sample ID	Analyte	Concentration (mg/kg)	Sample Depth meters (feet)			Sample Date
BH093	Fluoride	7,480	6.1 (20.00)	to	6.7 (22.00)	3/15/1991
BH093	Fluoride	21,400	6.7 (22.00)	to	7.3 (24.00)	3/15/1991
BH093	Fluoride	10,000	7.3 (24.00)	to	7.9 (26.00)	3/15/1991
BH230	Fluoride	10,834	0.76 (2.50)	to	0.9 (3.00)	3/11/1991
BH230	Fluoride	11,097	1.1 (3.5)	to	1.19 (3.9)	3/11/1991
SD017	Fluoride	10,300	0 (0)	to	1.22 (4.00)	2/1/1995

Table 4.4-8 Sampling Locations Exceeding a Screening Criterion that Will Not be Removed in Alternative 2 Cleanup Implementation

Sample ID	Analyte	Concentration (mg/kg)	Sample Depth meters (feet)	Sample Date
SD195	Fluoride	14,800	0 (0) to 1.22 (4.00)	10/17/1995

Source: SFC, 1996 and 1998.

Soil samples collected from 0 to 1.2 meters (0 to 4 feet) bgs at locations SD017 and SD195, and 0.76 to 1.19 meters (2.5 to 3.9 feet) bgs at location BH230 contained fluoride concentrations above the screening criterion (SFC, 1998). SFC has proposed excavating the top layer (0 to 0.3 meter [0 to 1 foot] bgs) of soil at this location, but remediation below 0.3 meter (1 foot) has not been proposed. When the SFC site is released for unrestricted use following implementation of Alternative 2, excavation and regrading of the site during future construction activities could bring this soil to the surface and potentially result in localized surface soil concentrations exceeding Region 6 screening values for residential use.

During site reclamation activities, SFC proposes to conduct mitigation procedures to protect workers from inhalation of dust that may be contaminated with chemical or radiological contaminants (see Chapter 5).

Overall, the risk of the pubic coming into contact with hazardous chemicals remaining on the SFC site would be low; therefore, the impact would be SMALL.

4.4.2.3 Potential Nonfatal and Fatal Occupational Injuries

Alternative 2 involves major construction (excavation and demolition) activities in addition to the construction of an on-site rail loading facility. These activities have the same potential for industrial accidents as Alternative 1, i.e., construction vehicle and demolition equipment accidents, material-handling accidents, falls, etc. These accidents could result in temporary injuries, long-term injuries and/or disabilities, and even fatalities. The NRC does not anticipate any of the proposed activities to be any more hazardous than expected for a major industrial construction or demolition project.

To estimate the number of potential nonfatal and fatal occupational injuries that would result from implementation of Alternative 2, data on nonfatal and fatal occupational injuries per year were collected from the DOL, Bureau of Labor Statistics, for the year 2005, as described in Alternative 1 (see Section 4.4.1.3). The expected nonfatal and fatal injuries presented in Table 4.4-9 were based on SFC's estimated peak labor force of 73 employees and a total workforce of 220 man-years performing construction work over a 4-year period. An estimated 6.6% of the workforce is expected to experience nonfatal injuries, which would result in approximately five injuries during the peak period of construction and 14 injuries over the 4-year period. The number of fatalities that would be expected to occur over the 4-year period is estimated to be less than 1 (0.02). Thus, the impact from nonfatal and fatal injuries would be SMALL.

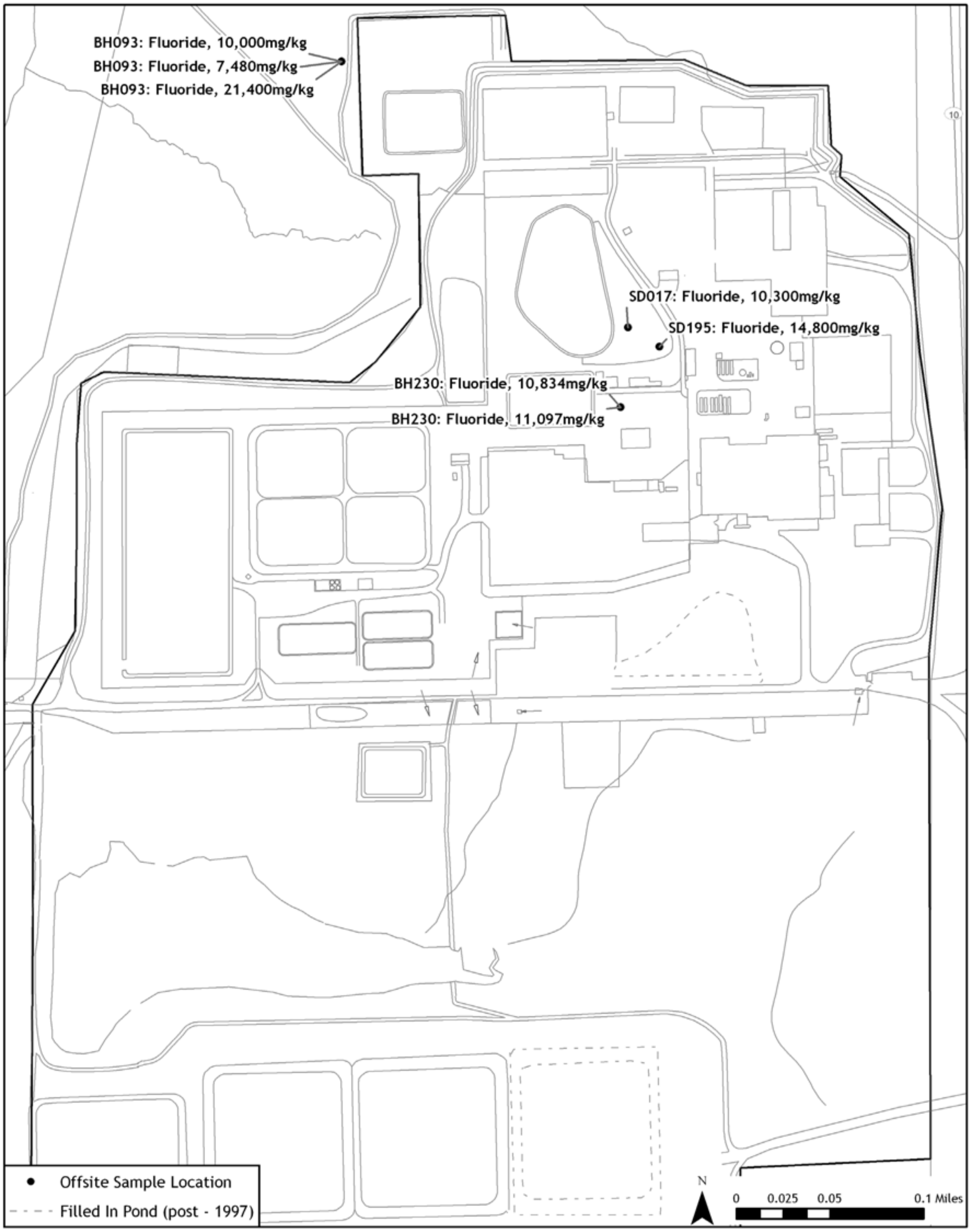

Figure 4.4-3 Soil Sample Locations Outside Soil Removal Areas and Depth of Alternative 2

Table 4.4-9 Expected Occupational Injuries for On-site Workers Under Alternative 2

Category	Injury Rate	Peak Year	Total for 4 Years
Nonfatal Injuries	0.066	5	14
Fatal Injuries	0.00011	0.008	0.02

Source: DOL, 2005.

4.4.3 Alternative 3: Partial Off-site Disposal of Contaminated Materials

This section describes the potential radiological and nonradiological health impacts on the surrounding population and the proposed SFC reclamation workforce during implementation of Alternative 3.

4.4.3.1 Public and Worker Radiation Doses and Risks

Table 4.4-10 summarizes estimated public and worker radiation doses that would be expected under Alternative 3. The doses would be well within the appropriate regulatory dose limits. The estimated maximum collective lifetime dose to members of the public during reclamation would be 0.02 person-sievert (2.0 person-rem). The average collective lifetime dose to reclamation workers would be 0.35 person-sievert (35 person-rem). Although SFC proposes that the State of Oklahoma, the DOE, or another federal entity would be responsible for long-term custody of the ICB and the disposal cell, because of the long half-lives of the radionuclides at the SFC facility and site, at some point in the future the perpetual care provision might lapse. The estimated public and worker radiation risks for Alternative 3 are the same as those estimated for Alternative 1 since all of the dose receptors are the same, and since the same effluents, work conditions, DCGLs, and CLs were used in the analysis.

Table 4.4-10 Public and Worker Radiation Doses Under Alternative 3

Dose Receptor	Individual Annual Dose mSv/yr (mrem/yr)	Individual Lifetime Dose mSv (mrem)	Collective Lifetime Dose person-Sv (person-rem)
Off-site Public Doses during Reclamation	0.005 (0.5)	0.02 (2.0)	0.02 (2.0)
Average Worker Doses during Reclamation	2.2 (220)	8.8 (880)	0.35 (35)
Maximum Annual Worker Doses during Reclamation	7.4 (740)	N/A	N/A
Long-term Public Doses in the Restricted Area if Custodial Care of the ICB is Lost (Residential Farmer Scenario)	0.54 (54)	38 (3,800)	N/A
Long-term Public Doses in the Unrestricted Area	0.095 (9.5)	6.6 (660)	N/A
Worker Doses during the Custodial Care Period	0.002 (2)	0.6 (60)	N/A

N/A – Not Applicable.

Therefore, SFC employed the residential farmer scenario and the benchmark dose approach used for Alternative 1 (see Section 4.4.1) as the basis for estimating the DCGLs for the proposed ICB. SFC determined the benchmark dose for radium to be 0.54 millisievert (54 millirem) per year, which is within the public radiation protection limit of 1 millisievert (100 millirem) per year. The estimated individual lifetime dose, assuming the residential farmer lived in the ICB for 70 years, would be 38 millisievert (3,800 millirem).

The analysis used the CLs that SFC developed to estimate doses for habitation on the unrestricted areas of the site. The CLs represent lower concentrations of residual radionuclides that would ensure application of the ALARA principle to unrestricted areas of the site. The estimated annual dose to a member of the public in the unrestricted area of the site would be about 0.095 millisievert (9.5 millirem) per year, which is within the public radiation protection limit of 1 millisievert (100 millirem) per year. If the individual resided in the unrestricted area for 70 years, the lifetime dose would be about 6.6 millisievert (660 millirem).

Table 4.4-11 summarizes the estimated public and worker radiation risks for Alternative 3. The estimated public and worker radiation risks for Alternative 3 are the same as those estimated for Alternative 1 since all of the risk receptors are the same, and since the same effluents, work conditions, DCGLs, and CLs were used in the analysis. The annual radiation doses, either to members of the public or to workers, would be within regulatory limits, and all the estimated individual lifetime probabilities of LCFs would be low (10^{-6} to 10^{-3}); therefore, the significance levels of all public or worker radiation doses and risks for Alternative 3 would be SMALL.

Table 4.4-11 Summary of the Public and Worker Estimated Probabilities of LCFs under Alternative 3

Risk Receptor	Individual Annual Risk (LCF)	Individual Lifetime Risk (LCF)	Collective Lifetime Risk (LCF)
Off-site Public Risks during Reclamation	3.0×10^{-7}	1.2×10^{-6}	1.2×10^{-3}
Average Worker Risks during Reclamation	8.8×10^{-5}	3.5×10^{-4}	1.4×10^{-2}
Maximum Annual Worker Risks during Reclamation	3.0×10^{-4}	NA	NA
Long-term Public Risks in the Restricted Area if Custodial Care of the ICB is Lost (Residential Farmer Scenario)	3.2×10^{-5}	2.3×10^{-3}	NA
Long-term Public Risks in the Unrestricted Area	5.7×10^{-6}	4.0×10^{-4}	NA
Worker Risks during Custodial Care Period	8.0×10^{-7}	2.4×10^{-5}	NA

4.4.3.2 Exposures to Hazardous Chemicals

SFC's proposed reclamation activities would remove the vast majority of chemical (nonradiological) contamination present on the SFC site outside of the disposal cell area. The disposal cell would be in the same location as described in Alternative 1 (see Section 4.4.1.2), with potentially reduced dimensions and volume because a portion of the contaminated materials (3%) would be shipped to an off-site facility licensed to accept such materials.

As described for Alternative 1, fluoride was detected above a screening criterion in one sample (BH093) at the northwest corner of the site, but at a depth of 6.7 to 7.9 meters (22 to 26 feet) bgs. It is unlikely that future receptors would contact soil at this depth; therefore, this area is not of concern for adverse health effects resulting from direct contact.

During site reclamation activities, SFC proposes to conduct mitigation procedures to protect workers from inhalation of dust that may be contaminated with chemical or radiological contaminants (see Section 5).

The disposal cell would be capped, and a perimeter fence would be constructed around the ICB. For contamination to pose a human health risk, there must be a complete pathway of exposure from the contamination to human receptors. The cap would prevent human exposure to the chemical contamination in the disposal cell; therefore, the impact on the occupational worker and the public following reclamation would be SMALL.

4.4.3.3 Potential Nonfatal and Fatal Occupational Injuries

Alternative 3 involves major construction activities (construction, excavation, and demolition) with the potential for industrial accidents related to construction and demolition vehicle accidents, material-handling accidents, falls, etc. These accidents could result in temporary injuries, long-term injuries and/or disabilities, and even fatalities. The NRC does not anticipate any of the proposed activities to be any more hazardous than expected for a major industrial construction or demolition project.

To estimate the number of potential nonfatal and fatal occupational injuries that would result from implementation of Alternative 3, data on nonfatal and fatal occupational injuries per year were collected from the DOL, Bureau of Labor Statistics, for the year 2005, as described in Alternative 1 (see Section 4.4.1.3). The expected nonfatal and fatal injuries presented in Table 4.4-12 were based on SFC's estimated on-site peak labor force of 78 employees and a total workforce of 220 man-years performing construction work over a 4-year period. An estimated 6.6% of the workforce is expected to experience nonfatal injuries, which would result in approximately five injuries during the peak period of construction and 14 injuries over the 4-year period. The number of fatalities that would be expected to occur over the 4-year period is estimated to be less than 1 (0.03). Thus, the impact from nonfatal and fatal injuries would be SMALL.

Table 4.4-12 Expected Occupational Injuries for On-site Workers Under Alternative 3

Category	Injury Rate	Peak Year	Total for 4 Years
Nonfatal Injuries	0.066	5	14
Fatal Injuries	0.00011	0.009	0.03

Source: DOL, 2005.

4.4.4 No-Action Alternative

This section describes the potential health radiological and nonradiological impacts on the surrounding population if no action was taken at the SFC site.

4.4.4.1 Public and Worker Radiation Doses and Risks

Table 4.4-13 summarizes estimated public and worker radiation doses and risks under the no-action alternative. The doses to the off-site public would be minimal (far less than those from active reclamation) because there would be no processing or stabilization of radioactive material. If conditions deteriorated such that environmental releases of radioactivity could occur, the SFC license would require corrective measures. There would be no atmospheric release of soil suspended in air or facility effluents. Therefore, this analysis did not estimate doses or risks to the off-site public under the no-action alternative.

Table 4.4-13 Public and Worker Radiation Doses Under the No-Action Alternative

Dose Receptor	Individual Annual Dose mSv/yr (mrem/yr)	Individual Lifetime Dose mSv (mrem)	Lifetime Dose person-Sv (person-rem)
Off-site Public Doses during License Continuation	<0.005 (0.5)	<0.005 (0.5)	<0.005 (0.5)
Average Individual Worker Doses during License Continuation	0.27 (27)	8.0 (800)	0.056 (5.6)
Maximum Individual Annual Worker Doses during License Continuation	1.2 (120)	N/A	N/A
Long-term Public Doses in the Restricted Area if Custodial Care of the ICB is Lost (Residential Farmer Scenario – Average Contamination Levels)	26 (2,600)	1,800 (180,000)	N/A
Long-term Public Doses in the Restricted Area if Custodial Care of the ICB is Lost (Residential Farmer Scenario – Maximum Contamination Levels)	210 (21,000)	14,000 (1,400,000)	N/A

N/A – Not Applicable.

Under the no-action alternative, SFC workers would conduct routine maintenance and surveillance tasks during the continuing license phase. Worker radiation doses would be similar to those observed historically at the SFC site. This analysis assumed that average annual worker doses would continue at about 0.27 millisievert (27 millirem) per year as long as SFC maintained the license. The maximum worker dose, based on historical measurements for SFC workers, would be about 1.2 millisievert (120 millirem) per year. These doses are well within the NRC occupational radiation protection standard of 50 millisievert (5 rem) per year. SFC estimates that it would take seven workers to perform continued maintenance and surveillance activities under the no-action alternative (SFC, 2006, Section 2.1.1). The analysis estimated the lifetime doses to these seven workers by assuming that each worker would spend 30 years employed at the site under continuing license conditions. The lifetime TEDE to the average worker would be 8.0 millisievert (800 millirem), and the lifetime TEDE to the maximally exposed worker would be 36 millisievert (3,600 millirem). The estimated annual collective TEDE to the seven workers would be 0.002 person-sievert (0.2 person-rem) per year, and the lifetime collective dose (assuming all seven workers spent 30 years employed at the site) would be 0.056 person-sievert (5.6 person-rem). The analysis did not estimate collective doses to workers over the license continuation period because the length of the continuing license period is indeterminate. For the no-action alternative, the SFC site would be under license to the NRC in perpetuity. However, as a means of comparison to the other alternatives, the residential farmer scenario was analyzed to estimate the public doses if there was no control of the site. SFC derived DCGLs using the benchmark dose method without consideration of institutional controls and solely in relation to the dose received from pathways that relate to residual radioactive materials in surface soil. The DCGLs represent a maximum exposed individual (MEI) dose of 0.54 millisievert (54 millirem) per year for each of natural uranium, thorium-230, and radium-226. For alternatives involving the remediation or decontamination of soil, the sum-of-ratios approach would limit the dose for any mixture to 0.54 millisievert (54 millirem) per year. For the no-action alternative, however, the doses to the MEI would not be limited to 0.54 millisievert (54 millirem) per year because no remediation or decontamination would occur. The analysis estimated the MEI dose by dividing the existing contamination concentrations for each radionuclide by the appropriate DCGL (to determine how much in the residual contamination would be in excess of the DCGLs), multiplying that result by the benchmark dose of 0.54 millisievert (54 millirem) per year, then summing over the radionuclides. Because it is not possible to determine the condition of the residual radioactive contamination at the time the license would lapse, the analysis made two estimates: (1) doses based on the average soil concentrations, and (2) doses based on the maximum soil concentrations. The resulting MEI doses would be about 26 millisievert (2,600 millirem) per year for the average soil concentration condition and 210 millisievert (21,000 millirem) per year for the maximum soil concentration condition. These doses would be far in excess of the 1-millisievert (100-millirem)–per-year dose limit to members of the public. The estimated lifetime doses, assuming 70 years of site occupancy, would be about 1,800 millisievert (180,000 millirem) for the average soil concentration condition and 14,000 millisievert (1,400,000 millirem) for the maximum soil concentration condition.

Table 4.4-14 summarizes the estimated public and worker radiation risks under the no-action alternative if there were no license controls. The annual probability of an LCF to the average industrial worker would be 1.1×10^{-5}, and the estimated lifetime probability of an LCF would be 3.3×10^{-4}. The annual and lifetime probabilities of LCFs to the maximally exposed worker would be 4.8×10^{-5} and 1.4×10^{-3}, respectively. These estimated individual worker lifetime risks would be low (10^{-5} to 10^{-2}), and the annual radiation doses would be within the regulatory limit of 50 millisievert (5 rem) per year; therefore, the impact of worker radiation exposures and risks during institutional controls would be SMALL.

The resulting lifetime probabilities of LCFs for the residential farmer for the average and maximum soil concentrations would be 9.2×10^{-2} and 7.2×10^{-1}, respectively, which are much greater than the probabilities for the other alternatives. Further, the annual public radiation doses would be far in excess of the regulatory limit of 1 millisievert (100 millirem) per year; therefore, if there were no license controls on the site, the significance level of public radiation exposures and risks for the no-action alternative would be LARGE.

Table 4.4-14 Public and Worker Estimated Probabilities of LCFs Under the No-Action Alternative

Risk Receptor	Individual Annual Risk (LCF)	Individual Lifetime Risk (LCF)
Off-site Public Risks during License Continuation	N/A	N/A
Average Worker Risks during License Continuation	1.1×10^{-5}	3.3×10^{-4}
Maximum Annual Worker Risks during License Continuation	4.8×10^{-5}	N/A
Long-term Public Risks in the Restricted Area for hypothetical Residential Farmer Scenario– Average Contamination Levels	1.3×10^{-3}	9.2×10^{-2}
Long-term Public Risks in the Restricted Area for hypothetical Residential Farmer Scenario – Maximum Contamination Levels	1.0×10^{-2}	7.2×10^{-1}

4.4.4.2 Exposures to Hazardous Chemicals

The NRC staff performed a screening-level risk analysis was performed in order to assess potential adverse health effects associated with chemical (nonradiological) contamination in soils and sediments at the SFC site. Soil and sediment data from previously conducted investigations were compared to background soil concentrations and human health-based, medium-specific screening levels for residential use. Data on this analysis is presented in Appendix D.

The data show that fluoride levels in soil and sediment exceed background concentrations and Region 6 health-based screening criteria at many locations throughout the site. Exceedances of Region 6 health-based screening criteria and background levels also were noted for arsenic (five locations), lead (three locations), antimony (two locations), and lithium, molybdenum, nickel, vanadium, copper, and chromium (one location each).

Under the no-action alternative, there would be no removal of soil; therefore, conditions at the site would remain the same and the impact of chemical exposures on the public and occupational workers would be SMALL. In the long-term, if there was a loss of license controls the impact could become LARGE.

4.4.4.3 Workforce Fatalities and Injuries

Under the no-action alternative, no work will be performed at the site other than minimal maintenance. Therefore, the risk of workforce fatalities and injuries would be SMALL.

4.5 Transportation Impacts

As a result of the surface reclamation activities proposed by SFC, there would be an increase in vehicular traffic operating on the SFC site and accessing the site from public highways. This increase in traffic would include construction workers commuting in private vehicles, earthmoving equipment operating on-site, large trucks delivering equipment and materials to the site, and, in the case of Alternatives 2 and 3, railcars or trucks transporting contaminated materials (raffinate sludge) to a uranium mill or licensed disposal facility. Potential impacts could include traffic congestion on local highways, increased air pollution from vehicle emissions, increased potential for traffic accidents, potential radiation doses to individuals who share the transportation corridor with radioactive material shipments, and radiation doses from transportation accidents that involve radioactive materials. The following sections discuss potential nonradiological local transportation impacts near the SFC site and potential radiological and nonradiological impacts from the off-site shipment of contaminated materials. Appendix E describes the analytical methodologies used in the analysis to estimate potential nonradiological impacts associated with vehicle emissions and accidents as well as radiological impacts.

4.5.1 Alternative 1: On-site Disposal of Contaminated Materials (the Licensee's Proposed Action)

Under Alternative 1, local highways would experience short-term increased use by workers commuting to and from the SFC site and by trucks delivering supplies for the site reclamation, including the geomembrane liner, rock, and other materials. Quantitative analyses were performed to determine (1) the potential for this increased traffic to reduce traffic flow, (2) the effects of vehicle emissions, and (3) the probability of fatalities occurring due to increased highway use as a result of both vehicle accidents and vehicle emissions.

4.5.1.1 Highway Capacity Impacts

The NRC staff evaluated the effects of SFC's implementation of Alternative 1 on traffic flow on State Highway 10 and other nearby roadways. The focus of the evaluation was on the quality of traffic flow on a roadway, including the ability of users to travel at the speed limit, the number and duration of traffic interruptions, and the overall comfort and convenience of the roadway to its users (TRB, 2000). SFC estimated that site reclamation would occur over a four-year period. During the start-up and finish of reclamation activities, traffic impacts would be relatively minor. To conservatively identify potential transportation impacts, the NRC staff assumed that most major construction activities could be completed within one year, during which time most of the consolidated waste materials would be placed within the disposal cell and the final engineered barrier would be installed. An estimate of the total number of vehicle trips that would be generated during this one-year period of intensive site reclamation activities was provided by

SFC and is shown in Table 4.5-1. The table also identifies the overall distances that would be traveled. Trips to and from the SFC site would be associated with commuting construction workers and the delivery of construction materials. Under Alternative 1, construction-related traffic would add approximately 810 vehicles per day (i.e., 405 vehicles going two ways) to the local roadways, principally State Highway 10, from which vehicles would enter and exit the SFC site.

Table 4.5-1 Estimated Daily and Total Local Transportation Traffic

Type of Vehicle Traffic	Estimated One-Way Trips (km)[a]	Alternative 1: On-Site Disposal	No-Action Alternative
Commuting Workers [b]	40.2	75	6
Normal Deliveries	40.2	75	6
Fly Ash	82.1	28	0
Riprap from Off-Site	12.9	40	0
Riprap from On-Site	1.6	40	0
Sand, Drain Layer, and Bedding	12.9	9	0
Clay Liner and Clay Cap	1.6	40	0
Clean Backfill	1.6	85	0
Topsoil	1.6	13	0
Total Daily Two-Way Vehicle Count	--	810	24
Total Daily Two-Way (km)	--	18,502	966
Total Local (km)[b]	40.2	4,625,416	241,410

Source: SFC, 2006.
[a] To convert to miles, divide by 1.6094.
[b] Assumes an average of 75 employees on site 250 working days per year.

A two-lane state highway such as State Highway 10 has a design capacity of up to 2,800 passenger cars per hour (67,200 cars per day) (HCM, 1985). While the daily addition of about 810 vehicles would nearly double the existing traffic count on this roadway (existing traffic count is 810, see Table 3.5-1), the estimated increased volume of about 1,620 vehicles per day represents a small percentage of the design capacity of State Highway 10. The increased traffic volume would be noticeable to users of State Highway 10, and minor traffic slowdowns or delays might occur at the entrance to the SFC site and at the intersection of State Highway 10 and U.S. Highway 64 about 1.6 km (1 mile) north of the SFC facility. These impacts on traffic flow would be SMALL in that the increased traffic would not destabilize the traffic flow along the roadway. Other highways in the vicinity (e.g., I-40 or U.S. Highway 64), which have higher capacities than State Highway 10 (typically 2,000 vehicles per hour per lane [TRB, 2000]), would be even less affected in terms of traffic flow from implementation of Alternative 1. Moreover, all impacts on traffic flow would be short term; following SFC's completion of site reclamation, traffic conditions would return to normal. In summary, the impact of Alternative 1 on the traffic flow of the local transportation network, including State Highway 10, U.S. Highway 64, and I-40, would be SMALL.

4.5.1.2 Risk of Vehicle Accidents

Motor vehicle safety is typically measured through accident rates for the type of vehicle being driven. This analysis assumes that all traffic traveling to and from the SFC site would involve the use of trucks. SFC estimates that implementation of site reclamation activities under Alternative 1 would result in an increase in vehicle miles traveled within 82 km (51 miles) of Gore, Oklahoma. Specifically, the number of local vehicle miles traveled in the region would increase from the baseline of about 241,400 km (194,750 miles) to 4.6 million km (2.9 million miles) (see Table 4.5-1). Based on DOE data, the average accident injury and fatality rates for trucks in Oklahoma are 2.85×10^{-7} per truck km (1.77×10^{-7} per truck mile) and 1.47×10^{-8} per truck km (9.13×10^{-9} per truck mile), respectively (DOE, 2002a). Multiplying the total local distance to be traveled under Alternative 1 (see Table 4.5-1) by the average accident injury and fatality rates for trucks in Oklahoma results in an estimate of the total number of potential truck-related injuries and fatalities that could potentially occur during reclamation of the SFC site. During the intensive one-year period, the predicted risk of injuries and fatalities from traffic accidents could increase to an estimated 1.3 injuries and 0.068 fatality from the baseline condition of 0.069 injury and 0.0036 fatality without the proposed action. This indicates that about one injury could occur; however, since this predicted risk of a fatality is less than one, it can be concluded that no truck-related fatalities are likely to occur as a result of SFC's reclamation activities under Alternative 1. There would be no long-term direct or indirect traffic accident-related effects because following completion of intensive site reclamation activities by SFC, the risk of fatalities would revert to at or near those identified under baseline conditions. Therefore, the impact of traffic-related accidents on the area surrounding the SFC site during site reclamation activities would be SMALL.

4.5.1.3 Nonradiological Vehicle Emissions

This analysis focuses on the incremental risks associated with inhalation exposure to nonradiological particulate emissions from vehicles used during site reclamation activities under Alternative 1. These emissions would primarily be in the form of tire/brake particulates, diesel exhaust, and fugitive dust (resuspended particulates from the roadway). Strong epidemiological evidence exists suggesting that increases in ambient air concentrations of PM_{10} (particulate matter with a mean aerodynamic diameters less than or equal to 10 microns) lead to increases in mortality (EPA, 1996a, 1996b). Currently, it is assumed that no threshold exists and that the dose-response functions for most health effects associated with PM_{10} exposure, including premature mortality, are linear over the concentration ranges investigated (EPA, 1996a). Over both the short and long terms, fatalities may result from life-shortening respiratory or cardiovascular diseases (EPA, 1996a) expressed as latent cancer fatalities (LCFs [nonradiological]).

The analysis was based on a methodology developed and accepted by the DOE (DOE, 2002b), whereby the risk of fatal exposure to particulate emissions (potential for LCFs) is calculated as a function of total emissions from transportation (DOE 2002a). Unit risk factors for trucks (and railcars) are shown in Table 4.5-2. The study area population of 182,192 within 40 km (25 miles) of the site (see Table B.6-1) is also an input to the analysis.

Table 4.5-2 DOE-Calculated Vehicle Emission Unit Risk Factors

Vehicle Class	Weight (tons)	Tire/Brake Particulates (g/km)	Fugitive Dust (g/km)	Diesel Exhaust (g/km)	Total Emissions (g/km)	Unit Risk Factor (fatalities/km per person/km^2)
Class VIIIB Trucks	40	0.030	0.26	0.141	0.43	1.5E-11
Railcar	N/A	N/A	0.26	0.481	0.74	2.6E-11

Source: DOE, 2002a.
Class VIIIB trucks include heavy-duty trucks with a gross vehicle weight of 27,216 kg (60,001 lbs) and up.
N/A - Not Applicable.

As previously stated for this alternative, the number of local vehicle miles traveled in the region would increase by 241,400 km (194,750 miles) to 4.6 million km (2.9 million miles), an increase of 4.4 million km (2.7 million miles). Conservatively assuming that these additional miles would occur within a one-year intensive portion of the construction period, inhalation exposure to vehicle-related emissions could result in an additional 0.00055 LCF (a probability of 1 in 2,000). This very small risk would represent a fraction of the more than 1,500 estimated fatalities per year from all causes (CDC, 2002) that would otherwise likely occur in the population in proximity to the SFC site (see Table B.6-1). Long-term indirect effects of inhalation of vehicular-generated particulates would not occur because there would be little to no activity conducted at the restricted portions of the SFC site following completion of reclamation activities. Therefore, the impact of increased vehicle emissions is SMALL.

4.5.1.4 Radiological Impacts from Routine Transportation and Transportation Accidents

Under the on-site disposal alternative, radiologically contaminated materials would be consolidated and placed within an on-site disposal cell. No materials would be transported off-site; therefore, no off-site transportation-related radiological impacts or accidents would occur under this alternative.

4.5.2 Alternative 2: Off-site Disposal of All Contaminated Materials

Under Alternative 2, local off-site transportation would involve workers commuting to and from the SFC site, the delivery of normal supplies as well as materials for reclamation activities, and off-site shipments of contaminated materials by rail. As previously mentioned, a rail spur would be constructed to serve the SFC site. Since the SFC site is not currently served by rail, the potential transportation impacts related to Alternative 2 would address the introduction of rail traffic to the site, with a resultant analysis of potential rail-related traffic fatalities, a potential increase in LCFs from nonradiological air emissions, and a potential increase in LCFs resulting from radiation doses to workers (transportation crews), members of the public who live near transportation routes, and individuals who share the transportation corridor with radioactive material shipments. In addition, members of the public who live along the rail transportation routes could realize an increase of LCFs due to exposure to radiation released by transportation accidents that involve radioactive materials.

4.5.2.1 Highway Capacity Impacts

Under Alternative 2, during the most intensive year of site reclamation activity, about 496 vehicles per day (see Table 4.5-3) would be added to the roadways near the SFC site, primarily due to the commuting workforce and the delivery of materials to the site (see Table 4.5-3). Even with this additional traffic volume, State Highway 10 would remain significantly below its design capacity (67,200 cars per day), and the increase would not be noticeable to users of State Highway 10 except at the entrance to the SFC site and at the intersection of State Highway 10 and U.S. Highway 64, which is about 1.6 km (1 mile) north of the SFC facility. However, another factor that would affect traffic flow along State Highway 10 would be construction of a rail grade crossing of State Highway 10 by SFC to connect the SFC site with the Union Pacific line. During construction of the grade crossing itself, traffic along State Highway 10 likely would be reduced to one lane or stopped intermittently.

Table 4.5-3 Estimated Daily and Total Local Transportation Traffic

Type of Vehicle Traffic	Estimated One-Way Trips (km)[a]	Alternative 2: Off-site Disposal	No-Action Alternative
Commuting Workers	40.2	75	6
Normal Deliveries	40.2	75	6
Fly Ash	82.1	0	0
Riprap from Off-site	12.9	0	0
Riprap from On-site	1.6	0	0
Sand, Drain Layer, and Bedding	12.9	0	0
Clay Liner and Clay Cap	1.6	0	0
Clean Backfill	1.6	85	0
Topsoil	1.6	13	0
Total Daily Two-Way Vehicle Count	--	496	24
Total Daily Two-Way (km)[b]	--	12,386	966
Total Local (km)[b]	40.2	3,096,486	241,410

Source: SFC, 2006

[a] To convert to miles, divide by 1.6094.

[b] Assumes an average of 75 employees on site 250 working days per year.

SFC's use of the railway grade crossing of State Highway 10 would also be affected by the use of the rail spur when it is crossed by railcars entering/leaving the SFC site. To accommodate the movement of railcars entering and exiting the SFC site, State Highway 10 would be subject to intermittent, short-duration closures to accommodate the movement of the empty and filled railcars. It was assumed that off-site shipments of contaminated materials would occur during the most intensive one year of site reclamation activities and that a total of about 20 railcars per day would enter or exit the SFC site (10 empty cars entering, 10 filled cars exiting). In other words, State Highway 10 could experience closure to accommodate the crossing of railcars about twice per working day. The increased numbers of commuting workers, use of the rail spur, and construction deliveries to the SFC site would have a MODERATE impact on the quality of traffic flow in the vicinity of the site.

In addition, traffic flow along Interstate 40 and U.S. Route 64 under Alternative 2 would not be appreciably affected because of the small volume of vehicular traffic that would be generated compared with their significantly greater design capacities and current low traffic volumes. Therefore, the potential short-term impacts on the regional highway network would be SMALL. Long-term indirect effects would not occur because there would be no activity following SFC's completion of site reclamation and traffic conditions would return to normal.

4.5.2.2 Vehicle/Rail Accidents

The analysis included two-way (round-trip) distances for commuters and deliveries (see Table 4.5-3), as well as for off-site shipments of contaminated materials (see Appendix E, Table E-3) asuming that all railcars would return from the disposal facility to the SFC site for reuse. Based on predicted local and off-site truck traffic volumes, and using the DOE data for Oklahoma accident injury and fatality rates for trucks of 2.85×10^{-7} per truck km [1.77×10^{-7} per truck mile] and 1.47×10^{-8} per truck km [9.13×10^{-9} per truck mile], respectively (DOE, 2002a), the short-term potential for injuries and fatalities to occur from local traffic accidents could increase by 0.882 and 0.0455, respectively. Since the predicted risk is less than one, it can be concluded that no truck-related injuries or fatalities are likely to occur as a result of SFC's reclamation activities under Alternative 2.

In the short-term, rail-related accidents could increase by 2.09 injuries and 1.39 fatalities, based on the national average rail accident injury rate of 7.82×10^{-8} per railcar km (4.86×10^{-8} per mile) and a fatality rate of 7.82×10^{-8} per railcar km (4.86×10^{-8} per mile) (DOE, 2002b). Therefore, about two injuries and one fatality could be expected to occur. This risk represents a very small fraction of the more than 1,500 estimated fatalities per year from all causes (CDC, 2002) that would otherwise likely occur in the population in proximity to the SFC site (see Table B.6-1). There would be no long-term direct or indirect traffic accident-related effects because following completion of intensive site reclamation activities by SFC, the predicted risk of fatalities would revert to at or near those identified under baseline conditions. Therefore, the impact of traffic-related accidents on the area surrounding the SFC site during site reclamation activities would be SMALL.

4.5.2.3 Nonradiological Vehicle Emissions

The site reclamation activities proposed by SFC under Alternative 2 would result in an estimated increase in local vehicle mileage of about 3.1 million km (1.9 million miles) (see Table 4.5-3). In addition, off-site rail shipments of contaminated materials would involve the movement of 3,678 railcars (i.e., approximately 15 railcars out and 15 in per day assuming a 250-day work year; see Table E-1). The greatest distance that these shipments would travel is about 12.4 million railcar km (77 million miles). This distance was bounded by the most distant disposal alternative feed location.

Using the same risk-based evaluation method described for Alternative 1 to evaluate impact, the short-term risk of an LCF from inhalation of increased vehicle-related emissions that would occur under Alternative 2 would be 0.00037 fatality (one in 37,000) for local truck traffic and 0.044 fatality (one in 440) for off-site rail shipments. These predicted fatalities would represent very small fractions of the more than 1,500 fatalities that occur per year from all causes within the potentially affected population of the region surrounding Gore, Oklahoma (CDC, 2002). They also represent very small fractions of the more than 3,200 fatalities from all causes expected to occur in the population (see Table E-3) along the proposed rail corridor. Long-term direct effects would not occur because there would be no activity after one year. Long-term indirect effects of the inhalation of vehicular- or rail-generated particulates would not occur because there would be little to no activity conducted at the restricted portions of the SFC site following completion of reclamation activities. Therefore, the impact of increased vehicle emissions would be SMALL.

Latent Cancer Fatality from Exposure to Ionizing Radiation

A latent cancer fatality (LCF) is a death from cancer resulting from, and occurring an appreciable time after, exposure to ionizing radiation. Death from cancer induced by exposure to radiation may occur at any time after the exposure takes place. However, latent cancers would be expected to occur in a population from one year to many years after the exposure takes place. To place the significance of these additional LCF risks from exposure to radiation into context, the average individual has approximately 1 chance in 4 of dying from cancer (LCF risk of 0.25).

The U.S. Environmental Protection Agency has suggested (Eckerman et al., 1999) a conversion factor that for every 100 person-sievert (10,000 person-rem) of collective dose, approximately six individuals would ultimately develop a radiologically induced cancer. If this conversion factor is multiplied by the individual dose, the result is the individual increased lifetime probability of developing an LCF. For example, if an individual receives a dose of 0.00033 sieverts (0.033 rem), that individual's LCF risk over a lifetime is estimated to be 2×10^{-5}. This risk corresponds to a 1 in 50,000 chance of developing a LCF during that individual's lifetime. If the conversion factor is multiplied by the collective (population) dose, the result is the number of excess LCFs.

Because these results are statistical estimates, values for expected LCFs can be, and often are, less than 1.0 for cases involving low doses or small population groups. If a population group collectively receives a dose of 50 sieverts (5,000 rem), which would be expressed as a collective dose of 50 person-sievert (5,000 person-rem), the number of potential LCFs experienced from within the exposure group is 3. If the estimated number of LCFs is less than 0.5, on average, no LCFs would be expected.

Source: NRC, 2005

4.5.2.4 Radiological Impacts from Routine Transportation and Transportation Accidents

This section summarizes the results of an analysis of the potential for increases in the number of LCFs within the population of transportation workers (i.e., rail yard workers) and members of the general public who work and live along or share the proposed rail transportation routes to a disposal facility or alternate feed mill. The methodology used to predict these effects is described in more detail in Appendix E.

The shipment of contaminated materials off-site under Alternative 2 would result in a predicted increase in LCFs of 1.25×10^{-6} and 4.56×10^{-7} in the affected general public population and rail yard workers, respectively (see Appendix E, Table E-24). The increase in the risk of an LCF to the maximally exposed member of the public would be 5.88×10^{-7} (see Appendix E, Table E-25).

These short-term changes in LCFs from the incident-free transportation of radioactive materials would be small in that they would be very small fractions of the likely number of cancer fatalities from all sources in a population similar to the size of the population along the proposed rail corridor (369,000, see Table E-3). The National Cancer Institute has estimated the lifetime risk of contracting a fatal cancer in the United States from all sources as 23.42% for males and 19.82% for females (NCHS, 2006). Long-term indirect effects would not occur because there would be no exposure to radiological contaminants following completion of the off-site shipment of contaminated materials.

Section E.4 describes the methodology used to estimate the radiological impacts from transportation accidents. Although all off-site shipments of contaminated materials would be by railcar under Alternative 2, accident impacts were assumed to be bounded by the truck accident scenario (see Section E.4.2.1). The increase in the number of LCFs from the maximum reasonably foreseeable accident ranges from 2.32×10^{-7} to 9.26×10^{-6} LCFs for accidents that could occur in rural and suburban areas, respectively (see Table E-26). The increase in the risk of an LCF to the maximally exposed individual (MEI) from exposure to radioactive materials from an accident would be 2.02×10^{-7} (see Table E-26).

These short-term changes in potential LCFs and accident fatalities would be SMALL in that they would be small fractions of the number of cancer deaths from all sources likely to occur in the affected populations (about 21,000 cancer fatalities from all sources [NCHS 2006] and about 89,000 accident fatalities in rural areas, and about 5.8 million cancer fatalities and about 25 million accident fatalities in urban areas [CDC, 2002]). The increased risk of an LCF would be similarly SMALL in comparison to the national cancer rates of 23.42% for males and 19.82% for females (CDC, 2002). Long-term indirect effects would be unlikely after a radiological accident because of the requirements for cleanup by local, state, and Federal authorities.

4.5.3 Alternative 3: Partial Off-site Disposal of Contaminated Materials

Under Alternative 3, local off-site transportation would involve workers commuting to and from the SFC site, the delivery of normal supplies and materials for reclamation activities, and off-site shipments of contaminated materials by truck. The transportation impacts associated with implementation of Alternative 3 would include an increase in truck traffic over the current baseline conditions, with a resultant increase in traffic fatalities, a potential increase in fatalities from air emissions from these vehicles, and potential for an increase in LCFs from radiation doses to workers (transportation crews) and members of the public who live near or share the transportation corridor with off-site shipments.

4.5.3.1 Highway Capacity Impacts

Under Alternative 3, during the most intensive year of site reclamation activity, about 768 vehicles per day would be added to nearby roadways, primarily due to the increased workforce and construction vehicles bringing materials to the site (see Table 4.5-4). In addition, off-site shipments of contaminated materials would add five truck trips (round trips, see Table E-15) per day to State Highway 10, for a total of 773 per day. These additional trips would nearly double the existing traffic count on State Highway 10, but the overall increased volume of about 1,583 vehicles per day (810 existing plus 773) would remain below the highway's design capacity. This increase would not be noticeable to users of State Highway 10, except at the entrance to the SFC site and at the intersection of State Highway 10 and U.S. Highway 64 north of the site. Any delays would not destabilize the traffic flow along the roadway. Traffic flows along other highways in the vicinity of the SFC site (e.g., I-40 and U.S. Route 64), which have higher design capacities than State Highway 10 (typically 2,000 vehicles per hours per lane [TRB, 2000]) would be even less affected. All traffic impacts would be short-term. Following SFC's completion of site reclamation, traffic conditions would return to normal. In summary, the impact of Alternative 3 on the traffic flow of the local transportation network, including State Highway 10, U.S. Highway 64, and I-40, would be SMALL.

Table 4.5-4 Estimated Daily and Total Local Transportation Traffic

Type of Vehicle Traffic	Estimated One-Way Trips (km)[a]	Alternative 3: Off-Site Disposal	No-Action Alternative
Commuting Workers	40.2	75	6
Normal Deliveries	40.2	75	6
Fly Ash	82.1	27	0
Riprap from Off-Site	12.9	38	0
Riprap from On-Site	1.6	38	0
Sand, Drain Layer, and Bedding	12.9	8	0
Clay Liner and Clay Cap	1.6	38	0
Clean Backfill	1.6	85	0
Topsoil	1.6	13	0
Total Daily Two-Way Vehicle Count	--	768	24
Total Daily Two-Way (km)[b]	--	18,247	966
Total Local (km)[b]	40.2	4,561,844	241,410

Source: SFC, 2006.
[a] To convert to miles, divide by 1.6094.
[b] Assumes an average of 75 employees on site 250 working days per year.

4.5.3.2 Vehicle Accidents

During the year of intensive site reclamation activities, local vehicle mileage would increase to about 4.5 million km (2.8 million miles), which is about 4.3 million km (2.7 million miles) more than current baseline conditions (see Table 4.5-4). In addition to local travel, SFC would ship a portion of the on-site contaminated materials off-site, either to a licensed disposal facility or to an alternate feed mill, as appropriate. The off-site shipment of these materials would require 638 trucks (about two trucks entering and leaving the site per day). The analysis is based on round-trip miles for commuters and deliveries, as well as for the off-site shipments, assuming that all trucks would return from the off-site facility to the SFC site for reuse. Under Alternative 3, the predicted risk for the short-term increase in traffic volumes would be an additional 0.668 injury and 0.107 fatality during the year of intensive site reclamation activities. Since the predicted risks are less than one, it can be concluded that no truck-related injuries or fatalities are likely to occur as a result of SFC's reclamation activities under Alternative 3. There would be no long-term direct or indirect traffic accident-related effects because following completion of site reclamation activities by SFC, the predicted risk of fatalities would revert to at or near those identified under baseline conditions. Therefore, the impact of traffic-related accidents on the area surrounding the SFC site during on-site reclamation activities would be SMALL.

4.5.3.3 Nonradiological Vehicle Emissions

During the year of reclamation activities, local vehicle mileage would increase by about 4.3 million km (2.7 million miles) over the current baseline conditions. In addition, as listed in Table E-1, shipments of disposal materials to Clive, Utah, would involve 638 trucks. These shipments would travel about 2.8 million truck km (1.7 million miles) (see Table E-15). Under Alternative 3, the short-term changes from increased vehicle emissions could result in an additional 0.0023 fatality (see Table E-16, local and off-site). This change in the number of fatalities would be small in that it would be a very small fraction of the more than 1,500 fatalities per year from all causes that would likely occur in the study area population of 182,192 (see Table B.6-1).within 40 km (25 miles) of the SFC facility (CDC, 2002). This change also would be a small fraction of the more than 1,200 fatalities that likely would occur in the affected off-site population of 146,000. Long-term indirect effects would not occur because there would be no activity following reclamation activities. Therefore, the impact of increased vehicle emissions would be SMALL.

4.5.3.4 Radiological Impacts from Routine Transportation and Transportation Accidents

Using the methodology described in Appendix E, the NRC staff's analysis estimated the potential increases in the number of LCFs for transportation workers (i.e., truck crews) and members of the general public who lived along or shared the truck transportation routes. Under Alternative 3, the short-term increase in LCFs could include 4.19×10^{-6} LCFs in the affected off-site public population and 1.81×10^{-5} LCFs in the truck crews (see Table E-23). The increase in the risk of an LCF to the maximally exposed member of the public and transportation worker (i.e., a truck driver) would be 2.20×10^{-8} and 5.04×10^{-7}, respectively (see Table E-25).

These short-term changes in LCFs from the incident-free transportation of radioactive materials would be SMALL in that they would be very small fractions of the number of cancer fatalities likely to occur in the affected populations of about 146,000. Using the lifetime cancer statistic for males (NCHS, 2006), about 34,000 cancer fatalities from all causes would likely occur in the affected population. Long-term indirect effects would not occur because there would be no exposure to radiological contaminants following completion of the off-site shipment of contaminated materials.

The increase in the number of LCFs from the maximum reasonably foreseeable accident would be the same as that under Alternative 2, 2.32×10^{-7} to 9.26×10^{-6} LCFs for accidents that could occur in rural and suburban areas, respectively (see Table E-26).

4.5.4 No-Action Alternative

Local transportation for the no-action alternative (i.e., the current baseline condition) involves workers commuting to and from the SFC site and normal deliveries of supplies. Transportation impacts under the no-action alternative would include traffic on local highways, air pollution from vehicle emissions, and traffic accidents. The analysis performed quantitative assessments for fatalities from increased vehicle accidents and from vehicle emissions. There would be no radiological impacts from routine transportation or transportation accidents because SFC would not ship radiological materials off the site.

4.5.4.1 Highway Capacity Impacts

Current activities at the SFC site account for approximately 24 round trips per day. The quality of traffic flow on State Highway 10 and the surrounding roadway network is high. Therefore, the impacts on traffic flow would be SMALL.

4.5.4.2 Vehicle Accidents

The current annual vehicle mileage of commuting employees at the SFC site is estimated at 241,410 km (150,000 miles). Based on DOE data regarding the average accident injury and fatality rates for trucks in Oklahoma (2.85×10^{-7} per truck km [1.77×10^{-7} per truck mile] and 1.47×10^{-8} per truck km [9.13×10^{-9} per truck mile], respectively) (DOE, 2002b), predicted traffic accident injuries and fatalities would remain at 0.0688 and 0.00355, respectively, per year (see Table E-17). Since the predicted risk is less than one, it can be concluded that traffic fatalities would be unlikely to occur in the vicinity of the SFC site. The impacts of vehicle accidents would be SMALL.

4.5.4.3 Nonradiological Vehicle Emissions

Based on the total vehicle miles traveled under this alternative, the short-term increased risk in fatalities from inhalation of vehicle emissions is predicted to be 2.86×10^{-5} fatality per year (see Table E-16). This rate represents a very small fraction of the more than 1,500 fatalities per year that occur from all causes among the population in the vicinity of the SFC site (CDC, 2002). The impacts of vehicle emissions would be SMALL.

4.6 Cumulative Impacts

The CEQ regulations implementing NEPA define cumulative effects as:

> "the impact on the environment which results from the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions" (40 CFR § 1508.7).

A study area within approximately 64 km (40 miles) of the SFC site of was examined to determine the potential for cumulative impacts in combination with the proposed action. Cumulative impacts are presented below for resource areas in which the licensee's proposed site reclamation activities, when considered in combination with anticipated changes related to other activities in the region, may result in additive or interactive effects.

As previously noted in Section 3.4, nitrate contamination has been found in the Process Area at the SFC site and in the agricultural lands at the southern end of the site. In the short term, these sources will continue to provide nitrate loading to the Illinois River; however, because river flows far exceed surface and groundwater flow from the site, the actual increases in nitrate concentration in the river that would occur from the SFC site would likely be low, estimated by the NRC staff at 0.02 mg/L (SFC, 2005). In the long-term, remedial actions proposed for the Process Area would result in a reduction in the off-site flow of nitrates from this area, but the proposed action does not include specific remedial actions for nitrate contamination in the agricultural lands. As a result, nitrates from this location would continue to migrate unabated into the Illinois River, but at a rate less than 0.02 mg/L. It has been estimated that there is a nitrate loading of 29 million kilograms/year to the Illinois River basin from other point and nonpoint sources such as confined animal feeding operations (poultry and cattle), land application of poultry litter, and use of septic tanks (Meo, 2007). When compared to the contribution from these other sources, the cumulative long-term contribution of nitrates to the river basin from the SFC site would be small.

Following completion of SFC's reclamation of its Gore, Oklahoma, site under Alternatives 1 and 3, it is proposed that about 131 hectares (324 acres) of the property be transferred in perpetuity to the custody of the State of Oklahoma or the United States. About 112 hectares (276 acres) would be released for unrestricted future redevelopment. Under Alternative 2, SFC would release the entire site for unrestricted future development. Based on information provided by SFC, a private energy group expressed some interest in building an ethanol production facility, including a port and a rail spur, on a small parcel of land on the south edge of SFC's property (SFC, 2006). The group reportedly has not pursued this inquiry any further. Given the speculative nature of the inquiry, the development of an ethanol production facility on the SFC property is not considered to be a reasonably foreseeable future action and is not considered further in this cumulative impacts analysis.

To further define the activities that could result in a cumulative impact on the various resource areas, other federal and non-federal activities in the county and region were researched, and pertinent activities were reviewed in this EIS. This search identified proposed plans by the Cherokee Nation to construct a port on the Kerr Reservoir and two proposals involving construction of a new coal-fired electric generating power plant and an addition to an existing power plant.

In 1999, the Cherokee Nation proposed constructing a port on the Arkansas River at the former USACE Sequoyah Recreation Area (including the Sallisaw Creek Public Use Area), which was closed in the 1980s. This site is about 32 km (20 miles) downstream of the SFC site, near the confluence of Kerr Lake and Sallisaw Creek. However, the Cherokee Nation has undertaken no development on the project. Since no definite plans have proceeded beyond initial announcements for the Cherokee Nation port on the Arkansas River, it is not considered to be a reasonably foreseeable future action and is not considered further in this cumulative impacts analysis.

The proposal to construct a new coal-fired electric generating power plant in Sallisaw, Oklahoma, was cancelled by its sponsor, Tenaska, in June 2007 (Keen, 2007). Therefore, it is not considered further in this cumulative impacts analysis.

The proposal for new coal-fired generating capacity would involve expansion of the Shady Point coal-fired power plant near the Poteau River in Panama, LeFlore County, Oklahoma (AES, 2006). This site is close to the Arkansas border, about 57 km (35 miles) southeast of the SFC site. The owner of the Shady Point coal-fired power plant, AES Corporation, is proposing to add a 650-megawatt (MW) coal-fired unit to the existing 320-MW facility. Coal mined in Oklahoma is trucked to this power plant, and coal mined outside of Oklahoma is transported by rail. An application for this expansion is under review by the Oklahoma Department of Environmental

Quality (ODEQ, 2007). It is possible that construction (not operation) of the new unit at the Shady Point plant could overlap with reclamation of the SFC site.

Small or no cumulative impacts would result from the possible overlap of construction activities associated with the power plant addition when considered in combination with the proposed construction activities proposed by SFC for reclamation of its site. The rationale for this conclusion is discussed for each of the following resource areas:

- **Land Use –** The two sites that would be affected by construction activities are more than 57 km (35 miles) apart. This distance precludes the potential for cumulative land use impacts. Cumulative land use impacts would be SMALL.

- **Historic and Cultural Resources –** There would be no cumulative adverse impacts on cultural or historical resources since avoidance is the primary method of addressing impacts on these resources.

- **Visual and Scenic Resources –** At more than 57 km (35 miles) from the SFC site, the coal-fired electrical unit addition that has been proposed for development would be located too distant from the SFC site to result in cumulative visual impacts. Therefore, cumulative direct and indirect impacts on visual resources could be characterized as SMALL.

- **Climate, Meteorology, and Air Quality –** The two sites that would be affected by construction activities are more than 57 km (35 miles) apart. Best management practices would be applied at both sites to reduce fugitive dust. Moreover, the distance between the two sites precludes the potential for cumulative air quality impacts. Cumulative air quality impacts would be SMALL.

- **Geology, Minerals, and Soils –** There would be disturbance of soils and geology at all of the proposed construction sites; however, these sites are not in sufficient proximity to result in a cumulative impact on the same resources, either locally or regionally. Cumulative impacts would be SMALL.

- **Water Resources –** The two projects would be constructed within the Arkansas River drainage basin. The AES expansion of the Shady Point power plant would be more than 57 km (35 miles) from the SFC site, near the Poteau River, which drains into the Arkansas River at the Arkansas/Oklahoma state line. The application of best management practices during construction at each of the locations would significantly reduce the potential for cumulative impacts on water resources. Cumulative impacts on water resources would be SMALL.

- **Ecological Resources –** Construction-related activities that would occur during reclamation of the SFC site and the expansion of the AES power plant would result in the temporary disturbance of ecological resources. Reclamation activities at the SFC site would be restricted to the site and possibly along the route of the proposed rail spur, and with the implementation of mitigation measures, any potential impacts would be minimized. Moreover, the affected area encompasses a negligible percentage of the habitat surrounding the site, thereby not noticeably changing the cumulative impacts already existing from other local and regional activities. The power plant is not in sufficient proximity to result in cumulative impacts on ecological resources, either locally or regionally. Cumulative impacts on ecological resources would be SMALL.

- **Socioeconomic Conditions –** Both projects under consideration would result in the employment of construction workers. SFC estimates that about 72 workers would be required to conduct the proposed reclamation activities. Construction at the AES Shady Point power plant would likely employ less than 1,000 workers. The region would benefit economically from this construction-related employment. Additional temporary or permanent housing may be needed. However, the projects are sufficiently distant from each other that the possibility for conflicts in demands for housing for commuting workers would be minimized. The Shady Point project is much closer to Fort Smith, Arkansas, and would likely draw workers from that area. The SFC site is closer to Muskogee and Tulsa, Oklahoma. The two cities are 114 km (71 miles apart). These impacts would be SMALL.

- **Environmental Justice –** Although minority and low-income populations reside in the vicinity of the two projects under consideration, there would be no overlap of construction activities that would result in disproportionately high and adverse human health and environmental effect on such populations. These impacts would be SMALL.

- **Noise –** The construction-related activities that would occur during reclamation of the SFC site and expansion of the AES power plant would result in the generation of noise. SFC's site reclamation activities would not affect any sensitive off-site receptors. Moreover, the two construction sites are not in sufficient proximity to result in cumulative impacts on local or regional noise conditions. Cumulative noise impacts would be SMALL.

- **Transportation –** As discussed under Socioeconomic Conditions, the two projects are sufficiently distant from each other that the possibility for conflicts resulting from increased traffic of commuting workers would be minimal. Cumulative transportation impacts would be SMALL.

- **Public and Occupational Health –** SFC's site reclamation activities would result in a site that would be protective of public and occupational health in the long term. The other construction project would not generate similar, if any, significant public or occupational health effects. These cumulative impacts would be SMALL.

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5. MITIGATION

Mitigation measures during the proposed SFC site reclamation would be those actions or processes (e.g., management plans) implemented by SFC to control and minimize potential impacts from demolition and construction activities. These measures would be in addition to actions taken to comply with applicable laws and regulations, including permits. This chapter summarizes the mitigation measures that were proposed by SFC for implementation of site reclamation activities. The same mitigation measures apply to the proposed action (Alternative 1) and Alternatives 2 and 3. The proposed mitigation measures described in this chapter do not include environmental monitoring activities. Environmental monitoring activities are described in Chapter 6 (Environmental Measurement and Monitoring Programs) of this EIS.

The mitigation measures proposed by SFC follow best management practices; these measures are described in the *Reclamation Plan* (SFC 2006a) and briefly summarized in the *Environmental Report* (SFC 2006b). The NRC staff has reviewed the mitigation measures proposed by SFC and did not identify additional mitigation measures that it would recommend.

As a result of informal consultation with USFWS, the NRC staff is developing a mitigation plan for USFWS approval. This mitigation plan would be designed to minimize potential adverse effects on the endangered American burying beetle, prevent any "takes" of migratory bird species, enhance upland woodland habitat, and preserve the hydrologic gradient of the proposed clay borrow area.

5.1 Mitigation Measures for Proposed Construction Activities

5.1.1 Run-on/Runoff Control

Procedures proposed by SFC for control of runoff and run-on water and containment of other liquids include:

- Runoff generated from demolition operations will be contained on concrete or asphalt pads or in building sumps.

- Run-on diversion berms will be installed up-slope of the facility, as necessary, to minimize run-on of storm water into the demolition work area. The berms will be inspected periodically and modified or extended, as necessary, during demolition operations.

- Runoff retention berms will be installed down-slope of the facility, as necessary, to minimize runoff of decontamination liquids and sediment. The liquids contained will be pumped to a collection sump for removal and then be transferred to appropriate receiving ponds. The berms will be inspected periodically and modified or extended, as necessary, during demolition operations.

In addition to berms, runoff control devices that are currently in place and others, such as silt fences, will be used, if necessary, and as required by SFC's Storm Water Pollution Prevention Plan.

5.1.2 Dust Control

Dust generation will be minimized during all preparation, salvage, and demolition operations. A detailed dust suppression program would be included in the cleanup contractor's work plan, which would be reviewed by NRC. The source of water for SFC's dust suppression system would be Lake Tenkiller. SFC is permitted to use up to 2,218 million liters (586 million gallons) from the lake each year. It is estimated that the proposed reclamation activities will require 95.8 million liters (25.3 million gallons) per year. In the unlikely event that additional water is needed, it would be obtained from the Illinois River under the provisions of a temporary construction permit to be granted by the Oklahoma Water Resources Board. General procedures proposed by SFC for control of dust include the following:

- During demolition and removal operations, equipment and structure surfaces will be sprayed with water to prevent dust generation.

- A chemical fixant may be applied to surfaces prone to dust generation and high-efficiency particulate air (HEPA) vacuuming equipment may be utilized, if necessary.

- Haul roads and areas used for loading, off-loading, material evaluation, and disposal will be periodically sprayed with water to control dust generation, and a speed limit of 15 miles per hour for construction equipment and vehicles will be enforced.

- Excavation, material-handling, and stockpile development work areas will be sprayed with light applications of water using hoses with mist or fog nozzles, as necessary.

- Material stockpiles on the site will be covered with a geotextile or sprayed with a crusting agent during nonoperational periods to minimize fugitive dust emissions.

5.1.3 Residue Management

Procedures proposed by SFC for control of residues include:

- Liquids generated during dust control or soil moisture conditioning will be contained in the building sumps, area tanks, or on concrete or asphalt pads.

- The liquid, sediment, and solids collected in the sumps, tanks, and pads, will either be reused, transported to the disposal cell, or treated for permitted discharge.

5.1.4 Contamination Control

Procedures proposed by SFC for contamination control include:

- Personnel, vehicles, and testing equipment will be surveyed for contamination prior to leaving the restricted area of the facility.

- All workers involved in demolition operations will be surveyed for contamination at the exit screening station and will shower, if necessary, prior to leaving the facility.

- Only authorized personnel will be allowed access to the work area during demolition operations. Access will be restricted during active operations and at the disposal cell. Signs and/or barrier tape will be used to post areas where access is restricted.

5.2 Proposed Mitigation Plan for USFWS Approval

On February 27, 2008, the NRC staff engaged in an informal Section 7 consultation with the USFWS at the SFC site regarding the licensee's proposed *Reclamation Plan* (SFC, 2006a) and groundwater *Corrective Action Plan* (SFC, 2003). As a result of this informal consultation, USFWS concluded in a follow up letter on March 13, 2008, that suitable habitat and soil for the endangered American burying beetle is present at the SFC site and the beetle could be adversely impacted by the proposed *Reclamation Plan*. The USFWS also noted the need to adhere to the Migratory Bird Treaty Act (MBTA), which prohibits the taking, killing, and possession of migratory birds, and their eggs, young, or active nest. Finally, the USFWS requested mitigation for the loss of habitat for migratory birds, the American burying beetle, and other fish and wildlife resources. To address and meet these requirements, NRC is developing a mitigation plan that incorporates the USFWS recommendations and guidelines outlined in their March 13, 2008, letter. The principal components of the proposed mitigation plan are summarized below.

In order to avoid any adverse impacts on the American burying beetle, SFC will follow Conservation Approach 1 and Avoidance Measure 1 as described in USFWS guidance "Conservation Approaches for the American Burying Beetle"(see Appendix C, Consultation Letters). Specifically, prior to undertaking any ground-disturbing activities associated with the proposed *Reclamation Plan*, SFC will have an American burying beetle survey performed by a Section 10 permitted biologist. This survey is required to be done during the beetle's active season (May 20 to September 20). All survey results, positive or negative, must be submitted in writing to the USFWS Oklahoma field office for review prior to initiating any ground-disturbing activities. If any beetles are identified at the site, either the "*Bait Away Protocol* or *Trap and Relocation Protocol*" must be employed prior to ground disturbance to avoid adversely affecting the beetle. Any bait away, trapping, or relocation must be coordinated with the Oklahoma field office under an appropriate Section 10 permit from the USFWS. If baiting away or trapping and relocation are conducted, a respective "Relocation Data Form" or "Bait Away Form" must be submitted to the Oklahoma field office within 30 days following cessation of relocation or bait away efforts. Section 7 consultation is not considered complete until the proper form is submitted.

To meet the "no take" (i.e., no mortality) provision of the MBTA, clearing of any woodland or potential nesting area should be done outside of the nesting season of migratory birds in Oklahoma (from August 1 to the end of February as per USFWS recommendations). To afford the best protection to both the American burying beetle and migratory birds, however, SFC noted that clearing activities could be done between August 1 and September 20, when migratory birds have completed nesting and the American burying beetle is still active.

The principal wooded area impacted by SFC's proposed reclamation plan is a 6-hectare (15-acre) block of young forest in the southern part of the site. This secondary-growth oak-hickory forest area, which is habitat for nesting migratory birds and potentially the American burying beetle, has been identified by SFC as a source of borrow material needed for construction and capping of the proposed engineered disposal cell. Once borrow operations are completed, the 6 hectares (15 acres) will be graded to ensure surface water flow to the north-northeast (the existing hydrologic gradient), covered with topsoil and reseeded. To help mitigate the habitat loss associated with modification of the existing borrow area habitat, Sequoyah Fuels Corporation proposes to recontour, regrade, and revegetate portions of the site outside of the engineered disposal cell footprint within the 131-hectare (324-acre) proposed ICB. A total of 124 acres inside the ICB will be regraded, covered with 15 centimeters (6 inches) of topsoil, and revegetated with a native seed mix (see Table 2.2-3). Of the 50 hectares (124 acres), 34 hectares (83 acres) will involve substantial excavating and recontouring in order to recreate the original topography of the site prior to its development (following the USGS 7.5-minute quadrangle maps). The principal areas to be excavated and recontoured are currently occupied by the industrial settling ponds and a lake. Once the initial vegetation becomes established, the 50 hectares (124 acres) will undergo natural succession by pioneer tree species, followed by development of an upland oak-hickory climax forest. Of the remaining 69 hectares (171 acres) within the ICB, approximately 40 hectares (99 acres) now consists of open pastureland and 29 hectares (72 acres) are wooded. Over time, all of these components will merge into a contiguous 123-hectare (305-acre) tract of climax upland forest within the ICB, which will serve as potential habitat for migratory birds and the American burying beetle. The 50 hectares (124 acres) to be regraded, recontoured, and restored versus the loss of 6 hectares (15 acres) in the proposed borrow area represents a mitigation ratio of more than 8:1.

References

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(USFWS, 2008) U.S. Fish and Wildlife Service. Letter from Kenneth Frazier, Division of Ecological Services, to Allen Fetter, U.S. Nuclear Regulatory Commission, responding to request for NEPA Section 7 consultation regarding the American burying beetle and the Migratory Bird Treaty Act. March 13, 2008.

6. ENVIRONMENTAL MEASUREMENT AND MONITORING PROGRAMS

This chapter describes the environmental measurement and monitoring programs that would be implemented during reclamation and long-term maintenance programs for the alternatives that involve total or partial on-site disposal of contaminated materials (i.e., Alternatives 1 and 2). Measurement and monitoring programs include: (1) direct monitoring of radiological gaseous and liquid effluents from cleanup activities, and (2) monitoring and measurement of pollutants in ambient air, surface water, sediment, groundwater, soils, and direct (gamma) radiation in the near-field environment.

6.1 Radiological Measurements and Environmental Monitoring

Throughout the operating life of the SFC facility (operation began in 1970), there have been ongoing evaluations of the impacts of plant operations, including monitoring of air and liquid discharges, soil sampling, and groundwater sampling. The results of this historical monitoring are provided in SFC's *Site Characterization Report* (SFC, 1998). Historical results of monitoring also are provided in the annual groundwater monitoring report (SFC, 2006a). Since the cessation of production operations, both airborne and liquid effluents have diminished significantly. No airborne effluent release points exist; thus, no airborne effluent monitoring is required. However, perimeter air samples continue to be collected at the restricted area fence line. Soil and vegetation sampling requirements also have been reduced. Historical surface water and effluent stream monitoring locations continue to be monitored on a reduced frequency. These locations include drainages, seeps, streams, and the effluent discharge and its receiving waters. The OPDES permit (OK0000191) and OPDES Storm Water Industrial General Permit Authorization (OKGP00046) for the site prescribe surface water sampling for both the liquid effluent stream and storm water discharge from the site (see Section 1.5.4).

By license amendment 31 to SFC's NRC license, the NRC staff approved SFC's *Groundwater Monitoring Plan* (NRC, 2005). SFC's approved *Groundwater Monitoring Plan* identifies (1) hazardous constituents in the groundwater that resulted from licensed site operations; (2) groundwater protection standards for the hazardous constituents; and (3) groundwater monitoring locations, frequency, and parameters.

For the purposes of groundwater monitoring, SFC identified antimony, arsenic, barium, beryllium, cadmium, chromium, fluoride, lead, mercury, molybdenum, nickel, nitrate, radium-226, selenium, silver, thallium, thorium-230, and uranium as COCs or hazardous constituents (SFC, 2005). The main constituents with sizable groundwater contaminant plumes are arsenic, nitrate, fluoride, and uranium. For each of these 18 constituents, a groundwater protection standard was set in accordance with concentration limits found in 10 CFR Part 40, Appendix A, or in the EPA's National Primary Drinking Water regulations. The standards in 10 CFR Part 40 and in the EPA's regulations have been determined to be protective of public health and safety. The hazardous constituents present at the SFC site and the protection standards for each of those constituents are identified in Table 3.3-5. The radium standard was revised to apply to combined radium-226 and radium-228 to be consistent with Table 5C of 10 CFR Part 40, Appendix A (NRC, 2005).

Under the approved *Groundwater Monitoring Plan*, SFC will collect and analyze samples from the groundwater, drainages and seeps, and surface water. The frequency of monitoring for each location is provided in Table 6.1-1. SFC is required under its NRC license to submit by April 1 of each year the results of its monitoring analyses in a groundwater compliance monitoring summary report (NRC, 2005).

Table 6.1-1 Frequency and Locations of SFC's Groundwater Monitoring Program

Aquifer System	Wells	Parameters Analyzed
Background Groundwater Quality Monitoring (Sample Annually)		
Terrace	MW007, MW070, MW073	See Note 1
Shallow Bedrock	MW007A, MW110A	See Note 1
Deep Bedrock	MW007B	See Note 1
Compliance Monitoring (Sample Annually)		
Terrace	MW008[2], MW010[2], MW014[2], MW019[2], MW025[2], MW035[2], MW036[2], MW040, MW042, MW045, MW049, MW053[2], MW054[2], MW056, MW062, MW075[2], MW077[2], MW079[2], MW080[2], MW086[2], MW087	Uranium, Nitrate (as Nitrogen), Fluoride, Arsenic (MW040: Barium also)
Shallow Bedrock	MW012A[2], MW014A[2], MW018A[2], MW042A, MW047A, MW048, MW049A[2], MW050A[2], MW052A, MW057A[2], MW059A, MW062A, MW065A[2], MWO67A[2], MW081A, MW084A[2], MW086A[2], MW089A, MW097A, MW099A, MW107, MW108, MW111A, MW112A, MW115A, MW121A, MW122A, MW123A, MW124A, MW125A, MW126A, MW127A, MW129A, MW130A, 2303A, 2346	Uranium, Nitrate (as Nitrogen), Fluoride, Arsenic
Deep Bedrock	MW059B, MW090B, MW098B, MW100A, MW105B, MW128B	Uranium, Nitrate (as Nitrogen), Fluoride, Arsenic
Corrective Action Monitoring (Sample Quarterly)		
Terrace	MW031, 2248	Uranium, Nitrate (as Nitrogen), Fluoride, Arsenic
Shallow Bedrock	MW095A, 2224A, 2224B, 2247	Uranium, Nitrate (as Nitrogen), Fluoride, Arsenic
Deep Bedrock	None	None
Seep and Drainage Monitoring (Sample Quarterly)		
Terrace	None	None
Shallow Bedrock	2242, 2243, 2244, 2245, 2246	See Note 3
Deep Bedrock	2241	See Note 3

Table 6.1-1 Frequency and Locations of SFC's Groundwater Monitoring Program

Aquifer System	Wells	Parameters Analyzed
Surface Water Monitoring (Sample Annually)		
2201	Illinois River – 1600 feet Upstream of 001 Confluence	Uranium, Nitrate (as Nitrogen), Arsenic, Combined Radium-226 and–228
2202	Illinois River – 600 feet Downstream of 001 Confluence	Uranium, Nitrate (as Nitrogen), Arsenic, Combined Radium-226 and–228
2203	Arkansas River – Upstream toward Highway 64 Bridge	Uranium, Nitrate (as Nitrogen), Arsenic, Combined Radium-226 and–228
2204	Arkansas River – Downstream near I-40 Bridge	Uranium, Nitrate (as Nitrogen), Arsenic, Combined Radium-226 and–228

Source: SFC, 2006a.

Notes:
1. Analyze for antimony, arsenic, barium, beryllium, cadmium, chromium, fluoride, lead, molybdenum, nickel, nitrate (as N), combined Radium-226 and–228, selenium, thallium, thorium-230, and uranium.
2. Well will be abandoned and plugged as necessary to allow reclamation activities.
3. Analyze for antimony, arsenic, nitrate (as N), lead, thallium, and uranium.

The monitoring locations for groundwater, surface water/storm water discharge, and air are shown on the map on Figure 6.1-1. Ecological monitoring was not conducted for baseline conditions or during operations, nor is any planned for reclamation activities.

6.2 Radiation Safety Program during Reclamation

SFC's Radiation Safety Program, which is provided as Attachment D of the SFC *Reclamation Plan* (SFC, 2006b), describes measures to protect workers, the public, and the environment during remediation. The program is designed to be flexible, recognizing that the amount of radioactivity and the associated hazards would be reduced as the project progresses. The Radiation Safety Program may be modified to be commensurate with the activities being performed. SFC would review and approve the Radiation Safety Program and any revisions that are made during the project. Any such adjustment to the requirements of the Radiation Safety Program would be made in accordance with SFC's document control procedures. This section briefly summarizes the intent and content of the Radiation Safety Program during site reclamation.

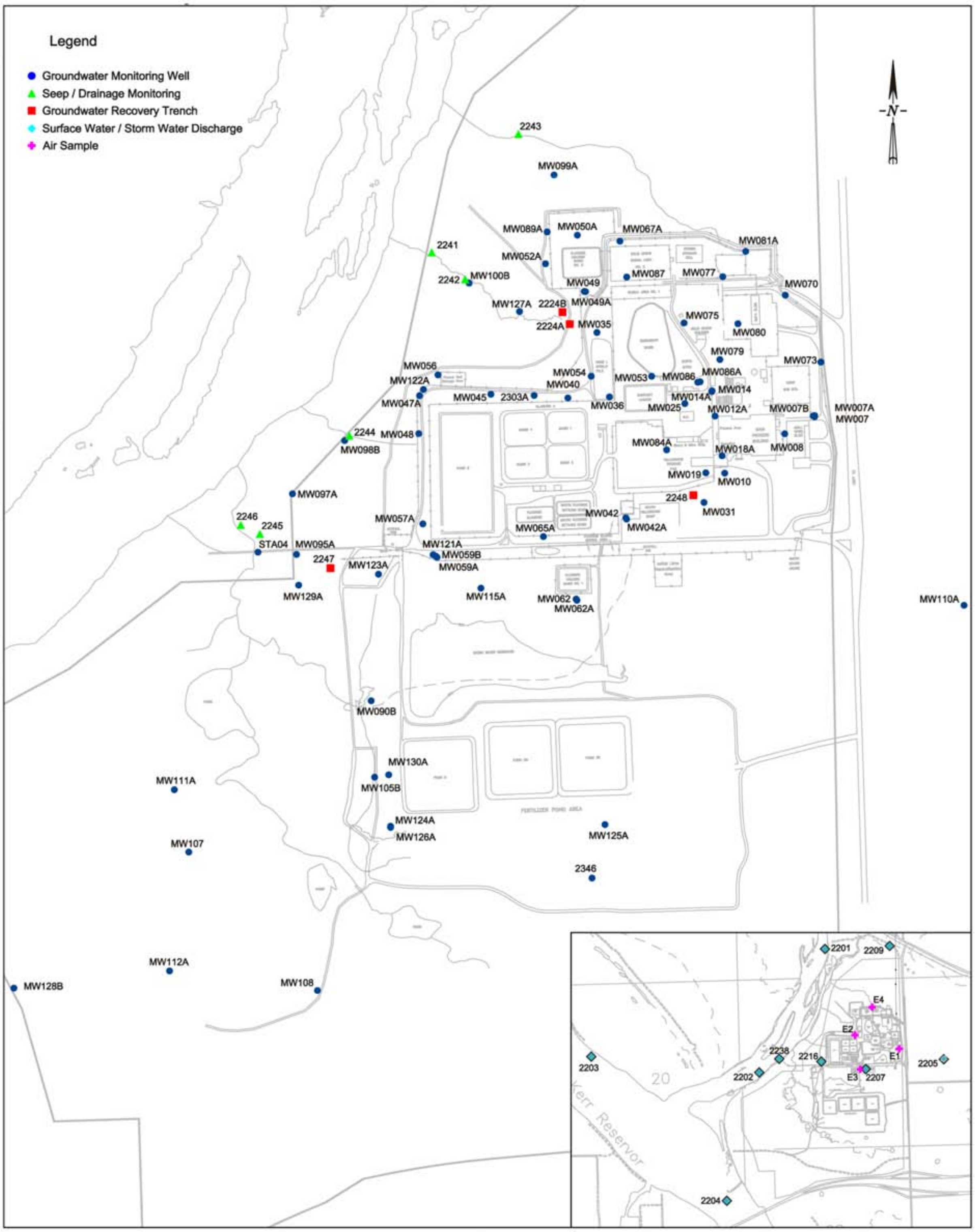

Figure 6.1-1 SFC Environmental Sampling Locations

6.2.1 Air Monitoring Program

SFC's *Environmental Report* (SFC, 2006c) states that during reclamation, air samples would be collected in accordance with their NRC source material license SUB-1010 (NRC, 2006). SFC also would collect air samples in general and localized areas when and/or where there is potential for the generation of airborne radioactive material. These samples would be used to verify that the confinement of radioactive material is effective and provide warning of elevated concentrations for planning or response actions.

6.2.2 Contamination Control Program

SFC would practice contamination control measures and monitor their effectiveness through the performance of radiation surveys. Personnel exposures to radioactive material would be controlled by the application of engineering, administrative, and personnel protection provisions. Engineering controls (primarily containment, isolation, ventilation, and decontamination) would be used, as practicable, to minimize or prevent the presence of uncontained radioactive material. Administrative controls (e.g., access control, postings and barriers, procedures, hazardous work permits, and establishment of action levels for radiation surveys) would be used to control work conditions and work practices. SFC has indicated that the details regarding the contamination control program would be consistent with the Radiation Safety Program maintained under the existing license.

6.2.3 Radiation Surveys

SFC would perform radiation surveys to identify the types and levels of radiation in an area or during a task. The results of the surveys would be used to identify or quantify radioactive material and evaluate potential and known radiological hazards. Radiation surveys include contamination measurements, radiation or exposure rate measurements, and measurements of radioactive materials on personnel. Measurements would be made of alpha, beta, and gamma radiation, as required for the specific situation encountered. SFC has indicated that the details regarding radiation surveys would be consistent with those described in the Radiation Safety Program maintained under the existing license.

6.2.4 Instrumentation Program

SFC would calibrate and maintain their radiation safety instrumentation in accordance with radiation safety procedures documented as part of the Radiation Safety Program.

References

(NRC, 2005) U.S. Nuclear Regulatory Commission. "Amendment 31– Sequoyah Fuels Corporation – Materials License No. Sub-1010– Approval of Request to Authorize a Groundwater Compliance Monitoring Plan." August 22, 2005.

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(SFC, 1998) Sequoyah Fuels Corporation. *Site Characterization Report*. December 15, 1998.

(SFC, 2005) Sequoyah Fuels Corporation. *Groundwater Monitoring Plan*, Sequoyah Facility. February 2005.

(SFC, 2006a) Sequoyah Fuels Corporation. *2005 Annual Groundwater Report*. January 31, 2006.

(SFC, 2006b) Sequoyah Fuels Corporation. *Reclamation Plan: Sequoyah Facility*. Rev.2.

(SFC, 2006c) Sequoyah Fuels Corporation. *Environmental Report* [for the] *Reclamation Plan*. October 13, 2006.

7. COST BENEFIT ANALYSIS

7.1 Introduction

This section describes the data, methods, and results of the cost benefit analysis undertaken for the SFC site reclamation alternatives evaluated in this EIS. The analysis conforms to the guidance contained in NUREG-1748, *Environmental Guidance for Licensing Actions Associated with NMSS Programs*, Section 5.7 (NRC, 2003), and procedures outlined in NUREG-1757 Vol. 2, Rev. 1, Appendix N (NRC, 2006).

A cost benefit analysis compares the full resource costs of each site reclamation alternative over the entire project lifetime to the anticipated benefits. The analysis compares each alternative to the baseline (i.e., the no-action alternative) to evaluate incremental costs and benefits. The purpose of conducting the cost benefit analysis is to assess how the proposed action will maximize net benefits to society, including potential economic, environmental, public health and safety, and other advantages. The analysis should address whether the potential benefits exceed the potential costs, recognizing that some benefit and cost flows over time cannot be monetized (assigned a dollar value) and must be considered qualitatively (OMB, 1996).

The lifecycle costs of the proposed SFC *Reclamation Plan* and alternatives to that plan were compared to the no-action alternative. In accordance with NUREG-1757, *Consolidated Decommissioning Guidance* (NRC, 2006), the main benefits that were measured consisted of (1) the monetary value of the collective radiation dose averted, (2) regulatory costs avoided, and (3) changes in land values (agricultural production). The benefits were compared to the total lifecycle reclamation costs, denoted as $Costs_R$, the transportation and disposal costs, and the opportunity cost of the land associated with each alternative. The opportunity cost of land recognizes the differences (and foregone benefits) between the varying acreage that would be released for unrestricted use proposed under each alternative. The net benefits for each alternative are discussed in Section 7.5.

> **Lifecycle Costs**
> All costs that would occur during and after site reclamation, including the remedial action and construction costs and long-term operating, monitoring, surveillance and maintenance costs.
>
> **Opportunity Cost of Land**
> Represents the alternative uses and foregone benefits that can be derived from the land. For example, if land is lying fallow and not being productively cultivated or used for grazing, the opportunity cost would be represented by the loss of income that the owner would have received if the land had been put to productive use. When land use is restricted or encumbered, for whatever reason, there is an associated opportunity cost related to those restrictions.

7.2 Description and Costs of the Alternatives

7.2.1 No-Action Alternative

The no-action alternative costs reflect the cumulative present value of annual costs necessary to control erosion or other problems and the long-term maintenance of the entire 243-hectare (600-acre) SFC site. The cumulative present value of costs measures the present worth sum of all future annual costs associated with this action. Since these costs will occur annually in future years, the analysis involves summing them into the present, using discounting principles that consider the time value of money. The no-action costs reflect annual surveillance and maintenance activities to ensure that the buildings and equipment are maintained in a safe condition and that contaminated materials are controlled indefinitely. The activities that SFC would undertake under the no-action alternative would consist of sampling and analysis of monitoring wells, NRC inspection support, preparation of annual reports, mowing, and general maintenance. SFC proposed that a staff of one engineer/manager (part time), one administrative person (part time), two security guards, and two technicians (both full time) would be required to sustain these activities. SFC estimated that the annual operations and maintenance costs amounting to $368,394 could be funded by an $18.4 million annuity escrow fund using a 2% interest rate return expectation (SFC, 2006). The size of the fund was calculated by dividing the estimated annual costs by the interest rate of 2%. In addition, the no-action alternative's cumulative costs also reflect 13 years of annual spending on planned groundwater treatment and recovery. Therefore, the total cost of the no-action alternative is estimated at $19.8 million.

The no-action alternative is used as a baseline against which the other alternatives can be compared under the "with project" and "without project" evaluation framework. The with/without comparison is used to measure the incremental costs and benefits arising from site reclamation.

7.2.2 Alternative 1: On-site Disposal of Contaminated Materials (the Licensee's Proposed Action)

Alternative 1 would involve consolidating and placing all contaminated materials (soils, sludges, sediments, trash, drums, chipped pallets, etc.) in an on-site disposal cell. Due to the variability in disposed material density and the amount of soil that may actually be excavated, the disposal cell location and layout has been preliminarily designed to accommodate material volumes ranging from 5.1 million to 12 million cubic feet (i.e., a 4.05- to 8.1-hectare [10- to 20-acre] footprint) (SFC, 2006). On-site disposal of all contaminated materials is estimated to cost $32.6 million dollars. This cost represents the sum total of remediation/reclamation activities and regulatory costs.

7.2.3 Alternative 2: Off-site Disposal of All Contaminated Materials

Alternative 2 would involve excavating all contaminated materials, loading the materials onto gondola railcars, and transporting the waste to a disposal facility licensed to accept such materials.

The projected volume of contaminated materials to be shipped is estimated to be approximately 254,850 cubic meters (9 million cubic feet) (SFC, 2006). Option 1 would involve transporting all contaminated materials by railcar to the Energy*Solutions* facility in Clive, Utah and is estimated to cost $254 million. Option 2 would involve transporting all materials by rail to the WCS facility in Andrews, Texas. The cost of this option was estimated to be $143 million. Clive, Utah, is approximately 2,424 rail kilometers (1,505 miles) from Gore, Oklahoma, while the distance from Gore to Andrews, Texas, is approximately 1,221 rail kilometers (759 miles). The cost estimate differences reflect the different distances between the disposal sites and Gore, Oklahoma. To estimate the cost of transporting the waste by rail to WCS, the ratio of the rail kilometer distance for WCS to EnergySolutions was applied to the total rail shipping and off-site disposal cost per ton (for EnergySolutions from Option 1) as a scaling factor.

7.2.4 Alternative 3: Partial Off-site Disposal of Contaminated Materials

The costs of Alternative 3 reflect a blend, or composite cost, based on disposition or recovering/reusing the raffinate sludge and other sludges and sediments (North Ditch, Emergency Basin, and Sanitary Lagoon) and potentially reusing the uranium constituents recovered from these materials. Transportation to five facilities that could potentially accept the materials was costed. Uranium reuse and recovery applies to only the White Mesa facility, located in Blanding, Utah. Therefore, White Mesa was the only facility that could potentially offer a rebate to SFC, as described below. Alternatively, if the other sludges and sediments (North Ditch, Emergency Basin, and Sanitary Lagoon) cannot be used as alternate feed stock, they would be disposed of at one of three locations that could accept this form of waste. Contaminated materials other than the raffinate sludge and the other sludges and sediments identified in Table 7-1 would be placed in an on-site disposal cell. The partial off-site disposal options are presented in Table 7-1.

Table 7-1 Alternative 3: Partial/Blended Disposal/Alternate Feed Options

Alternative 3 – Options					
Material Type	**White Mesa, (Blanding, Utah)**	**Rio Algom (Grants, New Mexico)**	**Pathfinder Shirley Basin (Mills, Wyoming)**	**Energy Solutions, (Clive, Utah)**	**WCS, (Andrews, Texas)**
Raffinate Sludge (11.e.(2))	√	√	√	√	√
Other*	√		√	√	√

* Sludges and sediments from the Emergency Basin, the North Ditch, and the Sanitary Lagoon.

The following disposal options were evaluated for the raffinate sludge and other sludges and sediments:

1. White Mesa + Pathfinder (Option 3-1-1)
2. White Mesa + EnergySolutions (Option 3-1-2)
3. White Mesa + WCS (Option 3-1-3)
4. Rio Algom + Pathfinder (Option 3-2-1)
5. Rio Algom + EnergySolutions (Option 3-2-2)
6. Rio Algom + WCS (Option 3-2-3)

In addition, the following options are possible and would involve transporting the raffinate sludge and the other sludges and sediments to one facility (although disposal of all materials at Rio Algom might be possible, this option was similar to the Pathfinder option and was not assessed separately):

1. EnergySolutions (Option 3-3-1)

2. WCS (Option 3-3-2)

3. Pathfinder Shirley Basin (Option 3-3-3)

4. White Mesa (Option 3-4)

The costs of each of these options are shown in Table 7-2 and Table 7-6, and the detailed unit costs and costing parameters and assumptions are provided in Appendix F, Cost Analysis.

Appendix F, Table F-18 also shows all of the assumptions and parameters that were used to estimate the potential monetary rebate that would apply to each alternative involving White Mesa and the recovery of uranium constituents from the raffinate sludge. The estimated rebate was based on applying current market prices for uranium (in $/lb, obtained from official sources) and industry information regarding recovery factors and processing costs associated with handling and processing the 11e.(2) alternate feed tonnages as feedstock. The latter assumptions and parameters on industry standards were obtained from responses to Requests for Additional Information (see notes in Table F-18 for details).

Transportation and Disposal Costs and Shipper Price Quotes

To determine current transportation costs for transporting the designated materials via truck, licensed shippers were contacted. A total of seven carriers provided price quotations. The carriers were provided with (1) a uniform description of the materials and shipping specifications for the raffinate sludge and other sludges and sediments, (2) the nature of the materials, (3) the super sack packaging configuration and approximate weights of the super sacks, (4) the potential final destinations, and (5) the assumption that the material would be shipped as LSA-II exclusive use with IP-2 packaging. The shippers were requested to provide rate quotes that would also include fuel charges and tolls.

Lifecycle Costing Framework and Discounting

Discounting is a process to convert future values into present worth amounts for the purposes of comparing apples to apples, and to acknowledge the time value of money. Since some annual costs (e.g., those related to long-term site control and maintenance and groundwater remediation) will arise in future years, they are converted to present worth equivalents using the following formula and discount rate:

$$\text{Present Value of Future Costs} = \left(\frac{FV\ Cost}{1+i^{n}}\right)$$

A 2% discount rate was used in this section because it is consistent with regulatory guidance for the level of discount rate to be used for long-term planning horizons (3%), and because it matches the rate used to calculate the fund value for financial assurances purposes. The fund value represents the present value of a series of uniform payments for long-term site control and inspections. The 2% rate represents the return expectation on the annuity escrow fund that would pay for the annual long-term surveillance and monitoring activities for each alternative. This rate is also close to the current 3% discount rate suggested by the Office of Management and Budget (OMB) in their guidance document for programs with durations longer than 30 years.

Appendix F, Tables F-15 through F-17 provide the rate quotes received expressed in terms of rates per load, total costs of transporting the materials, and dollars per ton corresponding to these costs. The tables also include the minimum, mean, and maximum quotes and distribution figures showing the range of the variation. For the costing of the Alternative 3 options, the mean quote, in dollars per ton, was used for each respective shipping option.

The disposal and recovery costs (White Mesa), expressed in dollars per ton, were obtained from SFC (SFC, 2007) and personal communication by NRC staff with the facilities.

7.3 Total Costs

Appendix N of NUREG 1757, Vol. 2, Rev. 1 specifies the categories of the total costs of an action that should be evaluated for the cost benefit analysis. Among these cost categories are the monetary cost of the remediation action ($Cost_R$), the monetary cost for transport and disposal ($Cost_{WD}$), the monetary costs of worker accidents during the remediation action ($Cost_{ACC}$), the monetary cost of traffic fatalities during transportation of the waste ($Cost_{TF}$), the monetary cost of the dose received by workers performing the remediation action and transporting waste to the disposal facility ($Cost_{WDose}$), the monetary cost of the dose to the public from excavation, transport and disposal of the waste ($Cost_{PDose}$), and other costs as appropriate for the particular action ($Cost_{other}$) (NUREG-1757). The total cost analysis comparisons focus on combined remediation plus disposal and transportation costs. The other costs outlined above (besides remediation and transport and disposal) were below threshold levels and not added to total costs.

Table 7-2 shows the total costs consisting of remediation, transport and disposal per each alternative. The average discounted lifecycle costs ($Costs_{R\,+}\,Cost_{WD}$) per km, per ton, and per ton/km are also shown across all options. The data in Table 7-2 show that shorter distances between the SFC site and the WCS facility in Andrews, Texas, can result in potentially lower total costs compared to the other disposal alternatives. However, WCS and PMC costs are roughly comparable and Table 7-2 shows that the licensee's proposed action is the least cost alternative.

7.4 Benefits of the Alternatives

The benefits of each alternative can first be assessed by how effectively each functions in removing residual radioactivity from the SFC facility site, thereby enabling either (1) release of the property for unrestricted use and termination of the license, or (2) release of the property under restricted conditions and termination of the license. Benefits also can be classified by when they could potentially arise over time.

The future benefits that are attributable to each alternative and directly related to the future land use of the SFC property were quantified and monetized. These benefits were (1) the monetized benefit from the collective radiation dose averted (explained below) and (2) the agricultural benefit associated with the unrestricted acreage that could be used productively in the future.

Under the "with" and "without" project evaluation framework pursuant to Executive Order 12866, the radiation dose and risk assessments presented in Appendix D (Radiation Dose and Risk Assessments) were evaluated for each alternative, including the no-action alternative. The

Table 7-2 Total Costs per Alternative and Costs per Unit

Alternative	**Total Cost$_{R+WD}$** (= remediation plus transport and disposal)	**Distance from SFC (Gore, OK) to Disposal Site (km)**	**Total Cost Per Km**	**Total Cost Per Ton[1]**	**Total Cost Per Ton Km**
Alternative 1: On-site Disposal (the Licensee's Proposed Action)	$32,585,758	-		$104	
Alternative 2: Off-site Disposal of All Contaminated Materials					
Option 1: Transport of all materials by rail to EnergySolutions, Clive, Utah	$254,384,341	2,424	$104,944	$815	$0.34
Option 2: Transport of all materials by rail to WCS in Andrews, Texas	$143,143,383	1,221	$117,235	$458	$0.38
Alternative 3: Partial Off-site Disposal					
Option 1: Raffinate sludge to be transported by truck to White Mesa, Blanding, Utah[3]. Other sediments to be transported by truck to either:		**Weighted Distance from SFC[2] (km)**			
1. Pathfinder Shirley Basin, Mills Wyoming[2]	$36,257,131	1,617	$22,418	$116.1	$0.07
2. EnergySolutions, Clive, Utah[2]	$36,420,245	1,705	$21,359	$116.7	$0.07
3. WCS, Andrews, Texas[2]	$35,874,519	1,509	$23,779	$114.9	$0.08
Option 2: Raffinate sludge to be transported by truck to Rio Algom, Grants, New Mexico. Other sediments to be transported by truck to either:					
1. Pathfinder Shirley Basin[2]	$37,441,472	1,293	$29,968	$119.9	$0.09
2. EnergySolutions[2]	$37,604,586	1,380	$27,243	$120.4	$0.09
3. WCS[2]	$37,058,860	1,184	$31,304	$118.7	$0.10
Option 3: Transport raffinate sludge and other sludges and sediments via truck to either:					
1. EnergySolutions	$38,900,070	2,190	$17,763	$124.6	$0.06
2. WCS	$35,701,488	1,038	$34,394	$114.3	$0.11
3. Pathfinder Shirley Basin	$37,944,034	1,675	$22,653	$121.5	$0.07
Option 4: Transport raffinate sludge and other sludges and sediments via truck to White Mesa, Blanding Utah	$36,015,411	1,607	$22,412	$115.4	$0.07
No-Action Alternative	$19,774,929				

[1] Total cost per ton was calculated based on the total quantities of all materials. Includes the same total quantity for all alternatives (approximately = to 312,217 tons of materials).
[2] Reflects the weighted distance (weighted by the tonnage of materials being disposed of at each option), where applicable, for those Alternative 3 options (noted) with two final disposal destinations.
[3] White Mesa, in Blanding, Utah, is 1,607 truck km from Gore, Oklahoma.
[4] Other sediments include Emergency Basin Sediment, North Ditch Sediment plus Sanitary Lagoon Sediment.

differences in radiation doses (collective person-rems over time) between the no-action alternative (without project) and the other alternatives (with project scenarios) were calculated, valued, and compared as avoided costs or the collective benefits from averted future radiation doses attributable to each alternative.

The U.S. Census of Agriculture (for Sequoyah County, Oklahoma) was used to calculate a net farm cash income per acre associated with the net acres under each alternative that could potentially be farmed under unrestricted land use conditions. The following sections provide details on how these benefits were measured.

7.4.1 Monetized Benefits of Collective Radiation Dose Averted

The direct public health and safety benefits from removing residual radioactivity relate to the avoided collective radiation doses that would no longer be experienced by the relevant population(s) at the site. These populations were taken from the Appendix D scenarios related to reclamation activities (and the number of workers/people who could be exposed) and the lifetime collective doses associated with the residential farmer scenario.

The monetized value of the collective radiation dose averted was calculated by first monetizing the collective doses associated with each respective alternative. Under NRC guidelines for cost benefit analysis, in order to incorporate the benefits associated with reclamation activities that remove residual radioactive contamination from a site (and thereby ensure the public health and safety), there is a procedure for assigning a dollar value to the physical measures of exposure to radiation. The avoided potential exposure that is attributable to reclamation and remedial safety activities, as well as the potential exposure under the no-action alternative, represents the collective radiation dose averted that is then monetized or assigned a dollar value in the cost benefit analysis. This procedure ensures that the benefits from public health and safety actions, unique to each reclamation alternative, can be compared and counted in the analysis.

Collective doses measured in person-rems per year were obtained from this EIS, Section 4.4 (Public and Occupational Health Impacts), and Appendix D (Radiation Dose and Risk Assessments). The doses reflected both reclamation period worker exposures and the long-term potential exposure that was modeled using the residential farmer scenario. These monetized values were then subtracted from the no-action alternative's monetized collective dose (modeled using the collapse of SFC's proposed ICB and breakdown in institutional controls as a worst-case potentiality, or upper bound).

A given alternative's potential dose to select individuals represents a cost. However, the collective doses that would be avoided by the existence of that particular alternative are represented by the no-action alternative's collective dose less the collective dose of each alternative's reclamation plan. This procedure is consistent with the "with" and "without project" framework method of cost benefit analysis guidance in Executive Order 12866. Under this evaluation framework, "but for" the given disposal alternative, the worst-case collective dose associated with the no-action alternative would occur. This worst-case collective dose is averted by the given disposal alternative; consequently, it is considered a benefit associated with that alternative.

The formula used to calculate collective dose was sourced from NUREG-1757 Vol. 2, Rev. 1, Appendix N, equation (N-1), which is reproduced below.

B_{AD} = \$2,000 x PW($AD_{collective}$), where:

- B_{AD} = benefit from averted doses for a remediation action, in current U.S. dollars
- \$2,000 = value in dollars of a person-rem averted (see NUREG/BR-0058, "Regulatory Analysis Guidelines of the U.S. Nuclear Regulatory Commission," Revision 2, [NRC, 1995]), and
- PW($AD_{collective}$) = present worth of a future collective averted dose.

Collective doses that would be experienced over time (i.e., over the course of a 70-year period corresponding to the residential farmer scenario) were multiplied by the NUREG dollar value per person-rem averted, \$2000, in each individual year and expressed as the cumulative present value. Since the number of person-rems of total exposure and the dollar value was uniform for each year, the present value of an annuity formula (a uniform series) was applied. The following formula was used to calculate the present value of future collective doses per each alternative:

Monetized Collective Dose per Alternative:

$$= value\ per\ \ person\ rem\ x\ \ person\ rems\ x\left(\frac{1-[1+i]^{-n}}{i}\right)$$

where i represents the discount rate of 2%.

Example:

= (\$2,000 x 54) x 1-[1+.02]$^{-70}$ / .02

= \$4,049,851

The 2% discount rate was chosen to be consistent with the 2% rate that was used to discount future long-term monitoring and site surveillance costs over the 1,000-year period used to establish the fund size, or present worth, of the financial assurance obligation. Table 7-3 presents the calculations that were performed to estimate the benefits per each alternative associated with the averted collective dose.

It should be noted that moving beyond a 70-year modeling framework (from the individual residential farmer scenario) would generate significantly larger net benefits. It is entirely plausible that, over a 1,000-year period, successive generations would farm this acreage and be exposed to radiation. If the annual averted person-rems calculation were carried out over a 1,000-year period, the net averted benefits would be significantly larger than the amounts shown in Table 7-4, which correspond to a period of 70 years. However, since the benefits measured are similar across alternatives, scaling these benefits upward would not alter the relative outcomes or conclusions for each option considered in the cost benefit analysis. The main differences are reflected in cost measures.

Table 7-4 shows the monetized value of the collective radiation dose averted per each alternative. The value of the collective radiation dose averted was calculated by subtracting each alternative's collective dose from the no-action alternative's collective dose. Taking proactive measures to protect the public's health and safety by safely disposing of contaminated sludge and sediments has a monetary value compared to the no-action alternative. This is the concept that is conveyed by the term "value of collective dose averted." According to Table 7-4, by taking no action at the SFC site, the monetized cost of future exposure from residual radioactivity would total $195 million. By taking reclamation and remediation actions at the site per each disposal alternative, the public can avoid these costs. The value of the collective dose averted measures these avoided costs that are public health and safety benefits.

Table 7-3 Monetized Value of Collective Radiation Doses per Alternative

	Person-rems	Dollar Value of Averted Person-rems	Present Worth of Future Collective Dose
Alternative 1: On-site Disposal of All Contaminated Materials (the Licensee's Proposed Action)			
Off-site public and worker doses during reclamation	33.5	$2,000	$67,000
Long-term public radiation dose	3,780	$2,000	$4,049,851
Total			$4,116,851
Alternative 2: Off-site Disposal of All Contaminated Materials			
Off-site public and worker doses during reclamation	36	$2,000	$72,000
Long-term public radiation dose	660	$2,000	$706,474
Total			$778,474
Alternative 3: Partial Off-site Disposal			
Off-site public and worker doses during reclamation	37	$2,000	$74,000
Long-term public radiation dose	3,780	$2,000	$4,049,851
Total			$4,123,851
No-Action Alternative			
Off-site public and worker doses during license cont.	6.1	$2,000	$12,200
Long-term public radiation dose	182,000	$2,000	$194,992,820
Total			$195,005,020

Table 7-4 Benefits Associated with Value of Collective Radiation Dose Averted per Each Disposal Alternative

Alternative	Present Worth of Future Collective Dose	Value of Collective Dose Averted
Alternative 1: On-site Disposal of All Contaminated Materials (the Licensee's Proposed Action)	$4,116,851	$190,888,169
Alternative 2: Off-site Disposal of All Contaminated Materials	$778,474	$194,226,546
Alternative 3: Partial Off-site Disposal	$4,123,851	$190,881,169
No-Action Alternative	$195,005,020	–

7.4.2 Benefits from Future Agricultural Land Use Associated with Unrestricted Acres

Other potential economic benefits are associated with the opportunity cost of land at the SFC site. The opportunity cost of the Sequoyah Fuels land represents the next best alternative and highest use of the acreage if it were available for unrestricted use and/or development. If a particular reclamation alternative allows either a portion or all of the former facility acreage to be deemed open for unrestricted use, then in theory the hypothetical future economic benefit can be approximated by examining adjacent lands. The capitalized economic value of those acres functioning at their highest and next best alternative use would represent the benefit that could be compared to the future annual costs of the particular reclamation alternative. The capitalized economic value is a way of expressing the total cumulative value of income derived from this acreage forever, or in perpetuity. Since the NRC reclamation time horizon contemplates a 1,000-year time period, it is appropriate to use the capitalized value.

Adjacent agricultural lands have been used for rangeland and cattle grazing activities in the past (SFC, 2006), and SFC has received several offers to purchase its farmlands in the past at fair market values and has also sold several parcels and company-owned houses at market prices (SFC, 1999). The land also could be used for recreational purposes, as open parkland, as a wildlife sanctuary, or possibly for an industrial park (SFC, 2006). These other potential land uses also have associated economic benefits that can be estimated and compared to costs. However, the actual and perceived quality of the groundwater will also influence the future uses that are achievable for these lands.

Data on the value of agricultural production was obtained from the U.S. Census of Agriculture, 2002, for Sequoyah County, Oklahoma (USDA, 2004). The average dollar income of farms with net gains from production was used to estimate the future net income per acre that may be possible if select unrestricted acres were used for agriculture. Table 7-5 shows how the original data from the Census of Agriculture for the State of Oklahoma was used to measure agricultural benefits associated with each unrestricted release alternative.

The assumption used in Table 7-5 is that the unrestricted acres would be used in the long-term, over a 1,000-year period for agricultural purposes. For simplification purposes, the calculation assumes that an average yield associated with an average mix of representative crops and farm operations for Sequoyah County would apply to the unrestricted acres being released.

The present worth of future benefits associated with the off-site disposal of all contaminated materials would result in the greatest agricultural benefit because of the larger number of acres that would be released for unrestricted use. It should be noted that the cumulative value of net farm cash income associated with the off-site disposal of all contaminated materials also was applied to the no-action alternative's "Other Costs" as a measure of the opportunity cost of the no-action alternative's land footprint.

Table 7-5 Economic Benefits Associated with Agricultural Use on Unrestricted Acres per Alternative

		Alternative 1: On-site Disposal	**Alternative 2: Total Off-site Disposal**	**Alternative 3: Partial Off-site Disposal**
1	Hectares released for unrestricted use	112	243	112
2	Acres released for unrestricted use	276	600	276
3	2007 net cash farm income of operations, farms with net gains (Sequoyah County)	$19,487	$19,487	$19,487
4	Average size of farm acres Sequoyah County	177	177	177
5	Net cash income per farm acre	$110	$110	$110
6	Estimated net cash income per disposal alternative acres	$30,387	$66,059	$30,387
7	Capitalized value of net cash income (i = 2%)	$1,519,351	$3,302,936	$1,519,351
8	2007 Present value of net cash income, (PV, ANN PMT, n = 1,000 yrs, i = 2%)	$1,519,351	$3,302,936	$1,519,351

Source: USDA, 2004; DOL, 2002.

7.4.3 Benefits from Avoided Regulatory Costs

The concept of avoided regulatory costs relates back to the licensee's ability to avoid costs associated with a site that has been released for unrestricted use. For example, the licensee may avoid specific costs associated with restricted release. These costs could include additional license fees and financial assurances related to site restrictions. Avoided regulatory costs are treated as a benefit of the unrestricted release alternatives.

Benefits associated with avoided regulatory costs were calculated as the cost difference in terms of regulatory compliance between each disposal alternative and the no-action alternative. This cost difference was represented by the difference between the long-term site control plan for each disposal alternative option (off-site and partial off-site) and the more extensive site control plan (larger costs) associated with the no-action alternative. The long-term fund amount (regulatory cost) associated with both Alternative 1 and Alternative 3 (partial off-site) were modeled by referring to 10 CFR Part 40, Appendix A, Criterion 10. Criterion 10 provided a 1978 amount equal to $250,000 (in 1978 dollars) that was then escalated to 2007 dollars using the U.S. Consumer Price Index for those years. For the no-action alternative, the more extensive long-term site control plan was based on estimated annual long-term maintenance costs that would be required to conduct sampling, testing, and monitoring activities. A fund is set up at time period 0, the current time, to ensure that there will be sufficient annually recurring funds over the life of the 1,000-year period. The annual interest on the fund should provide the source for these annual costs. A 2% interest rate expectation was used. The sizing of the initial fund (also described as how the fund was capitalized) was determined by dividing the expected annual cost for long-term monitoring and control by the 2% interest rate. Because of discounting future amounts so far into the future, the present value (PV) of ($\$1 / [1 + i]^{n=1000}$) is virtually identical to the PV of a perpetuity, using the formula PV = ($\$1 / i$). This is the rationale for why the annual long term maintenance cost amount was divided by the interest rate in the cost template calculations provided in Appendix F.

7.4.4 Other Benefits Not Quantified and Monetized

The site reclamation activities associated with SFC's proposed plan would also stimulate local employment and spending on goods and services within the Sequoyah County area (see Appendix B.6, Socioeconomics). Local resources and materials, supplies, and equipment may be purchased during site reclamation activities. These short-term, nonrecurring activities would be beneficial, especially if they did not divert resources from other areas (i.e., they constituted a net increase to regional gross domestic product and not simply a transfer of economic activity within Sequoyah County). In addition, the cost benefit analysis did not quantify the value of a reduction in public opposition. It needs to be acknowledged that some public opposition to Alternative 1, the On-site Disposal Alternative, exists and was communicated at the public meeting.

7.5 Net Benefits: Comparing Total Costs to Total Benefits per Each Alternative

Table 7-6 combines all of the quantified and monetized costs and benefits into a single comparative statement for assessment purposes. Net benefits are equal to total benefits minus total costs**.** The results show that the licensee's proposed action results in the greatest net benefits of all the alternatives. This result is relatively close to the partial off-site disposal option associated with Alternative 3, Option 4 (use of raffinate sludge and other sludges and sediments as alternate feedstock at White Mesa). There is a 2% ($3.4 million) difference between Alternative 3, Option 4, and Alternative 1 that is based only on costs. It should be noted that Alternative 3, Option 4, factors in a dollar rebate used to offset total costs based on the potential recovery of uranium from the materials. Since the market price of uranium has been volatile, a sensitivity analysis for this option was conducted.

Value of Reduction in Public Opposition. Since the cost benefit analysis did not quantify or monetize the value of a potential reduction in public opposition, it is reasonable to assume that the 2% cost difference between Alternative 1 and Alternative 3, Option 4, would be narrowed since public opposition would be reduced with implementation of Alternative 3, Option 4. This latter conclusion is based on qualitative observations and inputs received from stakeholders at the public meeting and is based on reasonable impressions and processing of feedback from residents and community stakeholders. The value of a reduction in public opposition is an intangible benefit that has not been quantified but is important to disclose during the decision-making process.

Sensitivity Analysis. Appendix F, Table F-19 shows all assumptions and parameters used to calculate the rebate associated with recovered uranium constituents. Conservative assumptions were used in calculating the potential value of recovered uranium associated with Alternative 3, Option 4. The spot price for uranium on March 18, 2008, was used to determine the value of recovered uranium. Uranium prices are expected to continue to be volatile in the future, with a greater possibility for price appreciation based on fundamental market conditions and supply/demand projections. A sensitivity analysis was conducted to examine the responsiveness of the total rebate (with the rebate based on the industry standard calculation of 20% of net revenues to the processor) to changes in the market price of uranium (see Table 7-7). Column (1) of Table 7-7 shows market prices of uranium ranging from the current price of approximately $70/pound (lb), up to $300/lb. Column (2) shows the calculated rebate associated with these market prices. All of the parameters and assumptions used in Table F-19 to calculate the rebate were retained except the variation in price. Column (3) reproduces the current baseline estimated rebate used in the analysis for Alternative 3, Option 4, while column (4) shows the cost difference between the baseline rebate and the projected scenarios at different prices.

The sensitivity analysis shows that a $50 increase in the market price of uranium would increase the potential rebate by approximately $750,000.

Table 7-6 Summary of Cost Benefit Analysis and Net Benefits per Each Alternative (millions of dollars)

	Costs					Benefits				
Alternative	**Total $Cost_{R+WD}$ (remediation plus transport & disposal less regulatory)**	**Cost of CollectiveDose**	**Opportunity Cost of Land[1]**	**Regulatory Costs**	**Total Costs**	**Value of Collective Dose Averted**	**Regulatory Costs Avoided[2]**	**Capitalized Value of Net Agricultural Income**	**Total Benefits**	**Net Benefits[3]**
Alternative 1: On-site Disposal of All Contaminated Materials (the Licensee's Proposed Action)	$31.8	$4.1	$0.80	$1.8	$38.5	$190.9	$17.62	$1.5	$210.0	$171.5
Alternative 2: Off-site Disposal of All Contaminated Materials										
Option 1: Transport of all materials by rail to EnergySolutions, Clive, Utah	$254.4	$0.8			$255.2	$194.2	$18.42	$3.3	$215.9	$(39.2)
Option 2: Transport of all materials by rail to WCS in Andrews, Texas	$143.1	$0.8			$143.9	$194.2	$18.42	$3.3	$215.9	$72.0
Alternative 3: Partial Off-site Disposal										
Option 1: Raffinate sludge transported by truck to White Mesa, Blanding Utah; other sediment transported by truck to either:										
1. Pathfinder Shirley Basin, Mills, Wyoming	$35.5	$4.1	$0.80	$1.8	$42.2	$190.9	$17.62	$1.5	$210.0	$167.9
2. EnergySolutions, Clive, Utah	$35.6	$4.1	$0.80	$1.8	$42.3	$190.9	$17.62	$1.5	$210.0	$167.7
3. WCS, Andrews, Texas	$35.1	$4.1	$0.80	$1.8	$41.8	$190.9	$17.62	$1.5	$210.0	$168.2
Option 2: Raffinate sludge to be transported by truck to Rio Algom, Grants, New Mexico. Other sediments to be transported by truck to either:										
1. Pathfinder Shirley Basin	$36.6	$4.1	$0.80	$1.8	$43.3	$190.9	$17.62	$1.5	$210.0	$166.7
2. EnergySolutions	$36.8	$4.1	$0.80	$1.8	$43.5	$190.9	$17.62	$1.5	$210.0	$166.5
3. WCS	$36.3	$4.1	$0.80	$1.8	$43.0	$190.9	$17.62	$1.5	$210.0	$167.1
Option 3: Transport both sludge and combined sediments via truck to either:										
1. EnergySolutions, Clive, Utah	$38.1	$4.1	$0.80	$1.8	$44.8	$190.9	$17.62	$1.5	$210.0	$165.2
2. WCS, Andrews, Texas	$34.9	$4.1	$0.80	$1.8	$41.6	$190.9	$17.62	$1.5	$210.0	$168.4
3. Pathfinder Shirley Basin	$37.1	$4.1	$0.80	$1.8	$43.9	$190.9	$17.62	$1.5	$210.0	$166.2
Option 4: Transport both sludge and combined sediments via truck to White Mesa, Blanding Utah	$35.2	$4.1	$0.80	$1.8	41.9	$190.9	$17.62	$1.5	$210.0	$168.1
No-Action Alternative	$1.4	$195.0	$18.42	$3.3	$218.1	$-	$-	$-	$-	$(218.1)

1 Opportunity cost of land is equal to the foregone value of agricultural net income that would be forfeited by not having the available incremental acres for cultivation associated with the next best alternative.
The opportunity cost was calculated by subtracting the total income associated with the On-site Disposal Alternative from the Off-site Disposal net capitalized farm income.

2 Equal to the cost difference in terms of regulatory compliance between each disposal alternative and the no-action alternative. This cost is the difference between the long-term site control plan for this option and the more extensive site control plan for the no-action alternative.

3 Note that values within "( )" are deficits, or costs in excess of benefits.

Table 7-7 Sensitivity Analysis of the Potential Rebate (@ 20% of Net Revenues) to Changes in the Market Price of Uranium

(1)	(2)	(3)	(4)
Market Price Scenario ($/lb)	**Potential Rebate at Variable Market Prices for Uranium ($/lb)**	**Estimated Baseline Rebate at Current Market Price of Uranium ($70/lb)**	**Cost Difference Between Baseline Rebate and Higher Price Rebate**
$70	$773,497	$773,497	$-
$100	$1,240,352	$773,497	$466,856
$150	$2,018,446	$773,497	$1,244,949
$200	$2,796,539	$773,497	$2,023,043
$250	$3,574,632	$773,497	$2,801,136
$300	$4,352,726	$773,497	$3,579,229

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8. SUMMARY OF ENVIRONMENTAL CONSEQUENCES

8.1 Unavoidable Adverse Environmental Impacts

Implementing SFC's proposed action for reclamation of its Gore, Oklahoma, site or one of the reasonable alternatives, would result in unavoidable adverse environmental impacts. The unavoidable adverse environmental impacts associated with each alternative are described in detail below.

8.1.1 Alternative 1: On-site Disposal of Contaminated Materials (the Licensee's Proposed Action)

Under Alternative 1, SFC has proposed to construct an on-site disposal cell and establish an ICB of approximately 131 hectares (324 acres) in size around the disposal cell. In order to prevent potential human and ecological exposure to on-site contamination, SFC proposes transferring the area within the ICB in perpetuity to the custody of the State of Oklahoma or the United States. This unavoidable adverse environmental impact on land use would be MODERATE.

Alternative 1 also would involve unavoidable adverse environmental impacts on geology and soils through excavation of clay for the liner system and removal of contaminated soils. Visual resources would be adversely affected as a result of construction of the on-site disposal cell. All of these impacts would be mitigated through grading and revegetation of the disposal cell cover to create a more natural looking landscape and can be characterized as SMALL. The potential for adverse impacts on vegetation with consequent adverse effects on the American burying beetle and migratory bird species would be mitigated through the implementation of a USFWS-approved mitigation plan. Other SMALL short-term, unavoidable adverse environmental impacts that would occur during implementation of reclamation activities include dust, noise, and increased traffic.

8.1.2 Alternative 2: Off-site Disposal of All Contaminated Materials

Alternative 2 would require SFC to consolidate and move the contaminated sludges, soils, and debris off-site by rail for disposal at a disposal facility licensed to accept such materials. To transport the contaminated materials off-site, a railroad spur would be constructed to connect the site with the Union Pacific rail line. The spur would pass through a previously undeveloped area of pastureland, hayfields, and forestland and would cross two intermittent streams, resulting in the loss of habitat and vegetation. It is anticipated that the railroad spur would remain in place following reclamation. The unavoidable adverse environmental impacts associated with land-use would be SMALL since the area is currently traversed by numerous existing roadways and rail lines. The unavoidable adverse environmental impacts on ecological resources associated with construction of the railroad spur (e.g., loss of habitat and vegetation with the potential for adverse effects on the American burying beetle) could be mitigated and, therefore, would be SMALL to MODERATE.

Alternative 2 also would involve unavoidable adverse environmental impacts on geology and soils through excavation of clay for the liner system and removal of contaminated soils. Visual resources would be adversely affected as a result of construction of the on-site disposal cell. All of these impacts would be mitigated through grading and revegetation of the disposal cell cover to create a more natural looking landscape and can be characterized as SMALL. In addition, other short-term, SMALL unavoidable adverse environmental impacts that would occur during implementation of reclamation activities include dust, noise, and increased traffic.

8.1.3 Alternative 3: Partial Off-site Disposal of Contaminated Materials

Under Alternative 3, the unavoidable adverse environmental impacts would be a combination of those associated with Alternatives 1 and 2. Following the licensee's reclamation activities to excavate and consolidate contaminated materials, a portion of the contaminated material would be transported by SFC off-site via truck for disposal, with the remainder of the contaminated materials placed in an on-site disposal cell. Following completion of site reclamation activities, SFC proposes that the area within the proposed ICB be transferred in perpetuity to the custody of the State of Oklahoma or the United States. This unavoidable adverse environmental impact on land use would be MODERATE.

Alternative 3 also would involve unavoidable adverse environmental impacts on geology and soils through excavation of clay for the liner system and removal of contaminated soils. Visual resources would be adversely affected as a result of construction of the on-site disposal cell. All of these impacts would be mitigated through grading and revegetation of the disposal cell cover to create a more natural looking landscape and can be characterized as SMALL. The size of the disposal cell under this alternative may be slightly smaller than the disposal cell described for Alternative 1; however, the size of the proposed restricted area would be the same, with only the capacity and height of the disposal cell differing. The potential for adverse impacts on vegetation with consequent adverse effects on the American burying beetle and migratory bird species would be mitigated through the implementation of a USFWS-approved mitigation plan. Other short-term, SMALL unavoidable adverse environmental impacts that would occur during implementation of reclamation activities include dust, noise, and increased traffic.

8.1.4 No-Action Alternative

Under the no-action alternative, SFC would be required to maintain the entire 243-hectare (600-acre) site indefinitely under restricted conditions and perform site surveillance and maintenance to ensure the facility is maintained in a safe condition and that contaminated materials are controlled. However, there would be continued potential for contamination of groundwater because the source of such contamination would not be addressed. This long-term use restriction and the adverse impacts on the existing environment associated with contaminated soils and groundwater resources would indefinitely prevent future development of the site for any other purpose. The no-action alternative is an unacceptable alternative because it does not comply with the requirements of 10 CFR 40, Appendix A (Criteria Relating to the Operation of Uranium Mills and the Disposition of Tailings or Wastes). The unavoidable adverse impacts associated with implementation of this alternative would be LARGE.

8.2 Relationship Between Local Short-Term Uses of the Environment and the Maintenance and Enhancement of Long-Term Productivity

Consistent with the CEQ's definition as well as the definition provided in Section 5.8 of NUREG-1748, *Environmental Review Guidance for Licensing Actions Associated with NMSS Programs*, this EIS defines short-term uses and long-term productivity as follows:

- Short-term uses generally affect the present quality of life for the public (e.g., the cleanup of a contaminated site).

- Long-term productivity affects the quality of life for future generations based on environmental sustainability (e.g., the period after the termination of a license to operate a facility).

The anticipated short-term uses and long-term productivity of the site under each alternative are discussed below.

8.2.1 Alternative 1: On-site Disposal of Contaminated Materials (the Licensee's Proposed Action)

Under Alternative 1, construction of the on-site disposal cell would necessitate the short-term commitment of resources (e.g., money and labor) and would permanently commit other resources (e.g., energy, water, and land). The short-term use of these materials would result in the isolation of contaminated materials and provide for groundwater corrective actions in a manner that would be protective of human health and the environment both on- and off-site. In addition, workers, the public, and the environment may be exposed to increased amounts of hazardous and radioactive materials over the short-term as a result of reclamation activities. However, short-term impacts would be minimized by the implementation of appropriate mitigation measures and resource management and the impacts would be SMALL. After completion of site reclamation activities, SFC proposes releasing 112 hectares (276 acres) for unrestricted use and development, benefiting the long-term productivity of the local area and region. These land use impacts would be MODERATE.

8.2.2 Alternative 2: Off-site Disposal of All Contaminated Materials

Under Alternative 2, SFC would conduct site cleanup, construction, transportation of contaminated materials by rail, and soil backfilling and revegetation activities. Construction of a rail spur and off-site transport of contaminated waste would involve a permanent commitment of land, energy, and water (the rail spur would not be removed by SFC following completion of site reclamation activities). These impacts would be SMALL to MODERATE.

Workers, the public, and the environment may be exposed to increased amounts of hazardous and radioactive materials over the short term as a result of reclamation activities. Short-term SMALL impacts would be minimized through the implementation of appropriate mitigation measures and resource management.

Remediation of contaminated soils and groundwater would permit long-term uses of the entire 243-hectare (600-acre) site for unrestricted use and future development. The short-term land use and socioeconomic impacts would be SMALL. However, there could be MODERATE long-term positive benefits to the long-term productivity of the local area and region.

8.2.3 Alternative 3: Partial Off-site Disposal of Contaminated Materials

Alternative 3 would combine many of the effects of Alternatives 1 and 2. Construction of the disposal cell would necessitate the short-term commitment of resources and would permanently commit certain resources (e.g., energy, water, and land). The use of these resources would result in potential SMALL long-term socioeconomic benefits to the local area and the region. This alternative would also require a portion of on-site contaminated materials to be transported by truck to an off-site location for disposal or reuse as alternative feed at a uranium mill. This would provide for the enhancement of the long-term productivity of the site by removing the most contaminated materials. The impacts of this on the environment would be SMALL.

Following completion of site reclamation activities by the licensee, up to 131 hectares (324 acres) of the site would continue to be unavailable for long-term reuse because the on-site disposal cell is designed to isolate the on-site contaminated materials within the boundaries of an area restricted from public access. SFC proposes releasing the remaining 112 hectares (276 acres) for unrestricted use and development, benefiting the long-term productivity of the local area and region. These land use impacts would be MODERATE.

Workers, the public, and the environment may be exposed to increased amounts of hazardous and radioactive materials over the short-term as a result of reclamation activities. Short-term SMALL impacts would be minimized by the implementation of appropriate mitigation measures and resource management.

8.2.4 No-Action Alternative

The no-action alternative would preclude short-term uses of nearly the entire 243-hectare (600-acre) site due to the presence of contaminated soils and groundwater. In addition, continued long-term groundwater contamination would impact groundwater resources beyond the site boundary. The no-action alternative also would adversely affect long-term productivity at the SFC site because SFC would not conduct reclamation activities or institute groundwater corrective actions. The site would continue to be out of compliance with the criteria contained in 10 CFR Part 40, Appendix A, NRC's radiological criteria for decommissioning for license termination, and the site would remain restricted. The long-term productivity of the SFC site would not be enhanced under the no-action alternative, and impacts can be characterized as LARGE.

8.3 Irreversible and Irretrievable Commitment of Resources

Irreversible and irretrievable commitment of resources includes those resources whose use, as a result of implementation of a particular alternative, could not be recovered or recycled within a reasonable time frame. These typically involve the materials, capital, labor, energy, water, and land that are committed during construction, operation, and reclamation activities associated with implementation of an alternative.

For all of the proposed alternatives, the energy expended would be in the form of fuel consumed by equipment and vehicles used to perform the proposed reclamation activities and groundwater corrective actions, and the electricity used to operate the necessary stationary and portable equipment (e.g., pumps, lighting, general construction/demolition equipment). In addition, water would be obtained from Lake Tenkiller via the Sequoyah County Rural Water District No. 5. The electricity and fuel used during implementation of any alternative would not be recoverable, and thus, would be considered irretrievable. The licensee's use of water to conduct site reclamation activities, however, would not affect the ability of the local area or region to supply other industries in the vicinity of the SFC site with these resources. Specific resources that would be considered irreversible and irretrievable under each alternative are discussed below.

8.3.1 Alternative 1: On-site Disposal of Contaminated Material (the Licensee's Proposed Action)

Under Alternative 1, SFC proposes releasing 131 hectares (324 acres) within a proposed ICB for future restricted use. This area would include the land that would be used for the on-site disposal cell. Consequently, the land area within the proposed ICB would be unavailable for any other uses for perpetuity and thus its use would not be retrievable. Irreversible and irretrievable impacts on land use would be MODERATE.

The disposal cell would be constructed to contain the contaminated materials and would be sealed and covered with an engineered barrier topped with clean fill and topsoil. Construction of the disposal cell would not require significant amounts of off-site materials (about 3% of the total volume) because SFC would obtain a majority of the clean material from uncontaminated portions of the SFC site. A layer of clay would cap the disposal cell. The materials used in the construction of the disposal cell (clay and soil for liners and cover; rock from the quarry; polyurethane piping; and gas, oil, and other petroleum products for operation of trucks and machinery) are all considered irretrievable resources. The irreversible and irretrievable impacts of using these construction-related resources would be SMALL because the quantities would represent small quantities of the available resources.

Implementation of Alternative 1 would generate nonrecyclable radiological and nonradiological waste streams. Metals contained in demolition debris and equipment (steel, iron, copper, aluminum) may be considered unsalvageable due to radiological contamination. A large portion of these materials would be compacted into the cell and thus are considered irretrievable. These impacts would be SMALL.

8.3.2 Alternative 2: Off-site Disposal of All Contaminated Material

Under Alternative 2, buildings (except for the administration building and the electrical substation) would be demolished, contaminated materials would be excavated, and all debris and materials would be shipped off-site to a licensed disposal facility. The disposition of all these materials could be considered SMALL irretrievable impacts. SFC would use clean fill material from the SFC site to properly grade the site. The use of topsoil would be a SMALL irretrievable impact.

8.3.3 Alternative 3: Partial Off-site Disposal of Contaminated Material

Under Alternative 3, the land within the licensee's proposed ICB, including the land that would be used for the on-site disposal cell, would be transferred to the custody of the State of Oklahoma or the United States. This land, a maximum of 131 hectares (324 acres), would be unavailable for any other uses and would not be retrievable. The land use impacts of this proposal would be MODERATE. The proposed disposal cell would be constructed to contain the waste and would be sealed and graded with clean fill obtained from on-site sources. The irreversible and irretrievable impacts of the use of construction materials (clay, piping, petroleum products) would be the same as described for Alternative 1 (see Section 8.3.1).

8.3.4 No-Action Alternative

Under the no-action alternative, the SFC site could become an irretrievable resource due to contamination of land and groundwater. The property would be unavailable for any other future use or development. This irretrievable land use impact would be LARGE.

9. AGENCIES AND PERSONS CONSULTED

The following sections list the agencies and persons consulted for information and data for use in the preparation of this EIS.

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