Appendix C.8

Description of Activities and Impacts at the Hanford Site

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Description of Activities at the Hanford Site

C.8.1 INTRODUCTION

The U.S. Department of Energy (DOE) is preparing this Idaho High-Level Waste and Facilities Disposition Environmental Impact Statement (HLW & FD EIS) to analyze the environmental impacts of alternative methods of managing the Idaho National Engineering and Environmental Laboratory (INEEL) HLW. One alternative, the Minimum INEEL Processing Alternative, includes shipping INEEL HLW to the Hanford Site for immobilization in the proposed Hanford HLW vitrification plant. The Minimum INEEL Processing Alternative includes two shipping scenarios-Just-in-Time and Interim Storage-which are described in Section C.8.2. Under the Minimum INEEL Processing Alternative, INEEL HLW would be transported to the Hanford Site where it could be stored prior to waste processing. It would be processed in Hanford Site facilities (waste separations and vitrification) and shipped back to INEEL for interim storage pending disposal at a geologic repository.

The environmental impacts to the Hanford Site from managing and immobilizing Hanford Site HLW are described in the *Tank Waste Remediation System, Hanford Site, Richland, Washington, Final Environmental Impact Statement* (DOE 1996a), known as the TWRS EIS, and Record of Decision (62 FR 8693; February 26, 1997). The TWRS EIS analysis was used to support the analysis of the Minimum INEEL Processing Alternative because it analyzed alternatives that are similar to the Idaho HLW & FD EIS Minimum INEEL Processing Alternative. Consequently some, if not most, of the impact analysis for the INEEL alternative may be bounded by the TWRS EIS impact analysis and thus, the analysis can be incorporated by reference into the Idaho HLW & FD EIS (DOE 1993). For impacts that may exceed those presented in the TWRS EIS, calculations of the magnitude of the impacts can be derived from the TWRS EIS using scaling factors to determine whether the exceedances in impacts are substantial and, therefore, require additional analysis. This approach was used in the TWRS EIS analysis and in two TWRS supplement analyses (DOE 1997; 1998) and conforms to DOE NEPA guidance (DOE 1993).

For purposes of analysis under the National Environmental Policy Act, DOE assumed that the Hanford Site facilities would begin processing the INEEL HLW in 2028. This corresponds to the completion date for processing the Hanford tank wastes as presented in the TWRS EIS. Processing schedules for the Hanford tank wastes continue to evolve as the design and implementation of the Tank Waste Remediation System progresses. As more definitive information becomes available over the next 10 years, DOE will supplement this analysis as necessary.

This appendix addresses the potential environmental and human health impacts associated with the storage and treatment of INEEL HLW at the Hanford Site in conformance with NEPA requirements. The appendix does not address issues or impacts associated with the management of waste at the INEEL site or the transportation of waste to, or from, the Hanford Site. Those impacts are being considered as part of the analysis of the INEEL-related impacts. Specifically, this appendix:

- Summarizes the two scenarios for processing the waste at the Hanford Site (1) Just-in-Time Shipping and (2) Interim Storage Shipping (see Section C.8.2)

- Assesses the potential environmental impacts of the Minimum INEEL Processing Alternative at the Hanford Site. Both the Just-in-Time and Interim Storage Shipping Scenarios are evaluated. If there are no notable differences between the two scenarios in terms of potential environmental impacts, they are discussed collectively as the Minimum INEEL Processing Alternative. In cases where there are differences between the two scenarios they are discussed separately.

- Unless otherwise noted, all information in this appendix is based on the *Minimum INEEL Processing Alternative Hanford Site Environmental Impact Assessment Report* (Jacobs 1998). A comprehensive summary of the potential environmental impacts associated with the Hanford Site waste management activities is also presented in Jacobs (1998).

Following publication of the Draft EIS, DOE obtained updated information indicating that vitrification of INEEL mixed HLW at the Hanford Site would result in a larger volume of HLW glass than was analyzed in the EIS. Under the Minimum INEEL Processing Alternative, DOE had estimated that 730 cubic meters of vitrified mixed HLW (approximately 625 Hanford canisters) would be produced and transported back to INEEL. After the Draft EIS was issued, DOE Richland identified that their process for treating the INTEC HLW calcine would change. This change included dissolution of the calcine and raising the pH to 12 to be compatible with their process. This change resulted in an increase of the vitrified product. Based on this information, DOE estimates that 3,500 cubic meters of vitrified mixed HLW (approximately 3,000 Hanford canisters) would be produced under that alternative. Appendix C.5 and Section 5.2.9 present revised transportation impacts for the Minimum INEEL Processing Alternative associated with this larger mixed HLW volume.

C.8.2 DESCRIPTION OF ALTERNATIVE TREATMENT OF INEEL WASTE AT HANFORD

C.8.2.1 Introduction

This section describes alternatives for processing INEEL waste at the Hanford Site as a part of the Minimum INEEL Processing Alternative. This section also summarizes the waste to be processed. Additional information regarding the waste inventory and components of the alternatives are provided in Jacobs (1998). The description of alternatives in this section is limited to those activities associated with the potential treatment of INEEL waste that would take place on the Hanford Site. Activities associated with retrieving, handling, and packaging the waste at INEEL along with transporting the INEEL waste to and from the Hanford Site are not within the scope of this appendix. Appendix C.6 presents project descriptions for the activities at INEEL. All INEEL waste received at the Hanford Site for treatment would be returned to the INEEL for interim storage and/or disposal.

C.8.2.2 Minimum INEEL Processing Alternative

The Minimum INEEL Processing Alternative would involve processing approximately 4,000 cubic meters of calcine and approximately 160 cubic meters of cesium ion-exchange resin from the INEEL at the Hanford Site. Two transportation scenarios are evaluated from the standpoint of waste handling and interim storage requirements at the Hanford Site: (1) Just-in-Time Shipping, where the INEEL calcine would not be stored at the Hanford Site prior to processing and treatment, and (2) Interim Storage Shipping, where 308 cubic meters of calcine per year would be transported over a 14-year period and stored in new Canister Storage Buildings at the Hanford Site prior to processing and treatment. Calcine processing activities would include dissolution of the dry calcine powder, pH adjustment, lag storage in existing Hanford Site double-shell tanks, separation into HLW and low-activity waste fractions, vitrification, and packaging for shipment to INEEL. Calcine processing is summarized on Figure C.8-1. The cesium ion-exchange resin would be blended with the HLW feed, vitrified, and packaged for shipment to the INEEL.

C.8.2.3 Construction

Construction activities for this alternative would consist of building three Canister Storage Buildings and a Calcine Dissolution Facility. The Canister Storage Buildings would not be constructed if Just-in-Time Shipping were used. Each Canister Storage Building would be approximately 3,700 square meters (m^2) in plan area (footprint) and would consist of a large subsurface vault consisting of three individual bays each with a capacity of 440 Hanford Site (1.17 cubic meters) HLW canisters per bay or 1,320 canisters per Canister Storage Building. The below-surface vaults would be covered by an aboveground operating deck, within a prefabricated metal enclosure. Approximately 3,690 canisters of calcine would require storage. Preconstruction activities would take 1 year,

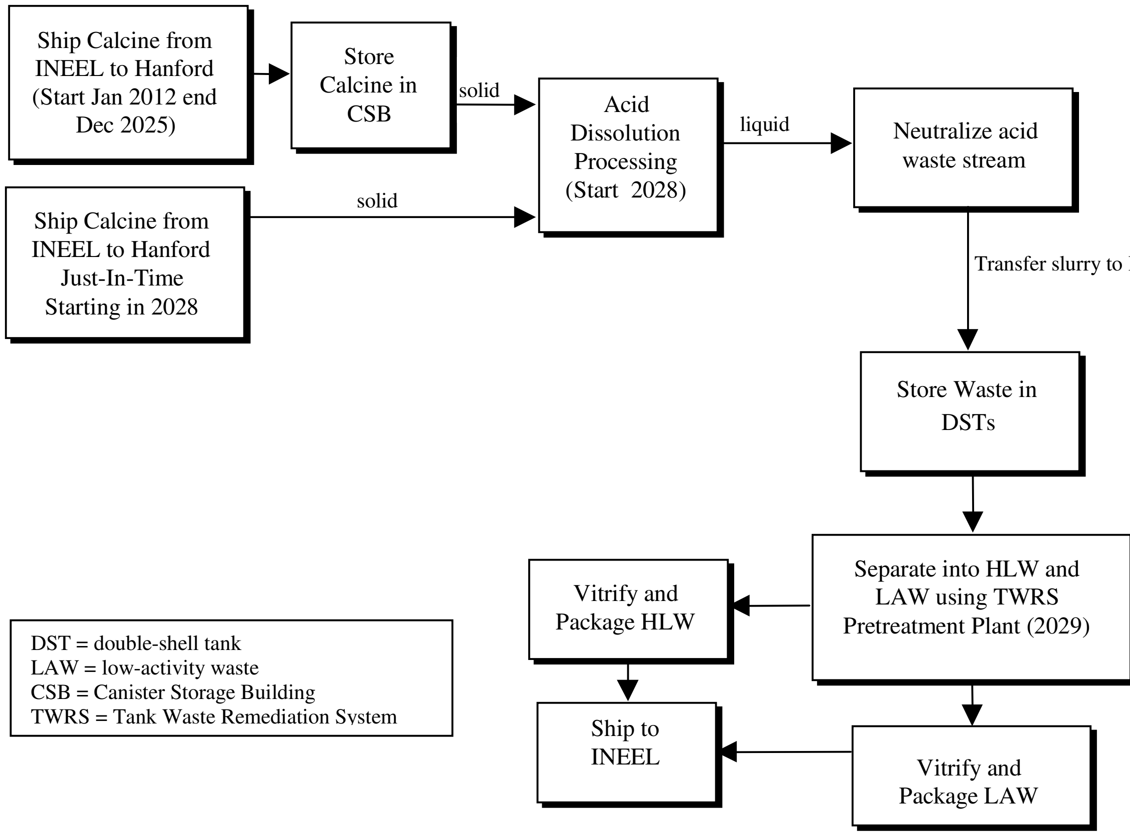


FIGURE C.8-1
Minimum INEEL Processing Alternative process flow diagram.

starting in January 2009, followed by two years of construction for the first Canister Storage Building. The two remaining Canister Storage Buildings would be constructed as needed. The first Canister Storage Building would be ready to receive INEEL calcine canisters in January 2012.

The Calcine Dissolution Facility would be approximately 3,800 m^2 in plan area and would be a hot-cell type facility. The Calcine Dissolution Facility would be constructed to provide systems to retrieve calcine from transport canisters, dissolve calcine, adjust pH, and transfer to the existing TWRS double-shell tank system. Preconstruction activities would start in 2021, while facility construction would start in 2024 with completion by December 2027.

C.8.2.4 Operations

Operations for the Canister Storage Building portion of this alternative would take place between January 2012 and April 2030. Shipment of calcine from the INEEL would begin in 2012 and vitrification operations at the Hanford Site would be complete in 2030. If Just-in-Time Shipping were used, no Canister Storage Building operations would be required. Operations of the Calcine Dissolution Facility would start in February 2028 and would end in April 2030. The existing waste separation facilities and the HLW and low-activity waste melters would operate from January 2029 through April 2030 (16 months).

Under the interim storage shipping scenario, INEEL would start shipping calcine canisters in

January 2012. Each year approximately 260 canisters (308 cubic meters) of calcine would be shipped from INEEL to the Hanford Site. Calcine shipments would be completed in December 2025.

The calcine canisters would be transferred to the calcine dissolution hot cell facility for calcine removal and dissolution. The facility would be operated to accomplish the following:

- Receive and unpackage calcine canisters.
- Rinse/decontaminate transport canisters.
- Transfer powdered calcine into stainless-steel vessels.
- Dissolve calcine in boiling nitric acid.
- Adjust calcine solution to pH of 7 using sodium hydroxide.
- Transfer liquid waste into double-shell tanks or directly into pretreatment system.

Following transfer into the double-shell tank system, the INEEL waste would be separated to create HLW and low-activity waste streams. This would involve sludge washing and enhanced washing with sodium hydroxide, solid/liquid separations, evaporating the liquid stream to concentrate waste, and removing cesium from the low-activity waste feed using ion exchange. The separated cesium-containing liquid stream that would come out of the ion-exchange process would be further evaporated and fed into the HLW stream.

The low-activity waste vitrification facility would be operated to accomplish the following:

- Receive and sample waste.
- Evaporate water from the waste and collect evaporator condensate for treatment or reuse for waste retrieval.
- Operate vitrification melters. (The TWRS EIS processing alternatives were based on the use of fuel-fired melters, which have been included as a representative process detail for impact analysis. Future evaluation may result in the selection of another melter configuration.)
- Pour molten glass into 2.6 cubic meters disposal containers.
- Cool the containers.
- Weld lids on containers and decontaminate exterior surfaces.
- Transfer containers to lag storage pending shipment to the INEEL.

The HLW vitrification facility would be operated to accomplish the following:

- Receive and sample waste.
- Separate solids and liquid using a centrifuge.
- Evaporate excess water from liquid waste and collect condensate for treatment.
- Operate one joule-heated melter with a capacity of 5 metric tons per day.
- Form glass at approximately 20 weight percent waste oxides.
- Pour glass monoliths in 1.17 cubic meters canisters.
- Cool, seal, and decontaminate exterior canister surfaces.
- Package glass into transport casks for shipment to INEEL.

The off-gas treatment system at both HLW and low-activity waste vitrification facilities would be operated to quench and cool off-gas, remove radionuclides and recycle to the vitrification process, and destroy nitrogen oxides.

Liquid effluent from both HLW and low-activity waste vitrification facilities would be treated after transferring the effluent to the Effluent Treatment Facility. The liquid effluent would be similar to the 242-A Evaporator condensate liquid that meets current waste acceptance criteria for the Effluent Treatment Facility.

C.8.3 AFFECTED ENVIRONMENT

This section provides a summary description of the existing environment at the Hanford Site that could be impacted by TWRS activities under the Minimum INEEL Processing Alternative. More detailed descriptions of environmental baseline conditions are provided in Volume Five, Appendix I of the TWRS EIS (DOE 1996a), in the *Hanford Site National Environmental Policy Act (NEPA) Characterization* (Cushing 1994 and 1995; Neitzel 1996 and 1997), in the *Hanford Site Environmental Report for Calendar Years 1994 and 1995*, (PNL 1995 and 1996), and in Jacobs (1998). All information contained in this section is from these sources unless otherwise noted.

The Hanford Site is in the semi-arid region of the Columbia Plateau in southeastern Washington State (Figure C.8-2). The Hanford Site occupies about 560 square miles of shrub-steppe and grasslands just north of Richland, Washington. The majority of this large restricted-access land area provides a buffer to the smaller areas within the Hanford Site historically used for nuclear materials production, waste storage, and waste disposal. About 6 percent of the land has been disturbed and is actively used. The Hanford Site extends approximately 48 miles north to south and 38 miles east to west.

The Columbia River flows through the northern part of the Hanford Site, turning south to form part of its eastern boundary. The Yakima River runs along part of the southern boundary and joins the Columbia River within the city of Richland. Adjoining lands to the west, north, and east are principally range and agricultural land. The cities of Richland, Kennewick, and Pasco (also known as the Tri-Cities) comprise the nearest population centers and are located southeast of the Site.

C.8.3.1 Geology and Soils

This geology section provides an overview of the Hanford Site's surface and subsurface environment and focuses primarily on the 200 Areas located in the center of the Site. With the exception of two potential borrow sites located approximately 4 miles to the north and west of the 200 Areas, and a third potential borrow site located between the 200-East and 200-West Areas, the 200 Areas would be the location of virtually all TWRS activities under the Minimum INEEL Processing Alternative.

Topography

The TWRS sites are located on and near a broad flat area of the Hanford Site commonly referred to as the Central Plateau. The Central Plateau is within the Pasco Basin, a topographic and structural depression in the southwest corner of the Columbia Basin. The basin is characterized by generally low-relief hills with deeply incised river drainage. The Central Plateau of the Hanford Site is an area of generally low relief, ranging from 390 feet above mean sea level at the Columbia River to 750 feet above mean sea level in the vicinity of the TWRS sites (see Figure C.8-3).

Geologic Structure and Soils

The Hanford Site is underlain by basalt flows. Sedimentary layers referred to as the suprabasalt sediments lie on top of the basalts. A thin layer of silt, sand, and gravel is found on the surface across much of the Site.

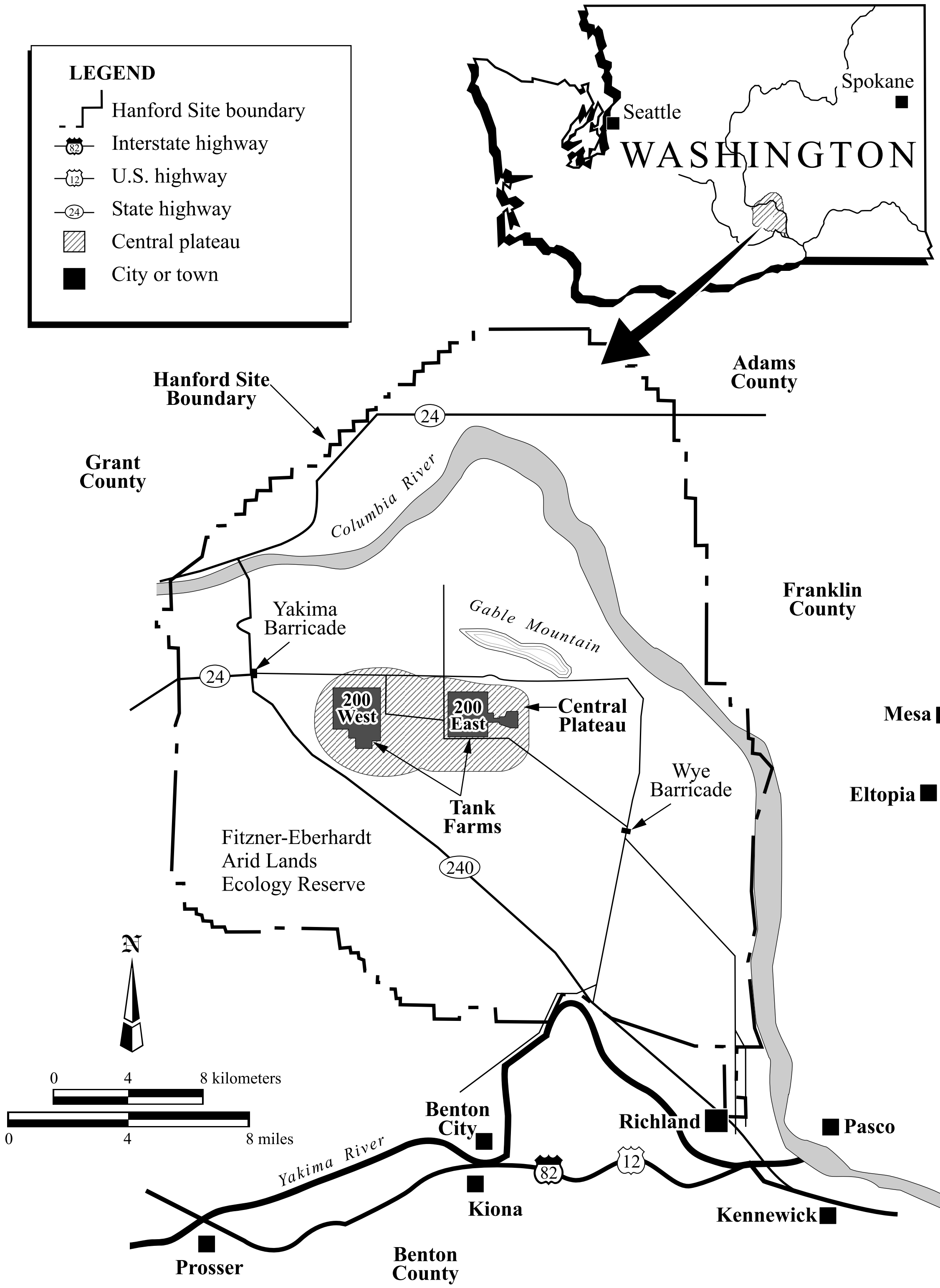
Soil in the 200 Areas consists of sand, loamy-sand, and sandy-loam soil types. Soil in the 200 Areas adjacent to facilities and other locations on the Hanford Site is slightly contaminated by various radionuclides.

Mineral Resources

The only mineral resources produced from the Pasco Basin are crushed rock, sand, and gravel. Deep natural gas production has been tested in the Pasco Basin without commercial success. Local borrow areas would supply rock, silt, sand, and gravel for processing alternatives requiring those materials.

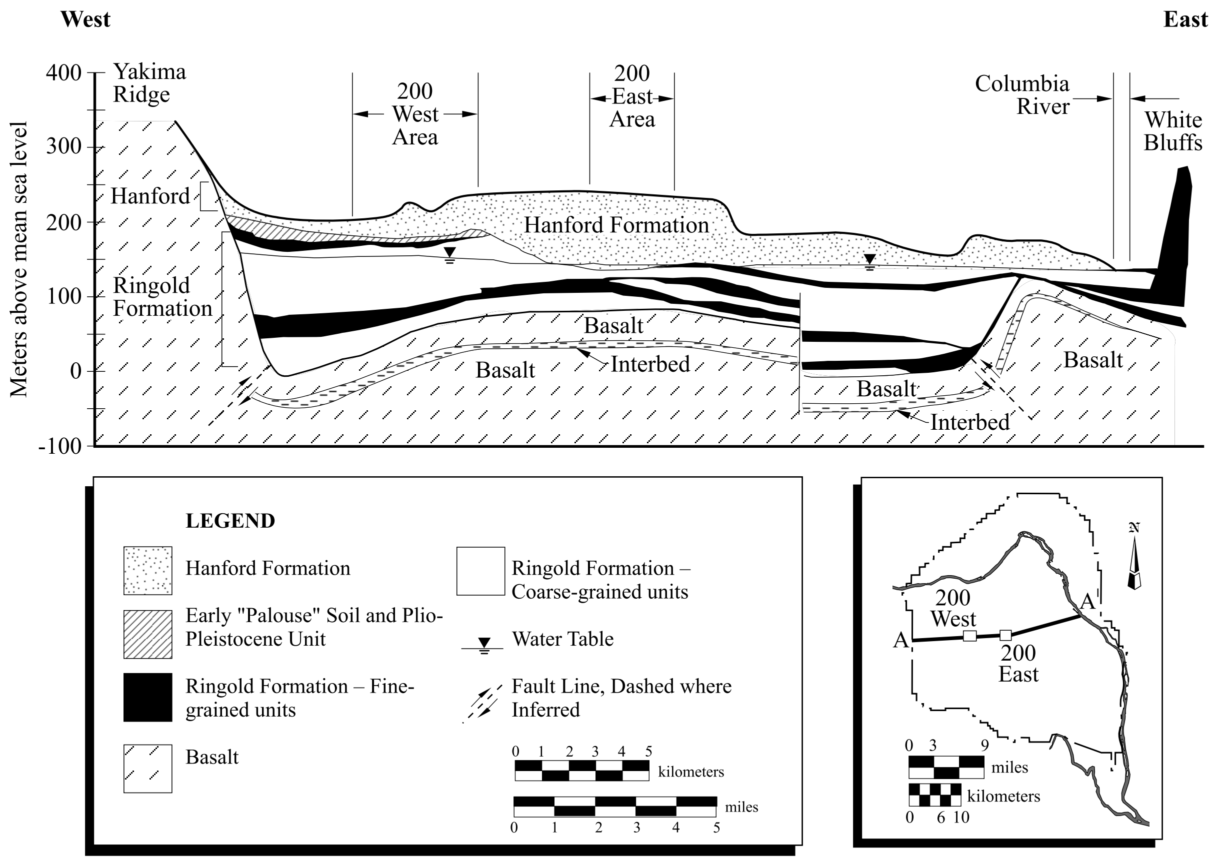
Seismicity

Seismic activity in the Hanford Site area is low compared to other regions of the Pacific Northwest. In 1936, the largest known earth-



SOURCE: DOE (1996a).

FIGURE C.8-2.
Hanford Site map and vicinity.



SOURCE: DOE (1996a).

FIGURE C.8-3.
Geologic cross section of the Hanford Site.

quake (a Richter magnitude of 5.75) in the Columbia Plateau occurred near Milton-Freewater, Oregon. Other earthquakes with a Richter magnitude of 5.0 or higher have occurred near Lake Chelan, Washington, to the northwest; along the boundary of the Columbia Plateau and the Cascade Mountain Range, west and north of the Hanford Site; and east of the Hanford Site in Washington State and northern Idaho. In addition, small-magnitude earthquake swarms that are not associated with mapped faults occur on and around the Hanford Site. An earthquake swarm is a series of earthquakes closely related in terms of time and location.

Four earthquake sources are considered relevant for the purpose of seismic design of TWRS sites: the Rattlesnake-Wallula alignment, Gable Mountain, an earthquake anywhere in the tectonic province, and the swarm area. For the Rattlesnake-Wallula alignment, which passes along the southwest boundary of the Hanford Site, a maximum Richter magnitude of 6.5 has been estimated. For Gable Mountain, an east-west structure that passes through the northern portion of the Hanford Site, a maximum Richter magnitude of 5.0 has been estimated. The estimate for the tectonic province was developed from the Milton-Freewater earthquake, with a Richter magnitude of 5.75. A Richter magnitude 4.0 event is considered the maximum swarm earthquake, based on the maximum swarm earthquake in 1973. The Hanford Site current design basis for new facilities is the ability to withstand a 0.2 gravity earthquake (Richter magnitude of approximately 6.4) with a recurrence frequency of 5.0×10^{-4}.

C.8.3.2 Water Resources

Water resources include surface water, the vadose zone (the area between the ground surface and underlying groundwater), and groundwater. The section also summarizes the existing quality of both surface and groundwater and withdrawal rates.

Surface Water

There are no naturally occurring water bodies or flood-prone areas near the TWRS sites. The Hanford Site and the surrounding communities draw all or most of their water from the Columbia River, which has radiological and nonradiological contamination levels below drinking water standards.

The onsite ponds (not used for human consumption) and springs that flow into the Columbia River all show radiological contamination from Hanford Site activities. Nonradiological contamination levels in the onsite ponds and springs are generally below limits set by drinking water standards.

Vadose Zone and Groundwater

A thick vadose 230 to over 300 feet, confined aquifer, and unconfined aquifers are present beneath the 200 Areas. The vadose zone is over 300 feet thick in the vicinity of the TWRS sites in the 200-East Areas. The confined aquifers are found primarily within the Columbia River Basalts. These aquifers are not a major focus of this appendix because they are separated from the TWRS sites by the vadose zone, an unnamed unconfined aquifer, and confining layers, and thus are not likely to be impacted.

Natural recharge to the unconfined aquifer of the Hanford Site is extremely low and occurs primarily in the upland areas west of the Hanford Site. Artificial recharge from retention ponds and trenches contribute approximately 10 times more recharge than natural recharge. Seasonal water table fluctuations are small because of the low natural recharge.

Water Quality and Supply

The following sections present water quality and supply for surface water and groundwater associated with the 200-East Area.

Surface Water

Water at the Hanford Site is supplied by the Columbia River, which is a source of raw water. River water is supplied to Hanford Site facilities through several distribution systems. In addition, wells supply water to the 400 Area and several remote facilities.

The Tri-Cities draw most (Richland and Kennewick) or all (Pasco) of their water supplies from the Columbia River. In 1994, water usage ranged from 2.4 billion gallons in Pasco to 7.4 billion gallons in Richland (Neitzel 1997). Each community operates its own water supply and treatment system.

The Columbia River provides water for both irrigation and municipal uses. Washington State has classified the water in the stretch of the Columbia River that includes the Hanford Reach as Class A, Excellent. Class A waters must be suitable for essentially all uses, including raw drinking water, recreation, and wildlife habitat. Both Federal and state drinking water quality standards apply to the Columbia River and are currently being met.

Groundwater

Groundwater is not used in the 200 Areas except for emergency cooling water, nor do any water supply wells exist downgradient of the 200 Areas. Three wells for emergency cooling water are located near B Plant in the 200-East Area. However, there are dry and groundwater monitoring wells in and around the 200 Areas. Hanford Site water supply wells are located at the Yakima Barricade, the Fast Flux Test Facility, and at the Hanford Safety Patrol Training Academy, all 8 miles or more from the TWRS sites in the 200-East Area.

Unconfined groundwater beneath the 200-East Area contains 14 different contaminants that have been mapped as plumes: arsenic, chromium, cyanide, nitrate, gross alpha, gross beta, tritium, cobalt-60, strontium-90, technetium-99, iodine-129, cesium-137, and plutonium-239 and -240.

In the 200-West Area, 13 overlapping contaminant plumes are located within the unconfined gravels of Ringold Unit E: technetium, uranium, nitrate, carbon tetrachloride, chloroform, trichloroethylene, iodine-129, gross alpha, gross beta, tritium, arsenic, chromium, and fluoride.

C.8.3.3 Meteorology and Air Quality

The following section describes meteorological and air quality conditions at the Hanford Site.

Meteorology

The Hanford Site is located in a semi-arid region. The Cascade Mountains to the west greatly influence the Hanford Site's climate by providing a rainshadow. This range also serves as a source of cold air drainage, which has a considerable effect on the Site's wind regime.

Good atmospheric dispersion conditions exist at the Hanford Site about 57 percent of the time during the summer. Less favorable dispersion conditions occur when the wind speed is light and the mixing layer is shallow. These conditions are most common during the winter, when moderately to extremely stable stratification exists about 66 percent of the time. The probability of an inversion period (e.g., poor dispersion conditions) extending more than 12 hours varies from a low of about 10 percent in May and June to a high of about 64 percent in September and October.

Air Quality

Air quality is good in the Hanford Site vicinity. The only air pollutant for which regulatory standards are exceeded is particulates. In 1994, concentrations of radionuclides and hazardous air pollutants were lower than regulatory standards both onsite and offsite.

C.8.3.4 Ecological Resources

Ecological resources on the Hanford Site are extensive, diverse, and important. Because the Hanford Site has not been farmed or grazed for over 50 years, it has become a refuge for a variety of plant and animal species.

The Hanford Site is one of the largest shrub-steppe vegetation areas remaining in Washington State, and nearly half of the Site's 560-square mile area is designated as ecological study areas or refuges. Shrub-steppe vegetation areas are considered priority habitat by Washington State because of their relative scarcity and their importance to wildlife species. The 200 Areas and the nearby potential borrow sites consist mostly of shrub-steppe habitat. The TWRS sites in the 200 Areas are currently heavily disturbed. However, the potential borrow sites are largely undisturbed.

Species of concern on the Hanford Site include Federal candidate species, Washington State threatened or endangered species, Washington State candidate species, and monitor species and sensitive plant species. No Federally-listed threatened or endangered plant or animal species occur on or around the Central Plateau (site of the TWRS facilities). Wildlife species of concern on the Central Plateau and vicinity include the loggerhead shrike, which is a Federal and Washington State candidate species, and the sage sparrow, which is a Washington State candidate species. Both species nest in undisturbed sagebrush habitat in the Central Plateau and nearby areas.

Other bird species of concern that may occur in shrub-steppe habitat of the Hanford Site are the burrowing owl, a Washington State candidate species; the ferruginous hawk, a Washington State threatened and Federal Category 2 candidate species; the golden eagle, a Washington State candidate species; the long-billed curlew, a Washington State monitor species; the sage thrasher, a Washington State candidate species; the prairie falcon, a Washington State monitor species; and Swainsons hawk, a Washington State candidate species. Nonavian wildlife species of concern include the striped whipsnake, a Washington State candidate species; the desert night snake, a Washington State monitor species; the pygmy rabbit, a Federal Category 2 candidate species; and the northern sagebrush lizard, also a Federal Category 2 candidate species (DOE 1996a).

Sensitive habitats on the Hanford Site include wetlands and riparian habitats. However, there are no sensitive habitats at or near any TWRS sites. The Hanford Site's primary wetlands occur along the Columbia River. Other Hanford Site wetland habitats are associated with human-made ponds and ditches (e.g., B Pond and its associated ditches located near the 200-East Area). Wetland plants occurring along the shoreline of B Pond include herbaceous and woody species such as showy milkweed, western goldenrod, three square bulrush, horsetail rush, common cattail, and mulberry, among others. Wildlife species observed at B Pond include a variety of mammals and waterfowl species. The fishery resource of the Columbia River is important to Native Americans.

C.8.3.5 Cultural Resources

Archaeological sites in the 200 Areas are scarce. Cultural resource surveys have been conducted within the 200-East Area covering all undeveloped areas. The number of prehistoric and historic archaeological sites recorded as the result of these surveys is very limited. Findings recorded in the areas around and including the TWRS sites consist of isolated artifacts and four archaeological sites. Cultural resources surveys of the TWRS sites and immediate vicinity in the 200-East Area, which were conducted in 1994, found no sites eligible for the National Register of Historic Places. Past surveys of the Phased Implementation Alternative site in the easternmost portion of the 200-East Area revealed no archaeological sites. However, both the 200-East and 200-West Areas contain potentially historic buildings and structures associated with the Hanford Site's defense mission.

Surveys of the 200-West Areas recorded a few historic sites, isolated archaeological artifacts, and a segment of the historic White Bluffs Road that runs across the Site between Rattlesnake Springs and the Columbia River. The White Bluffs Road, which has been nominated for the National Register of Historic Places, traverses the northwest corner of the 200-West Area. This road was used in prehistoric and historic times by Native Americans and was an important transportation route for Euro-Americans in the 19th and early 20th century for mining, agriculture, and other development uses. The segment in the 200-West Area is not considered an important element historically because it has been fragmented by past activities. However, the Confederated Tribes of the Umatilla Indian Reservation have indicated that the White Bluffs Road is important culturally to Native Americans even though it has been affected by past activities.

Native American Sites

The Hanford Site vicinity contains lands ceded to the United States both by the Confederated Tribes and Bands of the Yakama Indian Nation and the Confederated Tribes of the Umatilla Indian Reservation in the treaties of 1855. Until 1942, the Wanapum resided on land that is now part of the Hanford Site. In 1942, the Wanapum People moved to Priest Rapids when the Hanford Site was established. The Nez Perce Tribe also retained rights to the Columbia River under a separate treaty with the U.S. Government.

The area of the Hanford Site near the Columbia River has been occupied by humans for over 10,000 years, as reflected by the extensive archaeological deposits along the river shores. Inland areas with water resources also point to evidence of concentrated human activity. Recent surveys indicate extensive although dispersed use of semi-arid lowlands for hunting. However, surveys have recorded very few Native American sites or artifacts in and around the 200 Areas. Native American sites and artifacts have been identified at both McGee Ranch and the Vernita Quarry (potential borrow sites).

Native Americans have retained traditional secular and religious ties to the Hanford Site, although no specific sites of religious significance have been identified at the TWRS sites. However, affected Tribal Nations indicate that there are culturally important biota, sacred sites such as Gable Mountain, and other culturally important properties within areas that might be impacted by TWRS alternatives (e.g., groundwater downgradient from TWRS sites, the Columbia River, and locations downwind of possible TWRS air releases).

C.8.3.6 Socioeconomics

The socioeconomic analysis focuses on Benton and Franklin counties. These counties make up the Richland-Kennewick-Pasco Metropolitan Statistical Area, also known as the Tri-Cities. Other jurisdictions in Benton county include Benton City, Prosser, and West Richland. Connell is the largest city in Franklin county after Pasco. Neighboring counties (Yakima, Walla Walla, Adams, and Grant counties in Washington State, and Umatilla and Morrow counties in Oregon) are impacted by activities at the Hanford Site; however, in terms of socioeconomics, the Site's impacts on these counties are very small.

In 1995, the Hanford Site represented 22 percent of the area's total non-farm employment. With the rapid economic growth from the late 1980's, population rose as did the housing market. Housing prices declined in 1995 as the market softened when Hanford Site jobs were reduced.

As of 1990, the population within a 50-mile radius of the Hanford Site contained 19.3 percent minority and Native American residents and 17.3 percent low-income residents.

Most public service systems in the Tri-Cities operate well within their service capacity. Local school systems and some local public safety agencies are operating at or near their capacities.

Median household yearly income in Benton county was $43,684 in 1994, while per capita income was $22,053. Median household yearly income in Franklin county was $31,121 in 1994, while per capita income was $16,999. For Washington State, 1994 median household yearly income was $38,094 and per capita income was $22,526 (Neitzel 1997).

Benton county residents have approximately the same level of educational attainment as residents statewide, while Franklin county residents tend to have a lower level.

C.8.3.7 Land Use

Approximately 6 percent of the Hanford Site is actively used by Site operations, with the remainder left undeveloped. Nearly half the Site's area is designated for ecological or wildlife purposes.

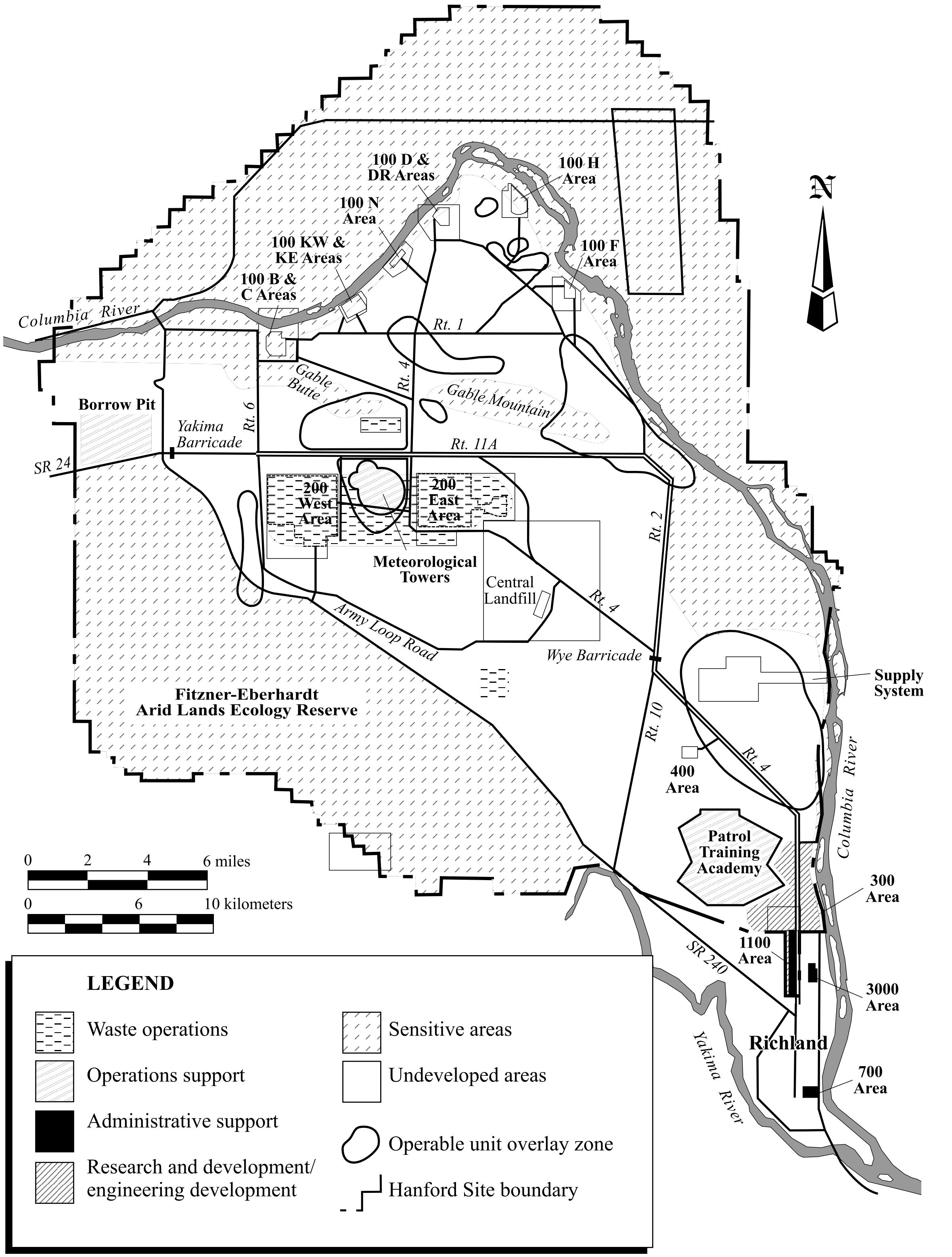
The 200 Areas historically have been used for processing and waste management activities. Current plans envision the 200 Areas to be dedicated exclusively as a waste management and disposal area for the entire Hanford Site (see Figure C.8-4).

The Draft Comprehensive Land-Use Plan for the Hanford Site, prepared by DOE, was released in August 1996. Both Benton County and the City of Richland released their land-use plans for the Site in 1996.

In April 1999, DOE issued a *Revised Draft Hanford Remedial Action Environmental Impact Statement and Comprehensive Land Use Plan* (DOE/EIS-0222D). This Revised Draft EIS will be used by DOE and its nine cooperating and consulting agencies to develop a comprehensive land-use plan for the next 50 years for the Hanford Site. Under DOE's preferred alternative, the Central Plateau (200 Areas) geographic area would be designated for Industrial-Exclusive use. An Industrial-Exclusive land-use designation would allow for continued waste management operations within the Central Plateau geographic area. This designation would also allow expansion of existing facilities or development of new waste management facilities.

Prime and Unique Farmland

The Farmland Protection Policy Act requires Federal agencies to consider prime or unique farmlands when planning major projects and programs on Federal lands (7 CFR 657.4). Federal agencies are required to use prime and unique farmland criteria developed by the U.S. Department of Agriculture Natural Resources Conservation Service. The Natural Resources Conservation Service has determined that due to low annual precipitation in southeast



SOURCE: DOE (1996a).

FIGURE C.8-4.
Existing land use map.

Washington State, none of the soil occurring on the Hanford Site would meet prime and unique farmland criteria without irrigation.

C.8.3.8 Aesthetic and Scenic Resources

Visually, the Hanford Site is characterized by wide-open vistas interspersed with over a dozen large industrial facilities (e.g., reactors and processing facilities). The 200 Areas contain several large processing facilities.

Site facilities can be seen from elevated locations (e.g., Gable Mountain), a few public roadways (State Routes 24 and 240), and the Columbia River. Facilities in the 200-East Area can be seen only in the visual background from offsite locations. For purposes of study, viewing areas are generally divided into four distance zones: the foreground, within 0.5 mile; the middleground, from 0.5 to 5 miles; the background, from 5 to 15 miles; and seldom-seen areas that are either beyond 15 miles or are unseen because of topography (Figure C.8-5).

C.8.3.9 Noise

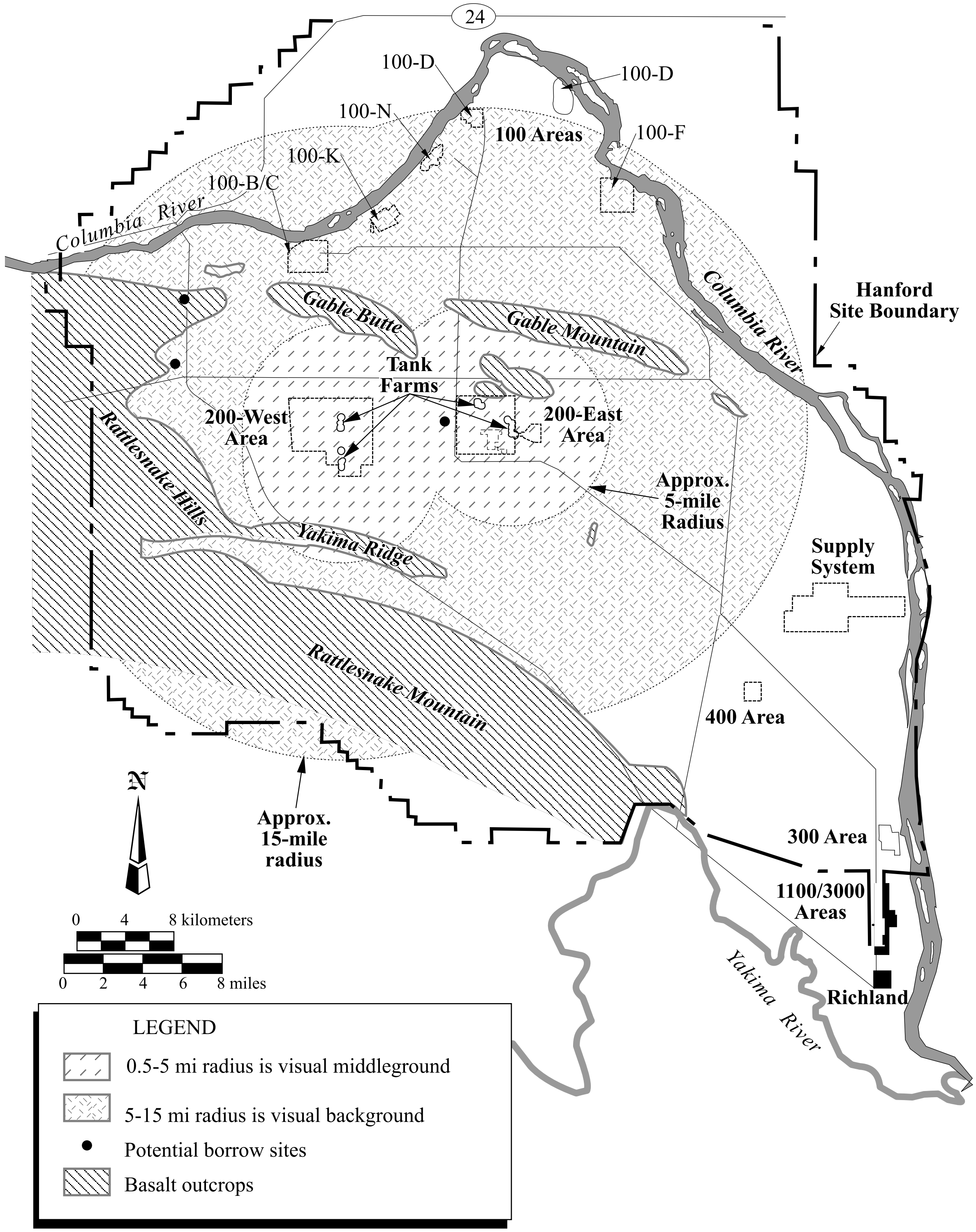
Noise produced by current, routine operations at the Hanford Site does not violate any Federal or Washington State standards (Washington Administrative Code 173-60). Even near the operating facilities along the Columbia River, measured noise levels are lower than noise experienced in parts of the city of Richland (less than 52 decibels on the A scale [dBA] versus 61 dBA) (dBA is a noise scale used to describe sounds in the frequencies most readily detected by human hearing). Noise levels measured near intake structures at the Columbia River are well within the 60 dBA tolerance levels for daytime residential use. Three miles upstream of the intake structures, measured noise levels fall well within levels suited for daytime and nighttime residential use. Moreover, the relative remoteness of population centers from the Hanford Site as a whole (and the TWRS sites in particular) gives the Site a Class C (industrial) classification with a maximum allowable equivalent sound level of 70 dBA in compliance with Washington State and Federal standards. The equivalent sound level integrates noise levels over time and expresses them as continuous sound levels. Native Americans have expressed the concern that Hanford Site religious locations such as Gable Mountain are near enough to TWRS areas to potentially be impacted by TWRS activities.

C.8.3.10 Traffic and Transportation

Direct rail service is provided to the Tri-Cities area by the Burlington Northern Santa Fe and Union Pacific Railroads. The rail system on the Hanford Site itself consists of approximately 130 miles of tracks. It extends from the Richland Junction (at Columbia Center in Kennewick) where it joins the Union Pacific commercial railroad track, to an abandoned commercial right-of-way near the Vernita Bridge in the northwest portion of the Site. There are currently about 1,400 railcar movements annually at the Site, transporting a wide variety of materials including coal, fuels, hazardous process chemicals, and radioactive materials and equipment. Radioactive waste has been transported on the Site without incident for many years.

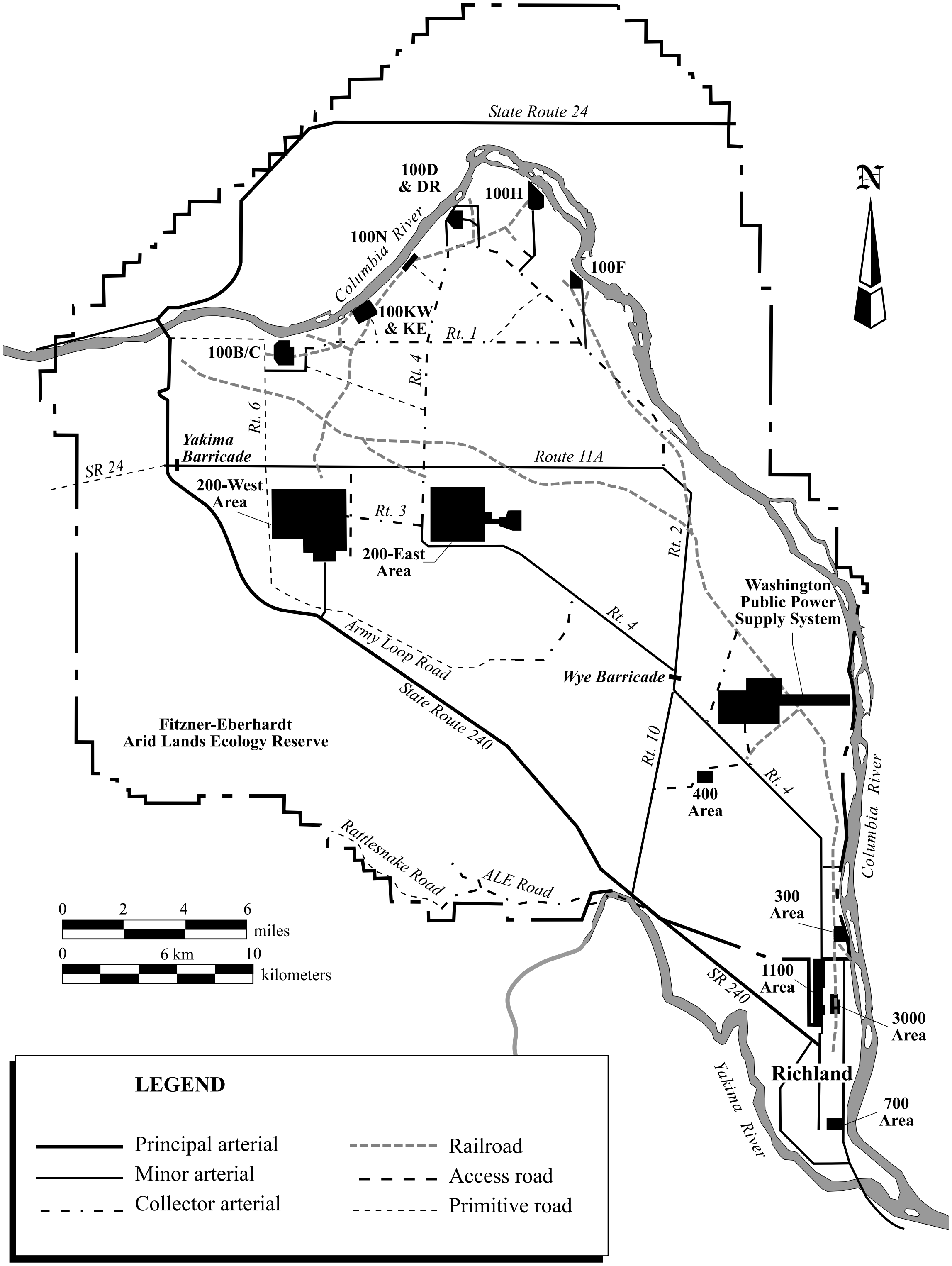
Regional road transportation is provided by a number of major highways including State Routes 24 and 240 and U.S. Interstate Highways 82 and 182. State Routes 24 and 240 are both two-lane roads that traverse the Hanford Site. State Route 24 is an east-west highway that turns north at the Yakima Barricade in the northern portion of the Site. State Route 240 is a north-south highway that skirts the eastern edge of the Fitzner-Eberhardt Arid Lands Ecology Reserve (Figure C.8-6).

A DOE-maintained road network within the Hanford Site, mostly paved and two lanes wide, provides access to the various work centers. The primary access roads on the Site are Routes 2, 4, 10, and 11A. Primary access to the 200 Areas is by Route 4 South from Richland. The 200-East Area is also accessed from Route 4 North off Route 11A from the north. July 1994 traffic counts on Route 4 indicated severe congestion west of the Wye Barrier (at the intersection of Routes 10 and 4 South) during Hanford Site shift changes. However, completion of the State Route 240 Access Highway (Beloit Avenue) linking the 200 Areas with State Route 240 in late 1994, and declining Hanford Site employment, have reduced the congestion on Route 4.



SOURCE: DOE (1996a).

FIGURE C.8-5.
Potential viewing areas of 200-East and 200-West Areas.



SOURCE: DOE (1996a).

FIGURE C.8-6.
Hanford Site roadway and railroad system.

Stevens Road at the 1100 Area leading into the Site from Richland (Stevens Road becomes Route 4 South further north onsite) also has experienced severe congestion. The 240 Access Highway completion and reduction of Hanford Site employment appear to have reduced this congestion somewhat, although no specific traffic count data are available to quantify this assessment.

Access to the 200-West Area is also provided from Route 11A for vehicles entering the Site through the Yakima Barricade and from Route 6 off Route 11A from the north. No congestion problems are reported on these roadways.

Public access to the 200 Areas and interior locations of the Hanford Site are restricted by manned gates at the Wye Barricade and the Yakima Barricade (at the intersection of State Route 240 and Route 11A).

C.8.3.11 Radiological Environment

This section summarizes 1995 data on radiation doses from operations at the Hanford Site and the potential future fatal cancers attributable to exposures. More recent data indicate that the radiological conditions at the Hanford Site are not appreciably different from those described in this section.

Each year the potential radiation doses to the public from Hanford Site radiation sources are calculated as part of the Hanford Site Environmental Monitoring Program. In particular, the dose to the hypothetical maximally exposed individual is calculated as described in the Hanford Site Environmental Report published each calendar year. This hypothetical maximally exposed individual is assumed to live where the radiation dose from airborne releases would be larger than for a resident of any other offsite location. The maximally exposed individual also is assumed to drink water from the Columbia River; eat food grown with Columbia River irrigation water; and use the river extensively for boating, swimming, and fishing (including eating fish from the river). The exposure calculation for this hypothetical individual is based on Hanford Site data from actual reported releases, environmental measurements, and information about operations at Hanford Site facilities.

The calculated dose in 1995 to the maximally exposed individual near the Hanford Site was a total of 0.02 millirem compared to 0.05 millirem reported for 1994. The DOE radiation dose limit for a member of the public is 100 millirem. Thus, the 1995 total dose to the maximally exposed individual was far below the limit.

U.S. Environmental Protection Agency regulations impose a dose limit of 10 millirem to a member of the public from radioactivity released in airborne effluents. The 1995 Hanford Site airborne dose to the maximally exposed individual of 0.006 millirem was far below this limit.

To estimate health effects for radiation protection purposes, it usually is assumed that a collective dose of 2,000 person-rem in the general population will cause one extra latent cancer fatality. In these calculations it does not matter whether 20,000 people each receive an average of 0.1 rem or 2 million people each receive an average of 0.001 rem. In either case, the collective dose would equal 2,000 person-rem and thus, one additional latent cancer facility would be expected. The 1995 collective dose to people surrounding the Hanford Site from Site releases was calculated to be 0.3 person-rem, which is lower than the 0.6 person-rem calculated for 1994. Compared to 2,000 person-rem causing one extra latent cancer fatality, the 0.3 person-rem from the Hanford Site in 1995 is not likely to cause any latent cancer fatalities.

C.8.4 ENVIRONMENTAL IMPACTS

This section describes the potential impacts to the existing environment (described in Section C.8.3) of implementing the Minimum INEEL Processing Alternative (described in Section C.8.2) at the Hanford Site. This section also discusses potential cumulative impacts of the Minimum INEEL Processing Alternative when added to impacts from past, present, and reasonably foreseeable actions; unavoidable adverse impacts; the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity; and irreversible and irretrievable commitment of resources.

C.8.4.1 Geology and Soils

Geology and soil impacts would include potential impacts to mineral resources, topography, and soils. In general, the more land disturbed, the higher the level of potential impacts to geologic resources. Mineral resources (i.e., silt, sand, gravel, and riprap) are presented in Table C.8-1. The earthen materials would be used primarily to make concrete for constructing treatment facilities and vaults. Some soil disturbance would be temporary; some would be permanent. Temporary disturbances include areas such as the trample zones around construction sites and work areas. Permanent disturbances include areas where facilities are located.

Just-in-Time Shipping Scenario

Under this scenario, additional Hanford Site sand and gravel resources would be required to make concrete for the construction of the Calcine Dissolution Facility and for the disposition of this facility after its mission is completed (Table C.8-1). No additional silt and riprap resources would be required. Incremental impacts to the potential Pit 30 borrow site, where the additional borrow material would be secured, would increase by approximately 1.3 percent, or 3.4×10^4 cubic meters over the 2.6×10^6 cubic meters calculated in the TWRS EIS for the Phased Implementation Alternative. The Pit 30 borrow site is located on the Hanford Site's Central Plateau between the 200-East Area and 200-West Area.

Under this scenario, small additional changes in topography would result from constructing the Calcine Dissolution Facility and securing borrow materials. The Calcine Dissolution Facility is assumed to be located on the representative site in the 200-East Area analyzed in the TWRS EIS for Phase 2 of the Phased Implementation Alternative.

Implementing this scenario would result in additional soil disturbances associated with the construction of the Calcine Dissolution Facility and the removal of earthen materials from the potential Pit 30 borrow site (Table C.8-1). Assuming that an area equal to the footprint of the Calcine Dissolution Facility plus a small buffer zone would be permanently disturbed, the permanent soil disturbances would increase by approximately 3.3 percent, or 3.9 acres over the 120 acres calculated for the Phased Implementation Alternative. Assuming that soil disturbances associated with the potential Pit 30 borrow site would be temporary, the temporary soil disturbances would be approximately 0.4 percent or 2.9 acres greater than the 790 acres calculated for the Phased Implementation Alternative.

Table C.8-1. Mineral resources and soil impacts – Minimum INEEL Processing Alternative.

Tank Waste Alternative		Mineral resource in cubic meters: Sand and gravel	Silt	Riprap	Soil disturbance[a] in acres: Temporary	Permanent
Phased Implementation Alternative[b]		2.6×10^6	5.7×10^5	9.6×10^5	790	120
Minimum INEEL Processing Alternative	Just-in-Time Shipping Scenario	3.4×10^4	NR[d]	NR	2.9	3.9
	Interim Storage Shipping Scenario	2.9×10^5	NR	NR	48	3.9
Total impacts[c]	Just-in-Time Shipping Scenario	2.6×10^6	5.7×10^5	9.6×10^5	790	120
	Interim Storage Shipping Scenario	2.9×10^6	5.7×10^5	9.6×10^5	840	120

a. These estimates are based on closure of the Hanford Site Tank Farms by filling tanks and covering them with a Hanford Barrier.
b. Estimates include remediation and closure as landfill (Phase 1 and 2).
c. Impact estimates include the Phased Implementation Alternative (Phase 1 and 2) plus the Minimum INEEL Processing Alternative.
d. NR = None required.

None of the increased impacts associated with this scenario would affect the local cost or availability of mineral resources or substantively change the understanding of the geology and soils impacts presented in the TWRS EIS for the Phased Implementation Alternative.

Interim Storage Shipping Scenario

This scenario would result in greater additional impacts than the Just-in-Time Shipping Scenario, in that it would include all of the impacts of the Just-in-Time Shipping Scenario plus the impacts associated with the construction and subsequent disposition of three new Canister Storage Buildings.

Additional sand and gravel for facility construction and subsequent disposition would be secured from the potential Pit 30 borrow site. Incremental impacts to this borrow site would increase by approximately 11 percent, or 2.9×10^5 cubic meters over the 2.6×10^6 cubic meters calculated in the TWRS EIS for the Phased Implementation Alternative (Table C.8-1). No additional silt or riprap resources would be required.

Under the Interim Storage Shipping Scenario, small additional changes in topography would result from constructing new facilities (Calcine Dissolution Facility and Canister Storage Buildings) and securing borrow materials. The Calcine Dissolution Facility is assumed to be located on the representative site in the 200-East Area analyzed in the TWRS EIS for Phase 2 of the Phased Implementation Alternative. The Canister Storage Buildings are assumed to be located in the 200 Areas adjacent to the site of the existing Hanford Site Canister Storage Building.

Soil disturbances associated with the Calcine Dissolution Facility are assumed to be permanent and would be the same as for the Just-in-Time Shipping Scenario (Table C.8-1). Soil disturbances associated with the potential Pit 30 borrow site (24 acres) and the Canister Storage Buildings (24 acres) are assumed to be temporary and would increase the temporary soil disturbances by approximately 6 percent, or 48 acres over the 790 acres calculated for the Phased Implementation Alternative.

Although this scenario would result in greater additional impacts than the Just-in-Time Shipping Scenario, it would not affect the local price or availability of mineral resources or substantively change the understanding of the geology and soils impacts presented in the TWRS EIS for the Phased Implementation Alternative.

C.8.4.2 Water Resources

The following section addresses water resources impacts related to the Minimum INEEL Processing Alternative. Surface water and groundwater are pathways for potential releases to the environment. Releases would travel by advection downward through the vadose zone, intercept the unconfined aquifer (saturated zone), and move laterally to points of discharge along the Columbia River. There would be no direct discharge to surface water.

Surface Water Releases

The Minimum INEEL Processing Alternative would generate liquid effluent; however, the effluent would not be discharged to surface waters and there would be no direct impacts to surface waters from the implementation of the alternative. Liquid stored in the double-shell tanks and liquid added to the tanks during waste retrieval activities ultimately would be removed and sent to an evaporator. Condensed water from the evaporator would be sent to the Effluent Treatment Facility in the 200-East Area. The water would be treated in the Effluent Treatment Facility using a variety of systems, including evaporation, to meet applicable regulatory standards. Ultimately the treated wastewater from vitrification processing would be discharged, with most contaminants removed, from the Effluent Treatment Facility to the State-approved land disposal facility site, a subsurface drain field near the north-central part of the 200-West Area. The discharged water would move through the vadose zone into the groundwater where it would slowly flow towards and discharge to seeps along the Columbia River and directly into the Columbia River. An estimated

100 years would be required for contaminants in groundwater to reach the Columbia River where they would rapidly mix with the large volumes of river water.

Concern has been raised in the past about the amount of tritium that would be released from the land disposal facility. The calcine would be in a solid state when shipped from INEEL to the Hanford Site, and the tritium would have been removed at INEEL. There would be no increase in tritium releases from the land disposal facility as a result of INEEL waste processing.

Surface Water Drainage Systems

The facilities for the Minimum INEEL Processing Alternative (Canister Storage Buildings for Interim Storage Shipping Scenario and Calcine Dissolution Facility) would be constructed on relatively level and flat terrain. No major drainage features are present. Construction activities would result in slightly altered localized drainage patterns for the temporary construction areas and for the permanent facilities. Excess water used for dust control purposes during construction and disposition activities would be collected and routed through erosion and sedimentation control measures prior to discharging to the existing approved National Pollutant Discharge Elimination System outfall and would be monitored following the current Storm Water Pollution Prevention Plan. The area around the Canister Storage Buildings, the Calcine Dissolution Facility, and the existing vitrification facilities would be recontoured to conform with the surrounding drainage patterns. Small increases in surface water runoff during the infrequent heavy precipitation events or rapid snowmelt would occur, but no flooding of drainage systems would occur.

Groundwater Releases

Potential impacts to groundwater would result from potential liquid losses during retrieval of tank waste and the leaching of residual waste that may be left in the double-shell tanks following retrieval. Waste transfer pipelines from the Calcine Dissolution Facility to the AP Tank Farm and from the AP Tank Farm to the vitrification facilities would be of double-wall construction in order to minimize the possibility of a leak to the environment. However, retrieval losses are not anticipated from these double-shell tanks or waste transfer systems. Therefore, no potential impact to the groundwater is anticipated for the Minimum INEEL Processing Alternative. In addition, all of the waste processing and treatment would be conducted in areas of the facility covered with a base that consists of a secondary spill containment system (e.g., engineered system constructed for detection and collection of spills) to prevent leaks and spills of waste until the accumulated materials are detected and removed. Such a base would prevent releases to the environment that could potentially impact groundwater.

For the Interim Storage Shipping Scenario, the Canister Storage Buildings are designed to include storage provisions to isolate containerized waste from the environment and prevent deterioration of container integrity. Additionally, secondary containment would be provided to prevent any inadvertent releases from entering the environment. Waste packages having a potential for residual liquid would have an absorbent agent added to ensure immobilization of potential liquid. In order to prevent contamination of the water supply, no restrooms or drinking water fountains would be located within the operational areas of the various facilities.

Implementing this alternative would result in minimal increases in impacts and would not change the understanding of the water resources impacts for surface water or groundwater presented in the TWRS EIS for the Phased Implementation Alternative.

C.8.4.3 Air Quality

Air pollutant emission estimates were developed and air dispersion modeling performed to analyze air quality impacts for the Phased Implementation Alternative of the TWRS EIS. The emission rates for criteria pollutants and radionuclides for the Minimum INEEL Processing Alternative were scaled from the TWRS EIS. Supporting calculations can be found in Appendix E of Jacobs (1998). Compliance with Washington State and Federal ambient air quality standards for radionuclides were measured at the maximum receptor location at the Hanford Site boundary along the Columbia River and on State Route 240. Compliance with the Federal standard for radionuclide releases was measured at the nearest residence.

Just-in-Time Shipping Scenario

Under this scenario, INEEL waste would be transported to the Hanford Site just in time for vitrification, and there would be no need to construct additional Canister Storage Buildings for interim storage. Therefore, only the Calcine Dissolution Facility and the vitrification facility are evaluated in this scenario as potential sources of air emissions.

Air Emission Sources. Air emission sources for the Just-in-Time Shipping Scenario would include construction of the Calcine Dissolution Facility, unloading and dissolving the INEEL calcined waste at the Calcine Dissolution Facility, separating and vitrifying the waste at the vitrification facility, and decommissioning the Calcine Dissolution Facility. The criteria pollutant emission rates from construction, operations, and decommissioning are presented in Table C.8-2. The radionuclide emission rates from operations are presented in Table C.8-3. The criteria pollutant and radionuclide emission rates for constructing, operating, and decommissioning the Calcine Dissolution Facility are based on annual emissions calculated in the project data presented in Section C.8.5.2. The emission rates for criteria pollutants were then scaled from the emission rates calculated in the TWRS EIS for the Phased Implementation Alternative. The criteria pollutant and radionuclide emission rates from operation of the vitrification facility are based on emission rates calculated in the project data presented in Section C.8.5.3. Supporting calculations are provided in Appendix E of Jacobs (1998).

Air Emission Concentrations. The criteria pollutant emission concentrations were calculated using the ISC2 spreadsheets developed to calculate the air emission concentrations for the TWRS EIS. The criteria pollutant emission concentrations resulting from construction, operations, and decommissioning are compared with state and Federal standards presented in Table C.8-4. The radiological doses to the nearest resident and the nearest offsite receptor were scaled from the receptor doses calculated in the TWRS EIS for the Phased Implementation Alternative. The radiological modeling results are compared with state and Federal standards in Table C.8-5. Supporting calculations are provided in Appendix E of Jacobs (1998).

Emission concentrations of carbon monoxide would be less than 1 percent of the Federal and state standards for construction, operations, or decontamination and decommissioning. Nitrogen oxide would be less than 1 percent, sulfur oxides would be less than 2 percent, and particulate matter with a diameter of 10 micrometers or less would be less than 16 percent.

Table C.8-2. Criteria pollutant emission rates for Minimum INEEL Processing Alternative – Just-in-Time Shipping Scenario.

			Operations (grams/sec)		
				Vitrification	
Pollutant	Construction (grams/sec)	D&D (grams/sec)	Unloading/ dissolution	HAW	LAW
Sulfur oxides	1.1×10^{-4}	7.5×10^{-5}	0.42	NA[a]	0.35
Carbon monoxide	0.084	0.056	4.7	NA	3.9
Nitrogen dioxide	0.084	0.056	0.28	NA	0.24
PM-10	2.4	2.4	NA	NA	NA

a. NA = Not applicable.

D&D = decontamination and decommissioning; HAW = high-activity waste; LAW = low-activity waste.

PM-10 = particulate matter with a diameter of 10 micrometers or less.

Table C.8-3. Radiological emission rates for Minimum INEEL Processing Alternative – Just-in-Time Shipping Scenario – operations phase.

Radionuclide	Unloading/ dissolution (curies per year)	Vitrification (curies per year)	
		HAW	LAW
Strontium-90	5.1×10^{-5}	5.2×10^{-5}	9.2×10^{-7}
Technetium-99	2.6×10^{-8}	9.0×10^{-10}	4.0×10^{-9}
Cesium-137	4.7×10^{-5}	2.4×10^{-5}	1.8×10^{-7}
Plutonium-238	7.0×10^{-8}	1.7×10^{-7}	1.1×10^{-8}
Plutonium-239/240	9.3×10^{-9}	6.2×10^{-9}	4.2×10^{-10}
Plutonium-241	3.2×10^{-8}	8.4×10^{-8}	1.7×10^{-9}
Americium-241	5.3×10^{-8}	2.0×10^{-8}	1.8×10^{-8}

HAW = high-activity waste; LAW = low-activity waste.

Table C.8-4. Criteria pollutant modeling results for Minimum INEEL Processing Alternative – Just-in-Time Shipping Scenario.

Pollutant	Averaging period	Construction ($\mu g/m^3$)	Operations ($\mu g/m^3$)	D&D ($\mu g/m^3$)	Standard ($\mu g/m^3$)	
					Federal	State
Carbon monoxide	1 hour	1.5	54	1.0	40,000	40,000
	8 hour	1.1	38	0.72	10,000	10,000
Nitrogen oxide	Annual	0.27	0.58	0.18	100	100
Sulfur oxides	1 hour	2.0×10^{-3}	4.8	1.4×10^{-3}	NA[a]	655
	3 hour	1.8×10^{-3}	4.3	1.2×10^{-3}	1300	NA
	24 hour	8.2×10^{-4}	1.9	5.4×10^{-4}	365	260
PM-10	Annual	3.6×10^{-4}	0.86	2.4×10^{-4}	80	60
	24 hour	18	NA	18	150	150
	Annual	7.8	NA	7.8	50	50

a. NA = Not applicable.

$\mu g/m^3$ = micrograms per cubic meter; D&D = decontamination and decommissioning; PM-10 = particulate matter with a diameter of 10 micrometers or less.

Table C.8-5. Radionuclide modeling results for Minimum INEEL Processing Alternative – Just-in-Time Shipping Scenario.

Receptor	Maximum dose (millirem/year)	Standard	
		State	Federal
Nearest resident[a]	2.3×10^{-5}	NA[c]	10
Offsite receptor[b]	2.8×10^{-5}	25	NA

a. Maximum predicted dose at the nearest residence to the 10 mrem/yr effective dose equivalent standard of 40 CFR Part 61.

b. Maximum accumulated dose equivalent at any offsite receptor to the 25 millirem per year standard contained in Washington Administrative Code 173-480.

c. NA = Not applicable.

The radiological dose to the nearest residents from radiological emissions would be less than 1 percent of the Federal standard, and the nearest offsite receptor dose would be less than 1 percent of the state standard.

Hazardous and toxic air pollutant emissions evaluated in the TWRS EIS for the Phased Implementation Alternative were less than 1 percent of the state and Federal standards. Hazardous and toxic air pollutants emissions from the Minimum INEEL Processing

Alternative would not exceed the emissions evaluated in the TWRS EIS for the Phased Implementation Alternative and would, therefore, be less than 1 percent of the state or Federal standards, with the exception of mercury oxide. Mercury oxide would reach concentration levels of 0.019 microgram per cubic meter compared to the state standard of 0.17 microgram per cubic meter. Mercury oxide would be less than 12 percent of the state or Federal standard. Supporting calculations are provided in Appendix E of Jacobs (1998).

The air emissions for the Just-in-Time Shipping Scenario are below the state and Federal standards and would not substantively change the understanding of the air impacts presented in the TWRS EIS for the Phased Implementation Alternative.

Interim Storage Shipping Scenario

Under this scenario, INEEL waste would be transported to Hanford approximately 20 years prior to being vitrified, which would require additional Canister Storage Buildings to be built for interim storage. The Canister Storage Buildings, Calcine Dissolution Facility, and vitrification facility are evaluated in this scenario as potential air emission sources.

Air Emission Sources. Emission sources for the Interim Storage Shipping Scenario would include air emissions from construction of the Canister Storage Buildings, construction of the Calcine Dissolution Facility, unloading and dissolving INEEL calcine waste at the Calcine Dissolution Facility, separating and vitrifying waste at the vitrification facility, and decommissioning the Canister Storage Buildings and the Calcine Dissolution Facility. The criteria pollutant emission rates from construction and decommissioning are presented in Table C.8-6. Since criteria pollutant emission rates from construction of the Canister Storage Buildings would exceed those from construction of the Calcine Dissolution Facility, and since construction activities for either facility would not take place during the same year, only construction emissions associated with constructing the Canister Storage Buildings are evaluated in this scenario. The criteria pollutant and radionuclide emission rates during operations would be the same as the emission rates for operations presented in Tables C.8-2 and C.8-3, respectively. The criteria pollutant emission rates for constructing and decommissioning the Canister Storage Buildings are based on annual emissions calculated in the project data presented in Section C.8.5.1. The emission rates for decommissioning the Calcine Dissolution Facility are based on annual emissions calculated in the project data presented in Section C.8.5.2. The emission rates for criteria pollutants were then scaled from the emission rates calculated in the TWRS EIS for the Phased Implementation Alternative. Since the Canister Storage Buildings and the Calcine Dissolution Facility would be decommissioned during the same year, the air emissions were combined in Table C.8-6.

Air Emission Concentrations. The criteria pollutant emission concentrations resulting from construction and decommissioning are compared with state and Federal standards in Table C.8-7. The criteria pollutant emission concentrations and radiological modeling results from operations would be the same as those previ-

Table C.8-6. Criteria pollutant emission rates for Minimum INEEL Processing Alternative – Interim Storage Shipping Scenario.

Pollutant	Construction (g/sec)	D&D (g/sec)
Sulfur oxides	3.4×10^{-3}	3.7×10^{-3}
Carbon monoxide	2.5	2.8
Nitrogen dioxide	2.5	2.8
PM-10	2.4	4.8

D&D = decontamination and decommissioning; g/sec = grams per second.
PM-10 = particulate matter with a diameter of 10 micrometers or less.

Table C.8-7. Criteria pollutant modeling results for Minimum INEEL Processing Alternative – Interim Storage Shipping Scenario.

Pollutant	Averaging period	Construction (μg/m³)	D&D (μg/m³)	Standard (μg/m³)	
				Federal	State
Carbon monoxide	1 hour	46	50	40,000	40,000
	8 hour	32	35	10,000	10,000
Nitrogen oxide	Annual	8.2	8.9	100	100
Sulfur oxides	1 hour	0.061	0.067	NA[a]	655
	3 hour	0.055	0.060	1,300	NA
	24 hour	0.025	0.027	365	260
PM-10	Annual	0.011	0.012	80	60
	24 hour	18	35	150	150
	Annual	7.8	16	50	50

a. NA = Not applicable.

μg/m³ = micrograms per cubic meter; D&D = decontamination and decommissioning; PM-10 = particulate matter with a diameter of 10 micrometers or less.

ously shown in Tables C.8-4 and C.8-5, respectively.

Emission concentrations of carbon monoxide would less than 1 percent of the Federal and state standards for construction, operations, or decommissioning. Nitrogen oxide would be less than 9 percent, sulfur oxides would be less than 1 percent, and particulate matter with a diameter of 10 micrometers or less would be less than 32 percent.

The radiological dose to the nearest residents from radiological emissions would be less than 1 percent of the Federal standard and the nearest offsite receptor dose would be less than 1 percent of the state standard.

Hazardous and toxic air pollutant emissions would be the same as those previously discussed for the Just-in-Time Shipping Scenario.

The air emissions for the Interim Storage Shipping Scenario are below the state and Federal standards and would not substantively change the understanding of the air impacts presented in the TWRS EIS for the Phased Implementation Alternative.

C.8.4.4 Ecological Resources

From an ecological resources standpoint, the key issues are (1) whether the land areas proposed for use currently are undisturbed or whether they have been disturbed by past activities; (2) the extent of potential impacts on sensitive shrub-steppe habitat, which is considered a priority habitat by Washington state; and (3) potential impacts on plant and animal species of concern (those listed or candidates for listing by the Federal government or Washington state as threatened, endangered, and sensitive). Most impacts would occur in the 200 Areas where TWRS waste is currently and projected to be stored and where waste treatment, storage, and disposal facilities would be located. Smaller impacts would be located at potential borrow sites where varying levels of borrow material would be secured to support facility construction.

Impacts to plant and animal species from exposures to radionuclides and chemicals were also evaluated in the TWRS EIS. Under the Phased Implementation Alternative, the consumption of contaminated groundwater that reaches the Columbia River was not expected to pose a threat to terrestrial or aquatic receptors. The primary radiological risk is a result of direct contact with stored waste, which is unlikely as long as institutional controls are present. This type of impact would not be expected under the Minimum INEEL Processing Alternative since all of the INEEL waste would have left the Hanford Site prior to the end of the institutional control period.

Just-in-Time Shipping Scenario

Under this scenario, the construction and subsequent decontamination and decommissioning of the Calcine Dissolution Facility would result in additional shrub-steppe habitat disturbances in the 200 Areas and at the potential Pit 30 borrow site (Figure C.8-7). To bound the impacts, it is assumed that the Calcine Dissolution Facility would be sited in an undisturbed portion of the representative 200-East Area site. Using this assumption, an additional 3.9 acres of shrub-steppe habitat would be disturbed in the 200-East Area. An additional 2.9 acres of shrub-steppe habitat at Pit 30 would also be disturbed to secure sand and gravel for facility construction and decontamination and decommissioning. There would be no additional impacts at the Vernita Quarry or McGee Ranch borrow sites. The total additional shrub-steppe habitat impacts would increase by approximately 1.3 percent, or 6.8-acres over the 540 acres calculated in the TWRS EIS for the Phased Implementation Alternative (Table C.8-8).

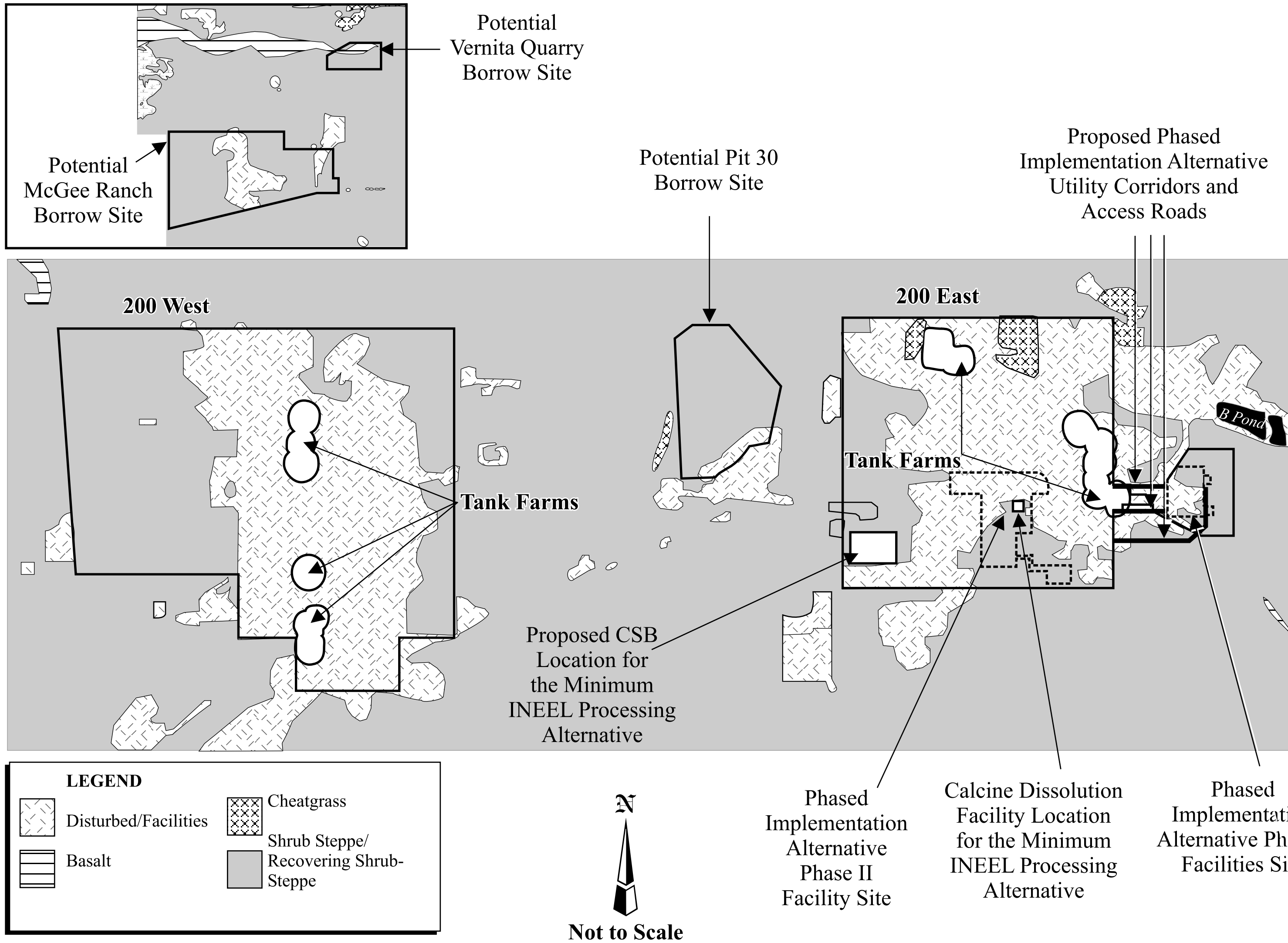
The additional impacts associated with this scenario would not substantively change the understanding of the ecological resource impacts presented in the TWRS EIS for the Phased Implementation Alternative. Shrub-steppe habitat impacts would still be less than 1 percent of the total remaining shrub-steppe on the Central Plateau and a small fraction of 1 percent of the Hanford Site's total shrub-steppe habitat. Implementing this scenario would not change the EIS's conclusion that there would be no adverse impacts to Hanford Site aquatic, wetland, or riparian habitats and no impacts to Federal- or state-listed threatened or endangered species. The incremental impacts to other species of concern would not be expected to result in substantive impacts to any species as a whole. Mitigation to reduce ecological impacts under this scenario would be performed in accordance with the Hanford Site Biological Resources Management Plan (DOE 1996b).

Interim Storage Shipping Scenario

This scenario would result in more impacts than the Just-in-Time Shipping Scenario because it would include all of the impacts of the Just-in-Time Shipping Scenario plus the impacts associated with the construction and subsequent decontamination and decommissioning of three new Canister Storage Buildings.

To bound the impacts, it is assumed that the Canister Storage Buildings would be sited in the 200-East Area adjacent to the site of the existing Canister Storage Building in undisturbed shrub-steppe habitat (Figure C.8-7). Using this assumption, as well as the bounding assumption that the Calcine Dissolution Facility would be sited in undisturbed habitat (as for the Just-in-Time Shipping Scenario), an additional 28 acres of shrub-steppe habitat would be disturbed in the 200-East Area. An additional 24 acres of shrub-steppe habitat at Pit 30 would also be disturbed to secure sand and gravel for facility construction and decontamination and decommissioning. There would be no additional impacts at Vernita Quarry or McGee Ranch. The total additional shrub-steppe habitat impacts would be approximately 9.5 percent, or a 52-acre increase to the 540 acres calculated in the TWRS EIS for the Phased Implementation Alternative.

Although this scenario would result in greater additional impacts than the Just-in-Time Shipping Scenario, it would still not substantively change the understanding of the ecological resource impacts presented in the TWRS EIS for the Phased Implementation Alternative. While the total shrub-steppe habitat impacts under this scenario would be greater than for the Phased Implementation Alternative, the affected habitat would represent less than 2 percent of the total remaining shrub-steppe on the Central Plateau and a small fraction of 1 percent of the Hanford Site's total shrub-steppe habitat. Implementing this scenario would not change the EIS conclusion that there would be no adverse impacts to Hanford Site aquatic, wetland, or riparian habitats and no impacts to Federal- or state-listed threatened or endangered species. The level of impact to other species of concern is related to the amount of shrub-steppe disturbed. Thus, while the impacts to other species of concern would be greater, they would not be expected to result in substantive impacts to any species as a whole. Mitigation to reduce ecological impacts under this scenario would be performed in accordance with the Hanford sitewide biological resources management plan.



SOURCE: Adapted from DOE (1996a)

FIGURE C.8-7.
Habitat impacts of the Phased Implementation Alternative and the Minimum INEEL Processing Alternative.

Table C.8-8. Revised shrub-steppe impacts - Minimum INEEL Processing Alternative.

Alternative		Total shrub-steppe disturbed in acres[a]		
		200 Areas	Potential borrow sites	Total[b]
TWRS Phased Implementation Alternative[c]		240	300	540
Minimum INEEL Processing Alternative	Just-in-Time Shipping Scenario	3.9	2.9	6.8
	Interim Storage Shipping Scenario	28	24	52
Total impacts[d]	Just-in-Time Shipping Scenario	240	300	550
	Interim Storage Shipping Scenario	270	320	590

a. These estimates are based on closure of the Hanford Site Tank Farms by filling tanks and covering them with a Hanford Barrier. Numbers have been rounded to two significant digits.

b. Differences in total values reflect rounding.

c. Estimates include remediation and closure as landfill (Phase 1 and 2).

d. Revised impact estimates include the total Phased Implementation Alternative (Phase 1 and 2) plus the Minimum INEEL Processing Alternative.

TWRS = Tank Waste Remediation System.

C.8.4.5 Cultural Resources

The approach used to assess cultural resources for the Minimum INEEL Processing Alternative was to (1) define specific land areas that would be disturbed by construction, operation, and decommissioning and decontamination activities and (2) identify prehistoric or historical materials or sites at those locations that might be adversely impacted. Whether or not an area has been previously disturbed is an important variable in cultural resource impact analysis because areas previously disturbed are highly unlikely to have culturally or historically important resources.

Native American remains and other specific sites of religious and cultural importance exist at various locations around the Hanford Site; approximately 94 percent of these sites have not been disturbed by past activities and are currently unused. The Native American perspective on resources differs in many ways from that of Euro-Americans (Harper 1995).

Development of the Hanford Site has substantially altered the natural landscape. Buildings have been erected, soil and water have been disturbed, and the distribution of plants and animals has been altered. Environmental cleanup and restoration activities will cause further alterations in the visual landscape, disrupt wildlife, and change plant communities, taking the Site even farther away from its natural state. Such changes affect the relationship between the Native Americans and their native lands.

Access to the Hanford Site by Native Americans, as well as all members of the public, had been restricted until the end of the Hanford Site's production mission. Tribal Nations have continued to express the desire to access and use Hanford Site areas. The Phased Implementation Alternative would have long-term impacts on Native American land access and use. However, access to and use of the 200 Areas would be restricted despite the selection of the Phased Implementation Alternative because of environmental contamination of areas surrounding the Tank Farms (e.g., the existing processing facilities). Since the Calcine Dissolution Facility and the Canister Storage Buildings for the Minimum INEEL Processing Alternative would be decommissioned and decontaminated, this alternative would have no impact on future Native American land use or access.

In accordance with the mitigation action plan for the TWRS EIS, DOE completed a cultural resources review of the proposed location for the Phased Implementation Alternative facilities (HCRL 1998). That review concluded that although there are cultural resources within the proposed TWRS project area, they are not of local or national significance and do not qualify for listing in the National Register of Historic Places. DOE would amend the on-going TWRS cultural resources evaluation, if necessary, to include new activities associated with the Minimum INEEL Processing Alternative.

C.8.4.6 Socioeconomics

This section addresses socioeconomic impacts related to the Minimum INEEL Processing Alternative and compares this alternative to the TWRS EIS Phased Implementation Alternative. The socioeconomics analysis focuses on key indicators of the potentially impacted area, including Hanford Site employment and the effects of Site employment levels on employment, population, taxable retail sales, and housing prices in the surrounding area. DOE analyzed potential impacts to public services and facilities (schools; police and fire protection; medical services; sanitary and solid waste disposal; and electricity, natural gas, and fuel oil) based on the results of the socioeconomic modeling of the key indicators of socioeconomic impacts.

The Minimum INEEL Processing Alternative would exceed the Hanford Site baseline employment level by approximately 3.5 percent between 2023 and 2027. An additional increase for this alternative would occur in the operational years from 2028 to 2030. The increase exceeds the baseline by approximately 10 percent for the Interim Storage Shipping Scenario and 9.1 percent for the Just-in-Time scenario and would then sharply decline in 2031. Table C.8-9 presents the baseline employment for the Hanford Site and the impacts in total number of employees and the percent change that would occur for the Minimum INEEL Processing Alternative.

In comparison with the Phased Implementation Alternative, the Minimum INEEL Processing Alternative would increase the Hanford Site employment by 6 percent or 514 workers in the year 2030. This change would not have a substantial impact on Hanford employment.

Tri-Cities Area Employment. The Interim Storage Shipping Scenario of the Minimum INEEL Processing Alternative would increase the Hanford Site employment 0.63 percent over the baseline (about 530 jobs in 2030). A 0.56 percent increase in employment over the calculational baseline, or about 470 jobs in 2030 for the Just-in-Time Shipping Scenario would occur for employment impacts on the Tri-Cities.

Population and Housing. Population under the Minimum INEEL Processing Alternative would follow the changes related to Hanford Site employment resulting in a peak of 1.6 percent for the Interim Storage Shipping Scenario and 1.4 percent for the Just-in-Time Shipping Scenario above the calculational baseline in 2030, followed by a decline through 2032. This level of change would not result in a boom/bust pattern, which could impact housing and public facilities.

Housing prices reflected the pattern of employment under the Minimum INEEL Processing Alternative, with prices peaking in 2030 at 3.2 percent for the Interim Storage Shipping Scenario and 2.8 percent for the Just-in-Time Shipping Scenario above the calculational baseline. Prices would then fall through the year 2032.

Electricity, Natural Gas, and Fuel Oil. The Minimum INEEL Processing Alternative would peak for electrical demands during the operation phase. The peak would be more substantial than the population growth incremental demand. The peak for the operation phase would occur after the population demand peak since waste vitrification is an electrical power-intensive operation.

The incremental electrical demand would be a substantial increase over the 1994 estimated Hanford Site electrical requirements of approximately 57 megawatts. This demand is considerably lower than Site electrical usage in the 1980s, when average Site requirements were approximately 550 megawatts. The incremental demand under the Minimum INEEL Processing Alternative would be similar to the Phased Implementation Alternative, no more than 1.5 percent of the Pacific Northwest electrical generation system's guaranteed energy supply capacity. Additional hydroelectric generating capacity, which is the primary electrical power source in the region, is being constructed in the region. There are also proposals being consid-

Table C.8-9. Hanford Site employment changes from the baseline for selected years with TWRS Phased Implementation Alternative and Minimum INEEL Processing Alternative.

Year	Baseline level	Phased Implementation Alternative		Minimum INEEL Processing Alternative[a]	
		Change	Percent change	Change	Percent change
1997	14,900	790	5.3	0	0.0
1998	14,900	2,300	15.4	0	0.0
1999	14,800	3,300	22.3	0	0.0
2000	14,600	3,100	21.2	0	0.0
2001	14,400	1,400	9.7	0	0.0
2002	14,000	540	3.9	0	0.0
2003	13,500	540	4.0	0	0.0
2004	13,100	870	6.6	0	0.0
2005	12,800	2,400	18.8	0	0.0
2006	12,280	3,260	26.5	0	0.0
2007	11,760	4,120	35.0	0	0.0
2008	11,240	4,980	44.3	79	0.7
2009	10,720	5,840	54.5	79	0.7
2010	10,200	6,700	65.7	79	0.8
2011	10,200	6,100	59.8	88	0.9
2012	9,675	5,500	56.8	9	0.1
2013	9,150	4,900	53.6	88	1.0
2014	8,625	4,300	49.9	88	1.0
2015	8,100	3,700	45.7	88	1.1
2016	8,140	3,680	45.2	88	1.1
2017	8,180	3,660	44.7	9	0.1
2018	8,220	3,640	44.3	88	1.1
2019	8,260	3,620	43.8	88	1.1
2020	8,300	3,600	43.4	88	1.1
2021	8,320	3,340	40.1	88	1.1
2022	8,340	3,080	36.9	9	0.1
2023	8,360	2,820	33.7	9	0.1
2024	8,380	2,560	30.5	300	3.5
2025	8,400	2,300	27.4	300	3.5
2026	8,320	1,902	22.9	300	3.5
2027	8,240	1,504	18.3	300	3.6
2028	8,160	1,106	13.6	32	0.4
2029	8,080	708	8.8	740	9.2
2030	8,000	310	3.9	820	10.3
2031	7,760	252	3.2	310	4.0
2032	7,520	194	2.6	0	0.0
2033	7,280	136	1.9	0	0.0
2034	7,040	78	1.1	0	0.0
2035	6,800	20	0.3	0	0.0
2040	5,700	10	0.2	0	0.0

a. The Minimum INEEL Processing Alternative includes the Interim Storage Shipping Scenario employment. For the Just-in-Time Shipping Scenario, employment would be substantially less from 2008 through 2024 and similar or slightly less from 2024 through 2032.

ered by various utilities in the region to construct natural gas-fired power plants.

Natural gas is a minor energy source in the Tri-Cities area, and incremental consumption related to population growth under the Minimum INEEL Processing Alternative would have negligible impacts. The operation phase of this alternative also would require up to 3,000 gallons per day of fuel oil. No substantial impacts on local supply or distribution systems would be expected from this level of demand.

C.8.4.7 Land Use

Land-use impacts are addressed in terms of the compatibility of temporary and permanent land-use commitments under each alternative with past, present, and planned and potential future uses of the land and the surrounding area. A map of planned land uses at the Hanford Site can be found on Figure C.8-8. Also addressed are potential conflicts with land uses adjacent to the land that would be impacted under the alternative and unique land uses near the TWRS sites. Nearby land includes the Hanford Reach of the Columbia River and the Fitzner-Eberhart Arid Land Ecology Reserve. Conflicts among alternative Federal, state, local, and tribal nation land-use policies, plans, and controls are described separately in Section C.8.4.17.

All major activities would occur within the current boundaries of the 200 Areas. For more than 40 years, the 200 Areas have been used for industrial and waste management activities associated with the Hanford Site's past national defense mission and current waste management and environmental restoration cleanup mission. The 200 Areas consist of approximately 6,400 acres.

Just-in-Time Shipping Scenario

Under this scenario, additional land-use commitments would result from construction of the Calcine Dissolution Facility and removal of earthen materials from the potential Pit 30 borrow site. No additional land would be committed at the potential Vernita Quarry and McGee Ranch borrow sites. Assuming an area equal to the footprint of the Calcine Dissolution Facility plus a small buffer zone would be permanently committed to waste disposal, the permanent land-use commitments would increase by approximately 3.3 percent, or 3.9 acres (Figure C.8-9) over the 120 acres calculated for the Phased Implementation Alternative. Assuming that disturbances at the potential Pit 30 borrow site would be temporary, the temporary land-use commitments would increase by approximately 0.4 percent, or 2.9 acres over the 790 acres calculated for the Phased Implementation Alternative (Table C.8-10).

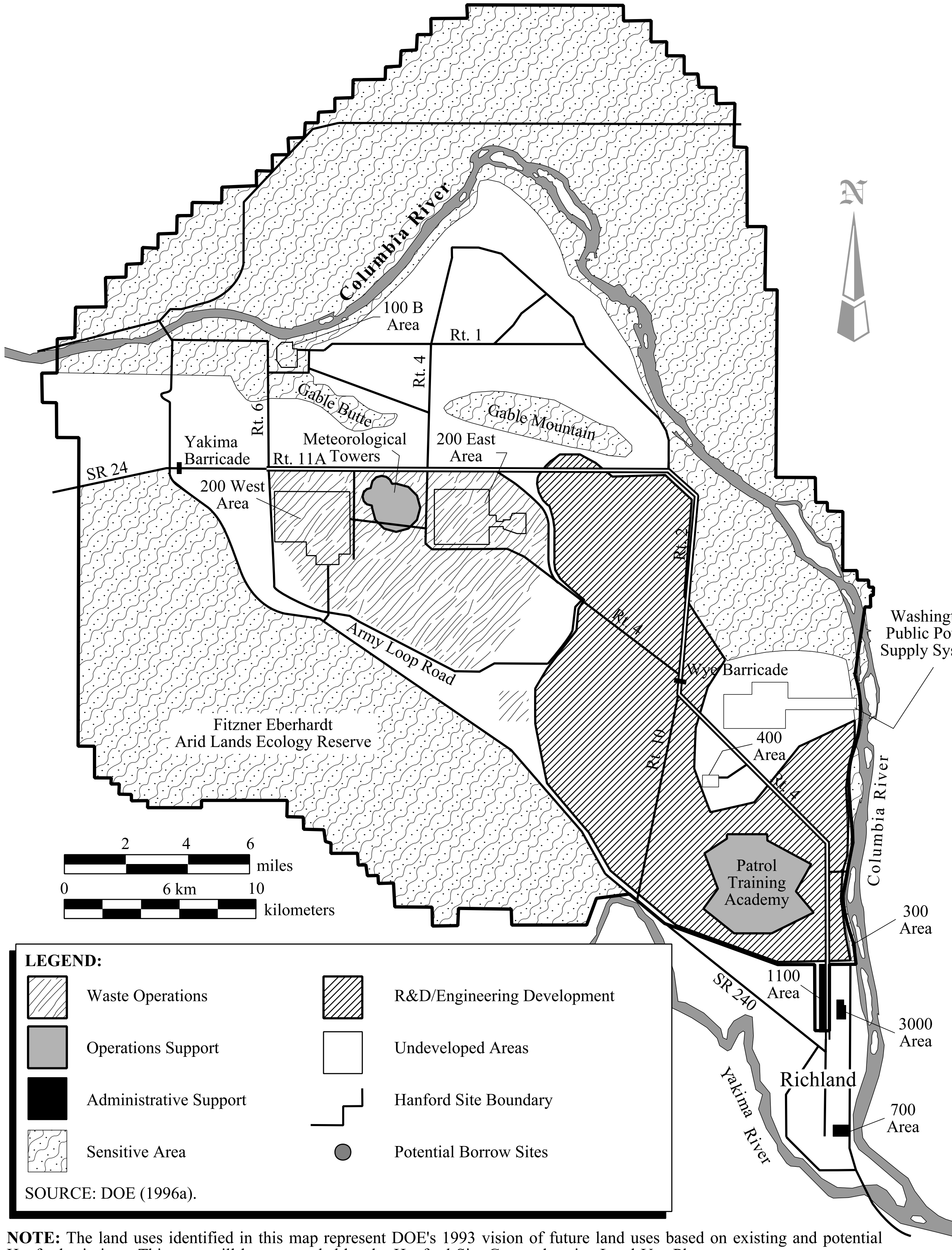
The small increases in land-use commitments resulting from this scenario would be confined to the 200 Areas and would not substantively affect the understanding of the land-use commitments presented in the TWRS EIS for the Phased Implementation Alternative. The land-use commitments would still constitute only a small fraction of the 6,400 acres of land within the 200 Areas and would be consistent with past, present, and planned and potential future uses of the land and surrounding area (Figure C.8-10).

Interim Storage Shipping Scenario

This scenario would result in greater additional impacts than the Just-in-Time Shipping Scenario because it would include all of the impacts of the Just-in-Time Shipping Scenario plus the impacts associated with the construction and subsequent decontamination and decommissioning of three new Canister Storage Buildings.

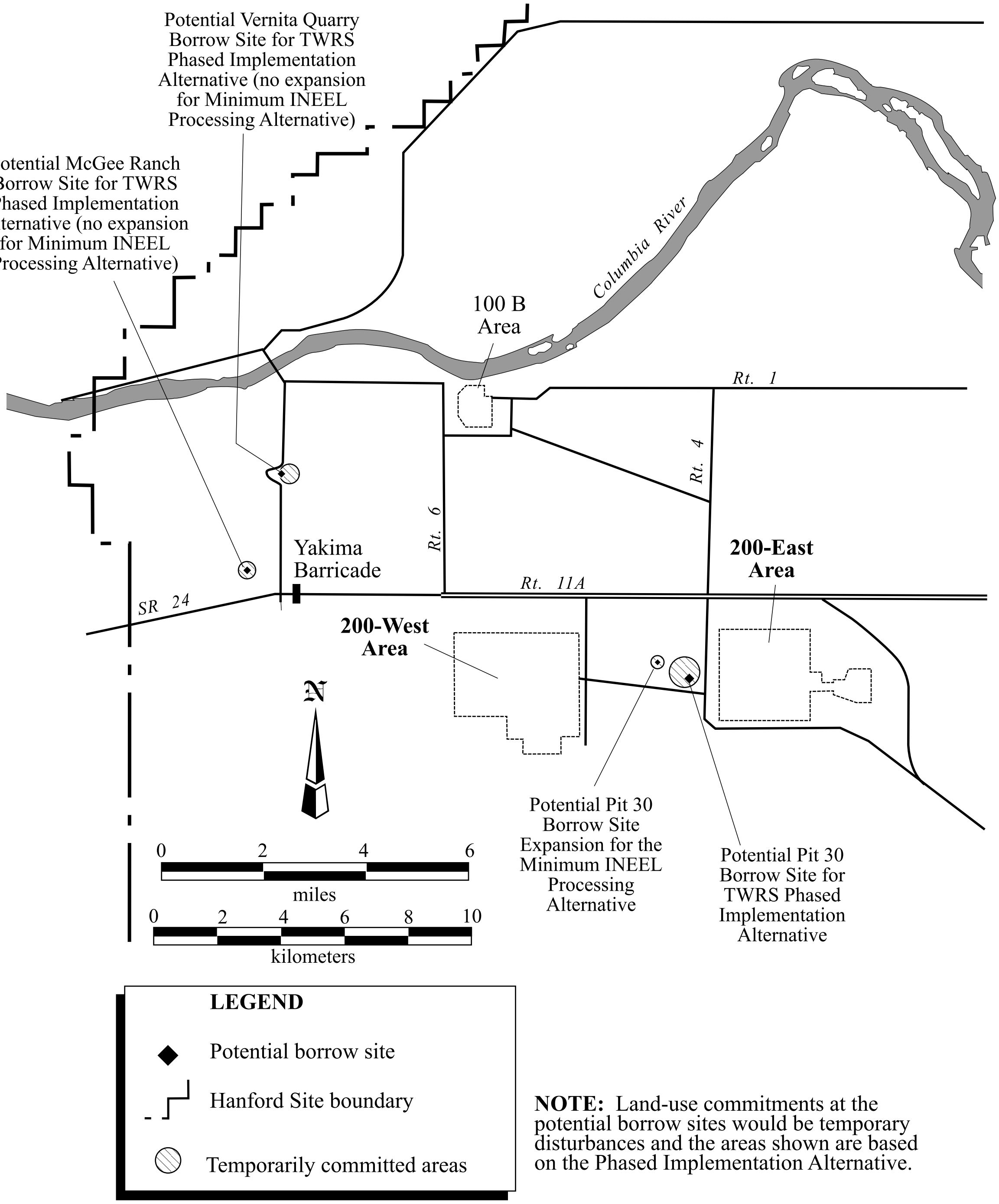
Land-use commitments associated with the Calcine Dissolution Facility are assumed to be permanent and would be the same as for the Just-in-Time Shipping Scenario. Disturbances associated with the potential Pit 30 borrow site (24 acres) and the Canister Storage Buildings (24 acres) are assumed to be temporary and would increase the temporary land-use commitments by approximately 6.1 percent, or 48 acres over the 790 acres calculated for the Phased Implementation Alternative.

Although this scenario would result in greater additional impacts than the Just-in-Time Shipping Scenario, the additional land-use commitments would still be confined to the 200



NOTE: The land uses identified in this map represent DOE's 1993 vision of future land uses based on existing and potential Hanford missions. This map will be superseded by the Hanford Site Comprehensive Land Use Plan.

FIGURE C.8-8.
Future land use map for the Hanford Site.



NOTE: Land-use commitments at the potential borrow sites would be temporary disturbances and the areas shown are based on the Phased Implementation Alternative.

SOURCE: DOE (1996a).

FIGURE C.8-9.
Land-use commitments at potential borrow sites.

Table C.8-10. Revised land-use commitments – Minimum INEEL Processing Alternative.

Alternative		Temporary land commitments[a] (acres)	Permanent land commitments[b] (acres)
Phased Implementation Alternative[c]		790	120
Minimum INEEL Processing Alternative	Just-in-Time Shipping Scenario	2.9	3.9
	Interim Storage Shipping Scenario	48	3.9
Total Impacts[d]	Just-in-Time Shipping Scenario	790	120
	Interim Storage Shipping Scenario	840	120

a. Temporary land-use commitments include the construction and operation phases; land used for facilities, construction laydown areas, and materials storage areas; and land used at the three borrow sites.

b. Permanent land-use commitments include areas that would be covered by Hanford Barriers, low-activity waste disposal vaults, and the contaminated portions of processing facilities.

c. Estimates include remediation and closure as landfill (Phase 1 and 2).

d. Impact estimates include the total Phased Implementation Alternative (Phase 1 and 2) plus the Minimum INEEL Processing Alternative.

Areas and would still not substantively affect the land-use commitments as presented in the TWRS EIS for the Phased Implementation Alternative. While the land-use commitments would constitute a slightly larger fraction of the 6,400 acres of land within the 200 Areas, they would not exceed the land available for waste management within the 200 Areas. The land-use commitments would still be consistent with past, present, and planned and potential future uses of the land and surrounding area.

C.8.4.8 Aesthetic and Scenic Resources

The visual impacts from the Phased Implementation Alternative would result from the construction of facilities associated with waste retrieval, processing, treatment, and storage. The Hanford landscape is characterized primarily by its broad plateau near the site's center. The visual setting provides sweeping vistas of the area broken up by more than a dozen large Hanford Site facilities (e.g., processing plants and nuclear reactors). The 200 Areas, where virtually all proposed facilities would be constructed, presently contain three large processing facilities as well as several multi-story support facilities. The facilities proposed for the Phased Implementation Alternative would be similar in size and appearance to the existing facilities.

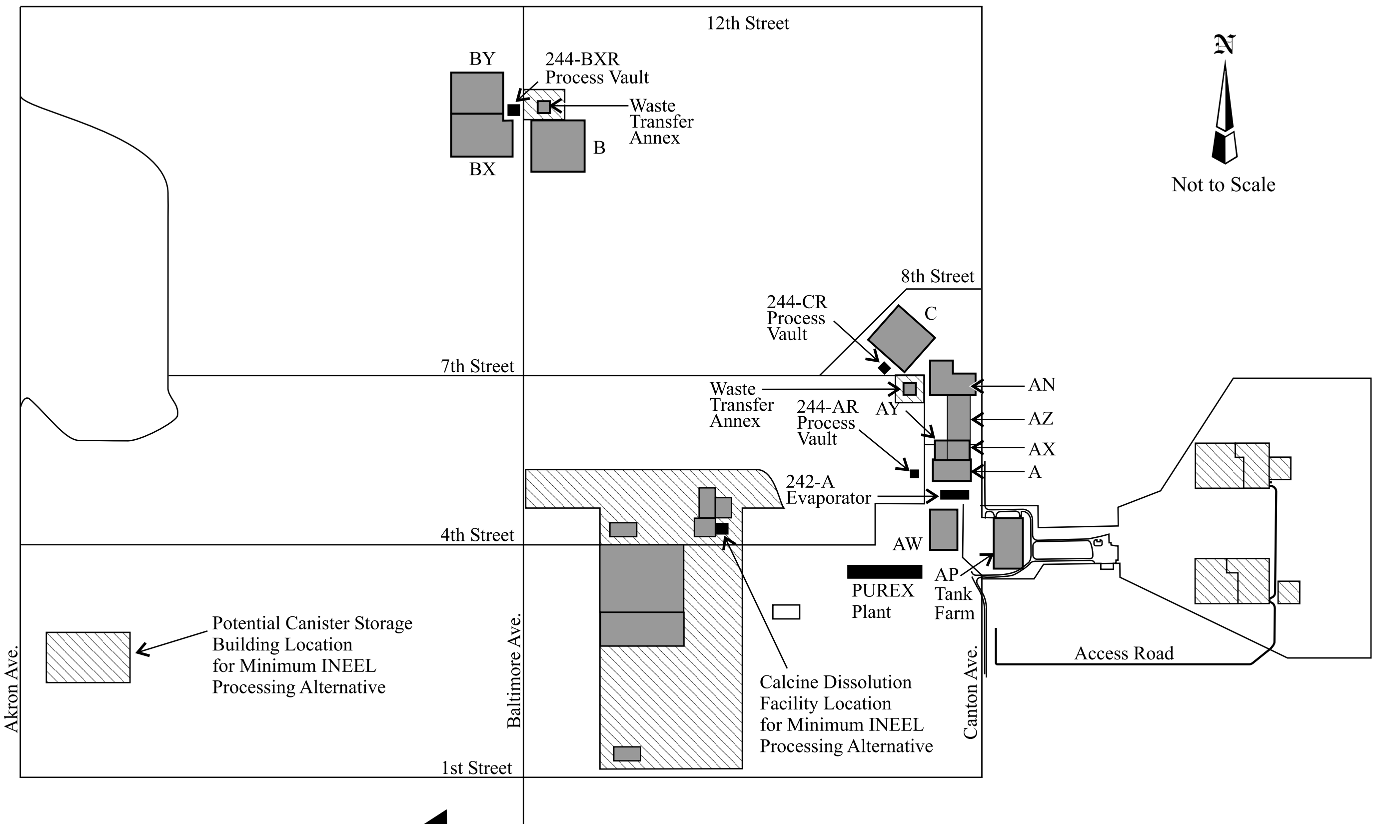
The visual impacts from the Minimum INEEL Processing Alternative, both scenarios, would result from construction of facilities associated with waste storage, pretreatment, and treatment. The primary visual impact would be from the approximately 150 feet high stacks on each immobilization facility. The stacks would be visible from certain segments of State Route 240. Under certain atmospheric conditions, plumes would be visible at certain Site boundaries. No facilities or plumes would be visible from the Columbia River (DOE 1996a).

The facilities proposed for the Minimum INEEL Processing Alternative would be similar in size and appearance to the existing Hanford Site facilities. Visual impacts would be minor and similar to the impacts that currently exist.

C.8.4.9 Noise

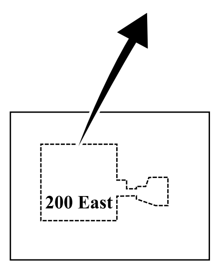
Potential noise impacts would be minor. During both the construction and operation phases, some increase in noise levels onsite would occur due to the operation of heavy equipment and offsite due to vehicular traffic along existing roadways. Construction noises would result from the operation of scrapers, loaders, bulldozers, graders, cranes, and trucks. Because of the Site's remote and natural setting, noise impacts to resident wildlife species are a concern. Table

200 East Area



LEGEND

- Permanently committed areas
- Temporarily committed areas



SOURCE: DOE (1996a).

SST Farms: T, TX, TY, U, S, SX, B, BY, BX, C, AX, and A

DST Farms: SY, AN, AZ, AY, AP, and AW

NOTE: Land-use commitments shown are based on the Phased Implementation Alternative, except as noted.

FIGURE C.8-10.
Land-use commitments in the 200-East Area.

C.8-11 presents an analysis in which a scraper, bulldozer, and grader were assumed to operate at the same location to assess the upper impact limit likely to occur. To place these noise levels in perspective, the table also presents reference noise levels. The table shows there would be some short-term disturbance of noise-sensitive wildlife near the TWRS activities during construction. Construction noise levels would approach background levels at 2,000 feet. Noise levels due to operations would be low and would result almost exclusively from traffic.

Operational phase noise impacts would be largely related to operating process equipment (e.g., evaporator, mixer pumps, and melter and quencher) and from traffic. Because the waste treatment process equipment would be operating inside enclosed structures, exterior noise levels would not substantially increase. All facilities and working conditions would be in compliance with the Occupational Safety and Health Administration's occupational noise requirements (29 CFR 1910.95). Pursuant to these requirements, noise exposures for an 8-hour duration would not exceed 85 dBA. In cases where the workers would be exposed to noise levels exceeding this value, administrative controls, engineering controls, or personal protective equipment use would be required to reduce the noise exposures below the allowable maximum.

The above assessment characterizes potential noise impacts from the TWRS Phased Implementation Alternative. Under the Minimum INEEL Processing Alternative, noise impacts would be less because there would be less construction activity.

C.8.4.10 Traffic and Transportation

This section describes how vehicular traffic associated with the Minimum INEEL Processing Alternative would impact the roadway system of the Hanford Site and vicinity. The roadways of primary concern would be (1) the segment of Stevens Road at the 1100 Area, which is the primary Site entrance for the city of Richland and (2) the segment of Route 4, which is a continuation of Stevens Road northward into the Hanford Site, west of the Wye Barricade. Stevens Road and Route 4 are by far the Hanford Site's most heavily traveled north-south route. Both of the road segments experienced heavy peak hour congestion in the recent past, although congestion has declined in 1995 as Site employment levels declined. The standard traffic level of service hierarchy ranges from Level of Service A (least congested) to Level of Service F (most congested). Conditions worse than Level of Service D are considered unacceptable. Prior to mid-1995, morning peak hour congestion on Stevens Road frequently reached Level of Service F, while on Route 4, it frequently reached Level of Service E.

To estimate vehicular traffic impacts, expected incremental traffic volumes (approximately 98 percent personal vehicles and 2 percent trucks) were added to estimated future baseline Hanford Site traffic volumes. The analysis focused on the peak year of activity. The approximate timeframes before and after the peak year when increased traffic congestion also would be expected were identified as well. Because Hanford Site traffic volumes typically reach their daily peaks during the morning shift change, this analysis focused on the morning peak hour, the time period of expected greatest impact.

Table C.8-11. Probable bounding case cumulative noise impact during the construction phase.

Equipment type	Noise level 15 meters (dBA)	Cumulative noise level (dBA)[a] at 15 meters (50 feet)	at 100 meters (330 feet)	at 400 meters (1,300 feet)
Scraper	88			
Dozer	80	90	74	62
Grader	85			

a. dBA is decibels on the A scale, which adjusts noise levels to account for human hearing capabilities. These levels compare to a food blender (90 dBA), riding inside a car at 40 miles per hour (70 dBA), and normal speech (60 dBA).

The impact of the vehicular traffic associated with the traffic volume was estimated based on the number of people who would be commuting to and from work to support the Minimum INEEL Processing Alternative activities, including construction and operations. Peak traffic flows would occur in the year 2030 and would result in extreme peak hour congestion (level of service E) on Stevens Road at the 1100 Area. On Stevens Road the morning peak hour volume would be approximately 2,200 vehicles. On Route 4 the incremental Minimum INEEL Processing Alternative traffic volume of 360 vehicles would produce peak hour traffic that would result in level of service B or C conditions. Congestion associated with the Phased Implementation Alternative for Stevens Road would begin to build in 2007 and would continue at high levels until a 2031 peak, the end of activities associated with the Minimum INEEL Processing Alternative. Most traffic would be associated with the TWRS EIS Phased Implementation Alternative until 2029.

For the Phased Implementation Alternative, congestion on Route 4 west of the Wye Barricade would begin to build in 2007 and would continue at high levels until 2024, prior to activities associated with the Minimum INEEL Processing Alternative. Most traffic would be associated with the TWRS EIS Phased Implementation Alternative until 2029.

Traffic and Transportation Accidents. The traffic scenarios analyzed included employee traffic to and from work and transportation of building materials and other miscellaneous materials to support the alternatives. The incidence rates for injuries and fatalities were based on U. S. Department of Transportation statistics, Washington State Highway accident reports, and Hanford Site statistics.

The projected traffic accidents calculated for the Minimum INEEL Processing Alternative were 14 injuries and 0.18 fatalities for commuter traffic accidents. For truck transportation accidents, the total injuries were projected to be 15; for rail accidents resulting in injuries, 0.66. Fatalities would be less than 1 for each case. Supporting calculations are provided in Appendix E of Jacobs (1998).

Rail Traffic. The Minimum INEEL Processing Alternative would involve 26 rail shipments per year to bring materials onto the Site. Offsite shipments of HLW are addressed in Section 5.2.9.

Other Risks Associated With Traffic/Transportation. Chemical exposures from potential transportation accidents while transporting chemicals to support dissolution, pretreatment, and treatment (similar chemicals that would be used for the Phased Implementation Alternative) would result in health consequences similar to those evaluated in the TWRS EIS for the Phased Implementation Alternative. However, more shipments would be required to support the Phased Implementation Alternative resulting in a higher probability of an accident and therefore would bound chemical health risk for the Minimum INEEL Processing Alternative.

C.8.4.11 Health and Safety

Carcinogenic and noncarcinogenic adverse health effects on humans from exposure to radioactive and chemical contaminants associated with each of the following categories of risk were evaluated for the Phased Implementation Alternative in the TWRS EIS.

- Remediation risk resulting from routine remediation activities, such as retrieving waste from tanks and waste treatment operations
- Post remediation risk, such as the risk resulting from residual contamination remaining after the completion of remediation activities
- Post remediation risk resulting from human intrusion directly into the residual tank waste remaining after remediation.

Just-in-Time Shipping Scenario

Under this scenario, there would be radiological risk because of airborne releases and direct exposures associated with operations and decontamination and decommissioning at the Calcine Dissolution Facility and operations at the separations and vitrification facilities (Table C.8-12). The risk to the maximally exposed individual involved worker was calculated in the TWRS EIS based on an assumed dose rate equal to the administrative control limit of 500 millirem per year and an exposure duration equal to the duration of the operation requiring the greatest amount of time, up to a maximum of 30 years. For the Phased Implementation Alternative, the exposure duration was the full 30 years (based on continued Tank Farm and evaporator operations), which resulted in a radiation dose to the maximally exposed individual involved worker of 15 rem. The operation requiring the greatest amount of time under the Just-in-Time Shipping Scenario would be calcine dissolution (estimated to require 2.25 years, see Section C.8.5.2). This would result in a radiation dose to the maximally exposed individual involved worker of 1.1 rem. Because the TWRS EIS radiation dose is greater than the dose calculated for this scenario, the TWRS EIS radiation dose is bounding and this scenario would not change the understanding of the maximally exposed individual involved worker dose presented in the TWRS EIS.

The radiological risk to the involved worker population was calculated in the TWRS EIS based on the number of workers required for each operation, the anticipated dose each individual would receive (assumed to be either 200 millirem per year or 14 millirem per year, depending on the operation), and the duration of each operation. The Phased Implementation Alternative was calculated to result in approxi-

Table C.8-12. Estimated public and occupational radiological impacts.[a]

Receptor	Phased Implementation Alternative	Minimum INEEL Processing Alternative: Just-in-Time Shipping Scenario	Minimum INEEL Processing Alternative: Interim Storage Shipping Scenario
Total collective involved worker dose (person-rem)	8,200	320	350
Total number of involved worker latent cancer fatalities	3.3	0.13	0.14
Maximally exposed offsite individual dose (millirem/year)	0.29	1.7×10^{-5}	1.7×10^{-5}
Integrated offsite maximally exposed individual dose (millirem)	4.9	2.9×10^{-5}	2.9×10^{-5}
Noninvolved worker dose (millirem/year)	0.23	1.3×10^{-5}	1.3×10^{-5}
Integrated noninvolved worker dose (millirem)	2.4	2.3×10^{-5}	2.3×10^{-5}
Dose to population within 80 kilometers of Hanford Site (person-rem per year)	23	1.3×10^{-3}	1.3×10^{-3}
Total collective dose to population (person-rem)	390	2.3×10^{-3}	2.3×10^{-3}
Estimated number of latent cancer fatalities in population within 80 kilometers of Hanford Site	0.19	1.1×10^{-6}	1.1×10^{-6}

a. Derived from Jacobs (1998).

mately 3.27 latent cancer fatalities to the involved worker population. Under the Just-in-Time Shipping Scenario, the worker population would receive additional dose from calcine dissolution operations (23 persons per year × 2.25 years × 0.2 rem = 10 person-rem, see Section C.8.5.2); Calcine Dissolution Facility decontamination and decommissioning (312 persons per year × 2 years × 0.2 rem = 130 person-rem, see Section C.8.5.2); and separations and vitrification operations (657 persons per year × 1.4 years × 0.2 rem = 180 person-rem, see Section C.8.5.3). The cumulative additional dose (320 person-rem) would result in an additional latent cancer fatality risk to the worker population of 0.13, which represents an increase of 3.9 percent over the 3.27 latent cancer fatalities calculated for the Phased Implementation Alternative in the TWRS EIS (Table C.8-12). Because this scenario would result in less than one additional latent cancer fatality, it would not appreciably change the understanding of involved worker risk presented in the TWRS EIS for the Phased Implementation Alternative.

Under this scenario, there would be additional risk to the noninvolved worker and general public associated with the radiological air emissions from the Calcine Dissolution Facility and the separations and vitrification facilities. Air emissions data for these two sources are provided in Sections C.8.5.2 and C.8.5.3, respectively. The dose to each receptor resulting from the additional emissions was estimated by scaling from the doses calculated for the Phased Implementation Alternative (see Appendix E of Jacobs 1998). Two scaling factors were developed, one for each emission source, based on emissions at the stack before dispersion. The dose to each receptor was estimated by applying the scaling factors to the dose calculated for the TWRS EIS and then summing the doses from the two sources. Calculation results are presented in Table C.8-12. For both the noninvolved worker and general public, the latent cancer fatality risk would increase by less than 1 percent over the risk calculated in the TWRS EIS. Thus, this scenario would not substantively change the understanding of risk to the noninvolved worker and general public presented in the TWRS EIS for the Phased Implementation Alternative.

This scenario would not result in any additional vitrified HLW being shipped from the Hanford Site to a geologic repository. The latent cancer fatality risk due to HLW transportation would, therefore, remain unchanged from that presented in the TWRS EIS (Table C.8-13). Transportation of INEEL HLW to the Hanford Site and the return of the vitrified HLW and low-activity waste to INEEL are addressed in Section 5.2.9.

This scenario would also result in very small nonradiological chemical risk due to chemical emissions from the Calcine Dissolution Facility and the separations and vitrification facilities. The chemical emission rates for this scenario would be three to five orders of magnitude lower than the comparable rates for the Phased Implementation Alternative (Tables C.8-14 and C.8-15) and the duration of the emissions would be much shorter than for the Phased Implementation Alternative, with the exception of mercury. The INEEL waste would have a higher mercury concentration than the TWRS EIS waste and would result in higher air emission concentration levels. The maximally exposed individual noninvolved worker and maximally exposed individual general public exposure to mercury would result in a hazard quotient of 5.4×10^{-3} and 8.7×10^{-4} respectively [supporting calculations provided in Appendix E of Jacobs (1998)], well below the benchmark value of 1.0. The resulting nonradiological chemical emissions for this scenario would be only a small fraction of the chemical emissions calculated for the Phased Implementation Alternative. Thus, the TWRS EIS risk is bounding, and this scenario would not change the understanding of the nonradiological chemical risk presented in the TWRS EIS.

Interim Storage Shipping Scenario

This scenario would result in slightly greater additional risk to the involved worker than the Just-in-Time Shipping Scenario because it would include all of the exposures associated with the Just-in-Time Shipping Scenario plus the exposures associated with operations at the Canister Storage Buildings (Table C.8-12). The operation requiring the greatest amount of time under this scenario would be the Canister

Table C.8-13. Vitrified HLW transportation risk – Phased Implementation Alternative.

Receptor	LCF risk
Onsite population	3.1×10^{-4}
Offsite population	3.2×10^{-3}

LCF = latent cancer fatality.

Table C.8-14. Chemical emissions during routine operations – Phased Implementation Alternative.

Receptor	Hazard quotient
Maximally exposed individual involved worker	0.31
Maximally exposed individual noninvolved worker	0.13
Maximally exposed individual general public	7.5×10^{-5}

Table C.8-15. Comparison of chemical emissions during routine operations from the Phased Implementation Alternative and Minimum INEEL Processing Alternative.

	Emission rate (mg/sec)	
Emissions[a]	TWRS EIS Phased Implementation Alternative	Minimum INEEL Processing Alternative[b]
Boron	6.4×10^{-4}	5.8×10^{-8}
Barium	4.7×10^{-6}	1.5×10^{-9}
Cadmium	1.2×10^{-5}	1.4×10^{-8}
Chromium	2.5×10^{-4}	5.4×10^{-9}

a. Emissions listed are releases that would occur under the Phased Implementation Alternative that would also occur under the Minimum INEEL Processing Alternative.

b. These values represent the combined emission rates from the Calcine Dissolution Facility and the separations and vitrification facilities.

mg/sec = milligrams per second

Storage Building operation (estimated to require 19 years; see Section C.8.5.1). Canister Storage Building operations would result in a radiation dose to the maximally exposed individual involved worker of 9.5 rem. Because the TWRS EIS radiation dose is greater than the dose calculated for this scenario, the TWRS EIS radiation dose is bounding and this scenario would not change the understanding of the maximally-exposed individual involved worker dose presented in the TWRS EIS.

The involved worker population dose would increase by approximately 34 person-rem due to operations at the Canister Storage Buildings (see Section C.8.5.1.), bringing the cumulative additional dose for this scenario to 350 person-rem. This cumulative dose would result in an additional latent cancer fatality risk to the worker population of 0.14, or a 4.3 percent increase over the 3.3 latent cancer fatalities calculated in the TWRS EIS for the Phased Implementation Alternative (Table C.8-12). Although the worker risk would increase under this scenario, there would be less than one additional latent cancer fatality. Thus, this scenario would not appreciably change the understanding of involved worker risk presented in the TWRS EIS for the Phased Implementation Alternative.

Under this scenario, the additional radiological risk to the noninvolved worker and general public would be the same as for the Just-in-Time Shipping Scenario because operations at the Canister Storage Buildings are assumed to result in no additional airborne radiological releases (see Section C.8.5.1).

This scenario would not result in any additional vitrified HLW being shipped from the Hanford Site to a geologic repository. The latent cancer fatality risk due to HLW transportation would, therefore, remain unchanged from that presented in the TWRS EIS (Table C.8-13). Transportation of INEEL HLW to the Hanford Site and the return of the vitrified HLW and low-activity waste to INEEL are addressed in Section 5.2.9.

This scenario would result in the same nonradiological risk as the Just-in-Time Shipping Scenario because operations at the Canister Storage Buildings are assumed to result in no additional airborne chemical releases (see Section C.8.5.1).

Long-Term Anticipated Health Effects

The Minimum INEEL Processing Alternative would result in no additional long-term human health risks to future users of the Hanford Site. Following processing and treatment, the immobilized INEEL HLW and low-activity waste canisters would be transported back to INEEL for interim storage and eventual disposal. There would be no additional sources of potential groundwater contamination left onsite following completion of remediation. Implementing either shipping scenario would result in the same long-term human health risk impacts as calculated in the TWRS EIS for the Phased Implementation Alternative (Table C.8-16).

Intruder Scenario

The TWRS EIS included an analysis of long-term intruder risk. The intrusion scenario used was a postulated well-drilling scenario on the Hanford Site after the assumed loss of institutional control. The latent cancer fatality risk was calculated for a hypothetical driller and a post-drilling resident. The driller was assumed to be an individual who drills a well through the tank waste. The post-drilling resident was assumed to be an individual who lives on a parcel of land over the exhumed waste, from which he obtains 25 percent of his vegetable intake. For the Phased Implementation Alternative, the latent cancer fatality risk was calculated to be 8.5×10^{-5} for the driller and 4.2×10^{-4} for the post-drilling resident.

The Minimum INEEL Processing Alternative would result in no additional risks from inadvertent human intrusion at Hanford Site. Following processing and treatment, the immobilized INEEL HLW and low-activity waste canisters would be transported back to INEEL for interim storage and eventual disposal. There would be no additional onsite sources of contamination to increase the potential risks from a postulated well drilling intrusion scenario. Implementing either shipping scenario would result in the same risks to the driller and post-drilling resident as calculated in the TWRS EIS for the Phased Implementation Alternative.

C.8.4.12 Accidents

The accident analysis considers human health risks from (1) nonradiological/nontoxicological occupational accidents and (2) radiological and toxicological accidents. Accidents could potentially result from current Tank Farm operations and from construction and operations of pretreatment, treatment, and storage and disposal facilities to support the Phased Implementation Alternative.

Just-in-Time Shipping Scenario

Under this scenario INEEL waste would be transported to Hanford just in time for vitrification, and there would be no need to construct additional Canister Storage Buildings for interim storage. Therefore, only the Calcine Dissolution Facility and the vitrification facility are evaluated in the scenario as potential sources of accidents.

Nonradiological Nontoxicological Occupational Risk. The numbers of worker-years required to construct, operate, and decommission the Calcine Dissolution Facility were calculated from the data provided in Section C.8.5.2, to be 1,100; 52; and 620, respectively. The number of worker-years required to operate the vitrification facility was calculated from the data provided in

Table C.8-16. Long-term anticipated health effects – Phased Implementation Alternative.[a]

Risk / Hazard	Year	Exposure scenario	Bounding[b]	Nominal[c]
Incremental Lifetime Cancer Risk[d]	2,500	Native American	1.2×10^{-4}	2.6×10^{-5}
		Residential farmer	9.6×10^{-6}	1.9×10^{-6}
		Industrial worker	3.0×10^{-6}	7.2×10^{-8}
		Recreational user	2.7×10^{-7}	1.2×10^{-8}
	5,000	Native American	4.3×10^{-3}	7.1×10^{-4}
		Residential farmer	3.4×10^{-4}	2.0×10^{-5}
		Industrial worker	1.0×10^{-4}	2.6×10^{-6}
		Recreational user	9.6×10^{-6}	2.6×10^{-7}
	10,000	Native American	6.9×10^{-4}	6.2×10^{-4}
		Residential farmer	6.8×10^{-5}	4.0×10^{-5}
		Industrial worker	7.4×10^{-6}	6.2×10^{-6}
		Recreational user	7.8×10^{-7}	6.0×10^{-7}
Hazard quotient	2,500	Native American	0.72	0.6
		Residential farmer	0.12	0.11
		Industrial worker	1.1×10^{-4}	9.1×10^{-5}
		Recreational user	1.6×10^{-5}	1.2×10^{-5}
	5,000	Native American	120	34
		Residential farmer	21	6.3
		Industrial worker	0.022	5.2×10^{-3}
		Recreational user	3.0×10^{-3}	7.1×10^{-4}
	10,000	Native American	7.7×10^{-3}	1.4
		Residential farmer	1.6×10^{-3}	2.2×10^{-3}
		Industrial worker	3.7×10^{-4}	4.7×10^{-4}
		Recreational user	4.9×10^{-5}	6.3×10^{-5}

a. Source: DOE (1996a).

b. Bounding case health effects are based on conservative assumptions designed to ensure that the results provide an upper bound of long-term risks.

c. Nominal case health effects are based on average rather than conservative assumptions.

d. Incremental lifetime cancer risk based on long-term exposure to radionuclides and carcinogenic chemicals in groundwater (risk below 1.0×10^{-6} is considered low, risk above 1.0×10^{-4} is considered high).

Section C.8.5.3 to be 990. The total recordable cases, lost workday cases, and fatalities were calculated using the same incidence rates used in the TWRS EIS. The results of the calculations are presented in Table C.8-17. The supporting calculations are provided in Appendix E of Jacobs (1998). The Just-in-Time Shipping Scenario would result in an incremental worker risk of 4 percent for construction and 1 percent for operations as shown in the revised impacts to the Phased Implementation Alternative. It should be noted that decommissioning was added to construction.

Radiological and Toxicological Accidents. The potential accidents evaluated in the TWRS EIS are those that could occur while storing, transferring, pretreating, and vitrifying the INEEL waste. The radiological and chemical constituents and concentrations in the INEEL waste inventory are not the same as the Hanford waste and for a given accident would result in lower dose consequences. To determine the dose consequences of comparable accidents evaluated in the TWRS EIS, a unit-liter dose was calculated for the INEEL waste and compared with the unit-liter dose that was used in the TWRS EIS analysis. Assuming the same atmospheric dispersion factors, respirable rates, fraction of respirable material released in the accident, and dose-to-risk conversion factors, scaling factors based on the difference in the unit-liter doses were developed for estimating the latent cancer fatality risk resulting from INEEL waste accidents. The scaling factors are presented in Table C.8-18 and the supporting calculations for the scaling factors are provided in Appendix E of Jacobs (1998).

Applying the scaling factors in Table C.8-18 to the accident scenarios evaluated in the TWRS EIS for the Hanford waste would result in the latent cancer fatality risks presented in Table C.8-19. The INEEL waste spray release accident scenario would be bound by the comparable TWRS EIS accident by one order of magnitude. The INEEL waste deflagration scenario would be bound by the comparable TWRS EIS accident by two orders of magnitude. The INEEL waste line-break scenario would be bound by the comparable TWRS EIS by a factor of two. The INEEL waste breached canister of vitrified HLW scenario would be bound by the comparable TWRS EIS by two orders of magnitude. The INEEL waste beyond-design-basis earthquake would be bound by the comparable TWRS EIS by one order of magnitude. Retrieval accidents were not evaluated in this analysis. It was assumed that after the calcined waste has been dissolved and transferred to the storage tanks the condition of the waste would make it readily transferable to the separations facility and, as a result, would require a minimum amount of sluicing.

The chemical risk from the postulated accident for the INEEL waste was based on the relatively large concentration of mercury in the waste. The organic constituents have been removed from the waste during the calcine process at INEEL. Mercury is the only chemical in the waste with a concentration that could exceed the American Industrial Hygiene Association Emergency Response Planning Guidelines (ERPG)-1 severity level. The mercury concentrations were calculated for the various receptors and the corresponding Emergency Response Planning Guideline levels are presented in Table C.8-20.

Supporting calculations are provided in Appendix E of Jacobs (1998). The chemical accidents evaluated in the TWRS EIS would remain bounding for all accidents except for the line-break accident and the spray release accident scenarios. The INEEL waste line-break scenario would result in an ERPG-2 for the noninvolved worker receptor compared to ERPG-1 calculated in the comparable TWRS EIS accident. The INEEL waste spray release accident scenario would result in an ERPG-3 for the noninvolved worker receptor compared to ERPG-2

Table C.8-17. Occupational accident risk.

Alternative		Construction			Operations		
		TRC	LWC	Fatality	TRC	LWC	Fatality
Phased Implementation Alternative		4,200	1,100	1.4	1,900	940	2.7
Minimum INEEL Processing Alternative	Just-in-Time Shipping Scenario	170	43	0	23	12	0
	Interim Storage Shipping Scenario	230	57	0	27	13	0
Total Impacts	Just-in-Time Shipping Scenario	4,400	1,100	1.4	1,900	950	2.7
	Interim Storage Shipping Scenario	4,400	1,200	1.4	1,900	950	2.7

a. LWC = lost workday cases; TRC = total recordable cases.

Table C.8-18. Scaling factors for estimating latent cancer fatality risk for INEEL waste accidents.

Accident scenario	Scaling factor
Spray scenario	0.097
Hydrogen gas deflagration	0.012
Line break during pretreatment	0.58
Breached canister	3.7×10^{-3}
Beyond design basis earthquake	0.033

Table C.8-19. Radiological accident impacts for the Minimum INEEL Processing Alternative.[a]

Process title	Maximally-exposed individual dose (rem)	Noninvolved worker dose (rem)	Offsite population (person-rem)	Latent cancer fatalities to offsite population
Spray release from jumper pit	0.19	42	390	0.19
Hydrogen deflagration in waste storage tanks	0.050	21	44	0.022
Line break during pretreatment	2.6×10^{-4}	0.060	0.56	2.8×10^{-4}
Dropped canister of vitrified HLW	2.2×10^{-12}	1.5×10^{-9}	4.9×10^{-9}	2.5×10^{-12}
Beyond design basis earthquake	0.15	64	130	0.067
Breached calcine canister while unloading[b]	4.7×10^{-6}	3.3×10^{-3}	0.010	5.2×10^{-6}

a. Derived from Jacobs (1998).

b. This accident scenario is unique to the INEEL waste form (calcine). Impacts for this scenario were not scaled from the TWRS EIS.

Table C.8-20. Toxicological accident impacts for the Minimum INEEL Processing Alternative.[a]

Process title	MEI[b] involved worker	MEI noninvolved worker	MEI general public	Involved worker population	Noninvolved worker population	General public population
Spray release from jumper pit	ERPG-2[c]	ERPG-3	<ERPG-1	ERPG-2	ERPG-3	<ERPG-1
Hydrogen deflagration in waste storage tanks	ERPG-2	ERPG-2	<ERPG-1	ERPG-2	ERPG-2	<ERPG-1
Line break during pretreatment	<ERPG-1	ERPG-2	<ERPG-1	<ERPG-1	ERPG-2	<ERPG-1
Dropped canister of vitrified HLW	<ERPG-1	<ERPG-1	<ERPG-1	<ERPG-1	<ERPG-1	<ERPG-1
Beyond design basis earthquake	ERPG-2	ERPG-3	<ERPG-1	ERPG-2	ERPG-3	<ERPG-1
Breached calcine canister while unloading[d]	<ERPG-1	<ERPG-1	<ERPG-1	<ERPG-1	<ERPG-1	<ERPG-1

a. Derived from Jacobs (1998).

b. MEI = maximally-exposed individual.

c. ERPG = Emergency Response Planning Guidelines.

d. This accident scenario is unique to the INEEL waste form (calcine). Impacts for this scenario were not scaled from the TWRS EIS.

calculated in the comparable TWRS EIS accident.

In addition to the accidents evaluated in the TWRS EIS, a breached canister of calcine waste was analyzed. A dropped canister of calcine waste could potentially occur in the canister dissolution facility while the canister is being transferred from the transportation cask. The accident could occur as a result of mechanical failure or human error. It is assumed that 40 percent of the 1.17 cubic meters of waste in the canister is released and suspended in the air. It is further assumed that each stage of a two-stage high-efficiency particulate air filter system filters 99.95 percent of the suspended waste. The radiological and toxicological impacts to the various receptors are presented in Tables C.8-19 and C.8-20. Supporting calculations are provided in Appendix E of Jacobs (1998).

The radiological latent cancer fatality risk from accidents evaluated for the Just-in-Time Shipping Scenario are less than the risk from comparable accidents evaluated in the TWRS EIS. Only the chemical risk from the spray accident and line-break accident would exceed the chemical risk to the noninvolved worker evaluated for comparable accidents in the TWRS EIS. However, the spray accident and line-break accident are bound by other accidents evaluated in the TWRS EIS. The hydrogen gas deflagration, high-efficiency particulate air filter failure, and beyond-design-basis earthquake accidents evaluated in the TWRS EIS would exceed ERPG-3 for the noninvolved worker. Therefore, the Just-in-Time Shipping Scenario would not substantively change the understanding of impacts from radiological and chemical accidents presented in the TWRS EIS for the Phased Implementation Alternative.

Interim Storage Shipping Scenario

Under this scenario INEEL waste would be transported to the Hanford Site approximately 20 years prior to being vitrified. This would require additional Canister Storage Buildings to be built for storage of INEEL waste prior to vitrification. The Canister Storage Buildings, Calcine Dissolution Facility, and the vitrification facility are evaluated in this scenario as potential sources of accidents.

Nonradiological Nontoxicological Occupational Risk. The number of worker-years required to support the Calcine Dissolution Facility and vitrification facility would be the same as was previously discussed for the Just-in-Time Shipping Scenario. However, additional worker years would be required to construct, operate, and decommission the Canister Storage Buildings. The results of the calculations are presented in Table C.8-17. The Interim Storage Shipping Scenario would result in an incremental worker risk of 5.5 percent for construction and 1.5 percent for operations as shown in the revised impacts to the Phased Implementation Alternative.

Radiological and Toxicological Accidents. The radiological and toxicological accidents evaluated in the Just-in-Time Shipping Scenario would be common to the Interim Storage Shipping Scenario. The potential for a dropped canister of calcine waste could occur in a Canister Storage Building as the canister is being transferred from the transportation cask. However, this accident would be comparable to the canister accident in the Calcine Dissolution Facility and would result in the same radiological and chemical risk. As with the Just-in-Time Shipping Scenario, the Interim Storage Shipping Scenario would not substantively change the understanding of impacts from radiological and chemical accidents presented in the TWRS EIS for the Phased Implementation Alternative.

C.8.4.13 Cumulative Impacts

The NEPA implementation regulations define the term "cumulative impact" as the impact on the environment that results from the incremental impact of an action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency undertakes those actions. Cumulative impacts result from individually minor but collectively significant actions taking place over time (40 CFR 1508.7).

This section describes potential cumulative impacts associated with implementing the Minimum INEEL Processing Alternative. Other actions that could impact the Hanford Site are also identified, and, when possible, a qualitative discussion of their potential cumulative impact is provided.

The Minimum INEEL Processing Alternative, as described in Section ***C.8.2***, would involve treatment of INEEL waste at the Hanford Site. It would also require waste management activities at INEEL, transportation of the untreated waste to Hanford, and transportation of the treated waste from Hanford to INEEL. The activities analyzed in this appendix included only those that would take place at the Hanford Site. Implementation of the Minimum INEEL Processing Alternative would require additional offsite activities not analyzed here (e.g., waste transportation). Such activities would result in cumulative impacts that are not described.

There would be no long-term disposal of INEEL waste at Hanford as the result of the Minimum INEEL Processing Alternative and, therefore, there would be no cumulative long-term disposal impacts to the Hanford Site. Because the INEEL waste would be processed following completion of planned retrieval and treatment of the Hanford Site tank waste, many of the resource area impacts would not be cumulative.

Actions at the Hanford Site that could result in cumulative impacts with the Minimum INEEL Processing Alternative include the Hanford Site waste management and environmental restoration programs, operation of the Environmental Restoration and Disposal Facility, the management of spent nuclear fuel, and activities at the U.S. Ecology Site. The level of activity associated with many of the Hanford Site cleanup functions would be declining by the time treatment of the INEEL waste would begin. Among the cumulative impacts that would occur are impacts to land use and biological resources, human health, transportation, and socioeconomics.

Actions at Other DOE Sites or Facilities and Programmatic Actions that Could Potentially Impact the Hanford Site

Programs or actions at other DOE sites and DOE programmatic evaluations that could impact the Hanford Site are discussed in the TWRS EIS. Potential cumulative impacts would be similar to those identified for the TWRS waste treatment alternatives and include impacts on land use, habitat, health, air quality, transportation, and socioeconomic issues.

Actions Adjacent to the Hanford Site

In addition to DOE waste management activities, there are other nuclear facilities at, or near, the Hanford Site that could contribute to radioactive releases. These facilities include a commercial radioactive waste burial site, a commercial nuclear power plant, a nuclear fuel production plant, and a commercial low-level radioactive and low-level mixed waste treatment facility. These ongoing operations, combined with the proposed Minimum INEEL Processing Alternative, would cumulatively impact socioeconomics, air emissions, health, transportation, and land use.

Currently Planned or Reasonably Foreseeable DOE Actions at the Hanford Site

This section describes the currently planned and reasonably foreseeable actions at the Hanford Site having potential cumulative impacts. The activities are grouped into actions on the Central Plateau and actions in other Hanford Site areas. A number of proposed actions at the Hanford Site may contribute to the cumulative impacts from proposed actions under the Minimum INEEL Processing Alternative. Because the majority of the activity associated with the proposed action would occur approximately 30 years in the future, a quantitative analysis of cumulative impacts from all potential projects is not possible. A complete description of currently planned or reasonably foreseeable DOE actions at the Hanford Site is provided in the TWRS EIS.

The facilities and operations associated with the Minimum INEEL Processing Alternative would occur on the Central Plateau. Currently planned or reasonably foreseeable actions that would occur on the Central Plateau include:

- Closure of the single-shell tanks and double-shell tanks. Current planning includes closure of the Hanford Site Tank Farms following completion of waste retrieval actions. The end state for the Tank Farms is not currently defined. There is a potential for cumulative impacts on land use and habitat resources, air emissions, and socioeconomics.

- Waste Receiving and Processing Facility. The Waste Receiving and Processing Facility would be used to process alpha-contaminated waste for onsite disposal or transuranic waste for eventual shipment to the Waste Isolation Pilot Plant. No potentially cumulative impacts have been identified for this action.

- Effluent Treatment Facility and Liquid Effluent Retention Facility. These facilities would provide for collection, retention, treatment, and disposal of liquid waste, including liquid effluents from the TWRS treatment facilities. No potentially cumulative impacts have been identified for this action.

- U.S. Ecology Low-Level Radioactive Waste Disposal Facility. The U.S. Ecology Low-Level Radioactive Waste Disposal Facility occupies 100 acres of land leased by DOE to Washington state. The facility is located just southwest of the 200-East Area and receives low-level waste from commercial organizations. U.S. Ecology is assumed to continue to receive and emplace commercial low-level waste onsite through the year 2063. There is a potential for cumulative impacts on land use and transportation.

Other currently planned or reasonably foreseeable DOE actions at other Hanford Site areas are documented in the TWRS EIS. To the extent that some of these activities would take place during the same time as the Minimum INEEL Processing Alternative, they have the potential to result in cumulative impacts on land use, habitat, traffic, and socioeconomics.

Summary of Cumulative Impacts

Although many of the activities described previously would occur at the same general time as the Minimum INEEL Processing Alternative, few quantifiable cumulative impacts would be expected because of differences in the nature of the activities and their physical separation.

From a broader environmental perspective, cumulative impacts can be expected in such areas as land use and habitat resources. For example, multiple projects each impacting a small amount of sensitive shrub-steppe habitat eventually could have a more substantial impact by fragmenting the habitat and reducing the total amount of shrub-steppe habitat remaining on the Hanford Site. The cumulative population dose would increase slightly as a result of additional waste treatment operations. Other resource areas such as air quality, socioeconomics, and transportation would have less potential for cumulative impacts due to the schedule for the various activities. Retrieval and treatment of Hanford Site tank waste would be completed prior to initiating INEEL waste processing, so there would be no cumulative air quality impacts from waste processing. Finally, the baseline employment levels at the Hanford Site are projected to be approximately one-half of the current level by 2029 when treatment of the INEEL waste would take place.

The proposed activities would be carried out against the baseline of overall Hanford Site operations. Assuming the Hanford Site's environmental restoration and waste management mission does not change, it is likely that the future range of operational impacts would not be greater than the current impacts associated with Hanford Site waste and operations.

C.8.4.14 Unavoidable Adverse Impacts

This section summarizes the potential unavoidable adverse impacts at the Hanford Site associated with the Minimum INEEL Processing Alternative. Identified herein are those unavoidable adverse impacts that would remain after incorporating all mitigation measures that were part of the development of the TWRS EIS alternatives. Potentially adverse impacts for the Minimum INEEL Processing Alternative are described in Sections C.8.4.1 through C.8.4.12. Additional practicable mitigation measures are identified in Section C.8.4.20 that could further reduce the impacts described in this section.

Geology and Soils

Total soil disturbance would be 52 acres for the Minimum INEEL Processing Alternative (Section C.8.4.1). Large volumes of borrow material would be excavated at the Pit 30 potential borrow site. Borrow material excavation would leave shallow terrain depressions at the excavation site.

Air Quality

Although no applicable air quality standards would be exceeded, substantial air emissions would occur, even with applicable implementation of additional practicable mitigation measures (Section C.8.4.3). Construction and operation activities would result in increased levels of air emissions. Construction activities would produce fugitive dust (particulates) and combustion emissions from the use of heavy equipment and motor vehicles. Operation activities would produce radionuclide emissions, combustion emissions, and hazardous air pollutants. Radionuclide emissions would include strontium-90, technetium-99, americium-241, plutonium isotopes, and cesium-137.

Water Resources

The vadose zone and groundwater aquifer beneath portions of the Hanford Site, including the 200 Areas, currently are contaminated at levels that exceed drinking water standards. Controls on the use of Hanford Site groundwater currently are in place and are expected to continue well into the future.

The Minimum INEEL Processing Alternative would not involve release of waste into the currently contaminated vadose zone beneath the 200 Areas, and eventually into the underlying groundwater aquifer. Therefore, this alternative would not result in levels that exceed water quality requirements (Section C.8.4.2)

Land Use

Permanent land-use commitments would be 3.9 acres for the Minimum INEEL Processing Alternative; however, the potential exists that permanent commitment of land in the 200 Areas to waste disposal uses could occur at the Hanford Site. While the TWRS EIS alternative land use would be compatible with current land use and current plans for future land use of the 200 Areas, the committed areas would be inaccessible for alternative land use. The amount of land involved would be small compared to the total Central Plateau waste management area of the Hanford Site (Section C.8.4.7).

Transportation

The Minimum INEEL Processing Alternative would involve additional motor vehicle traffic, mostly from employees commuting to and from TWRS sites. There would be an increased traffic congestion during daytime peak hours on Stevens Road north of Richland and on Route 4 west of the Wye Barricade. This congestion would especially occur during the period of peak employment (2028 to 2030), which is largely associated with operational activities. Potential transportation accidents, both onsite and offsite, could cause injuries, illness, and a small risk for a fatality (Section C.8.4.10).

Noise

Because the TWRS sites would be located in the interior of the Hanford Site and would be a long distance from populated offsite areas, the only unavoidable adverse noise impact would be temporary wildlife disturbances near construction sites from heavy equipment use (Section C.8.4.9).

Aesthetic and Scenic Resources

Constructing facilities and performing borrow site excavation activities would affect the visual environment, particularly from elevated locations onsite (e.g., Gable Mountain, Gable Butte, and Rattlesnake Mountain that are used by Native Americans for religious purposes). Facilities developed in the 200-East Area would be visible in the distant background from State Route 240 and from offsite elevated locations. Section C.8.4.8 provides more detail on unavoidable adverse impacts.

Biological and Ecological Resources

The Minimum INEEL Processing Alternative would affect shrub-steppe habitat in the 200 Areas and at least one of the three potential borrow sites (Section C.8.4.4). In the affected shrub-steppe habitat areas, there would be a loss of plants; loss or displacement of wildlife species (e.g., birds, small mammals); and a resulting loss of food supplies for birds of prey and predatory mammals.

A small percentage (less than one-half of 1 percent) of the Hanford Site's total shrub-steppe area would be affected, and only individual species members potentially would be impacted, rather than the species as a whole. However, a number of plant and wildlife species of concern (species that are classified as candidates for listing as threatened or endangered, or by the state as monitor or sensitive species) potentially would be affected.

Given that the sites proposed for HLW management facilities under the Minimum INEEL Processing Alternative all lie within the boundaries of 200 East Area, habitat fragmentation is not a concern. All of the proposed sites are in an area dedicated to industrial use since the 1940s that already contains a number of established facilities and is encircled by perimeter roads. Although some shrub-steppe habitat is present in undeveloped portions of 200 East Area, its value as wildlife habitat is diminished by the fact that it is effectively isolated from large, unbroken expanses of shrub-steppe to the north and south. One of the proposed facilities would be placed outside of 200 East Area, thus no unbroken tracts of shrub-steppe habitat (or any other habitat) would be affected.

Cultural Resources

Prehistoric and historical materials and sites in the 200 Areas are scarce, and the TWRS sites currently are heavily disturbed (the 18 Tank Farms) or partly disturbed (the proposed waste treatment facility sites) (Section C.8.4.5).

Socioeconomics

The Minimum INEEL Processing Alternative would involve short-term socioeconomic impacts that would stem largely from rapid fluctuations in employment during construction and operations (Section C.8.4.6). However, these impacts would not affect the on-going Phased Implementation Alternative and would not produce impacts on housing prices stemming from rapid increases in local population. The increases in local population also would not require hiring additional local police and fire department personnel. The increase in local population would lead to increased enrollment in schools but not to an adverse effect.

Health Effects

The Minimum INEEL Processing Alternative would pose some risks of adverse health effects. The risk of adverse health effects would be limited mainly to workers (Section C.8.4.11).

Accidents

The Minimum INEEL Processing Alternative would involve potential accidents. This would include occupational, radiological, and chemical accidents that could cause injuries, illness, and latent cancer fatalities. Occupational injuries, illnesses, and fatalities would be directly dependent on the number of person-years of labor required to complete the activity. Thus, the more person-years of labor the more injuries, illnesses, and fatalities (Section C.8.4.12 for accidents).

Committed Resources

The Minimum INEEL Processing Alternative would consume water, concrete, and electricity; would use borrow materials; and would consume process chemicals. Although all of these resource consumption impacts would be within existing capacity, the resources would be unavailable for alternative uses.

C.8.4.15 Relationship Between Short-Term Uses of the Environment and Maintenance and Enhancement of Long-Term Productivity

For the Minimum INEEL Processing Alternative, the short-term period was considered to be the construction, operation, and decontamination and decommissioning phases (scheduled to be completed by 2032). Most short-term environmental impacts would occur during the construction and operations phases. Over the short-term there would be increased air emissions and noise, solid and liquid waste generation, and increased risk of accidents and illness, primarily to workers involved with implementing the alternative compared to not performing remedial action. Implementing the alternative would consume both natural and human-made resources (e.g., fuels, concrete, steel, and chemicals) but would not be expected to cause shortages or price increases as a result of their resource consumption. Over the short term, land areas would be committed that would affect biological resources.

Compared with performing no Hanford Site tank waste remedial action, the Minimum INEEL Processing Alternative would increase expenditure of Federal funds in the Tri-Cities. These would result in increased employment and economic activity associated with these expenditures. The Minimum INEEL Processing Alternative would have short-term impacts on the human environment through short-term fluctuations in employment and population and the associated impacts on public services.

The long-term impacts on the natural environment of the Minimum INEEL Processing Alternative would be due in large part to how much waste would remain on the Hanford Site after the alternative was fully implemented, and how much of the remaining waste would be immobilized or left untreated. Since all the waste is shipped to the Hanford Site from INEEL and then returned to INEEL, no long-term impacts associated with disposal or storage would occur.

C.8.4.16 Irreversible and Irretrievable Commitment of Resources

Just-in-Time Shipping Scenario

Under this scenario, additional irreversible and irretrievable commitment of resources would be required to support the construction, operation, and decontamination and decommissioning of the Calcine Dissolution Facility and operations at the separations and vitrification facilities (Table C.8-21). Resource requirements for the Calcine Dissolution Facility and the separations and vitrification facilities are provided in Sections C.8.5.2 and C.8.5.3, respectively. Incremental impacts for most resource commitments would range from 1 to 32 percent but would be generally very small (less than 5 percent). The largest incremental impact (32 percent) would be for fossil fuel, which would result primarily from operations at the separations and vitrification facilities. This scenario would not substantially change the understanding of irreversible and irretrievable commitment of resources presented in the TWRS EIS for the Phased Implementation Alternative.

Interim Storage Shipping Scenario

This scenario would result in slightly greater irreversible and irretrievable commitments of resources than the Just-in-Time Shipping Scenario because of the additional resource requirements for construction, operation, and decontamination and decommissioning of three new Canister Storage Buildings (Table C.8-21). Resource requirements for the Canister Storage Buildings, the Calcine Dissolution Facility, and the separations and vitrification facilities are provided in Sections C.8.5.1, C.8.5.2, and C.8.5.3, respectively. Incremental impacts would be slightly larger than for the Just-in-Time Shipping Scenario but would still be small (generally less than 10 percent). The largest incremental impact (34 percent) would again be for fossil fuel, due primarily to operations at the separations and vitrification facilities. Although the incremental impacts for this scenario would be slightly greater, this scenario still would not substantially change the understanding of irre-

Table C.8-21. Revised irreversible and irretrievable commitment of resources – Minimum INEEL Processing Alternative.

Tank Waste Alternative		Component	Commitment
Phased Implementation Alternative[a]		Land permanently committed (acres)	120
		Sand/gravel/silt/rip rap (cubic meters)	4.1×10^{6}
		Steel (metric tons)	3.4×10^{5}
		Concrete (cubic meters)	1.1×10^{6}
		Total water usage (cubic meters)	1.9×10^{7}
		Electric power (GWh)	1.1×10^{4}
		Fossil fuel (cubic meters)	1.9×10^{5}
		Process chemicals (metric tons)	9.8×10^{5}
		Cost (billions of dollars[b])	30 to 38
Minimum INEEL Processing Alternative	Just-in-Time Shipping Scenario	Land permanently committed (acres)	3.9
		Sand/gravel/silt/rip rap (cubic meters)	3.4×10^{4}
		Steel (metric tons)	3.2×10^{3}
		Concrete (cubic meters)	2.6×10^{4}
		Total water usage (cubic meters)	1.6×10^{5}
		Electric power (GWh)	930
		Fossil fuel (cubic meters)	5.9×10^{4}
		Process chemicals (metric tons)	1.0×10^{5}
		Cost (millions of dollars)	360
	Interim Storage Shipping Scenario	Land permanently committed (acres)	3.9
		Sand/gravel/silt/rip rap (cubic meters)	2.9×10^{5}
		Steel (metric tons)	1.6×10^{4}
		Concrete (cubic meters)	7.0×10^{4}
		Total water usage (cubic meters)	1.7×10^{5}
		Electric power (GWh)	940
		Fossil fuel (cubic meters)	6.4
		Process chemicals (metric tons)	1.0×10^{5}
		Cost (millions of dollars)	820
Total impacts[c]	Just-in-Time Shipping Scenario	Land permanently committed (acres)	120
		Sand/gravel/silt/rip rap (cubic meters)	4.1×10^{6}
		Steel (metric tons)	3.4×10^{5}
		Concrete (cubic meters)	1.1×10^{6}
		Total water usage (cubic meters)	1.9×10^{7}
		Electric power (GWh)	1.2×10^{4}
		Fossil fuel (cubic meters)	2.5×10^{5}
		Process chemicals (metric tons)	1.1×10^{5}
		Cost (billions of dollars[b])	30 to 39
	Interim Storage Shipping Scenario	Land permanently committed (acres)	120
		Sand/gravel/silt/rip rap (cubic meters)	4.4×10^{6}
		Steel (metric tons)	3.6×10^{5}
		Concrete (cubic meters)	1.2×10^{6}
		Total water usage (cubic meters)	1.9×10^{7}
		Electric power (GWh)	1.2×10^{4}
		Fossil fuel (cubic meters)	2.5×10^{5}
		Process chemicals (metric tons)	1.1×10^{6}
		Cost (billions of dollars[b])	31 to 39

a. Estimates include remediation and closure as landfill (Phase 1 and 2).
b. Total estimated cost range including repository fee.
c. Total impact estimates include the total Phased Implementation Alternative (Phase 1 and 2) plus the Minimum INEEL Processing Alternative.

versible and irretrievable commitment of resources presented in the TWRS EIS for the Phased Implementation Alternative.

C.8.4.17 Conflict Between the Proposed Action and the Objectives of Federal, Regional, State, Local, and Tribal Land-Use Plans, Policies or Controls

All activities proposed for the Hanford Site, under both the Just-in-Time Shipping Scenario and the Interim Storage Shipping Scenario of the Minimum INEEL Processing Alternative, would occur with the 200 Areas. Thus there would be no conflicts between land use plans associated with construction andoperations of waste storage and treatment facilities under this alternative and Federal, state, or local plans and policies. However, the Minimum INEEL Processing Alternative would present similar conflicts with land use plans and policies of Tribal Nations as presented in the TWRS EIS for the Phased Implementation Alternative. These conflicts are summarized in Sections C.8.4.5 and C.8.4.19.

C.8.4.18 Pollution Prevention

The Minimum INEEL Processing Alternative would be required to incorporate pollution prevention into their planning and implementation activities as would be required by the Phased Implementation Alternative. This includes reducing the quantity and toxicity of hazardous, radioactive, mixed, and sanitary waste generated at the Hanford Site; incorporating waste recycle and reuse into program planning and implementation; and conserving resources and energy.

C.8.4.19 Environmental Justice

For each area of technical analysis presented in the TWRS EIS, a review of impacts to the human and natural environment was conducted to determine whether any potentially disproportionately high and adverse impacts on minority populations or low-income populations would occur. The review included potential impacts on land use; socioeconomics (e.g., employment, housing prices, public facilities, and services); water quality; air quality; health effects; accidents; and biological and cultural resources. For each of the areas of analysis, impacts were reviewed to determine whether there would be any potential high and adverse impacts to the population as a whole due to construction, routine operations, or accident conditions. If an adverse impact was identified, a determination was made as to whether minority populations or low-income populations would be disproportionately affected.

For the purposes of that assessment, disproportionate impacts were defined as impacts that would affect minority and Native American populations or low-income populations at levels appreciably greater than their effects on non-minority populations or non-low-income populations. Adverse impacts were defined as negative changes to the existing conditions in the natural environment (e.g., land, air, water, wildlife, vegetation) or in the human environment (e.g., employment, health, land use).

During consultation with affected tribal nations on the TWRS EIS, representatives of the Yakama Indian Nation and the Confederated Tribes of the Umatilla Indian Reservation expressed the view that impacts associated with the alternatives could adversely impact the cultural values of affected tribal nations to the extent that they involve disturbance or destruction of ecological and biological resources, alter land forms, or pose a noise or visual impact to sacred sites. The level of impact to cultural values associated with natural resources would be proportional to the amount of land disturbed under each alternative.

A similar concern to Native American populations may be raised by the Minimum INEEL Processing Alternative. This concern would involve continued restrictions on access to portions of the 200 Areas that could restrict access to the 200 Areas by all individuals, including the Confederated Tribes and Bands of the Yakama Indian Nation and the Confederated Tribes of the Umatilla Indian Reservation. The Tribes have expressed an interest in access to and unrestricted use of the Hanford Site. Land use restrictions under the Minimum INEEL Processing Alternative would last until 2032.

The Department has concluded that the Minimum INEEL Processing Alternative would not result in high and adverse impacts on the population as a whole, but recognizes that Native American tribes in the Hanford region consider the continuation of restrictions on access to lands at Hanford to have an adverse impact on all elements of the natural and physical environment and to their way of living within that environment.

C.8.4.20 Mitigation Measures

In the TWRS EIS, measures were addressed to mitigate potential impacts of the Phased Implementation Alternative, including (1) measures to prevent or mitigate environmental impacts and (2) additional measures that could further reduce or mitigate potential environmental impacts described previously in other portions of the TWRS EIS, if deemed necessary. The TWRS EIS focused on measures to mitigate potential impacts during remediation and indicated that future NEPA documentation would specifically address in detail impacts and mitigation of post-remediation tank closure where, for example, most of the borrow site activity impacts would occur.

The type of impacts resulting from the Minimum INEEL Processing Alternative would be similar to those evaluated in the TWRS EIS for the Phased Implementation Alternative. Therefore, the same type of mitigation measures would be included for the Minimum INEEL Processing Alternative.

C.8.5 CALCINE PROCESSING PROJECT DATA

C.8.5.1 Canister Storage Buildings

Overview

This project describes the costs and impacts of the Canister Storage Buildings (Canister Storage Buildings) necessary to store INEEL calcined waste under the Interim Storage Shipping Scenario. Under this scenario, the INEEL calcine would be shipped to the Hanford Site for storage in a Canister Storage Building beginning in 2012. Each year, approximately 260 canisters (308 cubic meters) of calcine would be shipped from INEEL to the Hanford Site. Additional Canister Storage Buildings would be constructed as needed. A total of three Canister Storage Buildings would be required to store the INEEL calcine. Shipments to the Hanford Site would be completed in 2025, and the INEEL waste would remain in storage pending the availability of the Calcine Dissolution Facility (Section C.8.5.2) and TWRS separations/vitrification facilities (Section C.8.5.3).

General Project Objectives

The project described in this Project Summary is part of the Interim Storage Shipping Scenario under the Minimum INEEL Processing Alternative of this Idaho HLW & FD EIS. The Interim Storage Shipping Scenario involves shipments of calcine from INEEL to the Hanford Site for storage in Canister Storage Buildings prior to the availability of the TWRS treatment facilities. The project addresses the costs and provides data to support the impacts analysis for the Canister Storage Buildings.

Process Description

The Canister Storage Buildings receive solid calcine from the INEEL. Calcine would be packaged in Hanford Site HLW canisters, each with a capacity of approximately 1.17 cubic meters. The calcine canisters would be stored until the calcine dissolution processes begin in 2028 (timed to coincide with the availability of double-shell tank storage space in the AP Tank Farm).

Facility Description

The Canister Storage Building presented is based upon a three-bay facility currently under construction at the Hanford Site to store spent nuclear fuel canisters. Over the last 10 years, several design packages have been developed for Canister Storage Buildings at both the Hanford Site and the Savannah River Site. The following three design documents were reviewed as part of this analysis:

- Project W-379 Spent Nuclear Fuel Canister Storage Building Detail Design Report August 1996

- Project W-464 Conceptual Design Report for Immobilized High-Level Waste Interim Storage Facility (Phase 1) HNF-2298, Revision 1

- DWPF Sludge Plant CAC Cost Estimate, dated December 14, 1983

Each Canister Storage Building would be approximately 3,700 cubic meters in plan area and would consist of a large subsurface vault with three individual bays. Each bay could hold 440 Hanford HLW canisters [the Hanford canisters are 0.61 meter (2 feet) in diameter by 4.5 meter (14 feet and 9 inches) long], for a total of approximately 1,320 Hanford HLW canisters per Canister Storage Building.

The Canister Storage Buildings consist of below grade concrete vaults accessed through a grade level operating deck. The operating deck is enclosed by a prefabricated metal structure. The operating deck is designed to support a 160,000 pound shielded canister transporter. The canister load-in/load-out area, operating deck, and support building are equipped with a HVAC system with high-efficiency particulate air filters. The Canister Storage Building vault areas are cooled by a natural convection cooling system that utilizes once-through unfiltered air, which exits through a common stack. The Canister Storage Building has a material service/design life of 75 years.

The cost data for this project are based upon current Hanford conceptual design information presented in Hanford Project W-464 for a three-bay Canister Storage Building constructed in the 200-East Area of the Hanford Site. The cost of the shielded canister transporter and other canister handling equipment was not included in the cost estimate for this project. It is assumed that all HLW canister handling equipment would have been purchased previously by the Hanford TWRS program and can be utilized for the INEEL waste. Construction and operations project data appear in Table C.8-22; decontamination and decommissioning data appear in Table C.8-23.

C.8.5.2 Calcine Dissolution Facility

Overview

This project describes the costs and impacts of the Calcine Dissolution Facility. The Calcine Dissolution Facility receives solid calcine from the Canister Storage Buildings (under the Interim Storage Shipping Scenario) or directly from INEEL (under the Just-in-Time Shipping Scenario). The calcine is received in Hanford Site HLW canisters, which are emptied and the solids dissolved using nitric acid. Undissolved solids (gamma-emitting alumina and zirconia) are removed and the resultant solution is neutralized using sodium hydroxide to a pH of 7. The dissolved calcine product is stored in existing double-shell tanks (specifically the AP Tank Farm which is well within its 50-year design life). The solution is then transferred to the existing TWRS separations/vitrification facilities (see Section C.8.5.3) for final treatment.

General Project Objectives

The project described in this Project Summary is part of the Minimum INEEL Processing Alternative of this Idaho HLW & FD EIS. INEEL waste would be received at the Hanford Site in a solid (calcine) form and would be dissolved at the Calcine Dissolution Facility to produce a material compatible with the existing double-shell tanks and TWRS separations/vitrification processes. This project addresses the costs and provides data to support the impacts analysis for the Calcine Dissolution Facility.

Process Description

Canisters containing calcine would be transported from a Canister Storage Building to the Calcine Dissolution Facility in a shielded canister transporter (under the Interim Storage Shipping Scenario), or unloaded from rail cars shipped from the INEEL (under the Just-in-Time Shipping Scenario). The Calcine Dissolution Facility would process the calcine over 27 months, starting in February 2028 and ending in April 2030. It is assumed that the calcine would be processed as a mixed alumina/zirconium calcine at average concentrations. At 80-percent

Table C.8-22. Construction and operation project data for Canister Storage Building (HCSB-1).

Generic Information	
Description/function and EIS Project number:	Interim storage of INEEL Calcine
EIS alternatives/options:	Min. INEEL Proc. Alternative
Project type or waste stream:	Calcine
Action type:	New
Structure type:	Concrete and steel buildings
Size: (m^2)	11,710
Other features: (pits, ponds, power/water/sewer lines)	None
Location:	
Inside/outside of fence:	Hanford 200 Area
Inside/outside of building:	
Construction Information	
Schedule start/end:	
Preconstruction:	
CSB #1:	January 2009-January 2010
CSB #2:	January 2014-January 2015
CSB #3:	January 2019-January 2020
Construction:	
CSB #1:	January 2010-January 2012
CSB #2:	January 2015-January 2017
CSB #3:	January 2020-January 2022
Number of workers: (new/existing)	79/0 each yr
Nonradiation	79
Number of radiation workers	None
Average annual worker radiation dose (rem/yr)	None
Transportation mileage	
Truck: (km/yr)	200,000
Rail:	0
Employees: (km/yr)	2,130,074
Heavy Equipment:	
Equipment used	Excavator, grader, crane, delivery trucks
Hours of operation: (hr/ yr)	15,600
Acres disturbed (per CSB)	
New (acres)	15
Previous (acres)	None
Revegetated (acres)	None
Air Emissions:	
Construction total: (tons/ yr)	1,022
Dust: (tons/yr)	216
Major gas (CO_2) from diesel exhaust: (tons/ yr)	764
Contaminants[a] from diesel exhaust: (tons/ yr)	42
Effluents:	
Sanitary wastewater: (L/ yr)	1,943,598
Solid wastes:	
Construction trash: (m^3/yr)	936
Hazardous/toxic chemicals and wastes	
Generation (used lube oil): (m^3/yr)	3
Storage/inventory: (m^3/yr)	0.2
Pits/ponds created: (m^2/yr)	465 (per CSB)

Table C.8-22. Construction and operation project data for Canister Storage Building (HCSB-1) (continued).

Construction Information (continued)	
Water Usage: Dust control: (L/yr) Domestic water: (L/yr)	 151,400 1,943,598
Energy requirements Electrical: (MWH/yr) Fossil fuel: (L/yr)	 2,850 354,276
Operational Information	
Schedule start/end: CSB #1 CSB #2 CSB #3	 January 2012-April 2030 January 2017-April 2030 January 2022-April 2030
Number of workers each year of operation (new/existing) Total: Radiation workers: Average annual worker radiation dose: (person-rem/yr)	 9/0 9/0 1.8
Transportation mileage Truck: Rail: Employees: (km/yr)	 0 0 242,667
Heavy equipment: Hours of operation: (hrs/yr)	Canister transporter, occasional delivery trucks 5,840
Air emissions: Fossil fuel emissions: (tons/yr)	 302
Effluents: Sanitary wastewater: (L/yr)	 221,423
Solid wastes: Sanitary/industrial trash: (m^3/yr)	 50
Radioactive wastes:	None
Hazardous/toxic chemicals and wastes Generation: (m^3/yr)	 1.11
Pits/ponds used: (m^2)	None
Water usage Process water: (L/yr) Domestic water: (L/yr)	 0 221,423
Energy requirements Electrical: (MWH/yr) Fossil fuel: (L/yr)	 44 132,626

a. CO, NO_x, SO_2, hydrocarbons, particulates.

operating efficiency, the facility has the capacity to handle six Hanford (1.17-cubic meters) canisters per day. This is also the feed rate necessary to meet the TWRS vitrification plant operating capacities.

The Calcine Dissolution Facility processing zones are Unloading/Loading, Air Lock/Decon, and Hot Cell with Inter Zone Transfer.

Unloading/Loading. Calcine is delivered into the unloading/loading bay by a shielded canister transporter, which contains the canister enclosed within a shielded cask. This cask is centered over a receiving plug within the unloading/loading building. The transporter removes the plug and lowers the canister into the transfer cage located below ground level which moves the canister through the rest of the process. The transporter then replaces the plug and returns to retrieve another canister.

Air Lock/Decon. Calcine canisters are moved into the air lock in preparation for hot cell entry.

Table C.8-23. Decontamination and decommissioning project data for Canister Storage Building (HCSB-1).

Decontamination and Decommissioning (D&D) Information	
Schedule start/end:	June 2030-June 2031
Number of workers each year of D&D (new/existing):	84/0 per year
Number of radiation workers (D&D):	None
Avg. annual worker radiation dose:	0 (person-rem/yr)
Transportation mileage	
Truck: (km/yr)	390,000
Rail:	0
Employee: (km/yr)	2,264,889
Heavy equipment	
Equipment used:	Mobile cranes, roll-off trucks, dozers, loaders
Hours of operation: (hrs)	49,920
Acres disturbed	
New: (acres)	None
Previous: (acres)	None
Revegetation: (acres)	45
Air emissions: (None/Reference)	
Dust: (tons/yr)	0
Gases (CO_2): (tons/yr)	2,445
Contaminants[a]: (tons/yr)	134
Effluents	
Non-radioactive sanitary wastewater: (L)	2,066,610
Solid wastes	
Non-radioactive (industrial): (m^3/yr)	996
Hazardous/toxic chemicals & wastes	
Generation (used lube oil): (m^3/yr)	9.45
Storage/inventory: (m^3/yr)	0.73
Pits/Ponds created:	None
Water usage	
Process water: (L)	151,400
Domestic water: (L)	2,066,610
Energy requirements	
Electrical: (MWh/yr)	1,500
Fossil fuel: (L)	1,133,683

a. CO, NO_x, SO_2, hydrocarbons.

This area is also used for decontamination during normal operation and also for maintenance operations on cranes and equipment within the hot cell. Normal decontamination occurs within this area on empty canisters and cages. Empty calcine canisters are decontaminated for reuse in the HLW vitrification process.

Hot Cell. Canisters are delivered through the air lock into the hot cell. The first operation is to cut open the canister. The cutting operation also bevels the edge to allow for rewelding and reuse of the canisters. This operation is required to be under a negative pressure relative to the surroundings and provide positive dust control and total spark control. Cutting waste is directed to a grinder to granularize the cutting waste for subsequent processing.

After opening, the canister contents are removed using a vacuum-assisted auger design which transfers the calcine to one of two bins. The canister is then pre-cleaned to remove or stabilize the remainder of the powder. The entire operation of cutting, vacuuming, and pre-cleaning the canister is within a constant dust controlled process, sealed to prevent dust migration.

The calcine is delivered by vacuum to a cyclone separator which discharges into one of two feed bins. The feed bins are equipped with 0.03 micron sintered metal filters. Exhaust from the feed bin filters is routed through dual high-efficiency particulate air filters prior to discharging to the atmosphere.

Calcine is delivered from the feed bins to the dissolving tanks using rotary feeders. The dissolving tanks are operated using 6 molar nitric acid and are heated by steam for 2 hours prior to discharge. The dissolving tanks are agitated using a bottom rake and propeller design with a thorough mixing level of agitation. The concentration of the nitric acid is monitored during the cooking stage to keep above a 1-molar concentration. This should dissolve the majority (approximately 97 weight percent) of the calcine solids. Once the cooking stage is completed, any undissolved solids are separated and the solution is transferred to pH adjustment tanks where the pH is adjusted to basic conditions (above a pH of 7) with sodium hydroxide. This solution is then pumped into the double-shell tanks of the AP Tank Farm for lag storage pending further processing in the TWRS separations/vitrification facility. Assuming the calcine can be placed in solution using 10 liters (2.6 gallons) of nitric acid per kilogram of calcine, dissolution and neutralization of the INEEL HLW calcine would result in approximately 19.8 million gallons of calcine solution over a 17-month period of operations. Although the volume of the dissolved calcine is relatively large, the total radioactivity of this material is small in comparison to the Hanford tank wastes. The undissolved solids are transferred to the TWRS vitrification facility for processing into HLW glass.

Inter Zone Transfer. The transfer cage is mounted on wheels and is transported by gravity on an inclined track. Stops are installed at each key point to hold the cage in place while undergoing different handling steps. After the calcine is unloaded, the canister is returned through a continuous track to the unloading/loading building. The empty canister is removed by a transporter vehicle in a similar manner as the unloading operation and the cage is returned to its original position for processing another canister. Up to five canisters would be in process at any one time.

Double-Shell Tanks Lag Storage

The eight 1-million gallon double-shell tanks in the AP Tank Farm would be used for lag storage of the dissolved calcine solution prior to separations and vitrification. This would require that the Calcine Dissolution Facility be located close to the double-shell tanks. The solution from the Calcine Dissolution Facility pH control tanks would be pumped into the tanks for lag storage. While in storage, the slurry would be continuously mixed to prevent sludge settling. Once sufficient waste had accumulated in the tanks to support operations of the TWRS separations/vitrification facilities, the waste would be slurried using a mixer pump and pumped to the separations facility through the waste transfer lines.

Facility Description. This project addresses the costs and impacts of the Calcine Dissolution Facility. The Calcine Dissolution Facility includes three operating levels with floor space of 16,256 square feet on the Main Floor, 9,640 square feet on the Lower Floor, and 14,567 square feet on the Upper Floor. The Calcine Dissolution Facility is designed to house the equipment and systems for receiving the INEEL calcine canisters, dissolving the calcine, transferring the neutralized calcine solution to the double-shell tanks, and collecting any undissolved solids for processing in the HLW vitrification facility.

The Calcine Dissolution Facility building consists of four potentially contaminated zones and a clean zone for normal office and control operations. Zone 1, Hot Cell and the Crane Maintenance area, is kept at -0.75 inch W.C.; Zone 2 is at -0.25 inch W.C.; Zone 3 is a -0.1 inch W.C.; and Zone 4 is at -0.05 inch W.C. The clean zone is at 0.1 inch W.C.

Zone 1 is supplied with high-efficiency particulate air filtered air from an incoming air handler as well as air from Zone 3 which is not required for Zone 2. Negative pressure is maintained and the exhaust air is filtered through two high-efficiency particulate air filters prior to exhausting to outside air environment.

Zone 2, which is made up of the Air Lock/Decon area and the transport trenches, receives air from Zone 3 and pressure is maintained negative to Zone 3. Exhaust air is filtered by two high-efficiency particulate air filters prior to exhausting to the outside air environment.

Zone 3 contains the Direct Operations, Motor Gallery, and Mechanical Room. Zone 3 supplies air to Zone 1 and Zone 2 is kept negative to outside air and to Zone 4. Because this is air is completely used by other zones it is also filtered by two high-efficiency particulate air filters prior to exhausting to the outside air environment.

Zone 4 is the canister incoming and outgoing area. It has its own air supply and provides an air lock between the building and outside air for incoming and outgoing materials. It is maintained negative to outside air, and the exhaust air is filtered by two high-efficiency particulate air filters prior to exhausting to the outside air environment.

The clean zone is maintained positive to outside air and contains offices, change rooms, control room and storage. This space is separately heated and air conditioned from the rest of the space.

The construction and operations project data for the Calcine Dissolution Facility appear in Table C.8-24; the decontamination and decommissioning data appear in Table C.8-25.

C.8.5.3 Calcine Separations and Vitrification

Overview

This project describes the costs and provides data to support the impacts analysis associated with the processing of dissolved calcine from the Calcine Dissolution Facility in the TWRS separations/vitrification facilities. The separations/vitrification facilities are existing TWRS facilities as described in the TWRS EIS under the Phased Implementation Alternative. The separations/vitrification facilities would process INEEL calcine waste for 17 months. This project provides covers operational impacts only; construction and decontamination and decommissioning of the TWRS separations/vitrification facilities are covered in the TWRS EIS.

General Project Objectives

The project described in this Project Summary is part of the Minimum INEEL Processing Alternative of this Idaho HLW & FD EIS. This project addresses the costs and impacts of operating the TWRS separations/vitrification facilities to process the INEEL waste.

Process Description

Separations and vitrification of the INEEL waste would require operation of the existing TWRS equipment, transfer line(s) from the double-shell tanks to the separations/vitrification facilities, and continuous mixing of the double-shell tanks.

The separations process would involve the following steps:

- Solids washing and solid-liquid separations
- Separations processing to remove cesium, technetium, strontium, and transuranics from the liquid stream
- Vitrification of the solid fraction and any undissolved solids from calcine dissolution in the Calcine Dissolution Facility in the TWRS HLW vitrification facility
- Vitrification of the liquid fraction in the TWRS low activity waste vitrification facility

After washing and separations processing, the waste would be stored in tanks within the vitrification facilities where it would be characterized and evaporated to remove excess water. The concentrated liquid or slurry waste would then enter the melter feed section of the vitrification facility.

The low-activity waste stream would be combined with glass formers. In order to produce a glass product with acceptable properties, the low-activity waste glass formulation is limited to 15 weight percent sodium oxide in the glass. Glass formers would be added to the melter feed to maintain the required sodium oxide loading. Following vitrification, the molten low-activity waste glass would be poured into 1.8 meters long by 1.2 meters wide by 1.2 meters high (2.6 cubic meters) steel boxes. A total of 14,400 cubic meters or 5,550 containers of vitrified low-activity waste would be produced.

Table C.8-24. Construction and operation project data for the Calcine Dissolution Facility (CALDIS-001).

Generic Information	
Description/function and EIS project number:	Facility to unload INEEL calcine containing canisters and separate waste into HAW and LAW
EIS alternatives/options:	Minimum INEEL Processing Alternative
Project type or waste stream:	INEEL Aluminum and Zirconium Calcine and SBW Ion Exchange Resin
Action type:	New
Structure type:	Concrete and steel building
Size: (m^2)	3,761
Other features: (pits, ponds, power/water/sewer lines)	Extension to existing underground utilities
Location:	Hanford 200 Area
Construction Information	
Schedule start/end:	
Construction:	Dec. 2023 - Dec. 2027
Number of workers: (new/existing)	
Nonradiation	286/0 each yr
Number of radiation workers	None
Average annual worker radiation dose (rem/yr)	None
Transportation mileage	
Truck: (km/yr)	67,500
Rail:	0
Employees: (km/yr)	7,711,407
Heavy Equipment:	
Equipment used	Excavators, graders, cranes, concrete trucks, material delivery trucks, and water trucks
Hours of operation: (hr/yr)	2,080
Acres disturbed and duration:	August 2010 – December 2037
New (acres)	6.80
Previous (acres)	None
Revegetated (acres)	None
Air Emissions:	
Construction total: (tons/yr)	83
Dust: (tons/yr)	56
Major gas (CO_2) from diesel exhaust: (tons/yr)	25
Contaminants[a] from diesel exhaust: (tons/yr)	1.4
Effluents:	
Sanitary wastewater: (L/yr)	7,035,679
Solid wastes:	
Construction trash: (m^3/yr)	3,384
Hazardous/toxic chemicals and wastes	
Generation (used lube oil): (m^3/yr)	0.39
Storage/inventory: (m^3/yr)	0.36
Pits/ponds created: m^2	465
Water Usage:	
Dust control: (L/yr)	151,400
Domestic water: (L/yr)	7,035,679
Energy requirements	
Electrical: (MWH/yr)	208
Fossil fuel: (L/yr)	47,237

Table C.8-24. Construction and operation project data for the Calcine Dissolution Facility (CALDIS-001) (continued).

Operational Information	
Schedule start/end:	February 2028-April 2030
Number of workers each year of operation (new/existing)	
Operations	15/0
Maintenance	6/0
Support	2/0
Total:	23/0
Radiation workers:	23 (included in above total)
Average annual worker radiation dose: (person-rem/yr)	4.6 (200 millirem/worker)
Transportation mileage	
Truck:	662,990
Rail:	0
Employees: (km/yr)	620,148
Heavy equipment:	
Hours of operation: (hrs/yr)	3,650
Air emissions:	
CO_2 from diesel exhaust (tons/yr)	3,431
Contaminants[a]: (tons/yr)	187
Process radioactive air emissions: (Ci/yr)	1.99×10^{-4}
Other oxide air emissions: (kg/yr)	
B_2O_3	6.52×10^{-7}
BaO	2.44×10^{-8}
CaO	1.12×10^{-6}
CdO	2.40×10^{-7}
Cr_2O_3	9.41×10^{-8}
Fe_2O_3	1.50×10^{-7}
$MgCO_3$	6.79×10^{-7}
MnO	3.48×10^{-9}
Effluents:	
Sanitary wastewater: (L/yr)	565,858
Solid wastes:	
Sanitary/industrial trash: (m^3/yr)	127
Process output	
Dissolved calcine to TWRS treatment system: (L/yr)	33,288,889
Radioactive wastes:	
HEPA filters: (m^3/yr)	8
Misc. radioactive wastes: (m^3/yr)	34
Total: (m^3/yr)	42
Hazardous/toxic chemicals and wastes	
Generation (hazardous wastes): (m^3/yr)	1

Table C.8-24. Construction and operation project data for the Calcine Dissolution Facility (CALDIS-001) (continued).

Operational Information (continued)	
Process chemicals (nitric acid, sodium hydroxide): (m^3/yr)	31,371
Pits/ponds used: (m^2)	None
Water usage	
Process water: (L/yr)	26,750,511
Domestic water: (L/yr)	565,858
Energy requirements	
Electrical: (MWH/yr)	13,615
Equivalent fuel oil to generate required steam: (L/yr)	670,197
Equipment/vehicle fuel: (L/yr)	82,892
Total fossil fuel: (L/yr)	753,089

a. CO, NO_x, SO_2, hydrocarbons.

The HLW stream would also be combined with glass formers. The limiting constituent in the HLW stream is zirconium. In order to produce a glass product with properties acceptable for disposal in the proposed geologic repository, the HLW glass formulation is limited to 13 weight percent zirconium oxide in the glass. Glass formers would be added to the melter feed to maintain the required zirconium oxide loading. Following vitrification, the molten HLW glass would be poured into 1.17 cubic meters canisters. A total of ***3,500*** cubic meters or ***3,000*** canisters of vitrified HLW would be produced.

The vitrification processes would generate large off-gas streams that would be treated to minimize air emissions. The off-gas treatment systems would capture and partially recycle contaminants in the off-gas streams back to the melter feed streams.

Liquid effluents from both the HLW and low-activity waste vitrification facilities would be treated at the existing Effluent Treatment Facility. The liquid effluent from processing the INEEL waste would be similar to Hanford's 242-A Evaporator condensate stream, which meets the current waste acceptance criteria for the Effluent Treatment Facility.

Facility Description

This project addresses the cost and impacts of the operation of the TWRS separations/vitrification facilities to process the INEEL calcine waste. The separations/vitrification facilities and support facilities would be constructed as described for the Phased Implementation Alternative in the TWRS EIS. The HLW vitrification facility would be designed to produce 20 metric tons of HLW glass per day. The low-activity waste facility would be designed to produce 185 metric tons per day of low-activity waste glass. Vitrified low-activity waste and HLW would be placed on pads in the 200-East Area or returned to Canister Storage Buildings until it can be transported back to INEEL. Construction and operations project data appear in Table C.8-26.

Table C.8-25. Decontamination and decommissioning project data for the Calcine Dissolution Facility (CALDIS-001).

Decontamination and Decommissioning (D&D) Information	
Schedule start/end:	April 2030-April 2032
Number of workers each year of D&D (new/existing):	312/0 each yr
Number of radiation workers (D&D):	312
Avg. annual worker radiation dose:	62 (200 mrem/worker)
Transportation mileage	
Truck: (km/yr)	42,500
Rail:	0
Employee: (km/yr)	8,405,631
Heavy equipment	
Equipment used:	Dozers, dump trucks, loaders, cranes, concrete trucks
Hours of operation: (hrs)	2,080
Acres disturbed	
New: (acres)	None
Previous: (acres)	None
Revegetation: (acres)	6.80
Air emissions	
Non-radioactive:	
Gases (CO_2): (tons/yr)	51
Contaminants[a]: (tons/yr)	2.78
Radioactive	
HEPA filtered offgas: (Ci/yr)	0.80
Effluents	295,264
Radioactive	132,860
Spent decontamination solution: (L/yr)	
Non-radioactive	
Sanitary wastewater: (L)	7,669, 763
Radioactive wastes	3,679
Radioactive waste quantity[b]: (m^3/yr) (Ci/yr)	37
Solid wastes	
Industrial trash: (m^3/yr)	3,689
Hazardous/toxic chemicals & wastes	
Generation (used lube oil): (m^3/yr)	394
Storage/inventory: (m^3/yr)	0.02
Pits/Ponds created:	None
Water usage	
Dust control water: (L/yr)	151,400
Process water: (L/yr)	295,264
Domestic water: (L/yr)	7,669,763
Total water: (L/yr)	8,116,427
Source of water:	Columbia River
Energy requirements	
Electrical: (MWh/yr)	156
Fossil fuel: (L)	47,237

a. CO, particulates, NO_x, SO_2, hydrocarbons.

b. All tanks, pipes, vessels, pumps, filters and other equipment in immediate contact with process stream.

Table C.8-26. Project data for Calcine Separations/Vitrification (CALVIT-001).

Generic Information	
Description/function and EIS Project number:	Separation and Vitrification of HAW and LAW component at Hanford Treatment Facilities
EIS alternatives/options:	Min. INEEL Proc. Alternative
Project type or waste stream:	INEEL Aluminum and Zirconium Calcine and SBW
Action type:	Ion Exchange Resin
Structure type:	Existing facility
Size: (plain view)	
Other features: (pits, ponds, power/water/sewer lines)	None
Location:	Hanford 200 Area
Inside/outside of fence:	Inside
Inside/outside of building:	Inside
Operational Information	
Schedule start/end:	
Construction:	January 2029-April 2030
Number of workers: (new/existing)	708/0 each yr
Nonradiation	657/0 each yr
Number of radiation workers	131
Average annual worker radiation dose (rem/yr)	(200 millirem/worker)
Heavy equipment	
Hours of operation	0
Transportation mileage	
Truck: (km/yr)	250,000
Rail:	283,000
Employees: (km/yr)	19,089,778
Air emissions from vitrification	
HAW component	
Radionuclides (Ci/yr)	
Cs-137	2.36×10^{-5}
Sr-90	2.57×10^{-5}
Y-90	2.57×10^{-5}
Tc-99	8.99×10^{-10}
Am-241	2.02×10^{-8}
Pu-238	1.73×10^{-7}
Pu-239 and 240	6.125×10^{-9}
Pu-241	8.40×10^{-8}
LAW Component	
Chemicals (g/sec)	
SO_2	4.98×10^{-1}
NO_2	5.63×10^{-1}
CdO	3.80×10^{-12}
Cr_2O_3	1.21×10^{-12}
Cl_2	8.02×10^{-4}
B_2O_3	2.90×10^{-11}
CaO	7.52×10^{-10}
Fe_2O_3	2.99×10^{-12}
UO_2	7.04×10^{-15}
BaO	3.94×10^{-13}

Table C.8-26. Project data for Calcine Separations/Vitrification (CALVIT-001) (continued).

Operational Information (continued)	
LAW Component (continued)	
Radionuclides (Ci/yr)	
Cs-137	1.79×10^{-7}
Sr-90	4.62×10^{-7}
Y-90	4.62×10^{-7}
Tc-99	3.98×10^{-9}
Am-241	1.84×10^{-8}
Pu-238	1.14×10^{-8}
Pu-239 and 240	4.16×10^{-10}
Pu-241	1.69×10^{-9}
Effluents:	
Sanitary wastewater: (L/yr)	17,418,570
Solid wastes:	
Construction trash: (m^3/yr)	3,925
Radioactive wastes:	
Vitrified waste output:	
LAW volume (m^3/yr)	10,417
LAW boxes (2.6 m^3/box) per year	4,019
HAW volume (m^3/yr)	530
HAW glass canisters (1.17 m^3/canister) per year	453
HEPA filters: (m^3/yr)	8
(Ci/yr)	23
Misc. radioactive wastes: (m^3/yr)	966
(Ci/yr)	966
Hazardous/toxic chemicals and wastes	
Generation (hazardous wastes) (m^3/yr)	0
Pits/ponds used:	None
Water usage	
Process (HAW and LAW processing): (L/yr)	1,826,200,000
Domestic (HAW and LAW processing): (L/yr)	17,418,570
Energy requirements	
Electrical: (MWH/yr)	642,857
Fossil fuel: (L/yr)	4,140,000

Appendix C.8 References

Cushing, C. E., 1994, *Hanford Site National Environmental Policy Act (NEPA) Characterization*, PNL-6415, Rev. 6, Pacific Northwest National Laboratory, Richland, Washington, August.

Cushing, C. E., 1995, *Hanford Site National Environmental Policy Act (NEPA) Characterization*, PNL-6415, Rev. 7, Pacific Northwest National Laboratory, Richland, Washington, Septe mber.

DOE (U.S. Department of Energy), 1993, *Recommendations for the Preparation of Environmental Assessments and Environmental Impact Statements*, DOE, Office of NEPA Oversight, Washington D.C., May.

DOE (U.S. Department of Energy), 1996a, *Tank Waste Remediation System, Hanford Site, Richland Washington, Final Environmental Impact Statement*, DOE/EIS-0189, U.S. Department of Energy and Washington State Department of Ecology, Richland, Washington, August.

DOE (U.S. Department of Energy), 1996b, *Draft Site Biological Resources Management Plan*, DOE/RL 96-32, Revision 0, U.S. Department of Energy Richland Operations Office, Richland, Washington, September 1996.

DOE (U.S. Department of Energy), 1997, *Supplement Analysis for the Proposed Upgrades to the Tank Farm Ventilation, Instrumentation, and Electrical Systems under Project W-314 in Support of Tank Farm Restoration and Safe Operations*, DOE/EIS-0189-SA1, U.S. Department of Energy Richland Operations Office, Richland, Washington, June.

DOE (U.S. Department of Energy), 1998, *Supplement Analysis for the Tank Waste Remediation System*, DOE/EIS-0189-SA2, U.S. Department of Energy Richland Operations Office, Richland, Washington, May.

Harper 1995, *Performing Conventional Risk Assessment, Risk Management and Risk-Based Land Use Planning Methods and Concepts to Incorporate Tribal Cultural Interests and Treaty-Reserved Right*, Pacific Northwest National Laboratory, Richland, Washington.

HCRL (Hanford Cultural Resources Laboratory), 1998, *Cultural Resources Review of the TWRS Mitigation Planning Support - Phase One Project*, Project Number 98-0200-022, Pacific Northwest National Laboratory, Richland, Washington, May 22.

Jacobs (Jacobs Engineering Group, Inc.), 1998, *Minimum INEEL Processing Alternative Hanford Site Environmental Impact Assessment Report*, Rev. 1, November 6.

Neitzel, D. A., 1996, *Hanford Site National Environmental Policy Act (NEPA) Characterization*, PNL-6415, Rev. 8, Pacific Northwest National Laboratory, Richland, Washington, May.

Neitzel, D. A., 1997, *Hanford Site National Environmental Policy Act (NEPA) Characterization*, PNL-6415, Rev. 9, Pacific Northwest National Laboratory, Richland, Washington, August.

PNL (Pacific Northwest National Laboratory), 1995, *Hanford Site Environmental Report for Calendar Year 1994*, PNL-10574, Richland, Washington, June.

PNL (Pacific Northwest National Laboratory), 1996, *Hanford Site Environmental Report for Calendar Year 1995*, Richland, Washington, June.