The Columbia River flows through the northern part of the Hanford Site and, turning south, forms part of the eastern site boundary. The Yakima River runs near the southern boundary of the Hanford Site, joining the Columbia River at the city of Richland that bounds the Hanford Site on the southeast. Rattlesnake Mountain, Yakima Ridge, and Umtanum Ridge form the southwestern and western boundaries. Saddle Mountain constitutes the northern boundary of the Hanford Site. Two small east-west ridges, Gable Butte and Gable Mountain, rise above the plateau in the central part of the Hanford Site. Adjoining lands to the west, north, and east are principally agricultural and rangeland. The cities of Kennewick, Pasco, and Richland (Tri-Cities) and the city of West Richland constitute the nearest population centers and are located south-southeast of the Hanford Site.

4.2 Land Use

DOE completed the Hanford Comprehensive Land-Use Plan Environmental Impact Statement (HCP EIS; DOE 1999) in September 1999. A Record of Decision (ROD) was issued on November 2, 1999 (64 FR 61615), which adopted the Preferred Alternative as discussed in the EIS. The purpose of this land-use plan and its implementing policies and procedures is to facilitate decision-making about Hanford Site uses and facilities over at least the next 50 years. The Preferred Alternative map from the Final HCP EIS ROD shown in Figure 4.2 represents the DOE future land-management values, goals, and objectives. The land-use plan consists of several key elements that are included in the DOE Preferred Alternative in the Final HCP EIS (DOE 1999). These elements include a land-use map that addresses the Hanford Site as five geographic areas—Wahluke Slope, Columbia River Corridor, Central Plateau, all other areas of the site, and the Fitzner/Eberhardt Arid Lands Ecology Reserve (ALE). The key elements of the Hanford Comprehensive Land-Use Plan include a map that depicts the planned future uses, a set of land-use designations defining the allowable uses for each area of the Hanford Site, and the planning and implementing policies and procedures that will govern the review and approval of future land uses. Together these four elements create the Hanford Comprehensive Land-Use Plan. Much of the land is undeveloped, providing a buffer area for the smaller operations areas. Public access to most facility areas is restricted.

The key features of the Hanford Site that form the basis for the five geographic areas used in the environmental impact analysis and land-use plans are summarized as follows:

Wahluke Slope. The area north of the Columbia River and the Hanford Site proper encompasses approximately 357 km^2 (138 mi^2) of relatively undisturbed or recovering shrub-steppe habitat managed by the U.S. Fish and Wildlife Service (FWS) for DOE. These lands consist of two overlay wildlife management units within the Hanford Reach National Monument/Saddle Mountain National Wildlife Refuge, the 130 km^2 (50 mi^2) Saddle Mountain Unit, and the 225 km^2 (87 mi^2) Wahluke Unit. Portions of the Saddle Mountain Unit, which is closed to public access, still serve as buffer areas for the Hanford Site. The Wahluke Unit is open to public recreational access. A small strip of land approximately 1.62 km^2 (0.63 mi^2) located between State Route (SR) 243 and the Columbia River west of SR 24 is managed by the Washington State Department of Fish and Wildlife.

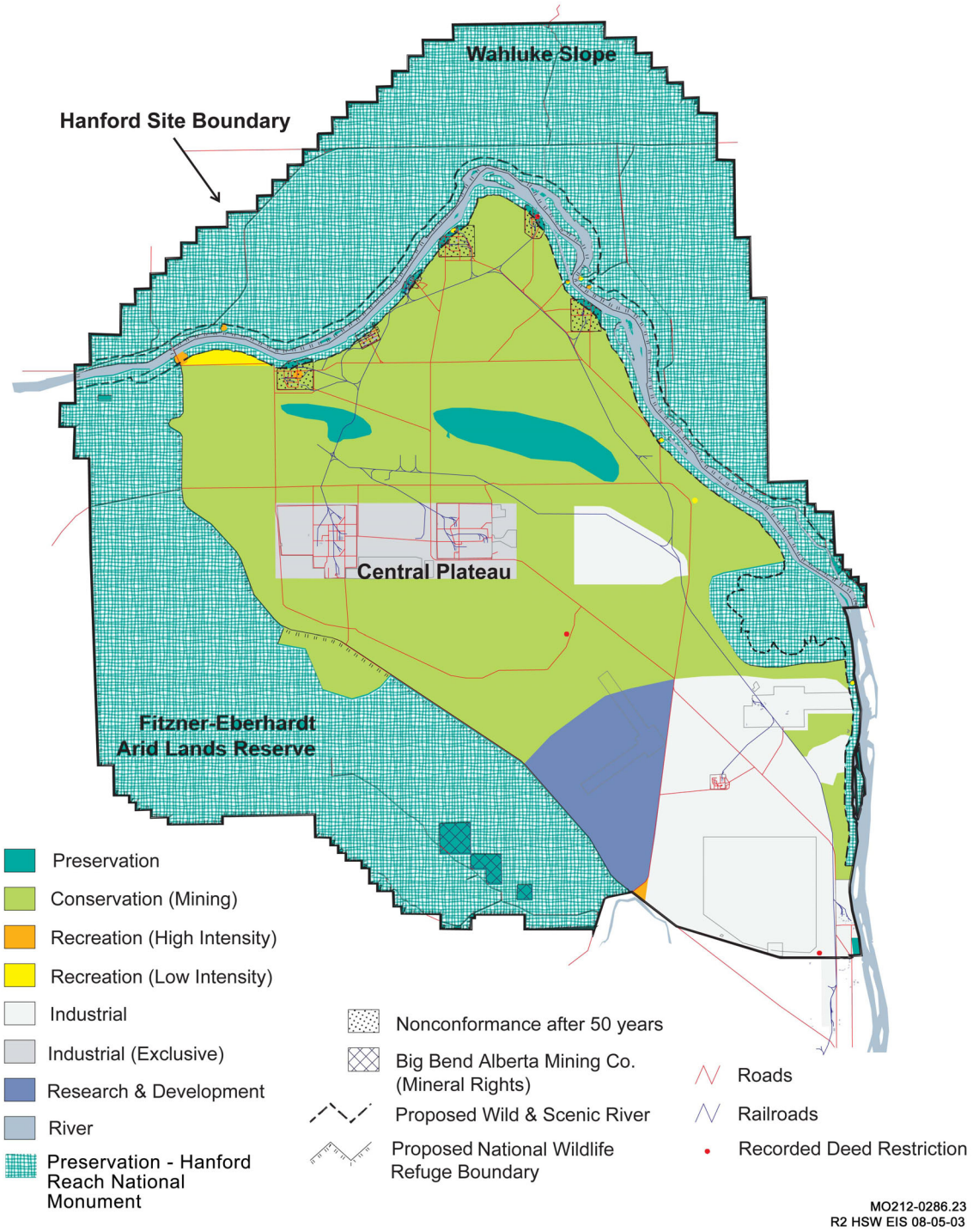

Figure 4.2. DOE Preferred Alternative for Land Use on the Hanford Site from the Final Hanford Comprehensive Land-Use Plan EIS Record of Decision (64 FR 61615)

Columbia River Corridor. The 111.6 km^2 (43.1 mi^2) Columbia River Corridor, which is adjacent to and runs through the Hanford Site, is used for boating, water skiing, fishing, and hunting of upland game birds and migratory waterfowl. Although public access is allowed on certain islands, access to other islands and adjacent areas is restricted because of unique habitats and the presence of cultural resources.

The area within the Columbia River Corridor known as the Hanford Reach includes a quarter mile (402-m) strip of land on either side of the Columbia River, as well as the islands and water surface area. Along the southern shoreline of the Columbia River Corridor, the 100 Areas occupy approximately 68 km^2 (26 mi^2). The facilities in the 100 Areas include nine retired plutonium production reactors, associated facilities, and structures. In the vicinity of the 100-H Area, closure permit restrictions of the Resource Conservation and Recovery Act (RCRA) of 1976 (42 USC 6901 et seq.) that are associated with the 183-H Solar Evaporation Basins have been instituted. Institutional controls are expected for the RCRA post-closure and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 (42 USC 9601 et seq.) remediation areas.

Central Plateau. The 200 East and 200 West Areas occupy approximately 51 km^2 (19.5 mi^2) in the Central Plateau (the 200 Area Plateau) of the Hanford Site. Facilities located on the 200 Area Plateau were built to process irradiated fuel from the production reactors. The operation of these facilities resulted in the need for treatment, storage, and disposal facilities for radioactive and hazardous wastes. Unplanned releases of radioactive and non-radioactive waste have contaminated some parts of the 200 Areas. The U.S. Navy also uses Hanford nuclear waste treatment, storage, or disposal facilities. Institutional controls are expected for the Central Plateau.

A commercial LLW disposal facility, operated by US Ecology, Inc., currently occupies 0.4 km^2 (0.16 mi^2) of the 200 Area Plateau. The facility is located on a portion of the 100 ac (originally 1000 ac) leased by the State of Washington from the federal government and subleased to US Ecology, Inc.

All Other Areas. All Other Areas comprise 689 km^2 (266 mi^2) and contain the 300, 400, and 1100 Areas; Energy Northwest facilities; and a section (2.6 km^2 [1 mi^2]) of land currently owned by the State of Washington for the disposal of hazardous substances.

The Hanford 1100 Area and the Hanford railroad southern connection (from Horn Rapids Road to Columbia Center) have been transferred from DOE ownership to Port of Benton ownership to support future economic development. Although the 1100 Area is no longer under DOE control, it was included in the HCP EIS to support the local governments with their State Environmental Policy Act (SEPA) EIS analyses of the Hanford sub-area of Benton County under the State of Washington Growth Management Act (RCW 36.70A).

The 300 Area is located just north of the city of Richland and covers 1.5 km^2 (0.6 mi^2). The 300 Area is the site of former reactor fuel fabrication facilities and is also the principal location of nuclear research and development facilities serving the Hanford Site.

The 400 Area, located southeast of the 200 East Area, is the site of the Fast Flux Test Facility (FFTF). DOE has decided to permanently shut down this facility.

Energy Northwest currently operates Columbia Generating Station on land leased from DOE. The land is approximately 10 km (6 mi) north of the city of Richland. The land was leased for the operation of three nuclear power plants. Construction of two of the plants was halted. Other industrial options for the site are currently being considered. Under the terms of the lease agreements, DOE would need to approve alternative uses of the land.

In 1980, the federal government sold a 2.6 km^2 (1 mi^2) section of land (known as Section 1.0) south of the 200 East Area, near SR 240, to the State of Washington for the purpose of non-radioactive hazardous waste disposal. To date, this parcel has not been used for hazardous waste disposal. The deed requires that if it were used for any purpose other than hazardous waste disposal, ownership would revert to the federal government.

Additional activities in the All Other Areas include:

(1) *A specialized training center*: The Hazardous Materials Management and Emergency Response (HAMMER) Volpentest Training and Education Center is used to train hazardous materials response personnel. It is located north of the former 1100 Area and covers about 32 ha (80 ac).

(2) *A regional law-enforcement training facility*: The Hanford Patrol Training Academy, located adjacent to HAMMER, provides a range of training environments including classrooms, library resources, practice shoot houses, an exercise gym, and an obstacle course.

(3) *A national research facility*: The Laser Interferometer Gravitational Wave Observatory (LIGO), built by the National Science Foundation for scientific research, is designed to detect cosmic gravitational waves. The facility consists of two optical tube arms, each 4 km (2.5 mi) long, arrayed in an L shape, and is extremely sensitive to vibrations.

(4) *Fitzner/Eberhardt Arid Lands Ecology (ALE) Reserve Unit:* The 308.7 km^2 (119.2 mi^2) ALE, a Research Natural Area, is part of the Hanford Reach National Monument and is managed by the U.S. Fish and Wildlife Service (FWS). ALE is located in the southwestern portion of the Hanford Site and is managed as a wildlife reserve and environmental research area. The public is generally restricted from the reserve.

4.2.1 Hanford Reach National Monument

On June 9, 2000, portions of the Hanford Site including ALE, Saddle Mountain Wildlife Refuge, Wahluke Slope, White Bluffs, the sand dune area northwest of the Energy Northwest site, historic structures (including homesteads from small towns established along the riverbanks in the early 20th century), and land 0.4 km (¼ mi) inland on the south and west shores of the 82-km (51-mi) long Hanford Reach, the last free-flowing, non-tidal stretch of the Columbia River, were designated as a National Monument (Figure 4.3) by President Clinton (65 FR 37253). Also included in the 78,900-hectare

(195,000-acre) monument were the McGee Ranch and Riverlands areas and the federally owned islands within that portion of the Columbia River.

On June 14, 2001, U.S. Department of Energy, Richland Operation Office (DOE-RL) and the FWS signed an amended Memorandum of Understanding (MOU) addressing management responsibilities for the Hanford Reach National Monument. As a result of the MOU, the FWS is the lead agency in producing a Comprehensive Conservation Plan (CCP) for management of the Hanford Reach National Monument. Development of the CCP will be a public process, including input from local governments, Native American Tribes, stakeholders, and others, including a Federal Advisory Committee for the Hanford Reach National Monument. The DOE will participate in writing the CCP and, in cooperation with the FWS, approve the plan. Under the MOU, which is intended to remain in effect for 25 years, DOE and the FWS will produce agreements for site access, security, emergency preparedness, mutual assistance, wildland fire response, and cultural and biological resource management.

4.2.2 200 Areas

The focus of the HSW EIS is on waste storage, treatment, and disposal activities. For a description of the facilities, refer to Section 2. The Central Waste Complex (CWC) is located in the 200 West Area (Figure 4.4). Low-level waste (LLW), mixed low-level waste (MLLW), and transuranic (TRU) waste from onsite and offsite generators are stored in CWC pending treatment or disposal.

The Waste Receiving and Processing Facility (WRAP) is located in the 200 West Area. It began operations in 1997 and can process TRU waste, certify TRU waste and LLW for disposal, and provide limited treatment of MLLW. The 4,800 m^2 (52,000 ft^2) facility is located near the CWC, and is designed to process 6,800 drums and 70 boxes of waste annually for 30 years (Poston et al. 2001).

T Plant Complex, located in the northeast corner of the 200 West Area, consists of two major facilities: T Plant canyon and 2706-T Facility. T Plant Complex is used for waste verification, decontamination of equipment, repackaging of radioactive wastes, and storage of pressurized water reactor spent fuel from an offsite reactor. It is also capable of macroencapsulation of debris and contaminated equipment, and neutralization and repackaging of organic and inorganic lab packs. Twenty-seven metric tons (30 tons) of spent nuclear reactor fuel from Shippingport, Pennsylvania, stored at T Plant Complex, are being moved to the Hanford Canister Storage Building. DOE ultimately plans to ship this fuel to Yucca Mountain. K Basins sludge will be moved to T Plant and stored in cells.

The 200 Areas Effluent Treatment Facility (ETF), located in the 200 East Area (Figure 4.5), provides treatment and storage for hazardous and radioactive liquid waste. Liquid effluents are treated to remove metals, radionuclides, and ammonia, as well as to destroy organic compounds. The facility, in operation since 1995, is capable of treating 570 L (150 gal) per minute. Treated effluent is stored in verification tanks, sampled and analyzed, and discharged via pipeline to the State-Approved Land Disposal Site (SALDS), north of the 200 West Area or to the Treated Effluent Disposal Facility (TEDF) east of the 200 East Area (Poston et al. 2002).

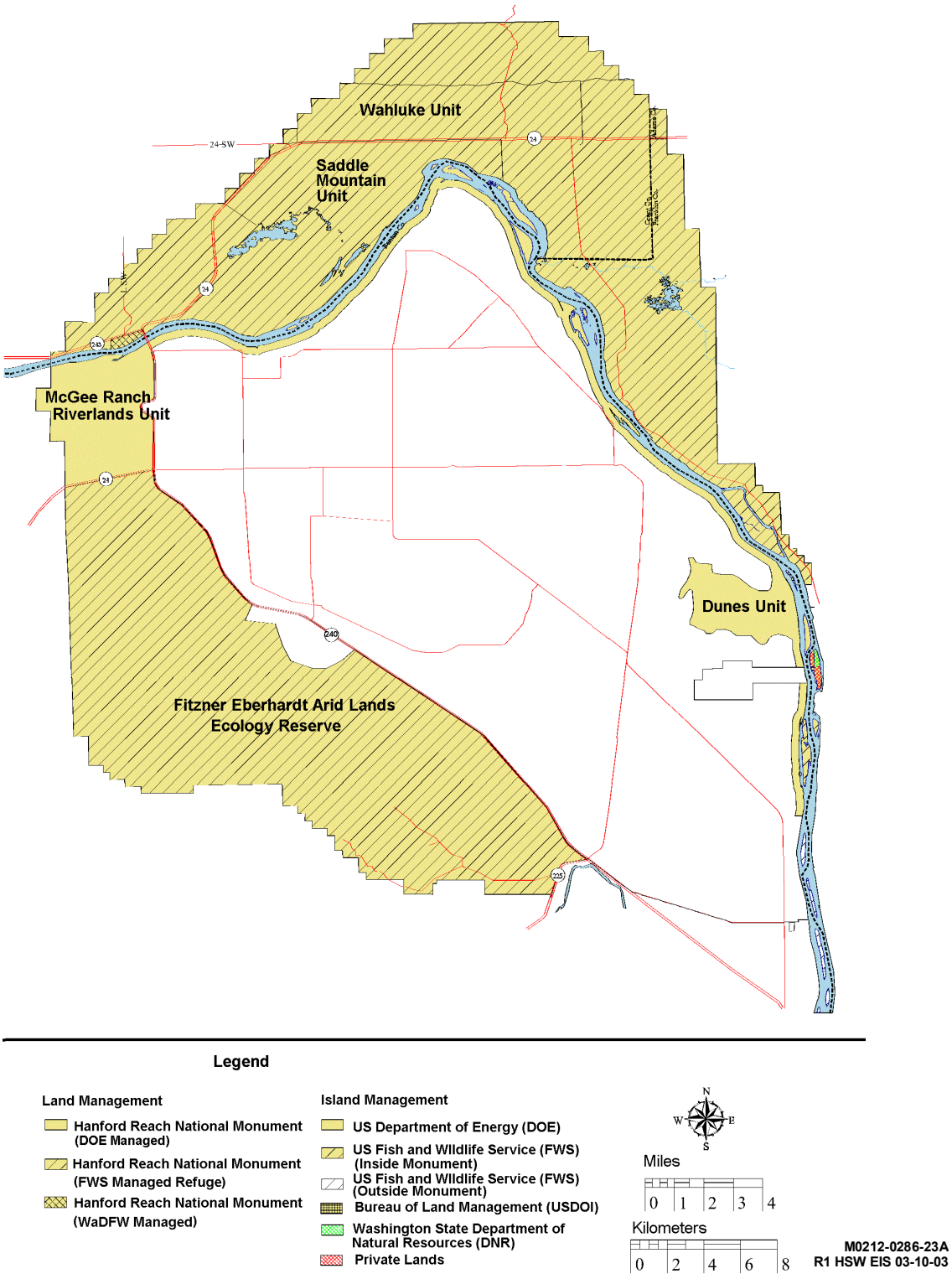

Figure 4.3. Hanford Reach National Monument

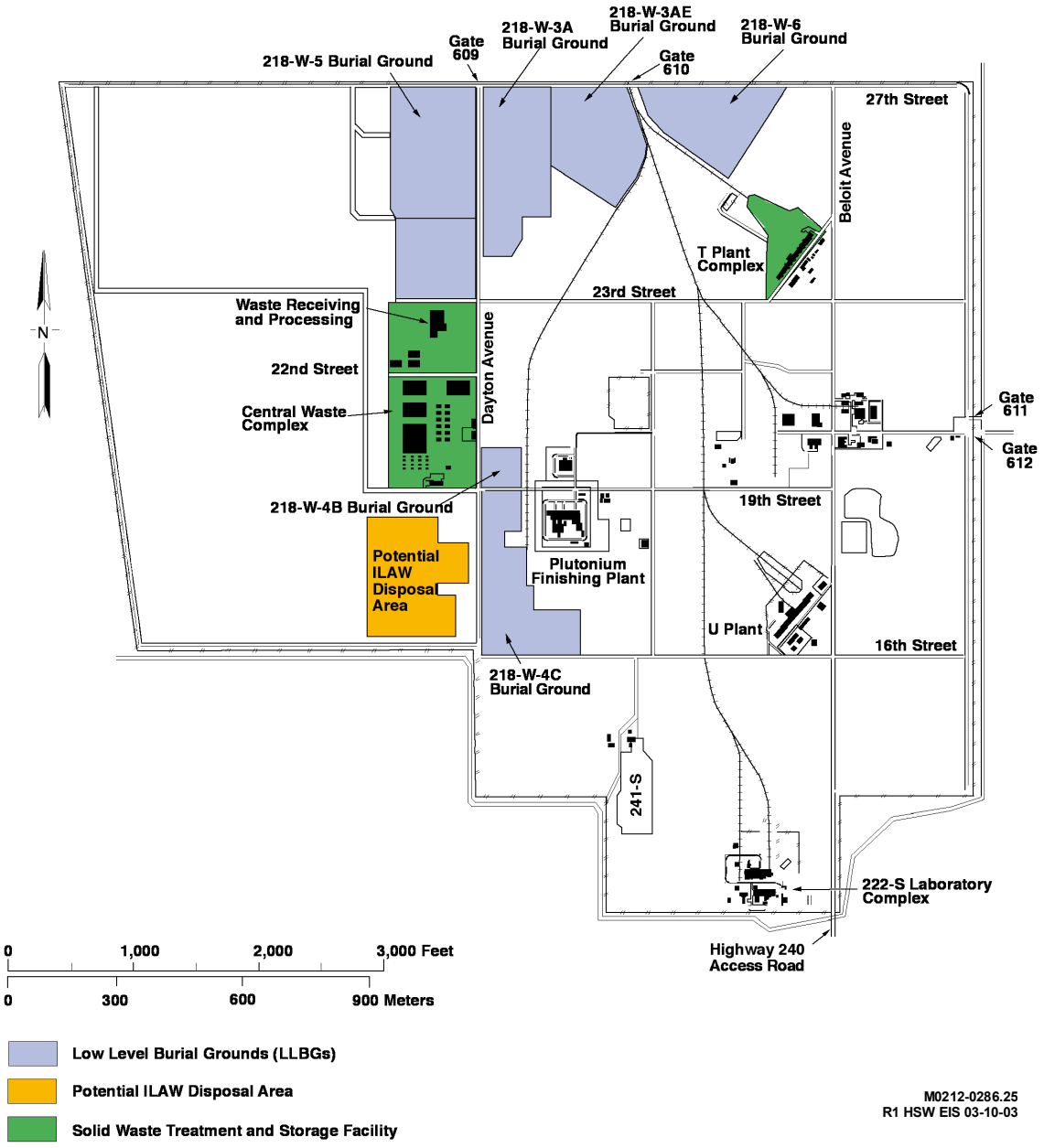

Figure 4.4. 200 West Area

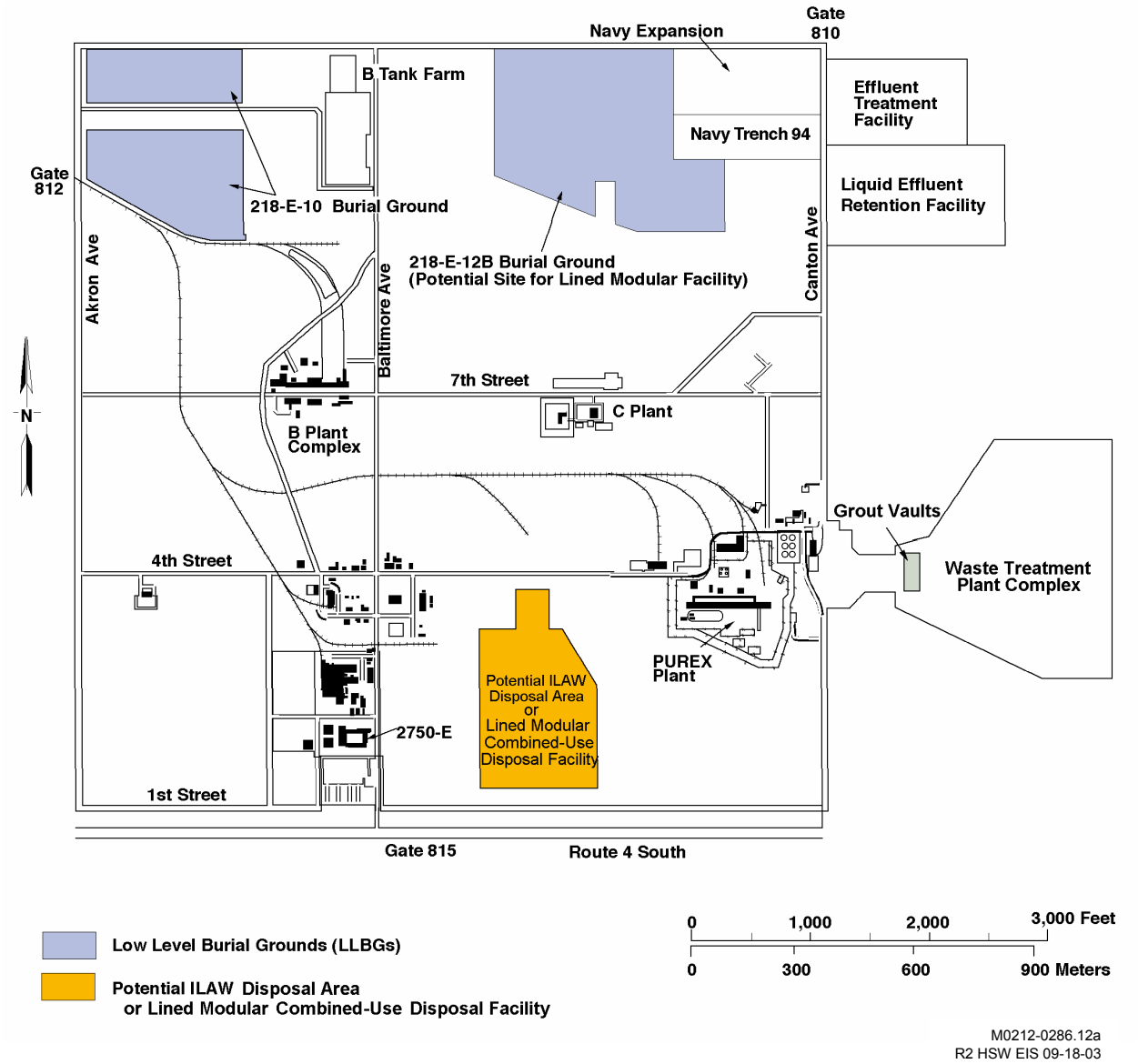

Figure 4.5. 200 East Area

The Liquid Effluent Retention Facility (LERF), located in the 200 East Area, consists of three surface impoundments for the temporary storage of process condensate from the 242-A Evaporator and other aqueous wastes. Each basin has a capacity of 29.5 million L (7.8 million gal) and is constructed of two flexible high-density polyethylene membrane liners. Beneath the secondary liner is a soil/bentonite barrier. Each basin is covered by a mechanically tensioned floating membrane cover, designed to minimize evaporation of the contents and screen unwanted material from entering the basin. The facility began operation in 1994 and receives liquid waste from the RCRA- and CERCLA-regulated cleanup activities.

The 200 Areas Treated Effluent Disposal Facility (TEDF) began operation in 1995 and is a collection and disposal system for permitted waste streams. TEDF has a capacity of 12,900 L/min (3,400 gal/min). Effluent to the ponds must meet drinking water standards before discharge.

The Low Level Burial Grounds (LLBGs) are eight separate waste disposal areas located in the 200 Areas. Information summarizing specifics concerning the LLBGs are found in Appendix D.

The Biological Control Program was established in 1999 to control the growth of deep-rooted vegetation over contaminated and potentially contaminated waste sites. Deep-rooted vegetation growing on or near contaminated waste sites can take up radionuclides and other contaminants into their roots and transport them to the surface. Those contaminants can subsequently spread outside controlled areas as the plants are eaten by animals or are transported by weather. As part of the Biological Control Program, herbicides are applied to kill deep-rooted plants and noxious weeds. The effectiveness of the program is directly related to the timeliness of herbicide application. Spraying herbicides is typically performed in all seasons of the year except deep winter, although the early spring application is most critical, as all later applications depend on it for effectiveness. The elimination of contaminated plant species reduces the number of potential mechanisms for spreading contaminants, as well as reducing biological uptake by insects, small mammals, and birds. Selective herbicides are sometimes applied to minimize deep-rooted vegetation, while allowing shallow-rooted vegetation to remain for erosion control and evapotranspiration (soil water removal). The 200 Areas, including some LLBGs, contain relatively small areas of surface contamination as a result of biotic intrusion by deep-rooted plants or burrowing animals. Surface contamination is present in three of the older LLBGs (218-E-10, 218-E-12B, and 218-W-3AE) and amounts to less than 0.1 ha (0.25 ac) of contaminated surface area compared to a total of about 100 ha (250 ac) in the 200 East and 200 West Areas. As part of the Biological Control Program, areas of underground contamination, such as the LLBGs, cribs, ponds, ditches, and inactive disposal sites, are cleaned up and stabilized as needed to prevent further spread of surface contamination. Areas of surface contamination are posted, monitored, and surveyed at least annually to document their radiological status. Personal protective clothing and special procedures are required for entry into these surface contamination areas. However, surveys of the 200 Area contaminated soil sites during 2001 indicated that radionuclide concentrations were below soil concentration limits established to protect onsite workers (Poston et al. 2002).

The Environmental Restoration Disposal Facility (ERDF) for CERCLA cleanup wastes is located in the 200 Area Plateau between the 200 East and 200 West Areas (Figure 4.1). It is used for the disposal of radioactive, hazardous, dangerous, and mixed wastes generated during waste management and remediation activities at the Hanford Site. ERDF began operation in July 1996 and currently consists of 4 cells, covering an area of approximately 20 ha (50 ac). Two cells received wastes until September 2000 and are no longer active. The third cell began receiving wastes in June 2000, and the fourth cell has not been used to date (Poston et al. 2002). Alternatives proposed in the HSW EIS include the use of a site near ERDF for disposal of operational wastes.

Alternatives for disposal of ILAW include newly constructed trenches on a site just south of the CWC (Figure 4.4), new trenches southwest of the Plutonium-Uranium Extraction (PUREX) Facility in the 200 East Area, or one of several potential combined-use disposal facilities (Figure 4.5).

Area C, a large polygonal area approximately 368 ha (909 ac) located adjacent to the south side of State Route (SR) 240 and centered approximately on the intersection of Beloit Avenue and SR 240, has been identified as a borrow-use area for the fine-grade silt loam and coarse-grade basalt needed to cap the LLBGs (Figure 4.1).

4.3 Meteorology and Air Quality

Air resources addressed in this section include climate and meteorology, atmospheric dispersion, and ambient air quality.

4.3.1 Climate and Meteorology

The Hanford Site is categorized as a mid-latitude semiarid region. Summers are warm and dry, while winters are cool with occasional precipitation. Intense heating during the day and nocturnal cooling produce large diurnal temperature variations. The Cascade Mountain range, beyond Yakima to the west, greatly influences the climate of the Hanford area by means of its rain shadow effect. The Cascade Mountains limit the Pacific Ocean maritime influence by blocking the passage of frontal systems and causing less rain and cloud-cover on the lee (east) side of the mountains. This mountain range also serves as a source of cold air drainage with a considerable effect on the wind regime at the Hanford Site.

Climatological data for the Hanford Site are compiled at the Hanford Meteorology Station (HMS). The HMS is located just outside the northeast corner of 200 West Area and about 4 km (3 mi) west of the 200 East Area. Data from the HMS are representative of the general climatic conditions for the region and describe the specific climate of the 200 Area Plateau. Meteorological measurements have been made at the HMS since late 1944. Prior to the establishment of the HMS, local meteorological observations were made at the old Hanford townsite (1912 through late 1943) and in Richland (1943-1944). A climatological summary for Hanford is provided in Hoitink et al. (2002). To accurately characterize meteorological differences across the Hanford Site, the HMS operates a network of automated monitoring stations. These stations, which currently number 30, are located throughout the site and in neighboring areas (Figure 4.6). A 124-m (408-ft) instrumented meteorological tower operates at the HMS, Station 21. A 61-m (200-ft) instrumented tower operates at each of the 100-N, 300, and 400 Area meteorology-monitoring sites. Most of the other network stations utilize short-instrumented towers with heights of about 9 m (30 ft). Instrumentation on each tower is described in Table 4.1. Data are collected and processed at each monitoring site and key information is transmitted to the HMS every 15 minutes. This monitoring network has been in full operation since the early 1980s.

Wind. Wind data at the HMS are collected at 2.1 m (7 ft) above the ground and at the 15.2-, 61.0-, and 121.9-m (50-, 200-, and 400-ft) levels on the 124-m (408-ft) tower. Each of the three 61-m (200-ft) towers has wind-measuring instrumentation at the 10-, 25-, and 60-m (33-, 82-, and 197-ft) levels. The short towers measure winds at 9.1 m (30 ft) above ground level.

Prevailing wind directions near the surface on the Hanford 200 Area Plateau are from the northwest in all months of the year (Figure 4.7). Winds from the northwest occur most frequently during the winter and summer. Winds from the southwest also have a high frequency of occurrence on the 200 Area Plateau. During the spring and fall, the frequency of winds from the southwest increases and winds from the northwest correspondingly decrease.