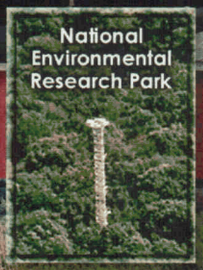
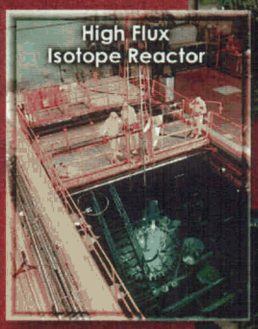
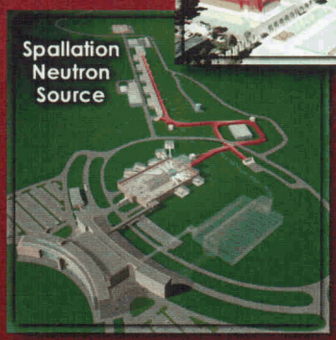
ORNL/TM-2000/237

Oak Ridge National Laboratory

Land and Facilities Plan







UT-BATTELLE

December 2000

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OAK RIDGE NATIONAL LABORATORY
LAND AND FACILITIES PLAN

December 2000

Prepared by
OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee 37831-6302
managed by
UT-Battelle LLC
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The information in the *Oak Ridge National Laboratory Land and Facilities Plan* was obtained with the cooperation of the professional staff of the Oak Ridge National Laboratory. For additional information, contact

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Comments on the 1999 *Oak Ridge National Laboratory Land and Facilities Plan* have been addressed and resolved as appropriate in this update. Recognizing that land and facilities planning is not a static process, this document will continue to address comments with additional updates electronically published as needed.

An electronic version of this document is available on the World Wide Web:
http://www.ornl.gov/~dmsi/landUse/

Front cover designed Brett Hopwood,
ORNL Computing, Information, and
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ACRONYMS AND ABBREVIATIONS

ACM	asbestos-containing material
ADS	Activity Data Sheet
AEC	U.S. Atomic Energy Commission
AMCL	Advanced Materials Characterization Laboratory
AMSE	American Museum of Science and Energy (Oak Ridge)
ARIMs	Accelerator and Reactor Improvement and Modifications
BES	Basic Energy Sciences
BIO	Basis for Interim Operation
BMAP	Biological Monitoring and Abatement Program
BSR	biological significance ranking
BTC	Building Technology Center
BVEST	Bethel Valley Evaporator Service Tank
CAS	Condition Assessment Survey
CBS	Center for Biological Sciences
CCII	Computational Center for Industrial Innovation
CCS	Center for Computational Science
CCWS	Central Chilled Water System
CDR	conceptual design report
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CESAR	Center for Engineering Systems Advanced Research
CFC	chlorofluorocarbon
CFR	*Code of Federal Regulations*
CH8	Corehole 8
CIP	Comprehensive Integrated Plan
CO_2	carbon dioxide
CROET	Community Reuse Organization of East Tennessee
CSB	Computational Sciences Building
CSMB	Center for Structural Molecular Biology
CTD	Chemical Technology Division
CTF	Central Training Facility
CWA	Clean Water Act
d	day
D&D	decontamination and decommissioning
DOE	U.S. Department of Energy
DOELAP	Department of Energy Laboratory Accreditation Program
DOSAR	Dosimetry Applications Research Facility
DOT	U.S. Department of Transportation
DX	direct expansion
E^2SF	Energy and Environmental Systems of the Future
ED&C	Engineering Design and Construction
EM	Environmental Management
EPA	U.S. Environmental Protection Agency
ES&H	environment, safety, and health
ESHQ&I	environment, safety, health, quality, and infrastructure
ET	evapotranspiration
ETMC	East Tennessee Mechanical Contractors

ACRONYMS AND ABBREVIATIONS (cont'd)

ETNGC	East Tennessee Natural Gas Company
ETTP	East Tennessee Technology Park
EUWG	End Use Working Group
FAB	Facility Authorization Basis
FACE	Free Air CO_2 Enrichment
FAMMIS	Facility and Maintenance Management Information System
FDDI	Fiber Distributed Data Interface
FED	Fusion Energy Division
FFA	Federal Facilities Agreement
FIMS	Facility Information Management System
FRC	Field Research Center
FRP	Facilities Revitalization Project
FTS	Federal Telecommunications System
FY	fiscal year
GAAT	Gunite and Associated Tank
gal	gallon
GJC	Grand Junction Colorado
gpd	gallons per day
GPE	general-purpose equipment
gpm	gallons per minute
GPP	general plant project
h	hour
HEPA	high-efficiency particulate air
HFIR	High Flux Isotope Reactor
HPRR	Health Physics Research Reactor
HRIBF	Holifield Radioactive Ion Beam Facility
HSWA	Hazardous and Solid Waste Amendments of 1984
HTML	High Temperature Materials Laboratory
HVAC	heating, ventilation, and air conditioning systems
I&C	Instrumentation and Controls
IRA	interim remedial action
ISOL	Isotope Separator On-Line
IT&M	Inspection, Testing, and Maintenance
IWMF	Interim Waste Management Facility
JIBS	Joint Institute for Biological Sciences
JICS	Joint Institute for Computational Sciences
JINS	Joint Institute for Neutron Sciences
kV	kilovolt
kVA	kilovolt-ampere
LAN	local area network
LCFG	Laboratory for Comparative and Functional Genomics
LDRD	Laboratory Directed Research and Development
LGWOP	Liquid and Gaseous Waste Operations Project
LI	Line Item
LLLW	liquid low-level (radioactive) waste
LSD	Life Sciences Division
LWS	Laboratory Waste Services

M&I	management and integration
M&O	management and operating
MAA	Material Access Area
MAB	Man and the Biosphere
MFAB	master fire alarm box
Mgd	million gallons per day
MOU	Memorandum of Understanding
MRF	Metal Recovery Facility
MS&E	Materials Science and Engineering
MSL	mean sea level
MSRE	Molten Salt Reactor Experiment
MVST	Melton Valley Storage Tanks
MW	megawatt
NABIR	Natural and Accelerated Bioremediation Research
NEON	National Ecological Observation Network
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NHPA	National Historic Preservation Act
NOAA/ATDD	National Oceanic and Atmospheric Administration/Atmospheric Turbulence Diffusion Division
NPDES	National Pollutant Discharge Elimination System
NRC	Nuclear Regulatory Commission
NRWTP	Nonradiological Wastewater Treatment Plant
NSAC	Nuclear Science Advisory Committee
OCB	oil circuit breakers
ORAU	Oak Ridge Associated Universities
ORCAS	Oak Ridge Center for Advanced Studies
ORELA	Oak Ridge Electron Linear Accelerator
ORFICN	Oak Ridge Federal Integrated Communications Network
ORIC	Oak Ridge Isochronous Cyclotron
ORISE	Oak Ridge Institute for Science and Education
ORLaND	Oak Ridge Laboratory for Neutrino Detectors
ORNL	Oak Ridge National Laboratory
ORO	Oak Ridge Operations Office (DOE)
ORR	Oak Ridge Reservation
OSHA	Occupational Safety and Health Act of 1970
OSR	Operational Safety Requirement
OSTI	Office of Scientific and Technical Information
P&E	Plant and Equipment
PCB	polychlorinated biphenyl
PCSD	President's Council on Sustainable Development
PdM	predictive maintenance
PM	preventive maintenance
PMF	probable maximum flood
psi	pounds per square inch
PVC	polyvinylchloride
PWTC	Process Waste Treatment Complex

ACRONYMS AND ABBREVIATIONS (cont'd)

PWTP	Process Waste Treatment Plant
R&D	research and development
RCRA	Resource Conservation and Recovery Act
REDC	Radiochemical Engineering Development Center
RIB	radioactive ion beam
RI/FS	Remedial Investigation/Feasibility Study
RMO	Reservation Management Organization
ROD	Record of Decision
RPM	Risk-Based Priority Model
RPSC	Robotics and Process Systems Complex
RPV	replacement property value
RTS	Radiochemical Technology Section
S&M	surveillance and maintenance
SAMAB	Southern Appalachian Man and the Biosphere
SAMS	Space Allocation Management System
SANS	Small Angle Neutron Scattering
SAR	Safety Analysis Report
SARUP	Safety Analysis Report Update Program
SC	Office of Science
SDI	Shared Data Initiative
SLLW	solid low-level (radioactive) waste
SNS	Spallation Neutron Source
SSD	Solid State Division
SWSA	Solid Waste Storage Area
TDEC	Tennessee Department of Environment and Conservation
TERF	Terrestrial Ecosystem Research Facility
TLD	thermoluminescent dosimeter
TRU	transuranic
TS	Treatability Study
TSC	Technical Support Center
TSCA	Toxic Substances Control Act
TSD	Transportation Safeguards Division (DOE Albuquerque Operations Office)
TSDF	hazardous waste treatment, storage, and disposal facility
TSF	Tower Shielding Facility
TSRs	Technical Safety Requirements
TVA	Tennessee Valley Authority
TWRA	Tennessee Wildlife Resources Agency
UEFPC	Upper East Fork Poplar Creek
UL	Underwriters' Laboratories, Inc.
URL	Uniform Resource Locator
USDA	U.S. Department of Agriculture
USQD	Unreviewed Safety Question Determination
UT	University of Tennessee
VOC	volatile organic compound
WAC	Waste Acceptance Criteria
WM	Waste Management
WOCC	Waste Operations Control Center
WSSs	Work Smart Standards

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Southern Appalachian Man and the Biosphere
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1. INTRODUCTION

Oak Ridge National Laboratory (ORNL) is the nation's largest and most diverse energy research and development (R&D) institution in the U.S. Department of Energy (DOE) laboratory complex. Its activities are focused on basic and applied R&D to advance the nation's energy resources, environmental quality, and scientific knowledge.

Major DOE Office of Science (DOE-SC) research programs depend not only on the national laboratory facilities, but also on the land base of the Oak Ridge Reservation (ORR) to meet mission objectives. ORNL is managed by UT-Battelle LLC, which has the management and planning responsibility for ORNL facilities and for most of the ORR's undeveloped land area. This responsibility includes planning for approximately 18,000 acres of undeveloped and developed land (Fig.1.1).

The ORR land area currently supports multiple uses, and there is an increasing demand for additional uses (Fig. 1.2). With major changes in mission at the East Tennessee Technology Park (ETTP) and the Y-12 National Security Complex, demonstrating current land use (by ORNL as well as other users) and planning for future land use needs by DOE and ORNL are critical. An irreplaceable asset, the reservation is a vital part of ORNL. Decisions on how to use the land area impact not only at local and regional levels but also nationally and internationally. Letters received on the draft 2000 *ORNL Land and Facilities Plan* document strong external stakeholder interest in the Oak Ridge Reservation at local, regional, and national levels (see Appendix A).

Updated information on ORNL land and facilities use, revitalization, and planning is contained in this 2000 revision of the 1999 *ORNL Land and Facilities Plan*. Section 2, "ORNL Land Use Plan," provides information on current reservation uses (ORNL and others) and addresses ORNL plans for use of the land outside the ORNL fenced, developed site. Information on planned uses by non-ORNL projects (Bechtel Jacobs Company LLC, Tennessee Department of Transportation, etc.) is included when known.

To accomplish its mission of scientific research, ORNL staff are dependent upon the availability of a wide variety of buildings and equipment, including specialized experimental laboratories, user facilities, hot cells and nuclear reactors, and a large complement of office space and associated utility systems. ORNL's physical facilities are, however, quite old, and many have reached the end of their safe operating life. The poor condition of facilities is a key environmental, safety, and health concern and adds considerably to the overhead costs of research in terms of energy consumption, increased maintenance costs, and research inefficiencies.

To address this concern, revitalization of the ORNL campus has become a key initiative of the new ORNL prime contractor, UT-Battelle LLC, and Section 3, "ORNL Integrated Strategic Facilities Plan," incorporates the details of UT-Battelle's approach to upgrading the scientific resources and supporting infrastructure of the Laboratory and also provides information on comprehensive planning for facilities and uses within the ORNL developed area.

This plan complements and draws from recommendations provided in the DOE *Comprehensive Land-Use Planning Process Guide* (DOE 1996a) and feeds into the ORR comprehensive integrated planning document, *Comprehensive Integrated Planning Process for the Oak Ridge Operations Sites*, herein referred to as the *ORR Comprehensive Integrated Plan* (September 1999).

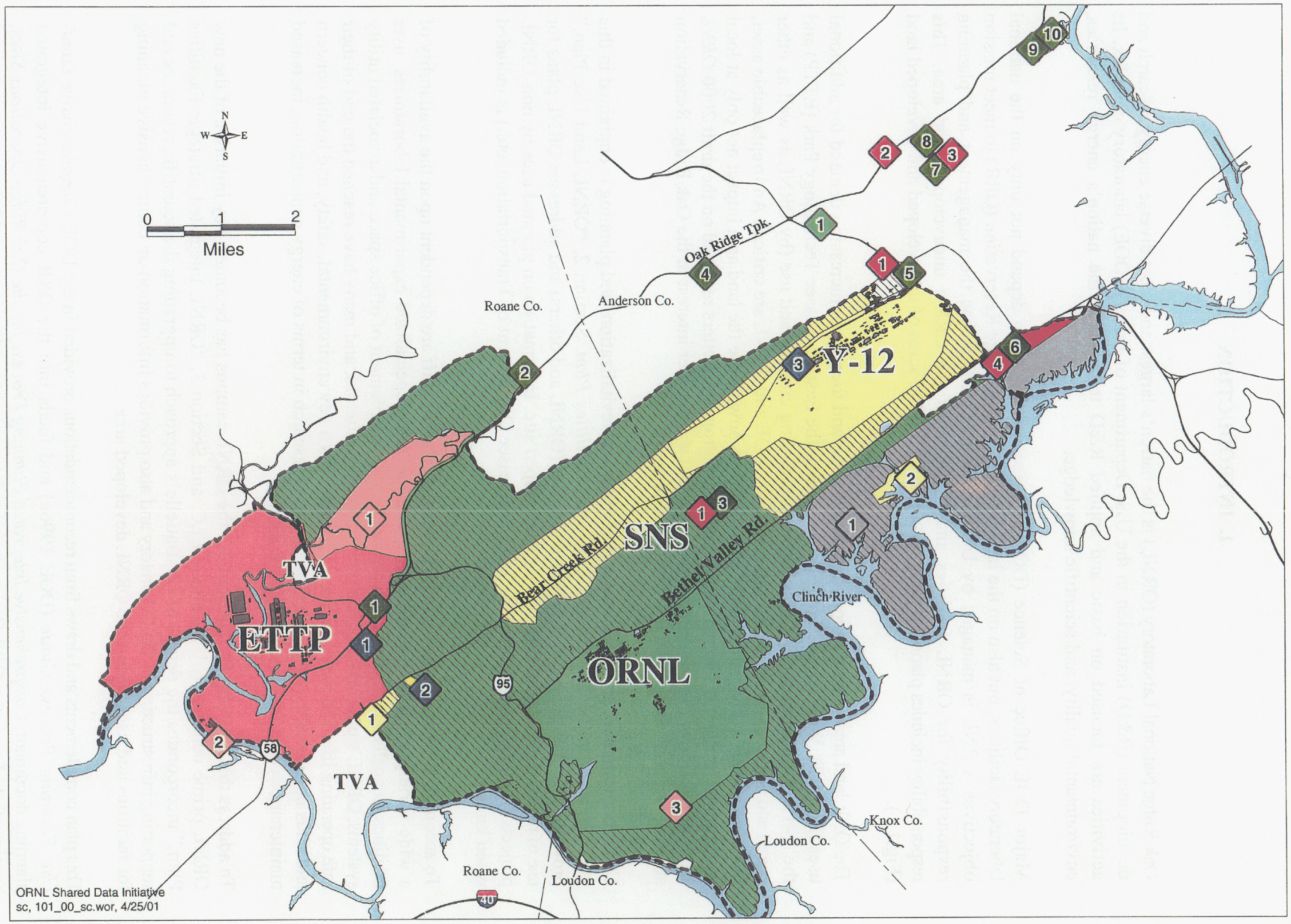
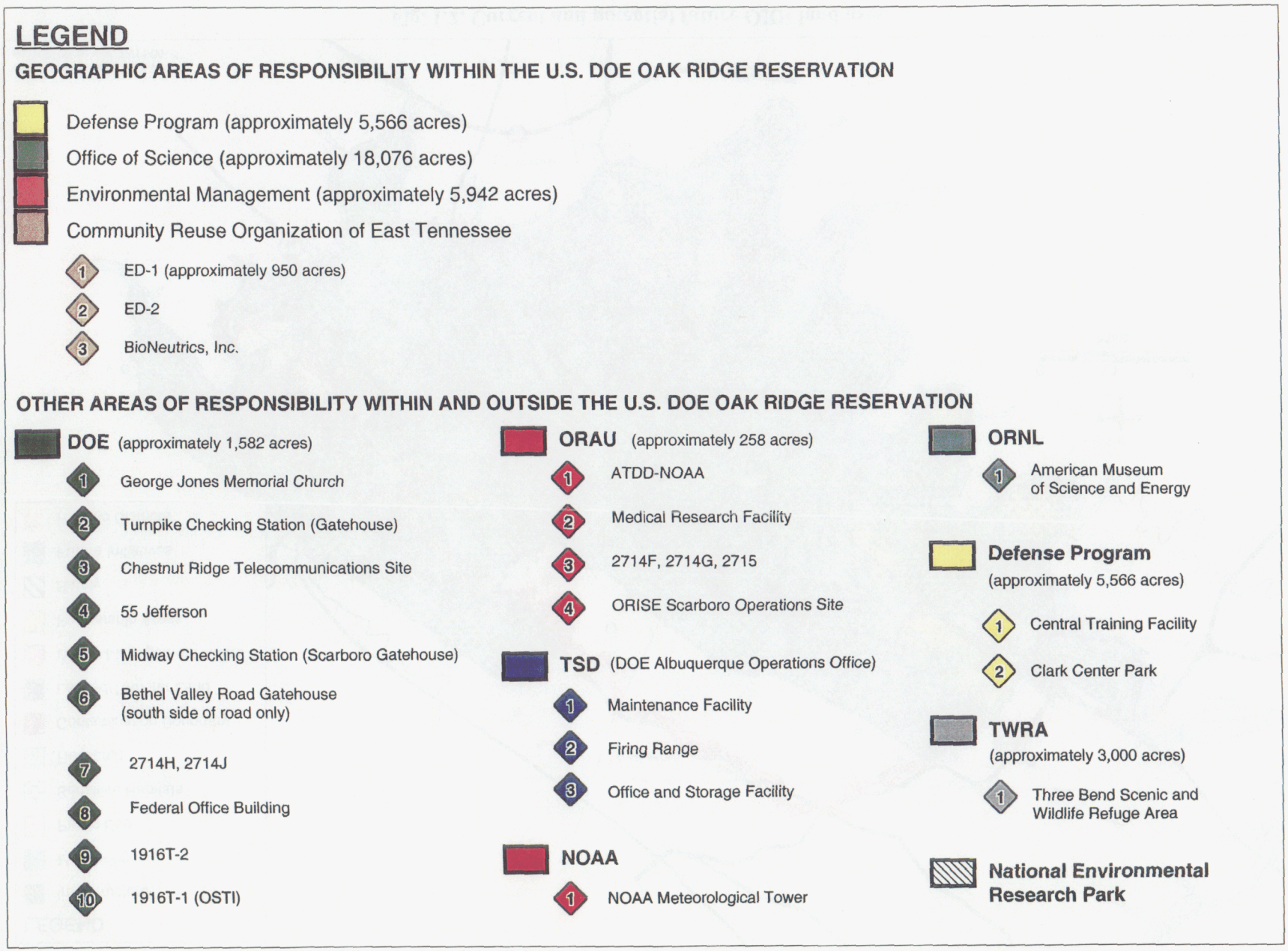


Fig. 1.1. Geographic areas of responsibility.


LEGEND
GEOGRAPHIC AREAS OF RESPONSIBILITY WITHIN THE U.S. DOE OAK RIDGE RESERVATION
Defense Program (approximately 5,566 acres)
Office of Science (approximately 18,076 acres)
Environmental Management (approximately 5,942 acres)
Community Reuse Organization of East Tennessee
1 ED-1 (approximately 950 acres)
2 ED-2
3 BioNeutrics, Inc.
OTHER AREAS OF RESPONSIBILITY WITHIN AND OUTSIDE THE U.S. DOE OAK RIDGE RESERVATION
DOE (approximately 1,582 acres)
1 George Jones Memorial Church
2 Turnpike Checking Station (Gatehouse)
3 Chestnut Ridge Telecommunications Site
4 55 Jefferson
5 Midway Checking Station (Scarboro Gatehouse)
6 Bethel Valley Road Gatehouse (south side of road only)
7 2714H, 2714J
8 Federal Office Building
9 1916T-2
10 1916T-1 (OSTI)
ORAU (approximately 258 acres)
1 ATDD-NOAA
2 Medical Research Facility
3 2714F, 2714G, 2715
4 ORISE Scarboro Operations Site
TSD (DOE Albuquerque Operations Office)
1 Maintenance Facility
2 Firing Range
3 Office and Storage Facility
NOAA
1 NOAA Meteorological Tower
ORNL
1 American Museum of Science and Energy
Defense Program
(approximately 5,566 acres)
1 Central Training Facility
2 Clark Center Park
TWRA
(approximately 3,000 acres)
1 Three Bend Scenic and Wildlife Refuge Area
National Environmental Research Park

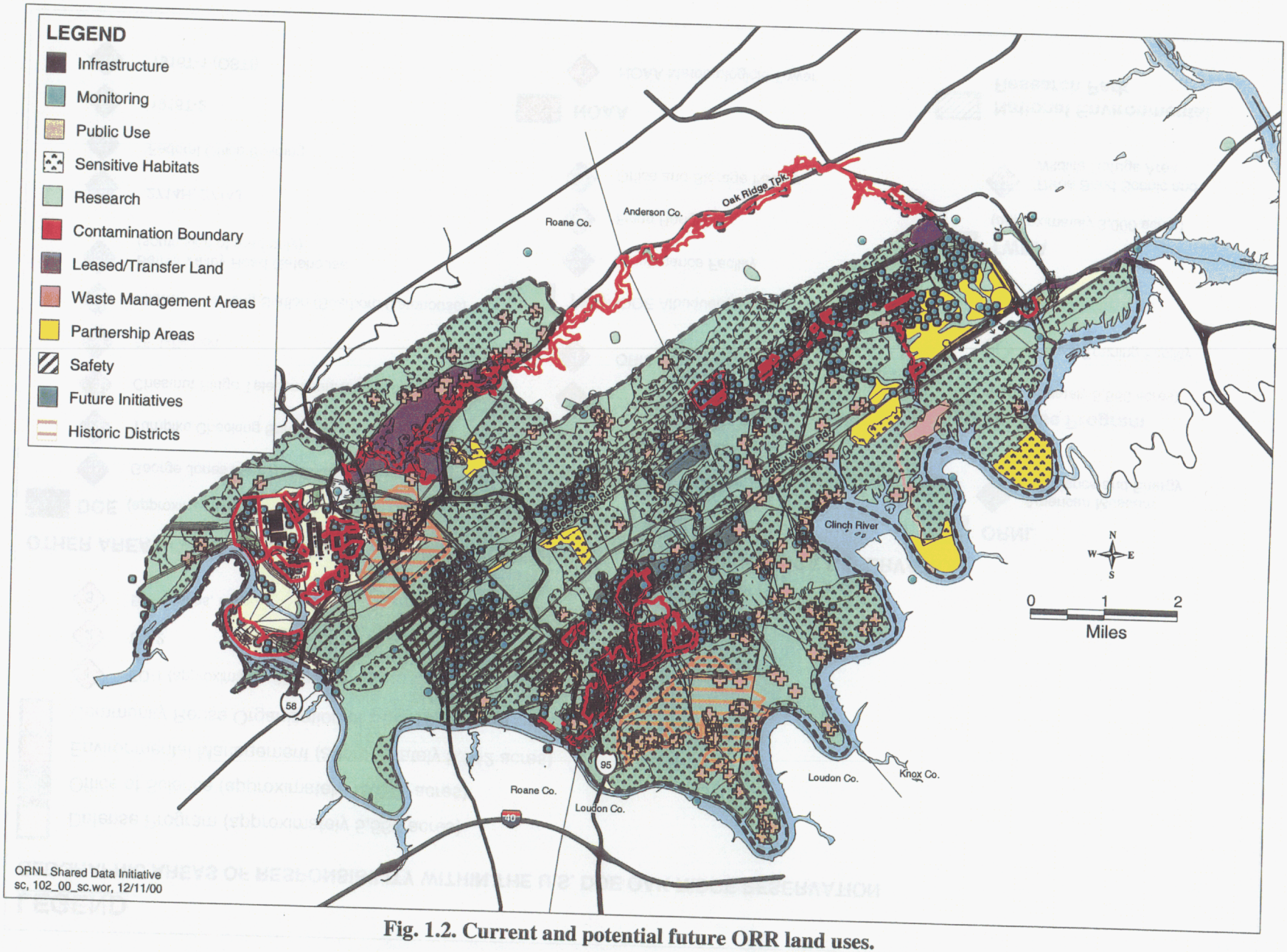


Fig. 1.2. Current and potential future ORR land uses.

1.1 LAND USE HISTORY OF THE OAK RIDGE RESERVATION

The land area now known as the ORR was established on September 19, 1942, when General Groves, Commander of the wartime "Manhattan Project," ordered the immediate purchase of a tract of land along the Clinch River between the cities of Kingston and Clinton, Tennessee, to be converted into a government reservation. The 58,575-acre military reservation (17 miles long by 7 miles wide) was to contribute to the manufacture of an atomic bomb within 3 years. It became the site of rapid construction of three separate production facilities (code named X-10, Y-12, and K-25) and a remote residential Townsite, all of which were managed behind a heavily guarded barbed-wire fence under strict military security (Souza et al. 1997).

1.2 SHIFTING OWNERSHIP

Of the original 58,575 acres of land purchased in 1942 by the federal government, 24,151 acres were disposed of and 34,424 acres remain, as indicated in Fig. 1.3. Approximately 25% of the disposed land was conveyed to the City of Oak Ridge for developmental purposes (almost 6,000 acres). It includes 2,371 acres of self-sufficiency parcels for residential, commercial, and industrial development; 270 acres for school sites; 1,172 acres for electrical, water, sanitary and storm sewer, drainage, roads and streets; 1,475 acres for municipal properties; and 29 acres for public housing. Land was also conveyed to Anderson County (28 acres), Oliver Springs (9 acres), the Tennessee Valley Authority (2,992 acres), and other federal agencies (63 acres). Land conveyed to the State of Tennessee was for health, forestry, agricultural research, and a biomedical graduate school (2,315 acres). Land conveyed for private entities and homeowners (12,692 acres) includes permanent road easements granted to the city, counties, and state to provide access to the area; 108 acres conveyed for rail service; 123 acres for area churches; 11,000 acres for house lots, country club and golf course development, sportsman's clubs, quarry operations, a cemetery association, Girl and Boy Scout organizations, and the hospital association for the medical complex. Self-sufficiency land requests from the City of Oak Ridge are discussed and identified in Appendix B.

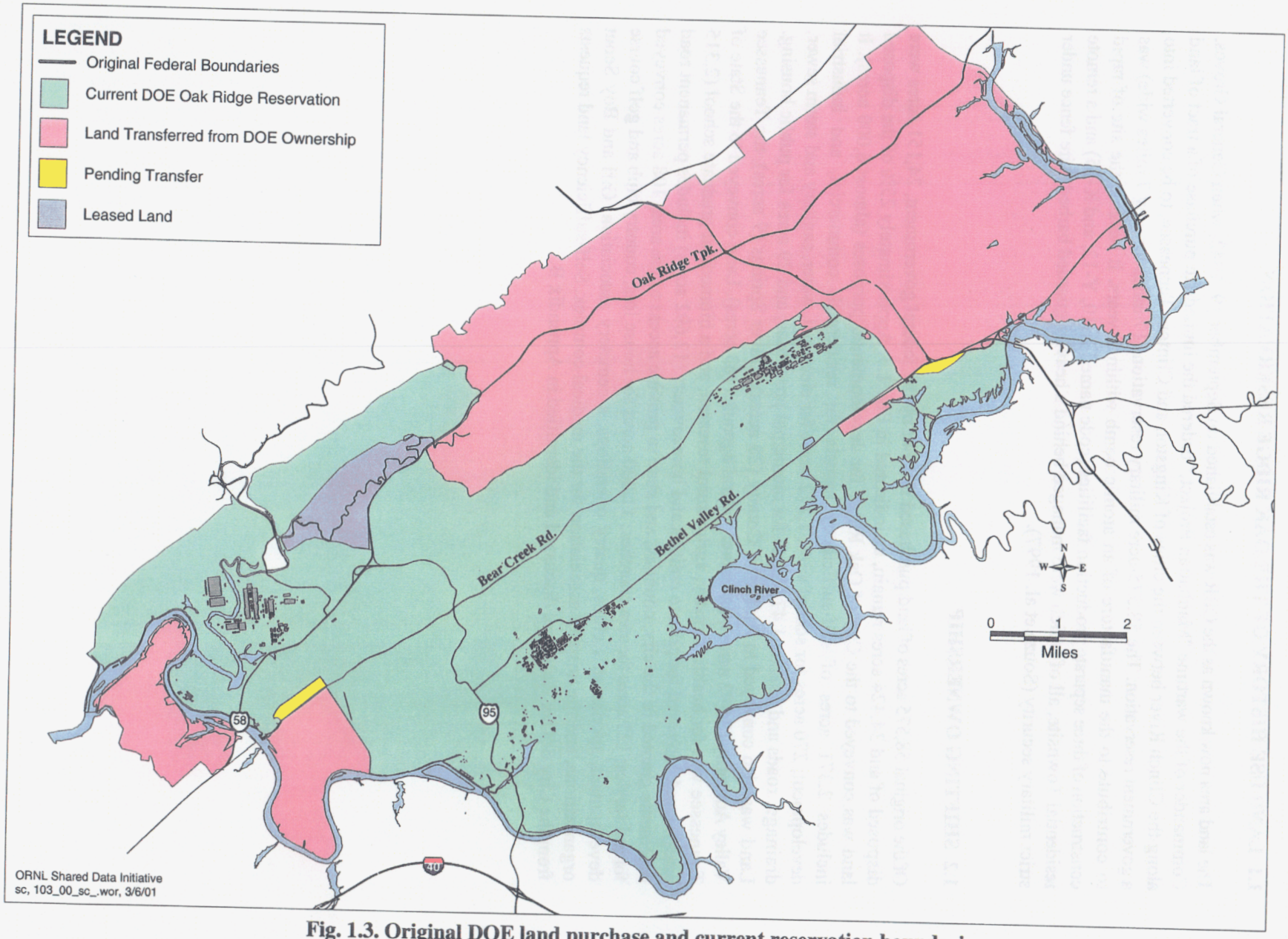


Fig. 1.3. Original DOE land purchase and current reservation boundaries.

2. ORNL LAND USE PLAN

The Department of Energy (DOE) has made the commitment that as it conducts its energy mission on behalf of the nation on the Oak Ridge Reservation (ORR), DOE will do so in a manner that is respectful of the land and local environment.

2.1 DOE VISION FOR LAND USE

The ORR is a unique and irreplaceable resource for DOE to use for its national science and technology missions. The DOE ORR vision, as stated in the *ORR Comprehensive Integrated Plan* (September 1999), emphasizes that the ORR serves as an integrated science, education, industrial, and technology complex managed by DOE in partnership with the private sector—supporting a dynamic regional and national economy. Future use is to include a mixture of activities that are compatible with and contribute to ongoing and anticipated DOE missions. According to current plans, the reservation will be used to support many of the same programs it currently supports while adapting to changing national goals and interests and to reduced federal budgets. Portions of the reservation will be used to promote the development of private-sector enterprises in ways that are consistent with and complementary to DOE missions. DOE's environmental management and reindustrialization initiative is highlighted at the ETTP; defense support, manufacturing, and storage at the Y-12 National Security Complex; and research and development at ORNL. Land use planning for ORNL identifies and prioritizes needs for preservation of reservation land to meet the requirements of existing and future scientific facilities, environmental research, education, and other compatible uses.

2.2 DEVELOPMENT OF THE LAND AND FACILITIES PLAN

The ORR is vital because the ability and/or opportunity to acquire another land area such as this is not feasible. In November 1996, an Oak Ridge National Laboratory (ORNL) land use planning team was charged with developing a land use plan and a process for reviewing and evaluating proposed land uses. The ORNL Land and Facilities Use Committee, chartered August 1998, now has the responsibility of updating the plan. In addition, input to the plan was solicited from external stakeholders. This revision updates the 1999 *ORNL Land and Facilities Plan* (ORNL 1999).

The land uses identified in the plan include

- land for future DOE mission initiatives,
- areas for maintaining DOE mission objectives,
- diverse areas for pursuing new DOE initiatives for ORNL,
- areas for regulatory compliance,
- areas for preservation of biological diversity,
- areas for educational and recreational activities, and
- controlled access areas for public recreation.

2.3 LAND USE DECISION MAKING AND PLANNING

Prerequisites to any decision include ensuring the health and safety of ORR employees and the public. Beyond health and safety and regulatory compliance, land use decision making and planning reflect the vision for land use. Recommendations on land use are made through the process described in Section 2.3.5 based on the land use vision statement and on guidelines for wise land use planning, land use priorities, and input by subject matter experts through a review process.

2.3.1 Guidelines for Land Use Planning

The following guidelines are used in planning and evaluating land uses:

- ensure compatibility with DOE mission and vision for land use,
- cluster like uses,
- preserve clean areas,
- reuse disturbed areas,
- prevent pollution,
- protect natural and cultural resources,
- balance costs and benefits,
- consider future generations,
- optimize appropriate recreational use,
- ensure compatibility with surrounding landscape,
- consider regional context,
- ensure consistency with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) remediation agreements, and
- consider stakeholder input.

2.3.2 Land Use Priorities

For any parcel of land that will be used to support DOE's ORNL mission, potentially competing uses may or may not be compatible with each other. The following priorities for land use have been established so that conflicts between competing uses, particularly those that are not compatible, can be resolved:

1. Preserve and protect land for meeting the requirements of existing and future scientific facilities and research programs so that DOE can continue to address its national science and technology missions.

2. Preserve and protect land to meet the requirements of environmental research by ensuring that adequate areas within the ORR are protected and preserved for their biological and physical diversity.

3. Preserve and protect land to meet the requirements of scientific and technical education by ensuring that suitable land is available for facilities and research areas needed to support educational opportunities on the ORR.

4. Allow for land uses that may not directly meet requirements for priorities 1, 2, and 3 for scientific facilities, environmental research, and scientific and technical education, but that would be compatible with these uses and not preclude future options. Decisions concerning these other uses are made on a case-by-case basis to ensure compatibility with higher-priority uses.

2.3.3 Review by Subject Matter Experts

The decision-making process includes review and evaluation of proposed land uses by subject matter experts. Review includes the potential to impact the following:

- current land uses,
- opportunities to pursue future initiatives,
- natural and cultural resources,

- health and safety,
- emergency preparedness,
- compliance,
- access control/security,
- real estate agreements,
- neighboring lands,
- utilities,
- public relations,
- changes to dose receptors,
- transportation,
- remediation and cleanup activities, and
- maintenance activities.

2.3.4 ORNL Land and Facilities Use Committee

The ORNL Land and Facilities Use Committee plans, reviews, and approves for recommendation to DOE all (ORNL and non-ORNL) proposed changes in the use of land and facilities within the ORNL developed area and ORNL projects proposed for the ORR outside the ORNL developed area (see Fig. 1.1). Review of proposed projects includes evaluation by appropriate subject matter experts. All projects are assessed to ensure compatibility with this revised *ORNL Land and Facilities Plan* and the *ORR Comprehensive Integrated Plan* (September 1999). Review through the ORNL Land and Facilities Use Committee ensures coordination of the site planning process described in Section 3.4.2. Planning goals and projects approved by the ORNL Land and Facilities Use Committee are incorporated into the *ORNL Land and Facilities Plan* and the *ORR Comprehensive Integrated Plan* updates. Approved ORNL projects for areas outside the ORNL developed area are submitted to the Reservation Management Organization (RMO) for review and concurrence and to the DOE ORR Management Team as described in the *ORR Comprehensive Integrated Plan*.

2.3.5 Review Process

Proposals for changes in land and facility use are submitted first to the ORNL Land and Facilities Use Committee for screening. This includes proposals from anyone planning activities within the ORNL developed area, as well as proposals initiated by ORNL projects or activities for areas outside the ORNL developed area.

Proposed actions within the ORNL developed area. Once approved by the ORNL Land and Facilities Use Committee, the proposed changes in land or facility use are then discussed with the DOE ORNL Site Office. If approved, an ORNL project review (i.e., National Environmental Policy Act) and other required reviews are initiated.

Proposed actions by ORNL outside the ORNL developed area. Once approved by the ORNL Land and Facilities Use Committee, the proposals are submitted to the RMO. If approved by the RMO, the proposals are submitted to the DOE ORR Management Team as described in the *ORR Comprehensive Integrated Plan* (September 1999).

Actions proposed within ORNL developed area	→	ORNL Land and Facilities Use Committee	→	DOE ORNL Site Office		
Actions proposed by ORNL outside ORNL developed area	→	ORNL Land and Facilities Use Committee	→	RMO	→	Process in CIP

2.3.6 Overlapping Land Use/Management Responsibilities

Some land areas for which ORNL has contractual responsibility (e.g., the National Environmental Research Park) overlap the Y-12 National Security Complex or Oak Ridge Associated Universities (ORAU) areas of responsibility. Within the overlap areas, the DOE contractors have day-to-day responsibility for management, operation, and maintenance as described in the *Oak Ridge Reservation Management Plan*, February 1999. Any proposed changes in land use within these overlap areas are reviewed by the RMO.

2.4 DESCRIPTION OF THE OAK RIDGE RESERVATION

2.4.1 Location

The ORR consists of 34,424 acres of federally owned lands within Anderson and Roane counties, Tennessee (Fig. 2.1). Most of the ORR is within the corporate limits of the City of Oak Ridge, Tennessee, and is located approximately 2 miles southwest of the population center of Oak Ridge. The ORR is bordered on the north and east by the population center of the City of Oak Ridge and on the south and west by the Clinch River/Melton Hill Lake impoundment. Knoxville, the largest city in east Tennessee, is located approximately 15 miles east of the ORR (Fig. 2.1).

2.4.2 DOE Facilities

About one-third of the ORR is occupied by the three major DOE facilities: ORNL, ETTP (formerly the K-25 Site), and the Y-12 National Security Complex. About 3500 acres are waste sites or remediation areas. The large land area surrounding the developed areas and waste sites serves as a buffer between the City of Oak Ridge and the DOE activities. Use of this buffer area has been primarily for environmental research, remediation, education, compliance monitoring, utilities, protection of natural and cultural resources, wildlife management, and limited recreation.

2.4.3 Physical Characteristics

2.4.3.1 Topography, Geology, and Hydrology

The ORR is the most complex geologically and hydrologically of all the DOE sites. Located in the Valley and Ridge Physiographic Province, the ORR is characterized by a series of narrow, elongated ridges and slightly broader intervening valleys that follow a northeast to southwest trend (ORNL 1992). Major valleys within the ORR include East Fork Valley, Bear Creek Valley, Bethel Valley, and Melton Valley. Major ridges within the ORR include Blackoak Ridge, East Fork Ridge, Pine Ridge, Chestnut Ridge, Haw Ridge, and Copper Ridge.

Topography is shown in Fig. 2.2. Elevation within the ORR ranges from a low of 750 feet mean sea level (MSL) along the Clinch River to a high of 1260 feet MSL along Pine Ridge (DOE 1989). Topographic relief between valley floors and ridge crests within the ORR is generally about 300 to 350 feet (ORNL 1992).

Valleys within the ORR are underlain by bedrock formations predominated by calcareous siltstones and limestones. Ridges within the ORR are underlain by bedrock formations predominated either by weathering-resistant sandstones and siliceous shales and siltstones or by siliceous dolostones that weather to form thick, residual, silty clay soils rich in chert and resistant to erosion (ORNL 1992). The width of these valleys and ridges is determined by geologic factors such as the dip angle and

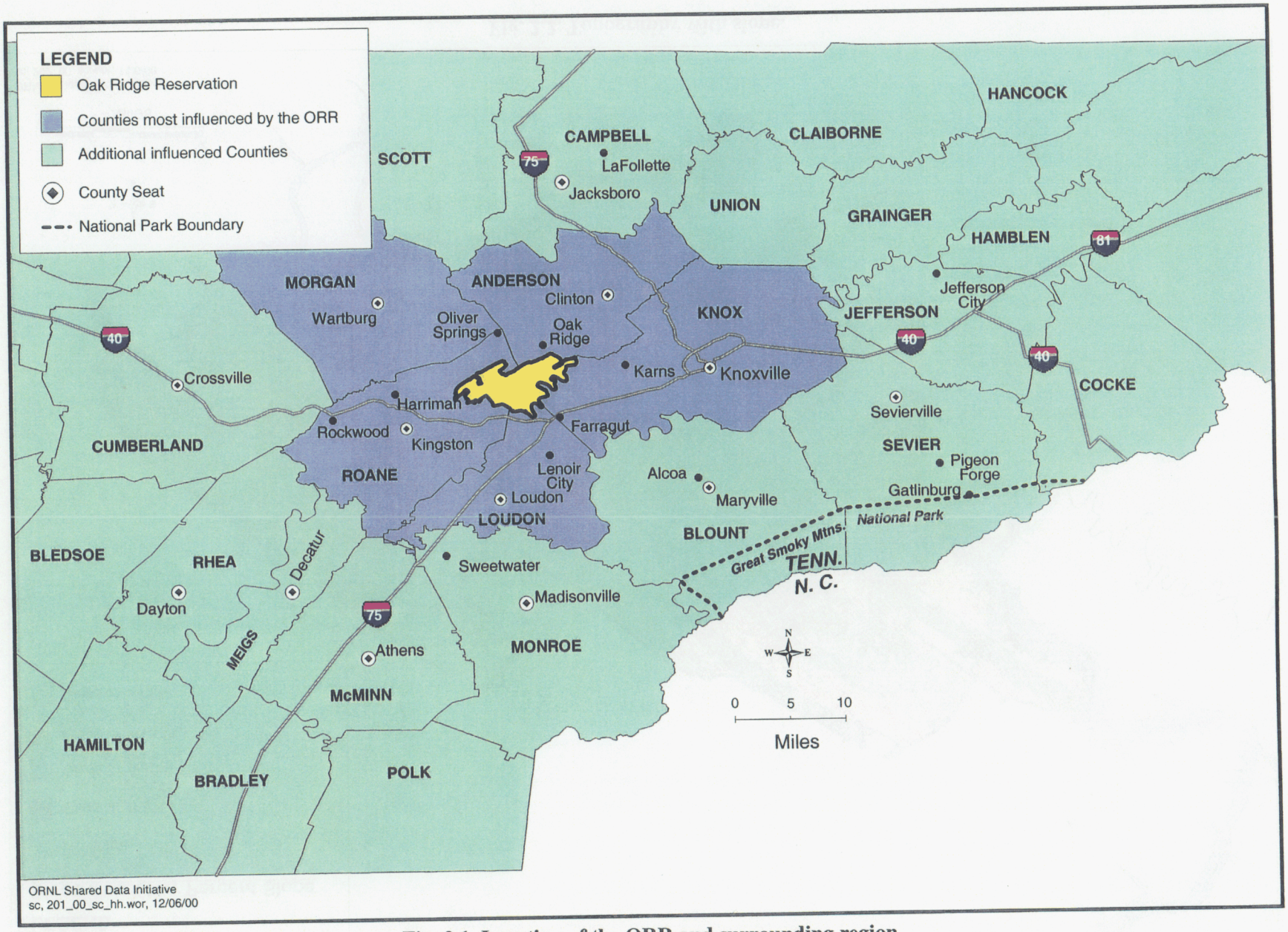


Fig. 2.1. Location of the ORR and surrounding region.

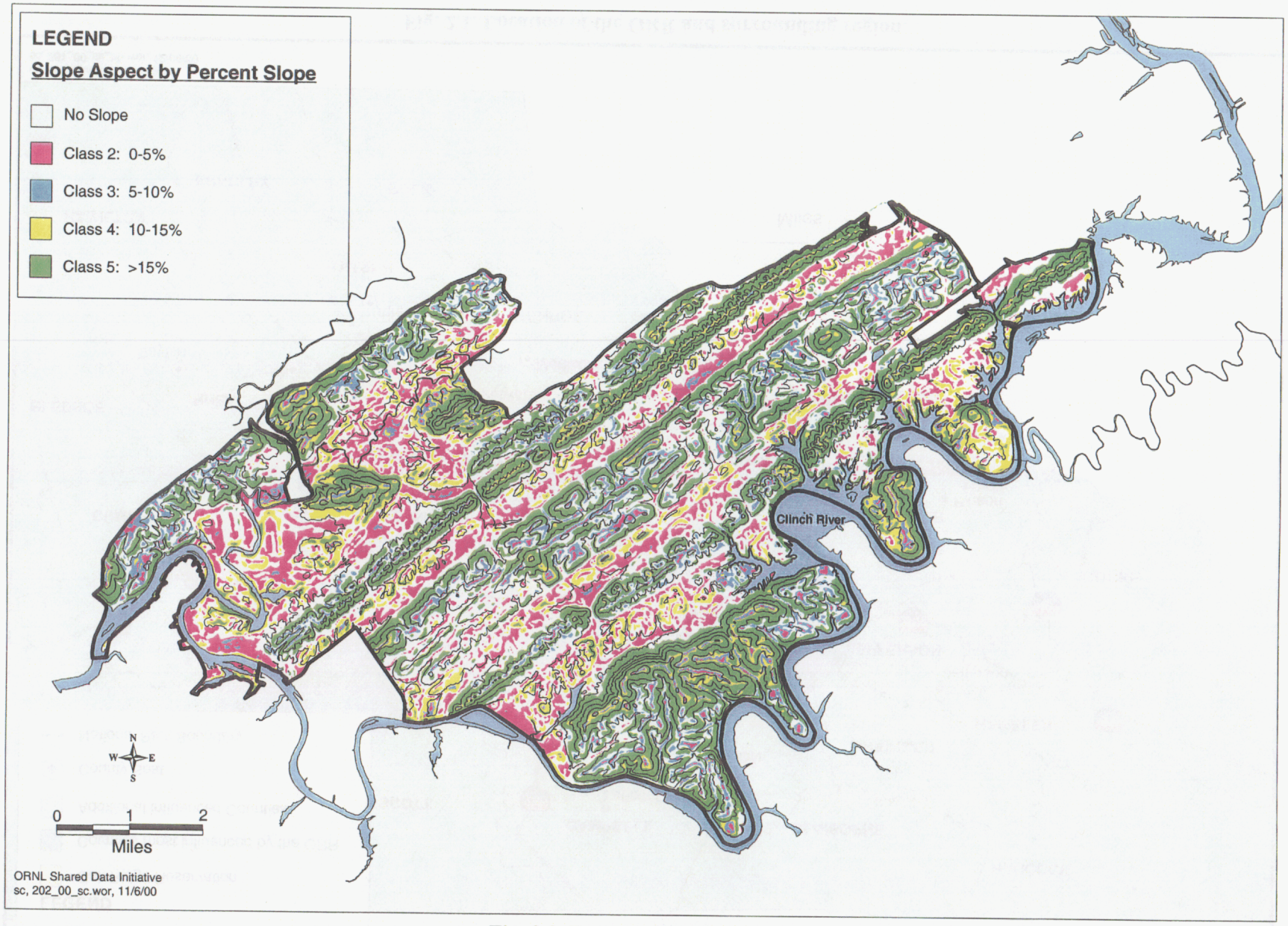


Fig. 2.2. Topography with slope.

formation thickening due to thrust faulting of underlying geologic formations. Weathering and erosion processes, coupled with the general dipping attitude of bedrock underlying the area, result in rather steep (commonly steeper than 45°) northwest-facing slopes, while southeast-facing slopes are commonly gentler, with inclinations of 5 to 25% (Fig. 2.2) (ORNL 1992).

The topographical features of the ORR reflect geological structures and processes beneath the surface. While groundwater flow in bedrock and, to some degree, surface water flow are controlled by widespread fractures in all bedrock formations on the ORR, the carbonate bedrock also displays dissolutional features and landforms collectively referred to as karst. Karst features represent a spectrum ranging from minor solutional enlargement of fractures to conduit flowpaths to enterable caves. All of these are evidenced on the ORR, associated with the carbonate strike belts along ridge lines and valley bottoms.

All three ORR facilities are situated on carbonate bedrock to some extent such that groundwater flow and contaminant transport are at least in part controlled by solution conduits in the bedrock.

A recent inventory of karst features on the reservation has identified numerous indications of karst development which vary from site to site. Karst features are displayed on Fig. 2.3. Surface evidence of karst development includes sinking streams (swallets) and overflow swallets, karst springs and overflow springs, enterable caves, and numerous sinkholes of varying size.

In general terms, karst appears most developed in association with the Cambro-Ordovician Knox group carbonate bedrock which underlies Copper Ridge, Chestnut Ridge, McKinney Ridge at the ETTP, and Blackoak Ridge. The highest density of sinkholes occurs in the Knox group, and drilling data suggest the largest solution cavities are associated with these formations, ranging up to 22 feet in height at the ETTP. Enterable caves on the reservation are almost exclusively restricted to the Knox group bedrock. Large springs in the Knox typically occur along the base of the ridges underlain by the Knox. Many appear to have been used for water supply purposes prior to DOE presence.

In contrast with the Knox, karst is less developed in the Chickamauga group carbonates that underlie the ORNL facilities area and much of the ETTP facilities area in a valley-bottom topographic position. Cavities encountered in drilling are typically smaller and often clay-filled. Caves developed in the Chickamauga regionally, as well as on the ORR, are sparse and typically small.

Problems in recent years related to property damage to residential homes on neighboring properties due to settlement have highlighted the potential for collapse in areas underlain by cavernous limestone. While it is not possible to quantify the risk of collapse on the ORR, it should be considered a potential condition but not necessarily an imminent one. Considering that the karst features are best developed in the Knox group carbonates, it stands to reason that collapse potential would be greatest in areas underlain by these formations.

The Clinch River is believed to represent the base level to which all groundwater in carbonate bedrock on the ORR would ultimately discharge, if not to surface water features on the ORR. The Tennessee Valley Authority (TVA) has performed probable maximum flood (PMF) studies along the Clinch River, which is the southern boundary of the ORR. PMF is the flood that can be expected from the most severe combination of critical hydrometeorological conditions that are reasonably possible over the entire watershed (ORNL 1992). The PMF level along the Clinch River at the mouth of Bearden Creek occurred at elevation 814.7 feet, while the PMF level at the mouth of White Oak Creek occurred at elevation 779.3 feet (ORNL 1992). Most of the ORR is located above the PMF elevation along the Clinch River.

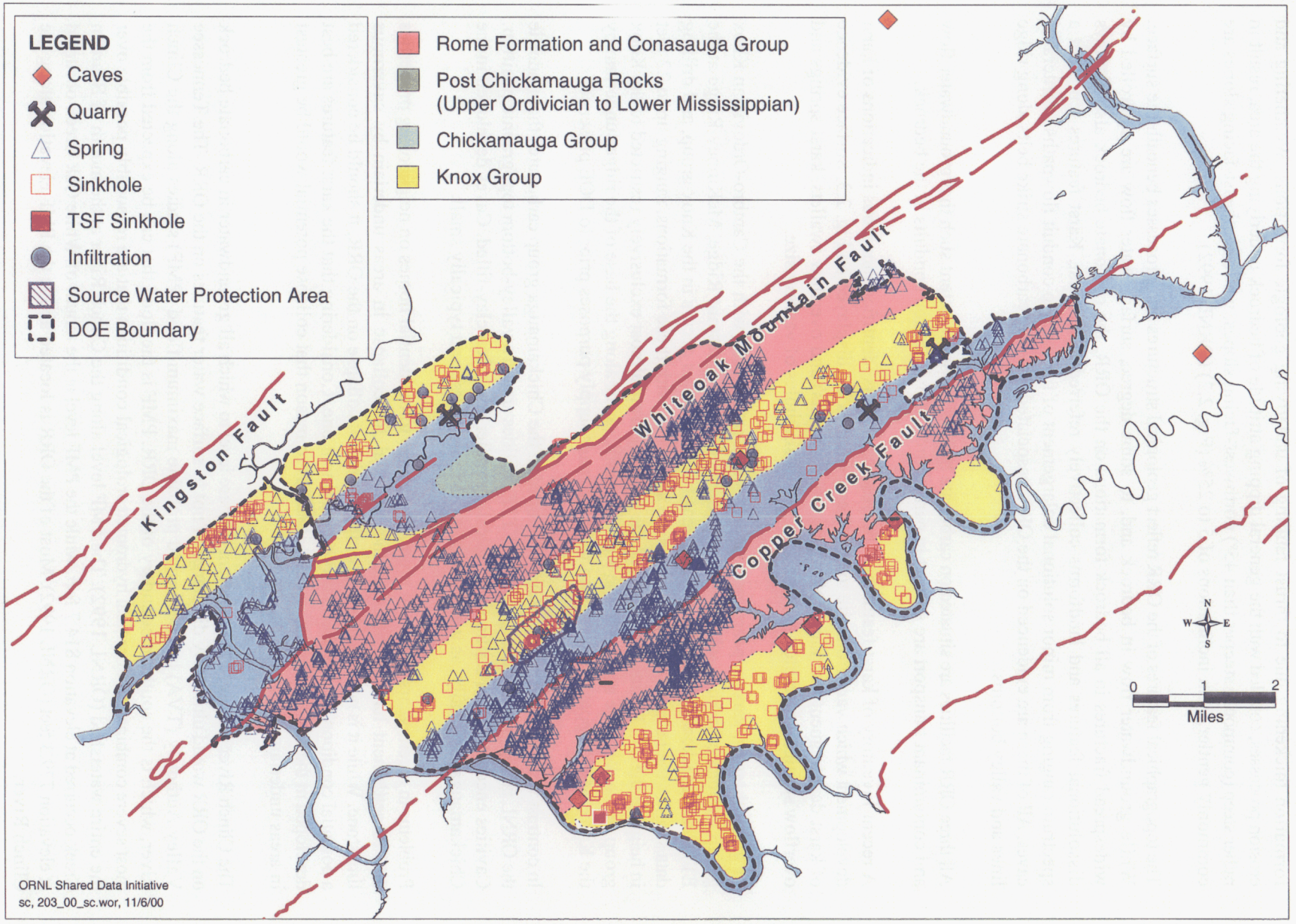


Fig 2.3. Geology with karst features.

Surface water hydrology on the ORR is characterized by a network of small streams that are tributary to the Clinch River (Fig. 2.4). Water levels in the Clinch River are regulated by TVA, and fluctuations in the river have an effect on tributary creeks and streams draining the ORR. The three DOE facilities on the ORR affect different subbasins of the Clinch River. Drainage from the ETTP enters Poplar Creek, which has a total drainage area of 136 square miles. Drainage from ORNL has its greatest effect on White Oak Creek, which has a total drainage area of 6.0 to 6.4 square miles. Drainage from the Y-12 National Security Complex enters both Bear Creek and East Fork Poplar Creek, which have total drainage areas of 7.4 and 30 square miles, respectively (DOE 1989).

2.4.3.2 Vegetation and Wildlife

The ORR is mostly contiguous native eastern deciduous forest. Prior to government acquisition as a security buffer for military activities, the ORR's approximately 1000 individual farmsteads consisted of forest, woodlots, open grazed woodlands, and fields. Results of remote-sensing analyses show that in 1994 about 70% of the ORR was in forest cover and about 20% was transitional, consisting of old fields, agricultural areas, cutover forest lands, roadsides, and utility corridors (Washington-Allen et al. 1995). Forested (hardwood and pine) areas (many in blocks greater than 100 acres) are found throughout the reservation. Cutover forest land includes about 1100 acres of pine plantations killed in 1994 by southern pine beetles (now regenerating or replanted). Additional areas are being cut to salvage timber as a result of the 1999-2000 pine beetle outbreak. Less than 2% of the reservation remains as open agricultural fields (Mann et al. 1996). The forests are mostly oak-hickory, pine-hardwood, or pine. Minor areas of other hardwood forest cover types are found throughout the ORR, including northern hardwoods, a few small natural stands of hemlock or white pine, and floodplain forests.

This large, relatively unfragmented area of mature eastern deciduous hardwood forest provides habitat for numerous wildlife species. Such blocks of forested area are increasingly uncommon in the Ridge and Valley Province and nationwide. In addition to the forested habitats and pine plantations, the ORR contains seminatural grasslands (hay) and forest edge (e. g., transmission line corridors through forest) which provide diversity of habitats suitable for a great variety of wildlife. Other wildlife habitats on the ORR include, but are not limited to, the following: old-field successional areas; unique or important vegetational communities; seminatural corridors; planted hardwoods and pines; bottomlands and wetlands, including an increasing number of beaver ponds; caves; and developed and semideveloped areas and roads.

The resulting diversity of wildlife species ranges from common species found in urban and suburban areas of eastern Tennessee to species with more restrictive requirements, such as interior forest bird species. The ORR hosts about 63 species of fish; 59 species of reptiles and amphibians; up to 260 species of migratory, transient, and resident birds; and 38 species of mammals, as well as innumerable invertebrate species. Among these, 20 species of federal- or state-protected vertebrate species have been confirmed in recent surveys (Mitchell et al. 1996). Furthermore, appropriate habitat for approximately 20 additional species has been identified.

Most of the ORR is relatively pristine when compared with the surrounding region, especially in the Ridge and Valley province (Mann et al. 1996). Viewed from the air, the ORR is clearly a large and nearly continuous island of forest within a landscape fragmented by urban development and agriculture. Many ecological communities (e.g., cedar barrens, river bluffs, and wetlands) with unique biota, often including rare species, are known to exist within the larger framework of mixed hardwood and pine forest on the ORR (Pounds et al. 1993).

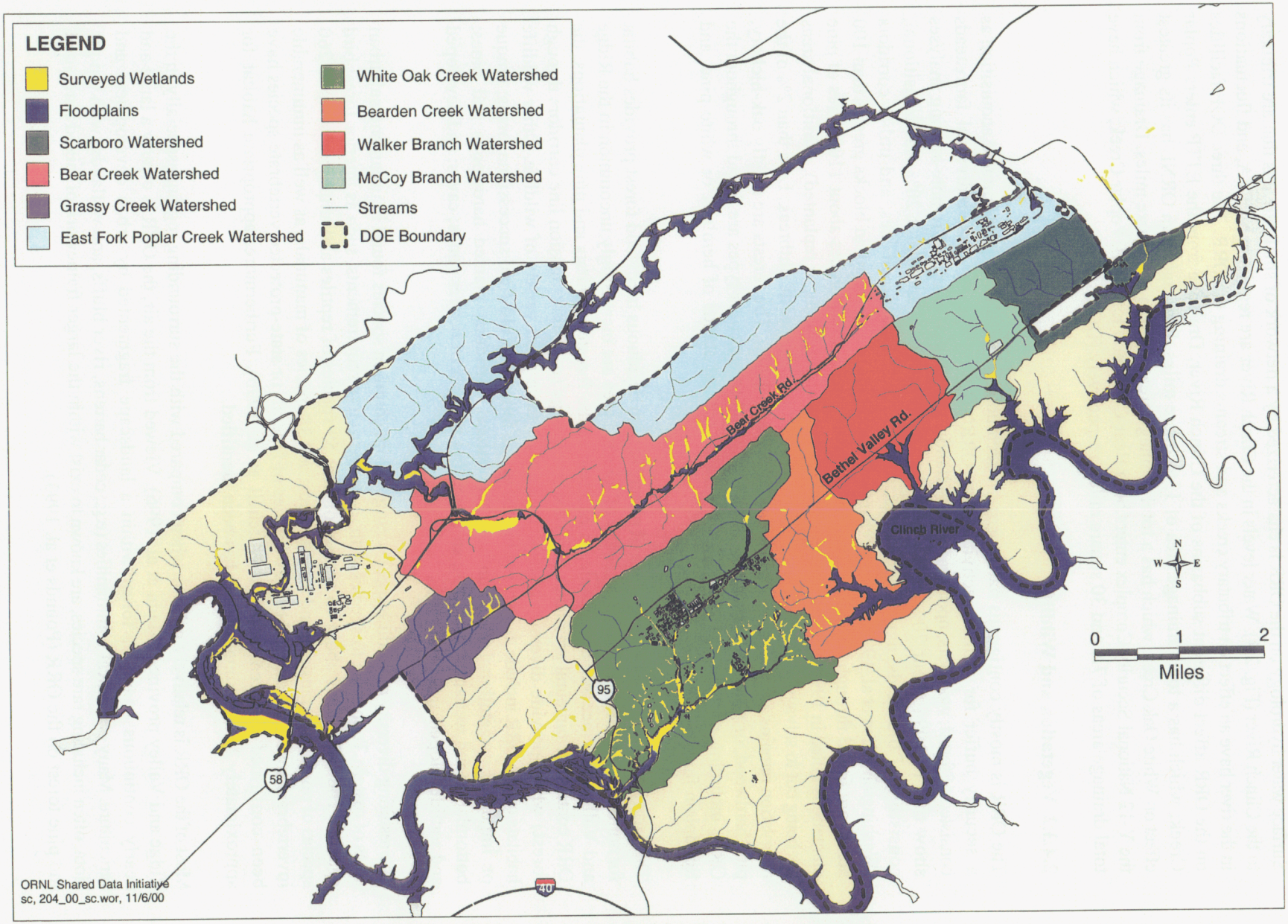


Fig. 2.4. Water, wetlands, floodplains, and watersheds.

2.4.3.3 Caves, Open Sinkholes, and Quarries

Caves, sinkholes, and quarries are found on the ORR. In addition to providing important habitat for some plants and animals, including sensitive species, these features are often attractive to people, yet can be hazardous. The numerous caves on the reservation are not open to the public, and access has been restricted to research and monitoring uses (Fig. 2.3). A large, open sinkhole is located near the Tower Shielding Facility Highway 95 entrance in an area maintained by periodic mowing. The sinkhole is fenced, and access is restricted. The area is not open to the public (Fig. 2.3).The three inactive quarries (Lambert, Kerr Hollow, and Rogers) are all in restricted areas and are not open to the public (Fig. 2.3).

2.4.4 Cultural Resources

Cultural resources on the ORR include (1) surface and buried archeological materials (artifacts) and sites dating to the Prehistoric, Historic, and Ethnohistoric periods; (2) standing structures that are over 50 years of age or are important because they represent a major historical theme or era; (3) cultural and natural places, selected natural resources, and objects with importance for Native Americans; and (4) American folk life traditions and arts. Fig. 2.5 shows general locations of cemeteries, churches, national historic landmarks, and old home structures. Additional information that may be considered sensitive is available in the cultural resource database for planning and evaluation purposes. A resource management plan for the ORR has been prepared.

2.4.5 Environmental Designations

The ORR has evolved into a biologically rich resource over the last 55 years. When acquired in 1942, aerial photos indicate that about half of the land was cleared. These cleared and cultivated areas have returned to forest through planted seedlings and natural succession, with about 70% of the ORR now in mature or maturing native forest. Ecological communities found within the larger framework of mixed hardwood and pine forests on the ORR include cedar barrens, river bluffs, and wetlands. As a result of urbanization, these communities are now absent or uncommon in areas surrounding the reservation.

Over 1100 vascular plant species are found on the ORR (compare this to The Great Smoky Mountains National Park, the most biologically diverse with respect to vascular plants of all the national parks in the contiguous U.S.; they list approximately 1650 species). Twenty-one plants listed by the state as rare (endangered, threatened, or special concern) are found on the ORR (Awl et al. 1996). The population of tall larkspur on the ORR is one of the largest populations known to occur anywhere in the world. The species is listed as "globally rare" by The Nature Conservancy and as "endangered" by the State of Tennessee.

Over 315 wildlife species are known to occur on the ORR. Twenty of the species listed as rare by the state have been verified as occurring on the ORR, with an additional 20 that may be here because the habitat is appropriate (Mitchell et al. 1996). The Tennessee Dace (listed by the state as in need of management) is found in numerous streams and tributaries on the reservation in contrast to declining or absent populations in streams outside the ORR. Listed rare species occur across the ORR in over 50 different locations which are protected as Research Park Natural Areas. Seven of these special areas are also registered State Natural Areas.

The combination of long-term protection for the land area and the biological richness of the ORR with the available research capability and proximity of diverse scientific expertise has resulted in the following state, regional, national, and international associations:

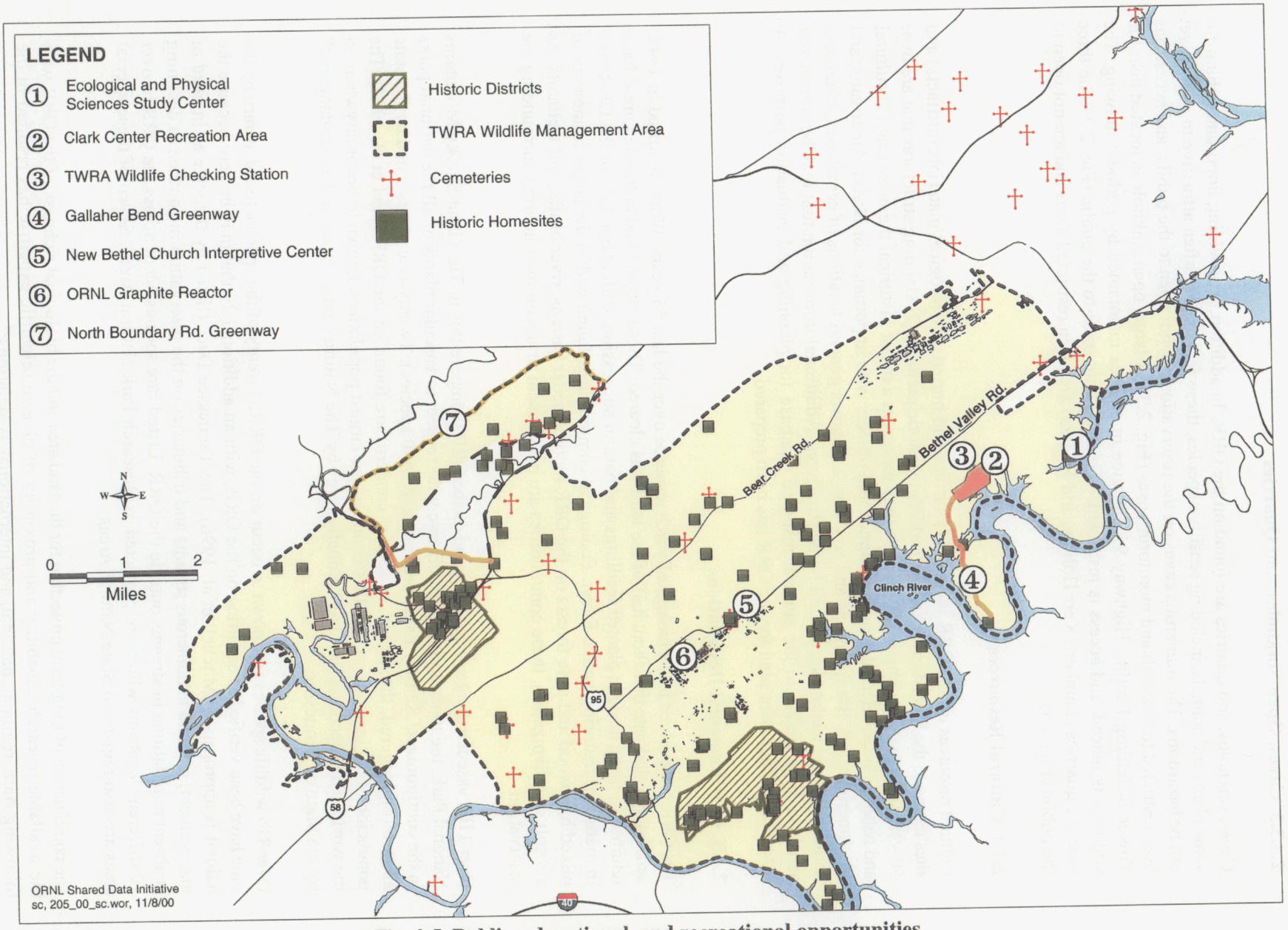


Fig. 2.5. Public, educational, and recreational opportunities.

- DOE National Environmental Research Park
- member of ParkNet (network of seven DOE National Environmental Research Parks)
- National Environmental Research Park Biosphere Reserve
- unit of the Southern Appalachian Biosphere (with Great Smoky Mountains National Park, Coweeta Hydrologic Laboratory, and others)
- member of Southern Appalachian Man and the Biosphere Cooperative [with U.S. Department of Agriculture (USDA), Forest Service, TVA, Economic Development Administration, U.S. Environmental Protection Agency (EPA), U.S. Fish and Wildlife Service, U.S. Geological Survey, National Park Service, U.S. Forest Service, Appalachian Regional Commission, and others]
- Oak Ridge Wildlife Management Area managed by the Tennessee Wildlife Resources Agency (TWRA)
- Three Bend Scenic and Wildlife Refuge
- State Natural Areas (registered)
- ORNL User Facility

2.4.5.1 State Natural Areas

Seven State Natural Areas were registered on the ORR in 1986 through an agreement between DOE and the Tennessee Department of Environment and Conservation (TDEC). These areas qualified as State Natural Areas because of rare plant species, animal species, or community types (Fig. 2.6). Additional areas found to have significant biological species and communities are being proposed for State Natural Area registration.

2.4.5.2 Oak Ridge Wildlife Management Area

The ORR is a Tennessee Wildlife Management Area through an agreement between DOE and TWRA. The agreement provides for protection of wildlife habitat and species (including several threatened and endangered species) and restoration of other wildlife habitat and species. Management of the ORR for wildlife is also a type of land use (see Section 2.5.7).

2.4.5.3 Wetlands

The ecological functioning of approximately 580 acres of wetlands on the ORR provides water quality benefits, stormwater control, wildlife habitat, rare species habitat, and landscape and biological diversity (Fig. 2.4).

Wetlands occur across the ORR in low-elevation positions primarily in the riparian zones of headwater streams and their receiving streams, as well as in Clinch River embayments. Most of the wetlands on the ORR are classified as palustrine forested, scrub-shrub, and emergent wetlands (Cowardin et al. 1979). Wetlands identified to date range in size from several square yards at small seeps and springs to approximately 25 acres at White Oak Lake. A high percentage of the wetlands on the ORR are less than one acre in size and occur in headwater areas. Wetlands greater than one acre are typically associated with river embayments, other areas affected by the fluctuating water levels of the Clinch River reservoirs (e.g., Poplar Creek), areas in which water has been artificially impounded (e.g., White Oak Lake), and beaver ponds.

Activities that affect wetlands are regulated under federal law [Section 404 of the Clean Water Act (CWA), Federal Water Pollution Control Act, 33 USC1251] and state law (Tennessee Water Quality Control Act, TN Code Annotated 70-324). Federal and state permits are required to conduct dredge and fill activities in a jurisdictional wetland. Impacts to wetlands are avoided whenever possible. However, if impacts are unavoidable, they are minimized through steps such as project design changes

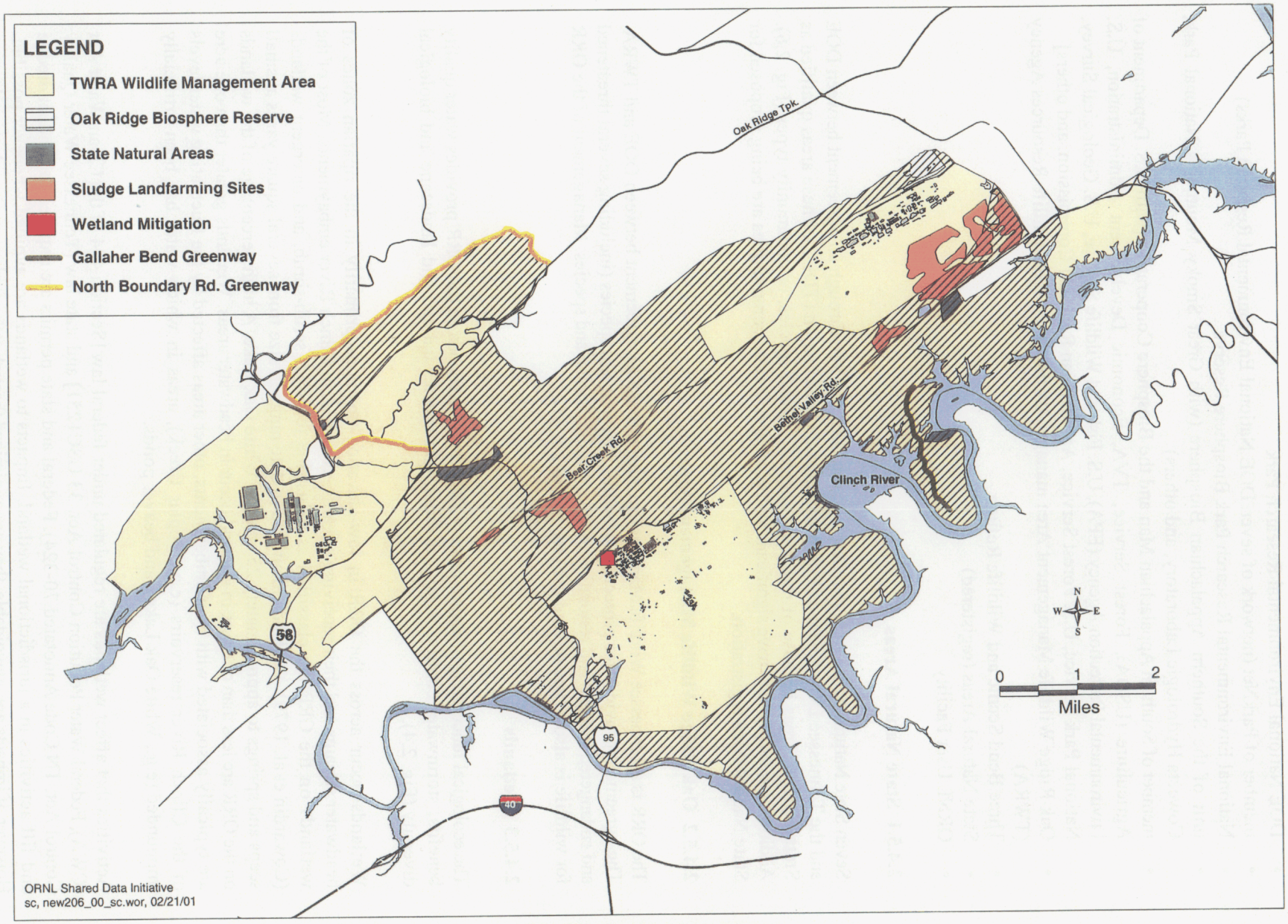


Fig. 2.6. Partnership areas.

or the implementation of Best Management Practices. Compensatory mitigation in the form of wetland restoration, creation, or enhancement is a required permit condition under certain circumstances.

2.4.5.4 Nature Conservancy Biodiversity Ranked Areas

Over 270 occurrences of significant plant and animal species were recognized by The Nature Conservancy in its preliminary report of biodiversity on the ORR as part of Common Ground, the DOE Future Land Use Initiative (The Nature Conservancy 1995).

In addition, using a national ranking system, over 69 preliminary conservation sites were identified with occurrences of rare species and communities and other important features (e.g., caves, springs). These sites generally had clusters of important species or communities, with special emphasis placed on those species and elements designated as globally imperiled, rare, or uncommon in The Nature Conservancy and Natural Heritage Network ranking system. The sites also include the landscape features and ecological processes (i.e., watersheds) believed to be important for sustaining the occurrences of important species and communities. The sites were evaluated and given a biological significance ranking (BSR) based on their conservation significance. Sites on the ORR were rated BSR2 (very high significance), BSR3 (high significance), and BSR4 (moderate significance). The BSR5 category (of general biodiversity interest) was not used in The Nature Conservancy's report, although it notes that "forested land on ORR would fit in this or an above category." The Nature Conservancy areas of biological significance are identified in Fig. 2.7. The Nature Conservancy maintains ORR records of rare plant and animal species in the Biological and Conservation Database.

2.4.5.5 Nature Conservancy Landscape Complexes

The Nature Conservancy report also recommended protection of three large land areas on which are found many highly ranked conservation sites [i.e., those with rare communities and rare species, hardwood forests greater than 100 acres, and critical watersheds (The Nature Conservancy 1995) (Fig. 2.7)].

2.4.5.6 Research Park Endangered Species Habitats (Natural Areas)

Rare plant and animal species (state and/or federal candidate, and/or listed) are provided protection through preservation of the habitat that is required for their survival. Such critical habitat is established on the best available information about the need of the rare species and is protected through Research Park Natural Area designations. Fig. 2.8 shows the ORR areas designated as habitat for rare species.

2.4.5.7 Research Park Endangered Species Potential Habitats (Reference Areas)

Reference areas serve two functions. They provide protection to habitat with high potential for rare plant or animal species, and they provide protection for common or representative plant or animal communities that can serve as baseline areas for research and monitoring. Many of the areas originally designated as Research Park Reference Areas have been found to contain rare plant or animal species and have been changed to a Research Park Natural Area designation. Fig. 2.8 shows these areas as potential habitat for rare species.

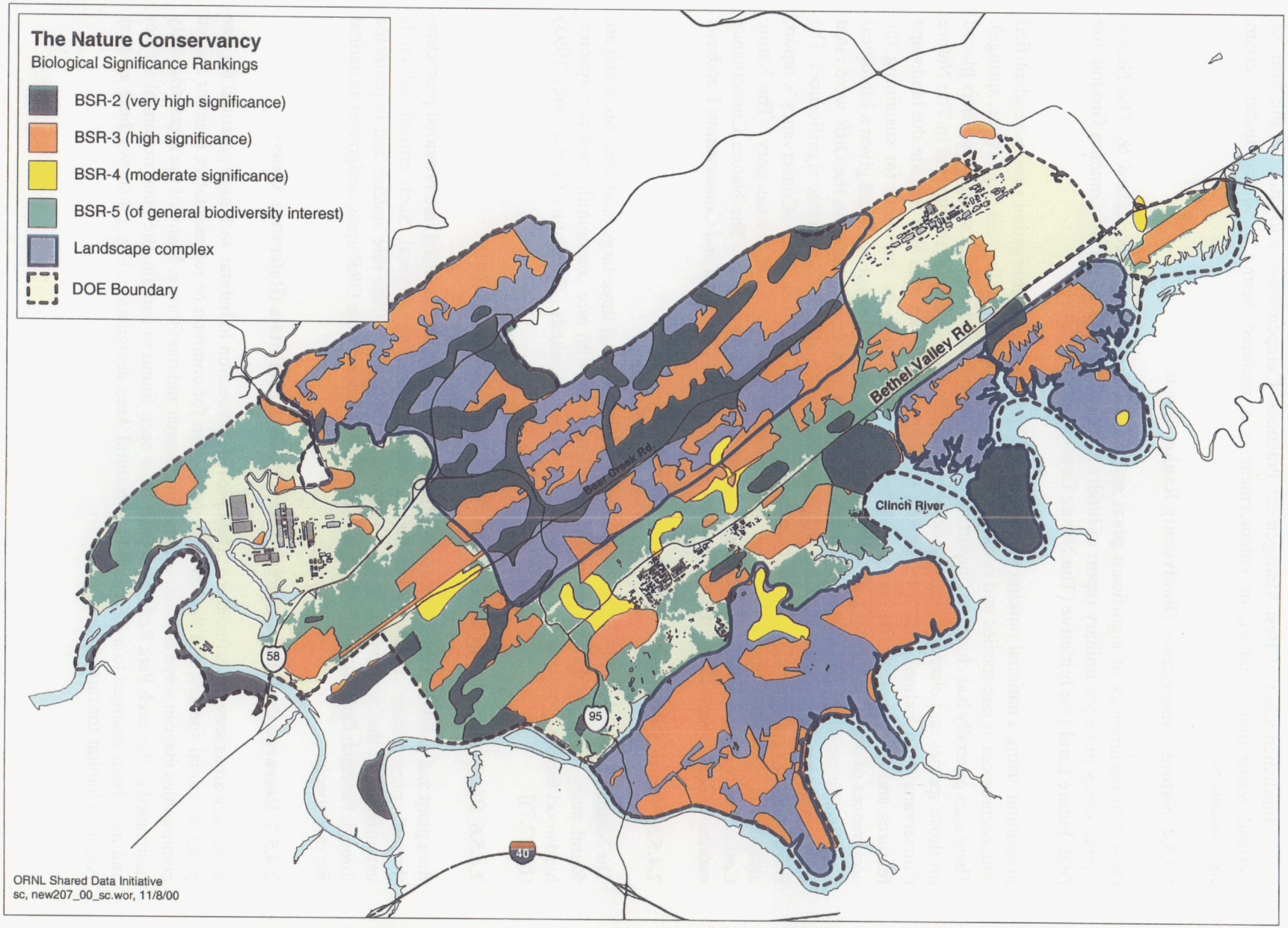


Fig. 2.7. The Nature Conservancy biodiversity rankings and landscape complexes.

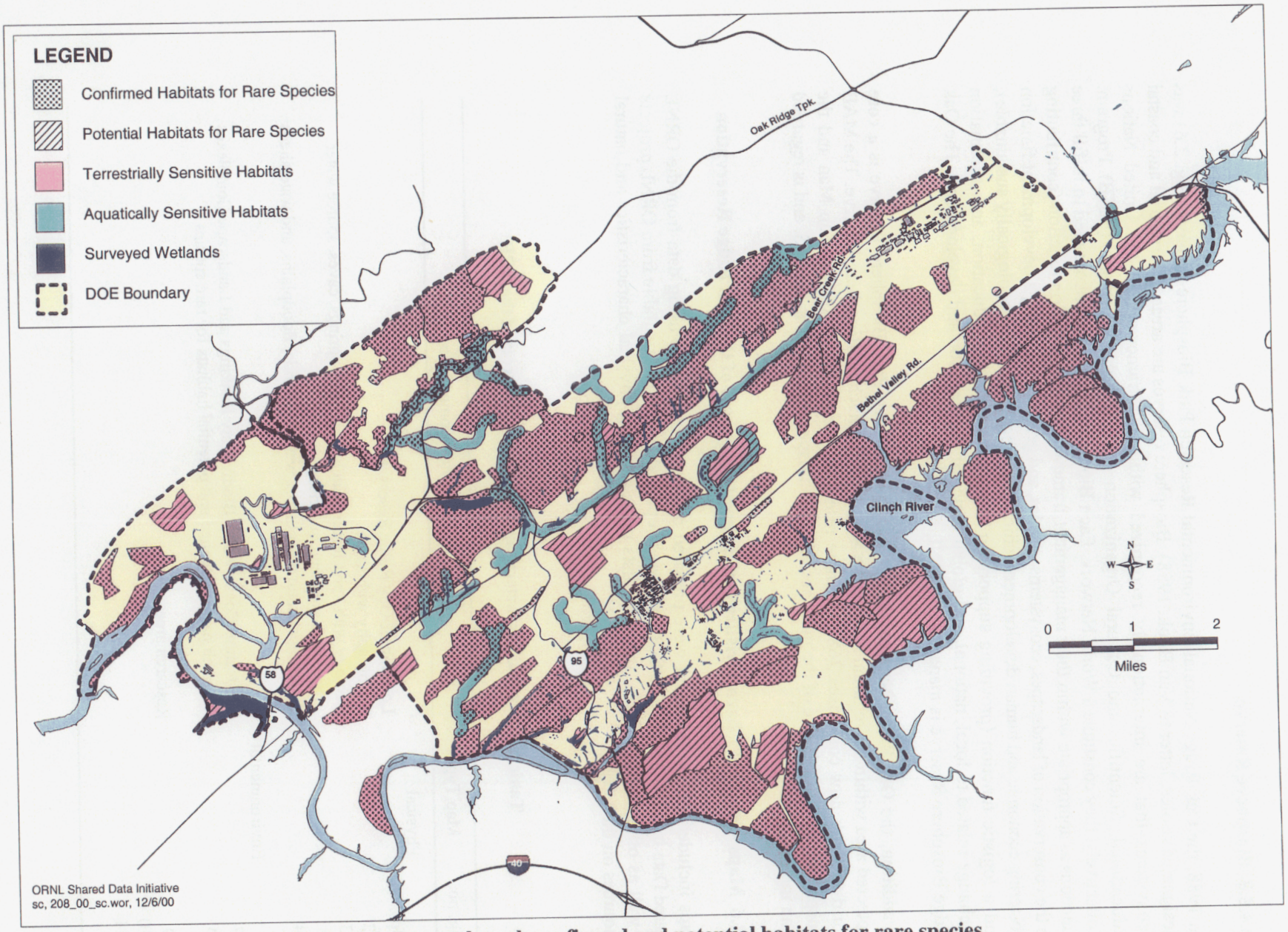


Fig. 2.8. Research park confirmed and potential habitats for rare species.

2.4.5.8 Biosphere Reserve

In 1988, the Oak Ridge National Environmental Research Park Biosphere Reserve (Fig. 2.6) was designated (Soles, letter to Van Hook, 1988). Biosphere reserves are areas of terrestrial and coastal ecosystems that are internationally recognized within the framework of the United Nations Educational, Scientific, and Cultural Organization Man and the Biosphere (MAB) Program. Collectively, they constitute a World Network. Each Biosphere Reserve is encouraged to fulfill three functions as appropriate within their management framework: a conservation function (contributing to the conservation of landscapes, ecosystems, species, and genetic variation); a development function (fostering economic and human development which is socioculturally and ecologically sustainable); and a logistic function (providing support for research, monitoring, education, and information exchange related to local, national, and global issues of conservation and development). The Oak Ridge Biosphere Reserve is managed by ORNL for DOE.

In addition, the Oak Ridge National Environmental Research Park Biosphere Reserve is a core protected area within the regional zone of the Southern Appalachian Biosphere Reserve. The MAB world network now comprises 368 biosphere reserves. The Southern Appalachian Man and the Biosphere (SAMAB) is one of the most active of 47 biosphere reserves in the U.S. and is regarded as an international model.

2.4.6 Maps - Physical Characteristics and Natural Resources of the Oak Ridge Reservation

Maps included in this document were prepared on MapInfo software using data from the ORNL Shared Data Initiative (SDI). The SDI database is updated as data are available from ORNL projects as well as other ORR projects. Table 2.1 lists maps showing physical characteristics and natural resources on the ORR.

Table 2.1. Physical characteristics and natural resources of the ORR

Fig. no.	Map Type	Main components
	Physical	
2.1		Location of Oak Ridge Reservation
2.2		Topography with slope
2.3		Geology with karst features including sinks, springs, caves, source water protection area, and quarries
2.4		Hydrologic features including water, wetlands, floodplains, and watersheds
	Environmental	
2.7		The Nature Conservancy Biodiversity Rankings and Landscape Complexes
2.8		Research park confirmed and potential habitats for rare species
2.9		Research areas
2.10		
2.11		

2.5 CURRENT LAND USE ON THE OAK RIDGE RESERVATION

2.5.1 National Environmental Research Park

Major DOE Office of Science scientific research programs use the ORR land base to meet mission objectives. In 1980, DOE established the Oak Ridge National Environmental Research Park. Consisting of approximately 20,000 acres, the Research Park serves as an outdoor laboratory for studying the nature of present and future environmental consequences from energy-related issues such as global and regional change, environmental stresses, and resource use (Fig. 1.1). It provides a protected land area for research and education in environmental sciences and is used to demonstrate that environmental quality can be compatible with energy technology development. Furthermore, the ORR is one of few sites in the nation where large-scale ecological research, environmental technology, and measurement science intersect against a backdrop of 30 years of environmental monitoring and research. The Research Park boundaries also form those of the Biosphere Reserve (Soles, letter to Van Hook, 1988).

The availability of the ORR protected lands and field research sites allows DOE [and its predecessor agencies, the U.S. Atomic Energy Commission (AEC) and the Energy Research and Development Administration] to support major field experiments that could not be done if the lands and associated ecological systems had not been protected and secured for such long-term studies. This research addresses fundamental questions about the effects of energy-related activities on ecological systems and compares such effects to the natural variation of ecological systems.

In addition, the Environmental Management (EM) program supports a variety of monitoring programs on the ORR to assess the effectiveness of remedial actions for reducing the release and transport of radiological and chemical contaminants from waste disposal sites. In the mid-1980s, long-term ecological monitoring programs were implemented for five ORR watersheds to assess the health and monitor the recovery of streams. Conventional monitoring approaches (laboratory toxicity tests, biota contaminant analyses, and benthic invertebrate and fish surveys) are combined with innovative, state-of-the-art techniques (biochemical indicators of fish health, biomarkers of genotoxicity, and in situ bioassays with endemic mollusks). Remote sensing information, current and historical aerial photography, and natural resource inventories developed in this program provide broad-scale information needed to characterize ecosystem status and dynamics over time.

The National Environmental Research Park is an ORNL User Facility with more than 700 users from colleges, universities, industries, ORNL, and other state and federal government agencies over the past 5 years. The National Environmental Research Park also serves as the umbrella for coordinating natural resource management on the entire ORR.

Environmental Field Research Areas. Lands of the ORR are used for research to meet the mission goals and objectives of DOE in many substantive ways. The research addresses major national issues and contributes to national and international collaborative initiatives on global climate change, tropospheric air quality, sustainable development, and biodiversity. These uses require protected blocks of land ranging from a few acres to more than 250 acres. Use of the land area for research is shown in Fig. 2.9. Areas with active research have been identified. Many of these active areas also include sites where research has been proposed (identified for specific projects for proposal submittals or pending actions) or is planned (areas with high potential for studying research issues of interest to DOE and other Research Park users).

The Oak Ridge National Environmental Research Park contains intensive, long-term ecological research areas, most notably Walker Branch Watershed, which is a gaged, 250-acre deciduous forest

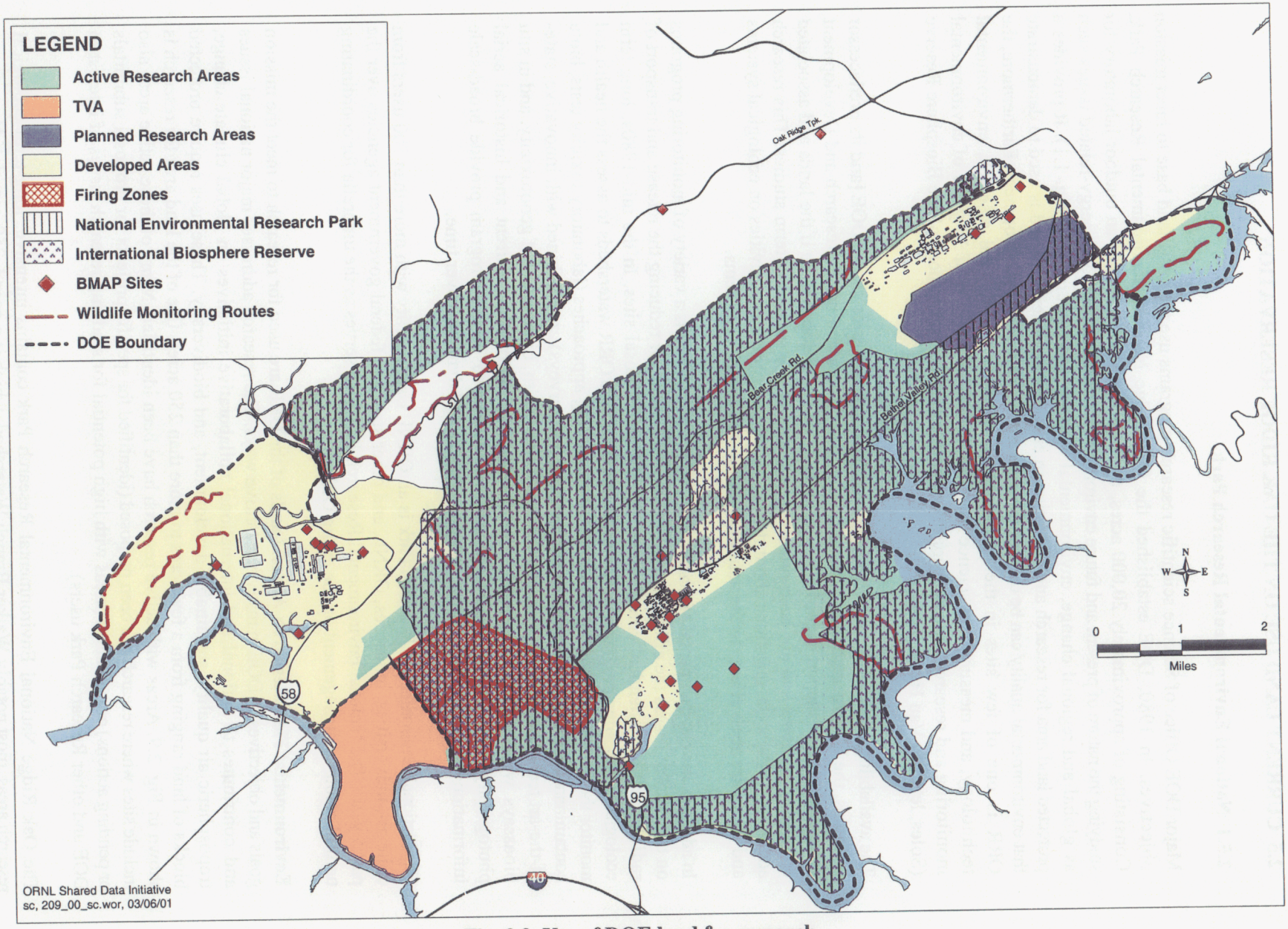


Fig. 2.9. Use of DOE land for research.

catchment with a 30-year record of forest and stream ecosystem experiments and monitoring. This research includes studies of hydrology, atmospheric chemical deposition, forest biogeochemical cycling, plant physiology and community dynamics, and stream ecology and nutrient cycling. Ongoing research includes (1) the Throughfall Displacement Experiment, a large-scale ecosystem-level manipulation designed to assess the effects of climate-related changes in precipitation on forest growth and productivity; (2) continuous measurements of trace gas fluxes between the forest and the atmosphere; (3) an experimental study of the rates and pathways of nitrogen cycling in the stream; and (4) National Oceanic and Atmospheric Administration/Atmospheric Turbulence Diffusion Division (NOAA/ATDD) air pollutant dry deposition monitoring. (NOAA has the longest record of air pollutant dry deposition measurements in the world at Walker Branch Watershed.) NOAA/ATDD has a similar long record of measuring solar radiation in various wavelengths, and the Walker Branch Solar Station is part of the Integrated Surface Irradiance Study, NOAA's national solar radiation observing network. Walker Branch is also a site in several national research networks, including the National Atmospheric Deposition Program. Several other streams on the ORR have been used for manipulative experiments to investigate the limitation of primary productivity and the ecological effects of ultraviolet-B radiation.

Three field facilities located at Source Area A in Waste Area Group 5 (WAG 5), West Bear Creek Valley, and Melton Branch Subwatershed are extensively instrumented to monitor storm driven unsaturated flow and saturated groundwater flow. The hydrologic and geochemical processes have been well characterized at each site, and instrumentation is available for performing sustained tracer injection studies. Investigations at the various sites have focused on quantifying the mechanisms of preferential flow and matrix diffusion in fractured saprolites and shale bedrock. Research findings have significantly improved our decision making strategies with regard to contaminant remediation in complex heterogeneous subsurface media.

In addition, several large lysimeters located west of the Y-12 National Security Complex in Bear Creek Valley are the site of manipulative, ecosystem-level experiments that use Genetically Engineered Microorganisms to investigate contaminant biodegradation in soil.

The thousands of acres of eastern hardwood forests on the ORR also support several large-scale ecological manipulation experiments that have established ORNL's national leadership role in global change impacts research. Diverse, complex, and large-scale experimental approaches are used to understand how forest ecosystems respond to the changes in temperature, precipitation, and atmospheric carbon dioxide (CO_2) concentrations expected from global climate change. For example, the Free Air CO_2 Enrichment (FACE) Facility in the 0800 Area was completed in 1997 to investigate the response of a forest ecosystem to increased CO_2 concentrations. This unique global change research facility is providing an opportunity for researchers from all over the U.S. to increase collaborative research on the effects that changes in precipitation or CO_2 may have on the long-term development of these forest communities.

Research use on the reservation has been categorized under four main research types. Fig. 2.10 shows the areas with active, proposed, and planned research for carbon cycling and management research, ecosystem dynamics research, global climate change research, and remediation research and monitoring. Specific research within these categories is described below and numbered corresponding to the research compartments shown in Fig. 2.11.

Carbon Cycling and Management Research. Carbon cycling research investigates the flows of carbon through ecosystems and the factors that control that flow, while carbon management research examines the mechanisms by which carbon is stored in ecosystems. Primary production and

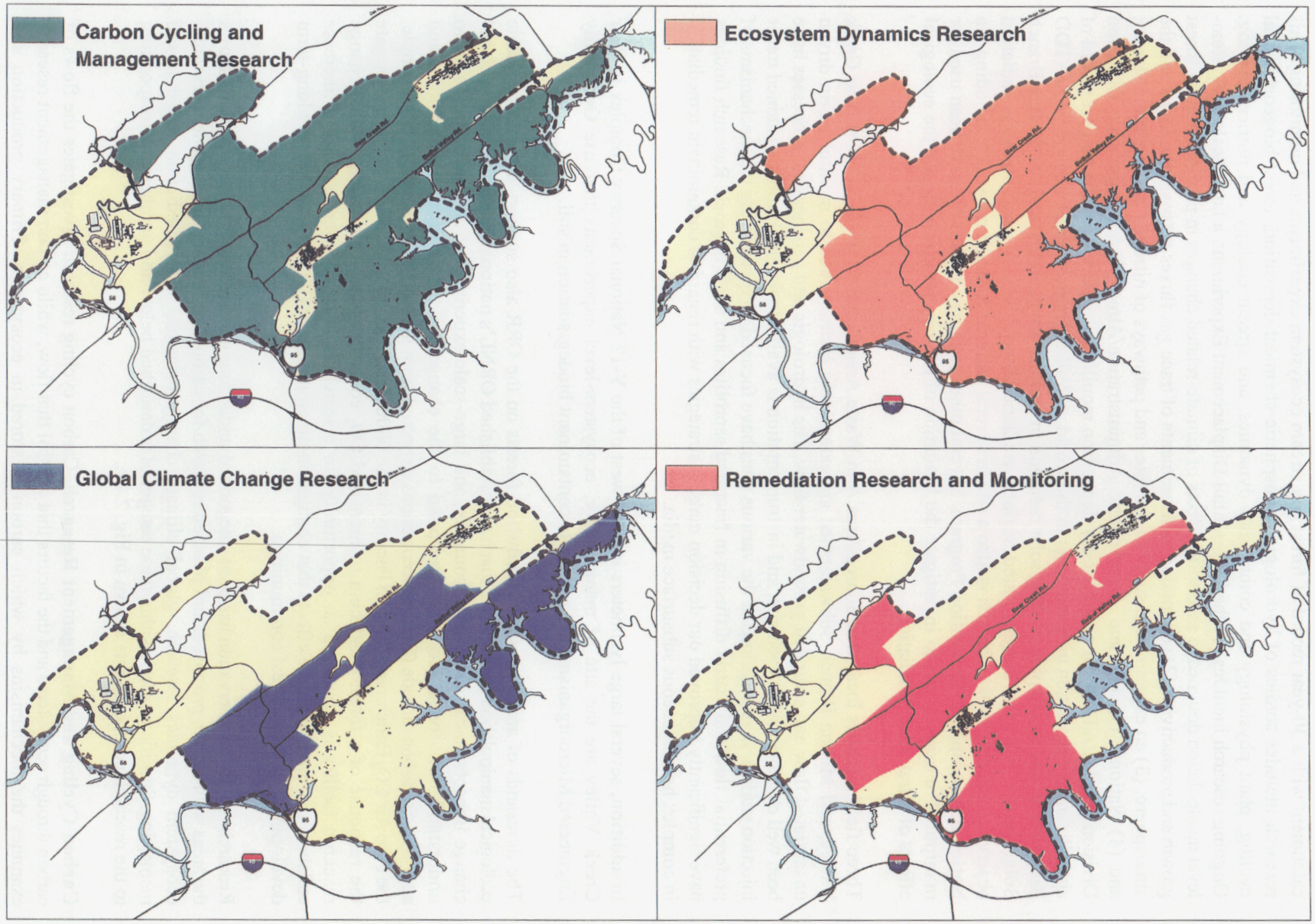


Fig. 2.10. Use of DOE land for specific types of research.

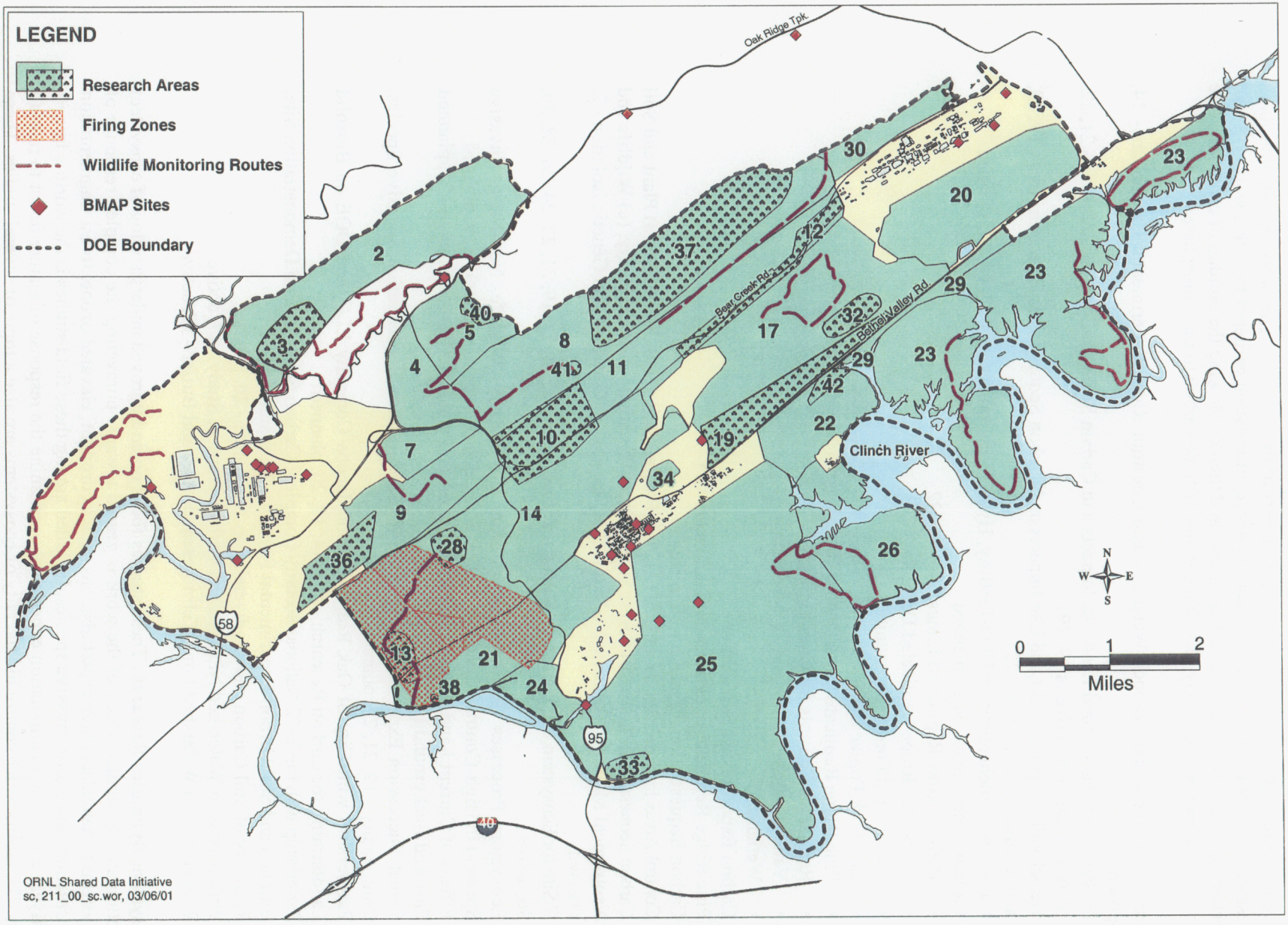


Fig. 2.11. Description of ORR research uses.

decomposition and soil carbon are key components of these studies. This work encompasses both terrestrial (forests and agriculture) and aquatic systems. Information garnered from this work will lead to better approaches for enhancing carbon uptake and thereby slowing the buildup of carbon dioxide in the atmosphere or conversely reducing the loss of fixed carbon to the atmosphere.

Control Area for Walker Branch Watershed and Chestnut Ridge Experimental Catchments - 14, proposed

- Bethel Valley Agricultural Land Use Impacts and Carbon Sequestration Research Area - 21, 22, planned (currently active in 19, 29)
- Bethel Valley Agricultural Land Use Impacts and Carbon Sequestration Research Area - 19, 29, active (also planned for 21, 22)
- Carbon Biogeochemistry in High-Fertility, Hydric Environments - 4, 7, 14, 21, planned
- Carbon Experimental Site - planned
  - Bethel Valley Replicated Limestone - 19, 22
  - Black Oak Ridge Replicated Dolomite - 2
  - Bottomland Forest Communities - 4
  - East Fork Poplar Creek - 5
  - Pine Ridge Replicate Experimental Catchments - 9
  - Replicated Controls for Chestnut Ridge - 25
  - Valley Bottom - 21
  - Wetland - 7
- Carbon Experimental Site - active
- Pine Ridge Replicate Experimental Catchments - 37
- Carbon Sequestration Research - 30, planned
- Control Areas for Research on Impacts of Urban Fragmentation with Respect to (a) Plant and Soil Carbon Sequestration Rates, (b) Forest Successional Dynamics on Biodiversity, (c) Wildlife and Neotropical Migrants, (d) Invasive Exotic Species, and (e) Geneflow and Genetic Isolation - 2, planned
- C Site for Ecosystem and Landscape Studies - 2, 5, 8, 9, 10, 11, 14, 17, 19, 21, 23, 24, 26, 28, 30, 36, active
- Ecosystem Processes (Carbon Sequestration, Biodiversity, Wildlife, Non-Native Invasive Species) in High-Contrast Landscapes (Dry Ridges, Wet Valley Bottoms) - 8, 9, planned
- Effects of Current Land Management Practices on Soil and Plant Carbon Storage - 23, planned
- Enriched Background Isotope Study, C-14 - 3, 9, 17, 22, active
- Forest Succession Experimental Sites for Wildlife, Carbon Sequestration, Invasive Species, Biodiversity - 19, 21, 22, planned
- Partnership with City of Oak Ridge, Bechtel Jacobs Company LLC, and DOE on Biosolid Landfarming for Carbon Research - 4, 5, 14, 17, 20, planned
- Partnership with the Y-12 National Security Complex, Carbon Sequestration Demonstration Site, Biomass and Soil Carbon Experimental Facility - 20, planned
- Recovery of Soil Carbon and Biodiversity on Ash Fields - 20, planned
- Walker Branch Watershed Nitrogen and Carbon Transect Study - 17, active
- Walker Branch Watershed Long-Term Research Area and Buffer - 17, active

Ecosystem Dynamics Research. These studies focus on an improved understanding of ecosystem function and dynamics. Much of the work is geared towards unraveling the complex response of ecosystems to natural and human perturbations such as drought, elevated ozone, forest fragmentation and isolation, and exotic invasive species. Included among these field studies is the world's largest multiyear ecosystem manipulation experiment to examine the response of mature forest to rainfall shifts. The factors which control biodiversity of ecosystems are also a topic of several studies. These

studies will improve our ability to predict ecosystem responses to change and help us better manage ecosystems so as to safeguard the resources they provide.

- Biofuels Research and Demonstration Site - 24, active (planned for 14, 19, 21, 23)
- Carbon Experimental Site, active
- Pine Ridge Replicate Experimental Catchments - 37
- Enriched Background Isotope Study, C-14 - 3, 17, 22, 36, active
- Forest Succession Experimental Sites for Invasive Species - 22, active
- Invasive Plant Control Research - Oriental Bittersweet - 8, active
- Exotic, Invasive Plant Research - 8, 17, 25, 26, 29, 30, active (13, 23, 25, 26, 29, 30, proposed)
- Long-Term Agricultural Impacts Research Plots - 32, 33, 34, active
- Long-Term Recovery from Agricultural Impacts - active
  - Complex Terrains - 17, 25, active (14, 26, planned)
  - Level Terrains - 19, active (22, planned)
- NOAA Partnership Area, NOAA Tower No. 2 and Footprint Area - 14, active
- NOAA Partnership Area, NOAA Tower No. 1 and Footprint Area - 17, active
- Partners in Flight Monitoring Route - 4, 5, 7, 8, 9, 11, 13, 14, 17, 21, 23, 25, 26, 30, area north of ETTP, ED-1, active
- Partnership with TWRA Wildlife Management Area on Wildlife Research, Monitoring, and Restoration - entire reservation, active
- Partnership with TWRA for biodiversity, educational, and research initiatives - 23, active
- Rare Plant Population Long-Term Monitoring - 29, active
- Throughfall Displacement Experiment - 17, active
- Tree Nutrition Study - 13, active
- Vascular Plant Monitoring Site - 28, 38, 39, 40, 41, 42, active
- Walker Branch Watershed Nitrogen and Carbon Transect Study - 17, active
- Walker Branch Watershed Long-Term Research Area and Buffer - 17, active
- Whole Tree Harvest Research - 28, active
- Biodiversity of Productive Riparian Areas - 4, 7, proposed
- Control Areas for Research on Impacts of Urban Fragmentation, with Respect to Invasive Exotic Species - 2, proposed
- Control Area for Walker Branch Watershed and Chestnut Ridge Experimental Catchments (Huston) - 14, proposed
- Forest Succession Experimental Sites for Invasive Species - 22, proposed
- Exotic, Invasive Plant Research - 13, 23, 25, 26, 29, 30, proposed (8, 17, 25, 26, 29, 30, active)
- Ecosystem Processes of Exotic, Invasive Plants in High-Contrast Landscapes - 9, proposed
- Large-Scale Catchment Study Area (Hanson) - 22, proposed
- Terrestrial Ecosystem Research Facility (TERF) - entire Research Park, proposed
- Biodiversity of Productive Riparian Areas - 14, 21, planned
- Biofuels Research and Demonstration Site - 14, 19, 21, 23, planned (active in 24)
- Biomass Recovery Plots - 9, planned
- Carbon Biogeochemistry in High-Fertility, Hydric Environments - 4, 7, 14, 21, planned
- Carbon Experimental Site - planned
  - Bethel Valley Replicated Limestone - 19, 22
  - Black Oak Ridge Replicated Dolomite - 2
  - Bottomland Forest Communities - 4
  - East Fork Poplar Creek - 5
  - Pine Ridge Replicate Experimental Catchments - 9
  - Replicated Controls for Chestnut Ridge - 25
  - Valley Bottom - 21
  - Wetland - 7

- Control Areas for Research on Impacts of Urban Fragmentation with Respect to (a) Plant and Soil Carbon Sequestration Rates, (b) Forest Successional Dynamics on Biodiversity, (c) Wildlife and Neotropical Migrants, (d) Invasive Exotic Species, and (e) Geneflow and Genetic Isolation - 1, 2, planned
- Ecosystem Processes (Carbon Sequestration, Biodiversity, Wildlife, Non-Native Invasive Species) in High-Contrast Landscapes (Dry Ridges, Wet Valley Bottoms) - 8, 9, planned
- Ecosystem Consequences of High Geological Complexity (Huston) - 5, planned
- Effects of Current Land Management Practices on Soil and Plant Carbon Storage - 23, planned
- Forest Succession Experimental Sites for Wildlife, Carbon Sequestration, Invasive Species, Biodiversity - 19, 21, 22, planned
- High-Complexity Shoreline Effects on Wildlife, Biodiversity, Biogeochemical Flux Rates - 26, planned
- Long-Term Recovery from Agricultural Impacts - planned
  - Complex Terrains - 14, 26, planned (17, 25, active)
  - Level Terrains - 22, planned
- National Ecological Observation Network (NEON) - entire Research Park, planned
- Partnership with City of Oak Ridge, Bechtel Jacobs Company LLC, and DOE on Biosolid Landfarming for Carbon Research - 4, 5, 14, 17, 20, planned
- Experimental Facility - 20, planned
- Pine Bark Beetle Recovery Area Research - 19, 21, 22, 29, planned
- Recovery of Soil Carbon and Biodiversity on Ash Fields - 20, planned
- Replicated Controls for Chestnut Ridge - 14, 17, 26, planned
- Role of High-Productivity Habitats in Wildlife Conservation - 4, 7, 14, 21, planned
- Urban/Industrial Impacts on Isolated Natural Areas - 30, planned

Global Climate Change Research. These studies examine the response of ecosystems to atmospheric and climatic changes and our ability to monitor those changes. Joint studies with NOAA evaluate our ability to measure gas fluxes (e.g., CO_2, H_2O) over whole watersheds and thereby infer watershed productivity and water flux. The Free Air CO_2 Enrichment (FACE) experiment, in which a closed-canopy sweetgum plantation is exposed to elevated carbon dioxide, examines long-term forest ecosystem response to elevated carbon dioxide. This study builds upon open-topped chamber experiments on the reservation in which tree seedlings are grown for multiple years under natural rainfall and light, but altered, carbon dioxide. Tree and grass crops for energy production are also the subject of field studies. These crops could provide an alternative energy source to fossil fuels. This suite of studies is aimed towards improving (1) our understanding of the impact of climate and the atmosphere on ecosystems and (2) our ability to manipulate ecosystems to mitigate negative effects of those changes.

- Biofuels Research and Demonstration Site - 24, active (planned for 14, 19, 21, 23)
- Free Air CO_2 Enrichment (FACE) - 24, active
- Global Carbon Cycle Studies - 24, active
- Global Climate Change Field Research Facility - 24, active
- NOAA Partnership Area, NOAA Tower No. 2 and Footprint Area - 14, active
- NOAA Partnership Area, NOAA Tower No. 1 and Footprint Area - 17, active
- Throughfall Displacement Experiment - 17, active
- Walker Branch Watershed Long-Term Research Area and Buffer - 17, active
- Control Area for Walker Branch Watershed and Chestnut Ridge Experimental Catchments - 14, proposed
- Large-Scale Catchment Study Area - 22, proposed
- Terrestrial Ecosystem Research Facility (TERF) - entire Research Park, proposed
- Biofuels Research and Demonstration Site - 14, 19, 21, 23, planned (active in 24)

Remediation Research and Monitoring. Like many other locations, production and research activities in the past have left the ORR with many sites contaminated with toxic chemicals and/or radionuclides. Scientists have taken advantage of on-site contamination to study in situ the pathways by which contaminants move through the sites (soils, air, groundwater), the chemical and physical changes that occur to contaminants, and approaches that could be used to remediate or clean up such sites. Long-term monitoring of such sites is an important component of understanding the fate of contaminants. Site characterization of hydrologic flow (the chief means of contaminant movement) is key to many field remediation studies; consequently, such study sites are often heavily instrumented. Oak Ridge was recently selected by DOE to be the Field Research Center (FRC) for DOE's Natural Acceleration Bioremediation Investigation Research (NABIR) program. The FRC provides a site to conduct research and obtain samples related to in situ bioremediation of metals and radionuclides. The FRC includes a contaminated area for experiments on a plume of contaminated groundwater, a background area that provides for comparison studies in an uncontaminated area, and ancillary structures located with a 3.2-mile radius of each other on the ORR. These studies will lead to an improved understanding of the fate of contaminated sites at Oak Ridge and elsewhere and the most effective approaches to their cleanup.

- Biological Monitoring and Abatement Site - 14, 19, 25, Upper Mitchell Branch east of ETTP, ED-1, active
- Hydrology Field Sites - 10, 11, active
- Natural Acceleration Bioremediation Investigation Research (NABIR) Field Research Center - 11, active
- Natural Acceleration Bioremediation Investigation Research Reference Area - 10, active
- Partnership with City of Oak Ridge, Bechtel Jacobs Company LLC, and DOE on Biosolid Landfarming for Carbon Research - 4, 5, 14, 17, 20, planned

Compartment identifications for research areas are shown in Fig. 2.11. Many research projects include most of the reservation land area, excluding facilities.

Entire Research Park and Other Land Areas Outside of Facilities.
- Center for Bioenergy Research
- Partnership with TWRA Wildlife Management Area on Wildlife Research, Monitoring, and Restoration
- C Site for Ecosystem and Landscape Studies
- Partners in Flight Cooperative Study Site

Specific active research projects within each compartment or area are described below. Proposed and planned research within these areas is described in Section 2.6.1 (Ecosystem Research).

Area 2
- C Site for Ecosystem and Landscape Scale Studies

Proposed research areas:
- Control Area for Impacts of Urban Fragmentation on Invasive Exotic Species

Area 3
- Enriched Background Isotope Study, C-14

Area 4
- Partners in Flight Monitoring Route

Area 5
- C Site for Ecosystem and Landscape Scale Studies
- Partners in Flight Monitoring Route

Area 7
- Partners in Flight Monitoring Route

Proposed research areas:
- Biodiversity of Productive Riparian Areas, Invasive Plant Species

Area 8
- C Site for Ecosystem and Landscape Scale Studies
- Partners in Flight Monitoring Route
- Invasive Exotic Plant Species Research
- Invasive Plant Control Research - Oriental Bittersweet

Area 9
- C Site for Ecosystem and Landscape Scale Studies
- Enriched Background Isotope Enrichment Site
- Partners in Flight Monitoring Route

Area 10
- C Site for Ecosystem and Landscape Scale Studies
- Hydrology Field Sites
- Natural Acceleration Bioremediation Investigation Research Reference Area

Area 11
- C Site for Ecosystem and Landscape Scale Studies
- Natural Acceleration Bioremediation Investigation Research (NABIR) Field Research Center
- Partners in Flight Monitoring Route

Area 13
- Tree Nutrition Study Partners in Flight Monitoring Route

Area 14
- C Site for Ecosystem and Landscape Scale Studies
- Partners in Flight Monitoring Route
- NOAA Partnership Area, NOAA Tower No. 2 Footprint Area
- Control Area for Walker Branch Watershed and Chestnut Ridge Experimental Catchments
- NOAA Partnership Area, NOAA Tower No. 2
- Biological Monitoring and Abatement Site
- Invasive Exotic Plant Species Research

Area 17
- C Site for Ecosystem and Landscape Scale Studies
- Walker Branch Watershed Long-Term Research Area and Buffer
- Enriched Background Isotope Study, C-14
- Invasive Exotic Plant Species Research
- Partners in Flight Monitoring Route
- NOAA Partnership Area, NOAA Tower No. 1 and Footprint
- Walker Branch Watershed Nitrogen and Carbon Transect Study
- Long-Term Recovery from Agricultural Impacts in Complex Terrains

Area 19
- C Site for Ecosyst em and Landscape Scale Studies
- Biological Monitoring and Abatement Site
- Long-Term Recovery from Agricultural Impacts in Level Terrains
- Bethel Valley Agricultural Land Use Impacts and Carbon Sequestration Research Area

Area 21
- C Site for Ecosystem and Landscape Scale Studies
- Partners in Flight Monitoring Route

Area 22
- Enriched Background Isotope Study, C-14
- Forest Succession Experimental Sites for Invasive Plant Species

Area 23
- C Site for Ecosystem and Landscape Scale Studies
- Partnership with TWRA, Biodiversity Educational and Research Institute or ECOEDge
- Partners in Flight Monitoring Route

Area 24
- C Site for Ecosystem and Landscape Scale Studies
- Global Climate Change Field Research Facility
- Invasive Exotic Plant Species Research
- Free Air CO_2 Enrichment (FACE)
- Global Carbon Cycle Studies
- Biofuels Research and Demonstration Site

Area 25
- Biological Monitoring and Abatement Site
- Partners in Flight Monitoring Route
- Long-Term Recovery from Agricultural Impacts in Complex Terrain
-

Area 26
- C Site for Ecosystem and Landscape Scale Studies
- Partners in Flight Monitoring Route

Area 28
- C Site for Ecosystem and Landscape Scale Studies
- Whole Tree Harvest Research
- Vascular Plant Monitoring Site - experimental

Area 29
- Rare Plant Population Long-Term Monitoring
- Invasive Exotic Plant Species Research

Area 30
- C Site for Ecosystem and Landscape Scale Studies
- Partners in Flight Monitoring Route

Area 32
- Ongoing Long-Term Agricultural Impacts Research Plots

Area 33
- Ongoing Long-Term Agricultural Impacts Research Plots

Area 34
- Ongoing Long-Term Agricultural Impacts Research Plots

Area 36
- Enriched Isotope Background Enrichment Study Area

Area 37
- Carbon Experimental Site, Pine Ridge Replicate Experimental Catchments

Area 38
- Vascular Plant Monitoring - Reference Site

Area 39
- Vascular Plant Monitoring - Reference Site

Area 40
- Vascular Plant Monitoring - Reference Site

Area 41
- Vascular Plant Monitoring - Reference Site

Area 42
- Vascular Plant Monitoring - Reference Site

ED-1 Area
- Partners in Flight Monitoring Routes
- Biological Monitoring and Abatement site
-

ETTP Area
- Partners in Flight Monitoring Route
- Biological Monitoring and Abatement sites

More detailed information on environmental research is found in *Environmental Sciences: Research, Assessment, and Technology to Understand and Meet the Challenges of the Future* (Environmental Sciences Division 1998) and on the Environmental Sciences Division World Wide Web site at http://www.esd.ornl.gov/.

In addition to DOE, past and present sponsors of research on the site include the National Science Foundation, the Department of Defense, the EPA, the USDA, the Forest Service, the Nuclear Regulatory Commission, and the Electric Power Research Institute. Ongoing research collaborations also exist with the National Oceanic and Atmospheric Administration and TVA.

2.5.2 Safety

To ensure employee and guest safety, buffer areas around training facilities and other hazard areas are identified with highly visible signage. Employees and guests are expected to comply with signage and are encouraged to report unsafe conditions observed in the field.

2.5.2.1 Training Facilities with Surface Danger Zones

Two contiguous major firing ranges are located within the ORNL area of responsibility: the Southeastern Couriers Transportation and Safeguards Training Facility, operated by DOE Albuquerque, and the Central Training Facility (CTF) operated by Wackenhut Services, Inc. (Fig. 2.12). The ranges and their surface danger zones or buffer areas encompass about 2500 acres. Public entry into these areas is prohibited and strictly controlled. The two range areas, which are located on the south side of Bear Creek Road about 5 miles west of the Y-12 Plant, extend from the DOE ORR boundary on the west to Highway 95 on the east and from Bear Creek Road on the north to the Clinch River on the south. The eastern portion of the site is operated by DOE's Transportation Safeguards Division Southeastern Courier Section and consists of four individual live-fire ranges and associated support facilities. The western portion of the range site is operated for DOE by Wackenhut Services, Inc., as a CTF and consists of an indoor range, five outdoor ranges, a shooting tower, three live-fire facilities, and assorted tactical facilities. Fire is directed to the south and southeast into an approximately 200-foot-high ridge. Safety analyses for the firing range activities were based on the absence of a permanent population in the downrange areas. Any change in land use in the vicinity of the firing ranges would entail a change in the safety analyses.

2.5.2.2 Emergency Planning Zones

Federal statutes [40 *Code of Federal Regulations* (*CFR*) parts 301, 302, 304, and 355] require each state, tribal, or local government to protect its citizens from releases of hazardous materials. The emergency planning zone around each ORO site (ETTP, ORNL, and the Y-12 National Security Complex) extends out 5 miles and is subdivided into emergency planning sectors that are defined by easily recognizable terrain features (*Oak Ridge Reservation Emergency Plan* 1998). Hazard assessments support the designation of emergency planning zones in which special planning is required to ensure that prompt and effective protective actions can be taken to minimize the risk to on-site personnel, the general public, and the environment in the event of an emergency.

2.5.3 Compliance and Monitoring

Operations at all facilities on the ORR must comply with environmental requirements established by federal and state statutes and regulations, executive orders, some DOE orders, and legal compliance and settlement agreements. The TDEC and EPA are principal among the regulatory agencies that issue permits, inspect operations, and oversee environmental compliance on the ORR. Changes in land use have the potential for impacting not only widespread ongoing compliance activities, but also operations at the EPA- and TDEC-regulated facilities. The facilities were intentionally located away from population centers with unpopulated land area between the facilities and local residents. Changes in the unpopulated land area could alter dose calculations required for meeting radiological

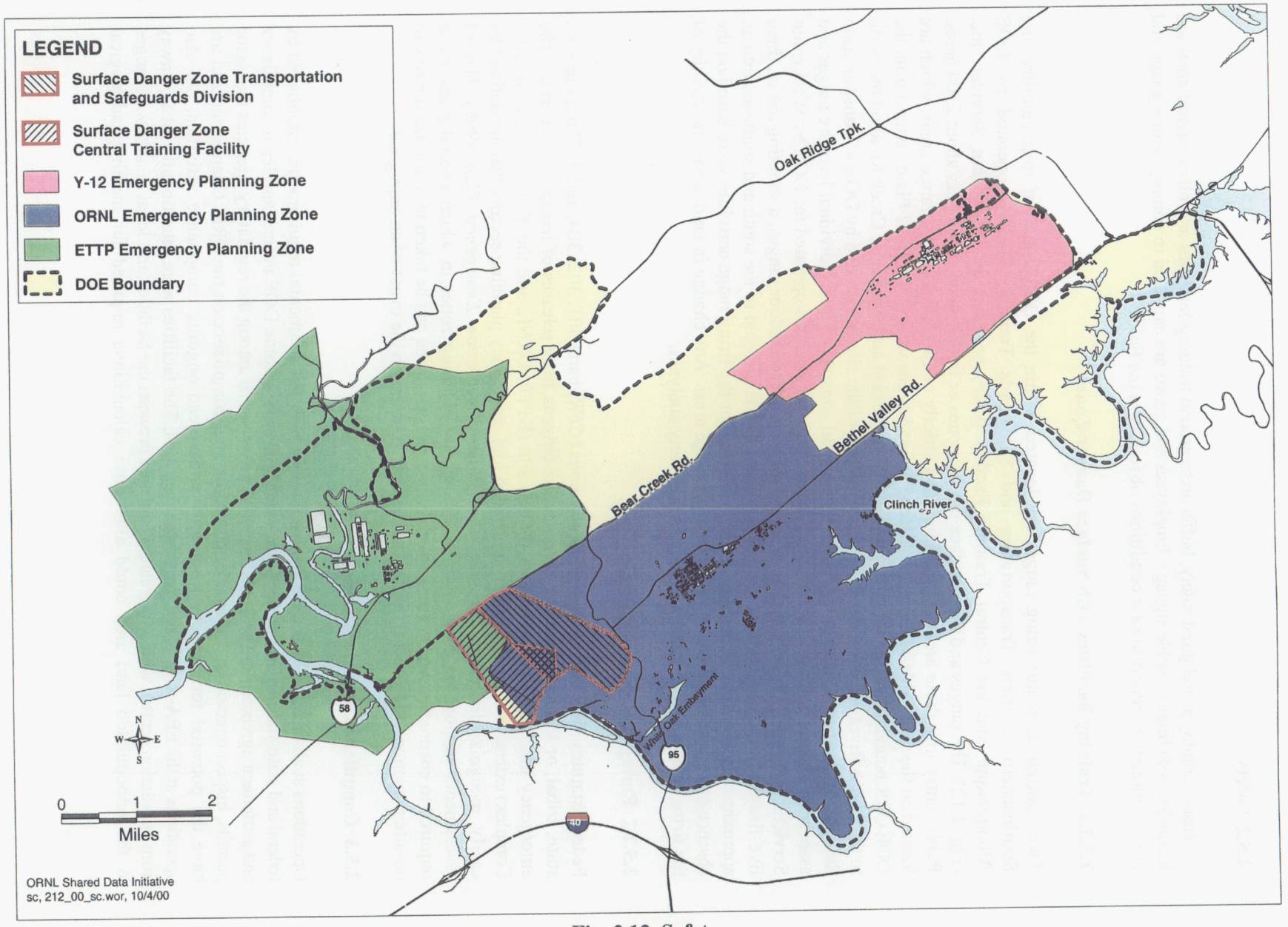


Fig. 2.12. Safety.

requirements, such as those in the Clean Air Act National Emission Standards for Hazardous Air Pollutants (NESHAP) [40 *CFR* 61, Subpart H], and thereby impact facility operations.

As regulatory agencies transition to watershed-based load-allocation permitting for wastewater discharges, the presence of additional new facilities on the ORR that need to discharge wastewaters to ORR streams under the National Pollutant Discharge Elimination System (NPDES) could cause DOE to reduce constituent concentrations in DOE-facility wastewater effluents in order to control watershed loading to an acceptable standard. An annual summary, prepared for the ORR environmental activities (White et al. 2000), can be found internally on the World Wide Web at http://www.ornl.gov/Env_Rpt/aser99/aser.htm. Fig. 2.13 shows environmental compliance and monitoring locations on the reservation.

2.5.3.1 Environmental Monitoring

Environmental monitoring on the ORR consists of two major activities: effluent monitoring and environmental surveillance. Effluent monitoring consists of the collection and analysis of liquid, gaseous, or airborne effluents at their sources. Environmental surveillance consists of the collection and analysis of samples of air, surface water, groundwater, foodstuffs, biota, and other environmental media from areas that have the potential to be affected by activities on the ORR. Data from the analyses are used to assess chemical and radiation exposures to members of the public and to demonstrate compliance with environmental permits and regulations.

2.5.3.2 Air Monitoring

The ORR has approximately 600 sources of potential airborne contaminants covered by approximately 72 air emission permits. Each source is permitted in accordance with regulations developed and enforced by TDEC. Point sources that emit radionuclides are regulated through EPA's NESHAP program, and the ORR has approximately 13 of these sources with potential doses greater than 0.1 mrem/year (White et al. 2000). NESHAP requires the use of dispersion modeling to calculate population exposures. Dispersion modeling requires local meteorological data.

Meteorological conditions on the ORR are provided by seven widely spaced meteorological towers. The data are used in dispersion modeling to predict impacts of facility operations. In addition, these data are essential as input to emergency response atmospheric models used in the event of accidental releases from a facility. The towers range from 100 to 330 feet in height, and data are collected at two to three levels above ground.

In addition to monitoring the sources of effluent release (e.g., stacks), ambient air is monitored at various locations on the ORR to determine whether effluents from the facilities are increasing levels of radiation or air contaminants. The ambient air monitoring program, which assesses the impact to air quality of operations on the entire ORR, includes operation of a network of perimeter air monitoring stations. These stations incorporate gamma radiation detectors as well as instrumentation for quantifying alpha-, beta-, and gamma-emitting radionuclides, uranium, tritium, and beryllium. NOAA/ATDD operates 16 meteorological towers for collection of routine observations throughout East Tennessee, including one at Walker Branch Watershed. Local climatological data for the Oak Ridge area includes records back to 1950.

2.5.3.3 Surface Water Monitoring

The primary statute governing the monitoring of effluent discharges to surface waters on the ORR is the CWA, which requires the issuance of NPDES permits. The ORNL NPDES permit lists 161 point-

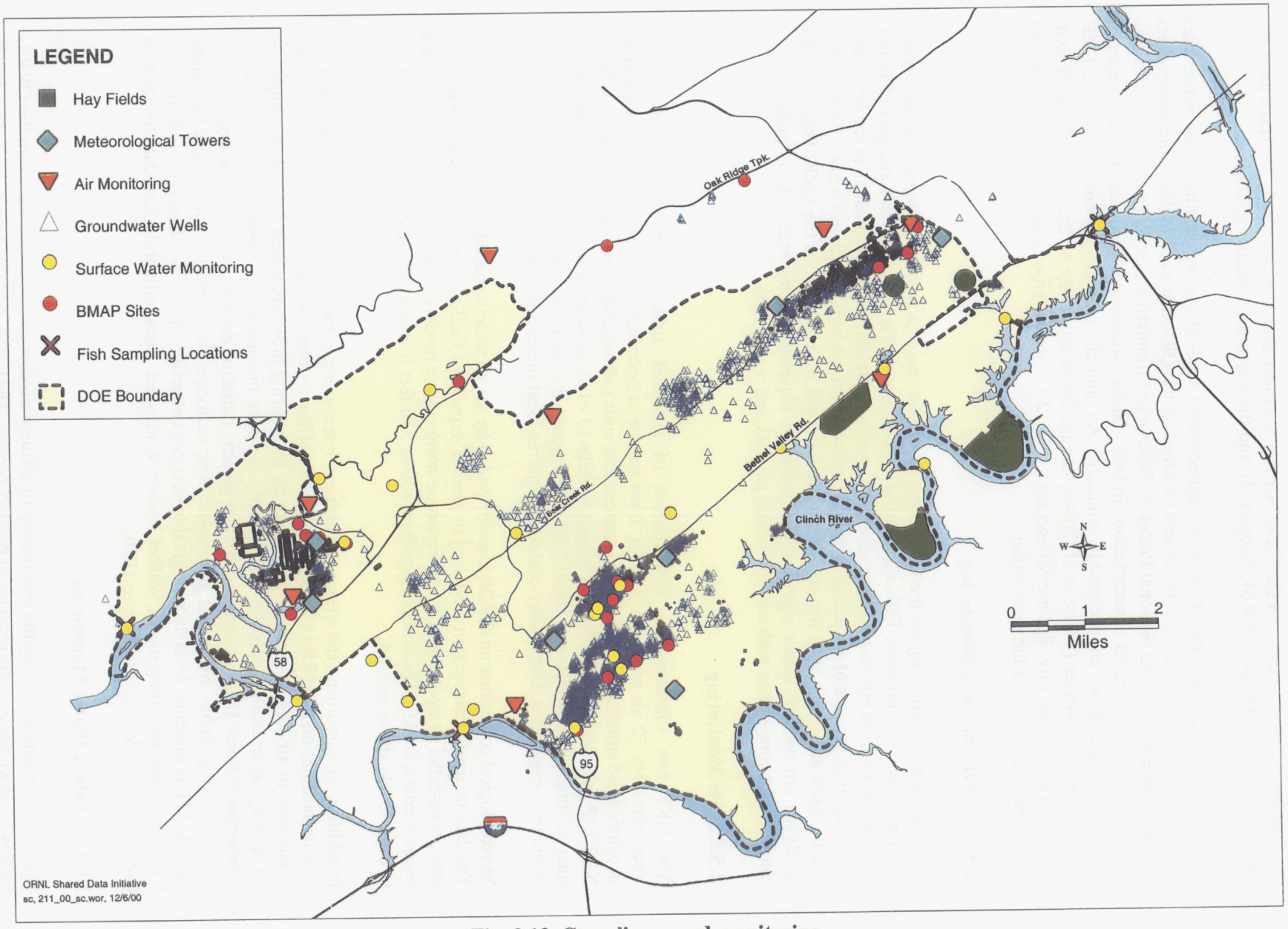


Fig. 2.13. Compliance and monitoring.

source discharges that require compliance monitoring, the Y-12 permit lists 100 sources, and the K-25 permit lists about 150, for a total of approximately 400 CWA discharge points for the ORR.

To assess the impact of ongoing, as well as past, discharges to receiving streams, surface water samples are collected from 22 stream locations on and around the ORR. Water quality measurements serve as guides to the health of the environment, and measurements therefore include sampling of reference streams upstream of operations on the ORR. Reference data are used to establish the baseline against which the health of ORR streams is assessed for regulatory purposes. These reference streams, which are located in undeveloped portions of the ORR, have been sampled for years and provide a long-term baseline against which current data can be evaluated. The sites were carefully selected, have been approved by the regulatory agencies, and must remain undisturbed for the indefinite future.

2.5.3.4 Groundwater Monitoring

Two geological units on the ORR, the Knox group and the Maynardville limestone of the Conasauga group, both consisting of dolostone and limestone, constitute the Knox aquifer. A combination of fractures and solution conduits in this aquifer control groundwater flow over substantial areas, and relatively large quantities of water may move relatively long distances. Active groundwater flow can occur at substantial depths in the Knox aquifer (300 to 400 feet), which is the primary source of groundwater to many streams (base flow) and most large springs on the ORR. Yields of some wells penetrating larger solution conduits exceed 1000 gal/min.

The direction of groundwater flow through an aquifer system is determined by the permeability of the strata containing the aquifer and by the hydraulic gradient, which is a measure of the hydraulic head over a specified distance. This difference in head constitutes the driving force for groundwater movement, whereas aquitards, which are geological units of lower permeability that deflect groundwater movement, constrain groundwater movement on the ORR, usually in a horizontal direction. The typical yield of a well in the aquitards is less than 1 gal/min. Potential groundwater exit pathways are shown to follow the path of the permeable strata.

Since contamination follows groundwater movement, information regarding the direction and rates of groundwater flow is needed for assessing the potential for contamination exposure. However, the geohydrology of the ORR is sufficiently complex that contaminant transport is difficult to predict on a local scale. For example, the leading edge of a contaminant mass such as tritium may migrate along fractures at a typical rate of 3 feet/d, whereas the center of mass of the contaminant plume migrates at less than 0.2 feet/d. Also, the center of mass of the volatile organic compound (VOC) plume east of the Y-12 National Security Complex lies at a depth of 300 feet, and transport takes place at this depth because VOCs are denser than water. Because of the geohydrologic complexity of the ORR and the many different regulations governing groundwater monitoring requirements (e.g., the Resource Conservation and Recovery Act, CERCLA, TDEC Solid Waste Management regulations, and regulatory requirements for groundwater monitoring for petroleum underground storage tanks), an integrated groundwater monitoring program has been established.

To fully comply with regulatory requirements, to delineate and predict the extent of groundwater contamination on the ORR, and to protect the public and the environment, a groundwater surveillance monitoring program is in effect. The program includes groundwater monitoring wells on the ORR. Although most wells are located at the facility sites, where contamination is greatest, the areas on the ORR containing groundwater monitoring wells are essential for providing regulatory compliance data and supporting monitoring program objectives.

Source Water Protection Area. The First Creek headwaters have been identified as a sensitive water source for the Aquatics Research Laboratory, Building 1504. Fig. 2.3 shows the First Creek Source Water Protection Area. The area is based on a combination of surface topography and geology. The southern boundary of the area was confirmed in June 1999 by groundwater tracing from disappearing streams to springs in the First Creek headwater. Extensive terrain modification or contamination of groundwater or surface water within this area will have adverse impacts on the water quality of First Creek and consequently impact the Aquatics Research Laboratory.

2.5.3.5 Terrestrial Vegetation Monitoring

Contaminants released from facilities on the ORR can accumulate in food crops and in terrestrial animals that feed on vegetation on the ORR. Because the primary exposure pathway for contaminants in humans is the ingestion of crops, meat (e.g., deer, geese, and wild turkey), and milk, both hay and food crops grown on or near the ORR are collected and analyzed to evaluate potential radiation doses.

Vegetables, such as tomatoes, lettuce, and turnips, are collected from local gardens which have been identified as potential deposition areas. Samples from each plot are analyzed for gross alpha and beta radiation, gamma emitters, and uranium. The results are compared to crops grown at a reference site outside the influence of ORR activities.

Because radionuclides can be transferred to humans from the environment through the food chain (e.g., grass to cow to milk to human), milk is considered a significant potential exposure source. Even small amounts of radionuclides deposited from airborne emissions can be significant because of the large surface area that can be grazed by a cow, the rapid transfer of milk from producer to consumer, and the importance of milk in the human diet. Milk is collected bimonthly from local producers and analyzed for radioactive iodine, radioactive strontium, and tritium.

2.5.3.6 The Biological Monitoring and Abatement Program

Biological monitoring of streams on the ORR has been conducted for more than 15 years. The Biological Monitoring and Abatement Programs (BMAPs) at the three DOE facilities on the ORR were developed to meet NPDES permit requirements and include tasks on (1) toxicity monitoring; (2) bioaccumulation in aquatic biota; (3) bioindicators of fish health; and (4) fish, macroinvertebrate, and periphyton community surveys. Additional BMAP tasks are required by the individual facility-specific NPDES permit. Each of these tasks utilizes water or fauna from streams near the ETTP (Mitchell Branch and Poplar Creek), ORNL (White Oak Creek and its tributaries), and the Y-12 Plant (East Fork Poplar Creek). In addition, reference streams used for comparison with contaminated sites include Scarboro Creek, Ish Creek, and Mill Branch (Peterson 2000; Smith 2000).

2.5.4 Contaminated Areas

Since 1942, the three plants on the ORR have had significantly different operations and missions, but all have generated various types of wastes that were disposed of on-site in waste management areas. On-site disposal of RCRA and/or PCB wastes ceased in the early 1980s. However, the early waste disposal practices have resulted in contaminated streams, groundwater, and soil on the reservation. Spills, piping leaks, and other inadvertent releases (historic use of lead-based paint or PCB-contaminated paint) have contributed to environmental contamination. Most of the contamination occurs within the waste management areas and the developed and fenced areas of the Y-12 Plant, ETTP, and ORNL (Fig. 2.14). Waste management at ORNL included such activities as the disposal of radioactive waste materials by shallow land burial from 1951 to 1993, the disposal of liquids in

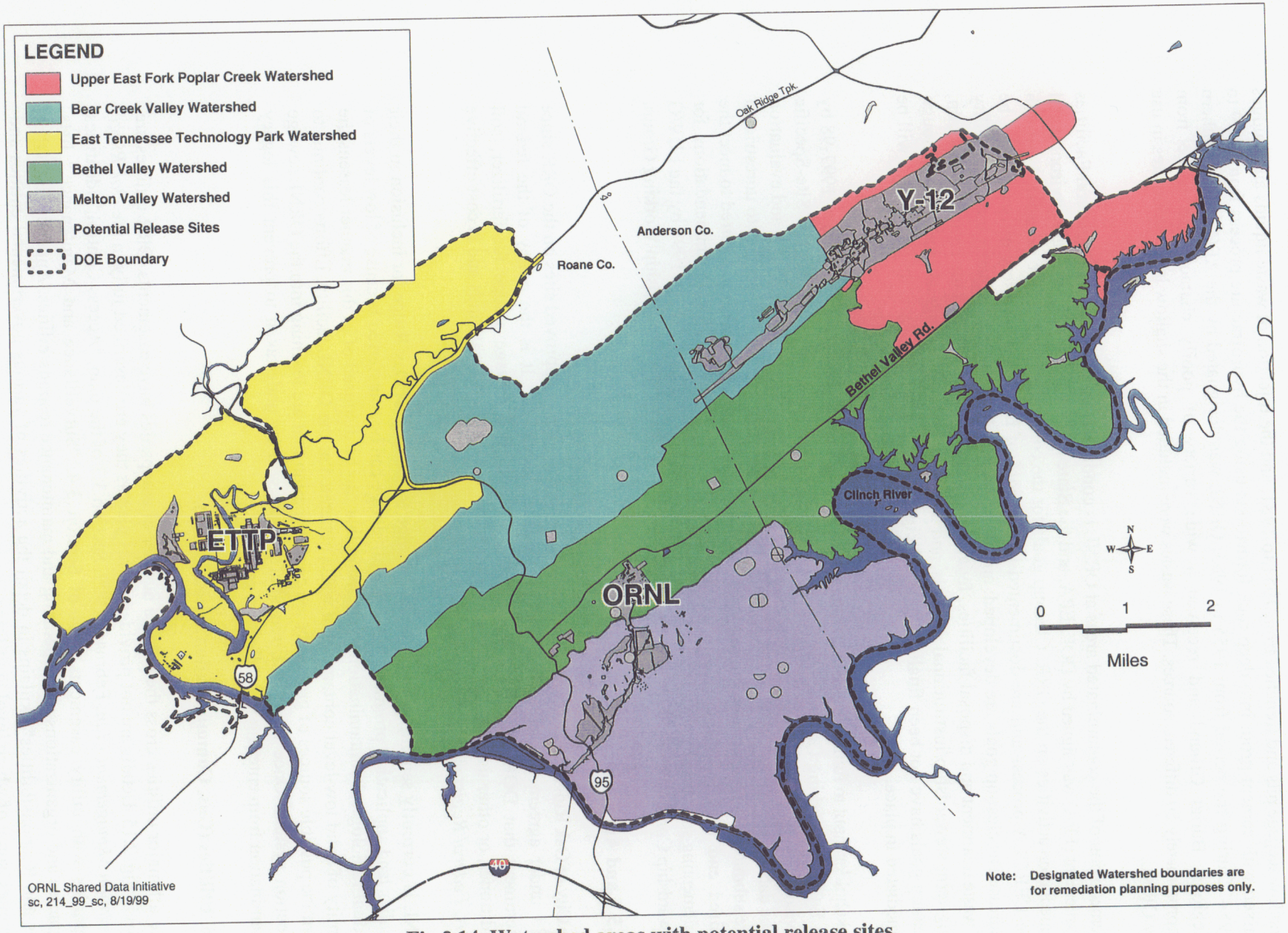


Fig 2.14. Watershed areas with potential release sites.

shallow seepage pits and trenches from 1951 to 1981, and the injection of waste liquids and sludges mixed with cement grout into deep rock formations using the hydrofracture process from 1959 to 1984. During the period from 1955 to 1963, ORNL was designated by the AEC as the Southern Regional Burial Ground and received a wide variety of poorly characterized waste from approximately 50 different sources. These wastes were included in the shallow land burial sites in use by ORNL.

Remediation of the contaminated areas at ORNL is conducted under CERCLA. A Federal Facilities Agreement (FFA) was signed by DOE, EPA, and the State of Tennessee to coordinate environmental remediation activities on the ORR. Cleanup goals for the contaminated areas are negotiated through the CERCLA process and are documented in a Record of Decision. A variety of issues must be addressed as cleanup goals are developed: anticipated future land and groundwater use, availability of waste treatment and disposal facilities, federal and state requirements that the remedy will attain, long-term stewardship/institutional controls, and risk to human and ecological receptors. Although cleanup goals have not been finalized, it is anticipated that some of the contaminated areas will be remediated in place.

Stakeholder input to future uses of the contaminated lands on the ORR was developed in 1997-98 by the End Use Working Group (EUWG), a citizens' group sponsored by the ORR EM Site-Specific Advisory Board. Technical data were provided by DOE's EM program. After review and evaluation of the data, land use recommendations ranging from restricted/government ownership to unrestricted were submitted to DOE to help guide its decisions on the levels of remediation required to meet the desired end uses for the contaminated areas on the ORR. Stakeholder recommendations for implementing stewardship for contaminated areas on the ORR were initiated in 1998 by the EUWG Stewardship Committee and were more fully developed in 1999 by the Stewardship Working Group.

2.5.5 Land Application of Biosolids

The City of Oak Ridge has been applying sanitary sewage sludge to approved sites on the ORR since 1983 under agreements with DOE and the State of Tennessee. It is the policy of the federal government that DOE consider beneficial use of municipal sewage sludge for fertilizer, soil conditioner, or other uses, when such use enhances resources on federal lands and is cost effective (EPA, *Federal Register* July 91-30448). Locations are shown in Fig. 2.6.

ORNL is currently sending sanitary sewage sludge to the City of Oak Ridge for inclusion in their biosolids land application program. While not all sludge can be transferred because of low levels of residual radiological contamination, the portion that can be disposed of in this manner lessens the quantity of solid low-level contaminated waste generated at the ORNL facility. Efforts continue to determine possible sources of ground-based contamination that are leaching into the ORNL sewage collection system. Once identified, remedial actions will be undertaken to prevent this legacy contamination from entering the collection grid.

2.5.6 Utilities (Gas, Communication Lines, Power)

Since all major utilities cross the ORR, a number of companies have easements. ORR utilities are shown in Fig. 2.15. Details are not provided in this plan as they are described fully in the *Oak Ridge Reservation Management Plan*, February 1999. Section 3.3 of the plan, "Access Control," identifies companies with utility easements. Part of Section 3.4, "Surveillance and Maintenance," lists companies and organizations with operating and maintenance responsibilities. Appendix E: "ORR Roles and Responsibilities" explains in detail the activities of various governmental entities and companies, some of which involve utilities.

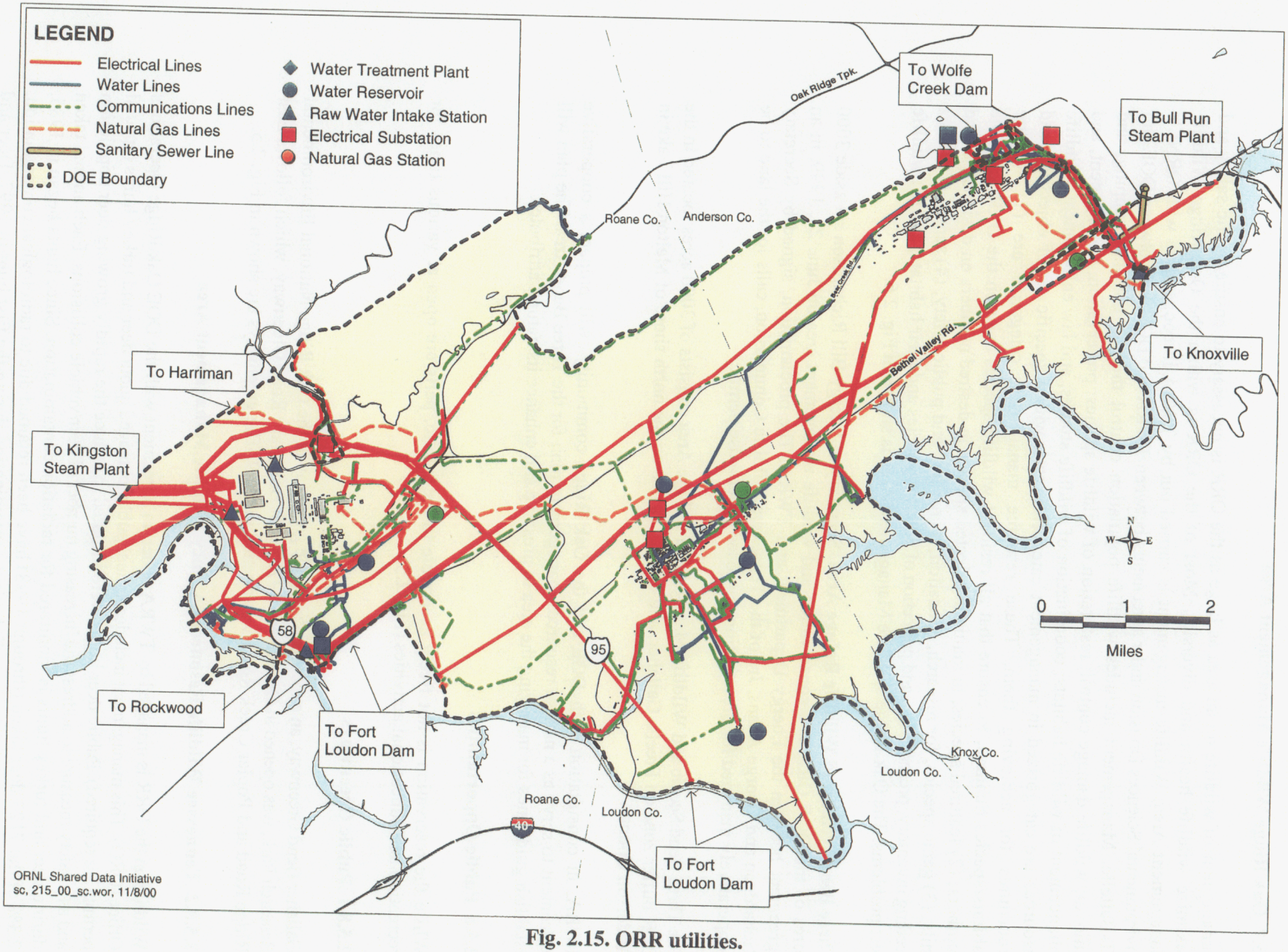


Fig. 2.15. ORR utilities.

2.5.7 Oak Ridge Wildlife Management Area

Management of wildlife on an area as large as the ORR is necessary to ensure public safety and maximize wildlife health and diversity. Most of the ORR is within the Oak Ridge Wildlife Management Area. Wildlife management is carried out by TWRA in cooperation with ORNL's Environmental Sciences Division under agreements between TWRA and DOE and between DOE and UT-Battelle. Management includes wildlife population control through hunting, trapping, and removal; wildlife damage control; restoration of wildlife species; preservation, management, and enhancement of wildlife habitats; coordination of wildlife studies; and law enforcement. Wildlife resources are categorized in management categories, each with a specific set of objectives and procedures for achieving them. These resource management categories are (1) wildlife habitats/species-richness, to ensure that all resident wildlife species exist on the ORR in viable numbers; (2) featured species, to maintain selected species in desired numbers on designated land units; (3) game species, for research, education, recreation, and public safety; (4) sensitive species needing inventory, preservation, and protection of both the species and their habitats; and (5) wildlife pest problems. The Oak Ridge Wildlife Management Area is shown in Fig. 2.6.

Three Bend Scenic and Wildlife Refuge Area. Secretary of Energy Bill Richardson set aside 3000 acres of the DOE ORR as a conservation and wildlife management area on June 23, 1999, in an agreement between the Energy Department and TWRA. The proclamation, signed by Secretary Richardson and George Akans, Jr., of the Tennessee Wildlife Commission, calls for the land to be cooperatively managed for preservation purposes under a use permit.

The Three Bend Scenic and Wildlife Management Refuge Area consists of 3000 acres located in the ORR buffer zone on Freels, Gallaher, and Solway bends on the north shore of Melton Hill Lake in Anderson County.

TWRA, in consultation with DOE and the Oak Ridge community, will prepare a cooperative agreement to serve as a natural resources management plan for the Three Bend Area. The plan will establish guidelines for managing the area to preserve and enhance its natural attributes.

2.5.8 Public Opportunities

While the reservation is not freely accessible to the public, parts are open at various times for recreation and educational activities (Fig. 2.5).

2.5.8.1 Public Greenways

Gallaher Bend Greenway, an experimental public greenway in the Oak Ridge National Environmental Research Park, was opened in December 1997. North Boundary Road Greenway, which follows East Ridge Road and Poplar Creek Road, was opened in 1999. The greenways are shown in Fig. 2.5.

2.5.8.2 Tennessee Wildlife Resources Agency Wildlife Management Area

Wildlife on the ORR is managed by TWRA under an agreement with the DOE Oak Ridge Operations Office (ORO). This management includes annual public managed quota deer and turkey hunts (special permits are required). Public deer hunts were initiated to reduce the rapidly growing deer population and as a safety measure to address the increasing number of deer/vehicle collisions. Each animal taken during deer and turkey hunts is monitored for radiation contamination. Since hunts began in 1985, 2.3% of the 7123 deer taken (through 1998) have been retained due to radiological contamination. One turkey was retained due to radiological contamination during the first hunt in 1997. Deer and

turkey hunt maps are available on the World Wide Web at http://www.ornl.gov/rmal/ huntinfo.htm. Additionally, TWRA has led public bird walks during the spring and coordinated bird counts for input to the Partners In Flight interagency program.

2.5.8.3 New Bethel Church Interpretive Center

New Bethel Baptist Church is one of the few remaining original structures of pre-Manhattan Project days. This facility is open to the public, and its interpretive center contains displays and artifacts relating to the building's use before and after government occupancy.

2.5.8.4 Walks/Tours

ORNL sponsors annual activities on the ORR (e.g., bird walks, wild flower hikes, and trips to field research sites) that are open for public participation. These are advertised in local media. In addition, ORNL participates in Community Day, which offers the public an opportunity to visit Laboratory facilities. In addition, bus tours of ORNL and parts of the Y-12 National Security Complex are available at the American Museum of Science and Energy.

2.5.8.5 Ecological and Physical Sciences Study Center

This educational program offers hands-on experiences in outdoor environmental and physical sciences for kindergarten through high school students, as well as programs to familiarize teachers with new concepts. The programs are primarily centered at historic Freels Cabin and require preregistration through the ORNL Office of University and Science Education.

2.5.8.6 ORNL Graphite Reactor

A registered National Historic Landmark, the Graphite Reactor's primary wartime mission was to produce the first gram quantities of plutonium for experiments at the University of Chicago. Afterwards, it was dedicated to the peace-time development of atomic energy and operated until 1963.

2.5.8.7 Other Public Facilities and Educational Programs

Facilities on the reservation operated by others and open to the public include the Clark Center Recreation Area, George Jones Memorial Church and the Wheat Community African Burial Ground near ETTP, the ETTP Visitors Overlook, and the Y-12 Visitors Center. The numerous ORNL educational opportunities are described on the Web at http://www.ornl.gov/seer/contents.html.

2.5.9 Facilities

A number of ORNL facilities, as well as facilities managed by ETTP, the Y-12 National Security Complex, and others, are located outside the ORNL developed area. ORNL facilities are identified in the "ORNL Integrated Strategic Facilities Plan" in Section 3 of this land use plan.

2.5.10 Other

Some land uses within the National Environmental Research Park are the responsibility of others as designated by DOE-ORO. These uses are identified in the *Oak Ridge Reservation Management Plan* (1999) and the *ORR Comprehensive Integrated Plan* (September 1999).

2.5.11 Maps - Current Land Use on the Oak Ridge Reservation

Maps included in this document were prepared on MapInfo software using data from the ORNL SDI. The SDI database is updated as data are available from ORNL projects as well as other ORR projects. Table 2.2 is a list of maps pertaining to current ORNL land usage.

Table 2.2. Current land use on the ORR

Fig. no.	Maps	Main components
2.5	Public, educational, and recreational opportunities	Ecological and Physical Sciences Study Center New Bethel Church Interpretive Center ORNL Graphite Reactor Gallaher Bend Greenway TWRA Wildlife Management Area Cemeteries, historic districts, churches, and homesites Clark Center Recreation Area North Boundary Road Greenway
2.6	Partnership areas	Sludge landfarming sites State Natural Areas TWRA Wildlife Management Area Oak Ridge Biosphere Reserve Gallaher Bend Greenway Wetland Mitigation Areas North Boundary Road Greenway
2.9 2.10 2.11	Research areas	National Environmental Research Park Active research areas Proposed research areas Planned research areas
2.12	Safety	Emergency planning zones Surface danger zones
2.13	Compliance and monitoring	Air monitoring sites Groundwater wells Surface water monitoring BMAP sites Meteorological towers Fish sampling locations
2.14	Contamination areas	Potential release sites EM watershed project boundaries
2.15	ORR utilities	Electrical lines Water lines Communications lines Natural gas lines Sanitary sewer lines Water treatment plants Water reservoirs Electrical substations Natural gas stations Main roads

2.6 FUTURE LAND USE ON THE OAK RIDGE RESERVATION

The Secretary of Energy's Land and Facility Use Management Policy states that DOE will exercise stewardship over its assets based on ecosystem management principles. Management of the ORR as a viable and healthy ecosystem provides the foundation required for environmental research and for pursuing future scientific initiatives. Planning for future land use requires management of the ORR as an ecosystem unit. Ecosystem management is not a land use objective in itself. It is, however, a method for achieving the land use objectives. Additionally, it provides a mechanism for preservation of the land area needed to pursue future scientific research opportunities such as neutron science. Future land uses will, in most cases, expand and build on current land uses, not replace them.

2.6.1 Ecosystem Research

Ecosystem management has been defined as the "... integration of ecological, economic, and social principles to manage biological and physical systems in a manner that safeguards the ecological sustainability, natural diversity, and productivity of the landscape." Ecosystem management must be based on an understanding of the factors governing the limits on ecosystem sustainability and the controls on ecosystem response to environmental change. Such an understanding requires comprehensive, multidisciplinary research on a variety of ecosystems under different levels of human influence. Research approaches that combine ecosystem monitoring and experimental studies are most valuable for developing a mechanistic understanding of ecosystem sustainability and factors controlling ecosystem change.

Within this context of ecosystem management, the ORR provides a combination of complex geology and hydrology; ecological diversity; fundamental ecosystem process research, modeling, and long-term data records; a historical record of land use change; and dynamic pressures on its ecosystems resulting from its suburban/industrial setting. Future research will capitalize on the wealth of historical and ongoing ecological research and monitoring on the ORR to address the fundamental sciences underlying the structure and function of ecosystems, response of ecosystems to stress, and sustainability of ecosystems. The focus of future experimental research and monitoring activities is identified in greater detail in Appendix C.

2.6.2 Identified New Future Land Uses

Maps for future land use reflect identified new future needs; current land uses do not preclude different future uses. Land planning, however, will need to incorporate current land use with identified new future land uses.

New future land uses include

- research facilities
- environmental research areas
- environmental partnership areas
- waste management facilities
- future initiatives
- transportation improvements
- education and recreation
- land transfers/lease areas

2.6.2.1 Research Facilities

Proposed locations of future research facilities are shown in Fig. 2.16 and are described in the following sections.

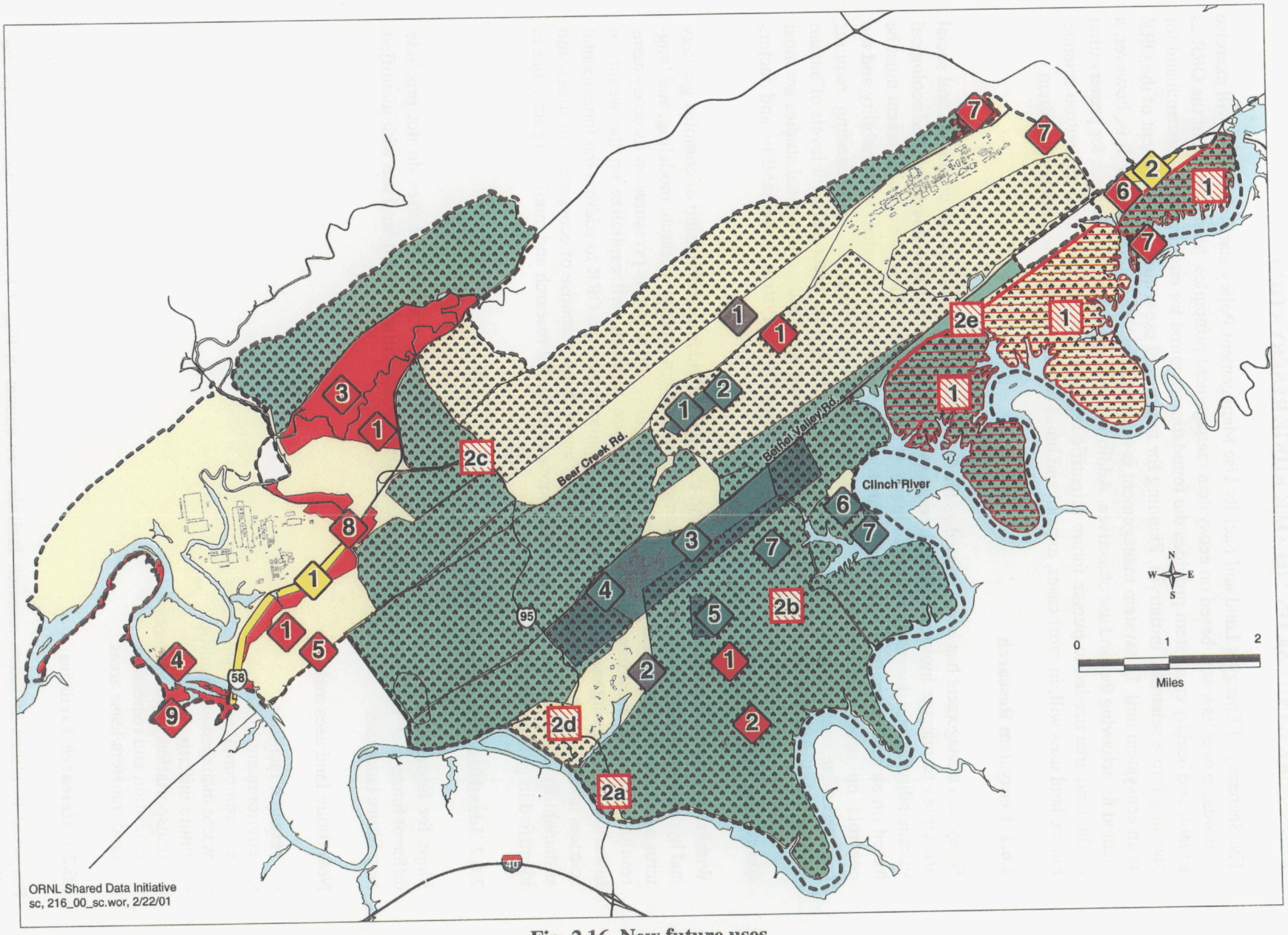
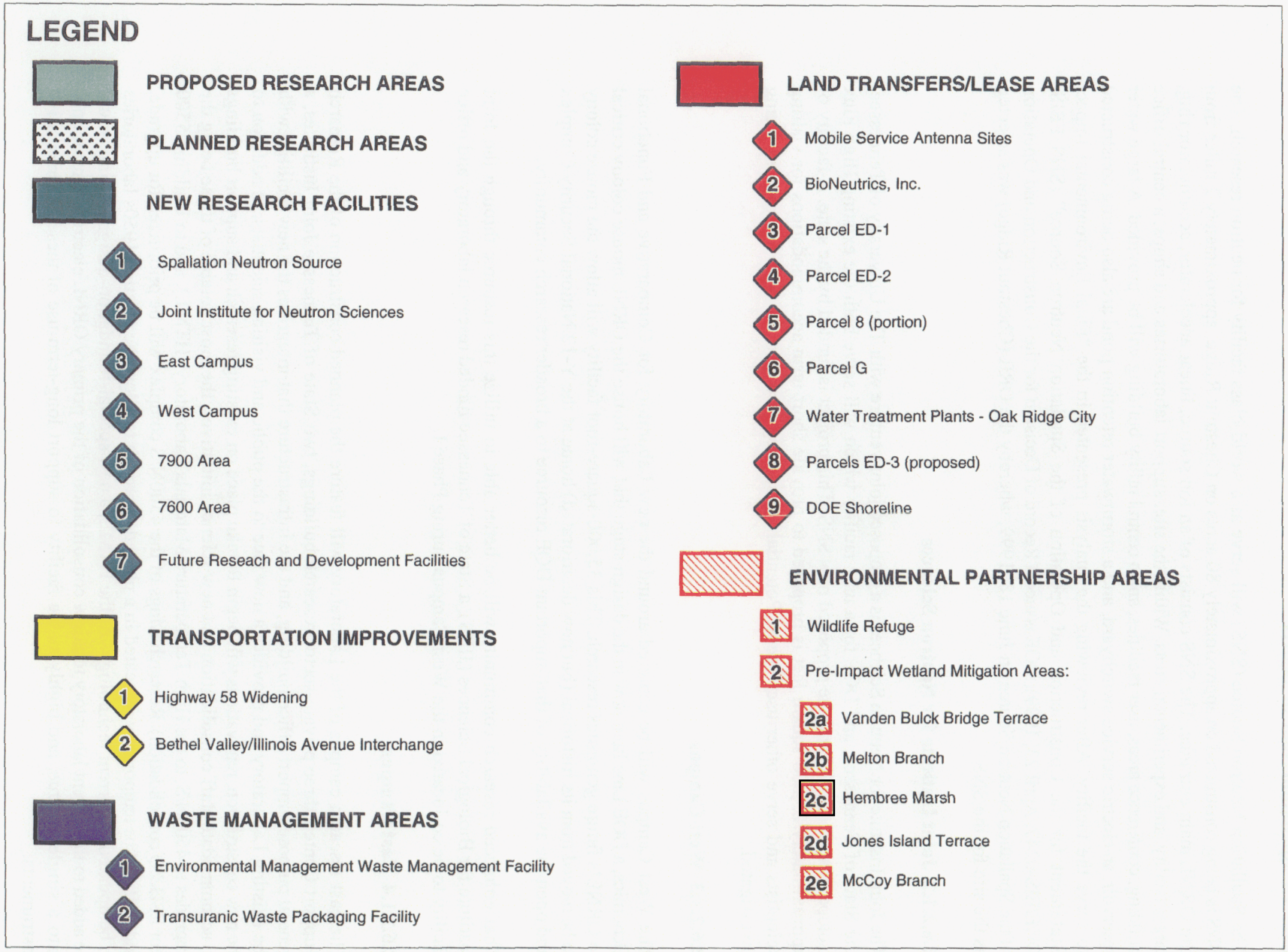


Fig. 2.16. New future uses.


LEGEND
PROPOSED RESEARCH AREAS
PLANNED RESEARCH AREAS
NEW RESEARCH FACILITIES
1 Spallation Neutron Source
2 Joint Institute for Neutron Sciences
3 East Campus
4 West Campus
5 7900 Area
6 7600 Area
7 Future Reseach and Development Facilities
TRANSPORTATION IMPROVEMENTS
1 Highway 58 Widening
2 Bethel Valley/Illinois Avenue Interchange
WASTE MANAGEMENT AREAS
1 Environmental Management Waste Management Facility
2 Transuranic Waste Packaging Facility
LAND TRANSFERS/LEASE AREAS
1 Mobile Service Antenna Sites
2 BioNeutrics, Inc.
3 Parcel ED-1
4 Parcel ED-2
5 Parcel 8 (portion)
6 Parcel G
7 Water Treatment Plants - Oak Ridge City
8 Parcels ED-3 (proposed)
9 DOE Shoreline
ENVIRONMENTAL PARTNERSHIP AREAS
1 Wildlife Refuge
2 Pre-Impact Wetland Mitigation Areas:
2a Vanden Bulck Bridge Terrace
2b Melton Branch
2c Hembree Marsh
2d Jones Island Terrace
2e McCoy Branch

2.6.2.1.1 Spallation Neutron Source

The Spallation Neutron Source (SNS) will serve as a world-class facility for neutron research. The SNS is being constructed on approximately 80 acres on Chestnut Ridge, approximately 2 miles from the ORNL main entrance. The SNS consists of an ion source, linear accelerator, accumulator ring, target facility, and experimental areas. Within the site, support laboratories and shops, a central office building, conference areas, user facilities, and a central utility building will be provided. A large water reservoir, an electric service switchyard, and a stormwater retention pond are also being constructed to serve the facility. After reviewing the analysis presented in the "Final Environmental Impact Statement for the Construction and Operation of the Spallation Neutron Source" (SNS FEIS, DOE/EIS-0247, April 23, 1999), DOE issued a Record of Decision for the Construction and Operation of the Spallation Neutron Source on June 18, 1999, whereby the ORR (Chestnut Ridge) was selected as the site for the SNS.

2.6.2.1.2 Joint Institute for Neutron Sciences

The Joint Institute for Neutron Sciences is a proposed joint venture with The University of Tennessee, the State of Tennessee, and DOE for a user facility which will serve both the existing High Flux Isotope Reactor (HFIR) and the proposed new SNS. This project is funded by the state. A facility of approximately 25,000 square feet is proposed to provide short-term accommodations for visiting scientists and serve other user needs. Potential sites, integrated into the SNS campus, are being investigated.

2.6.2.1.3 West Campus

The West Campus will be centered around the new Laboratory for Comparative and Functional Genomics, a DOE Line Item now in the design stage that will house the ORNL mouse colony critical to ORNL's future genomics research. This 35,000-square-foot facility will allow the mouse colony to be moved from its historical (but now deteriorated) home at the Y-12 National Security Complex and open the availability of that important DOE resource to a broader research community.

That enhanced research community will be better able to utilize this resource through the Joint Institute for Biological Sciences (JIBS), a State of Tennessee funded research laboratory and office facility to be co-located in the West Campus during Phase I.

2.6.2.1.4 East Campus

The east research campus of the Laboratory will feature the planned construction of the Research Support Center, three private-sector research buildings, two State of Tennessee Joint Institutes, a general purpose support office building, and the infrastructure that integrates the new facilities with the existing Laboratory and provides a new face to the public and visiting scientists. In addition to the new construction, renovations will begin to take place on existing research and support buildings to accommodate staff consolidation and new science initiatives, the most notable of those being the upgrades to 4500N/S, to the High Temperature Materials Laboratory (HTML), and to Building 5500 (for ESH&Q consolidation). Research wings of the 4500N/S complex will be prioritized for upgrade, and staff will be temporarily relocated in a phased approach to allow the existing 1950s laboratories to be updated to current technology. At the HTML, a new special-foundation-designed wing would be added to the current laboratory to allow consolidation of the primary ORNL electron microscopes into a single, unique, and highly stable facility to support long-term use of these supersensitive instruments.

2.6.2.1.5 Development in the 7600 and 7900 Areas

While not within the main ORNL campus boundaries, critical activities are occurring in the HFIR/ REDC complex (7900 Area) and the Robotics and Process Systems Complex (7600 Area) that are important to the overall ORNL revitalization initiative. The improvements to HFIR operations and research capabilities occurring during their ongoing upgrade program will make the reactor and adjacent facilities more user-friendly and available. To support that increase in mission, several DOE GPP-level projects will be undertaken that eliminate multiple trailers housing research and support staff, provide much-needed highbay operations and storage areas, and improve the user-facility status of the complex. The 7600 Area has been selected to be the location for consolidation of Fusion Energy Division staff and facilities that have been historically located at Y-12. To allow that consolidation to occur, staff from several divisions in existing 7600 space will have to be moved to the East Campus, upgrades provided for the vacated space, and several new DOE GPP facilities constructed (for offices and for highbay process space needs).

2.6.2.1.6 Research and Development Facilities

Space for future Melton Valley R&D Facilities has been identified bordering Melton Hill Lake (known as the Ramsey Drive Site). Approximately 39 acres of land adjoining the proposed Fusion Materials Irradiation Facility have been identified for future use. No specific facility designations have been identified for the site.

2.6.2.2 Environmental Field Research Areas

Environmental field research is proposed and/or planned across the entire reservation (except for the ETTP area) in addition to areas where it is already being done. Proposed research areas (identified for specific projects for proposal submittals or pending actions) or planned research areas (areas with high potential for studying research issues of interest to DOE and other Research Park users) are identified on Fig. 2.16.

Two projects, the National Ecological Observation Network (NEON) and the Terrestrial Ecosystem Research Facility (TERF), encompass the entire Research Park. Proposed and planned research projects corresponding to the compartments shown in Fig. 2.11 are listed below.

Area 2
Planned research areas:

- Carbon Experimental Site, Black Oak Ridge Replicated Dolomite
- Control Area for Impacts of Urban Fragmentation on (a) Plant and Soil Carbon Sequestration Rates, (b) Forest Successional Dynamics on Biodiversity, (c) Wildlife and Neotropical Migrants, and (d) Geneflow and Genetic Isolation

Area 4
Proposed research areas:

- Biodiversity of Productive Riparian Areas, Invasive Plant Species

Planned research areas:

- Carbon Experimental Site, Bottomland Forest Communities
- Carbon Biogeochemistry in High-Fertility, Hydric Environments
- Role of High-Productivity Habitats in Wildlife Conservation
- Partnership with City of Oak Ridge, Bechtel Jacobs Company LLC, and DOE on Biosolid Landfarming for Carbon Research

Area 5
Planned research areas:
- Carbon Experimental Site, East Fork Poplar Creek
- Ecosystem Consequences of High Geological Complexity
- Partnership with City of Oak Ridge, Bechtel Jacobs Company LLC, and DOE on Biosolid Landfarming for Carbon Research

Area 7
Planned research areas:
- Carbon Experimental Site, Wetland
- Carbon Biogeochemistry in High-Fertility, Hydric Environments
- Role of High-Productivity Habitats in Wildlife Conservation

Area 8
Proposed research areas:
- Ecosystem Processes (Carbon Sequestration, Biodiversity, Wildlife, Non-Native Invasive Species) in High-Contrast Landscapes (Dry Ridges, Wet Valley Bottoms)

Planned research areas:
- Ecosystem Processes (Carbon Sequestration, Biodiversity, Wildlife) in High-Contrast Landscapes (Dry Ridges, Wet Valley Bottoms)

Area 9
Planned research areas:
- Carbon Experimental Site, Pine Ridge Replicate Experimental Catchments
- Ecosystem Processes (Carbon Sequestration, Biodiversity, Wildlife, Non-Native Invasive Species) in High-Contrast Landscapes (Dry Ridges, Wet Valley Bottoms)
- Biomass Recovery Plots

Area 13
Proposed research areas:
- Invasive Exotic Plant Species Research

Area 14
Proposed research areas:
- Invasive Exotic Plant Species Research

Planned research areas:
- Long-Term Recovery from Agricultural Impacts in Complex Terrains
- Biofuels Research and Demonstration Site
- Replicated Controls for Chestnut Ridge
- Control Area for Walker Branch Watershed and Chestnut Ridge Experimental Catchments
- Carbon Biogeochemistry in High-Fertility, Hydric Environments
- Biodiversity of Productive Riparian Areas
- Role of High-Productivity Habitats in Wildlife Conservation
- Control Area for Pine Ridge Experimental Catchments (Sandstone and Shale Soils Similar to Pine Ridge)
- Partnership with City of Oak Ridge, Bechtel Jacobs Company LLC, and DOE on Biosolid Landfarming for Carbon Research

Area 17

Planned research areas:

- Replicated Controls for Chestnut Ridge
- Partnership with City of Oak Ridge, Bechtel Jacobs Company LLC, and DOE on Biosolid Landfarming for Carbon Research

Area 19

Planned research areas:

- Pine Bark Beetle Recovery Area Research
- Biofuels Research and Demonstration Site
- Forest Succession Experimental Sites for Wildlife, Carbon Sequestration, Invasive Species, Biodiversity
- Carbon Experimental Site, Bethel Valley Replicated Limestone

Area 20

Planned research areas:

- Y-12 Partnership Area, Carbon Sequestration Demonstration Site, Biomass and Soil Carbon Experimental Facility
- Recovery of Soil Carbon and Biodiversity on Ash Fields
- Partnership with City of Oak Ridge, Bechtel Jacobs Company LLC, and DOE on Biosolid Landfarming Sites for Carbon Research
-

Area 21

Planned research areas:

- Carbon Experimental Site, Valley Bottom (Huston)
- Biofuels Research and Demonstration Site
- Carbon Biogeochemistry in High-Fertility, Hydric Environments
- Biodiversity of Productive Riparian Areas
- Role of High-Productivity Habitats in Wildlife Conservation (Huston)
- Control Area for Pine Ridge Experimental Catchments (Sandstone and Shale Soils Similar to Pine Ridge)
- Bethel Valley Agricultural Land Use Impacts and Carbon Sequestration Research Area
- Pine Bark Beetle Recovery Area Research
- Forest Succession Experimental Sites for Wildlife, Carbon Sequestration, Invasive Species, Biodiversity

Area 22

Proposed research areas:

- Large-Scale Catchment Study Area
- Forest Succession Experimental Sites for Wildlife, Carbon Sequestration, Invasive Species, Biodiversity

Planned research areas:

- Carbon Experimental Site, Bethel Valley Replicated Limestone
- Long-Term Recovery from Agricultural Impacts in Level Terrains
- Control Area for Pine Ridge Experimental Catchments (Sandstone and Shale Soils Similar to Pine Ridge)
- Bethel Valley Agricultural Land Use Impacts and Carbon Sequestration Research Area
- Pine Bark Beetle Recovery Area Research

Area 23
Proposed research areas:
- Invasive Exotic Plant Species Research

Planned research areas:
- Biofuels Research and Demonstration Site
- Effects of Current Land Management Practices on Soil and Plant Carbon Storage
- Control Area for Pine Ridge Experimental Catchments (Sandstone and Shale soils similar to Pine Ridge)

Area 25
Planned research areas:
- Carbon Experimental Site, Replicated Controls for Chestnut Ridge

Area 26
Proposed research areas:
- Invasive Exotic Plant Species Research

Planned research areas:
- High-Complexity Shoreline Effects on Wildlife, Biodiversity, Biogeochemical Flux Rates
- Long-Term Recovery from Agricultural Impacts in Complex Terrain
- Replicated Controls for Chestnut Ridge
-

Area 29
Planned research areas:
- Bethel Valley Agricultural Land Use Impacts and Carbon Sequestration Research Area
- Invasive Exotic Plant Species Research

Area 30
Planned research areas:
- Urban/Industrial Impacts on Isolated Natural Areas, Invasive Exotic Plant Species Research
- Urban/Industrial Impacts on Isolated Natural Areas, Carbon Sequestration

2.6.2.3 Environmental Partnership Areas

"Environmental Partnership Areas" are sites of special environmental significance or sites with great potential for restoration and/or mitigation where state, federal, and educational agencies are working together or can work together to solve environmental problems. Some of these areas are shown in Fig. 2.6.

2.6.2.3.1 State Natural Areas

Additional areas on the reservation have the potential to qualify as State Natural Areas. Seven sites on the ORR were registered as State Natural Areas in 1986 in an agreement between DOE and the Tennessee Department of Conservation (now TDEC). Additional threatened and endangered species data have been collected since 1986 (Awl et al. 1996; The Nature Conservancy 1995).

To register a State Natural Area, the site must meet TDEC qualifying criteria as determined by a natural heritage evaluation and review by the State Natural Areas Advisory Committee. Registration of a State Natural Area is by a written, nonbinding registry agreement signed by the landowner and

the Commissioner. Protection of the natural area is a voluntary, nonbinding conservation tool which relies on the landowner's sense of pride and stewardship; the designation can be removed if DOE decides on an alternative land use and the designation is no longer appropriate.

2.6.2.3.2 Wetland Mitigation Areas

Over 580 acres in wetlands have been identified on the ORR. Some of these wetlands, including one of the single largest wetlands areas, are in areas where new program construction and waste management or remedial actions may occur, resulting in direct wetland impacts. Before any activities occur that will directly impact wetlands, it is necessary to obtain federal and/or state permits or to fulfill the substantive requirements of the law in those cases where permits are waived (e.g., CERCLA actions). Individual permits issued by the federal and state governments will, in most cases, require compensatory mitigation as a permit condition. Mitigation, in the wetland regulatory context, is a sequential process consisting of (1) avoidance of wetland impacts, (2) minimization of wetland impacts, and (3) if impacts are unavoidable, compensatory mitigation. Compensatory mitigation includes wetland restoration and wetland creation.

Bear Creek Valley Proposed Wetland Mitigation. DOE's EM program has prepared a preliminary wetland mitigation plan for an area in Bear Creek Valley. This proposed project will offset the planned destruction of wetlands associated with CERCLA-related activities in Bear Creek Valley. The area proposed for construction of the replacement wetlands is on the south side of Highway 95 near the intersection with Highway 58 and would include both wetland creation (12 acres) and enhancement (2 acres) to yield approximately 14 acres in mitigated wetlands (DOE 1999). The wetland mitigation proposal is coordinated by Bechtel Jacobs Company LLC and DOE EM. The proposed area is located within the ORNL area of responsibility.

Bethel Valley Pre-Impact Wetland Mitigation Evaluation. In 1999, ten sites in the Bethel Valley area of the ORR were evaluated with respect to their potential for pre-impact wetland mitigation (Durr 1999). Of these ten areas, the potential for success was ranked as "high" for three areas, "medium" for two areas, and "low" for the other five areas. There are not extensive areas of high-quality wetland mitigation opportunities in the Bethel Valley portion of the reservation. Most reliable water sources are positioned within narrow steep-sided hollows that offer little potential for lateral expansion with highly porous native soils that do not have the physical capacity to remain saturated for extended periods of time. However, at least 7.5 to 8 acres were determined to be suitable for small-scale wetland creation/enhancement projects, most requiring a relatively minor amount of earth moving to convert them to jurisdictional wetlands. An additional 8 acres of bottomland were identified that are more marginal. With extensive work, these marginal areas might be manipulated to support a dominance of wetland plant species or even open water environments, making a nice addition to the diversity of habitat within forested portions of the reservation.

The areas ranked as "high" or "medium" are shown in Fig. 2.16. Areas included in the evaluation and the potential acreages are:

(1) McCoy Branch (high) in lower McCoy Branch watershed contains approximately 1.5 acres of moderate- to high-quality creation potential plus approximately 0.5 acres of enhancement opportunity. The area includes young palustrine forested wetlands and emergent wetlands.

(2) Jones Island Terrace (high) includes a seasonal drainage with periodically inundated terraces, plus a number of small wet depressions. This site offers the potential for approximately 3 acres of creation and another 2 acres of enhancement of existing wetlands. Because of the site's close

proximity to the Clinch River, small open-water areas that can be used as feeding stations by migratory waterfowl are possible as well.

(3) Hembree Cemetery wetland in upper McNew Hollow (high) is a small, but high-quality palustrine forested/palustrine scrub-shrub area with approximately 0.75 acres of combined creation and enhancement potential.

(4) Melton Branch area (medium) is approximately 1.8 miles upstream of the confluence with White Oak Lake, just downstream from a palustrine forested wetland. Approximately 1 acre of wetland creation is possible within the primary terrace of Melton Branch with enhancement of an additional 1.5 acres.

(5) Vanden Bulck Bridge Terrace (medium) is located along the east bank of the Clinch River about 2000 feet downstream of Vanden Bulck Bridge. Opportunities exist to create about 1 acre of wetland and enhance an additional 1 acre.

(6) Lower Raccoon Creek watershed (low) is approximately 1200 feet upstream of confluence with Melton Hill Lake. The potential mitigation area lies within the flattened terraces of lower Raccoon Creek. The area contains an estimated 2 acres of low-quality mitigation opportunity.

(7) Lou Cagle Road (low) is in the upper watershed of an unnamed tributary to Melton Hill Lake. The area includes a mature palustrine forested wetland lying immediately adjacent to the unnamed tributary, but there is less than an acre of mitigation potential. There is little opportunity for lateral expansion due of relative steep topography.

(8) New Zion Cemetery (low) area currently supports a moderate high-quality palustrine forested wetland. The potential mitigation site is about 500 feet southwest of the New Zion Cemetery in the upper watershed of an unnamed tributary to Melton Hill Lake. The only possibility for mitigation is immediately adjacent to existing wetland areas.

(9) Friendship Cemetery (low) is near the Bearden Creek Bridge on Melton Valley Drive. It includes an unnamed tributary to Bearden Creek. It presents a number of low-quality wetland creation opportunities that total less than 1 acre.

(10) Bearden Creek (low) area encompasses a large flat at the upper end of the Bearden Creek watershed. The location contains a limited number of small depressions that support a dominance of hydrophytic vegetation and wetland hydrology, but it is less than 1 acre.

One approach to compensatory mitigation is pre-impact wetland mitigation which is undertaken to compensate for unavoidable wetland losses in advance of development actions. Among the advantages of pre-impact mitigation are (1) a greater potential for a successful mitigation project that effectively replaces wetland functions; (2) a reduction in permit processing times; and (3) economies of scale relating to the planning, implementation, monitoring, and management of mitigation projects.

The U.S. Army Corps of Engineers, the EPA, the U.S. Fish and Wildlife Service, the Natural Resources Conservation Service, and the National Marine Fisheries Service issued final policy guidance regarding the establishment, use, and operation of mitigation banks (*Federal Register*: November 28, 1995, Vol. 60, No. 228). The establishment of a pre-wetland mitigation on the ORR would require the involvement of several federal and state agencies, including the Corps of Engineers, EPA, Fish and Wildlife Service, and National Marine Fisheries Service, as well as the TDEC, TWRA, and TVA.

2.6.2.3.3 Wildlife Habitat Restoration

The TWRA has initiated a cooperative effort with TVA and Quail Unlimited to improve the wildlife habitat under TVA electrical distribution lines on the ORR by restoring native, warm season grasses. An approximately 70-acre demonstration plot was treated in 1998 with plans to convert additional acreage annually. Habitat improvement will enhance conditions for both resident wildlife and migratory birds, provide soil erosion control, and lower power line right-of-way maintenance needs. The habitat improvement will benefit quail, turkey, ground-nesting birds, rabbits, songbirds, snakes, mammalian predators, and other mammals. Some neotropical migratory birds are especially in need of this native grass habitat. Additionally, TWRA has plans to continue restoration of wildlife species and habitats such as Freels Bend.

2.6.2.4 Waste Management Facilities

Reservation land also is needed for the following EM waste management facilities (Fig. 2.16), which are in various stages of planning and development:

- EM Waste Management Facility (at East Bear Creek)
- Transuranic Waste Packaging Facility and connecting road from Highway 95

2.6.2.5 Future Initiatives

Land for future initiatives may not have specific projects associated with it. Diverse physical characteristics and the evaluation of proposed sites for past projects are factors used to identify suitability of such lands for future initiatives. Some of the general land areas identified for future needs are shown in Fig. 3.21.

Associated with reservation management are a number of infrastructure needs which are identified in Table 2.3.

Table 2.3. Oak Ridge Reservation infrastructure needs ($ in 000s)

Project	Estimated cost	Funding year
Bethel Valley Road Upgrades	3,000	FY 2001–03
Lambert Quarry Fencing	165	FY 2001
ORR Communications System	6,000	FY 2002
Upgrades to Road Barricades/Signs	165	FY 2002
4 x 4 3/4-Ton Truck with Fire Tank	35	FY 2002
D7 Bulldozer	400	FY 2004
Boundary Fence Upgrades	500	FY 2004
Bethel Valley Road/Highway 95 Intersection	3,000	FY 2005
Road Grader	140	FY 2005
D4 Bulldozer	125	FY 2006
Trackhoe Excavator	200	FY 2007
4 x 4 3/4-Ton Truck with Fire Tank	35	FY 2007
Hydroseeder Vehicle	115	FY 2008
Backhoe Excavator	60	FY 2009
Total	13,940	

2.6.2.6 Transportation Improvements

The following projects on the ORR have been identified as proposed by the Tennessee Department of Transportation:

- Highway 58 widening (initiated)
- Bethel Valley/Illinois Avenue interchange (initiated)
- Charles Vanden Bulck Bridge, Highway 95 (initiated)

2.6.2.7 Education and Recreation

A portion of East Fork Road (Parcel ED-1) is under consideration as a public greenway, expanding the North Boundary Road Greenway.

2.6.2.8 Land Transfers/Lease Areas

Areas identified by DOE that have recently or will soon be leased or released are shown in Fig. 2.16. They include the following:

Private-Sector Research Facilities: As described in Section 3.5.1, up to 25 acres of DOE property at the ORNL site will be transferred to the private sector to allow for construction and lease-back of research and office facilities for continuing the DOE mission at the site. Repurchase of this land by DOE at a specified time in the future will be provided for in the deed language.

Public Areas: DOE has leased an 8.5-acre parcel of federal land near Wisconsin Avenue in Oak Ridge to the City of Oak Ridge for a park.

Industrial Development: Areas that have been leased or may be leased/transferred for industrial development have been identified. These do not include facilities within the ETTP developed area. Actions include

- Parcel ED-1 [leased April 1998 to the Community Reuse Organization of East Tennessee (CROET) for industrial development]
- 100 acres of Parcel 8 (pending)
- Tower Shielding Facility (26 acres leased 1998 to BioNeutrics, Inc.)
- Parcel ED-2 (15 acres leased to CROET)
- Parcel ED-3 (450 acres currently under review for leasing to CROET)
- Parcel G (portion)
- Shoreline/floodplain along Boeing property
- Water Treatment Plant and associated facilities (transferred to City of Oak Ridge, 2000)

Mobile Service Antenna Sites: Mobile Service towers have been erected in six locations across the reservation (Fig. 2.16).

2.6.2.9 Oak Ridge Institute for Science and Education

The Oak Ridge Institute for Science and Education (ORISE), which is managed for DOE by ORAU, includes the 247-acre Scarboro Operations Site on the ORR. ORAU also manages several ORISE sites in downtown Oak Ridge, as shown in Fig. 1.1. DOE recently granted an easement to the Tennessee Department of Transportation for highway construction on the 24 acres east of Scarboro Creek, and it has been proposed to transfer about 20 acres immediately west of the creek to the City of Oak

Ridge. The remaining 203 acres, and the structures located on them, will be adequate for ORISE's current operations in support of the DOE mission. Because no ORISE town site includes developable land, the Scarboro site is the only land now available to accommodate future growth.

2.6.3 Maps - Future Land Use on the Oak Ridge Reservation

Maps included in this document were prepared on MapInfo software using data from the ORNL SDI. The SDI database was updated with data from ORNL and other subcontractors, as available. Table 2.4 lists the categories contained on the future land use map.

Table 2.4. ORNL future land use map

Fig. no.	Category	Main components
2.16	New research facilities	Spallation Neutron Source Joint Institute for Neutron Sciences East Campus West Campus 7600 Area 7900 Area Future Research and Development Facilities
	Research areas	Proposed research areas Planned research areas
	Environmental partnership areas	Bearden Creek Wetland Banking Wildlife Refuge
	Waste management areas	Environmental Management Waste Management Facility Transuranic Waste Packaging Facility
	Transportation improvements	Highway 58 Widening Bethel Valley/Illinois Avenue Interchange
	Land transfers/lease areas	Mobile Service Antenna Sites BioNeutrics, Inc. Parcel ED-1 Parcel ED-2

2.7 STAKEHOLDER INPUT

2.7.1 Stakeholder Definition

Recognizing that ORNL, ETTP, and the Y-12 National Security Complex have differing missions and diverse stakeholders, DOE requested that each site establish and implement a tailored stakeholder involvement plan.

ORNL stakeholders include those who use the land for DOE mission activities, those who fund activities on the ORR, those with state or federal regulatory interest, neighbors who may be impacted by land use decisions, and those with a perspective on regional/national/international impacts of ORR land use decisions.

2.7.2 Process for Input

Local stakeholder input was obtained through summarizing existing comments (e.g., the Common Ground process that solicited input from stakeholders in the surrounding communities in 1995). Additional input will be solicited from ORNL stakeholders not reached through the Common Ground process. The ORNL tailored stakeholder plan is included in Appendix D.

Stakeholder input on overall ORR planning was obtained through public review of the *ORR Comprehensive Integrated Plan* (September 1999).

2.7.3 Input Summary

2.7.3.1 Input Summary from Common Ground

The objectives of obtaining stakeholder input for the Common Ground process were different and more limited in scope than those of the ORNL land planning team; however, it provided valuable input. Objectives of stakeholder input for the Common Ground process were to (1) provide a basis for environmental remediation decision making by identifying stakeholder-preferred future land uses for the ORR; (2) foster comprehensive, integrated land use and site development planning, with integral public participation and involvement; and (3) provide for constructive reuse of surplus land and facilities by facilitating the transfer of assets no longer required by DOE to the private sector.

During 1994 and 1995, 359 people participated in the DOE Common Ground Process to identify stakeholder-preferred alternatives for future use of the ORR. These included internal stakeholders (people working with DOE and Lockheed Martin) and external stakeholders (people living and working in surrounding counties and people with regulatory or oversight responsibilities for the ORR).

Most participants supported DOE and, prospectively, other federal or state government missions as a major ORR land use. Preservation of the reservation's natural environment, especially its special natural habitats, was widely supported, as was selective industrial development, especially industry complementary to DOE missions. Low-impact recreational uses such as hiking and biking trails were widely supported, although more by external participants than internal participants.

Except for staff and other elements of the City of Oak Ridge, only limited support existed for residential uses. Limited support was expressed for forestry or agricultural research, but not for general agricultural uses. There was little support for use of the land for a transportation corridor and virtually no support for major commercial development (e.g., malls).

Release of the land was an especially controversial issue among stakeholders. Some spoke against releasing more ORR land; a few said that all land not needed for federal purposes should be released; and some said that release of land might be acceptable, but only under certain conditions (DOE 1996b).

2.7.3.2 Input from Other ORNL Stakeholders

Stakeholder letters received regarding the 1999 final and draft 2000 *ORNL Land and Facilities Plans* are included in Appendix E. Recognizing that land and facilities planning is not a static process, solicitation of tailored ORNL stakeholder responses will be ongoing. Input received subsequent to publication will be incorporated in update documents.

2.7.4 Use of Input

Responses of stakeholders external to ORNL and participants in the Common Ground process, as well as public comments received informally throughout the planning, will be evaluated for compatibility with the ORNL vision for land use. Where appropriate and possible, these responses have been or will be incorporated into the plan of current land uses and planning for future land uses.

Planning land uses is an opportunistic and dynamic process. Through the ORNL Land and Facilities Use Committee, additional comments, ideas, and suggestions will be evaluated in a timely manner for implementation and reviewed through the RMO as needed.

3. ORNL INTEGRATED STRATEGIC FACILITIES PLAN

3.1 PURPOSE

Revitalization of the Oak Ridge National Laboratory (ORNL) campus is a key initiative of the new ORNL prime contractor, UT-Battelle LLC, and this ORNL Integrated Strategic Facilities Plan describes the details of UT-Battelle's approach to upgrading the scientific resources and supporting infrastructure of the Laboratory. The facilities upgrade needs at ORNL are not unique, however, within the DOE Office of Science (DOE-SC) multiprogram laboratory system. DOE-SC's goal is to accomplish full modernization of its laboratories by 2012, as part of its "Laboratories of the 21st Century" initiative. This ORNL plan meets the planning objectives put forth by the Office of Science for that initiative.

The Integrated Strategic Facilities Plan defines future plans for ORNL facilities and site development. In addition, it serves as a reference source for a broad base of site and facilities characterization data. Future facility and land requirements are determined by the functional and physical adequacy of existing facilities and equipment and by future mission and program plans. This plan provides a summary of existing ORNL assets. The general plant projects (GPPs), general-purpose equipment (GPE), and Line Item (LI) construction projects required to support ORNL's future mission and program plans are identified, and the impacts of this construction on the site's assets are summarized.

3.2 SUPPORTING INFORMATION

This plan has been developed with the philosophy of referencing existing, relevant planning documents whenever possible and duplicating information from those documents only to the extent necessary to assure a cogent, comprehensive presentation of appropriate information within the context of this plan. Users, therefore, should access the referenced documents for detailed information. The *ORNL Land and Facilities Plan* will be updated periodically on the World Wide Web as significant changes to the information in the plan occur. *Paper copies of this plan should be utilized with the understanding that they may not contain the most current information available.*

Listed below are the key planning documents that support this plan. A short description of the referenced document is provided along with a World Wide Web Uniform Resource Locator (URL) address, if one is available. An organizational contact responsible for the specific document is also provided (Table 3.1).

3.2.1 Comprehensive Integrated Planning Process for the Oak Ridge Operations Sites

The *ORR Comprehensive Integrated Plan* is intended to assist U.S. Department of Energy (DOE) and contractor personnel in implementing a comprehensive/integrated planning process consistent with DOE Order 430.1A, "Life Cycle Asset Management." DOE contractors are charged with developing and producing the *ORR Comprehensive Integrated Plan*, which serves as a summary document, providing information from other planning efforts regarding vision statements, missions, contextual conditions, resources and facilities, decision processes, and stakeholder involvement. Available at URL http://www.ornl.gov/~dmsi/cip/.

Table 3.1. List of organizational contacts for documents/databases

Document/Web address, if applicable	Organizational Contact	Bldg/MS	Phone	UID*
Comprehensive Integrated Planning Process for the Oak Ridge Operations Sites (September 1999) (http://www.ornl.gov/~dmsi/cip/)	P. D. (Pat) Parr UT-Battelle	Bldg. 1505/MS 6038	576-8123	par
ESHQ&I Management Plan Information System (http://svr1.cmo.ornl.gov/eshwc/wc.dll?eshweb~TopPage)	P. E. (Patty) Cox UT-Battelle	Bldg. 1000/MS 6302	576-4183	pcx
Environmental Management Program Baselines (http://www.bechteljacobs.org/busmgt/baseline/Baselines.html)	D. A. (David) Starling Bechtel Jacobs Company LLC	Bldg. K-1225/MS 7293	576-6501	sa9
ESHQ&I Budget Formulation Submission for ORNL (http://www.ornl.gov/camext/CAMIndex.htm)	P. E. (Patty) Cox UT-Battelle	Bldg. 1000/MS 6302	576-4183	pcx
ESHQ&I Management Plan for ORNL (http://www.ornl.gov/camext/CAMIndex.htm)	R. J. (Rick) Forbes UT-Battelle	Bldg. 1000/MS 6302	574-0404	rfs
ORNL Facility Index (http://www-internal.ornl.gov/~q9t/facility/)	D. (Dave) Kennard UT-Battelle	Bldg. 1000/MS 6302	574-9282	k33
ORNL Institutional Plan (http://www.ornl.gov/inst_plan/IP_Outline.html)	M. B. (Bonnie) Nestor UT-Battelle	Bldg. 4500N/MS 6251	574-4173	mnj
ORNL Land and Facilities Plan (http://www.ornl.gov/~dmsi/landUse/)	A. R. (Tony) Medley, UT-Battelle P. D. (Pat) Parr, UT-Battelle	Bldg. 1000/MS 6302 Bldg. 1505/MS 6038	574-9156 576-8123	arm par
ORNL Laboratory Agenda (http://www-internal.ornl.gov/opsp/osp_labagenda.htm)	M. B. (Bonnie) Nestor UT-Battelle	Bldg. 4500N/MS 6251	574-4173	mnj
Oak Ridge Reservation Annual Site Environmental Report (http://www.ornl.gov/Env_Rpt/aser99/aser.htm)	M. G. (Mike) White UT-Battelle	Bldg. 4500S/MS 6131	241-5378	m9w
Oak Ridge Reservation Management Plan (http://www-internal.ornl.gov/orrmp/)	P. D. (Pat) Parr UT-Battelle	Bldg. 1505/MS 6038	576-8123	par
P&E Division Maintenance Work Plan: FY 2000 – 2001, (http://www.ornl.gov/~dmsi/landUse/) Available as a link from this site	W. D. (Danny) Davis UT-Battelle	Bldg. 2518/MS 6328	574-7921	wiv
ORNL Strategic Facilities Plan (http://www.ornl.gov/~dmsi/strategic_plan/index.html)	T. E. (Tim) Myrick UT-Battelle	Bldg. 1000/MS 6336	241-4597	uyt

*Users external to ORNL should add the extension @ornl.gov to all UIDs (e.g., par@ornl.gov).

The *ORR Comprehensive Integrated Plan* is a planning reference that identifies primary issues regarding major changes in land and facility use and serves all programs and functions on-site, as well as the DOE Oak Ridge Operations Office (ORO) and DOE Headquarters. The plan illustrates how the ORR, as a valuable national resource, is and shall be managed based on the principles of ecosystem management and sustainable development and how mission, economic, ecological, social, and cultural factors are used to guide land and facility use decisions. The long-term goals of the comprehensive integrated planning process, in priority order, are to support DOE critical missions and stimulate the economy while maintaining a quality environment.

3.2.2 ESHQ&I Management Plan Information System

The ESHQ&I Management Plan Information System was developed to serve as a management decision-making support tool. It accepts and stores data associated with ESHQ&I Activity Data Sheets (ADSs) either from the ORNL Program Management Tracking System or as direct input information into an ADS. The system accepts the risk matrix scores assigned to each ADS by the ORNL Risk Ranking Board and screens for entry of all pertinent data associated with an ADS, and support data validation where possible and appropriate. The system provides flexibility in viewing and editing data with powerful features for querying, indexing, and reporting data. Available on the World Wide Web at URL http://svr1.cmo.ornl.gov/eshwc/wc.dll?eshweb~TopPage.

3.2.3 Environmental Management Program Baselines

The Environmental Management Baseline is a fiscal year baseline used by the Bechtel Jacobs Company LLC to plan for completing the cleanup of EM work in the scope of the program. The objective of baseline is to contract for safely accelerating cleanup and maximizing cost effectiveness through the use of competitive subcontracting. Available on the World Wide Web at URL http://www.bechteljacobs.org/busmgt/ baseline/Baselines.html.

3.2.4 ESHQ&I Budget Formulation Submission for ORNL

ORNL's annual Environment, Safety, Health, Quality, and Infrastructure (ESHQ&I) Budget Formulation Plan is developed in accordance with the annual DOE Guidance Document for the ESHQ&I Planning Process. ESHQ&I activities are identified to ensure the health and safety of employees and the public; protection of the environment; and compliance with applicable laws, regulations, DOE policies and orders, and other ESHQ&I requirements while carrying out the site's missions and the planning for ORNL infrastructure needs which support R&D as well as the environment, safety, health, and quality (ESH&Q). This plan is developed using risk-based planning and priority-setting methodologies to (1) establish and communicate ESHQ&I expectations and requirements to the ORNL community, (2) support the development of Departmental budgets and secure funding for ESHQ&I programs and activities, (3) support the integration of ESHQ&I principles in site-wide work planning and execution, and (4) assess ESHQ&I performance and provide feedback to promote continuous improvement. Available at URL http://www.ornl.gov/camext/CAMIndex.htm.

3.2.5 ESHQ&I Management Plan for ORNL

The annual *ORNL Environment, Safety, Health, Quality, and Infrastructure (ESHQ&I) Management Plan* was developed to describe the approach used at ORNL to ensure the health and safety of employees and the public, protect the environment, comply with contractual requirements set forth in the Work Smart Standards (WSSs) agreed upon by the contractor and DOE, and manage physical assets and infrastructure from acquisition through operations and disposition. This plan documents

the systems and processes used by ORNL to (1) establish and communicate ESHQ&I expectations and requirements to the ORNL community, (2) identify and secure funding for ESHQ&I activities using risk-based planning and priority setting, (3) conduct R&D activities and operations through integration of ESHQ&I principles in work planning and execution, and (4) assess ESHQ&I performance and provide feedback to promote continuous improvement. The plan is prepared annually in accordance with guidelines in the annual *DOE Guidance Manual for the ES&H Planning Process for the Fiscal Year*, and its issuance satisfies the requirement in the DOE/UT-Battelle Management Contract, I-101. 970.5204-2 (c).

ORNL has an integrated ESHQ&I database system that enables ORNL to

- meet major ESHQ&I commitments,
- address key issues,
- manage unfunded ESHQ&I risks,
- systematically provide information for the reduction of ESHQ&I risks, and
- establish and maintain stakeholder confidence.

Available at URL http://www.ornl.gov/camext/CAMIndex.htm.

3.2.6 ORNL Facility Index

The ORNL Facility Index (http://www-internal.ornl.gov/~q9t/facility/) is an internally available Web-based database of ORNL facilities with related links that include ORNL site maps, the ORNL Facilities Management Database, the ORNL Area Responsibility Listing, the ORNL Condition Assessment Survey (CAS), the ORNL Space Allocation Management System (SAMS), the Property Management System (PRISM), and Whos. Photographs of the facilities are also available at this index. Available on the World Wide Web at URL http://www-internal.ornl.gov/~q9t/facility/.

3.2.7 ORNL Institutional Plan

ORNL produces an institutional plan each year to convey information about the Laboratory to DOE. The institutional planning process provides a means for DOE to consider the Laboratory as an institution (rather than as a collection of programs) and to review its mission, its health as an institution, and its plans for the future. DOE approval of ORNL's institutional plan indicates that the Laboratory's mission, vision, and strategic plan are aligned with Departmental needs and plans. Available on the World Wide Web at URL http://www.ornl.gov/inst_plan/IP_Outline.html.

3.2.8 ORNL Laboratory Agenda

UT-Battelle's plan for ORNL is guided by a commitment to achieving simultaneous excellence in the areas of science and technology; laboratory operations and environment, safety, and health (ES&H); and community service. The UT-Battelle Leadership Team has developed a Laboratory Agenda to provide a structured framework for the long-term initiatives, critical outcomes, and near-term actions through which it will deliver on this commitment. The Laboratory Agenda is focused on the most significant activities that UT-Battelle must accomplish to deliver on its vision of simultaneous excellence. It includes clear statements of the primary results that will be delivered to DOE over the next few years. Available at URL http://www-internal.ornl.gov/opsp/osp_labagenda.htm.

3.2.9 Oak Ridge Reservation Annual Site Environmental Report

This document contains a summary of environmental monitoring activities on the ORR and its surroundings. The monitoring and documentation criteria are described within the requirements of DOE Order 5400.1, "General Environmental Protection Program." The results summarized in this annual report are based on the data collected prior to and through the reported year. Available at URL http://www.ornl.gov/Env_Rpt/aser99/aser.htm.

3.2.10 Oak Ridge Reservation Management Plan

The primary purpose of this management plan is to define responsibilities and authority for ORR management. The management plan treats the ORR as a single site wherever possible and addresses roles and responsibilities for managing the physical and human resources of the reservation on both a day-to-day and long-term basis. The focus of the document is to address general overall reservation policy and management, particularly as it relates to the portion of the ORR outside the immediate site boundaries. Available at URL http://www-internal.ornl.gov/orrmp/.

3.2.11 P&E Division Maintenance Work Plan

The *Plant and Equipment (P&E) Division Maintenance Work Plan: FY 2000 – 2001* supports P&E Division's Long-Range Strategic Plan that, in turn, supports the *ORNL Institutional Plan* and the *ORNL ESHQ&I Management Plan*. The Maintenance Work Plan provides additional information required by DOE Order 430.1A, "Life Cycle Asset Management." This fulfills a two-part requirement to discuss maintenance requirements during the period FY 2000–01 to correspond with current budget preparations of those years. See Appendix F.

3.2.12 ORNL Strategic Facilities Plan

The *ORNL Strategic Facilities Plan* provides the following: a brief overview of the Facilities Revitalization Project (FRP) team established to accomplish the revitalization mission; a review of the current inventory and condition of existing ORNL facilities, as well as the programmatic mission drivers that are the basis for future facilities needs; and an outline of the specific facilities consolidation, upgrade, and new construction needs that leads to the overall Master Plan for ORNL development. The preliminary cost and schedule estimates for completing that Master Plan are then provided, followed by a short discussion of the conclusions and recommendations of the strategic planning exercise. Available at URL http://www.ornl.gov/~dmsi/strategic_plan/index.html.

3.3 CURRENT SITE AND PROGRAM DESCRIPTION

Programs at ORNL require a variety of buildings and equipment, including specialized experimental laboratories, a large complement of office space, and major utility and waste disposal facilities. ORNL has one of the oldest physical plants in the DOE laboratory system, and continuing efforts will be required to renovate and rehabilitate general-purpose buildings and utility systems that have deteriorated, as well as provide for new mission-related facilities for expanded scientific endeavors. Following is a description of ORNL's research and support facilities, including their current use status and operational condition, as well as a brief review of the new program areas of emphasis, with their related facilities needs.

3.3.1 Inventory of Current Facilities, Uses, and Infrastructure Needs

3.3.1.1 Current Facilities and Uses

ORNL's main site encompasses approximately 1100 acres in the Bethel (Fig. 3.1) and Melton (Fig. 3.2) valleys, approximately 10 miles southwest of the center of the city of Oak Ridge, Tennessee, with additional facilities located on the adjacent Copper Ridge (Fig. 3.3). ORNL also occupies space at the Oak Ridge Y-12 National Security Complex (Fig. 3.4) and leases some space off-site.

As indicated in Table 3.2, buildings at the Melton Valley and Bethel Valley sites and Copper Ridge comprise approximately 3.4 million gross square feet of building space; at the Y-12 National Security Complex, ORNL use accounts for approximately 1.4 million gross square feet of building space.

Facilities accepted into DOE's Environmental Management (EM) Program and those that are part of the waste management systems managed by Bechtel Jacobs Company LLC under the M&I contract for environmental management have been transferred to Bechtel Jacobs Company LLC to facilitate the accomplishment of contractual responsibilities. With the exception of these facilities, ORNL has full responsibility for its Bethel Valley and Melton Valley sites and surrounding areas. ORNL is also responsible for management of a 21,076-acre portion of the approximately 34,424-acre ORR, including ORNL facilities and most of the 20,000-acre Oak Ridge National Environmental Research Park. At the Y-12 National Security Complex, ORNL has responsibility for building maintenance and ESH&Q functions as approved by Memoranda of Understanding (MOUs) between ORNL and Y-12.

The ORNL site has many functions and requirements similar to those of a small city. It is supported by a dedicated fire department, a medical center, a security force, and a steam plant. Amenities include 37 miles of paved roads, 180 miles of unpaved roads, 27,000 feet of steam lines, 100,000 feet of treated water piping, and 115 acres of mowed grounds.

Table 3.2. ORNL building summary

Location	Buildings	Building sq ft	Trailers	Trailer sq ft	Total sq ft
ORNL main site	**428**	**3,359,508**	**85**	**73,161**	**3,432,669**
• UT-Battelle	296	2,912,870	52	46,243	2,959,113
• Bechtel Jacobs	132	446,638	33	26,918	473,556
ORNL off-site	**2**	**55,400**	**4**	**9,960**	**65,360**
• Museum (AMSE)	2	55,400			
• Colorado (GJC)			4	9,960	
ORNL at Y-12	**21**	**1,372,910**			**1,372,910**
Leased off-site	**5**	**163,572**			**163,572**
Total	**456**	**4,951,390**	**89**	**83,121**	**5,034,511**

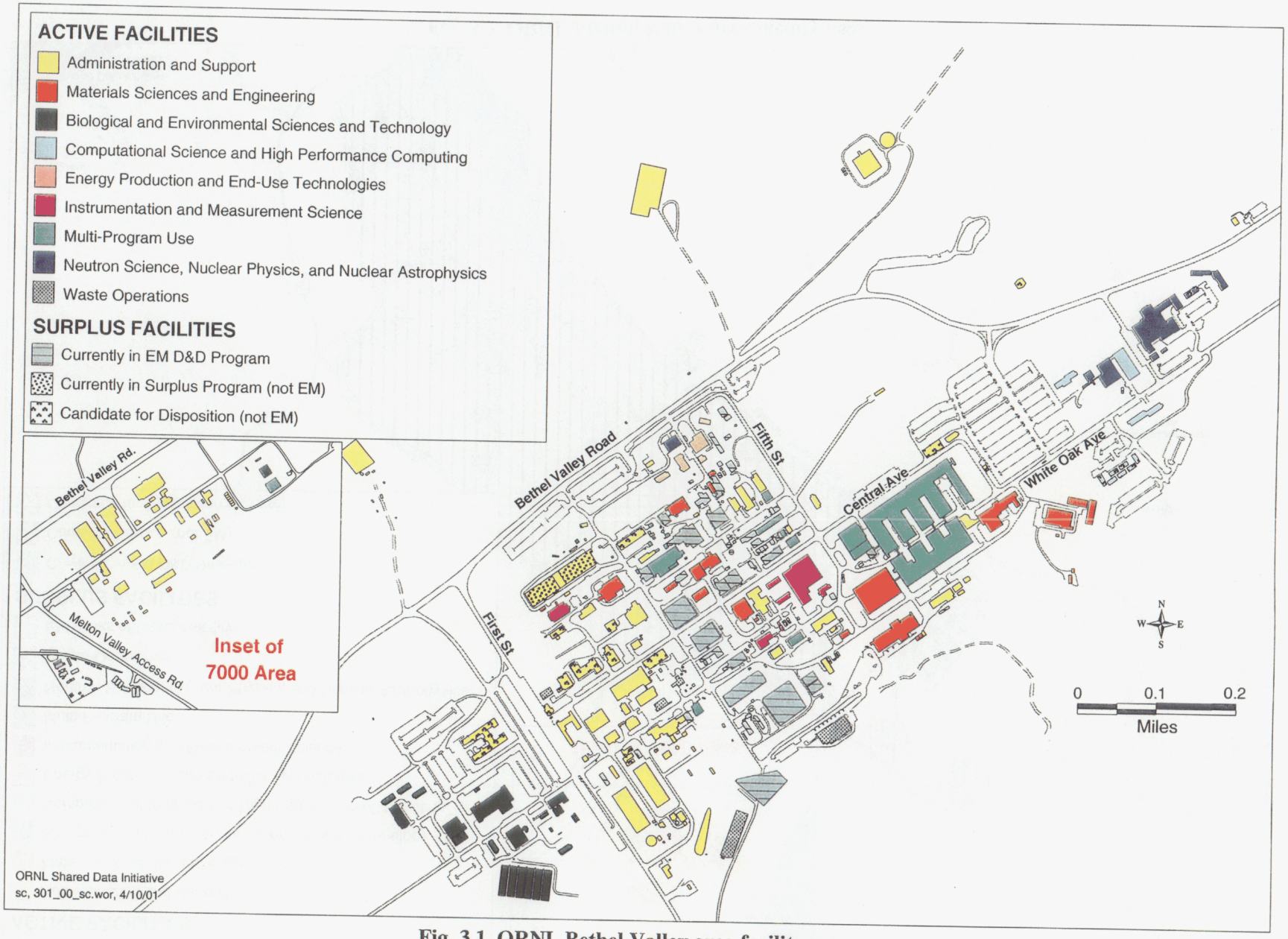


Fig. 3.1. ORNL Bethel Valley area facility uses.

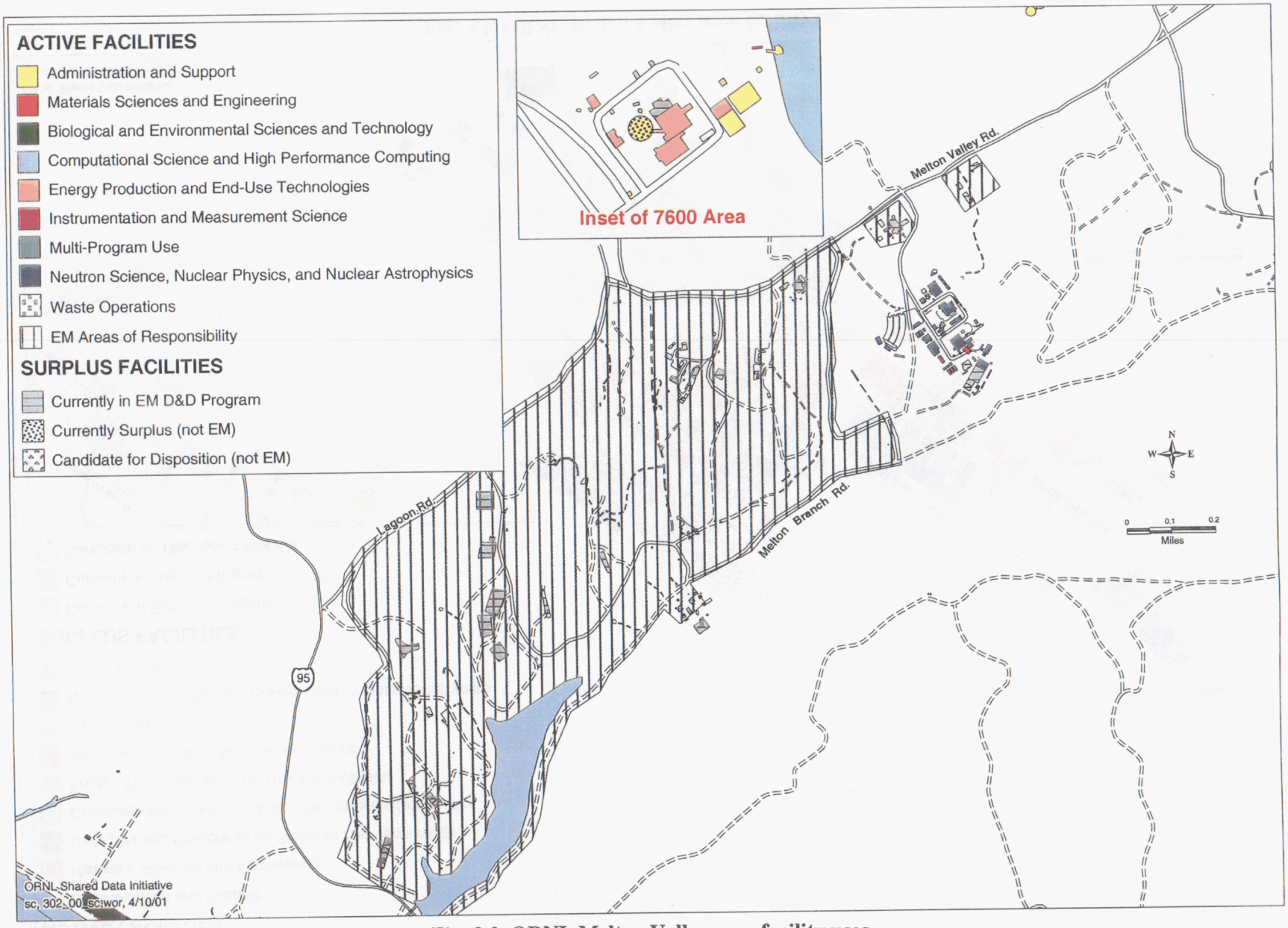


Fig. 3.2. ORNL Melton Valley area facility uses.

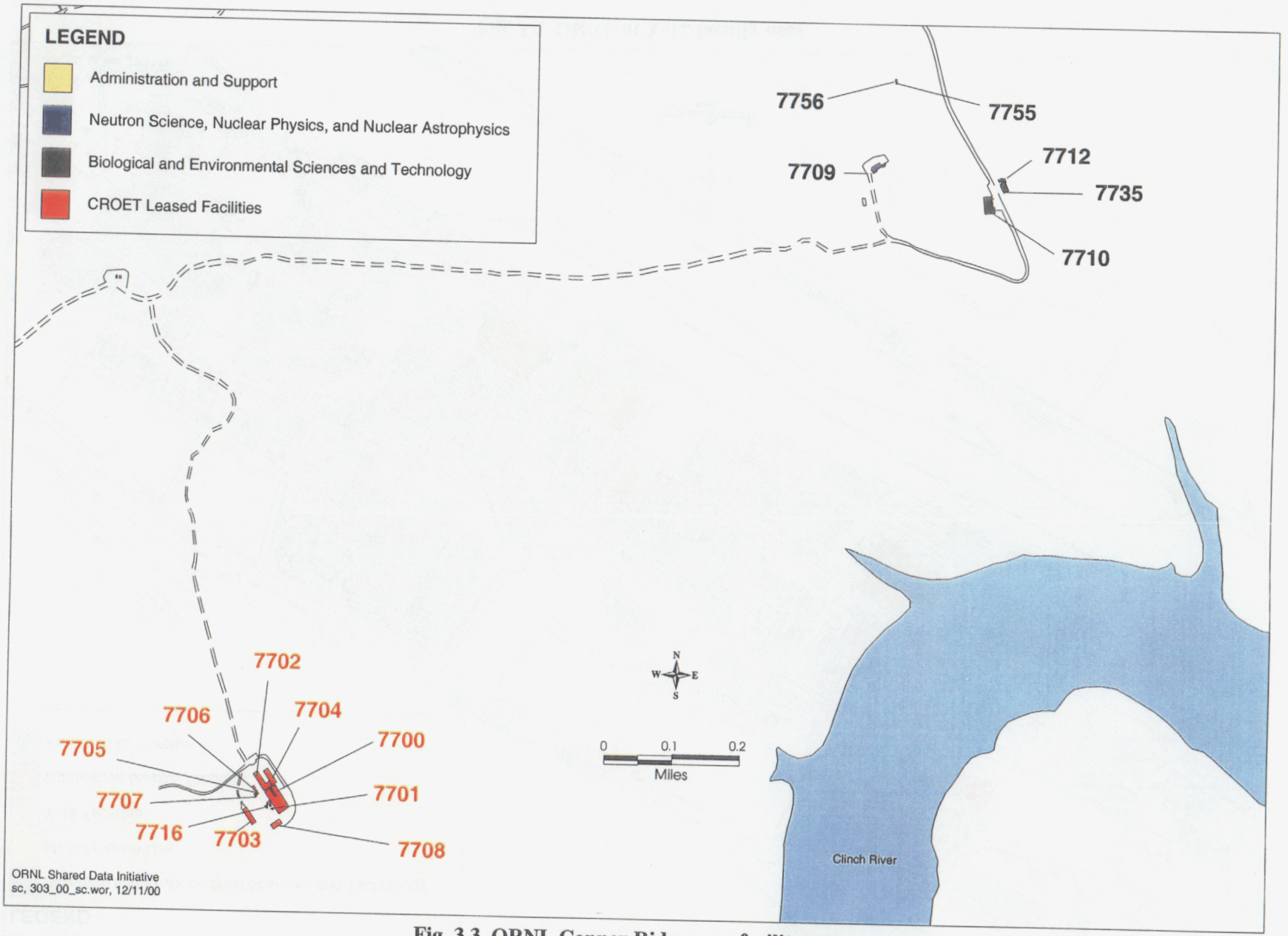


Fig. 3.3. ORNL Copper Ridge area facility uses.

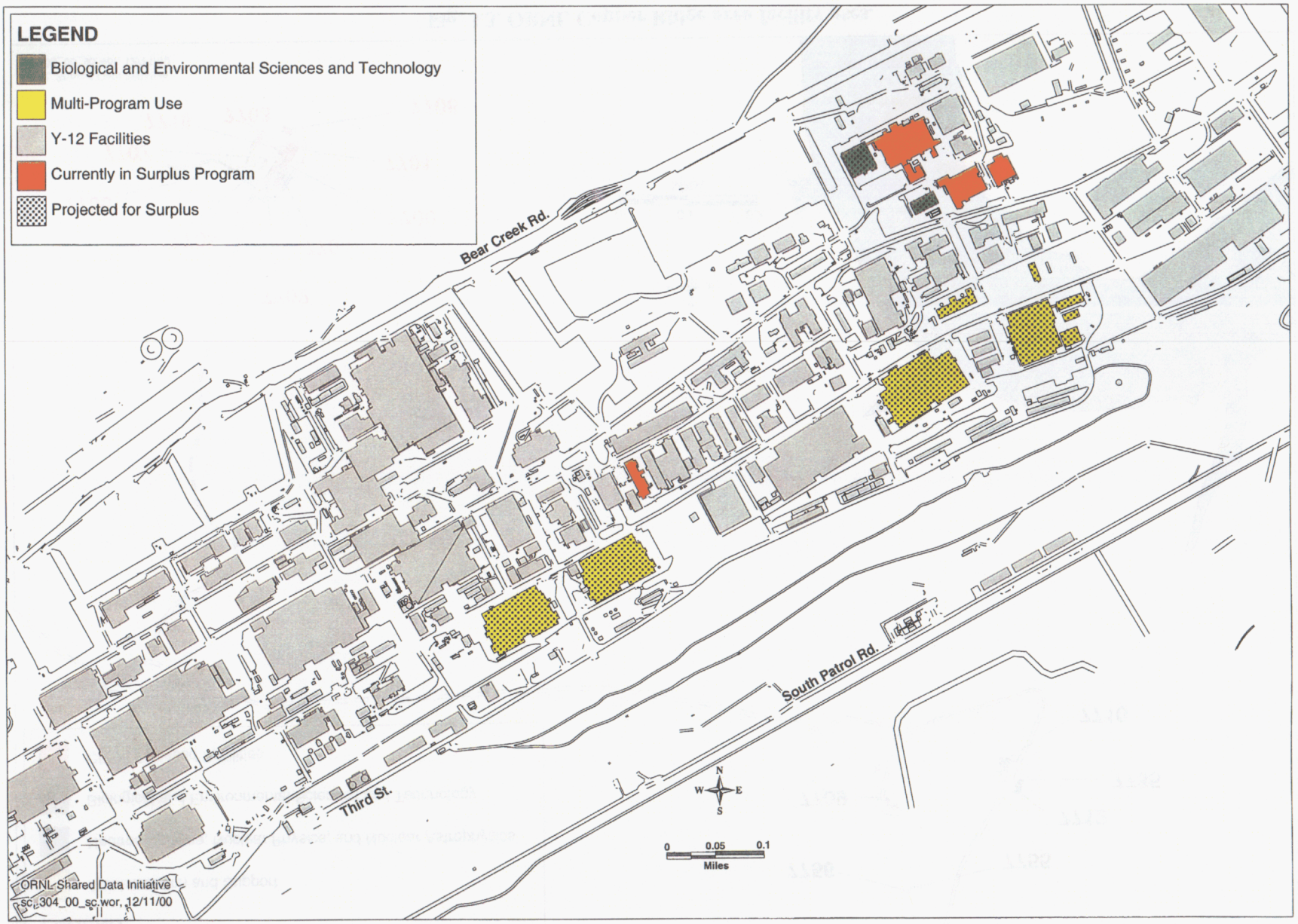


Fig. 3.4. ORNL at Y-12 facility uses.

The overall condition of the space is shown in Figs. 3.5 and 3.6, and a summary of space use is shown in Fig. 3.7. Photographs of a few of the representative substandard buildings are provided in Figs. 3.8–3.11. A summary of building age is shown in Fig. 3.12. As is clear from these figures, the majority of current ORNL space is substandard and needs to be replaced or upgraded in order to support the long-term research mission of the Laboratory.

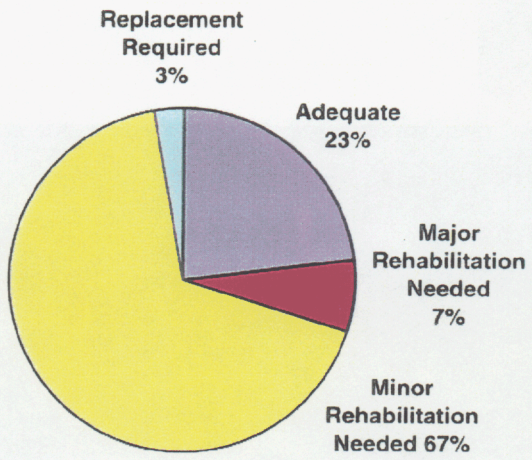


Fig. 3.5. Condition of space at ORNL.

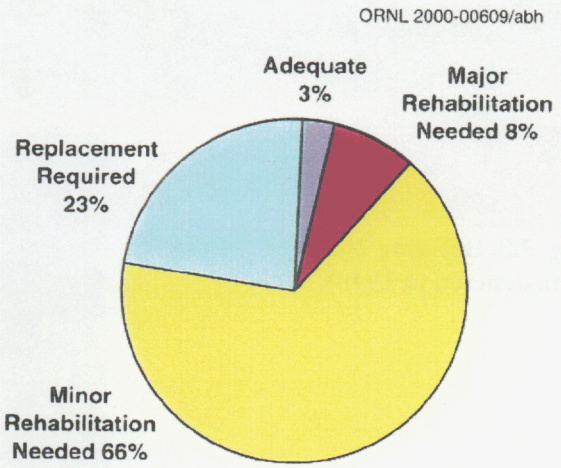


Fig. 3.6. Condition of ORNL space at Y-12.

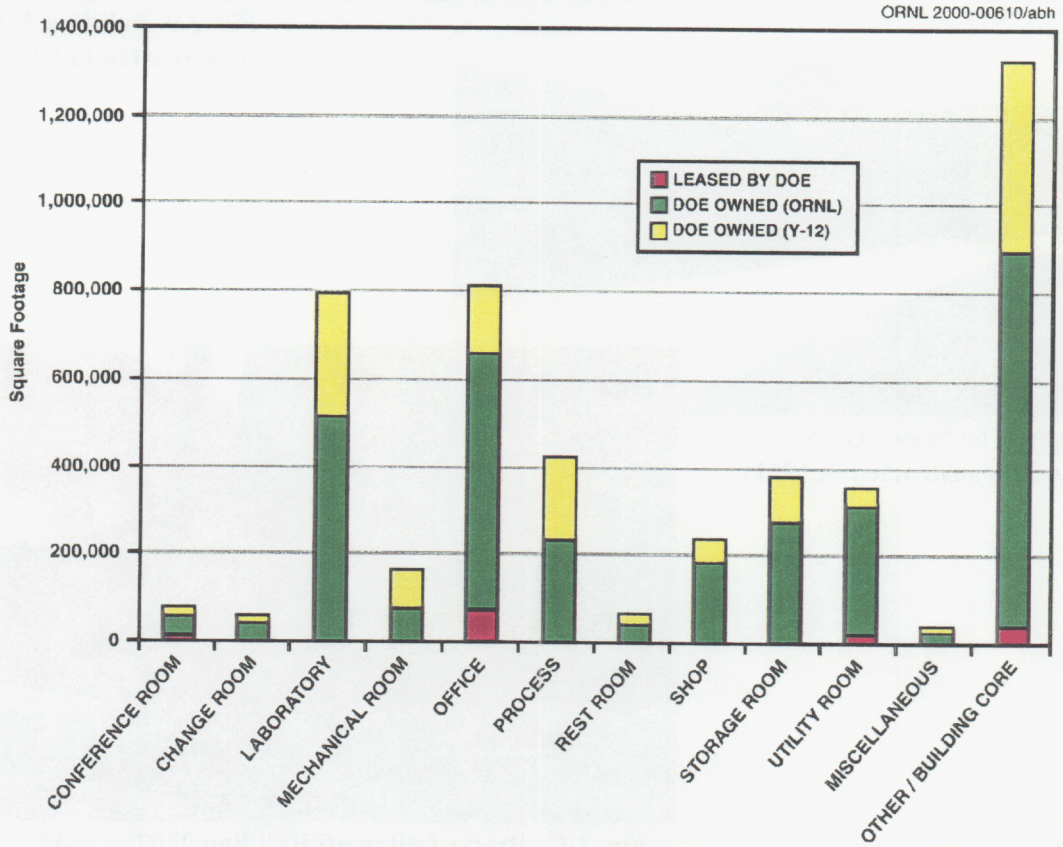


Fig. 3.7. Use of ORNL space.

Fig. 3.8. Building 2001 (constructed in 1948).

Fig. 3.9. Building 3550 (constructed in 1943).

Fig. 3.10. The "new" ORNL Cafeteria (constructed in 1951).

Fig. 3.11. Bricks falling off Building 9207 at Y-12.

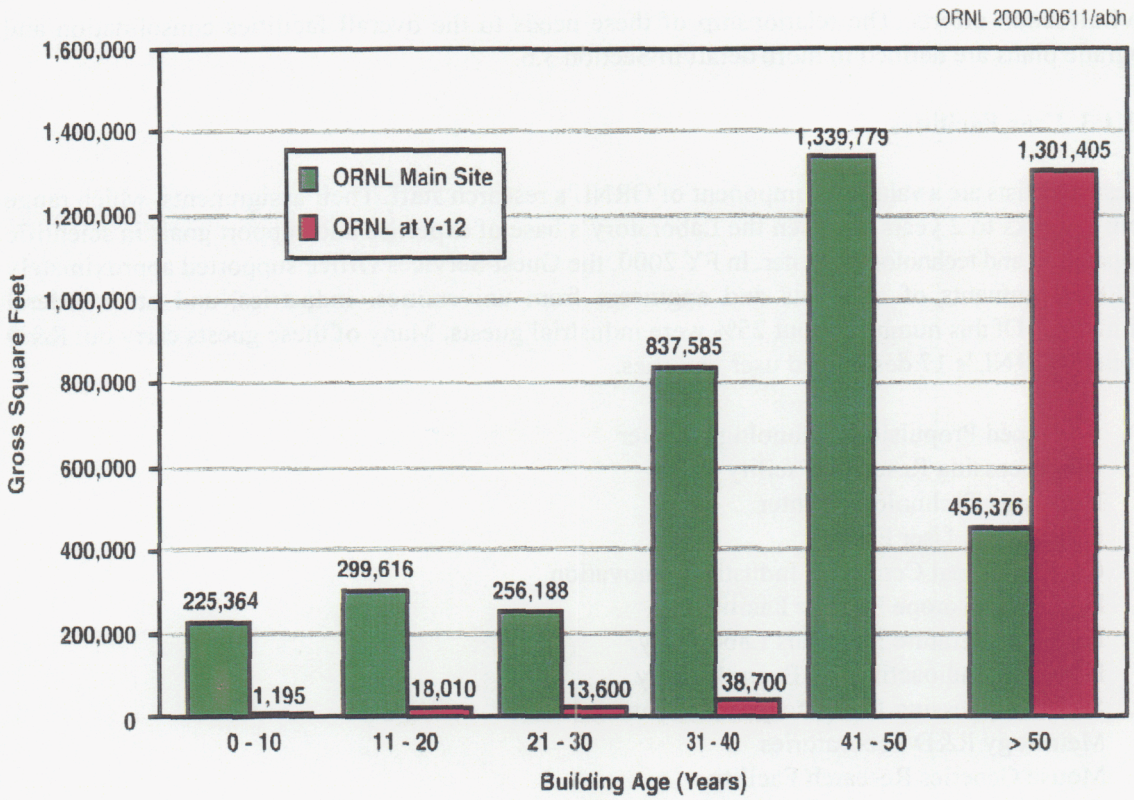


Fig. 3.12. Age of ORNL buildings.

3.3.1.2 Infrastructure Conditions and Limitations

To support research activities, a wide variety of infrastructure systems are in place across the Laboratory and, similar to the research facilities themselves, are in various stages of deterioration due to age. These systems include utilities (electrical, gas, compressed air, potable/process water, chilled water, steam, industrial gases, HVAC, stormwater collection, and telecommunications), transportation infrastructure (roads and parking areas), security (fencing, portals, building access controls), fire protection, and waste management (conventional and hazardous). While a detailed description of the conditions and needs in each of these areas is beyond the scope of this plan, it is important to understand that these infrastructure systems are critical to the mission of the Laboratory and must receive equal attention in revitalization planning.

The systems having the greatest need for refurbishment or replacement as part of the 21st Century Laboratories initiative are those related to upgrade of the electrical distribution system, process/chilled water systems, ventilation and exhaust systems, transportation infrastructure, and security. Many of these upgrades are driven by health and safety requirements that can no longer be met by 35- to 50-year-old electrical or heating, ventilating, and air-conditioning (HVAC) equipment, or for which reliability concerns cannot be tolerated (e.g., the primary potable water systems). Roadway conditions are primarily a concern related to travel safety on the portion of Bethel Valley Road bordering ORNL to the north and on Melton Valley Road providing access to the High Flux Isotope Reactor (HFIR) area. Issues related to parking availability are less of a concern at present, but must be a major component of master planning for the new ORNL campus. Similarly, site security upgrades are being required due to changes in DOE's approach to research laboratory operations, as well as the desire by UT-Battelle to have a more open campus environment as part of Laboratory

revitalization efforts. The relationship of these needs to the overall facilities consolidation and upgrade plans are defined in more detail in Section 3.6.

3.3.1.3 User Facilities

Guest scientists are a valuable component of ORNL's research staff. Their assignments, which range from 2 weeks to 2 years, broaden the Laboratory's base of expertise and support goals in scientific cooperation and technology transfer. In FY 2000, the Guest Services Office supported approximately 3000 assignments of scientists and engineers from universities, industries, and other federal institutions. Of this number, about 25% were industrial guests. Many of these guests carry out R&D at one of ORNL's 17 designated user facilities.

- Advanced Propulsion Technology Center
- Bioprocessing Research Facility
- Buildings Technology Center
- Californium User Facility
- Computational Center for Industrial Innovation
- High Flux Isotope Reactor Facility
- High Temperature Materials Laboratory
- Holifield Radioactive Ion Beam Facility
- Metals Processing Laboratory User Center
- Metrology R&D Laboratories
- Mouse Genetics Research Facility
- Oak Ridge Electron Linear Accelerator
- Physical Properties Research Facility
- Power Electronics and Electric Machinery Research Center
- Shared Research Equipment Program
- Surface Modification and Characterization Research Center
- Oak Ridge National Environmental Research Park (includes a variety of field user facilities such as Walker Branch Watershed, Natural and Accelerated Bioremediation Field Research Center, Melton Valley Watershed, Global Change Field Research Facilities, and NOAA Facilities; more detail on Research Park user facility sites is included in Sections 2.5.1 and 2.6.2.2)

3.3.1.4 Environment, Safety, Health, and Quality

The ORNL environment, safety, health, and quality programs strengthen scientific integrity, ingenuity, and innovation by helping line organizations protect the health and safety of workers and the public, monitoring the Laboratory's impact on the environment, ensuring compliance with federal and state statutes and DOE regulations in these areas, managing permitting and operations for newly generated waste, and supporting quality and effectiveness in operations.

The health and safety of ORNL employees is accomplished through management's commitment to successfully implementing and continually improving the Laboratory's Integrated Safety Management System (ISMS). ISMS is a systematic approach of integrating safety ("safety" includes safety, health, and environment) into management tools and systems and work control practices. ORNL is planning the deployment of integrated management systems as its approach to business management. Treating ISMS as a project and management system will ensure full integration and maximize the benefit of other systems and initiatives underway in support of the Laboratory's Agenda. Systems such as the Standards Based Management System (SBMS); Performance Based Management Systems; Roles, Responsibilities, Authorities, and Accountabilities; Facility Use Agreements; Facility Operations Model; and Facility Revitalization will institutionalize a method of conducting business which is

integral for the ISMS continuous improvement. Efforts are well underway with the development of these initiatives, and many have established milestones and assigned systems or project owners. Continuous improvement at ORNL will:

- Integrate safety into every aspect of research and development as well as support activities;
- Reduce the cost of doing business by ensuring that proper work planning and controls are established to eliminate down time and possible internal or external reviews;
- Improve employee feedback by establishing systems and mechanisms that encourage group interaction;
- Establish a culture that encourages sharing of lessons; and
- Assure employees that retribution for identifying safety issues will not be tolerated.

3.3.1.4.1 Environmental Management

Environmental Protection and Waste Services is ORNL's liaison with regulators, interpreting and translating requirements, managing all aspects of the permitting processes and operations for newly generated waste, and monitoring and reporting on the environmental impact of ORNL operations.

Environmental and waste services provided include:

- Programs focusing on ensuring ORNL's compliance with federal and associated state environmental regulations such as the Clean Air Act, Clean Water Act, Resource Conservation and Recovery Act (RCRA), Toxic Substances Control Act (TSCA), and Comprehensive Environmental Response, Liability, and Compensation Act.
- Monitoring (including sampling and sample management for laboratory analyses) for the ORNL site and the ORR to support compliance with permitted programs, compliance agreements, and regulatory requirements.
- Environmental surveillance on the ORR to monitor the effect of DOE activities on-site and off-site on environmental and natural resources.
- Environmental management to provide resources for the National Environmental Policy Act (NEPA), the National Historic Preservation Act (NHPA), state oversight agreements between DOE and the State of Tennessee, and coordination of environmental issues between ORNL and Bechtel Jacobs Company LLC.
- Ensuring that ORNL waste is properly characterized and certified to meet all requirements and assisting ORNL in getting its waste ready for receipt by Bechtel Jacobs Company LLC.

3.3.1.4.2 Health Services

The Health Services programs provide assessment of worker health and fitness for work assignments, providing on-site primary care for minor illnesses and injuries as well as first response for medical emergencies and monitoring both short- and long-term effects of occupational activities on worker health.

Health Services provides the following two major programs to the Laboratory:

- A program to assist in the maintenance and protection of optimal health through occupational medicine, psychology, and nursing and to maintain a close interface with allied health disciplines.
- A program offering employees counseling, treatment, rehabilitation, and/or referral services for a wide range of problems ranging from drug and alcohol abuse to marital, financial, job and/or career development issues.

3.3.1.4.3 Operational Safety Services

Operational Safety Services programs provide managers and employees with technical support, consultation, and oversight in the areas of industrial hygiene, radiation protection, occupational safety, and nuclear safety to minimize the risk of exposures to chemical, physical, radiological, and biological hazards.

Services provided in radiation protection include:

- Surveillance of ongoing activities involving radiation hazards
- Characterization of radiation and contamination hazards in work environments
- Identification of areas where hazards exist
- Clearance of materials
- Maintenance of an effective and efficient dose assessment program, including whole-body counting, bioassay, external dosimetry, and dosimetry data management
- Guidance and control for ALARA

Services provided by fire protection include:

- Establishment of a fire-safe posture at ORNL
- Ensuring fire-related threats to life, property, and the public are minimized

Services provided in industrial hygiene and occupational safety include:

- Chemical Carcinogen
- Confined Space
- Electrical Safety
- Ergonomics
- Hazcom/Laboratory Standard
- Hearing Conservation
- Indoor Air Quality
- Lead Surveillance and Controls
- Lockout/Tagout
- Respiratory Protection
- Scaffolding and Fall Protection
- Ventilation Surveillance and Control
- Construction Safety
- Reporting Services
- Other Consultative Services

Services provided in nuclear safety include:

- Management of the ORNL Facility Safety Program
- Management of the Nuclear Criticality Safety Program

3.3.1.4.4 Quality Services

Quality Services programs provide services in the areas of quality planning, quality engineering, inspection, surveillance and verification, assessment, occurrence and issues management.

Services provided in quality include:

- Interpretation of quality requirements for customers and ensuring the development of systems to implement those requirements
- Supplier Evaluation Services (SES)
- Procurement document quality reviews

- Suspect/counterfeit inspection and control
- ORNL Occurrence Reporting
- Operational Readiness Reviews
- Technical evaluations of quality-related activities
- Issues Management
- Alerts and Lessons Learned Program
- Radiographic, ultrasonic, liquid penetrant, magnetic particle, mass spectrometer examinations of materials and weldments
- Visual inspections of mechanical, electrical, structural, and civil activities
- Quality engineering functions for planning, design, construction, and acceptance
- Welding engineering functions for weld procedure, reviews, and consultation
- American Society of Mechanical Engineers (ASME) Section VIII "R" and "U" Stamp programs

3.3.1.4.5 Training Services

Training Services programs provide managing and integrating ORNL employee training programs supporting line organization management of employee training requirements and providing a variety of training services in the area of ESH&Q.

Training services provided include:

- Core competencies of analysis, program design, lesson plan development and maintenance, preparation of student and instructor materials and manuals, establishing qualifications and business event data in SAP, SAP data management for divisions, coordinating and scheduling facilities, course cost management, and systems design and development.
- Standards based management development to ensure that ORNL facilities are operated in a safe and environmentally responsible manner.

3.3.1.5 Hazardous Material Transportation, Storage, and Handling

Many buildings at ORNL receive, store, or use hazardous materials or chemicals. Storage of chemicals is typically limited to amounts that can be used in short periods and involve small amounts or consumer volumes, defined as laboratory quantities, which, if suddenly released, would have no measurable off-site impact. Larger volumes of hazardous materials may be stored in bulk at various locations. Only two facilities have been identified as bulk storage areas, and neither poses any off-site release impact. The refueling station is the primary location where large volumes of hazardous fuels and oils are stored. It is separated from other facilities by sufficient distance to minimize any on-site or off-site impact from an inadvertent spill, release, or fire. The Materials Receiving Area provides large-capacity storage for compressed gases used throughout ORNL. Gas cylinders are properly secured to prevent inadvertent tipover accidents, and hazardous gases are segregated to prevent the formation of toxic chemical combinations. Transportation of hazardous materials and chemicals is typically performed by the ORNL shipping and receiving function according to all applicable DOT regulations. Safety analysis studies have been completed for on-site transportation and show negligible risk due to small volumes of properly packaged hazardous materials moving at or under on-site speed limits.

Chemicals and radioactive materials in transit within the ORR are packaged in accordance with DOT regulations and are not considered capable of creating an off-site release of hazardous materials. Moreover, receipt, handling, and storage of bulk chemicals is not expected to affect facility operations. Efforts have been made to minimize the probability of these types of accidents so that the potential for off-site releases from the affected facilities is minimal.

3.3.1.6 Fire Protection

ORNL maintains a fully staffed and equipped fire department to respond to fire, medical, rescue, and other general emergencies. A comprehensive looped proprietary alarm system serves the ORNL facilities. ORNL facilities at the K-25 Site and the Y-12 National Security Complex are provided fire and emergency response by on-site fire departments. The ORNL Fire Station, located in Building 2500 near the western end of the Bethel Valley site, provides a central alarm signal response area and houses emergency equipment, including fire and rescue equipment and ambulances. A second alarm receiving location is provided at Building 4512, the Laboratory Emergency Response Center. Most ORNL buildings are equipped with fire protection systems that include a fire detection system, a fire alarm, an evacuation system, and sprinklers.

National and State of Tennessee codes and consensus standards require a rigorous Inspection, Testing, and Maintenance (IT&M) program of fire alarm and protective systems. The Fire Protection Systems Section performs and/or coordinates systems IT&M or repairs of all site fire systems.

Fire Protection Engineering reviews all engineering plans to ensure that fire codes and applicable DOE orders are met. For example, buildings are required to be spaced 50 or more ft apart to prevent a fire in one building from involving its neighbor. Buildings erected with less than 50 ft of separation must share fire detection and alarm systems. In addition, buildings may not be built more than three stories high because of limitations in the fire response equipment. Codes also require that roads to buildings be constructed with the capability to support the emergency response and fire equipment.

The system that supplies water for fire protection is generally adequate. However, a small percentage of the system has deficiencies due mostly to age. System weaknesses include (1) old deteriorated water lines that are likely to cause an impairment; (2) an inadequate number of sectional valves to isolate an impairment; (3) inadequate flow capacity at hydrants because of short run lengths; (4) dead-end lines without loops; and (5) insufficient lines to adequately service developing sites.

3.3.1.7 Unique Facilities

ORNL has a number of unique experimental and production facilities that involve nuclear or other hazardous materials. These facilities utilize design features for safety and implement administrative controls to minimize the probability and consequences of an accidental release of hazardous material to on-site and off-site receptors. The Safety Analysis Report Update Program (SARUP) is the mechanism used to identify nuclear facilities at ORNL. The SARUP process involves a series of evaluations and analyses to ensure that the operations within each identified nuclear facility are and can be maintained in accordance with DOE Orders 5480.23 and 5480.22.

SARUP has used a graded approach to categorize facilities and upgrade facility safety documentation. Initial SARUP efforts were developed in accordance with DOE Order 5481.1B, which has subsequently been canceled and superseded by DOE Orders 5480.23 and 5480.22. The first phase, completed in 1989, conducted hazard screening evaluations of all hazards present in all ORNL facilities. Facilities containing inventories of materials that exceeded the hazard screening threshold values required additional evaluation in accordance with 5481.1B. The hazard screening process resulted in the "classification" of facilities according to the potential consequences of their hazards. Initially, there were four facility hazard classifications: "generally accepted" (no hazard or standard industrial hazards), low, moderate, or high. Nuclear Category 1, 2, and 3 and the "radiological" classification for facilities were eventually added. Information from these evaluations resulted in the need for facilities to upgrade current safety documentation, primarily existing Operational Safety Requirement (OSR) documents, and generate interim safety documentation for facility operations.

DOE Orders 5480.23 and 5480.22, issued in 1992, required the development and implementation of Safety Analysis Reports (SARs) and Technical Safety Requirements (TSRs) for all facilities classified as nuclear. DOE-STD-1027-92 was issued to provide guidance to categorize a facility as nuclear based primarily on that facility's nuclear material inventory. The results of the 1027-92 evaluations determined the initial nuclear facility hazard category for all identified facilities. SARUP efforts focused on developing Basis of Interim Operations (BIOs) documents as the safety basis for the continued operations at designated nuclear facilities in the interim until final SARs could be developed. Existing OSRs were upgraded and were often included as part of the BIO. Each BIO and updated OSR has been submitted to DOE and has received approval. These documents are designated as Facility Authorization Basis (FAB) documents and will serve as the safety basis until DOE approves the final hazard classification presented in the detailed final SARs and TSRs. BIOs and OSRs are reviewed annually and updated as necessary.

SARs and TSRs are being prepared for the ten nuclear facilities for which ORNL has responsibility. Of these ten facilities, two have approved SARs and TSRs/Technical Specifications. All SARs and TSRs will have been submitted to DOE for approval by December 1999. ORNL has one Category 1 nuclear facility (i.e., HFIR), five Category 2 facilities, and four Category 3 facilities.

Changes and modifications to a nuclear facility or to the existing FAB documentation will be evaluated to determine if DOE approval is required using the Unreviewed Safety Question Determination (USQD) process as required by DOE Order 5480.21. All FAB changes evaluated by USQDs become part of the FAB documentation and are incorporated into the FAB during the annual review and update.

ORNL maintains a Web site at URL http://www-ons.ornl.gov/ons/ons.htm, which contains lists of nuclear facilities on the ORNL site, their facility hazard classification, and facility safety documentation (e.g., FAB documents).

Hazard categorization did not identify any ORNL facilities with chemical hazards which exceed threshold levels that would require implementation of the OSHA Process Safety Management Rule (29 *CFR* 1910.119) or the EPA Risk Management Plan Rule (40 *CFR* 68).

3.3.1.8 Waste Management and Environmental Restoration

Since April 1, 1998, Bechtel Jacobs Company LLC has conducted all of the DOE EM operations on the ORR. In this role, Bechtel Jacobs Company LLC assumed responsibility for the waste management, environmental restoration, technology deployment, and enrichment facilities programs at all DOE-ORO sites (ORNL, Y-12, ETTP, Paducah, and Portsmouth). ORNL Lockheed Martin Energy Research Corporation (now UT-Battelle) retained responsibility for its generator functions, including waste certification, waste characterization, and accumulation. To facilitate waste certification, UT-Battelle retained a small (core) staff with waste management experience to assist generators.

When UT-Battelle assumed responsibility for ORNL operations in April 2000, responsibility for the ORNL Environmental Management Program was shifted to the Environment, Safety, Health, and Quality Directorate. Under this directorate, the Environmental Protection and Waste Services Division is responsible for the Environmental Management Program Office, Environmental Protection Division, and Laboratory Waste Services Division; the Quality Services Division is responsible for the Waste Certification Office. Responsibility for the Environmental Technology Development Program was shifted to the Biological and Environmental Sciences Directorate. The major UT-Battelle goals for the EM Program are to (1) ensure effective interface with Bechtel Jacobs Company LLC in the management of ORNL waste and (2) coordinate the ORNL mission, work force, and Laboratory

environment as full-scale remediation in both Melton and Bethel valleys progresses in accordance with the accelerated cleanup plans.

Figs. 3.1, 3.2, 3.13, and 3.14 show the facilities operated by Bechtel Jacobs Company LLC, and Table G.2, Appendix G, provides a list, which will be updated as necessary to reflect contractual responsibilities of the specific contractor. Facilities are classified as CROET leased (CR), watershed projects (MV and BV), Waste Disposition (WD), and Waste Operations (WO). Buildings 3597 and 9735 have been accepted for transfer to the EM Program in October 2001. In addition, DOE EM is contracting with Foster Wheeler Environmental Corporation for the construction and operation of the Transuranic (TRU) Waste Packaging Facility. This facility, to be located adjacent to the Melton Valley Storage Tanks, will be used to package solid TRU waste and TRU waste sludges for transport to the Waste Isolation Pilot Plant in New Mexico for disposal.

Low volumes of wastes are produced by a number of UT-Battelle operations, resulting in an aggregate amount for the Laboratory that is substantial. However, another large volume of radioactive and hazardous waste comes from the remediation and demolition projects in the EM Program that will continue to increase over the next 10 years. Indeed, ORNL has 344 sites that are contaminated to the extent that they require monitoring and remediation. Previously, these sites were grouped into 20 Waste Area Groupings (WAGs) for management and budgeting. Currently, under the Bechtel Jacobs Company LLC EM Program, environmental restoration activities are organized on a watershed basis (Fig 3.15). Waste management activities across the ORR are organized under the Waste Disposition and Waste Operations Projects. Additional information on waste management activities is included in Appendix G.

3.3.2 ORNL's Programmatic Directions And Needs

To extend the nation's capabilities in key areas of science and technology, ORNL is pursuing major research initiatives in neutron sciences, complex biological systems, terascale computing and simulation science, energy and environmental systems of the future, and advanced materials. The University Partnerships Initiative is aimed at increasing the value of ORNL's science and technology through active involvement of university faculty and students in Laboratory programs. These initiatives are captured in the Laboratory Agenda and described in detail in the *ORNL Institutional Plan*. A brief overview of these initiatives is presented below. Needs for new facilities to support them are summarized in Table 3.3 at the end of this section.

3.3.2.1 Neutron Sciences

ORNL is engaged in a Neutron Sciences Initiative to ensure that the Laboratory continues its stewardship of neutron science in support of DOE's science missions. This initiative has two major elements: (1) the design and construction of the Spallation Neutron Source (SNS), a next-generation spallation neutron source facility, in collaboration with five other DOE national laboratories and (2) upgrades and refurbishment of the HFIR, which will greatly enhance the neutron science capabilities of the world's highest-power research reactor and extend its life well into the 21st century. By investing a portion of its Laboratory Directed Research and Development (LDRD) funds in neutron science, ORNL is preparing to take advantage of these new scientific tools and to integrate neutron science into research programs across the Laboratory. ORNL's strengths in neutron sciences constitute an integrated capability that spans programs across the entire Laboratory. Two major in-house facilities at present are the HFIR and the Oak Ridge Electron Linear Accelerator (ORELA) pulsed neutron source. In addition to neutron sources, facilities supporting ORNL's broad neutron science programs include the Radiochemical Engineering Development Center (REDC), the Radioisotope Development Laboratory, the Transuranium Research Laboratory, and the Irradiated Fuels Examination Laboratory.

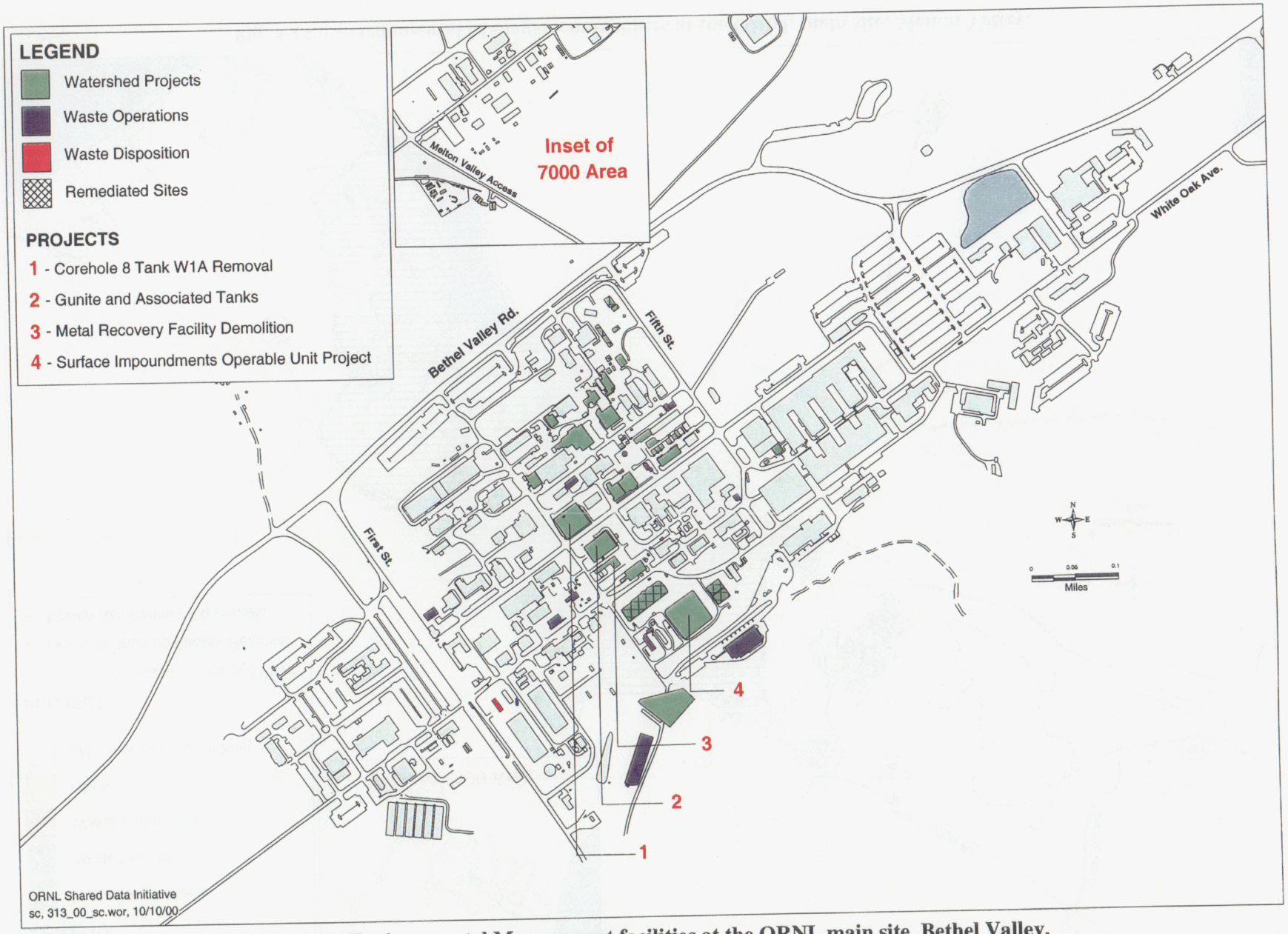


Fig. 3.13. Environmental Management facilities at the ORNL main site, Bethel Valley.

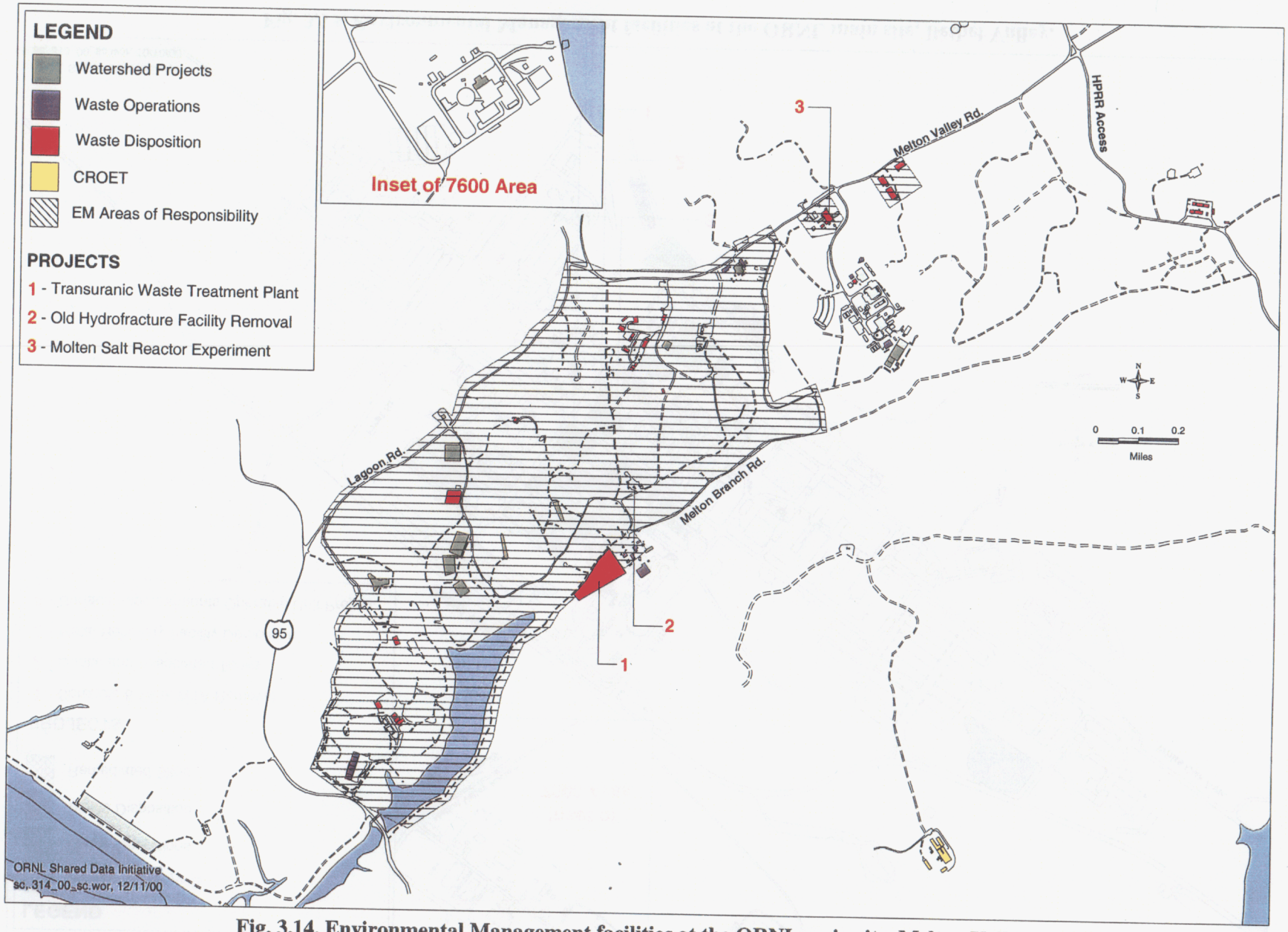


Fig. 3.14. Environmental Management facilities at the ORNL main site, Melton Valley.

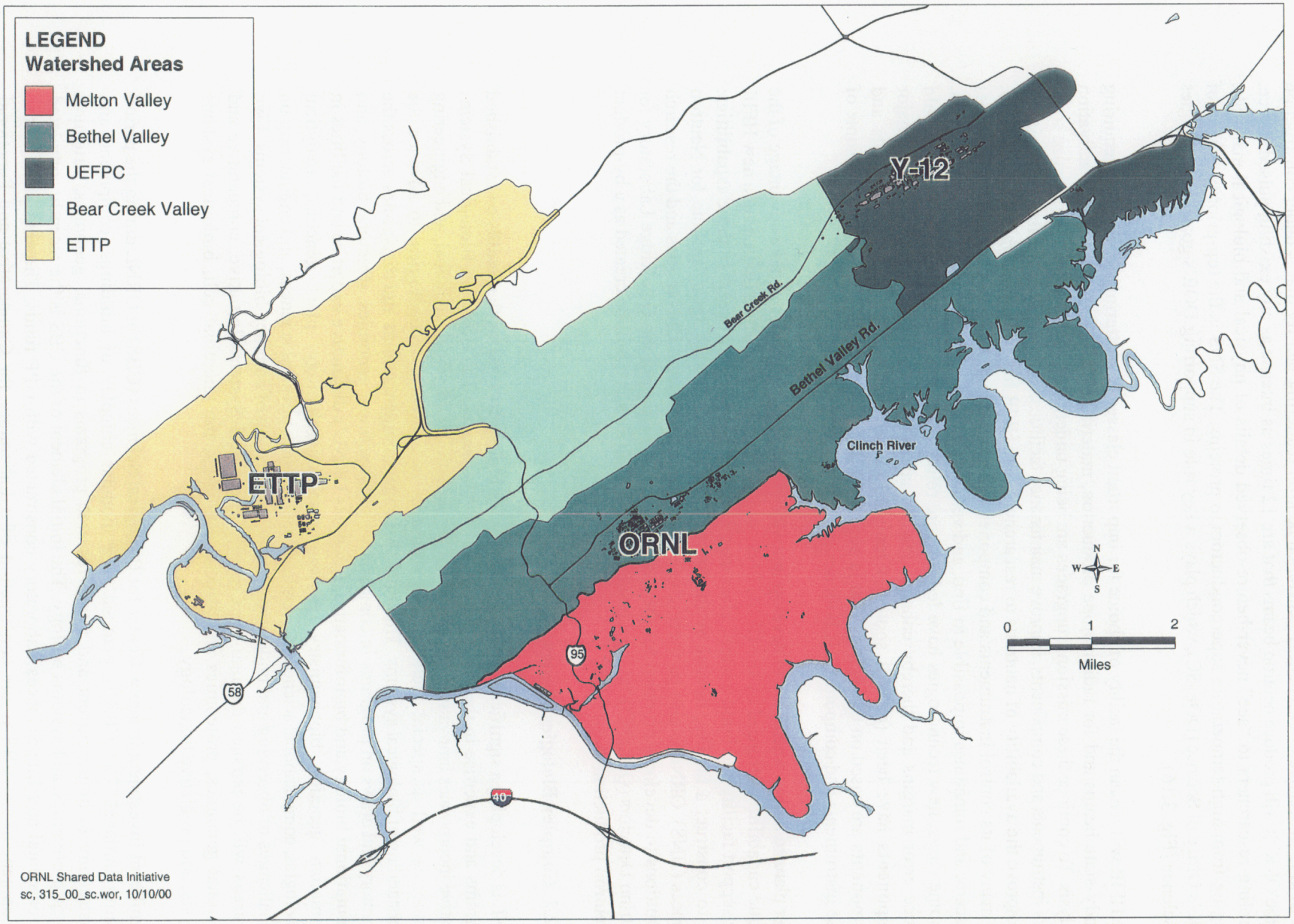


Fig. 3.15. Locations of Enviromental Management watershed areas.

The SNS is an accelerator-based, next-generation neutron scattering facility that is under construction on the ORR. It will produce neutron beams that are 12 times as intense as any existing pulsed source, enabling researchers to "see" never-before-observed details of physical and biological materials, ranging from high-temperature superconductors to proteins. The SNS is the top-priority project of DOE's Office of Science (DOE-SC), which plays a key role in supporting DOE's goals and strategies in science (Fig. 3.16).

The HFIR will remain the facility of choice for important classes of scattering experiments requiring steady-state beams and for radioisotope production, materials irradiation, and neutron activation analysis. To continue these missions, upgrades are being undertaken at the HFIR to modernize some of its instruments and components, improve maintenance facilities, add new capabilities, and maintain or improve the availability of neutrons to researchers. The HFIR has been in operation for 30 years, and many of its control instruments and components are increasingly difficult to repair. Spare parts are scarce and sometimes impossible to find, and vendors no longer manufacture some components. In some cases, new technologies have led to more reliable, more accurate components that could reduce error margins and thereby enhance reactor safety and efficiency. Although many major components have been (or will soon be) replaced or refurbished, remaining instruments and components are based on technology that is now more than 30 years old. Thus, replacing some of these instruments and components is both desirable and cost-effective.

Other planned improvements are to develop innovative research programs that take advantage of the unique capabilities afforded by the HFIR, SNS, and other neutron facilities (including a new HFIR user support facility); to build a world-class user program that provides access to these capabilities; and to construct a facility, funded by the State of Tennessee, for the Joint Institute for Neutron Sciences (JINS). ORNL is also partnering with Oak Ridge Associated Universities and the research institutions to develop a proposal for the design and construction of the Oak Ridge Laboratory for Neutrino Detectors (ORLaND), taking advantage of the neutrinos that will be created as a by-product of neutron production in the SNS.

3.3.2.2 Complex Biological Systems

ORNL is developing a significant program in complex biological systems that builds on established programs and expertise in the life and environmental sciences. The Complex Biological Systems Initiative incorporates innovative applications of computational, physical, chemical, and engineering science, as well as special facilities and resources in analytical technologies, to advance the understanding of biological systems. This initiative engages organizations and disciplines across the Laboratory and draws on programs in comparative and functional genomics, structural biology, and computational biology and bioinformatics. It focuses ORNL's distinctive expertise and facilities in mammalian genetics, biochemistry, environmental microbiology, plant genetics, analytical technologies, computational science and applied mathematics, physical sciences, and engineering on the challenges of observing and understanding the functioning of complex biological systems. Five key areas will be pursued through the Complex Biological Systems Initiative: comparative and functional genomics, proteomics and structural biology, the microbial cell, biological systems analysis, and predictive toxicology.

A significant investment in a new Center for Biological Sciences (CBS) at ORNL during the period is being initiated. The CBS is planned as a modular complex of buildings, equipment, and infrastructure to house current and future research programs in functional genomics, structural biology, proteomics, and systems biology. The initial element of the CBS is the recently completed Environmental and Life Sciences Laboratory constructed with GPP funds. The next phase in the development of the CBS is the construction of a Laboratory for Comparative and Functional Genomics (LCFG) to house the Mouse Genetics Research Facility. The LCFG, which will replace an

Fig. 3.16. Spallation Neutron Source.

aging building at the Oak Ridge Y-12 National Security Complex, will be constructed with DOE funding, beginning in FY 2001. In addition to the mouse colony, the LCFG will include laboratories with special phenotype screening and cryopreservation capabilities, thus supporting the ORNL Functional Genomics and Proteomics Program. The CBS will also encompass the Center for Structural Molecular Biology (CSMB) and the Joint Institute for Biological Sciences. The principal new capital resource needed to support the CSMB beyond 2003 is a beam line dedicated to structural biology on the SNS. Construction of a facility to house the Joint Institute for Biological Sciences will be funded by the State of Tennessee.

3.3.2.3 High-Performance Computing

DOE's Scientific Discovery through Advanced Computing Program is being developed to take the nation into a new era of information and communications technology. It will rapidly deploy computing and communications capability that is at least 10 times faster than today's fastest systems for government, academic, and industrial use.

This capability will revolutionize current approaches to solving complex problems in energy, the environment, fundamental research, and technology development, and it will stimulate the national system of innovation. Attaining the proposed capability will demand significant advances in computational resources. Fully exploiting the power of massively parallel machines requires the creation of new programming paradigms, languages, scheduling and partitioning techniques, and algorithms, and all of these elements must be integrated into systems that are accessible and useful to a diverse user community.

The Terascale Computing and Simulation Science Initiative is focused on the development and integration of skills and facilities for computing, modeling, and simulation and the application of these integrated resources to DOE's needs in science and technology. With computational power of 1.5 teraflops, ORNL has the nation's most powerful unclassified computing facility. In order to support the growing mission-critical computational needs of DOE, ORNL must continue to maintain state-of-the-art supercomputing and networking infrastructure. At the current rate of advance in computing capabilities, petascale computing will be required by 2010 to support programmatic needs.

In support of this effort, a new Computational Science Building is being promoted as one of the highest-priority new facility needs for ORNL. In addition, the State of Tennessee has committed funding for a new facility to house the Joint Institute for Computational Sciences, which promotes collaborative relationships among ORNL, UT, and the UT-Battelle core universities and encourages and facilitates the effective use of high-performance computing resources in the southeastern United States.

ORNL's computing infrastructure must also be upgraded to maintain the Laboratory's forefront position. ORNL's current backbone fiber infrastructure was installed 10 years ago. It was designed and architected to provide data interface service only within the main ORNL campus; it offers no service to outlying facilities and is frequently hundreds of feet from buildings where service is needed. It is essential to upgrade this infrastructure to at least 10 times the current capacity and to provide a direct feed to every major ORNL building and facility. In conjunction with this upgrade, several ORNL buildings should also be rewired with modern copper, fiber, and hubs able to support local and interlaboratory networks.

3.3.2.4 Energy and Environmental Systems of the Future

Our Energy and Environmental Systems of the Future (E^2SF) Initiative addresses the broad challenge, put forward in the Department's mission statement, of fostering "a secure and reliable energy system

that is environmentally and economically sustainable." This initiative marshals ORNL's extensive capabilities for R&D on energy production, distribution, and use and for research on the effects of energy technologies and decisions on the environment and society. It focuses on emerging challenges in carbon management, energy systems, and environmental and social systems. This initiative will sustain ORNL's position as DOE's major energy laboratory, providing comprehensive, coordinated support across energy efficiency and fossil, fusion, nuclear, and renewable energy. As DOE's major carbon management science and technology resource, we will expand our R&D on distributed energy resources for energy efficiency in the near term (now–2010), bioenergy for clean power in the middle term (2010–2020), and fundamental scientific breakthroughs for carbon sequestration and environmental modeling to build the science base for the future (2020 and beyond).

New facilities needed to support this initiative include an Engineering Technology Building and a Building Science Research Facility. ORNL is also pursuing the development of expanded resources for large-scale environmental process research, leveraging the facilities and land area of the Oak Ridge National Environmental Research Park, and for carbon composites research. Integration of ORNL's extensive capabilities in separations, bioengineering and biosciences, and chemical processing is under way to create a comprehensive and accessible resource for meeting needs in energy and carbon efficiency and pollution prevention through the Center for Separations and Chemical Processing.

3.3.2.5 Advanced Materials Initiative

A new initiative in advanced materials is aimed at sustaining ORNL's position as a leader in advanced materials science and technology underpinning DOE's energy resources mission. This initiative includes the development of a recognized capability in nanoscale science, engineering, and technology, including the construction of a Center for Nanophase Materials Science; the construction of a new Advanced Materials Characterization Laboratory (AMCL); the development of extraordinary tools for materials characterization; the extension of ORNL's capabilities for synthesis, characterization, and processing of soft materials; and the establishment of a Joint Institute for Advanced Materials.

Nanoscience is concerned with discovering, understanding, characterizing, and fabricating materials and systems with novel properties, phenomena, and processes that occur primarily because of their small size. An FY 2001–02 GPP is currently funded to modify existing space in Building 3500 for a dedicated facility for nanostructure characterization, inspection, and manipulation.

The Center for Nanophase Materials Science is a proposed national facility for advancing the understanding of nanoscale phenomena in materials. The center will leverage the unprecedented opportunity for new research on the structure and dynamics of nanoscale materials systems that will be afforded by the SNS and the upgraded HFIR. The center will be housed in a new 100,000-square-foot laboratory/office complex anticipated to be constructed adjacent to the SNS and the Joint Institute for Neutron Sciences (JINS). This facility will include clean rooms and specialized equipment for nanoscience research that cannot be accommodated in existing space at ORNL. The center responds to the recommendations of *Nanoscale Science, Engineering, and Technology Research Directions*, a 1999 report prepared by DOE's Office of Basic Energy Sciences Nanoscience/ Nanotechnology Group, and will provide a unique national resource in the nanosciences.

The AMCL is a proposed 12,000-square-foot structure that will provide the high-quality environment required to optimize the performance of sophisticated characterization equipment essential for the next generation of advanced materials R&D. It will also provide for the centralization of advanced materials structural characterization equipment. As part of the initial complement of instruments, the AMCL will house the Aberration-Corrected Electron Microscope, a $3 million instrument to be delivered to ORNL in FY 2003. This state-of-the-art microscope requires a specialized facility to

house it, with extremely low stray electrical and magnetic field levels and similarly low vibration levels. It will be joined by two scanning transmission electron microscopes belonging to the Solid State Division (SSD), which are currently being upgraded and will also represent state-of-the-art capability. Additional electron microscopes from the Metals and Ceramics Division, current and planned, will be housed in the AMCL.

3.3.2.6 University Partnerships

In support of the University Partnerships Initiative, ORNL is undertaking the development of the Oak Ridge Center for Advanced Studies (ORCAS) in cooperation with Oak Ridge Associated Universities. ORCAS will serve as a center of intellectual inquiry to encourage interactions between ORNL researchers and university faculty and students. A building to be constructed with funding from the State of Tennessee will provide offices for visiting faculty, state-of-the-art distance education classrooms, and high-speed network connections to facilitate communication with the six UT-Battelle core universities and other partners.

Table 3.3. Future mission facility needs

Title and description	Proposed funding year(s)/type
Joint Institute for Neutron Sciences ▸ Center to provide a world-class user program that provides access to the capabilities of the SNS, HFIR, and other ORNL neutron sciences research programs ▸ 60,000-square-foot facility housing office, laboratory, process, and meeting space for collaborations	FY 2004–05 $8M State funded
HFIR Maintenance Building ▸ Building to provide facilities critical to the maintenance and support of reactor operations ▸ 22,000-square-foot facility to house maintenance shops and process space	FY 2002–03 $2.9M GPP
Laboratory for Comparative and Functional Genomics ▸ Building to provide facilities for the location of the mutant mouse colony ▸ 32,000-square-foot facility with accredited, environmentally controlled accommodation areas for housing animal research	FY 2001–03 $13.8M LI
ORNL Center for Biological Sciences ▪ Research programs for functional genomics, structural biology, proteomics, and systems biology ▸ Staged facilities to house the Center for Biological Sciences user facilities ▪ 50,000-square-foot facility with a modular complex of buildings, equipment, and supporting infrastructure to be located in the West Campus	FY 2005–07 $20M LI
Joint Institute for Biological Sciences ▸ Center for the promotion and development of collaborative education and research in the biological sciences of functional genomics, structural biology, and computational biology and bioinformatics ▪ 60,000-square-foot facility housing office, laboratory, process, and meeting space for collaborations	FY 2002–03 $8M State funded
Computational Science Building ▪ Center for computer science research to address effective use of distributed computers and massive parallel computer systems composed of symmetric multiprocessing clusters linked with high-speed network fibers ▪ 100,000-square-foot facility to house supporting laboratories, process space, offices, and supporting infrastructure	FY 2001–02 $13M Private-sector funded

Table 3.3. Future mission facility needs (cont'd)

Title and description	Proposed funding year(s)/type
Joint Institute for Computational Sciences • User- and visitor-oriented facility to provide access to high-performance computers, inspire collaborations and outreach between ORNL and partnering universities, facilitate enhanced high-speed networking systems, and facilitate auxiliary technologies ‣ 40,000-square-foot facility to house computing system laboratories, offices, and meeting space for collaborations	FY 2003–04 $6M State funded
Engineering Technology Building ‣ Multidisciplinary R&D facility relevant to energy conservation and utilization; mechanical, structural, and thermal sciences; and manufacturing sciences • 100,000-square-foot private-sector-funded facility to house supporting laboratories, process space, offices, and supporting infrastructure	FY 2001–02 $13M Private-sector funded
Building Science Research Facility ‣ Building science initiatives for new materials research, systems integration and interaction, environmental factors research, and materials life cycle assessment ‣ 50,000-square-foot facility housing research staff, eight interior laboratories for material and component testing, outdoor space for model building testing to be located in the Central Campus • Facility to house building science user facilities	FY 2004–06 $20M LI
Laboratory Expansion for Nanoscience Metrology and Instrumentation ‣ Scientific and engineering research initiatives for nanomaterials, nanostructures, and their applications • 3,000-square-foot renovation of space in Building 3500 to house laboratory and process space with two new clean rooms	FY 2001–02 $1.2M GPP
Advanced Materials Characterization Laboratory • Next generation of research for materials characterization ‣ Centralization of advanced materials structural characterization equipment to include the Aberration-Corrected Electron Microscope ‣ Facility to house the advanced materials research user facilities • 12,000-square-foot structure with microscope modules	FY 2002–03 $4.8M GPP
Oak Ridge Center for Advanced Studies ‣ Theoretical and applied R&D-oriented facility to explore grand queries, big thoughts, and major potentials for long-term program development for ORNL and core universities • 30,000-square-foot facility to house state-of-the-art collaboration meeting room with teleconferencing and computing networking, offices, and information resource center	FY 2003–04 $4M State funded
Center for Nanophase Materials Science • National center for nanoscience research on soft materials, interfaces, nanoscale magnetism, and other nanophase systems that benefit from access to neutron scattering • Responds to BES panel recommendations for the creation of Nanoscale Science Research Centers ‣ Includes clean rooms and specialized equipment that cannot be accommodated in existing space ‣ 100,000-square-foot laboratory/office complex adjacent to the SNS	FY 2003–05 $25M LI

3.4 ORNL SITE PLANNING METHODOLOGY

3.4.1 Facilities Revitalization Project Scope and Planning Process

To accomplish the goal of a fully modernized Laboratory of the 21st Century, ORNL has established a dedicated project team. The FRP has been authorized by the DOE Oak Ridge Operations Office (DOE-ORO) as one of the high-priority initiatives of the new UT-Battelle management and operating (M&O) contractor team for ORNL. The FRP mission is to provide world-class facilities for ORNL staff, consolidated at the main ORNL site, with the first phase of construction to be completed within 5 years. As will be detailed later in this plan, the project will utilize a combination of DOE, State of Tennessee, and private-sector funding to accomplish the revitalization goals in the near term. This unique approach requires integrated planning and new facilities construction and operations models to be employed; hence, the decision to implement the first phase as an identifiable project with a specific short-term mission and scope. The FRP team will define the process, implement it for the first round of construction, and provide the project execution framework for the remaining phases of the revitalization effort. However, those future projects will be managed as part of the routine ORNL Facilities and Operations organization mission.

A Project Management Plan for the FRP has been issued (ORNL/TM-2000/174), which contains a definition of the project scope, the organizational roles and responsibilities, and the project approach (including the project Work Breakdown Structure). The FRP team reports to the Director for Facilities and Operations and has a Steering Committee led by the ORNL Deputy Directors for Operations and Science and Technology. DOE-ORO is providing direct support and leadership for the facilities revitalization effort through a similar Steering Committee headed by the ORNL Site Office Deputy Manager. DOE and the UT-Battelle team in Oak Ridge are committed to successfully implementing SC's vision of the Laboratory of the 21st Century, as detailed in the following Strategic Plan.

A comprehensive planning process has been employed by the FRP team in the development of this Strategic Plan. That process was initiated with a formal review of the *ORNL Institutional Plan* and hosting of a workshop with Laboratory senior managers to validate program directions and needs in each of the primary research mission areas, as well as to obtain input on the Laboratory priorities on support functions to be provided by the new campus. It was during that workshop that the guiding principles were also established for the architectural feel of the revised campus setting. Using this information and the existing ORNL facilities data as a baseline, a detailed review of all existing facilities and infrastructure conditions was conducted and an initial determination of strategic buildings made to guide consolidation planning. Those strategic facilities then formed the nucleus around which the resulting Master Plan was developed. For facilities considered nonstrategic (due to age, conditions, high maintenance costs), consolidation plans were then drawn up for all staff/equipment housed there, and by-building mapping of relocation needs produced. Those plans were reviewed with the management of each of the affected divisions, and modifications were made to accommodate specific needs. These consolidation plans then drove the siting and sizing of new facilities and infrastructure needs, and those new facilities were captured in the Master Plan layout.

Once the complete listing of facilities requirements was identified, decisions were made on expected funding type (DOE, State, or private-sector) for each identified project, and a formal prioritization process then implemented for the DOE projects to rank them within the overall ORNL capital assets program. This ranking information, along with reasonable expectations on availability of State, private-sector, and DOE expense funds through each of the project phases, was then used to sequence facilities construction plans and allow roll-up of funding estimates.

3.4.2 Resource Planning, Prioritization, and Allocation Process

For both capital construction and operating funds distribution at the ORNL site, a formal review and allocation process is conducted. Such facilities planning is required by DOE Order 430.1A, "Life Cycle Asset Management," which specifies that ORNL shall plan, acquire, operate, maintain, and dispose of physical assets as valuable national resources. Implementation of this order by the ORNL Facilities and Operations Strategic Planning Office is through a graded approach based upon best industry practice as agreed upon by the DOE SC and the local DOE oversight offices. The ORNL site planning methodology is outlined in Fig. 3.17.

The process generally consists of the following steps:

- Needs assessment identification — Needs assessments are performed by ORNL organizations and line management to identify the activities, systems, and programs needed to ensure the effective management of operations, ES&H, and infrastructure risks and to create a culture within ORNL that effectively integrates employee protection into work planning and the execution of work activities.

- Activity data sheet (ADS) preparation — ADSs contain the essential scope, schedule, cost estimate, and management information necessary for ORNL organizations to support planning and provide input to the budgeting process. ADSs are prepared for all landlord programs and activities needed to operate ORNL in a manner that protects the employees, the public, and the environment; meet those requirements set forth in the ORNL Work Smart Standards and by DOE; and ensure adequate infrastructure resources to meet the mission of the Laboratory.

- Risk-based prioritization of activities — The ORNL Risk Ranking Board uses a Risk-Based Priority Model (RPM) to perform risk evaluations of all landlord operations, ES&H, infrastructure, and other identified ADSs. Using the RPM, a risk-reduction benefit score is derived for each ADS, and ADS scores are used to establish preliminary priority lists that are reviewed by senior management. Priority adjustments are made as necessary in consideration of additional planning factors.

- Allocation of resources — Resource planning and allocation are done on the basis of programs essential for compliance, fulfillment of ORNL missions, and assurance of the safety and well-being of ORNL personnel, the public, and the environment. Resource allocation is determined by supporting the highest-ranking activities within the target funding levels. The ORNL Leadership Team and the DOE Site Office review and approve proposed GPP, GPE, and overhead programs.

For capital and operating cost requirements outlined in this plan, the individual projects will be evaluated through this formal process prior to funds allocation and project execution.

3.5 NEW FACILITIES AND INFRASTRUCTURE NEEDS

As outlined in Section 3.3, the current conditions of ORNL facilities and infrastructure and the future program needs of the ORNL research community point to requirements for significant upgrades and replacement of many of the existing Laboratory facilities. In response to this need, the FRP has been established by UT-Battelle to define and implement an integrated approach to exiting old facilities

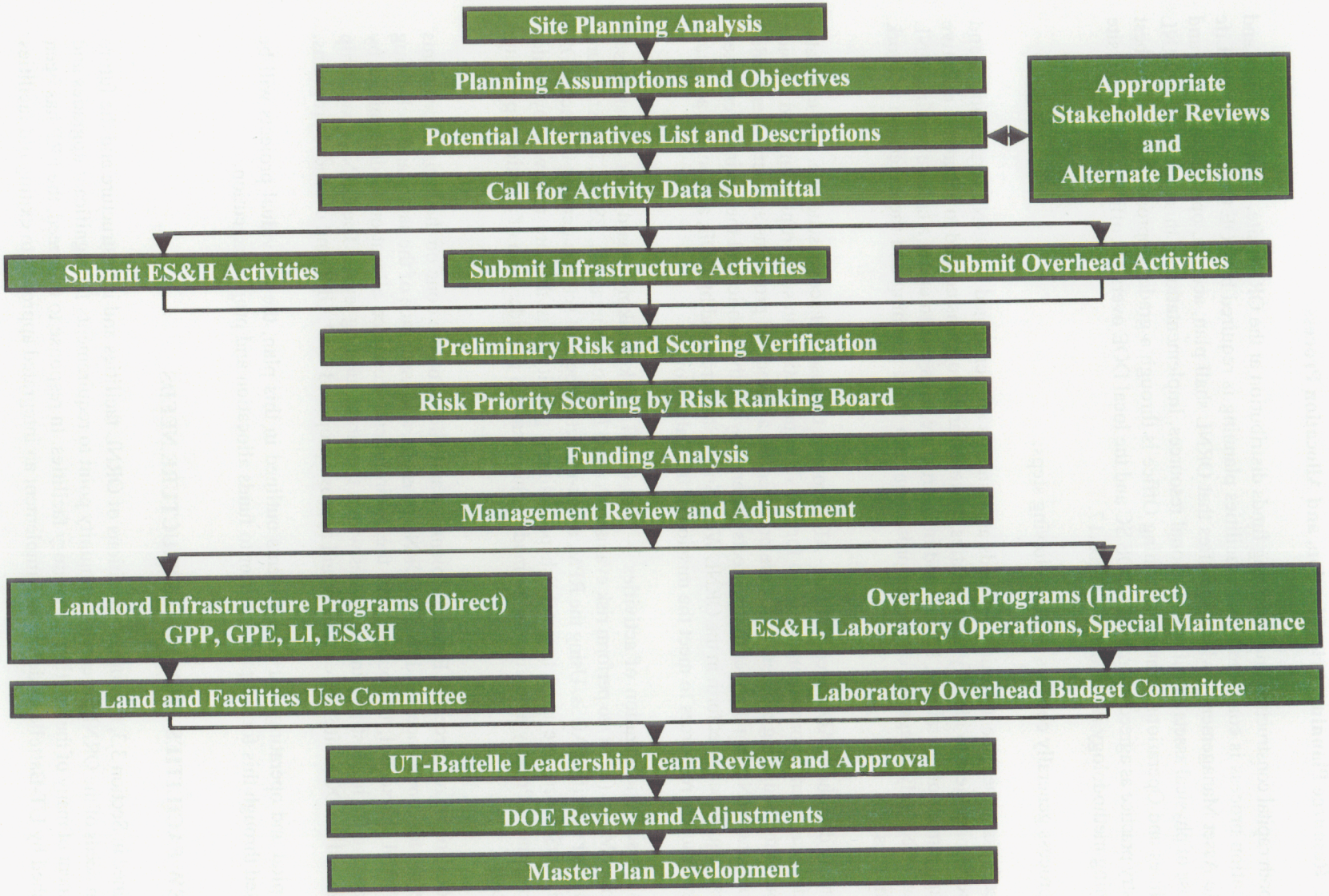


Fig. 3.17. ORNL site planning methodology.

and constructing new facilities over the next 10 years. The FRP team has completed a condition assessment and future growth analysis and has developed a comprehensive facilities consolidation plan that identifies, by building and occupying ORNL division, the space requirements and timing of moves to accomplish the revitalization objectives. The following section outlines the details of that consolidation process, including an overview of the integrated strategy for new facilities development, the planning basis for the staff/facilities consolidation, a division-level summary of the resulting plans, and identification of support infrastructure improvements that must accompany the consolidation efforts.

3.5.1 FRP Approach to Facilities/Infrastructure Improvements

The UT-Battelle facilities revitalization approach is to provide new integrated facilities constructed in close proximity to the existing ORNL strategic research facilities, utilizing a combination of DOE, State of Tennessee, and private-sector financial resources. UT-Battelle would focus DOE capital funding on capabilities that are not likely to be financially or technically feasible by third parties, use State funds for the type of shared scientific facilities appropriate for collaborative research, and use private-sector construction for light laboratory and office support needs that accompany research efforts. These facility types would be constructed in an integrated campus layout that allows the free flow of scientific research between multidivision teams, with consistent architectural themes, regardless of construction funding source. The details of the resulting Master Plan development approach are provided in Section 3.6.

Because of the magnitude of needed facilities improvements and the historical limitations on federal funding availability, UT-Battelle has proposed an innovative use of federal, private, and State funds to accomplish the facilities revitalization. The key component of this approach is the transfer of land ownership from DOE to allow for (1) construction and lease of buildings by the private sector and (2) siting and construction of the State of Tennessee facilities. A mutually acceptable approach for land transfer has been developed between the DOE-OR Realty Office and UT-Battelle that involves the use of DOE's authority under Section 161(g) of the Atomic Energy Act and the establishment of a not-for-profit 501(c)(3) corporation by UT-Battelle that would be the responsible party for acceptance of the DOE land, with subsequent lease of that land to the private sector for construction and lease-back of the property to UT-Battelle (with DOE approval) for research activities. Under this arrangement, UT-Battelle would utilize the 501(c)(3) corporation to oversee land management, building construction, and lease (for private sector) or MOU implementation (for State of Tennessee) for the FRP, and DOE would transfer, through fee simple title via a Quitclaim Deed, specifically identified parcels of land to that development corporation. A block-flow diagram of this approach is provided in Fig. 3.18. The legal and contractual details associated with this concept are beyond the scope of this document but can be obtained through contact with the UT-Battelle or DOE project managers.

As currently envisioned, approximately 25 acres of land would be transferred from DOE to the 501(c)(3) corporation to accommodate the needed construction. This land would be transferred in specific parcels associated with programmatic needs and location requirements related to the mission areas to be supported by the completed buildings. Following construction and operation of facilities on that land, DOE would maintain the right for repurchase of those parcels at some time in the future (expected to be 30 to 40 years), if desired.

The development of new facilities at ORNL will, of course, be accomplished in compliance with applicable environmental and other regulatory requirements associated with research operations. Because the campus revitalization is a federal activity (construction with federal funds and transfer

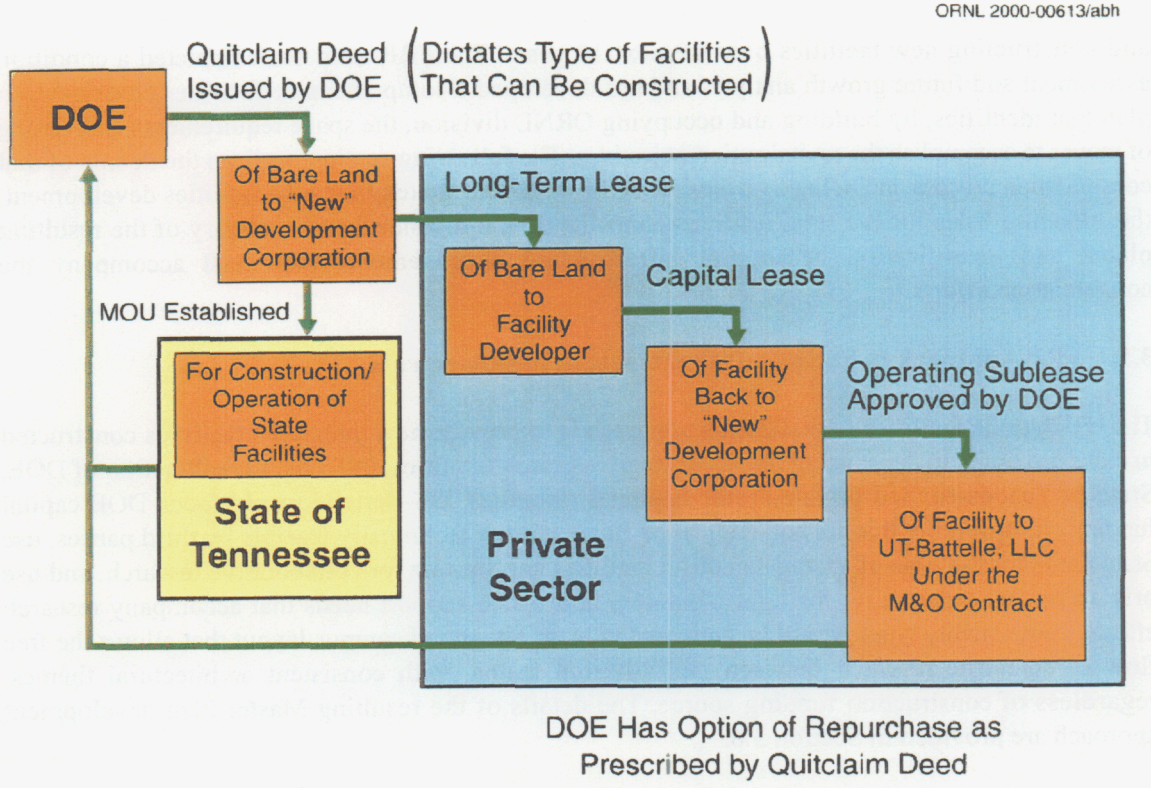


Fig. 3.18. Property/facility lease flow diagram.

of federal lands), its development will be addressed through the formal National Environmental Policy Act (NEPA) process, with appropriate NEPA documentation prepared to evaluate the impacts of the development approach. This NEPA review will only cover the activities defined for the 10-year modernization planning period since project scope beyond that time is not well understood. Similarly, with the transfer of federal property on the National Priorities List as part of the approach, a formal Comprehensive Environmental Response, Compensation, and Liability Act Section 120 (h) evaluation will have to be completed prior to the transfer to ensure that contamination liabilities (if any) are defined for all parties. For those older facilities for which plans are made for decommissioning and ultimate demolition, the historical value of the buildings (and the operations conducted in them) will be assessed and appropriate decisions made through the National Historical Preservation Act process to determine proper documentation of the sites and any desired preservation of equipment or facilities. Throughout all facilities construction and/or destruction activities, care will be taken to ensure control of releases to air and water resources, in full compliance with the Clean Water and Clean Air Acts. The safety of construction workers, surrounding ORNL staff members, and the general public will be of high priority as well, as the work is completed.

The FRP has incorporated energy efficiency, environmental sustainability, and brownfields reuse goals into the approach for new facilities development, and it is UT-Battelle's intention to make the new campus a showcase for environmental-friendly design. Several Energy Savings Performance Contractor and Federal Energy Management Program projects are already being undertaken on the ORNL site, and additional, much-broader-scoped projects are anticipated as part of the revitalization efforts. More details on the "green" nature of the new campus development are provided in the discussion of the Master Plan in Section 3.6.

3.5.2 Facilities Consolidation Process

3.5.2.1 Basis for Consolidation Planning

Consistent with the latest version of the *ORNL Institutional Plan*, the FRP strategy is to consolidate laboratory research and support operations into a set of strategic facilities located at the main ORNL site and transfer excess facilities that are nonstrategic, uneconomical, and/or underutilized and no longer support ORNL's current and future programmatic missions to other parties. The transfer of excess facilities could mean transfer to another contractor for alternate use, transfer to the Community Reuse Organization of East Tennessee (CROET) for reindustrialization initiatives, or if the appropriate criteria are met, transfer of excess facilities to the DOE Environmental Management Program for ultimate disposition. Facilities determined excess that cannot be transferred for alternate use must be placed in a state of minimum cost, with minimum utilities maintenance and surveillance ("cheap-to-keep") until ultimate disposition can be scheduled as outlined in Section 3.5.2.2.

As the FRP initiated the consolidation planning process, the first step was to compile a current list of facilities for which ORNL has responsibility using existing databases such as the Facility Information Management System (FIMS), the Space Allocation Management System (SAMS), and the ORNL Facility Index. Criteria were then established against which ORNL facilities were evaluated to determine if individual facilities were to be considered strategic or nonstrategic. Strategic facilities were assumed to be those facilities located within the main ORNL site that are essential for ORNL to enable world-class scientists to deliver world-class research. These facilities typically are flexible in use, have unique capabilities that are difficult and/or too costly to duplicate, and are critical to the research mission. Nonstrategic facilities were identified in the consolidation planning process as those facilities that were generally greater than 30 to 40 years old, were of high maintenance and operation cost, had a high backlog of deferred maintenance, and posed a potential risk to the health and safety of staff and the environment. Location of staff in remote locations was also a factor when determining nonstrategic facilities such as those at 1060 Commerce Park, 111 Union Valley, and ORNL facilities at the Y-12 National Security Complex. Single- and double-wide trailers, though often used for short-term temporary needs, were also determined to be nonstrategic.

The list of nonstrategic facilities was then divided into two categories: (1) candidate for disposition that met EM criteria and (2) candidate for disposition that did not meet EM criteria and would be the responsibility of the Office of Science (see Tables 3.4 and 3.5). Approximately 83 facilities (a total of 646,000 square feet) were determined nonstrategic and will remain solely the responsibility of the Office of Science; 35 facilities (a total of 1,131,000 square feet) would meet the EM criteria. Figs. 3.19 (main ORNL site) and Fig. 3.20 (Y-12 site) are detailed maps showing facilities that meet EM criteria in red, non-EM facilities in blue, and those facilities that are currently Bechtel Jacob's (EM contractor for the ORR) responsibility in yellow. All other facilities were considered strategic for ORNL in the next 5 to 10 years and were not assigned a unique color. Facilities that are the responsibility of the M&O contractor at Y-12 were also not assigned a unique color.

Looking at a Laboratory-wide consolidation strategy for ORNL, several basic assumptions were used in the consolidation process. The Laboratory needs to focus on more efficient space utilization within strategic buildings; thus, existing space holdings must be reduced. This is currently being accomplished with a recent increase in the space charge rate. Space that is or could be made available was evaluated, and scenarios were created for potential new tenants from those facilities determined nonstrategic. Clearly, the goal in the entire consolidation process will be to minimize the amount of moves, renovations, and/or upgrades required. The FRP looked for opportunities to group individuals

Table 3.4 Candidate for disposition (Environmental Management)

Building	Facility or area name	Gross sq ft	Year targeted for deactivation[a]
2000	Solid St. Lab & Qual Assur/Ins	22,660	FY 2001
2001	Information Center Complex	25,338	FY 2001
2010	Cafeteria Warehouse	13,099	FY 2005
2011	Electric & AC Service Center	5,618	FY 2003
2024	Quality Assurance & Inspect	10,300	FY 2001
2517	HRDP/Training	2,880	FY 2005
3003	Solid State Accel. Fac.	10,806	FY 2005
3019A	Radchem. Proc. Pilot Plnt	37,191	TBD
3036	Isotope Area Stor & Servic Bld	1,529	FY 2005
3037	Chemical Technology Offices	8,008	FY 2004
3080	Super Conductivity Laboratory	1,872	FY 2005
3100	Source & Sp Mat Vault	1,686	FY 2003
3503	High Rad Lvl Chm Eng Lab	13,716	FY 2004
3504	Geosciences Laboratory	3,952	FY 2005
3508	Elect. Services	13,863	FY 2002
3525	High-Rad Level Exam Lab.	27,000	TBD
3541	MSR Process Dev. Lab.	870	FY 2004
3542	Storage Building (for 3505 & 3517)	576	FY 2004
3543	MSR Dev Lab	651	FY 2005
3550	Research Lab Annex	14,036	FY 2004
3592	Coal Conversion Facility	694	FY 2004
3605	TSD Storage Building	416	FY 2004
3610	Storage Building	400	FY 2004
9201-02	Fusion Energy Building	257,200	FY 2004
9201-03	Eng Tech Div Ctr	187,300	FY 2003
9204-01	Fusion Energy-Eng Tech	221,400	FY 2003
9204-03	Isotope Separations	216,200	FY 2003
9401-01	Laboratory	12,000	FY 2003
9409-15	Cooling Tower, 9204-3	0	FY 2003
9610-02	Flammable Storage	683	FY 2003
9610-03	Flammable Storage	512	FY 2003
9735	Research Services Building	15,150	FY 2001
9999-01	Motor Generator (E 9204-3)	500	FY 2003
9999-03	Switchgear Building	2,400	FY 2004
9999-04	Switchgear Building	250	FY 2004
	Total	1,130,756	

[a]Assumes year that exit moves are complete and the deactivation ("cheap-to-keep") process can begin.

Table 3.5. Candidate for disposition (Office of Science)

Building	Facility or area name	Gross sq ft	Year targeted for deactivation[a]
0961	ORNL Visitor Overlook	3,596	FY 2002
1000	Engineering Office Building	59,503	FY 2004
2008	ORNL Whole Body Counter	4,368	FY 2005
2009	Cafeteria Warehouse	4,368	FY 2005
2013	West Maintenance Serv Ctr	11,969	FY 2002
2017	East Research Service Shop	228	FY 2003
2019	Solar Energy Lab/Laser Lab	800	FY 2001
2029	Information Center Com. Annex C	1,173	FY 2001
2030	Mobile Office Unit	720	FY 2001
2087	Storage, I&E	187	FY 2004
2088	Emerg Generator B 2000	161	FY 2001
2092	Storage	114	FY 2001
2093	Environmental Storage Building	420	FY 2001
2506	Fab Shop & Timekeeping	10,620	FY 2003
2647	Construction Engineering Trail	2,160	FY 2003
2652A	2652A Office Trailer	1,728	FY 2003
2652B	2652B Office Trailer	1,728	FY 2003
2652C	2652C Office Trailer	1,464	FY 2003
3017	Chem Tech Division Annex	10,140	FY 2006
3115	Solid State Offices	2,792	FY 2006
3136	Mock Up Test Facility	600	FY 2002
3523	I&C Storage	1,170	FY 2004
5000	Main Portal	4,360	FY 2003
5506	East Portal Bldg.	544	FY 2005
5553	Sentry Post 1E	60	FY 2005
6003	Modular Bldg. For Offices	7,056	FY 2003
6026A	6026A Office Trailer	1,728	FY 2002
6026B	6026B Office Trailer	1,728	FY 2002
6026C	6026C Office Trailer	1,728	FY 2002
6026D	6026D Office Trailer	1,728	FY 2002
6026E	6026E Office Trailer	1,728	FY 2002
6026F	6026F Trailer	1,728	FY 2002
6026G	Office Trailer, Double Wide	1,728	FY 2002
6556E	ER Field Operations Trailer	980	FY 2002
6556K	Trailer, Single Wide	288	FY 2002
6556L	Trailer, Single Wide	490	FY 2002
6556Q	ER Field Operations Trailer	648	FY 2002
7933	7933 Storage Trailer	520	FY 2006
7953A	Trailer	1,416	FY 2006
7953C	Trailer	1,344	FY 2006
7957	Office Trailer For 7920	500	FY 2006
7964A	Triple Wide Office Trailer	2,088	FY 2006
7964B	Triple Wide Office Trailer	2,088	FY 2006

Table 3.5. Candidate for disposition (Office of Science) (cont'd)

Building	Facility or area name	Gross sq ft	Year targeted for deactivation[a]
7964C	Trailer, Office	2,124	FY 2006
7964D	7964D Office Trailer	672	FY 2006
7964E	7964E Conference Trailer	2,400	FY 2006
7964F	7964F Office Trailer	1,288	FY 2006
7964G	Office Trailer, Triplewide	1,440	FY 2006
7964H	Solid State Office Trailer	1,970	FY 2008
7964I	Solid State Office Trailer	1,970	FY 2008
7965A	Trailer, Office	1,620	FY 2008
7965B	7965B Office Trailer	1,620	FY 2008
7965C	7965C Office Trailer	1,620	FY 2008
7968	Trailer	192	FY 2006
9102-01	Office Building 9102-01	6,250	FY 2003
9102-02	Office Building 9102-02	6,200	FY 2003
9105	Fusion Eng Office Bldg	7,400	FY 2001
9108	Office Building 9108	7,510	FY 2003
9207	Biology	247,500	FY 2001
9210	Mammalian Genetics	65,700	FY 2004
9211	Co-Carcinogenesis	76,600	FY 2001
9220	Virus Control Lab	22,350	FY 2001
9224	Cell Fractionation System	10,100	FY 2001
9422	LCTF Compressor	2,500	FY 2003
9720-39	Cold Storage Warehouse	8,000	FY 2003
9770-02	Radiation Source	155	FY 2003
XF158X	Solway Barn	5,120	FY 2002
XG1402	Freels Bend, Machine Storage Shed	245	FY 2002
XG1403	Freels Bend, Van Gilder Barn	4,356	FY 2002
XG1404	Freels Bend, Variable Dose Irradiation Facility	3,623	FY 2002
XG1405	Freels Bend, Shed	1,008	FY 2002
XG1406	Freels Bend, Exposure Field Control Room	N/A	FY 2002
XG1407	Freels Bend Block Building	N/A	FY 2002
XG1408	Freels Bend Aluminum Building	N/A	FY 2002
XG1409	Freels Bend Pump House	N/A	FY 2002
XG1410	Freels Bend Donkey Arena	N/A	FY 2002
XH1326	Freels Barn	N/A	FY 2002
XH1327	Donkey Barn	N/A	FY 2002
XH1401	Sheep Barn	N/A	FY 2002
XH1402	Freels White Barn	N/A	FY 2002
XH1403	Lagoon (2) Freels	N/A	FY 2002
XH1404	Underground Silo	N/A	FY 2002
XH1405	Silo,14X41	N/A	FY 2002
	Total	646,020	

[a]Assumes year that exit moves are complete and the deactivation ("cheap-to-keep") process can begin.

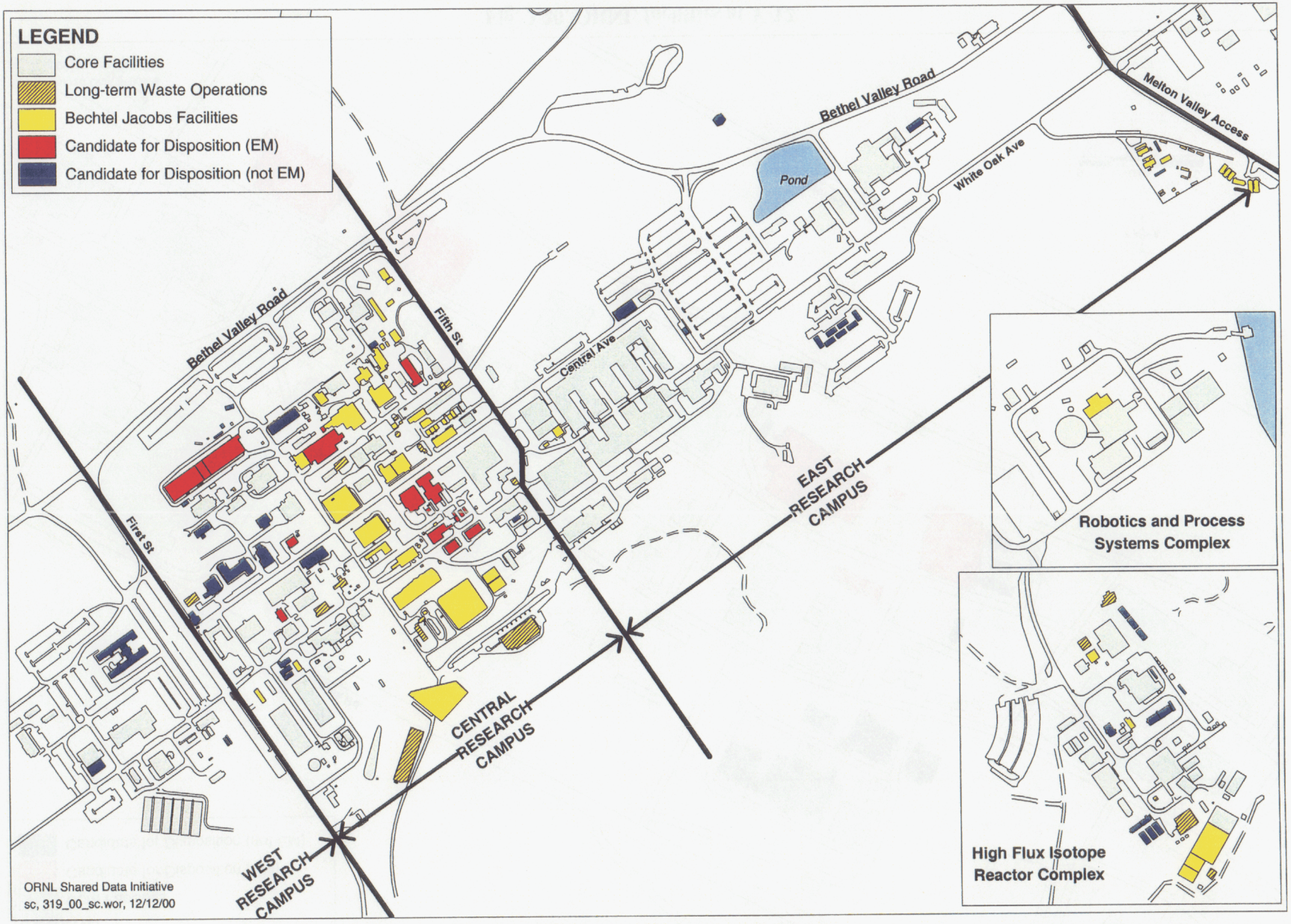


Fig. 3.19. Facilites at the main ORNL site.

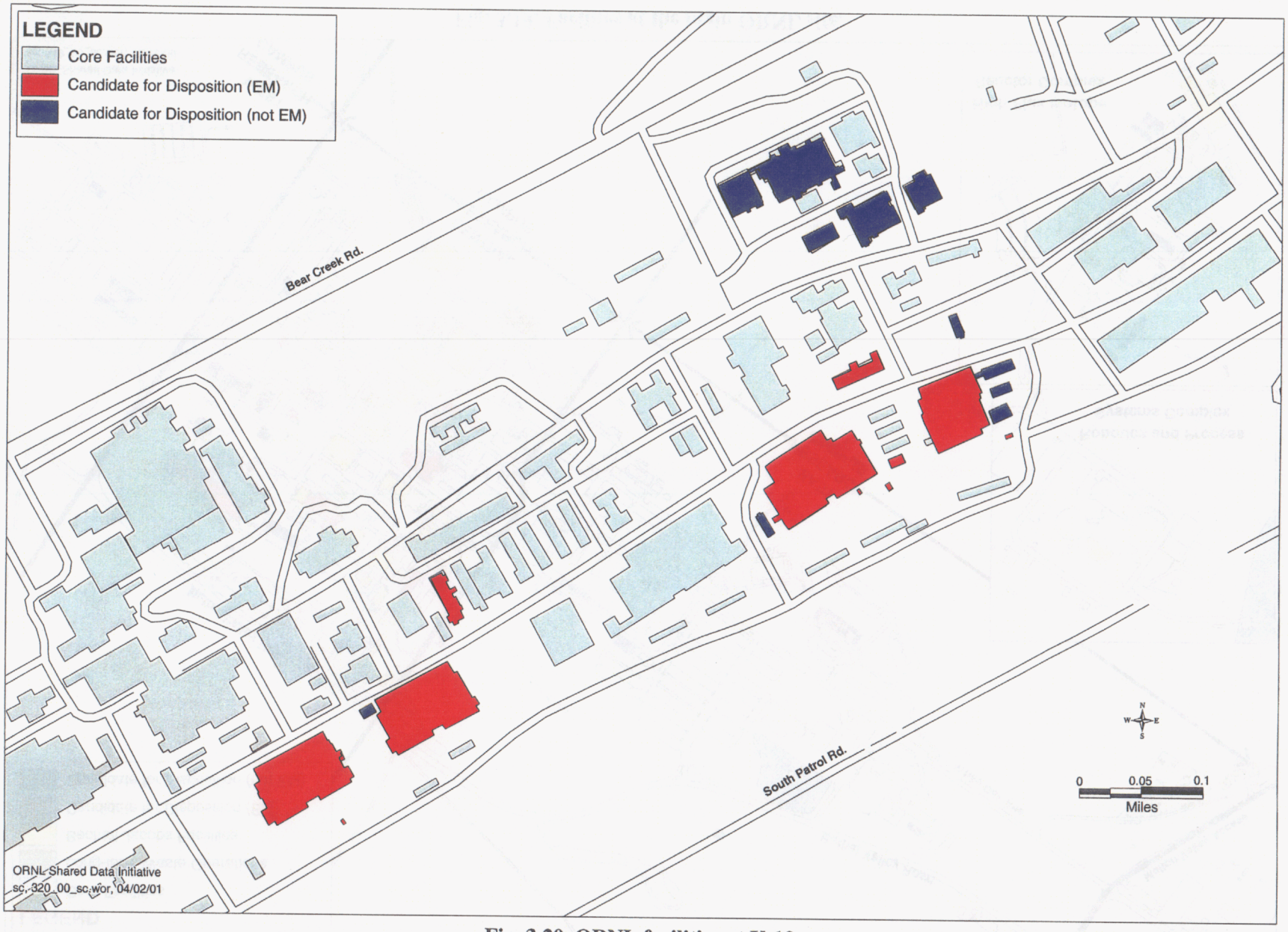


Fig. 3.20. ORNL facilities at Y-12.

within divisions close together to maximize their effectiveness and operations, while also investigating the possibility of co-locating divisions that complement each other in order to create new synergies. The outcome of this assessment and the consolidation plan will be discussed in detail in Section 3.5.3.

3.5.2.2 The "Cheap-to-Keep" Process

ORNL faces an enormous challenge in the deactivation and disposition of its nonstrategic facilities. Many of the facilities identified in the consolidation process are large, complex, and contain multiple hazards. As ORNL facilities reach their end of expected life and are declared excess, they transfer from an operational mode into a transition phase that prepares them for ultimate disposition. The transition phase of a facility's life cycle typically includes deactivation, surveillance and maintenance (S&M), and decontamination/decommissioning (D&D).

The transition phase begins once a facility has been declared excess or is forecasted to be excess to the current and future needs of ORNL. Once all occupants and required equipment have been vacated from the facility, the deactivation process can begin. The deactivation of a facility includes placing the facility in a stable and known condition, identifying hazards, and eliminating or mitigating the hazards. Deactivation must be appropriately planned, conducted, and documented in a manner consistent with the guiding principals and core functions of ORNL's integrated safety management policies and Work Smart Standards. Deactivation will place a facility in a safe shutdown condition in a state of minimum cost and minimum utilities, under surveillance and maintenance for an extended period of time ("cheap-to-keep" mode), until the eventual decommissioning of the facility is accomplished. Deactivation of nonutilized excess facilities should occur as soon as is reasonable and for as many facilities as possible.

S&M activities consist of two elements: surveillance and maintenance. Surveillance includes any activity that involves the scheduled periodic inspection of a facility, equipment, or structure as required by federal and State ES&H laws and regulations and DOE orders. Maintenance includes (1) any routine activity that is required to sustain property in a condition suitable to be used for its designated purpose and (2) preventative, predictive, and corrective maintenance. It will be the goal of the FRP to minimize the S&M duration and plan for early funding to support D&D activities. It can be expected that S&M activities will be much longer for those facilities that would be transferred to the EM Program.

3.5.3 Consolidation Plan

The FRP strategy is to consolidate Laboratory research and support operations into a set of strategic facilities located at the main ORNL site. This plan results in the reduction of ORNL space from the current level of over 4.5 million square feet to slightly over 3 million square feet. This consolidation effort would occur over a 5- to 7-year period, involving the movement of slightly over 400 staff from off-site locations (e.g., Y-12, 1060 Commerce Park, and 111 Union Valley) to renovated and existing space at the main ORNL site or new private-sector, State, DOE Line Item, and GPP space and would result in the need for the deactivation and demolition of approximately 118 buildings.

The consolidation summaries for the West, Central, and East Campuses, as well as the 7600 and 7900 Areas, are summarized in Table 3.6. A master consolidation summary (Appendix H, Table H.1) and campus/area consolidation summaries (Appendix H, pages H-5 through H-7) include more detailed information, such as current and new space requirements. It should be noted, however, that construction activities and staff relocations at the SNS site are not included in this planning activity because of the separate and unique nature of that activity.

Table 3.6. Master consolidation plan summary

Location[a]	Strategic facilities that support the consolidation effort	Facilities to be vacated[b]	
West Campus	1061 and 1062 Office Buildings	9210	
	Center for Biological Sciences	1060 COM	
	Environmental and Life Sciences Laboratory		
	Joint Institute for Biological Sciences		
	Laboratory for Comparative and Functional Genomics		
Central Campus	2018	2011	3504
	2033	2013	3508
	2518	2506	3525
	2525	3003	3543
	3500	3019A	
	4546	3080	
	Central Campus Research Building	3115	
East Campus	5500	1000	6026B
	6010	2000	6026C
	6025	2001	6026D
	4500N	2008	6026E
	4500S	2013	6026F
	Advanced Materials Characterization Laboratory	2019	6026G
	Computational Science Building	2024	6556E
	East Campus Research Office	2506	6556Q
	East Campus Service Building	2652A	6556S
	Engineering Technology Building	2652B	9102-1
	Joint Institute for Computational Sciences	2652C	9102-2
	National Transportation Research Center[c]	3017	9104-4
	Oak Ridge Center for Advanced Studies	3036	9201-2
	Research Office Building	3037	9201-3
	Research Support Center	3100	9204-1
		3503	9204-3
		3504	9224
		3550	9401-1
		5000	1060 COM
		6003	111 UNV
		6026A	
7600 Area	7601	9201-2	
	7602		
	7603		
	7605		
	7606A		
	7606B		
	7600 Area Office Building		
	7600 Area Highbay Building		
7900 Area	7900 Area Office Building I	7964A	7964F
	7900 Area Office Building II	7964B	7964G
	HFIR Highbay Storage	7964C	7965A
	HFIR Maintenance Building	7964D	7965B
	Manipulator Repair Facility	7964E	7965C

[a]See Figs. 3.19 and 3.20 for locations.

[b]Only facilities to be vacated in support of staff consolidation to main ORNL site. Tables 3.4 and 3.5 contain a listings of all ORNL facilities to be considered excess as part of the 10-year modernization effort.

[c]Off-site location.

3.5.4 Infrastructure Needs

3.5.4.1 Campus Improvements

Each of the campus improvement projects is discussed in Section 3.6.2 as part of the ORNL Master Plan for site development.

3.5.4.2 Utility Improvements

Major utilities, including electricity, natural gas, water, and telecommunications, are required at ORNL and are provided by outside entities. In addition, the Laboratory produces its own steam and compressed air and operates and maintains systems for the collection and treatment of sanitary, process, and industrial-type wastes. It is anticipated that the utilities infrastructure needed to support the FRP will include much of that currently in use; however, refurbishment and upgrades to the existing systems and new systems will be necessary to support both continuing operations as well as planned facilities. Detailed descriptions of ORNL utility systems are provided in Appendix I.

Upgrades to the electrical, potable water, process waste, telecommunications, and fire alarm systems are scheduled over the next several years. The most pressing need is to provide utility systems with redundant capability, which will require additional electrical switchgear as well as additional water lines and water valves. The main thrust of this upgrade program is to ensure that a single point failure in a utility supply system at one Laboratory location will have a minimal impact on the other locations and facilities served by that utility. Utilities that serve potentially hazardous facilities should be provided with the redundancy necessary to ensure operation or the capability of performing a safe shutdown of its operations. This strategy coincides with DOE's desire to ensure that all facilities have the same level of reliability and protection as those which fall into the "best protected class" in general industry. Table 3.7 identifies all infrastructure-related projects in support of the FRP and other ORNL site upgrades.

Table 3.7. Landlord infrastructure projects supporting the FRP and other site upgrades over the 10-year planning period ($ in thousands)

Infrastructure Projects[a]	TEC
New campus facilities/renovation	
GPP and GPE	46,000
Programmatic GPP	7,500
Landlord Line Items	164,500
Programmatic Line Items	78,900
Utility improvements (GPP and GPE)	63,100
Other landlord GPP/GPE	88,800
Other landlord Line Items	70,000
Total	518,800

[a]Appendix J provides activity data sheet identification for infrastructure projects by funding year.

Electrical. Plans for the ORNL Electrical Distribution System include the addition of alternate feeds, replacement of switchgear and transformers, rebuilding overhead feeders, and a general upgrading of many building service entrances in older facilities throughout the site. Other proposed projects will

require additions and/or alterations to the electrical distribution grid and new substations to provide a safe and dependable power supply to new and renovated facilities.

Fire Protection. ORNL facilities are protected from fire by remotely monitored fire alarm and sensing systems coupled with automatic sprinkler devices. A Line Item and GPP have been funded that will upgrade many of the old, outdated fire alarm systems in Laboratory facilities and add new systems to facilities currently not covered. These improvements will enhance fire protection capability for the Laboratory and ensure compliance with the requirements in fire protection standards.

Natural Gas. The long-range plan developed by the ORNL Steam Plant proposes to move away from using coal as a primary fuel. Natural gas will be used to fuel the steam plant, which will use fuel oil as a secondary fuel resource. The addition of a new, efficient natural gas/fuel oil-fired boiler will provide the most economical source of steam while avoiding a number of future costs associated with upgrading the existing coal firing, handling, and waste treatment systems. Evaluations of the existing 50-year-old natural gas distribution system are being conducted to determine upgrades for the most practical and efficient means of providing services for research and service support.

Sewer. Construction of the SNS, East Campus additions, and West Campus additions may require an update of the ORNL Sewage Treatment Plant. It is possible that flows from these new facilities will require plant additions and upgrades to allow treating larger volumes of wastes that may be generated. ORNL operations staff is currently working with an outside engineering firm to develop a computer model of the sanitary sewer system that will be used to predict facility impacts on the sewage collection and treatment system before the new facilities are built. The model will allow plant personnel to identify plant improvements that require capital investment as well as those that simply require an adjustment to the existing treatment process.

Water. Water usage is expected to remain relatively constant until the SNS comes on line. A number of expansions and improvements to the water system are in construction and are being planned. Currently, a new 1.5-million-gallon reservoir on Chestnut Ridge, adjacent to the existing 3-million-gallon concrete reservoir, is being constructed. The existing 3-million-gallon reservoir is in need of major repair, and the new 1.5-million-gallon reservoir will allow down time to complete repair activities. Redundancy of systems will allow for improved operations following repair activities. Two Line Item projects have been submitted for funding that will address the potential for cross contamination in the potable water system due to water lines that run through areas of known subsurface contamination. Several isolation methods, to include trenchless technology, are being evaluated.

Telecommunications. Telephone systems will continue to be upgraded as technology and demand change. Computer networking improvements will include the gradual upgrading of office wiring to include "Category 5" grade copper scale and/or fiber to the desktop and the migration of the existing network topology from shared-media to switched-media using a combination of layer-2 and layer-3 switches. The ORNL network backbone will remain fiber-optic based but will evolve from its current Fiber Distributed Data Interface (FDDI) technology base to a set of parallel FDDI, Gigabit Ethernet, and ATM networks that provide the flexibility to accommodate almost any network-intensive computing project while holding the line on costs for less demanding applications.

Transportation and Grounds. GPPs have been submitted which will improve the transportation and grounds in both the East and West Campuses. Inside the ORNL boundaries, roads providing access to new facilities will be constructed and others realigned to improve traffic flow. Plans include widening and/or relocating Bethel Valley Road and upgrading Melton Valley Road to improve access

and safety. Walkways will surround all new facilities and connect individual buildings with others in the same area and with parking areas.

HVAC. The HVAC design in each building depends on the specific features of each building. Large computer installations and certain other instruments must be housed in an area with low temperature and relative humidity. Other needs are associated with staff indoor air quality and facilities housing animal experimentation. Buildings having exhaust hoods generally have a 100% outside air system which operates very inefficiently. Examples of needs include refurbishment of HVAC system heating and cooling equipment, ductwork, filters, stacks, scrubbers, and alarm and backup systems. Several GPPs and LIs have been requested to refurbish existing systems and to install new systems. Evaluations are continually being made by P&E personnel and health and safety personnel to ensure that the air quality supplied by HVAC systems meets standards.

Steam. The steam production system consists of four dual-fuel boilers and one package-type boiler. The total capacity of the five boilers is 305,000 lb/h of saturated steam at 250 psig. Steam is supplied to Bethel Valley facilities and Melton Valley facilities in the 7500 and 7900 areas. The steam plant also houses the necessary auxiliaries such as feedwater pumps, draft fans, water softeners, fuel pumping stations, reducing stations, and fuel handling systems. Major refurbishment of the steam and air distribution systems took place in 1998 with plans to complete activities with planned projects. Systems are being refurbished to convert systems to gas-fired with oil-fired backup. A new fuel oil tank has been installed to ensure continued service to connected equipment. Boiler upgrades have taken place, and new projects are being funded to upgrade system components for long-term gas operation.

Waste. ORNL has responsibility for conventional waste, including sanitary/industrial wastes, process wastewater, and stormwater. Solid conventional wastes are regulated by the Tennessee Solid Waste Management Act. Bechtel Jacobs Company LLC is responsible for systems and operations for disposal of low-level radioactive, transuranic, hazardous, mixed, and toxic waste. Increased loads from facility and staff relocations to the Bethel Valley site will require refurbishment and expansion of existing systems. Descriptions of waste management activities are included in Appendix G.

Miscellaneous Systems. Miscellaneous systems include telecommunications, transportation and grounds, security systems, compressed air, distilled water, etc. Each of these systems is essential to the continued research mission at ORNL. Planning is included to ensure that, as facilities and infrastructure are built or refurbished, all miscellaneous systems will be included.

3.5.4.3 Security Improvements

Future security planning will continue to place an emphasis on appropriate security measures to protect against events that may cause adverse impacts on national security, the environment, and the health and safety of employees, guests, and the public while continuing to maintain an environment conducive to ORNL's research mission. Reconfiguration of ORNL's security perimeter is planned to be completed before FY 2002. The objective of this reconfiguration is to ease access by creating a more open, less restrictive atmosphere. This will be accomplished by realigning security fences and portal accesses and placing access controls on facilities outside security fencing. See Appendix K for additional information on security improvements.

Future Changes in Infrastructure. Site development planning is a real-time activity, evolving as necessary to meet changing needs. Infrastructure improvements are planned as changes in facility types and needs are made.

3.5.5 Other GPP/GPE

Although not categorized as FRP or utilities, other general GPP and GPE ADSs identify essential needs for the continued operation of the Laboratory. These projects and equipment needs typically are in support of ongoing operations and maintenance activities and planning, oversight, and management activities funded through the Office of Science Basic Energy Sciences landlord funds.

3.5.5.1 Other General GPPs

General GPP ADSs address concerns for site reservation activities and ongoing facilities operations to include the following categories:

- Facility additions and upgrades — Building 2500 - Fire Protection Headquarters, Building 7900 - HFIR Entrance, Building 2007 - Internal and External Dosimetry, Building 6012 - Computer Sciences Research, Building 4512 - Technical Support Building, and the site heavy equipment shed.
- Road improvements — Bethel Valley and Melton Valley.
- General facilities — Elevators, hot cell systems, data network systems, and motor/generator replacements.

Appendix J contains tables identifying those other GPPs that generally support additions to existing facilities, safety and health supporting projects, roads and grounds, and special projects.

3.5.5.2 Other General GPEs

General GPE ADSs address the following equipment categories:

- LDRD equipment.
- ES&H, quality, and security systems.
- Information and records management.
- Multiprogram research instrumentation.

Appendix J contains tables identifying those GPEs identified as other general GPEs.

3.6 ORNL MASTER PLAN

The Master Plan for development of the ORNL Laboratory of the 21st Century has been formulated to meet the scientific needs of the research community utilizing the facilities; provide a safe, quality, and energy-efficient work environment for ORNL staff; and ensure adequate flexibility and growth potential for future expanded research missions. The following description of the Master Plan includes a review of the basic guiding principles used in developing the plan, an overall view of the long-term Master Plan, and separate descriptions of each of the phases of the Master Plan growth.

3.6.1 Master Plan Vision/goals

The guiding principles for the ORNL Master Plan were developed early in the planning process and incorporated input from a variety of stakeholders, including ORNL research, operations, ESH&Q, land use, program development, and DOE staff. From formal brainstorming sessions, stakeholder surveys, management- and staff-level briefings, and written DOE guidance, an overall vision for the facilities revitalization effort was developed and adopted that states:

The vision of the FRP is to provide ORNL staff with world-class facilities, consolidated at the main ORNL site, that lay the foundation for ORNL's scientific excellence into the 21st century.

Accomplishing that vision as soon as possible then became the mission of the FRP team, with the highest-priority projects to be completed within a 5-year time frame. Specific Master Plan goals to be realized when modernization is complete were then defined in each of the following areas:

Scientific Mission: Support the multiprogram nature of the Laboratory and accommodate program growth and technology changes well into the 21st century. Integrate the program needs into a research campus environment that encourages interdisciplinary teaming.

Work Environment: Provide a quality work environment for employees and visitors that enhances their productivity and attracts the next generation of world-class scientists to ORNL. Facilities will contain the latest advances in information technology and research laboratory infrastructure and will be designed to provide maximum flexibility for program changes.

Environment, Safety, Health, and Security: Provide a safe, healthy, environmentally conscious, secure workplace for employees and visitors. The Master Plan should maximize the use of already disturbed (brownfield) areas for new development, emphasize energy efficiency and sustainability design features, and provide an open campus security environment wherever possible.

Operations and Maintenance: Facilities and infrastructure will be efficient to operate and maintain. New building designs will incorporate energy-efficient heating/cooling systems, utility services, insulation, and exterior surface materials that are state-of-the-art, yet durable and maintainable.

Architectural: The new ORNL campus will have a unifying architectural style that reflects the mulitprogram scientific nature of the Laboratory mission and celebrates the unique history of the main ORNL site and the natural beauty of East Tennessee. The new research facilities will be built around an identifiable campus center where staff, visitors, and the general public will be welcomed and allowed to meet and exchange ideas.

We believe the Master Plan, outlined as follows, achieves these goals in a most innovative and attractive manner.

3.6.2 The Master Plan for ORNL Site Development

A view of the Master Plan for long-term site development at ORNL is provided as Fig. 3.21, with the planned new facilities highlighted in color by phase of construction. This plan, incorporating the vision and goals described above, focuses on a multicampus layout (East, Central, and West Campuses) to accommodate the multiprogram nature of ORNL research activities. The East Campus was structured to continue the historical mission work in High Energy Physics, Computational Science, Chemical/Analytical Sciences and Engineering, and Materials Research, as well as provide expansion room for the Engineering Technology field of study and future collaborations with UT and the broader university community through new Joint Institutes. The West Campus Master Plan focuses on support of Environmental and Life Sciences research needs, making the Marilyn Lloyd Environmental and Life Sciences Complex historical vision a reality. The Central Campus plan for redevelopment was a bit more complicated, due to the presence of a large number of contaminated facilities that were critical to ORNL's early years and are now part of the EM Program for D&D. That portion of the ORNL site would continue to be a primary area for Solid State, Materials, Energy, Instrumentation, and Chemical Technology research, but with limited new facilities construction planned until D&D activities are completed in 10 to 15 years. Once the Central Campus area is

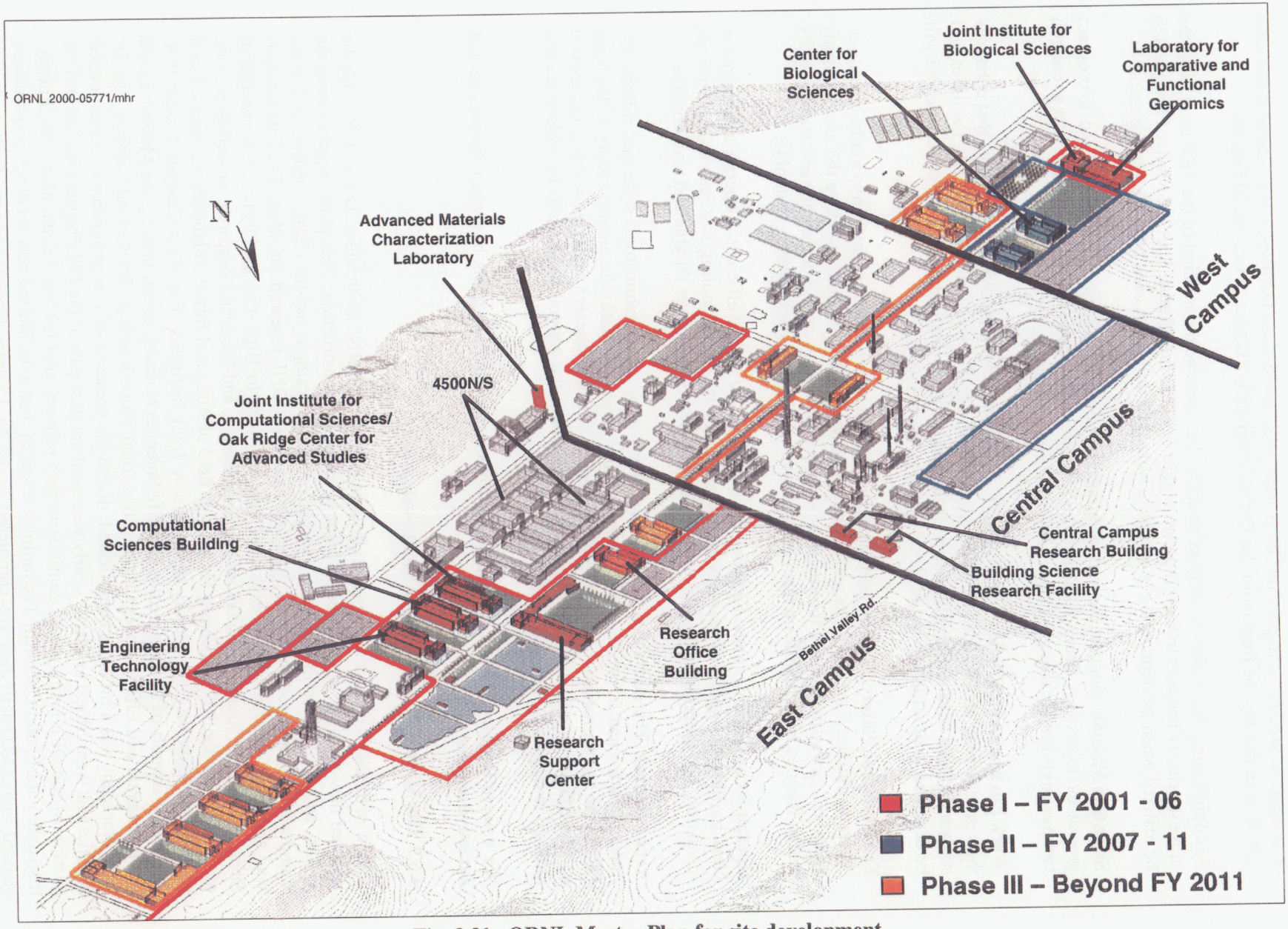


Fig. 3.21. ORNL Master Plan for site development.

returned to useable/buildable status, then additional research and support development would occur as part of the overall Master Plan.

The multicampus site layout provides identifiable campus centers to develop in the East, Central, and West portions of the site, around commons areas that promote researcher collaboration, and with reasonable walking distances maintained for all critical services to promote energy savings and improved worker health. The close-pack arrangement of new buildings, and their purposeful proximity to the existing strategic ORNL buildings, minimizes the area required for new development and allows reuse of already disturbed land (parking lots, remediated sites) in a brownfield-type approach. The natural areas on the hillsides overlooking the ORNL site to the north are maintained in their current state under this plan; a tree-lined avenue is established from east to west through the entire site; and an expansion of the historical Swan Pond is provided at the ORNL entrance to emphasize the natural beauty of Bethel Valley in which ORNL resides and to provide a water source to support energy-efficient operations of new facilities. This entrance area comes to a focal point at the Research Support Center (hereafter referred to as The Center), the centerpiece of the East Campus, where visitors to the Laboratory will be welcomed, conference facilities are provided, and ORNL staff are encouraged to congregate and collaborate in the main cafeteria facility and surrounding open areas.

Architectural consistency will be provided within each campus to ensure blending of new construction with the existing strategic structures, while allowing state-of-the-art improvements in building sustainability designs. Recognition of the history of the ORNL site will be a critical element of the design and siting of new buildings, with preference given, where possible, to protecting those important features of the Laboratory. The proposed site layout, use of between-building spaces, and dispersed parking concepts are predicated on a change in the physical security approach at the Laboratory. Such a change would involve, in its simplest form, elimination of the fence boundary to allow the East and West Campuses to become more open, and for access controls to be provided, instead, on a building-by-building basis through a badge-reader-type system at each building entrance.

The emphasis of the Master Plan is on the main ORNL site in Bethel Valley since the majority of the research staff and the old facilities are located there; however, the important missions at HFIR and the Robotics and Process Systems areas (the 7900 and 7600 Areas, respectively) are not overlooked in this plan. Facilities improvements and new construction investments will continue to be made in those areas throughout the planning horizon, as noted in the details of the Strategic Plan that follow. As well, the significant investment being made by DOE in constructing the SNS is factored into the ORNL Master Plan, with recognition of the entrance requirements for that facility and the availability of shared resources and facilities.

3.6.2.1 East Campus Design Features

The East Campus (see Fig. 3.21) is built around the new ORNL Center as the central point for interface with the public and for congregation of the Laboratory staff. That facility contains the visitor reception area, the main ORNL cafeteria, and the primary large auditorium for Laboratory seminars and briefings (with adjacent breakout conference rooms). These conference rooms would also become a critical resource to the Laboratory for support of normal research project teams, university/ commercial partnerships, and routine audit team space. Commons areas in front and behind The Center would provide a quality environment for staff/public interactions and congregating space for conference attendees and lunch-time crowds.

Support for the research mission is a primary emphasis in the East Campus design, with siting proposed for up to eight new research and related buildings within walking distance of The Center

and the current research/administration hub of 4500N/S. These buildings would be phased, as required by program growth, and located in strategic proximity to collaborating organizations. Existing research laboratories and offices in the 4500N/S complex, as well as those in the Physics and Computational Sciences complex in the 6000 Area and the HTML area (4515), would be upgraded, as required, under this Master Plan to bring them up to 21st century technology and infrastructure capabilities to allow them to continue serving as the research backbone for this portion of the Laboratory.

A key component of the new research capabilities in the East Campus will be the expected addition of facilities to house the Joint Institute for Computational Sciences (JICS) and the Oak Ridge Center for Advanced Studies, two of the commitments made by the State of Tennessee as part of the UT-Battelle facilities revitalization proposal. These user-facility/scientific-collaboration-type buildings will be consistent with the open public nature of the East Campus setting and will be sited to best accommodate scientific/public needs. The location currently shown in Fig. 3.21 is representative only, with final siting to be determined through agreements with UT, the State of Tennessee, and UT-Battelle management staff.

Utilities and infrastructure improvements will be made as part of the development of the East Campus, with upgrades anticipated in potable water, electrical distribution, steam, HVAC, and wastewater collection/distribution systems. As the majority of new facility construction activities are sited on the current main ORNL parking lot, replacement of that critical piece of infrastructure also becomes important. Traffic flow and parking availability planning has been factored into the Master Plan, with particular emphasis on traffic calming along Bethel Valley Road, visitor parking associated with The Center, and use of previously disturbed areas for provision of staff parking near their place of work assignments.

3.6.2.2 West Campus Design Features

The emphasis on the West Campus development (Fig. 3.21) is to consolidate Environmental and Life Sciences research activities into an identifiable complex surrounding a natural commons area. The existing strategic research facilities housing Environmental Sciences Division and Life Sciences Division (LSD) staff would be retained and upgraded as required to meet the state of science in the 21st century. Adjacent to those buildings, the new Laboratory for Comparative and Functional Genomics, the Joint Institute for Biological Sciences, and a proposed Center for Biological Sciences office/laboratory facility would be constructed around a commons area, all of which are tied visibly to the East Campus by the landscaped avenue that runs east to west through the main ORNL site. Accomplishing this vision for the West Campus will require the demolition of Building 1000, one of the prime examples of outdated, substandard office buildings that are the focus of the revitalization effort. Similar to the East Campus, upgrades will have to be made in the general infrastructure of the West Campus to accommodate planned growth and replace/reorient roadways and parking.

3.6.2.3 Central Campus Design Features

Few design features have been developed at this point for the long-range redevelopment of the Central Campus area (Fig. 3.21), since remediation of the majority of the structures there is still 10 to 15 years away. What is planned, however, is the continued use and upgrade of current strategic research facilities in the heart of the campus, the addition of a few key near-term facilities in proximity to existing concentrated program complexes (e.g., Energy Division and Solid State), and longer-term development of a central commons area to be bounded by future mission-related research laboratories/offices. In addition, the Master Plan includes an ultimate relocation of ORNL support

services capabilities from the 7000 Area into the center of the ORNL site to complete the consolidation of ORNL operations within the compact, three-campus setting. While the existence of closed/remediated EM sites within the Central Campus area will certainly restrict the location and type of buildings sited, sufficient unrestricted development areas are expected to be made available for the needed ultimate consolidation. In fact, early planned reuse of the remediated surface impoundments area for parking is a good example of the type of brownfield redevelopment that will be the hallmark of the Central Campus revitalization.

3.6.3 Master Plan Phase I: FY 2001–06

Accomplishment of all of the ORNL Master Plan objectives will obviously take many years. Phasing of the project will be required to correspond to the availability of each of the various funding types, the programmatic needs of the research organizations, and the constraints of the existing/planned infrastructure to support construction and operations. The discussion that follows of each of the planned construction phases is intended to outline the general goals that we would hope to accomplish during those time frames, blending the reality of these constraints with the strong push from the Office of Science to modernize ORNL on an accelerated schedule. The FRP has been separated into three primary phases, representing plans for the periods FY 2001–06, FY 2007–11, and beyond FY 2011. Obviously, the details of specific projects and timing gets less clear after the first 5 years, and for the period beyond FY 2011, information deals only with general programmatic mission potential and the hopefully successful remediation of the Central Campus area by EM.

Phase I is the most critical stage for the revitalization effort, as it is here that the concept of private-sector involvement and State of Tennessee investment in the ORNL campus upgrade must happen. It is here, also, where the "new" look of 21st Century ORNL begins to take shape around The Center in the East Campus and the Laboratory for Comparative and Functional Genomics in the West Campus. This phase also includes completion of the relocation of all ORNL staff from off-site locations at Y-12 and most leased space to the main ORNL site. Details of the activities in each campus area are outlined as follows.

East Campus. The research campus nature of the Laboratory will appear during Phase I, with the planned construction of The Center, three private-sector research buildings, two State of Tennessee Joint Institutes, a general purpose support office building, and the infrastructure that integrates the new facilities with the existing Laboratory and provides a new face to the public and visiting scientists. In addition to the new construction, renovations will begin to take place on existing research and support buildings to accommodate staff consolidation and new science initiatives, the most notable of those being the upgrades to 4500N/S, to the HTML, and to Building 5500 (for ESH&Q consolidation). Research wings of the 4500N/S complex will be prioritized for upgrade, and staff will be temporarily relocated in a phased approach to allow the existing 1950s laboratories to be updated to current technology. At the HTML, a new special-foundation-designed wing would be added to the current laboratory to allow consolidation of the primary ORNL electron microscopes into a single, unique, and highly stable facility to support long-term use of these supersensitive instruments.

While specifications are not complete for each of the primary new buildings in the Phase I East Campus, some basic footprint and program content planning has been completed. As described earlier, The Center would contain the most public parts of the campus, housing the visitor reception area, main Laboratory conference center, and cafeteria. This roughly 50,000-square-foot facility would be built with DOE Line Item funds and would become the "statement" building for ORNL, with design features that would emphasize the importance of ORNL as one of the country's premier research institutions and incorporate energy efficiency and sustainability in building materials of construction

and operation (Fig. 3.22). Its glass facade would front the expanded pond area to the east and a courtyard to the west, providing ORNL staff and visitors an opportunity to embrace the beauty of the East Tennessee setting of the Laboratory during their normal conduct of business. Similarly, each of the private-sector buildings would have a view to the north of the existing pond and hillside landscape, through glass-enclosed fronts that form the southern boundary of the new campus quadrangle. These roughly 100,000-square-foot laboratory/office buildings would be built in complementary style to The Center but would be focused on very specific research mission functions. One would be dedicated to the work performed by Engineering Technology Division, which will be moved from its location at Y-12 into a facility designed to house its special mechanical, thermal, and materials research needs. The second will be designed for movement of the ORNL supercomputer capabilities into 21st Century Laboratory space and establishment of a Computational Science Building at ORNL.

The third private-sector building is expected to house energy and materials research staff, as well as support organizations critical to the research mission.

The other new buildings in the East Campus area consist of a DOE GPP-funded office building adjacent to the existing Building 5002, and the two State-funded joint institutes. The Joint Institute for Computational Sciences (JICS) and the Oak Ridge Center for Advanced Studies (ORCAS) would be sited in the East Campus, in close proximity to The Center and the ORNL Computational Science Building to ensure close ties to those complementary functions. While the program content of these collaborative facilities is still being finalized and the specific siting of those buildings is still to be determined, the basic functions, interrelationships, and footprint are understood and have been accommodated in the Phase I plan. The East Campus Service Building has been proposed to provide a new, more space-efficient and centrally located home for the ORNL Graphics and Reproduction Center, along with office space to be used for temporary overflow space for staff being displaced during the 4500N/S complex upgrades. This facility is expected to utilize the standard office design concept for GPP offices that has worked so effectively in minimizing the cost of construction of standard office facilities at ORNL. The 4500N upgrade program would be initiated in Phase I and would focus on Wing 4 and the headhouse portions of that complex as the first Line Item project, with subsequent projects (over a 10-year period) sequenced as appropriate to address the laboratory upgrade needs in the rest of 4500N, 4500S, and the adjacent attached buildings, such 4501, 4505, and 4508.

The primary infrastructure improvements in the East Campus during Phase I will be associated with providing necessary utilities support to the new facilities construction, construction of the roads, ponds, and commons areas between buildings, and the replacement of parking that is eliminated by new campus construction. Another key infrastructure change during Phase I is the assumed reorientation of the security perimeter on the east end of the main ORNL site to allow building-controlled access in the East Campus and implementation of a revised traffic/parking plan.

West Campus. Phase I activities in the West Campus will be centered around the new Laboratory for Comparative and Functional Genomics, a DOE Line Item now in the design stage that will house the ORNL mouse colony critical to ORNL's future genomics research. This 35,000-square-foot facility will allow the mouse colony to be moved from its historical (but now deteriorated) home at Y-12 and open the availability of that important DOE resource to a broader research community.

That enhanced research community will be better able to utilize this resource through the Joint Institute for Biological Sciences (JIBS), a State of Tennessee funded research laboratory and office facility to be co-located in the West Campus during Phase I. Only the necessary infrastructure to support the construction and operation of these facilities will be provided in the West Campus during Phase I, with commons areas, restructured parking, and roads to await Phase II funding.

Fig. 3.22. The Research Support Center at Oak Ridge National Laboratory.

7600 and 7900 Areas Development. While not within the main ORNL campus boundaries, critical activities are occurring in the HFIR/REDC complex (7900 Area) and the Robotics and Process Systems Complex (7600 Area) in the Phase I time period that are important to the overall ORNL revitalization initiative. The improvements to HFIR operations and research capabilities occurring during their ongoing upgrade program will make the reactor and adjacent facilities more user-friendly and available. To support that increase in mission, several DOE GPP-level projects will be undertaken in Phase I that eliminate multiple trailers housing research and support staff, provide much-needed highbay operations and storage areas, and improve the user-facility status of the complex. The 7600 Area has been selected to be the location for consolidation of FED staff and facilities that have been historically located at Y-12. To allow that consolidation to occur, staff from several divisions in existing 7600 space will have to be moved to the East Campus, upgrades provided for the vacated space, and several new DOE GPP facilities constructed (for offices and for highbay process space needs). Locations of the planned new facilities in the 7600 and 7900 Areas are shown in Figs. 3.23 and 3.24.

General-Purpose Line Item, GPP, and GPE Projects. In addition to projects directly associated with the Facilities Revitalization Project, there are numerous projects for general-purpose facilities, improvements, and upgrades needed to assure the adequacy and viability of ORNL's utility system, facilities, and other site infrastructure. Figs. 3.25 and 3.26 show locations of general-purpose Line Items and major GPP and GPE projects in Bethel and Melton valleys, respectively. Descriptions of these projects are included in Appendix J.

3.6.4 Master Plan Phase II: FY 2007–11

Phase II of the Master Plan focuses on continuation of the upgrade to the 4500N/S complex in the East Campus area, on additional development of the West Campus quadrangle, and on refinements of the infrastructure (roads, parking, and utilities) across the ORNL site (Fig. 3.21). While the site construction efforts are smaller in Phase II of the plan, significant investments instead are being made in the placement of vacated buildings into "cheap-to-keep" mode and implementation of facility decommissioning for the highest-priority projects. During this phase, cost savings from the Phase I exit from inefficient buildings will peak and will help fund many of the ongoing maintenance improvements needed for the remaining inventory of ORNL facilities.

East Campus. The primary construction activities in the East Campus during this phase will be continuation of the 4500N/S complex laboratory upgrade projects, with completion of that work expected early in Phase III. Infrastructure improvements would also continue throughout Phase II, focusing on final road and parking lot upgrades to support the private-sector buildings, traffic calming improvements along Bethel Valley Road, and the more routine utilities and facilities needs for the existing main plant area.

West Campus. In the West Campus, Phase II brings form to the commons quadrangle at that end of the ORNL site. The existing Building 1000 will be demolished to eliminate that substandard space and provide room for a new Center for Biological Sciences Line Item facility as well as the common space between it and the Genomics Laboratory/Joint Institute for Biological Sciences complex further to the west. The Biological Sciences facility will provide space to complete the consolidation of all LSD staff from off-site and other on-site locations, finally bringing to fruition the concept of the Environmental and Life Sciences Complex. Additional parking will be constructed to the north of the complex to serve the entire area, and a modified entrance from Bethel Valley Road will be provided to improve traffic flow and public interaction at this end of the ORNL site.

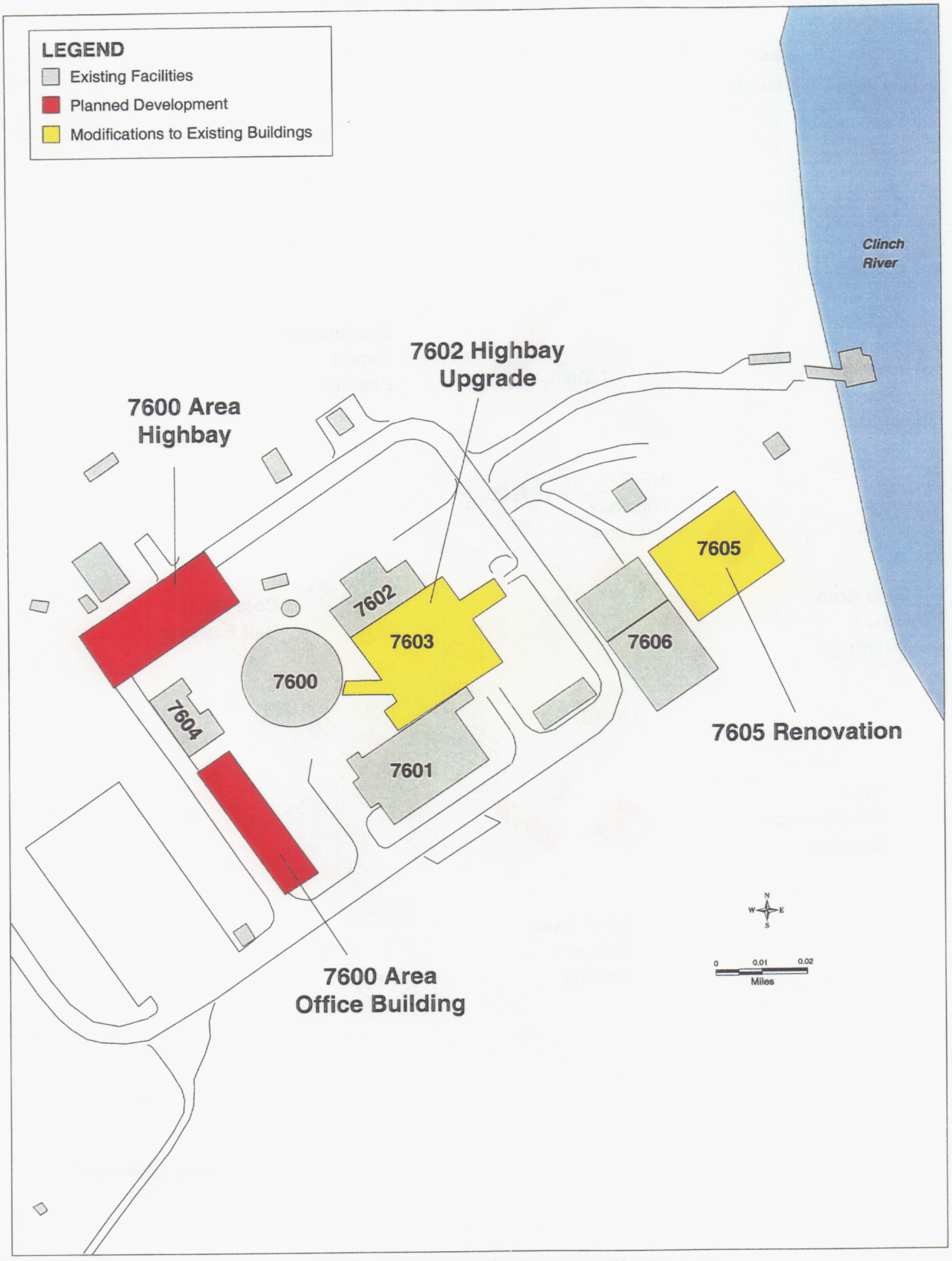


Fig. 3.23. Planned new facilities in the 7600 Area.

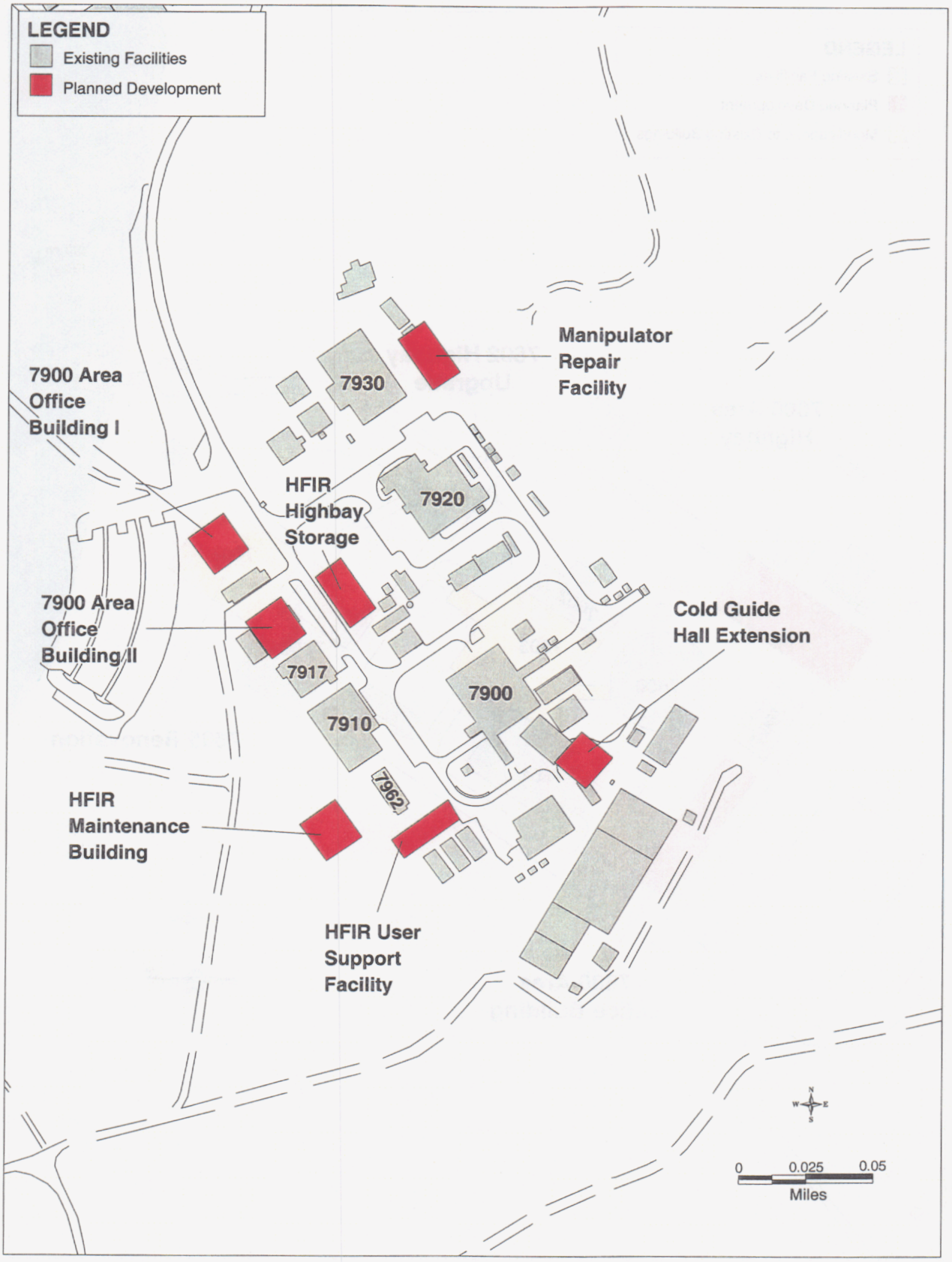


Fig. 3.24. Planned new facilities in the 7900 Area.

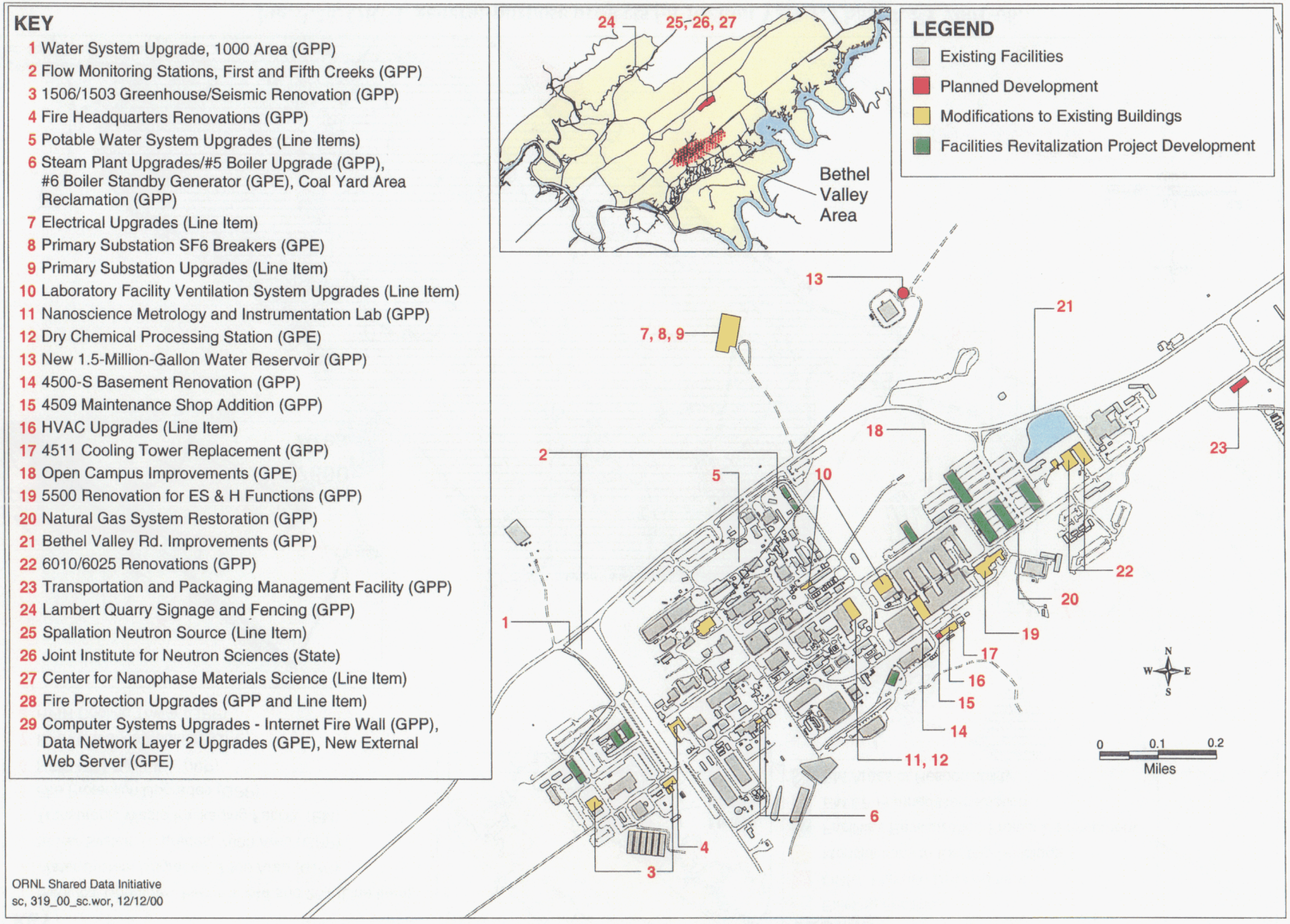


Fig. 3.25. ORNL general-purpose projects for Bethel Valley, Phase I, FY 2001-06.

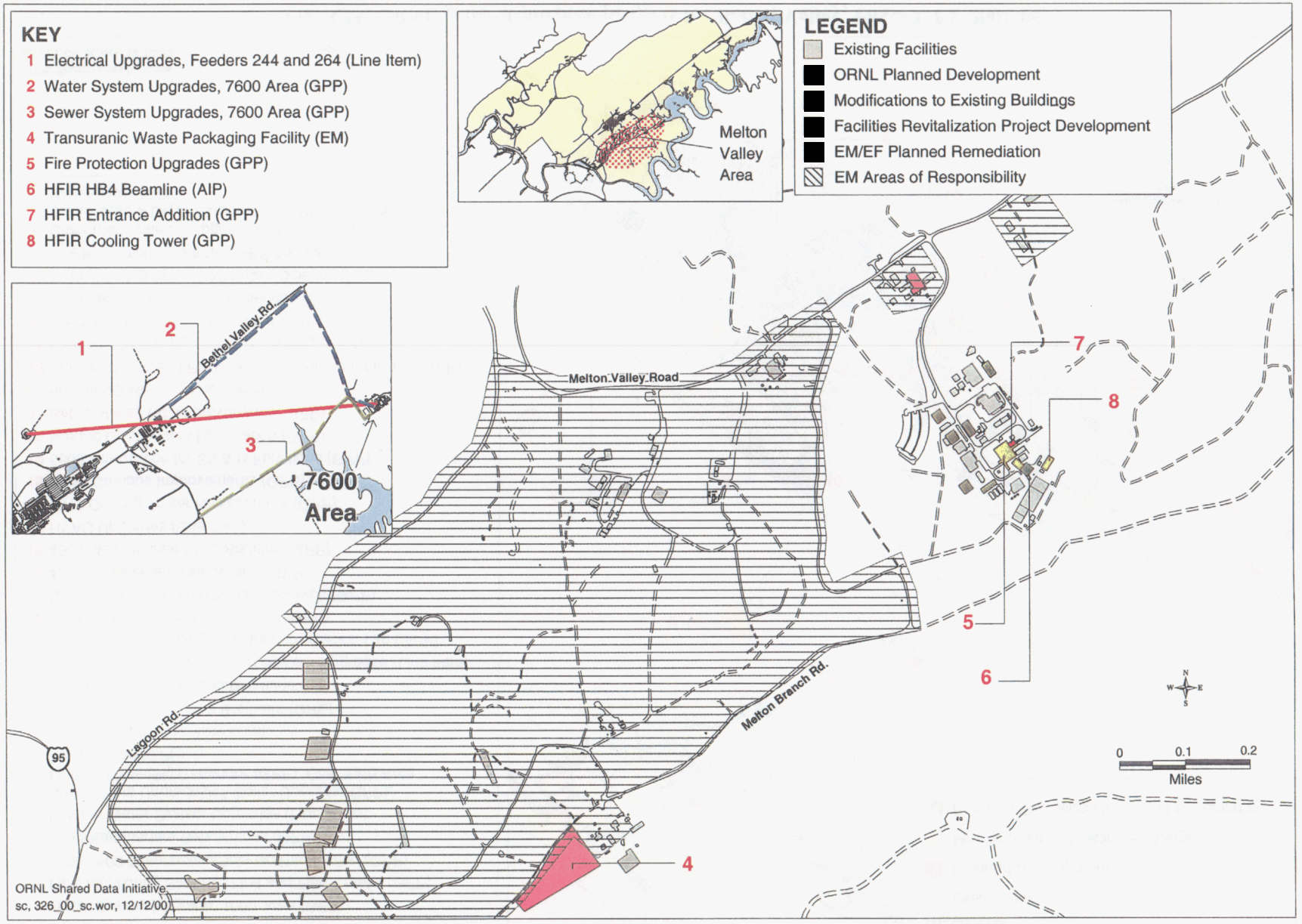


Fig. 3.26. ORNL general-purpose projects for Melton Valley, Phase I, FY 2001-06.

General-Purpose Line Item, GPP, and GPE Projects. In addition to projects directly associated with the Facilities Revitalization Project, there are numerous projects for general-purpose facilities, improvements, and upgrades needed to assure the adequacy and viability of ORNL's utility system, facilities, and other site infrastructure. Figs. 3.27 and 3.28 show locations of general-purpose Line Items and major GPP and GPE projects in Bethel and Melton valleys, respectively. Descriptions of these projects are included in Appendix J.

3.6.5 Master Plan Phase III: Beyond 2011

While programmatic and site infrastructure needs are not well defined for the period beyond FY 2011, the Master Plan has incorporated the necessary flexibility and expansion room to accommodate any level of growth that would conceivably occur. This phase of expansion could involve construction of office/laboratory space in the East Campus north of 4500N, additional office/laboratory space to the east of the 6000 Area, new Environmental and Life Sciences expansion in the West Campus, and/or redevelopment of a Central Campus area on sites that are remediated by the EM Program by that time frame (Fig. 3.21). The specific location and program content of those facilities would be determined in the outyears, but the Master Plan approach provides growth potential in areas adjacent to all major science centers within the ORNL main research campus. At this point in time, it may be appropriate to relocate the service functions currently being performed in the 7000 Area into the Central Campus redevelopment in order to make that support more efficient in serving the Laboratory research mission and allow appropriate disposition of those aging facilities.

Infrastructure needs to support the long-range site development would be addressed as decisions are made on the ultimate growth locations. Utilities upgrades and distribution, as well as road access and parking improvements, would be provided as required. During this phase, consideration will also be given to creating a bypass for the portion of Bethel Valley Road that forms the northern boundary of the ORNL site along the main entrance area. The bypass would route through traffic behind the low hills to the north of the ORNL main entrance and allow the existing road to become part of the ORNL campus, with appropriate boulevard landscaping and traffic calming to be incorporated.

3.7 PRELIMINARY COST AND SCHEDULE

Based on the facilities consolidation planning and Master Plan approach presented in previous sections, an analysis of the cost and schedule associated with implementation of the *ORNL Strategic Facilities Plan* has been completed. Currently, such cost and schedule information is necessarily very preliminary, since detailed construction project estimating has not yet been completed for most of the proposed facilities and the safe shutdown and decommissioning requirements of to-be-surplus facilities are just beginning to be understood. However, an attempt has been made to capture the order of magnitude of all significant cost elements and to provide a realistic time line for accomplishing the major site development activities.

3.7.1 Cost Estimating Methodology

The cost estimates provided are based on the use of site- or region-specific cost factors for each of the primary facility revitalization work activities expected to be accomplished during the planning period. These factors include (1) current operating costs of facilities at the Y-12 and main ORNL sites, as well as current lease costs for organizations that are at off-site locations; (2) transition costs for placing facilities in a "cheap-to-keep" mode; (3) routine annual S&M costs for facilities that are in the "cheap-to-keep" mode; (4) gross D&D costs for permanent disposition of surplus facilities; (5) construction costs for facilities to be built by DOE, the State of Tennessee, and the private sector; and finally

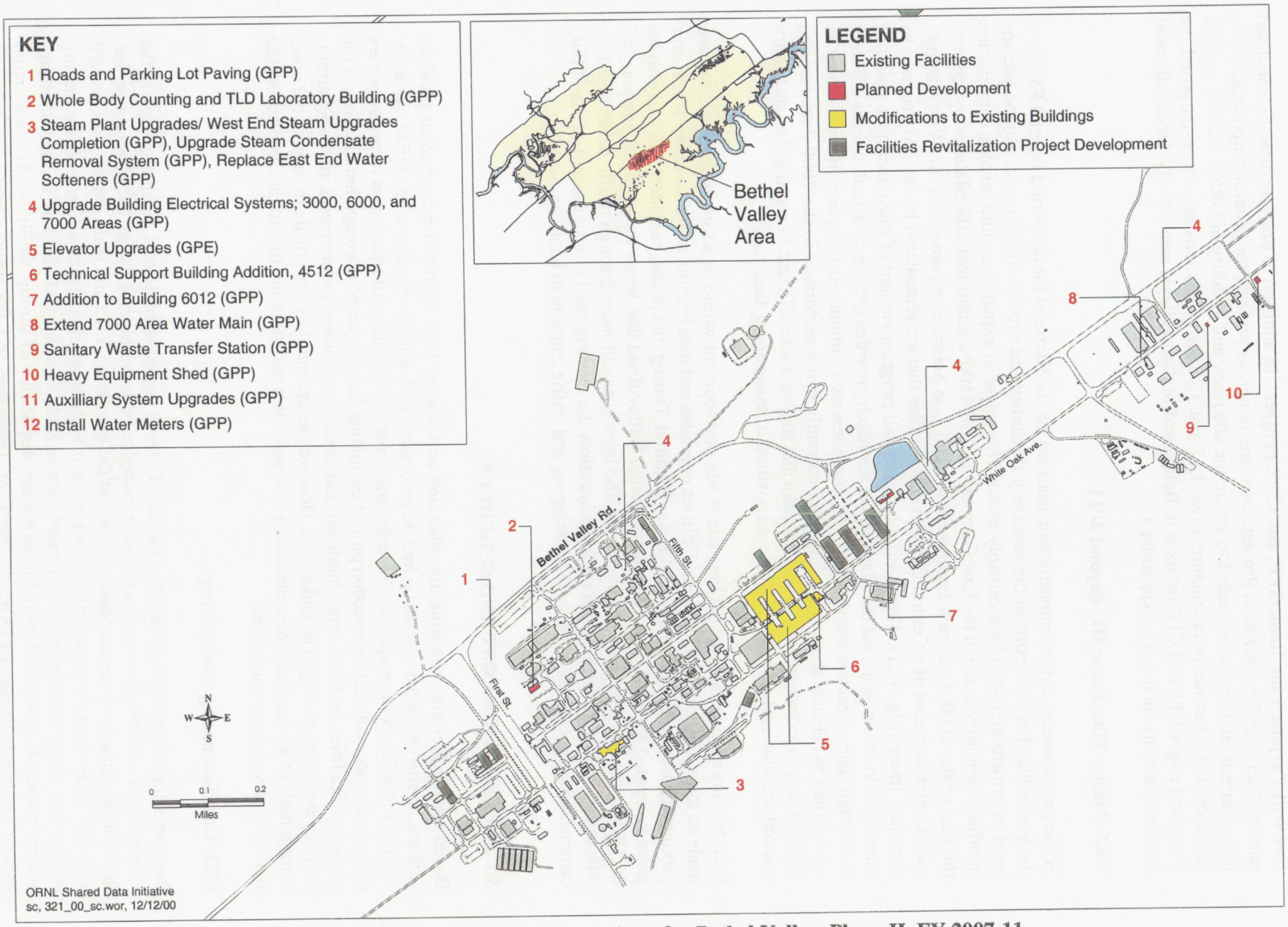


Fig. 3.27. ORNL general-purpose projects for Bethel Valley, Phase II, FY 2007-11.

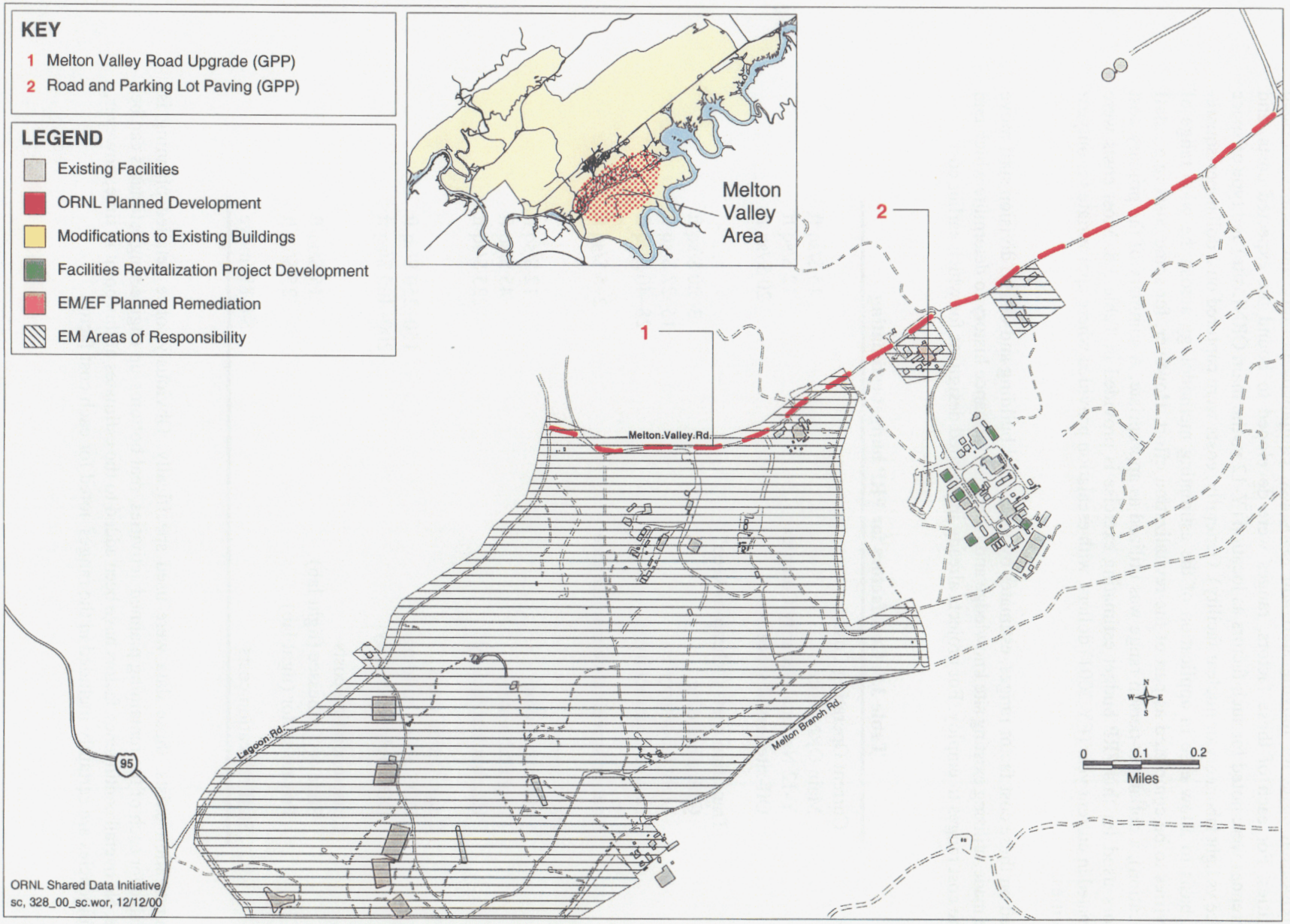


Fig. 3.28. ORNL general-purpose projects for Melton Valley, Phase II, FY 2007-11.

(6) relocation costs for moving staff and associated equipment/furniture into new/refurbished facilities. For each of these factors, ranges were developed to bound the expected costs, and differences were noted for such factors as location (Y-12 vs the main ORNL site) and type of space (office vs light laboratory or nuclear facility). Generally, costs were captured on a dollar-per-square-foot basis to allow ease in application of the estimating methodology across the wide range of activities to be completed as part of the revitalization effort. However, for some costs (e.g., staff relocation), a dollar-per-person range was utilized as appropriate. A summary of the primary cost factors used for this FRP budget estimating exercise is provided in Table 3.8. Most costs were estimated in current year (FY 2001) dollars, with escalation provided where appropriate for outyear activities.

Based on these cost factor ranges, estimates by individual building and ORNL division staff move were made, utilizing existing site knowledge and recent performance history to determine which end of the cost ranges to employ. For projects already in detailed design, or for which earlier cost

Table 3.8. Cost factors for FRP budget estimating

Current Operating Costs	
Main ORNL site	15 $/sq ft
Y-12 National Security Complex	12 $/sq ft
Off-site leased space	20 $ /sq ft
Transition costs ("cheap-to-keep")	
Office building	3–20 $/sq ft
Light laboratory	15–22 $/sq ft
Haz/nuclear facility	28–40 $/sq ft
Routine surveillance/maintenance	2–5 $/sq ft
D&D costs	
Office building	12 $/sq ft
Light laboratory	45 $/sq ft
Haz/nuclear facility	225 $/sq ft
Construction costs	
DOE office building	150–250 $/sq ft
DOE light laboratory	200–400 $/sq ft
Lease/operating costs	
State of Tennessee (light lab)	15 $/sq ft
Private sector (light lab)	25 $/sq ft
Staff relocation costs	$4–8K/move

documentation exists, those data were used specifically. Obviously, once detailed planning is available for each of the remaining planned activities, real bottoms-up engineering estimates can be made. No overall contingency factors have been added to the estimates at this point in time; however, contingencies are certainly included in the ranges noted for each cost factor.

3.7.2 Master Plan Schedule

An upper-level schedule has been developed that outlines the major construction activities to be conducted during each phase of the Master Plan implementation. This schedule (Fig. 3.29) provides an identification of the funding type; a project descriptive title; and a construction time line for all new building construction, major existing facility modifications, and primary infrastructure improvements required to support the facilities revitalization mission objectives. As can be seen from this schedule, multiple DOE capital projects are proposed to be underway simultaneously during each phase of the development plan, with the major early projects including completion of the Laboratory for Comparative and Functional Genomics (FY 2003), the 7600 Area Fusion Support Buildings (FY 2003), The Research Support Center (FY 2004), the East Campus Infrastructure Improvements (FY 2005), and the completion of the initial stage of the science laboratory upgrades in the 4500 North/South complex (FY 2005). In parallel to the ORNL improvements underway at that time, the SNS project will be completed (FY 2006) to complement the 21st Century Laboratory capabilities in Oak Ridge. Phase I investments by the private sector and State of Tennessee will also be critical to the new campus development, with all four of the State joint institutes expected to be operational by FY 2006 and the Engineering Technology and Computational Science laboratories to be the first private-sector facilities completed (FY 2002), followed by additional research office facilities/light laboratories to be constructed in the East and West Campus areas as required to support program growth and staff consolidation. By utilizing all three funding sources, it appears that most of the needed new facilities construction can be completed within the FY 2012 planning horizon, to be followed by more standard DOE construction schedules for specific programmatic needs in the years following.

A key to the accomplishment of DOE-SC's modernization vision is the consolidation of research and support staff from existing aging and substandard facilities into new or refurbished facilities. Once the staff and operations are removed from the older buildings, those facilities must be placed in a "cheap-to-keep" mode and put under a routine S&M program appropriate for each building.

Ultimately, those facilities must be decontaminated and decommissioned, either as part of an SC-funded program and/or as part of the EM remediation program. Based on our current understanding of the scope and complexity of this process for each of the buildings identified as surplus to ORNL needs, as well as a reasonable allocation of funds to address this part of the revitalization effort, a preliminary schedule for the staff relocation and facilities safe standby activities for the most critical ORNL facilities has been developed and is presented in Fig. 3.30. Only a few building decommissioning projects (Buildings 1000, 2000/01, and 5000) have been scheduled in the 10-year planning horizon, with the remaining work all to be conducted in FY 2012 and beyond. This schedule will have to be refined as funding profiles, project scope, and method of accomplishment are defined by DOE.

While knowledge of the phasing of construction projects and an understanding of consolidation schedules are important to the implementation of the FRP, the real measure of the success of the revitalization effort will be the identification and completion of the more global goals associated with the program. These goals include upgrading critical scientific facilities (i.e., securing the next teraflop computer, providing vibration-stabilized electron microscope laboratories, housing the ORNL mouse colony in accredited facilities); consolidating staff into more cost-effective quarters (i.e., ORNL at Y-12 staff relocated to the main ORNL site); providing significantly improved quality of work life facilities to keep existing staff and attract the next generation of world-class scientists (i.e., completion of The ORNL Center, reconfiguration of the security perimeter); and dispositioning excess

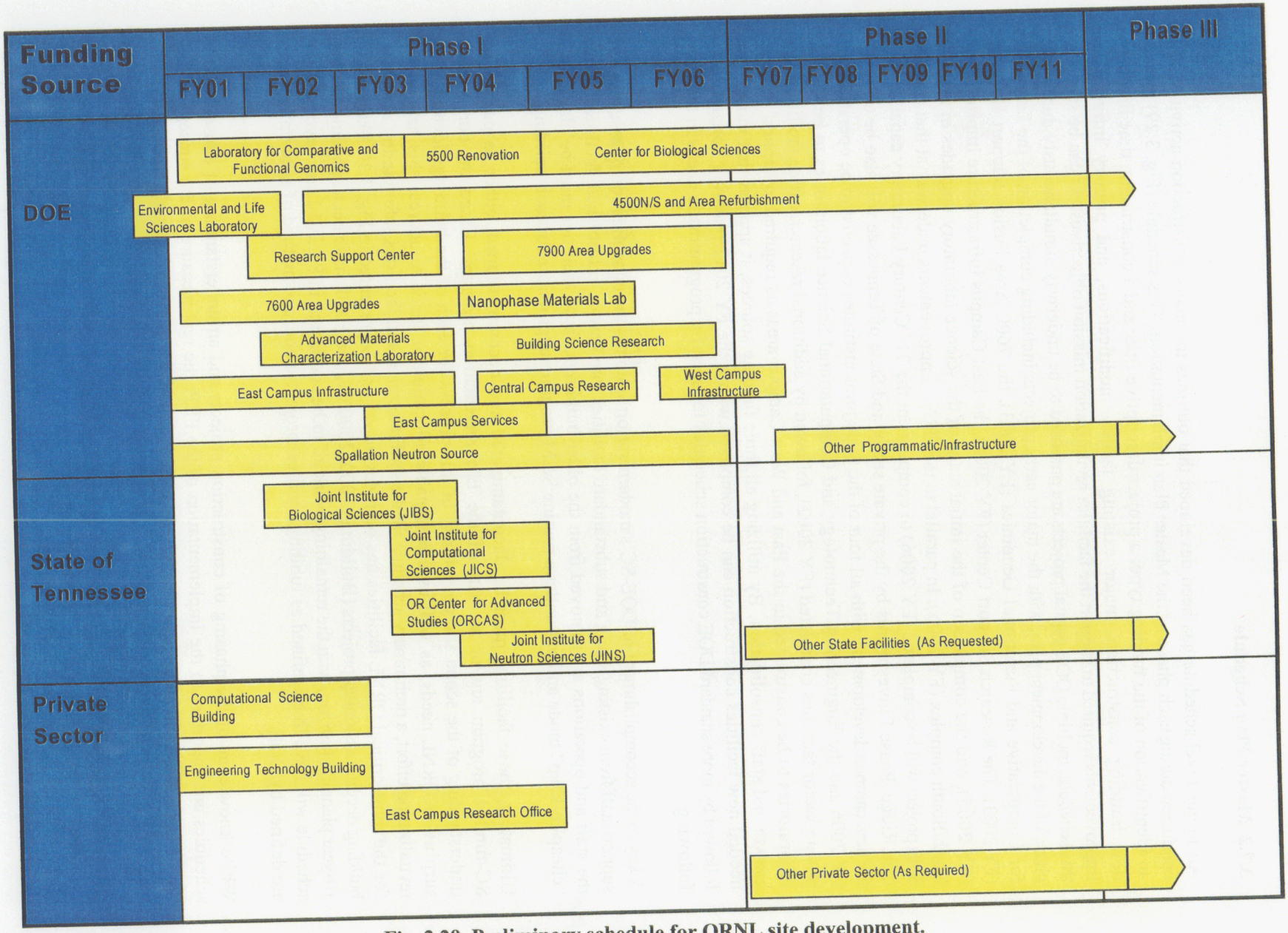


Fig. 3.29. Preliminary schedule for ORNL site development.

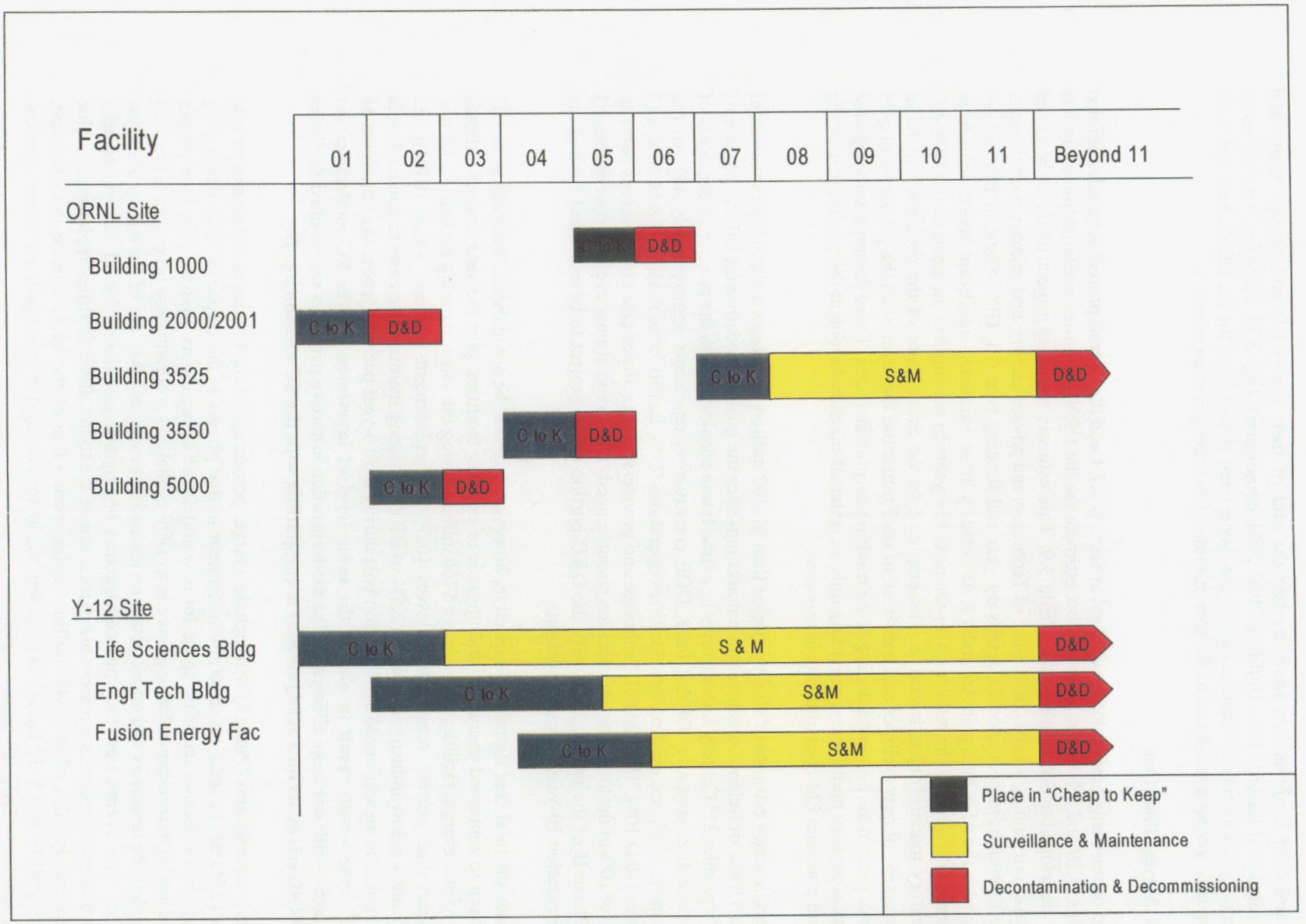


Fig. 3.30. Preliminary consolidation/D&D schedule for selected ORNL surplus facilities.

contaminated facilities that have reached the end of their useful life and remain health and environmental hazards (i.e., Building 2000/2001 demolition). Fig. 3.31 identifies these types of program goals as major milestones along the Phase I and II time lines for the ORNL East and West Campuses, giving a real focus to the true mission of the revitalization effort.

3.7.3 Master Plan Cost

Based on the costing methodology outlined in Section 3.7.1 and the overall project schedules defined in Figs. 3.29 and 3.30, a preliminary cost estimate for the ORNL facilities revitalization effort has been developed and is presented in Table 3.9. This estimate provides project totals by phase of construction; funding source (DOE, State of Tennessee, and private-sector); and primary cost element. More thorough, project-specific details by year and funding type (LI, GPP, State, or private) are included in the ADS listings in Appendix J. As noted by these estimates, significant investments from all funding sources will be required over the next 15+ years to accomplish the goals of the DOE-SC laboratory modernization initiative. The emphasis in the first phases of the program will be in construction of new facilities and transition of staff into those facilities, with the primary outlay in the later years in the decommissioning of the resulting surplus facilities. These decommissioning cost estimates are very preliminary, providing only an order-of-magnitude look at the relative size of the SC and potential EM commitments in this area.

The preliminary estimate of slightly higher than $1,200 million represents a significant investment by the Office of Science organization but accomplishes the goal of modernizing ORNL into one of DOE's premier 21st Century Laboratories in a time frame consistent with the programmatic needs of the research community. Of that total, DOE construction represents approximately 45% of the investment, continued existing/new facilities operations 25%, facility consolidation/S&M 10%, and facilities D&D 10%. The State of Tennessee and private-sector facilities cost contributions come to just over 10% of the total. The revitalization resource needs are spread almost evenly between Phase I and Phase II of the project, with only the D&D portion of the project to be expended beyond the modernization 10-year planning horizon.

To place the total cost figure in perspective, however, it should be noted that a "business as usual" approach to continued operations and upgrade of existing facilities, plus the sunk cost of ultimate D&D of nonstrategic facilities totals almost $700 million during the same planning period. And if one considers that current maintenance levels [0.5% of replacement property value (RPV)] are significantly below industry standards (2.5% of RPV), bringing maintenance costs to needed levels would result in an additional $200 million cost during the 10-year period. **Hence, the "business as usual" case would result in almost the same level of investment as the SC modernization approach—with one huge difference. The modernization initiative provides world-class facilities for ORNL scientists on a schedule that is compatible with the SC mission needs.**

The early investments (Phase I) will include a larger percentage of funds from the State and private sector (25% of the total construction investment in that phase) as the emphasis is on developing quality, cost-effective scientific space for new endeavors as rapidly as possible. The later phases depend less on those external funding sources, as DOE capital and programmatic investments are used to complete the laboratory and infrastructure revitalization as well as take care of the legacy of excess facilities. The overall new facilities construction or upgrade investment by all funding sources ($600 million) represents a reasonable percentage of the total ORNL facilities replacement value (approximately 70% of the $900 million replacement value of the basic science infrastructure, excluding HFIR and Y-12 facilities) reversing the historical trend of inadequate repair/replacement investment in the DOE laboratory complex.

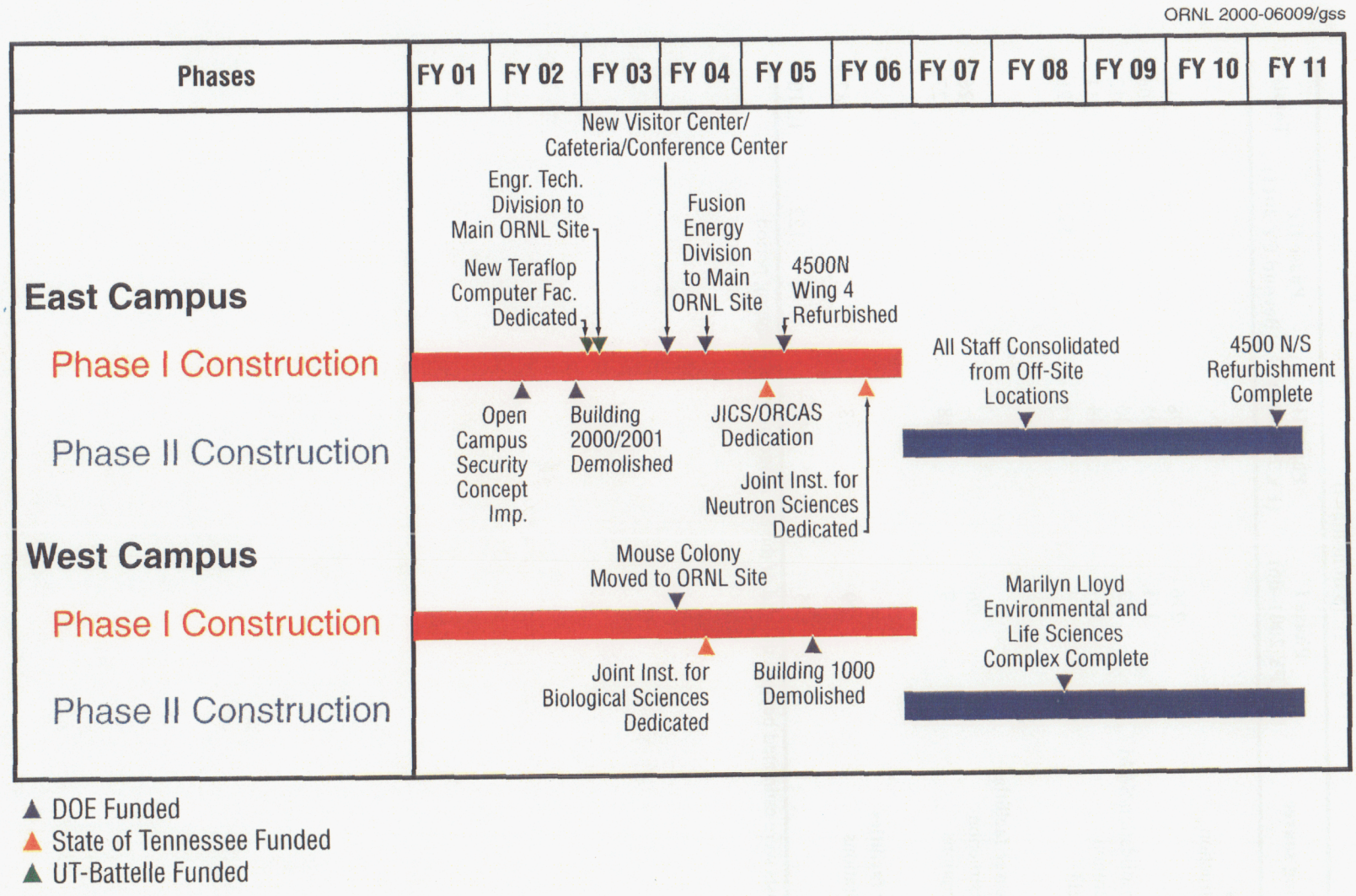


Fig. 3.31. Major milestones on the Facilities Revitalization Project schedule.

Table 3.9. Preliminary cost estimate for ORNL site development ($ in millions)

Funding source	Phase I (FY 2001–06)	Phase II (FY 2007–11)	Phase III[a] (Beyond FY 2011)	Totals
DOE facilities				
Capital construction				
Line Item	216	98	–	314
GPP/GPE	111	95	–	206
Facilities consolidation/S&M	73	40	–	113
Facilities operation	167	144	–	311
Facilities D&D	4	–	122	126
State of Tennessee facilities				
Facilities construction	26	–		26
Facilities operations	9	18		27
Private-sector facilities				
Facilities operations	29	58		87
Totals	635	453	122	1,210

[a]Only D&D costs were estimated beyond the end of the SC modernization planning period.

4. CONCLUSIONS AND RECOMMENDATIONS

As outlined in the preceding chapters, it is clear that revitalization of ORNL facilities is critical to the future mission of the Laboratory and that UT-Battelle has a comprehensive and innovative approach to accomplish that goal. As presented in Fig. 4.1 the facilities consolidation strategy results in a 25% reduction in the operating footprint and cost of research and support facilities and decreases the average age of key ORNL scientific resources by 20 years. A unified, integrated ORNL research campus results from the UT-Battelle revitalization strategy, with all staff relocated to the main ORNL site within the 10-year planning horizon. The Master Plan for the new campus layout incorporates state-of-the-art energy efficiency and sustainability criteria into the new research building designs and focuses on new development in brownfield and previously disturbed areas rather than greenfield sites.

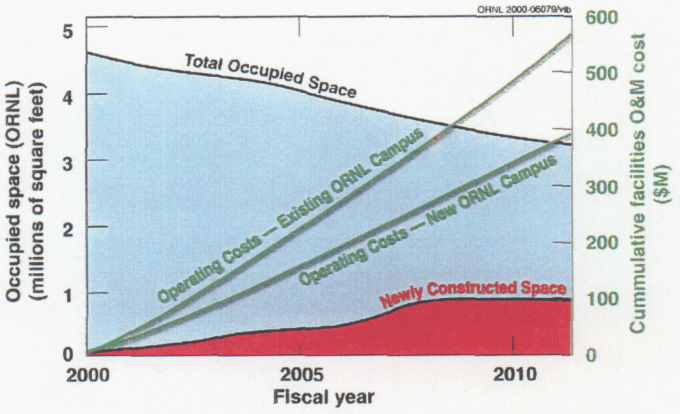


Fig. 4.1. Proposed ORNL campus revitalization significantly reduces Laboratory footprint and resulting operating costs.

Completing the 21st Century Laboratory vision for ORNL will require significant investment of resources, both operating and capital funds. UT-Battelle's recommended approach of utilizing DOE, State of Tennessee, and private-sector funds to accomplish the new campus development is the most cost-effective option for accelerated improvements at the site. Preliminary analysis of DOE cost savings (operating and cost of capital) from early use of private-sector funds for construction of research facilities shows over $50 million in cost avoidance over a 15-year period compared to the standard dependence upon DOE funding alone. Similarly, the State of Tennessee contribution of some $26 million in support for establishing joint institutes is expected to substantially increase collaborative research with the university community.

This *ORNL Strategic Facilities Plan* fully meets the objectives of the DOE Office of Science Laboratories of the 21st Century modernization initiative, resulting in a workable plan for revitalizing the world-class ORNL research institution. However, implementing this plan will require a concerted effort from the DOE-SC, State of Tennessee, and UT-Battelle team in a number of areas:

DOE Must:

1. Institute a policy framework that permits private-sector investments.
2. Support modernization initiative with new administration and congress.
3. Accelerate transfers of surplus facilities to DOE-EM.
4. Increase flexibility on use of overhead funds for infrastructure needs.

UT-Battelle Must:

1. Provide guarantees for private-sector investments.
2. Improve operational efficiencies and reduce overhead burdens.
3. Define and cost-effectively implement the FRP tasks.

State of Tennessee Must:
1. Appropriate and build Joint Institutes on the ORNL campus.
2. Establish MOUs with UT-Battelle and DOE on building operations and long-term ownership.

All of these actions are critical to the success of the revitalization effort, and all must be addressed early in FY 2001 to achieve the modernization objectives.

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APPENDIX A

ORNL Stakeholder Responses

The University of Georgia

Savannah River Ecology Laboratory

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FTS 239-2472
FAX 803-725-3309

Drawer E
Aiken, SC 29802

November 29, 2000

Ms. Patty Cox
Oak Ridge National Laboratory
Bethel Valley Rd.
Bldg. 1505, Room 305A
Oak Ridge, TN 37831-6038

Dear Ms. Cox:

I am writing to provide you with my thoughts concerning the issue of future land use at the Oak Ridge National Laboratory (ORNL). I have been prompted to submit these thoughts by a call for comments concerning the 2000 Draft Land and Facilities Plan for the ORNL and the Oak Ridge National Environmental Research Park (NERP). I make these comments as a person who was closely associated with the initial development of the NERP concept, while I worked at the DOE Headquarters (then called the Atomic Energy Commission) in the early 1970's. As the Population Ecologist for the AEC's Division of Biomedical and Environmental Research, I worked closely with Dr. Eugene P. Odum at the University of Georgia, to establish what eventually became the founding principles of the NERP Charter for the DOE, resulting in the establishment of the Savannah River Site as the nation's first designated NERP. I was subsequently given the task of serving as the liaison communicating between AEC/DOE Headquarters and management personnel at the Idaho National Engineering Laboratory, Los Alamos National Laboratory, and Hanford as these DOE sites developed plans to also become the locations of DOE NERP programs. I was also subsequently involved in Congressional hearings on federal land use for environmental research, where I presented comments concerning the DOE NERP Program. Since I returned from Headquarters to my present position here as a Senior Ecologist on the staff of the Savannah River Ecology Laboratory, I have been appointed to serve as the NERP Program Coordinator for the Savannah River Site (SRS).

Over these past thirty years, I have been particularly interested in watching the development of the NERP Program at Oak Ridge. It is therefore of great personal interest to me that the NERP program development at Oak Ridge seems to have come to a critical juncture. Of particular concern to me is that some of the basic principles of the DOE NERP program, as it was initially conceived at the various sites across the country in the 1970's, may now be unfamiliar to those charged with operating environmental programs and planning future land use at these sites. As was the case in the early 1970's, a misunderstanding of the basic NERP concept may often cause

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DOE program managers to be reluctant to make what they feel may be irreversible decisions to "lock-up" parcels of DOE land, thereby precluding them from future uses related to other agency missions in the future. While the NERP concept indeed includes the idea of setting-aside some reference parcels of the diverse habitat types found at each DOE site, what is often misunderstood by site management is that a NERP site must encompass the boundaries of the entire site land-holdings, not just smaller parcels of set-aside land. This means that developed facilities such as nuclear waste storage areas, nuclear fuels reprocessing areas, and locations for future planned activities such as the Spallation Neutron Source *not only can but must be included as integral parts of any site NERP program.* As explained in the material which will be enclosed with the mailed version of this letter, a NERP *must* have such facilities and developed industrial components within its boundaries. Otherwise, a DOE NERP would not be essentially different from lands in the National Park system, within the boundaries of which there are no such developed/industrial complexes. Because a NERP is designed to be a place to study the *interaction between* developed/industrial facilities and the environment, segments of both of these entities must exist within any NERP site's park boundaries.

Once the above concepts have been understood, it becomes obvious why the establishment of a NERP within the entire boundaries of the current Oak Ridge reservation would not only be good for future environmental research, but would also be good for future program/mission development in other areas relating to the DOE energy mission. At the same time, and for the same reasons, such a NERP Program would also be beneficial to local economic development interests since those developed/industrial facilities within the NERP lands, would be free to continue to provide important jobs and other economic benefits to the local region, while still serving as an important part of environmental research, education and demonstration/outreach at the site. These concepts have now, I am pleased to report, been well-accepted by DOE management as well as by local community and civic leaders here and around the Savannah River Site.

In order for an integrated NERP program to function adequately in the way it was initially conceived, there must be an assurance of long-term security and dedication of the lands contained therein to these NERP program goals. It has been generally agreed upon here at the Savannah River Site that this can best be accomplished through federal legislative designation of the entire SRS site as a National Environmental Research Park. We have been working towards these ends for several years now and are developing wording for legislation which we hope could be introduced into Congress next year. I would strongly urge any planning process at Oak Ridge to consider developing a similar congressional designation for a National Environmental Research Park.

In the process of demonstrating to legislators that the NERP concept has broad acceptance and support from the general public (i.e. the "man on the street"), we here have been fortunate in

obtaining an official endorsement for the legislative designation of the SRS as a National Environmental Research Park by a governing body of a major church organization. As indicated in the enclosed materials, this endorsement was made by the Trinity Presbytery of the Presbyterian Church (USA) in October 1999, and a copy of that resolution of endorsement is enclosed. I believe that you could find strong sentiment and support from similar religious organizations in Tennessee.

The Oak Ridge Reservation, along with the Savannah River Site and other similar DOE land holdings, constitute what is probably the single-most valuable land resource currently available to our nation and society in general to answer large-scale environmental questions which, to quote the findings of a blue-ribbon panel which evaluated the Savannah River Site, "if not answered at [such NERP sites] will probably never be answered"! All of these points are further documented in the enclosed information. I hope that this material will be useful to you and other members of the Oak Ridge management and local community leaders and scientists who may be involved in the development of the 2000 Draft Land and Facilities Plan.

Please let me know if I can provide you with any further information on any of these matters. I would be pleased to come and visit your site to pursue discussions along these lines with any of your staff who might be interested. In fact, this might be an appropriate time to convene a meeting of individual representatives of all of the current DOE NERP sites which would have common interests in these issues.

Yours very truly,

I. Lehr Brisbin, Jr.

I. Lehr Brisbin, Jr.
Senior Ecologist and Site NERP Program Coordinator
Savannah River Ecology Laboratory

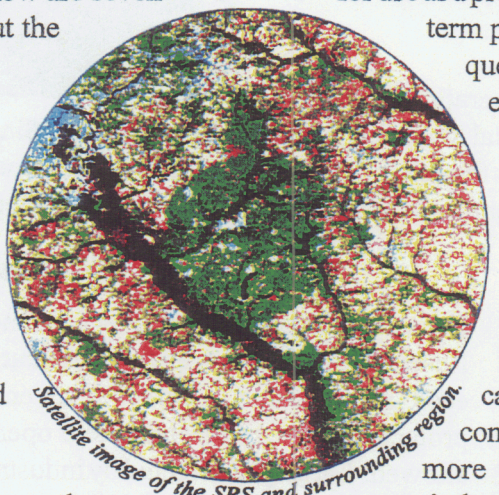
ILB/br/jg

the Savannah River Site National Environmental Research Park

It's not a National Park ...
the emphasis here is on research.

The Savannah River Site was designated as the first National Environmental Research Park (NERP) by the Atomic Energy Commission in 1972. NERPs were established to provide tracts of land where the effects of human impacts on the environment could be studied. There now are seven NERPs at DOE reservations throughout the United States.

NERPs are unique outdoor laboratories where ecologists, engineers and land managers work together to improve our understanding of how human activities affect the environment. These areas also serve as islands of habitat where native species thrive and endangered, threatened, and sensitive plants and animals are protected.



Satellite image of the SRS and surrounding region.

The existence of ongoing human activities such as energy production, industrial, and cleanup operations provide unique opportunities for study. However, portions of each NERP are protected from the effects of human activities as much as possible. NERPs are an important national legacy. Their continued existence will enable us to provide sites where new technologies can be developed that will help counteract the impacts of human activities both on the SRS and in other industrial areas throughout the United States and the world.

History of the NERP

In 1970 the Office of Science and Technology delivered to President Nixon ten recommendations concerning federal lands. The tenth recommendation instructed Federal agencies to accelerate their efforts to set aside locations for ecological research and wildlife preservation.

As a result of this recommendation, the Savannah River Site became the first National Environmental Research Park, or NERP. This opened the site to scientists from other government agencies, universities and private foundations for use as a protected outdoor laboratory where long-term projects could be conducted to address questions about human impacts on the environment.

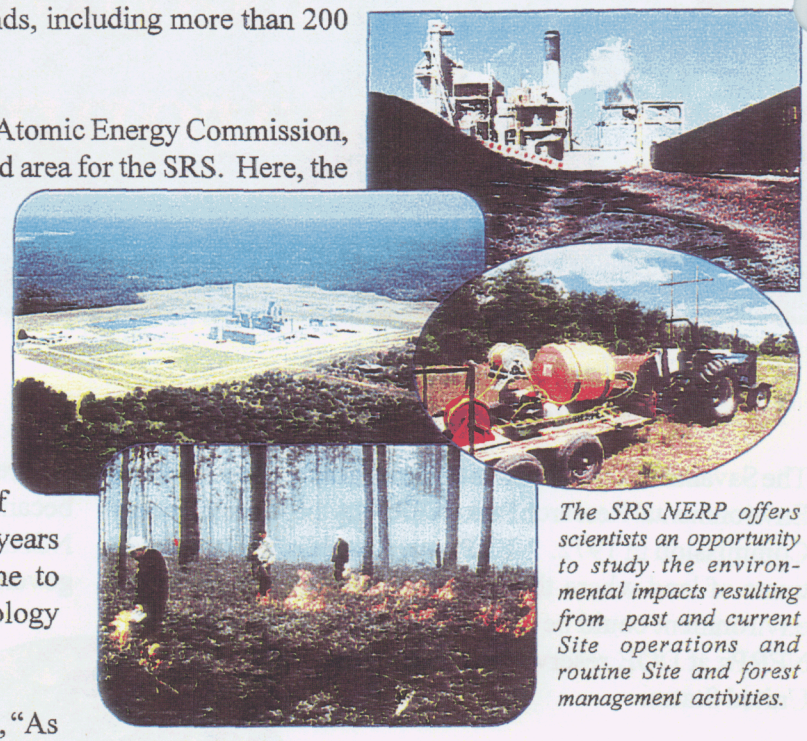
The value of the SRS NERP clearly is demonstrated in the more than 2,000 published scientific findings based on work done on-site. Resident scientists have produced a series of over 20 NERP technical reports describing and cataloging the plants, animals, ecological communities, and habitats of the SRS. Also, more than 200 doctoral dissertations and master's theses have proven the value of this national treasure in educating environmental scientists and in providing us with a broader understanding of how to minimize adverse impacts of human activities on the environment.

Ecological research at Lost Lake on the SRS.

The Savannah River Site NERP

Along the western border of the state of South Carolina lies the Savannah River Site, a Department of Energy nuclear production facility. Spanning more than 300 square miles, the SRS plays a key role in the nation's defense mission by housing nuclear materials and waste processing facilities, as well as research laboratories. Roughly 85% of the site is forested and over 20% of the site is valuable wetlands, including more than 200 Carolina bays.

At the height of the Cold War in the early 1950s, the Atomic Energy Commission, now the Department of Energy, acquired the vast land area for the SRS. Here, the government built reactors to produce nuclear materials for weapons, and the site served a critical role in maintaining America's military defense during the years that followed. Today, the site still serves important functions in national defense, waste processing, environmental remediation and ecological research. Unlike a national park, the SRS NERP serves as an outdoor laboratory for environmental research on energy technologies and the effects of human activities on the natural environment. In the years since the park was first named, the SRS has come to demonstrate the compatibility of nature, human technology and environmental research.



The SRS NERP offers scientists an opportunity to study the environmental impacts resulting from past and current Site operations and routine Site and forest management activities.

Greg Rudy, Manager of the DOE-SR Operations says, "As the country's first National Environmental Research Park, the Savannah River Site advanced the science of ecology while fulfilling its major defense missions. This foundation is essential as the Site continues its national defense and environmental work and prepares to take on new nuclear missions in support of our Nation's international nonproliferation efforts in the post Cold-War era."

Set-Aside Areas

The Mixed Swamp Forest Set-Aside Area.

Especially valuable components of the Savannah River NERP are the DOE Research Set-Aside Areas, representative habitats that DOE has preserved for ecological research. These 30 areas, encompassing more than 14,000 acres, are protected from most routine site operations, and active management is not allowed. Largely unaffected by industrial activities, the Set-Aside Areas serve as natural reference areas or "controls" for environmental research and monitoring efforts. Set-Asides provide baseline areas for comparing the effects of human activities and valuable information on how contaminated areas should look and function after they have been cleaned up.

NERP Objectives

- **Assess and predict impacts of human activities on natural ecosystems.**
- **Manage for sustainable natural resources (timber, wildlife, soil, water, and air).**
- **Develop environmental restoration and cleanup methods and standards.**

For further information on the SRS NERP, please contact Dr. Michael H. Smith; SREL; (803) 725-2959; Smith@SREL.edu

[11 Sept. 1998]

The University of Georgia
Savannah River Ecology Laboratory

SOUTHERN APPALACHIAN MAN AND THE BIOSPHERE
SAMAB

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U.S. Geological Survey, Biological Resources Division

Department of Energy's Oak Ridge National Laboratory

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Oak Ridge National Environmental Research Park

Coweeta Hydrologic Laboratory

Grandfather Mountain, Inc.

Mt. Mitchell State Park, NC

nnessee River Gorge Trust, Inc.

http://sunsite.utk.edu/samab
email: samab@utk.edu

December 1, 2000

Ms. Patricia Parr
Oak Ridge National Laboratory
PO Box 2008
Oak Ridge, TN 37831-6038

Dear Pat,

Thank you for the opportunity to comment on the 2000 Draft ORNL Land and Facilities Plan. The public land and facilities whose future is considered here are indeed national and international assets. Though I am not exactly sure from this document what a "tailored stakeholder involvement plan" means, I think it is good that DOE and ORNL are moving in the direction of something by that name.

In the limited time that I've had to review this, I am not sure that I have developed a full appreciation for the mass of material that is here. However, some specific comments lead to some more-general concerns that I have, as follows:

Section 1.2 "A Shift to Public Ownership" seems mis-titled. Should this not read *A Shift Back to Community and Private Ownership*? The land considered here was put into Federal public ownership in the '40s as a contiguous reserve of landscape units that results in many of its unique values today. A key concern for the future of this land is the piecemeal shift back to multiple parcels with diverse and conflicting management objectives and practices. This section has some wonderful statistics that, with some additional text, could point out this crucial facet of the planning issue that needs to be addressed, and the critical need to be viewing any individual planning efforts in the context of a comprehensive view and planning effort for the reservation.

Of special concern seems to be the future of the "self-sufficiency land requests from the City of Oak Ridge." A number of these are within the "ORNL geographic area of responsibility" and of course future use of any/all of them potentially affect the value of the reservation for many of its key future uses. These areas are merely referenced at the end of Section 1.2 and receive only minimal treatment in Appendix B. I think the issue of deciding their future needs to be elevated to greater prominence in this plan.

In Section 2.1 I am confused by the apparent contradiction between the statement that the DOE intent is "...to manage the reservation as a single parcel" and the de facto situation in which planning for and management of the reservation is occurring under multiple contracts, agreements, and assessments without benefit of a clear, comprehensive, stakeholder-based master plan and planning process for the whole reservation. I realize that the ORNL plan alone cannot remedy this situation, but here at the beginning of Section 2 would be a good place to describe this situation and perhaps propose a direction toward, or the need for, a solution.

Section 2.3 on land use decision making and planning is a crucial section that is evolving in the right direction. A fundamental planning element missing from Section 2.3.1 Guidelines for Land Use Planning is to *consider the regional context*. (This is different from ensuring compatibility with surrounding landscape.) One of the major points you make in this plan is how the reservation has values and opportunities that are rare or not available anywhere else in the region. Planning and decision making regarding future actions on the reservation must be made with consideration of this regional (and indeed national and international) context.

Another fundamental element missing from Section 2.3 is stakeholder participation, input, or review in the planning and decision-making process. Instead, this is relegated to Section 2.7, which describes mostly a process (Common Ground) that occurred in the past. Sections 2.7.3.2 and 2.7.4 recognize that "Planning land uses is an opportunistic and dynamic process" and state that additional stakeholder input will be solicited, evaluated, and incorporated in update documents. I strongly urge that this process of stakeholder participation be beefed up to include active participation and review and incorporated as an integral part of the planning and decision-making process and that it be described in Section 2.3.

In Section 2.4.5, fourth bullet, you could delete "unit" and state that this is a "core protected area within the regional zone of cooperation of the Southern Appalachian Biosphere Reserve."

In Section 2.4.5.8, the world network now comprises 368 biosphere reserves. You might mention in this section that SAMAB is one of the most active of 47 biosphere reserves in the US, and is held up as a model internationally for fulfillment of the three functions that you describe.

Sections 2.5.1-7 do a nice job of describing the research, monitoring, and several other uses of the reservation, but Section 2.5.8 seems very thin considering how important public education, outreach, and recreation are (or did

I miss a whole section somewhere on educational/outreach uses?). I'm sure there are more statistics on educational/student use, interpretive walks, and such uses than are reflected here – this should be beefed up and presented as a basis for much more of such activity in the future-uses Section 2.6.2.7, which also is very thin. These uses, ranging from environmental education of many types for many ages, to ecotourism, could be very important to the image, economy, and environment of the area.

I hope these comments are useful. I would be happy to elaborate on any of them if I have not been clear, especially if it can be part of an expanding "tailored stakeholder involvement process" or other process of stakeholder participation.

Sincerely,

Robert S. Turner
SAMAB Executive Director

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION

November 29, 2000

Mrs. Patty Cox
Department of Energy
Oak Ridge National Laboratory
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Oak Ridge, Tennessee 37831

Dear Mrs. Cox:

Thank you for the opportunity to provide comments on the 2000 Draft Land and Facilities Plan for the Department of Energy's Oak Ridge Reservation. We have reviewed the Draft and find it to be thorough and very well presented. We now offer the following general comments, and look forward to reviewing and commenting on the revised plan. We certainly recognize the significance of the 35,000-acre Reservation to DOE's mission activities, and we expect that those activities, current and future, will take precedence in this planning process.

The Oak Ridge Reservation represents one of the largest intact and contiguous forests remaining in the Ridge and Valley physiographic province, a region that has been largely converted to non-forested uses. Today, only about 43% of the province is forested, while nearly 50% has been converted to pasture and crop land. This statistic alone underscores the significance of protecting the Reservation's vast forestlands from conversion to other uses, particularly the 25,000 acres of relatively undisturbed forest referred to as "buffer". The Reservation represents a significant reservoir of biological diversity, providing habitat for native and rare species of plants and animals that is scarce elsewhere in the Ridge and Valley. This large, contiguous forested area also plays an important role in carbon cycling, thereby contributing positively to air quality, and to human and ecosystem health. We strongly encourage DOE to continue to protect these vast and irreplaceable forestlands, intact.

We certainly recognize the biological significance of the Reservation, particularly the 25,000 acres that have been relatively undisturbed since 1942. The Reservation's biological significance has been amply documented, and that documentation is well referenced throughout the Draft. As noted in the Oak Ridge Reservation Research Focus on page C-3, ongoing biological research is critical to gaining a full understanding of the many complex biological processes that are supported on the Reservation. We strongly encourage DOE to continue this research and to use adaptive resource management approaches to ensure the long-term sustainability and viability of the reservation's native and rare species, their habitats, rare and high quality natural communities, and the biological processes that sustain them.

We sincerely appreciate the ongoing cooperation between DOE and our Department toward the protection of several ecologically significant areas on the reservation. A formal agreement, entered into between the Department of Environment and Conservation and DOE in December 1985, established 7 such areas on the Reservation as Registered State Natural Areas. Through ongoing cooperative research, we have

identified new areas to propose for such recognition and are redefining the boundaries of others. We are preparing a new Natural Areas Registry Agreement reflecting these proposed changes and look forward to presenting it to DOE in the near future. DOE is to be commended for its commitment to the protection and stewardship of these and other sensitive areas on the Reservation. However, we believe that to ensure the long-term conservation of these areas, such protection should be binding and perpetual through means such as conservation easements and formal Designation as State Natural Areas. Therefore, we ask that the plan reference intent to provide for binding and perpetual protection of natural areas on the Reservation. We would be happy to cooperate with DOE on delineating and protecting such areas.

We also recognize the ongoing interests of city and county leaders, as well as private developers, in continued releases of Reservation lands for development. Such development can contribute positively to economic growth and quality of life; however, it should not come at the cost of irreplaceable public lands. It is referenced in the Draft that of the 58,575 acres that comprised that original Reservation, 24,151 acres have already been disposed of. We oppose the continued divestiture of public lands for private or public development. Such development should take place on land acquired from non-public owners, not on lands held in the public trust by DOE. There are certainly adequate private land holdings in the Oak Ridge area to sustain the region's desired growth and development. This approach provides adequate opportunities for sound economic growth while at the same time protecting the integrity of an important and irreplaceable natural resource. It is well documented that such "green spaces" around and near communities contributes significantly to the quality of life of its citizens.

In summary, DOE has been entrusted with an invaluable and irreplaceable public resource whose biological significance has been well documented. We believe that DOE has a responsibility to the people of Tennessee, and of the United States, to protect that resource from development that is not critical to DOE's mission activities. Further, we believe that DOE should provide for binding and perpetual protection of intact forestlands and ecologically sensitive habitats within the Reservation. Such actions will serve to protect these unique natural resources from development, and will leave a lasting legacy of environmental stewardship for generations yet to come. This action will provide a safe refuge for plant and animal species that are faced with ever dwindling habitat, while at the same time providing opportunities for research, passive outdoor recreation, and environmental education. These opportunities are proven to contribute significantly to quality of life and will serve as an important balance to what will surely be an acceleration of economic development in the Oak Ridge area.

Thank you again for the opportunity to comment. Should you have any questions regarding these comments, please contact me at 615-532-0431.

Sincerely,

Reginald G. Reeves
Director

c: Brian Bowen, DNH
Patricia Parr, DOE-ORNL

DateThu, 30 Nov 2000 051046 -0500
FromPatrice Cole <pcole2@utk.edu>
Subjectcomments on draft ORNL Land and Facilities Plan
Tocoxpe1@ornl.gov
CcJAMES.P.GROTON.JR@saic.com, pcole2@utk.edu

Ms. Cox

On behalf of Tennessee Citizens for Wilderness Planning, I offer the following comments on the draft ORNL Land and Facilities Plan.

We applaude the significant increase in emphasis on the conservation and research values of the lands in question. The Oak Ridge Environmental Research Park, which includes much of the land that is the subject of this plan, provides unique and irreplaceable opportunities for ecological research. These areas are already used by many students and faculty of the University of Tennessee, as well as being critical to many of the researchers at ORNL. Collaborations between UT and ORNL researchers on field projects conducted on the ORR strengthen both institutions and create a synergy that enhances the economic development of this region.

Similarly, the conservation significance of these lands cannot be over estimated. The fact that so much of the land area served as a buffer to the federal facilities for decades has allowed it to become ecologically significant. Evidence of this is provided by The Nature Conservancy's ranking of Biologically Significant Areas on the Oak Ridge Reservation. We believe that DOE has a critical stewardship role in the protection of these lands that have a rare combination of ecologically sensitive areas with meaningful research sites.

We also concur with the Guidelines set forth in sections 2.3.1, including the emphasis on clustering like uses, preserving clean areas, reusing disturbed areas, protecting natural and cultural resources, considering future generations, optimizing appropriate recreational use, and considering stakeholder input. We strongly agree with Land Use Priorities set forth in 2.3.2, especially #2 ("Preserve and protect land to meet the requirements of environmental research by ensuring that adequate areas within the ORR are protected and preserved for their biological and physical diversity.") and #3 ("Preserve and protect land to meet the requirements of scientific and technical education by ensuring that suitable land is available for facilities and research areas needed to support educational opportunities on the ORR.").

We have one concernIt remains unclear how stakeholder input will be included "up front" in the initial decision-making process. There is no mention of how, or whether, stakeholder input will be incorporated into the decisions of the Land and Facilities Use Committee. We would like to see more details regarding mechanisms and consequences of stakeholder input in the final document.

Thank you for the opportunity to comment on this important land use plan.

Patrice Cole
Tennessee Citizens for Wilderness Planning

Review of Draft ORNL Land and Facilities Plan – Roger C Dahlman, Program Manager SC/OBER, 12/6/2000

The draft Plan is comprehensive and compelling, and effectively supports DOE's future missions and visions for excellent and innovative scientific research. Details of the Plan are logically linked to the broad institutional goal of assuring ORNL's status as a world-class Laboratory for multidisciplinary research. The Plan expresses a sense of a research-first priority in use of land and facility resources, which is quite appropriate, and this concept will continue to serve DOE and the Nation's science goals.

Clearly, the Plan is forward-looking both in terms of justifying existing resource use (i.e., land and facility) for current programs, and in the reasonable anticipation of future resource needs. This is especially important with respect to environmental research because intrinsically, these needs will require the unique land, water and atmospheric resources and the scientific infrastructure afforded by ORNL and the Oak Ridge Reservation. These Oak Ridge resources are unique on a nation-wide basis. The Plan recognizes broad requirements for the research enterprise, and responsibly provides appropriate and compelling justification for wisely using the Oak Ridge resources for environmental research purposes. The strategic importance of having the kind of resources described in the Plan available as an "outdoor laboratory" cannot be over emphasized.

DOE's Office of Biological and Environmental Research has a vital stakeholder interest in the ORNL Land and Facilities Plan because implementation of its programs at ORNL critically depend on present and future availability of first-class facilities, including those qualities that create "outdoor laboratories" for environmental research. The Plan correctly provides for long-term integrity of environmental resources needed to support current and prospective research activities.

There appear to be omissions with respect to environmental research facilities in the list of "user facilities" (item 3.3.1.3). Existing facilities such as Walker Branch Watershed, the Free-Air-CO2-Enrichment (FACE) facility, CO2 Flux Measurements as a component of AmeriFlux Network among others should be included in the list.

DateFri, 01 Dec 2000 142124 -0600 (CST)
Fromcbullington@tnc.org
SubjectComments on Draft ORNL Land and Facilities Plan
Tocoxpe1@ornl.gov
Ccsdavis@tnc.org, jholmes@tnc.org
Reply-tocbullington@tnc.org

Ms. Cox,

I would like to provide a few brief comments on the November draft of the land and facilities plan for ORNL on behalf of The Nature Conservancy of Tennessee. We have thoroughly reviewed the draft copy that was provided to our office. In general, we believe that this is a very well-organized document that contains a wealth of information. There has obviously been a lot of input and information gathering for the various components of the plan. Likewise, we were very pleased to see the map (Figure 2.7) from the Conservancy's Common Ground project of several years ago that involved the delineation of significant landscape biodiversity areas on the Oak Ridge Reservation.

We realize that the ORNL plan must obviously coordinate many complex multiple-use issues. However, it is the hope of The Nature Conservancy that the map of the high biodiversity areas from the Common Ground project will be given primary consideration when making land use decisions at ORNL. In particular, it is our hope that a final land management plan will eventually evolve for the entirety of the Oak Ridge Reservation that addresses more permanent protection measures for areas designated as significant wildlife habitat. We believe that ORNL has made a great effort to identify and protect the valuable natural resources of the reservation. However, it seems that this draft version of the land and facilities plan is somewhat unspecific as to long-term protection of critical habitats. As an example, it was noticed in Appendix B that there are many self-sufficiency parcels for the city of Oak Ridge that are still unresolved from a land use perspective. Many of these parcels overlap with the most important biodiversity areas that were identified from the Common Ground project (i.e. In Figure B.1 parcels 1, 2, D, 10, 11, 14, 15 and others). It is our hope that these parcels will be set aside as part of a permanent conservation area on the Oak Ridge Reservation. In particular, we believe the land adjoining the Clinch River to be particularly important.

We hope that these comments are useful to you and will be given more consideration. Likewise, I thank you for the opportunity to provide comments on this plan. The Nature Conservancy has enjoyed the privilege of working with ORNL and hopes to continue as a partner in the future. Please feel free to contact me for clarification on these comments if needed.

Sincerely,
Chris

Chris Bullington, Director of Conservation Planning
The Nature Conservancy of Tennessee
2021 21st Avenue South, Suite C-400; Nashville, TN 37212
phone(615) 383-9909; fax (615) 383-9717

DateThu, 30 Nov 2000 164011 -0500
From"Thomas, Tom" <ThomasT@orau.gov
SubjectCORRECTIONORNL Land and Facilities Plan
To'"pcx@ornl.gov"' <coxpe1@ornl.gov
Cc"Cox, Rac" <CoxR@orau.gov, 'Pat Parr' <parrpd@ornl.gov

OPP 00-23

Patty Cox,

Thank you for the opportunity to review the draft plan. My immediate and lasting impression is the high value it places on the ecological significance of the Reservation. I hope the authors of all subsequent plans concerning the Reservation benefit from these pages.

Several comments and suggestions about the plan's coverage of ORAU and ORISE

Section 2.6.2.9 states that the Scarboro Operations Site consists of 247 acres, but the legend for Figure 1.1 states that ORAU is responsible for 247 acres, including ORISE sites in downtown Oak Ridge.

This discrepancy easily can be corrected, while at the same time clarifying the ORAU-ORISE relationship

(1) Change the parenthetical after ORAU in the Figure 1.1 legend to "(approximately 258 acres)."

(2) Rewrite section 2.6.2.9 as follows

*****
The Oak Ridge Institute for Science and Education (ORISE), which is managed for DOE by Oak Ridge Associated Universities (ORAU), includes the 247-acre Scarboro Operations Site on the ORR. ORAU also manages several ORISE sites in downtown Oak Ridge, as shown in Figure 1.1. DOE recently granted an easement to the Tennessee Department of Transportation for highway construction on the 24 acres east of Scarboro Creek, and it has proposed to transfer about 20 acres immediately west of the creek to the City of Oak Ridge. The remaining 203 acres and structures located on them will be adequate for ORISE's current operations in support of the DOE mission. Because no ORISE town site includes developable land, the Scarboro site is the only land now available to accommodate future growth.

*****

Please call if you have questions or need further information.

Tom Thomas
576-9561

December 7, 2000

Memo to: Patty Cox, ORNL/ESD, **pcx@ornl.gov**

From: Dr. R. P. Hosker, Jr., Director, Atmospheric Turbulence and Diffusion Division

Subject: Comments on draft version of ORNL Land and Facilities Plan (November 2000)

I spent several hours reading the subject document, and found it to be quite clear and well-written. My compliments to the authors; this was clearly a big job, and they did it well. Naturally I spent most of my time looking at matters that concern my laboratory (NOAA/ATDD) and our atmospheric studies on the Oak Ridge Reservation. I have a few comments and/or questions. I was using a copy of the printed draft report (ORNL/TM-2000/237), and will use the page and figure numbers from it.

(1) I had trouble understanding the colors on Figure 2.1 (p.2-5); what does the pink color signify? Is there an item missing from the Legend?

(2) At the top of p.2-21, which discusses on-going research at Walker Branch Watershed (WBW), there is no mention of the long-term nature of the atmospheric monitoring that has been operating at WBW since about 1985. NOAA/ATDD has probably the longest record of air pollutant dry deposition measurements in the world at WBW; the data are archived both by us and by the Canadians as part of a North American dry deposition data base. Also, NOAA/ATDD has been measuring solar radiation in various wavebands at WBW for a similar period, and our solar station has been part of the Integrated Surface Irradiance Study (ISIS), NOAA's national solar radiation observing network, since the mid-1990s. Data from all ISIS sites are archived both nationally and internationally (through the World Meteorological Organization, WMO). Perhaps a sentence or two could be added to the paragraph on 2-21, to point these things out.

(3) On p.2-25, one of the "NOAA Partnership" areas (9th bullet from the top) is shown as Area 21. This appears to be the old pine plantation at the 0800 area, where we used to have a tower. A number of ATDD and ESD studies were performed there, beginning about 1970. However, the pine plantation has been hard hit by pine bark beetles and other problems in recent years, and we removed the tower a year or two ago, because of safety concerns about dead trees falling on the tower and guy wires. We no longer have any facilities at the pine plantation, so I think you can remove Area 21 from any NOAA involvement. This might change in the future if ORNL were to replant the area with deciduous tree species; it would be quite interesting to study the carbon exchange of a young forest, and we would probably try to obtain funding to do so. But this research is at best a slight possibility, since it depends very much on ORNL use of the site.
Be sure to keep Area 14 in the listing; that will be the site of our replicate tower ("Tower #2").

(4) The same comment as in (3) applies on p.2-26, in the bullets near the bottom of the page. The 5th bullet refers to NOAA and Area 21. I think you can remove Area 21 (Area 14 is still of great interest; it should stay).

(5) The same comment applies on p.2-29. Remove the "NOAA Partnership" line from the topics under Area 21.

(6) Section 2.5.3.2 on p.2-33 discusses Air Monitoring; the second paragraph in this section describes the seven towers operated by ORNL, Y-12, and ETTP. If the report is intended to discuss only DOE assets, then this section is OK as written. However, NOAA/ATDD also operates 16 meteorological towers for collection of routine observations throughout eastern Tennessee, including one at WBW and one at the Oak Ridge water treatment plant, and several within the city of Oak Ridge. We also record local climatological data for the Oak Ridge area (with records going back to at least 1950), and were in fact the "official" site for the National Weather Service observations until the installation of the NW Oak Ridge ASOS site on Laboratory Road near the Federal Building, about two years ago. I don't know if you want/need to mention any of these things; my main point is that there are many more sources of meteorological data for the area than are mentioned in the draft section, and many of the staff at ORNL, Y-12, and ETTP routinely use NOAA/ATDD data in addition to that from the seven ORR towers.

(7) Section 2.5.3.2 also says that data are collected at 16 levels above ground to determine the vertical structure of the atmosphere. I think this must be a misunderstanding of some kind. The seven ORR towers all measure data at either two or three levels above ground, depending on the particular tower. ETPP used to operate a sodar (a kind of sound-based radar) to measure wind speed and direction above the ground, and this device can provide data at multiple levels above ground; I don't know the current status of this instrument, but I don't think it is in use. NOAA/ATDD intermittently operates a research sodar at WBW. But there is no mention of sodars in the text, and I'm not sure there should be, since they are not operated continuously. The point here is that the seven ORR towers do <u>not</u> provide data at 16 levels above the ground, and only provide wind data to a maximum height of 330 ft (100m). In practice, this really doesn't provide very much information about vertical atmospheric structure; you generally need data through several hundred m to describe the lower atmosphere adequately. Consequently I think the last sentence of the second paragraph in this section is actually misleading the way it is presently worded, and it needs to be fixed.

(8) Appendix C describes the ORR research focus. Pages C-3 through C-5 describe a number of research topics that are carried out on the ORR because of its unique characteristics. I don't know if this list is meant to be limited to just ORNL research, but I don't see why it should be. In particular, NOAA/ATDD conducts air-surface exchange studies of the interchange of heat, water vapor, carbon dioxide, ozone, sulfur dioxide, and other air pollutants at WBW (and soon, I hope) at our replicate tower, to understand and predict these exchanges for an eastern deciduous forest. These same studies on the longer

term, to elucidate the efforts of the seasons as well as events such as extended periods of drought or rainfall or extreme temperatures, also provide the information needed for improving global climate-related estimates of the carbon balance of the atmosphere, which is related to global warming. There should probably be a couple of bullets or sub-bullets describing this research, which has been under way in Oak Ridge for years (NOAA/ATDD has the second longest continuous measurements of these variables in the world). Our data are reported to the DOE-funded Ameriflux program (whose data base is maintained by CDIAC at ORNL) and to the world-wide Fluxnet program, which covers a very wide range of ecosystems.

(9) Also in Appendix C, on p.C-4, under Tropospheric Air Quality, you could mention NOAA's national AIRMoN program for wet and dry deposition; work for AIRMoN has been conducted at WBW by both NOAA/ATDD and ORNL/ESD staff since the mid-1980s. Also, although I'm not sure where to put it (maybe it needs a separate bullet), this section of the report seems to be a good place to mention NOAA/ATDD's long-term continuing solar radiation observations for NOAA's national solar radiation monitoring program, ISIS (Integrated Surface Irradiance Study); WBW is one of only 16 stations nationwide.

(10) Appendix D discusses the "tailored stakeholder" plan. On p.D-4, you may wish to add NOAA to section B, the list of other agencies supporting research conducted on the ORR. Also, I'm sure that the EPA has supported work at WBW and probably elsewhere on the ORR; shouldn't they be in this section, too?

That's all I have. If you wish to discuss any of these points at all, please don't hesitate to call me (576-1233) or to send an email (**hosker@atdd.noaa.gov**) , and I'll try to clarify any obscure statements.

I appreciate the chance to comment.

Advocates for the Oak Ridge Reservation
112 Newcrest Lane
Oak Ridge, Tennessee 37830

November 29, 2000

Ms. Patty Cox
Building 1000, MS-6302
Oak Ridge National Laboratory
Post Office Box 2008
Oak Ridge, Tennessee 37831-6269

Dear Ms. Cox:

Enclosed are comments from the Board of the Advocates of the Oak Ridge Reservation (AFORR) with regard to the recent (November, 2000) Draft of the ORNL Land and Facilities Plan.

We appreciate the opportunity to comment on this EA and are thankful that our comments will be taken into consideration in decisions as to future action regarding the ORNL management area.

Sincerely,

John Devereux Joslin, President

Enclosure

cc:
William J. Madia
George J. Malosh
A. R. Medley
W. F. Harris
T. E. Myrick

Comments on November, 2000 Draft ORNL Land and Facilities Plan

(ORNL/TM-2000/237)

by Advocates for the Oak Ridge Reservation (AFORR)

1. AFORR would like to complement the authors for major improvements in the year 2000 plan over the previous 1999 plan. The addition of extensive, thorough documentation of the conservation values and the present and future research uses of the lands of the Oak Ridge Reservation (ORR) is a major improvement. This is an excellent step toward documenting the multiple uses (current and future) of most of the entire land base of the ORR. This documentation should prove invaluable in future planning efforts.

2. AFORR also enthusiastically approves of the guidelines set forth in sections 2.3.1, especially the emphasis on clustering like uses, preserving clean areas, reusing disturbed areas, protecting natural and cultural resources, considering future generations, optimizing appropriate recreational use, and considering stakeholder inpu. We also strongly agree with Land Use Priorities set forth in 2.3.2, especially #2--"Preserve and protect land to meet the requirements of environmental research by ensuring that adequate areas within the ORR are protected and preserved for their biological and physical diversity"--and #3--"Preserve and protect land to meet the requirements of scientific and technical education by ensuring that suitable land is available for facilities and research areas needed to support educational opportunities on the ORR.".

3. AFORR does wish to point out that it remains unclear how stakeholder input will be included "up front" in the initial decision-making process with regard to land use changes. The process by which proposals for changes in land and facility use are approved is outlined in sections 2.3.4 and 2.3.5 and in Appendix D. However, there is description of how stakeholder input will be incorporated into the decisions of the ORNL Land and Facilities Use Committee (whether within or outside the ORNL developed area) or into subsequent decisions by DOE Oak Ridge Operations. While Appendix D does outline how "tailored stakeholder" input will be requested, it does not clearly indicate at what stage in the decision-making process such input will be solicited. We stress that stakeholder input is most effective, and that it results in greater public acceptance of decisions, when stakeholders are involved in the initial phases of decision-making.

4. AFORR would like to express its appreciation to the planners of the Facilities Revitalization Project for devising an excellent plan and following a commendable planning process. The section (3.4) is particularly well-written also. We commend the planners for making maximum use of already disturbed land and for minimizing use of undisturbed land. We also commend them for actively seeking public comment on their plan.

5. Appendix D lists a number of "identified" stakeholders. Perhaps this is intended as a partial list of "examples." However, a number of significant stakeholders are omitted, including our own organization! Besides AFORR, we think that Tennessee Conservation League and the Foundation for Global Sustainability and Oak Ridge Greenways should be listed under "F. Other Organizations." Also, the Southern Appalachian Man and the Biosphere (SAMAB) program should be included under category "E" and the Tennessee Valley Authority should be included under "D," since TVA manages much of the shoreline that abuts DOE property along the Clinch River.

APPENDIX B

Self-Sufficiency Parcels for the City of Oak Ridge

Self-Sufficiency Parcels for the City of Oak Ridge

In 1979, the Secretary of Energy approved a program to permit DOE to make financial assistance payments to the City of Oak Ridge for a 5-year period under the authority of the Atomic Energy Community Act of 1955. The city submitted a self-sufficiency plan which proposed that DOE sell land to the city for industrial and commercial development. ORO determined that the land could be transferred directly at fair market value to the city in support of the self-sufficiency program rather than being reported excess to the General Services Administration for screening and subsequent disposal. When the self-sufficiency program ended, certain remaining designated parcels that had been in review at the time were "grandfathered," thus permitting DOE to consider those transfers should the land become excess to the needs of DOE. These parcels are shown in Fig. B.1.

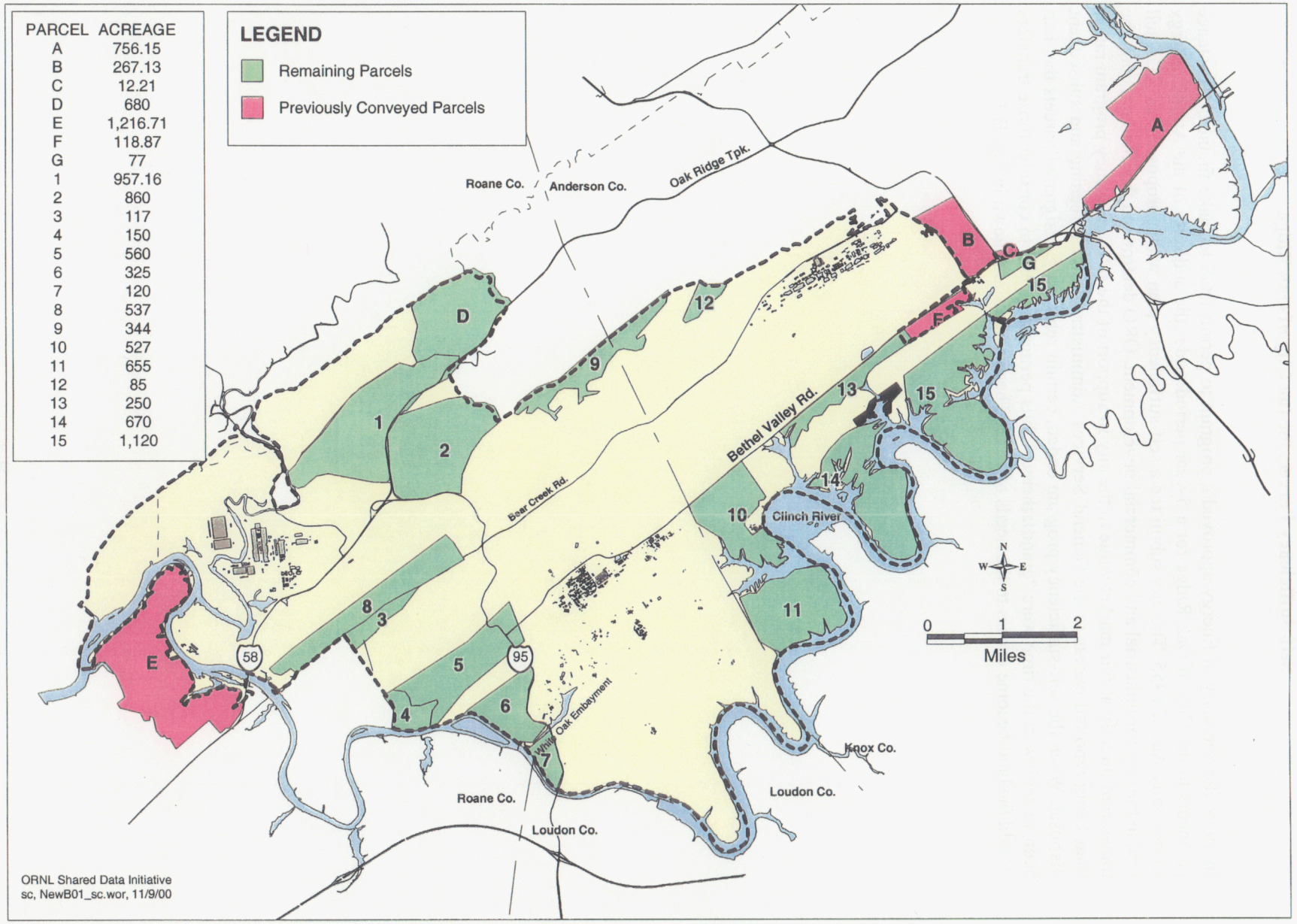

Fig. B.1. Oak Ridge Reservation self-sufficiency parcels.

APPENDIX C

Oak Ridge Reservation Research Focus

Oak Ridge Reservation Research Focus

The location of the ORR in a suburban/industrial setting in the Southeastern United States makes it a particularly valuable site for addressing several important issues dealing with future ecosystem management. The Southeastern United States is experiencing higher rates of population and industrial growth than most areas of the nation. Such growth will place increased stresses on the diverse ecosystems of the region, particularly the abundant forests and freshwaters. Forest productivity and vitality are important to the large forest products industry in the region, and water quality is critical for domestic, industrial, and recreational interests. The Southeastern United States is also thought to be among the most vulnerable regions to global climate change (Neilson and Marks 1994). Future management of terrestrial and aquatic ecosystems in the region will require a much better understanding of the interactions between these expected anthropogenic stresses and climate changes. Many species and communities in the Southeast are at the southern limits of their distributions, and warming may result in elimination. The humid climate and high rates of evapotranspiration (ET) in the Southeast increase the vulnerability to drought resulting from warming effects on ET or possible reductions in rainfall. Plant distributions and productivity, aquatic productivity and biodiversity, and water quality in the Southeast are likely to be strongly impacted by climate change.

One of the most important issues concerning the well-being and security of the nation is how to accommodate future economic development and maintain the ecosystem integrity and sustainability on which human systems ultimately depend. Management approaches to development and land use are frequently driven by emphasis on short-term productivity or economic gain, rather than the long-term sustainability of ecosystems. The ability to make rational decisions about land management and to be adaptable to changing needs and priorities while, at the same time, preserving long-term options requires a combination of long-term monitoring and research based on a fundamental understanding of the ecological processes and relationships necessary for long-term sustainability of ecosystem structure and function. The Ecological Society of America recently identified several barriers to long-term sustainability: (1) inadequate information on the biological diversity of environments, (2) widespread ignorance of the function and dynamics of ecosystems, (3) the openness and interconnectedness of ecosystems on scales that transcend management boundaries, and (4) a prevailing public perception that the immediate economic and social value of exploiting supposedly renewable resources outweighs the risk of future ecosystem damage or the benefits of alternative management approaches.

The ORR will be used for experimental research and monitoring activities addressing the following areas for the eastern deciduous forest type:

- Vegetation response to atmospheric stresses (ozone, high nitrogen deposition) under variations in climate (productivity, water use, natural pathogens);
- Changes in plant community dynamics in response to land use, atmospheric stresses, and climate variation (rare species, shifts in dominant vegetation types);
- Biogeochemical cycling and output of nitrogen with changes in nitrogen deposition and forest succession and growth;
- Interactions among different vegetation and animal communities at the landscape scale;
- Terrestrial-aquatic interactions under climate variations and terrestrial community succession or change; and
- Recovery of stream communities from past disturbances.

Expected outcomes:

- A viable, working framework and model for sustainable development of the Oak Ridge subregion.

- Establishment of the ORR as a national showcase for the environmental and social sciences missions of DOE.

- Creation of the long-term context within which the infrastructure assets of the ORR are preserved and enhanced for new initiative development.
  - -Bioremediation Demonstration Center
  - -Global Change Ecosystem Research
  - -Biofuels Feedstock Demonstrations
  - -Plant Genome Introductions
  - -Environmental Technology Demonstrations

Research on the ORR will continue to address major national issues and contribute to national and international collaborative research initiatives and issues such as:

Global Climate Change

- Manipulative experiments to evaluate impacts of future climate change
  - -U.S. Global Change Research Program
    - -Water balance manipulation
    - -Elevated CO_2
    - -Temperature manipulations
  - -NOAA/ATDD
    - -Air-surface exchange studies of interchange of heat, water vapor, carbon dioxide, ozone, sulfur dioxide, and other air pollutants
    - -Climate-related estimates of carbon balance of atmosphere

- Biodiversity
  - -Southern Appalachian Man and the Biosphere Program
    - -Biosphere Reserve Unit
    - -DOE National Environmental Research Park
    - -Threatened and endangered species
    - -Neotropical migratory birds
    - -Wildlife management

- Tropospheric Air Quality
  - -National Acid Precipitation Assessment Program
  - -North American Research Strategy for Tropospheric Ozone Program
  - -Ozone secondary air quality standard research

- Sustainable Development
  - -Council on Environmental Quality/PCSD Initiative
    - -Indices of sustainability
  - -DOE Science of Sustainability

- Endocrine Disrupters
  - -EPA/Interagency Endocrine Disrupter Initiative

- Multiple Stress Interactions
  -Climate Change X Ozone X Nitrogen

- Solar Radiation Monitoring
  -NOAA long-term observations for Integrated Surface Irradiance Study

There are a number of important issues where future research will draw upon the land resources of the ORR to meet future mission needs:

- Monitoring and Scaling Issues
  -National Environmental Monitoring and Research Program
  -National Index Site
  -National Environmental Report Card
  -National Aeronautics and Space Administration Ground-Truthing of Ecological Processes, Scaling
  -EPA Environmental Monitoring Technologies Test Bed

- Ecological Recovery
  -Natural and Accelerated Bioremediation Research Demonstration Site
  -Test Bed for Environmental Restoration Technologies
  -Demonstration of Ecological Recovery

- Basic Forest Biology Research
  -Genotypic and phenotypic mapping of significant forest species, either for global change research or for forest industry research
  -Forest biotechnology demonstrations
    -Short rotation woody crops
    -Herbaceous crops

- Other interagency research missions for which the ORR serves as a resource:
  -Wetlands research, wetlands banking
  -Wildlife research
    -Game species (e.g., deer and turkey)
    -Beaver
  -NOAA
    -Improving global climate-related estimates of carbon balance of atmosphere

- Landscape Dynamics/Land Use/Urban Ecosystems
  -Patch dynamics
  -Ecologically significant corridors
  -Minimum size of patch

APPENDIX D

ORNL Tailored Stakeholder Plan

ORNL Tailored Stakeholder Plan

Many individuals, communities, industries, agencies, and institutions are interested in the successful planning and growth of ORNL. While some of the stakeholders for ORNL are the same as those for ETTP and the Y-12 National Security Complex, many groups are specific to ORNL because of differing mission objectives. Recognizing these unique site needs, DOE has requested that each site establish and implement a "tailored" stakeholder plan. Through the tailored stakeholder plan, input specific to a particular site and its mission is targeted. This tailored stakeholder plan identifies the process used for ORNL. Local stakeholder input obtained in 1995 through the DOE Future Use Initiative for the entire Oak Ridge Reservation (ORR) has been incorporated into the ORNL plan as appropriate. General land use plans for the entire ORR are identified in a comprehensive integrated planning document published in September 1999, which included a public comment period. Continuing updates to this *ORR Comprehensive Integrated Plan* will have public review for comments and will incorporate tailored stakeholder input obtained through the site planning documents.

Requesting Input

Electronic communication is the preferred method of stakeholder review and input. Stakeholder review will be requested by E-mail, when possible, or by letter with reference to the document location on the World Wide Web. Reviewers unable to access the electronic version can request a hard copy of the document sections of interest. A comment box at the end of the Web document will facilitate reviewer input on individual document sections. Comments will be returned to Pat Parr, ORNL Area Manager, and Tony Medley, Director, ORNL Facilities and Operations Strategic Planning. The number of hits and the location of the hits on the document will be recorded. A copy of the letter transmitted to ORNL tailored stakeholders is included.

Incorporation of Stakeholder Comments

Tailored stakeholder comments, as well as others received throughout the process, will be evaluated for compatibility with the ORNL Vision for Land Use. Where appropriate and possible, these responses have been or will be incorporated into the Plan of Current Land Uses and Planning for Future Land Uses. Planning land uses is an opportunistic and dynamic process. Through the ORNL Land and Facility Use Committee, additional comments, ideas, and suggestions will be evaluated in a timely manner for implementation and reviewed through the Reservation Management Organization, as needed.

Responding to Stakeholder's Input

Receipt of stakeholder comments will be acknowledged. For the most part, however, a response to each stakeholder comment will not be provided to the stakeholder. Updated versions of the document will be brought to the attention of the participating stakeholders. Opportunities to comment on additional drafts of the document as well as document updates will be provided.

Identification of ORNL Tailored Stakeholders

A diverse group of agencies, institutions, and organizations will be contacted for stakeholder input and includes

A. DOE Oak Ridge Operations and Headquarters Sponsors/Programs - such as *ORNL Institutional Plan* reviewers, DOE Office of Science, DOE ORNL Site Office, National Environmental Research Parks.

B. Other agencies that support research - including UT-Battelle, National Oceanic and Atmospheric Administration, U.S. Environmental Protection Agency, Electric Power Research Institute, National Aeronautics and Space Administration, Department of Defense, Southern Appalachian Man and the Biosphere, National Park Service, Tennessee Valley Authority.

C. Educational users - The University of Tennessee, Oak Ridge Associated Universities, Tennessee Technological University, University of Tennessee Forestry Experiment Station.

D. Natural Resource Trustees or Agencies - DOE's List of Natural Resource Trustees, Tennessee Wildlife Resources Agency, Tennessee Department of Environment and Conservation Natural Heritage Program, Tennessee Department of Environment and Conservation Oversight Office, U.S. Fish and Wildlife Service, Tennessee Valley Authority.

E. Professional Organizations with Large-Scale Perspective on Ecosystem Management - Ecological Society of America, Association of Southeastern Biologists, Tennessee Nature Conservancy, Partners in Flight.

F. Other organizations - Friends of Oak Ridge National Laboratory, Tennessee Citizens for Wilderness Planning, World Engineering Partnership for Sustainable Development, Advocates for the Oak Ridge Reservation, Southern Appalachian Man and the Biosphere.

OAK RIDGE NATIONAL LABORATORY

MANAGED BY UT-BATTELLE FOR THE DEPARTMENT OF ENERGY

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November 20, 2000

Reggie Reeves
Division of Natural Heritage
TDEC
401 Church Street
8th Floor L&C Tower
Nashville, Tennessee 37243-0447

Dear Reggie:

Oak Ridge National Laboratory is requesting comments on the 2000 DRAFT Land and Facilities Plan. The plan's scope includes the Department of Energy's (DOE) Oak Ridge National Laboratory (ORNL) and the Oak Ridge National Environmental Research Park.

Changing federal missions has resulted in diverse recommendations, from within and outside of the DOE, regarding the future use of the Oak Ridge Reservation. There is continuing strong interest by Oak Ridge community leaders for release of land for residential and industrial development. And there are current and planned multiple uses of the land and facilities for DOE mission activities ranging from ecosystem research to reindustrialization to major new initiatives such as the Spallation Neutron Source and ORNL Facility Revitalization.

ORNL considers the DOE Oak Ridge Reservation a unique and irreplaceable resource for DOE to address its national science and technology missions. Approximately 25,000 acres, serving originally as buffer, have been fairly undisturbed since acquisition by the federal government in 1942. As a result, the Oak Ridge Reservation now includes large blocks of contiguous native forest with plant and wildlife species and communities now uncommon or absent in surrounding areas. This large, diverse, forested land area provides a foundation for ecological research, monitoring, demonstration, and educational activities at ORNL.

Due to the differing missions of DOE contractors, DOE has requested that each site establish and implement a "tailored" stakeholder plan. ORNL "tailored" stakeholders include research and development sponsors, natural resource trustees/agencies, educational users, and stakeholders with regional and national perspectives for land uses of the Oak Ridge Reservation. Your comments on this draft plan will provide valuable input for planning as well as documentation to DOE. The plan is also located on the web at: www.ornl.gov/~dmsi/landUse. Please provide comments to Patty Cox at email pcx@ornl.gov by December 1, 2000. Comments received after this time will be incorporated into the next update of the plan.

Sincerely,

Pat Parr

Patricia D. Parr, Area Manager
Oak Ridge National Laboratory

PDP:tcr

Enclosure

APPENDIX E

DOE/UT-Battelle Contract
(Section on Land-Use Planning and Management)

Excerpts from Contract No. DE-AC05-00OR22725

C-2. Statement of Work (SOW)

(a) Research and Development

(6) The Contractor shall manage and maintain government-owned buildings and facilities at the Laboratory site and the NERP, together with the utilities and appurtenances thereto. The Contractor is also responsible for certain buildings at the Y-12 Plant which house major facilities and equipment in support of ORNL programs. Some of the facilities at the Laboratory related to the cleanup of the site are managed by the DOE-Oak Ridge Operations (ORO) Environmental Management, Management and Integration prime contractor.

(e) Other Activities

(2) The Contractor shall support DOE/ORO in its responsibilities for land use planning and land management activities for the DOE Oak Ridge Reservation, which consists of 34,545 acres of federally-owned land. The Contractor's responsibilities, as directed by DOE and as identified in the DOE/ORO Reservation Management Plan and the Facility Information Management System (FIMS) database, include land and facility planning for the Laboratory site, conducting research and operational and maintenance activities within the NERP, and integrating reservation activities among contractors and other parties to support DOE's management responsibility.

Section I

I-131. 970.5204-60 Facilities Management (Nov 1997)

(a) *Site Development Planning.* The Government shall provide to the contractor site development guidance for the facilities and lands for which the contractor is responsible under the terms and conditions of this contract. Based upon this guidance, the contractor shall prepare, and maintain through annual updates, a Long-Range Site Development Plan (Plan) to reflect those actions necessary to keep the development of these facilities current with the needs of the Government and allow the contractor to successfully accomplish the work required under this contract. In developing this Plan, the contractor shall follow the procedural guidance set forth in the applicable DOE Directives in the Life Cycle Facility Operations Series listed elsewhere in this contract. The contractor shall use the Plan to manage and control the development of facilities and lands. All plans and revisions shall be approved by the Government.

APPENDIX F

P&E Division Maintenance Work Plan: FY 2000 – FY 2001

Oak Ridge National Laboratory

Plant and Equipment Division

Maintenance Work Plan

FY 2000–FY 2001

December 2000

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ACRONYMS AND ABBREVIATIONS

ACM	asbestos-containing materials
ALARA	as low as reasonably achievable
AMP	Asbestos Management Program
ATLC	Atomic Trades and Labor Council
CAIS	Condition Assessment Information System
CAS	condition assessment survey
CFC	chlorofluorocarbon
CY	calendar year
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
ES&H	environmental, safety, and health
ESH&Q	environmental, safety, health, and quality
ESPC	Energy Savings Performance Contract
FAMMIS	Facility and Maintenance Management Information System
FY	fiscal year
GPS	Global Positioning System
HFIR	High Flux Isotope Reactor
HVAC	heating, ventilating, and air-conditioning
IHEM	In-House Energy Management
ISM	Integrated Safety Management
LAN	local area network
M&C	Metals and Ceramics
MOU	Memorandum of Understanding
NPDES	National Pollutant Discharge Elimination System
ORNL	Oak Ridge National Laboratory
ORO	Oak Ridge Operations Office (DOE)
OSHA	Occupational Safety and Health Act of 1970
P&E	Plant and Equipment
PCB	polychlorinated biphenyl
PdM	predictive maintenance
PM	preventive maintenance
RCRA	Resource Conservation and Recovery Act
S&H	safety and health
SNS	Spallation Neutron Source
TSCA	Toxic Substances Control Act
TTD	Technical Training Department
TVA	Tennessee Valley Authority

EXECUTIVE SUMMARY

The Plant and Equipment (P&E) Division is responsible for management of real property maintenance (i.e., structures, systems, and components) and for providing maintenance support for programmatic research equipment and systems. P&E's policy is to maintain property, facilities, services, and utilities efficiently and economically according to proven maintenance management principles. The division's goal is to ensure that facility assets are in good working order, that they are appropriately protected, and that proper procedures are followed for use, acquisition, and disposal.

POLICY/OBJECTIVES

It is the policy of the P&E Division to maintain facilities, infrastructure, and associated systems in an efficient and economical manner in accordance with proven maintenance management principles. The division's goal is to assure continuing operations consistent with the Laboratory's programs and operating requirements and with consideration for the protection of life and property from nuclear, chemical, or other hazards.

P&E Division's adherence to environmental, safety, and health (ES&H) requirements is a primary objective in maintaining an effective maintenance program. P&E has a participative safety program to promote safety on and off the job.

The success of the division depends upon the effectiveness of its resources; therefore, P&E strives to provide its employees with the proper tools to complete their tasks. Appropriate training is provided to members of the division to enhance their present skills, to train for new endeavors, and to provide for safety and health awareness.

P&E Division strives to improve communications to support customers' needs and to convey maintenance practice requirements for effective results. Achieving a broader range of communications within the division has yielded a more productive and informed work force.

1. FOREWORD

P&E Division is responsible for effective preservation of facilities, infrastructure, and associated systems at the Oak Ridge National Laboratory (ORNL) site and portions of the Oak Ridge Y-12 National Security Complex that are occupied by ORNL. Modern maintenance management systems and practices are used to assure the continued service of the facilities for their intended use.

P&E Division has adopted Integrated Safety Management (ISM) as its overarching philosophy and performs work so that its mission is successfully accomplished while protecting the public, the workers, and the environment. After successfully completing the Phase I Verification in June 1999, P&E began preparations for the Phase II review. During that review, P&E was deemed in need of additional preparation. An intensive effort was begun in January 2000 and culminated in August 2000 with a revisit on the division's Phase II readiness. The division continued to solidify its program by engaging all employees, including the Bargaining Unit, in understanding and actively participating in implementing ISM.

The Facility and Maintenance Management Information System (FAMMIS) is P&E's integrated business management system. It allows near real-time tracking of customer and maintenance job costs, status, preventive maintenance scheduling, and history. The system provides the capability for tracking and trending of maintenance history, job delays, customer load, backlog, productivity, and other information needed to manage P&E's business. Environment, safety, health, and quality (ESH&Q) issues are addressed in the job planning process and supported by the system's capability to document hazard evaluation and other requirements. The system also provides information for managing the maintenance budget and uses current technology to provide a graphical user interface with advanced query tools to aid in the management of maintenance activities. A Web interface allows users to input maintenance job requests, query the status of outstanding requests, and appraise closed job requests.

The P&E Web server provides access to information needed by P&E personnel using intranet technology. The home page is continuously evolving and currently provides links to many applications and Web pages commonly used by P&E personnel and their customers. Some of these are the FAMMIS Web Interface, Area Responsibility Listings, P&E Absence Control Tracking System, Network Systems Information, P&E Procedures, Performance Measures, Condition Assessment Survey (CAS), and ES&H information, procedures, and guidelines. Organizational information such as mission, philosophy, values, organization charts, and P&E procedures and guidelines are available through the Web.

A local area network (LAN) provides access to FAMMIS, many commercial software packages, and shared services and files. The network has allowed P&E to manage access to commercial software economically by maintaining fewer shared copies, which are installed and configured centrally to ease user frustration and maintenance for these packages. The LAN provides the ability to share printers and files among work groups for more efficient management of these resources.

The Asbestos Management Program and Condition Assessment Survey groups were combined in January 2000. As a result, the asbestos survey information was merged into the Condition Assessment Information System (CAIS) Web Page. Asbestos survey data and pictures are now linked through the CAIS Web Page. The centralization of this important information provides convenient access for the location of asbestos-containing materials. This information is used by planners, supervisors, facility managers, and building occupants. To visit the present site, go to the CAIS Web page (located at http://www.pe.ornl.gov/cais/) and enter the facility identification number.

An annual review of maintenance equipment, building service equipment, and automotive and heavy equipment is performed to determine capital equipment needs for future budget years. These needs are prioritized and submitted for budget approval to assure that the critical needs are addressed on a priority basis and that the Laboratory is supported in a cost-effective manner.

Training of P&E Division personnel has been assessed by the Office of Training Services to assure compliance with U.S. Department of Energy (DOE) Order 5480.20. Recommendations were made concerning deletion of invalid procedures and changes in other administrative functions. It is now the view of the Office of Training Services, as reflected in the Training Order Implementation Plan, that P&E is responsible for providing qualified craft personnel to support nuclear facilities. The nuclear facilities will have direct responsibility to assure P&E personnel are trained and qualified on facility-specific work process and equipment in accordance with the order. Memoranda of Understanding (MOUs) are being added/revised to clarify this policy. Implementation of the MOUs are the responsibility of the Office of Training Services. P&E will assure personnel are trained to work safely and in compliance with ES&H regulations.

The ORNL In-House Energy Management (IHEM) Program has three noteworthy strengths: a full-time Energy Manager, an ongoing trend toward reduced site energy consumption, and a strong commitment to pursue alternative financing for energy-related projects. Relamping activities have replaced approximately 35,000 fluorescent lamps (40 percent of the inventory) with high-efficiency lamps and have replaced approximately 17,000 magnetic ballasts containing polychlorinated biphenyls (PCBs) with electronic, non-PCB ballasts. This project has saved energy, reduced the waste streams of these electrical components, and reduced the risk of PCB spills for the affected buildings. The IHEM Program is also currently working with P&E and Engineering personnel to complete the Chlorofluorocarbon (CFC) Chiller Replacement program and to implement the Steam Plant's 10-year master plan to convert from coal-fired boilers to natural-gas-fired boilers for steam generation. Finally, the IHEM Program has been successful in working with Engineering and DOE to implement a delivery order contract on the DOE Southeast Region "Super" Energy Savings Performance Contract (ESPC) and to kick off the development phase of a larger, site-wide delivery order. These delivery order contracts will provide third-party funding to implement energy conservation and infrastructure projects. The Energy Manager was the Project Facilitator for this ESPC effort, and he also supports the DOE Federal Energy Management Program by helping to instruct a live, televideo annual workshop for federal energy managers/engineers.

P&E received a Waste Prevention Award from DOE Oak Ridge Operations Pollution Prevention for enacting cooling system improvements at ORNL that significantly reduced the use of energy, water, and water treatment chemicals. BetzDearborn representatives worked with P&E personnel to train air conditioning refrigeration mechanics to clean and treat cooling water systems and to modernize the chemical feed and control systems on the Laboratory's cooling towers. New water treatment chemicals were identified that provide improved rust and corrosion protection and more effective control of scale, deposition, and microbiological fouling. The improvements in water treatment account for annual savings of $300K in electrical utility cost and $68K in water makeup.

DOE requested that all departmental chillers using Class I refrigerants that are greater than 150 tons and more than 15 years old be replaced by Calendar Year (CY) 2005. Seventeen large CFC chillers at the Laboratory have been replaced. ORNL was granted an exception to the ruling for replacement of seven additional CFC chillers. Three of these exceptions have been removed from service, three are used as emergency backup, and one is used on a temporary basis until the building is shut down. This completes DOE's required phaseout of the large CFC units. Approximately $250K is required to replace three CFC heating, ventilating, and air-conditioning (HVAC) units that are between 5 and 150 tons. These smaller units are planned for replacement as funding becomes available.

2. FY 2000 WORK PERFORMED

2.1 SIGNIFICANT ACCOMPLISHMENTS

P&E Division achieved a number of significant accomplishments during the fiscal year (FY) 2000 budget year, which are detailed in this section.

2.1.1 Safety & Health

P&E's Safety and Health Program is the administrative system responsible for maintaining a high level of safety and health awareness through pre-job planning and task execution. This program assures that supervisor and employee responsibilities are communicated and understood and provides employees with working conditions, procedures, and training required to perform all work tasks safely. By utilizing ORNL's Lessons Learned System, injury/illness investigations, periodic formal facility assessments, job task monitoring, and various concerns systems, P&E is able to support the goals of its Safety and Health Program. By ensuring that our program objectives are met, we ensure consistency with ORNL, UT- Battelle, and DOE requirements.

Accomplishments for FY 2000 include:

As a routine self-assessment measure, quarterly facility safety and health evaluations were completed. Team membership consisted of health and safety professionals and also included quality and environmental compliance professionals and facility managers or their designees. The goals of these assessments are to periodically review division work space, provide for consistent reviews, abate potential hazards (immediately, if possible), and document and track open observations until closure. The team also strives to educate facility management on current ES&H policy, as needed.

P&E has a weekly communication forum in which safety and health topics are disseminated throughout the division. The weekly Safety Meeting Message delivers consistent information (i.e., Lessons Learned, ES&H and radiation protection program bulletins, weekly injury/illness case narratives, and other pertinent safety and health topics) to every P&E employee. Supervisors use this information as the basis to conduct their weekly safety meetings. Signatures on the message attendance sheets denote their participation in that week's topic discussion. Completed attendance sheets are forwarded to the P&E Division safety and health office for review and retention.

Intensive reviews of new or revised standard operating procedures and job task evaluations are examples of P&E's ongoing effort to update procedures and work practices to ensure personal exposure to chemical and/or physical hazards are below industry standards. Periodic personal and area monitoring during routine and nonroutine tasks help govern the engineering and administrative controls and personal protective equipment needed. Recommendations are injected into the work process and documented, as applicable, to minimize or eliminate employee exposure to the hazard.

P&E Division management, staff, and hourly employees teamed with our Atomic Trades and Labor Council (ATLC) Health and Safety Representatives to develop a division safety incentive award program. The purpose of this award program is to recognize individuals within certain craft classifications, support staff, or management whose safety statistical numbers show either improvement or consistency over the previous quarter. It is anticipated that as this program matures, there will be a steady decline in P&E's injury/illness cases.

P&E's Safety and Health Program developed and implemented safety and health performance indicators as an online resource for managers. Additional safety and health graphics are presented to division management during P&E's monthly ES&H meeting. Both safety and health performance indicators and monthly statistical graphics are available on the P&E Web page located at URL http://www.pe.ornl.gov/internal/esh/.

P&E continues to raise safety and health awareness by promoting utilization of the Integrated Safety Management System (ISMS), Safety Meeting Messages, and the safety incentive award program. P&E Division will continue to strive toward consistently reducing the risk of injuries by preventing accidents and mitigating hazardous exposures and by anticipating, recognizing, evaluating, and controlling health hazards.

Radiological Control

P&E participates in ORNL's As Low As Reasonably Achievable (ALARA) Steering Committee monthly to review up-to-date division personnel exposure, discuss special projects, and modify radiation protection procedures. P&E did not submit a request that the ALARA Working Committee raise any employee's ALARA goal beyond the Laboratory's standard in FY 2000. We credit thoughtful work planning, better management of our human resources, and thorough job hazard evaluations for ensuring that no individual's radiological exposures would exceed the 600-mR goal. P&E will continue to participate in job pre-planning to ensure all personnel radiological exposure is ALARA.

2.1.2 Waste Minimization

The P&E Division continued to expand the scope of several waste reduction programs that were implemented in CY 1995. These programs have reduced the amount of waste (in pounds) generated (see Table 2.1).

Table 2.1. Waste reduction gains for total waste generated by P&E

Calendar Year	Waste generated (Pounds)		Total waste[a]	
	RCRA	PCB	Pounds generated	Percentage reduction[b]
1995	51,099	27,382	102,974	
1996	11,215	34,726	89,982	13
1997	984	22,642	33,026	63
1998	285	21,080	25,365	23
1999	621	1,791	5,959	76
2000[c]	198	791	3,010	49

[a]Total waste includes used oil, TSCA waste, and RCRA waste.
[b]Percentage reduction is based on previous year.
[c] Year to date.

The division operates a Decommissioning and Segregation Facility, located at Building 7020A, for the disposition of excess equipment, materials, and refrigeration equipment. Materials and equipment

are prepared for disposition by means of an existing set of contracts for recycling refrigeration equipment, scrap metal, and damaged furniture. P&E and Property Sales worked together to place a contract that sold material and equipment for recycle. More than 82 pieces of machine tools and equipment were sold that would have otherwise been disposed of as waste.

P&E continues to reduce water discharges from HVAC applications. Cooling tower blowdowns were reduced by increasing the cycles of concentration of tower water from three to five. This saved 21 million gallons of makeup water and associated dechlorination costs in 13 towers at ORNL for a $68K annual cost avoidance. Improvements in chemical treatment for tower water have reduced the scale on water-cooled condensers, which improves heat exchange and reduces electrical utility cost by $300K annually.

Also, P&E continues to replace existing once-through-water package units with air-cooled systems as they become problematic. This action saves water and treatment for outfalls (units typically use 2 to 3 gallons of water per minute per ton of cooling).

2.1.3 Training

The P&E Division provides trained personnel to support the mission, philosophy and values of ORNL in maintaining a safe, efficient, and effective work force. P&E works in cooperation with the Office of Training Services and the Nuclear Facilities Training Managers Forum to assure compliance with corporate, regulatory, and safety and health training-related requirements.

Accomplishments for FY 2000 include the following:

- Completed ISM Train-the-Leader Training.
- Assessed P&E Division Technical Training Program compliance with DOE O 5480.20A, "Personnel Selection, Qualification and Training," conducted by Office of Training Services.
- Conducted crew training on ISM using video and case studies.
- Completed training of P&E managers, supervisors, planners, and engineers on new P&E Work Control Procedure.
- Provided training of personnel and supported conduct of alignments and predictive maintenance on a Glove Box Off-Gas system (secondary confinement) fan in Building 3020 that services Building 3019. The training was designed to familiarize users with proper collection of vibration data on identified safety-related equipment and has application to nuclear safety significant systems identified in ORNL nuclear facilities.
- Continued to update training requirements profiles for P&E maintenance employees as personnel were reassigned and additional requirements were identified through surveys and interviews.
- Updated and implemented training for the National Electrical Code. Initiated training analysis on Programmable Logic Controllers. Began development of training on Power Line Hazards for work on or near power lines with high voltage (above 600 volts).

- Implemented training at High Flux Isotope Reactor (HFIR), Radiochemical Engineering Development Center (REDC), and Metals and Ceramics (M&C) facilities on overhead cranes, forklifts, and aerial lifts, and issued operator permits. P&E Training also participated in 22 critical lift plans within ORNL nuclear facilities.

- Retired several division-level training procedures following the assessment by the Office of Training Services. Procedures that have been discontinued are Development of Training, Conduct of Training Analysis, Conduct of On-the-Job Training, Training Documentation and Records Management, and Training Program Evaluation. Guidance and direction for division-level technical training will come from the Office of Training Services.

- Designed, developed, and implemented training for P&E managers, supervisors, planners, and engineers on P&E Procedure D-1.23, "Work Control," issued in April 2000. Additionally, Work Control Procedure training has been developed and presented to hourly workers.

2.1.4 ORNL Asbestos Management Program

The ORNL Asbestos Management Program (AMP), located within the P&E Division, is responsible for safe management of asbestos-containing materials (ACM) throughout the Laboratory. The program establishes requirements for safe handling of ACM and describes roles and responsibilities of supporting ORNL organizations. Also specified are uniform and effective control measures for removal, renovation, repair, and demolition of ACM to reduce the health risks for personnel at ORNL and to meet DOE, state, and federal requirements. Routine activities include compliance reporting to state and federal agencies and asbestos work authorization for approximately 250 jobs. Self-assessment of the program continued this year and was conducted by the Office of Environmental Compliance and Documentation.

Accomplishments for FY 2000 include the following:

Under the direction of the Asbestos Program Manager, inspectors from the CAS group surveyed more than 600 ORNL facilities as part of the ORNL Asbestos Survey. The new bar-code tracking system provided a computerized database for the storage and retrieval of asbestos-related information for these facilities. This system greatly enhances the capability of the AMP in providing an efficient means of collecting the survey information, which is available online at the P&E Home P age under CAS surveys.

The asbestos compactor continues to reduce the volume of asbestos and fiberglass waste going to the Y-12 Landfill. Cost avoidance associated with the waste reduction exceeds $35K per year.

There was continued utilization of the revised vacuum cleaning process. The revised guidelines allow for a single vacuum to be cleaned instead of having to wait for a mass cleaning, as was the previous practice. The process provides an improved way of cleaning asbestos vacuum cleaners.

P&E continued to schedule the asbestos training and retraining for the asbestos workers and supervisors and to maintain documentation records for asbestos workers to ensure continued regulatory compliance.

A new Asbestos Brake training program was initiated for the Automotive Mechanics. Training and retraining workers to the new Asbestos Operation and Maintenance training module was continued.

2.1.5 Utilities and Reservation Services

The Utilities and Reservation Services Department is responsible for providing a wide range of services to Laboratory customers. In addition to operating and maintaining the basic utility systems, Steam Plant, and Sewage Treatment Plant, the department also provides "central" services to Laboratory customers. Central services are services that are provided to the general plant population regardless of the programmatic affiliation. Included are such things as janitorial service; laundry; garage, roads and grounds maintenance; carpenter shop services; hoisting and rigging; and general transportation service. Employees within the department are involved in a wide array of activities to support operational and research activities at the Laboratory.

Accomplishments for FY 2000 include the following:

Water Distribution System

The Laboratory used 1.10 billion gallons of water to support ongoing operations. Maintaining a safe and reliable water system is essential to achieve ORNL objectives. Adequate fire protection capability must be maintained to preserve and protect the asset value of Laboratory facilities and to comply with current regulations. Process uses of water include once-through cooling and make-up water for cooling towers and account for over 93 percent of the total water use. Sanitary uses account for the other 7 percent of the total water usage. Routine monitoring of water quality and maintenance of effective cross-connection controls are essential to guarantee a safe water supply for employees and visiting guests at the Laboratory.

Routine sampling of water supplies is required by State law and will continue according to an established plan. Backflow preventers, a critical component of the Laboratory's cross-connection control program, will continue to be tested as scheduled and will be rebuilt or replaced as needed. Repairing water leaks and breaks will remain a priority. Strict in-stream chlorine limits established in the National Pollutant Discharge Elimination System (NPDES) Permit makes the timely repair of even minor leaks important. Operations personnel will continue to perform system walk-downs to identify and label all valves and fire hydrants. Concrete aprons will be installed around valve boxes in grassy areas to make it easier to find them when needed. All fire protection and major sectionalizing valves will be checked and operated annually to ensure proper function; valves which no longer operate freely or fail to close tightly will be repaired or replaced. Leaking fire hydrants will be serviced and rebuilt or replaced as resources allow. All valve pits will be kept free of water to help keep water supplies sanitary and to allow quick and easy pit access when needed. Maintenance painting of post indicator valves and fire hydrants has been a priority in recent years and most now have a fresh coat of paint. In addition to providing a weather-resistant coating, the fresh paint makes these important components more visible, thus reducing reaction times during emergency operations.

A new water system map, completed last year using MAPINFO software, has been walked-down to ensure accuracy. The new map has many advantages over the old operating schematic that was used in the past. Valve locations are more accurately shown as water lines have been layered onto the plant map. This allows operating personnel to quickly respond to emergencies and customer requests and should eliminate questions raised when locating components in the field. The new system also allows the attribution of system components. Valves, lines, and fire hydrants can be identified as to type, manufacturer, and other specifics, and maintenance history can be documented and accessed through a system browser.

The water plant where ORNL procures its water has been transitioned from a DOE contractor to the City of Oak Ridge. The City assumed control of the facility on May 1, 2000, without any problem.

As part of this transition, ORNL assumed control of approximately 7800 feet of 24-inch water supply line that was previously maintained and controlled by the contractor who operated the water plant. ORNL's responsibility now begins on the north side of Bear Creek Road, just west of the Y-12 National Security Complex. While this line is 52 years old, it remains in excellent condition. Sections of the line were removed during a line relocation project for the Spallation Neutron Source (SNS). Examination of these line sections indicated no tubercular or microbial growth inside the line. In addition, the sprayed-on concrete liner inside the pipe appeared almost new, and the overall outward appearance of the pipe was similar to that of new pipe. The sections of pipe that were examined had retained their original specifications (i.e., they were not "out of round" as had been anticipated and the outside diameter matched that of new ductile iron pipe). It has long been thought that this line was of poor quality, similar to that encountered in the 6000 Area of ORNL, but that is not the case. In the 6000 Area, the pipe has an elliptical shape that makes working on the line extremely difficult. Standard repair fittings and new pipe must be modified in order to make connections, install new valves, or make other repairs. The discovery that the 24-inch line is of standard dimensions reduces the need to maintain inventories of odd-sized system components and should greatly reduce the time required to make repairs and connections to this line when they are required.

Every few years, the State of Tennessee performs a "Sanitary Survey" of ORNL's water system. An inspector visits ORNL, reviews records, talks with operating personnel, and walks down the water system, evaluating it according to a set of standards developed by the Division of Water Supply. This year's inspection resulted in the State of Tennessee grading the Laboratory's water system as "Provisional" based on the need to repair the No. 1 Reservoir. ORNL had identified the need to repair and/or replace the 50-year-old reservoir and had a project in the funding pipeline, but since a deficiency had been noted in a prior inspection, the State deducted points from our inspection rating because ORNL had not yet performed the needed repairs or replacement. This rating provided the additional justification needed to secure funding for a new 1.5-million-gallon reservoir. This project is now under way, with the tank design having been completed and submitted to the State for approval. This approval is expected in mid-December 2000 at which time the contractor will begin construction. Completion of the project is expected in early summer 2001. Completion of this new reservoir will allow operating personnel to remove the old concrete reservoir from service and perform a thorough evaluation of its condition. Past inspections of the tank have been made by a diver who examined the structure while it was full. While this inspection gives a good indication of the tank's general condition, a more thorough and accurate evaluation will be made once it is taken out of service and drained. It is expected that no major structural deficiencies will be found. Maintenance actions on the tank have been ruled to be "operating," meaning that they will need to be funded through the water system operating account. To minimize the impact on the ORNL water customer, required repairs identified during the inspection will be prioritized and performed over the next few years using internal ORNL maintenance forces. By performing the work in this manner, P&E can better control the cost to the customer while ensuring that the most critical deficiencies are addressed in a prioritized fashion.

Electrical Distribution

The ORNL Electrical Distribution Department continues its exemplary performance with an uptime percentage of nearly 100 percent. There were three instances during the year when small areas within the Laboratory were without power for a total of a little over 2 hours. This performance is due to the department's commitment to reliability. All activities initiated on the electrical distribution system are intended to improve the system's operational reliability, efficiency, and safety.

ORNL is a unique facility with many diverse operations and requirements. Couple this with the overall age of facilities within the Laboratory and its supporting infrastructure, and the result is a

constant challenge for basic service providers. Personnel in the department must be highly adaptive and innovative in order to keep systems and facilities functioning as they should. Both operations personnel and maintenance support continually work together to plan and evaluate system conditions, requirements, and constraints to make sure that the ORNL customer can depend on the services provided.

Maintenance personnel in the department continue to place strict emphasis on making the systems as safe and reliable as possible. This is done by (1) removing switchgear and substations from service to perform routine cleaning, adjusting, and repairing; (2) identifying potential failure points and problem areas through use of thermographic imaging, power meters, and other proactive preventive maintenance techniques; and (3) clearing and maintaining utility rights-of-ways and pole structures. The system configuration is constantly evaluated to determine the need for new switches, ties, or other components that improve operational reliability.

The line crew has pursued another initiative throughout the year to remove old, abandoned, or unused wiring from poles throughout the site. In some areas the number and size of abandoned lines on poles were threatening to pull the poles down. The line crew and their supervision recognized these old wires as a threat to system reliability, particularly under conditions of winter ice or a snow storm. Permission was sought to begin removing these old wires as fill-in work. When the work load allowed, the line crew would work at removing identified wire from the poles. Using this approach, cost is minimized, and there is no impact on other ongoing work.

Aging equipment continually challenges department objectives. Much of the electrical distribution system equipment in the Laboratory is 50 years old, and maintenance requirements are increasing. Upgrades in the past have improved switching capabilities and replaced unserviceable circuit breakers. This year, work will begin on a Line Item Project intended to upgrade some of the most vulnerable areas of the electrical distribution system. Electricians and linemen from the department will be working with contractor personnel to install new switches, relays, and control circuits. Substation operators and supervision will be organizing tie-ins, arranging outages, and providing interface support between the Engineering Division, contractor personnel, and customer divisions. Work on this project promises to require close interaction among all groups in order to make sure tasks are carried out safely and efficiently.

Work was completed on a 1.5-mile-long extension of ORNL Circuit 264 into the SNS area. This temporary 13.8-kV circuit will be used by construction forces working on the SNS. Because of the critical nature of the construction schedule, the SNS is also considering having a second, parallel circuit run into the area. This redundant circuit would give a high degree of reliability that would allow critical construction testing and sequencing to continue uninterrupted under all conditions. Permanent power for the SNS will be provided through a new substation that will be constructed on the 161-kV line adjacent to the SNS site. The Tennessee Valley Authority (TVA) is currently meeting with the SNS construction contractor to work out the requirements. As it currently appears, TVA will likely construct the new substation and ORNL personnel will have operational responsibility.

HVAC Maintenance

P&E maintains 3763 pieces of HVAC/refrigeration equipment throughout ORNL. These include water chillers, air handlers, chilled water pumps, window units, environmental chambers, etc. The longest life expectancy of any HVAC component is 25 years. Since the average age of ORNL HVAC equipment exceeds this life expectancy, replacement of equipment is often economically justifiable.

The P&E Division continues to replace deteriorated, aged HVAC units throughout the Laboratory based on a graded approach and available funding. These replacements are more efficient, and this reduces operating and maintenance costs along with improved system reliability and indoor air quality. Table 2.2 lists package and split systems that have been replaced in recent years (not including air handlers, cooling towers, cooling water pumps, window units, and refrigerators).

Table 2.2. HVAC Equipment Replacement

Fiscal Year	Cost ($ in 000s)	Number of Units	Capacity (Tons)
1992	35	3	115
1993	55	4	57
1994	610	8	432
1995	2,940	14	4,336
1996	1,569	12	1,589
1997	955	12	352
1998	1,635	16	1,241
1999	2,899	19	1,283
2000	110	4	40
TOTALS	**$10,808**	**92**	**9,445**

Steam Plant Operations

The Steam Plant's continuing goal is to provide the Laboratory with a consistent, reliable, and economical supply of steam to be used in operations and processes and for space heating purposes. Last year, the Steam Plant generated over 637 million pounds of steam for use by customers in both the Bethel and Melton valley facility sites and once again achieved a 100 percent up-time operational record.

Effective management, operational control, and maintenance continue to be keys to achieving the Steam Plant goals. The plant is currently in the process of converting from using coal as its primary fuel to natural gas. Approximately 8000 tons of coal remained on the storage yard at the start of the October 2000 through the March 2001 heating season. Of this, approximately 50 percent is quality coal procured in the last year with the other 50 percent being base material that consists of stoker grade chips and an abundance of fine materials that are the result of 20 years of compaction and traffic. To close out the coal yard, efforts have been made to remove as much of the base materials as possible while avoiding digging into the clay liner beneath the coal. This base material is mixed with the remaining coal to form a mixture that is easier to burn. If it were not mixed, attempting to burn the base materials alone would be difficult. The mixture, however, is almost as easy to burn as is normal coal, requiring only a minimum of additional attention on the part of the operators and not affecting boiler maintenance requirements significantly.

Natural gas firing is intensifying as the new No. 6 Boiler is becoming the primary steam producer in the plant. Efforts are to maximize the efficient use of natural gas by loading this boiler in a manner that fully uses the demand allotment while avoiding any penalty charges for using noncontract fuel. Natural gas prices have increased dramatically throughout the country in the last 6 months. It is believed that this increase is a temporary spike that will only influence steam production rates over the near term. This year's large jump, when compared with historical pricing, reflects many years worth of price growth as compared to what has historically been considered normal. This cost increase will have some impact on other planned activities within the plant. Maintaining a relatively stable steam cost to the customer in the Laboratory has always been a priority. The increase in fuel costs, coupled with changes in the way the labor rate is calculated, will result in a significant increase in the cost of steam. To soften the impact on the customer, some planned, optional maintenance work will be postponed and other cost-saving initiatives pursued. The Laboratory, the directorate, and the department itself are all undergoing massive changes in the way work is performed. Every effort will be made to continue to provide continuous, reliable service at the lowest possible cost.

Streamlining the boiler overhaul process continues this year. Next year's overhaul outages are currently being planned and long-lead-time materials are being requisitioned. The emphasis during this overhaul period will once again be equipment reliability coupled with focusing on isolating and removing unneeded coal-related equipment and controls. Craftspeople are encouraged to identify weaknesses so that they can be evaluated by engineering and operations personnel to determine if alternatives are available and practical. A systems approach is important. The old boilers have been coal- or natural-gas-fired for many years, and as the coal systems and controls are removed, the ability to fire on natural gas must not be compromised. Each piece of equipment is part of a larger system that must work correctly in order to produce steam safely and efficiently. Each system and component will be examined and evaluated, and repairs and replacements will be made based on economy and reliability. The steam-producing system is expected to be able to function continuously throughout the winter heating season. In order to do this, every attempt is made to bring the plant's operating capability as close to "as new" as possible. Boiler refractory will be examined and replaced as necessary. Boiler tubes will be examined and tested to determine condition. Natural gas side burners will be removed and repaired or rebuilt as needed. Thermographic imaging will be used to determine the condition of boiler insulation and the presence of air leaks. Insulation will be replaced or enhanced, if needed, and air leaks will be stopped to the best degree possible. Boiler auxiliary systems (e.g., feedwater systems, forced and induced draft fans, and water softeners) will be examined and repairs made as needed. Laser alignment of fans and motors has proved successful in the past at reducing bearing failure and improving fan performance and will again be used. Other predictive maintenance tools such as vibration analysis and oil analysis will be used, as deemed appropriate, to ensure that the equipment and systems are operating properly. Electricians will be using power meters to evaluate the Steam Plant electrical system as the boilers and subsystems are taken down for maintenance. It is hoped that baseline signatures can be developed to reflect the operating characteristics of the electrical system inside the building. Because of the many pieces of electrical equipment in the Steam Plant, it is important to understand how one component or system affects others within the facility. By using the power meters, adjustments can be made in operations, maintenance, and equipment alignments that should improve overall facility efficiency and reliability.

The boiler overhaul period is season-dependent but once again is expected to run from mid-March through October. If past successes are any indication of future performance, this year's efforts will improve the overall operational reliability of the Steam Plant.

Steam Distribution System

Steam is distributed to over 100 buildings at the Laboratory and is used to both supply heat for creature comfort and to support research and other operational processes. Steam service is critical in all these facilities in the winter months to keep them warm and must be supplied to many of the buildings throughout the year for such things as humidity control, hot water, and provision of a backup to electric service on the central off-gas system. Maintenance of the steam distribution system is a year-round requirement, and special emphasis must be placed on making sure that the system will operate reliably during the winter months. Failures during the winter cannot be tolerated because of the potential for immediate impact on building systems and employee comfort.

Operations personnel continue to perform periodic inspections of steam pits to make sure they are kept free of water. Water accumulates in the pits when it rains or connections leak and is one of the major causes of component failure. Maintenance personnel continue emphasizing reliability and replacement of components. An example of this occurs whenever a portion of the system is taken down for maintenance. Workers have adopted a practice of replacing all condensate traps, strainers, and other wear-items at the same time. Over the years they have discovered that even though this requires additional work, it pays a dividend when a building or line segment has to be taken out of service only once, rather than many times as was previously experienced. The minor additional cost associated with replacing a component that may not yet have failed is more than made up by keeping the system operational for longer time periods without maintenance outages.

Other benefits include a reduction in the hazard exposure to operators. The most dangerous activities experienced when working on a steam system occur when the system is being shut down or pressured up. By reducing the number of incidences that place operating personnel in these situations, safety has greatly improved.

Operating and maintenance personnel received training in "Condensate Induced Water Hammer." This training included discussions of real-world incidents as well as glass piping models that allowed participants to witness how incidents develop and progress. All participants left with a new understanding of how steam systems operate and should be able to apply this knowledge to perform their jobs more safely.

An experienced group of operating and maintenance personnel continues to pay dividends. Both groups have many years of experience in operating and maintaining the steam system at ORNL, as well as experience received through craft training, etc. The water hammer training mentioned previously encouraged individuals to develop a systems approach instead of simply looking at each individual component. How everything interacts is important in understanding system needs and constraints. To build on this training, additional instruction will be provided to emphasize the systems approach to allow further development of these individuals' skills and expertise.

Compressed Air

The Laboratory uses large quantities of compressed air in its everyday operations. More than 2500 cfm of compressed air is used in HVAC controls, for tank sparging, and in many other types of process uses. This air is produced at the Steam Plant and is distributed throughout facilities in the Bethel Valley portion of the Laboratory. There are currently seven compressors which can be operated to provide air to customers in the plant. The primary air producer is a new, 3000-cfm, oil-less compressor that was placed into service a little over a year ago. It is backed up by one or more smaller compressors that are placed into and taken out of service as operating and maintenance requirements dictate.

The compressed air distribution system is largely maintenance-free because of the high-quality air being produced. Air dryers remove moisture from the air to a level of 40 ppm prior to distribution. Because of this, very little goes wrong within the distribution grid.

The compressors and air dryers within the plant require continuous attention. Adequate lubrication is a key factor in keeping mechanical equipment operating, and this equipment is no exception. Operations personnel constantly monitor equipment operation, and maintenance personnel must make adjustments to ensure continuous operation. Periodic rebuilds or replacement of key components or systems are performed to ensure reliability. Predictive maintenance techniques, such as vibration and oil analysis, are employed to provide additional insight into how equipment is functioning. Air dryer performance is also monitored and operating parameters logged and tracked. Desiccant condition is monitored and is replaced when its moisture removal properties have been diminished.

Sewage Treatment Plant

Sanitary sewage is collected from Laboratory facilities in both Bethel and Melton valleys and flows to an on-site treatment facility. This facility, located at the far southwestern edge of the Laboratory, is a packaged, extended-aeration, activated sludge plant rated at 300,000 gallons per day. Laboratory loads typically run between 150,000 to 200,000 gallons per day, but spike loads have been experienced at the facility up to its peak load capacity of 700,000 gallons per day.

A sanitary sewer study is currently underway that will create an accurate as-built map of the system as well as provide the information needed to develop a computer model of the system. A model of the system is being developed to allow operating and engineering personnel to determine potential impacts on the system and the treatment plant before new facilities are constructed or tied into the system. The Laboratory modernization plan, coupled with the impact of the SNS, provided the impetus to develop this modeling system. In addition to the SNS, there are 10 new additional buildings that have been identified for the Laboratory over the next 5 years and others in an expanded time frame. To ensure the sewer system in these growth areas can adequately handle the new flows, the computerized system will model the facilities' impact on the system while factoring in all other existing flows, pump station performance, infiltration, and treatment plant capabilities. The result will be that we can accurately determine if flows from a new facility (or facilities) will require an increase in line size, a pump station upgrade, or even an increase in treatment capacity. This will result in each facility having to provide whatever sewer system improvements are required as part of the project scope rather than being funded through an already overburdened general plant project system.

Operators continually monitor the treatment plant performance through visual observation, physical measurements, and use of analytical techniques in the on-site sewer lab. The biological process used to treat the wastewater is largely automatic with very few adjustments being needed to produce a clean effluent. Periodic problems with mechanical components are addressed as needed, and those requiring immediate attention to ensure compliance with the plant permit requirements are handled on a priority basis. The use of the sewer lab provides operating and maintenance personnel with real-time information on how the treatment process is working and allows minor adjustments to be made to hold the plant within close operating performance tolerances. The result is an effluent that consistently falls within the operating requirements identified in the Laboratory's NPDES operating permit.

Roads and Grounds

The Roads and Grounds Department is responsible for maintaining the outside physical appearance of the Laboratory by cutting the grass; cleaning and maintaining streets, sidewalks, and parking areas; and removing trash and unwanted scrap materials from the site. It is also responsible for maintaining

27 miles of power line right-of-ways and 180 miles of primary roads, secondary roads, fire roads, and parking lots. During the growing season, the department mows 100 acres of class A primary lawns weekly and 125 acres of secondary grounds at least monthly.

Coal Yard Runoff Treatment Plant

The Coal Yard Runoff Treatment Plant processed more than 19 million gallons of wastewater in FY 2000. The plant utilizes a neutralization, flocculation, and clarification process to adjust pH and remove solid particulates from wastewater coming off the coal storage yard and from within the Steam Plant. Operations at the plant were normal this year, with minimal problems. The only major repairs occurred early in the year when maintenance personnel removed and rebuilt the two main sedimentation basin pumps. These pumps move highly acidic wastewater through the process and are exposed to extreme operating conditions. Maintenance forces typically rebuild the pumps at least once a year in order to maintain reliable operation.

Natural Gas

The natural gas system consists of approximately 5 miles of above- and belowground steel pipe ranging from 1 inch in diameter to 6 inches in diameter. Line pressures range from 100 psi on the main 6-inch line serving the Steam Plant, down to 5 psi on the grid running to facilities in the Laboratory. Individual reducing stations located at each building further decrease the pressure to that required for the specific application.

The main user of natural gas at the Laboratory is the Steam Plant. It is supplied directly from the main reducing station north of the 7000 Area and all other users are then fed from two 100-psi to 5-psi regulators located at the Steam Plant. System maintenance has historically been minimal. The lines are walked down and surveyed for leaks annually, and the cathodic protection pipe-to-ground potential is recorded at that time.

The aboveground portion of the line serving the Steam Plant is in good-to-excellent condition after having been sandblasted and recoated in 1987. The remainder of the grid consists of 50-year-old underground steel pipe. This pipe is considered in fair-to-good condition, with only one leak experienced in the last 15 years. The cathodic protection installed on the line in the mid-1960s has been effective in preventing corrosion on the line.

Janitors

The janitors are responsible for providing trash pickup, cleaning, and other custodial activities to more than 170 buildings encompassing more than 2.5 million square feet. These individuals routinely empty more than 7000 trash cans located in 6100 rooms and clean more than 300 rest rooms and change rooms. Each janitor is responsible for more than 50,000 square feet of floor space, nearly double the square footage typically assigned to each individual in the standard estimating guides. Despite the enormity of the task, this group continues to perform well. A flat budget over the last few years has resulted in a gradual decline in the number of janitors available to perform this amount of work. Without additional resources, service intervals are expected to be lengthened.

Decontamination Laundry

The Decontamination Laundry cleans, sorts, issues and distributes radiologically contaminated and noncontaminated clothing items to employees engaged in maintenance, operations, or research activities at the Laboratory. Because of the nature of the work at the Laboratory, company-provided

clothing is essential. Radiological and other contaminants cannot be permitted to leave the plant site. Last year, the Laundry again processed approximately 500,000 pounds of clothing for more than 1200 employees who have chosen to use their services.

Employees working in the laundry will be challenged to reduce the cost of cleaning clothing due to increased costs for everything else. Alternatives will be explored, including polyester/cotton blends that will make pressing clothing unnecessary. New business will be sought with Bechtel Jacobs, Foster-Wheeler, and their subcontractors. First-class service will continue to be provided to major customers and long-term relationships will be cultivated to ensure steady or increasing levels of work. Initiatives during the year typically concentrate on cost containment and process improvement. Employees and staff within the Laundry routinely meet to discuss methods to improve through-put while reducing the cost-per-pound total. These efforts will continue to eliminate those costly actions and activities which add no value to the final process.

Garage and Transportation Services

The ORNL Garage routinely provides service to 550 cars and light-duty trucks, 60 pieces of heavy equipment, and more than 40 standby generators. These tasks involve tune-ups, oil changes, and general service required to keep the equipment in a safe and efficient operating condition. The talent of these individuals has been recognized by a researcher in the Computer Science and Mathematics Division over the last couple of years. Interested in developing computer models able to determine the crash worthiness of automobile and truck designs, garage mechanics completely dismantled a Ford Explorer and an Audi sedan. The researcher then digitized all of the vehicle's structural components, and the information was entered in a computer program that predicts how the vehicle behaves in a crash. The Ford Explorer has been reassembled and is in limited use at the Laboratory, and mechanics are awaiting instructions to reassemble the Audi. The researcher hopes to crash test the Audi, after reassembly, to validate the computer simulation. This work is an outstanding example of how on-site maintenance forces can team with research personnel to assist in research projects.

2.1.6 Information Systems and Technology

Enhancements to the Facility and Maintenance Management Information System (FAMMIS) were implemented in support of ISM. The job hazard evaluation checklist format was fully integrated into the job planning modules of the system. The master equipment list and location data were expanded to include more hazard and control identification for use in scheduled preventive maintenance and repair jobs. Other changes related to job grading criteria were implemented in support of the new P&E work control procedure.

Other significant FAMMIS changes were implemented to improve system efficiency and functionality. A significant enhancement combined the initial job request and planning screens to improve system efficiency. A job history report was implemented that allows retrieval of equipment and job history, in summary and detailed formats, by multiple criteria. The implementation of the Facility and Operations model service request with the "trouble ticket" option for quick response to minor maintenance jobs was completed in preparation for the pilot in October 2000.

Additional Web-based applications were developed to support the ISM implementation. The P&E Lessons Learned Tracking System was developed to track the review and application of lessons learned. The system tracks locally developed lessons, as well as dissemination of complex-wide lessons, and allows for search and retrieval of information by word. A database was implemented to store and track P&E's Tailgate Safety Meeting messages to allow easy retrieval of past messages and quick dissemination of the information to division personnel. The Safety Improvement Team (SIT)

database and tracking system was enhanced with an automated notification to the responsible manager when a new safety concern is entered by the ATLC safety representatives. Open concerns are tracked to resolution in the system.

The FAMMIS web application has proven to be a very successful tool for the preventive maintenance (PM) program customers. Facility personnel can easily access PM information to check the status of the facility equipment and the maintenance to be performed on that equipment. There is detailed task history associated with each piece of equipment back to January of 1999. Additional history back to 1996 is also available from the previous PM System that was replaced by FAMMIS last year. There are multiple reports to assist maintenance and facility personnel in determining frequency of task scheduling, the supervisor responsible for equipment maintenance, the individual who performed the maintenance work, and the equipment scheduled for maintenance in the near future. Additional reporting features have also been implemented to help supervisors track their PM work accomplishment and schedule performance.

Work continued on the project to update equipment and route map information and replace labels for items in the PM program. Digital photographs are also being taken of each item. Approximately one third of the equipment has been reviewed and relabeled.

2.1.7 Predictive Maintenance Program

P&E's Predictive Maintenance (PdM) Program has continued to grow in the past year. A major project was begun to apply PdM technologies in the Central Complex. Although not fully implemented, the project has proven beneficial in troubleshooting implementation hurdles and gaining more field support for the technologies. Future activities will provide good lessons learned, a safer working environment and further the acceptance of these technologies in everyday facility infrastructure maintenance and research support activities performed by P&E. Another project that has provided an opportunity for application of new technologies was initiated in partnership with our predictive maintenance tool vendor in a test project of wireless vibration sensors. Wireless sensors have been installed on a cooling tower that maintenance personnel cannot normally access during operation. The preliminary results have been very positive in providing experience with applying predictive technologies to improve efficiency and worker safety.

Predictive maintenance technologies have continued to enhance P&E's support of ORNL research and infrastructure. If not for the latest handheld machinery analyzer technology (CSI 2120-2 Machinery Analyzer) and the vision of a P&E work crew, a pump that provides air-conditioning support for the Building 4500N computer complex would remain in jeopardy. This chilled water pump is an electric-motor-driven centrifugal pump located in Building 4509. The data collection and analysis process made it simple to determine the primary vibration fault was due to the motor-to-base integrity (the motor was not sitting flatly on all four corners.) Repairs to this pump were frequent and incomplete until P&E began utilizing routine vibration data that was collected with the CSI 2120-2 Machinery Analyzer. In another case, Building 3144 research personnel contacted a P&E maintenance supervisor concerning a small exhaust fan that had been recently replaced. This fan was used to exhaust the experimental chamber at the Roof Research Center. This is the chamber that tests building materials that change from extremely hot to cold temperatures quickly. The new fan vibrated excessively when operated under the same conditions as the old unit. Initially, the customer and field maintenance personnel thought the fan needed to be balanced. The vibration analyzer quickly determined the fan was not out of balance, and through a series of readings, some inexpensive quick fixes were suggested. The final suggestion was that researchers avoid specific speeds because of resonance vibration from the research chamber.

The P&E project to implement predictive maintenance technologies into the Central Complex has continued to progress. The equipment preparation has taken longer than anticipated, primarily because employee safety is the first priority. Several supply fans that normally would require individuals to enter a plenum to take vibration data are being hard wired to a common location outside the plenum to permit the individual to safely collect routine data. The maintenance areas are being reconfigured and, even though this presents an obstacle to the project, there is a positive aspect to the record keeping as a result of this change that appears to make the inconvenience worth the wait. The project has provided lessons learned that can be applied to facilitate implementation of PdM technologies across ORNL.

An additional project was performed in partnership with our predictive maintenance tool vendor to test wireless vibration sensors. Wireless sensors have been installed on a cooling tower that, normally, maintenance personnel cannot access while it is in operation. There have been some unique problems such as trying to send or receive a signal through 3-foot-thick concrete walls. The preliminary results have been very positive and exciting. In the industrial work place, the application possibilities of this wireless technology are plentiful, considering motors, gearboxes, and other rotation devices are unsafe to have operating in personnel areas. The opportunity to work with new technology is unusual for maintenance personnel and has been welcomed by P&E staff.

2.2 FUNDING CHANGES

The total P&E Overhead/Space Charge Budget for FY 2000 was $17,255K. This budget was established by the Overhead/Space Charge Budget Committee at ORNL and does not represent the total budget that may be allocated through DOE for all maintenance-type activities conducted within the P&E Division. The budget was increased $2M in May 2000 for Laboratory Revitalization and funded facility repairs, maintenance, and upgrades. The cost to customers during FY 2000 was $54.98 per hour.

2.3 ASSESSMENTS

Internal ORNL groups perform regular assessments on various aspects of P&E activities and/or facilities. Fire Protection Engineering staff performed periodic facility inspections throughout the year. The findings from these assessments are tracked to closure in the Laboratory Issues Database System (LIDS). Upon completion, a 100 percent verification of closure is performed by Fire Protection Engineering personnel. The Office of Environmental Protection also assesses P&E activities in regard to compliance with Resource Conservation and Recovery Act (RCRA), Toxic Substances Control Act (TSCA), NPDES, Clean Air and Water permits, Industrial Waste Compliance, etc. P&E is issued internal noncompliances for any problems that are noted, and corrective action is taken to resolve the deficiency.

The largest number of assessments of P&E work occurs through the P&E self-assessment program. The objectives of the P&E self-assessment program include evaluation of achieving the mission and strategic objectives of the division and continual upgrade of the quality of operations, programs, services, and activities. These objectives provide for the highest levels of environmental compliance and the health and safety of workers and the public. The results of assessments are evaluated by management, areas for improvement are identified, and changes are initiated as required. Continuous improvement is achieved by understanding and evaluating internal and external customer expectations. Self-assessments are performed on P&E activities, with emphasis on areas of risk to safety, health, quality, and the environment. P&E implements the program through audits/

surveillance, surveys, performance indicators, management by walking around, and other formal self-assessment activities. During the year, the composition of the self-assessment steering team was changed to consist of staff from the P&E business management group, which provides a broad view from health and safety, quality, and business management professionals. The members have many years of combined experience in conducting and evaluating assessments.

Fifty-seven self-assessment activities were reported as closed during the period October 1, 1999, through September 30, 2000. Topics included waste certification activities (lamp, used oil and scrap metal recycling, waste acceptance criteria), chemical safety management, lockout/tagout, procedure program status, training compliance, issue closure objective evidence files, ISMS practices, fabrication and inspection activities (slings/chokers, Boot Shop, cranes, spent nuclear fuel canisters), program documentation review, P&E self-assessment program, quarterly work center ESH&Q inspections, measuring and test equipment, in-process job observations, air permit documentation, radiological work permits, small purchase credit card use and documentation, and accounting practices. Self-assessment deficiencies were corrected on the spot where possible. A method for efficiently tracking open self-assessment actions is being implemented.

3. FY 2001 WORK PLANNED

3.1 INTRODUCTION

With guidance from Laboratory management, P&E developed the FY 2001 Overhead/Space Charge Budget based on a needs assessment approach. Each Overhead/Space account was justified based on specific maintenance and operation requirements and appropriate manpower evaluations. The FY 2001 budget of $18,055K is the cumulative Overhead/Space Charge for facilities at both the ORNL and Y-12 sites.

Cost data for FY 2001 work planned are shown in Table 4.1. The total anticipated budget of $15,736K represents expense-funded maintenance at the ORNL site.

3.2 INITIATIVES

Work on capital and line item projects will continue to completion. Additionally, a number of new initiatives are scheduled to begin during FY 2001 if funding remains available. Once funded, the FY 2001 projects will be started and worked in conjunction with all the other ongoing projects and initiatives. P&E Division personnel will provide support for these projects in many ways, ranging from design input to final tie-ins.

3.3 DEFICIENCIES

The difference between the targeted funding level and the needed funding level will contribute to the following impacts and deficiencies:

- Although we have received some limited funding through the Overhead/Space Charge Budget cycle, implementation of DOE Order 430.1A may not be accomplished. We are taking a graded approach and implementing the order as funds allow.

- Staffing resources in the Technical Training Department will be redirected to accomplish tasks that are being identified due to changes in regulatory requirements and ongoing organizational restructuring. Full compliance with DOE Order 5480.20A will not be possible with the expected level of funding, although a graded approach will be utilized in implementing those portions of the order as funds allow. Efforts will be focused on identified nonreactor nuclear facility analyses to support training requirements.

- Corrective Maintenance Backlog will continue to increase.

3.4 ANALYSIS OF IN-HOUSE WORK FORCE

Details of the FY 2001 In-House Work Force are shown in Table 4.1.

3.5 TRAINING

Reduced funding authorizations and elimination of several P&E Training positions will require further shifting of program conduct and oversight to the Office of Training Services and clarification of agreements with the operating organizations. ORNL nuclear facilities will have direct responsibility to assure P&E personnel are trained and qualified on facility-specific work processes and equipment in accordance with the order. Memoranda of Understanding (MOUs) are being added/revised to clarify this policy. Implementation of the MOUs are the responsibility of the Office of Training Services. P&E will assure personnel are trained to work safely and in compliance with ES&H regulations.

Training initiatives for FY 2001 will include the following:

- Assure facility-specific training is provided to P&E personnel, as appropriate, to comply with DOE Order 5480.20A and 10 CFR 830.120.

- Continue to monitor and evaluate ES&H issues and provide training as appropriate. Identify and provide training to comply with ES&H regulations.

- Continue actions to more fully involve local area managers and supervisors in the training process, thereby allowing more control of training activities at the work center level.

3.6 UTILITIES AND RESERVATION SERVICES

HVAC and Central Chilled Water Operations

HVAC Maintenance at ORNL provides PM, PdM, and corrective maintenance for comfort and process heating and cooling equipment located throughout ORNL. There are 3,763 pieces of refrigeration equipment at ORNL with an estimated cooling capacity of 17,000 tons.

The operating budget provides labor and material to maintain everything from drinking fountains and window air conditioners to microprocessor-controlled chilled-water systems utilizing direct digital controls. Fourteen cooling-tower systems, 37 chilled-water systems, and 58 hot-water systems are monitored for corrosion control and microbiological fouling.

Additional requirements are being imposed by the U.S. Environmental Protection Agency (EPA) that impact maintenance spending and work activities. Any piece of equipment that contains more than 50 pounds of any refrigerant, and has a leak that exceeds the allowable leak rate, must be repaired or replaced within 30 days from the date the leak was discovered or should have been discovered. ORNL has 68 refrigeration units containing more than 50 pounds of refrigerant, and 40 of those have exceeded their expected life. As these units continue to age, they become less reliable and more susceptible to leaks.

Thirty percent of ORNL's electrical utility budget of $13.2M is used for air conditioning. Nearly $3M of that amount is used to cool outside air used in laboratories and offices. Efforts should be increased to improve efficiencies where there are high returns on investments. Calibration of controls and replacement of valves and dampers will eliminate simultaneous heating and cooling that is found throughout ORNL's once-through air systems.

Steam Plant

As ORNL alignments, organizations, and responsibilities are changed, opportunities to evaluate basic operating assumptions will likely become available. We must be flexible enough to recognize opportunities and take advantage of those that promise overall improvements to our operations.

Capital funding limitations continue to push benefits from the No. 6 Boiler Project out another year. Switch-over from coal to gas is occurring but at a slower pace than first planned. The fuel oil storage tank was completed this year and is in operation. Demand for the limited capital funds budget has impacted the procurement and installation of a standby generator that is needed to fire the No. 6 Boiler during power outages. It is hoped that priorities can be shuffled to allow funding for this improvement this year. An additional constraint is the increased cost of natural gas. Gas prices are much higher than could have been anticipated and this additional cost will require plant operations personnel to closely monitor expenditures throughout the year. The challenge will be to keep steam costs at a reasonable level while still maintaining plant safety and reliability.

Water Distribution System

As the water system and its components continue to age, maintenance efforts to replace valves and fire hydrants continue to increase. Small-diameter steel lines serving buildings built in the 1940s and 1950s have reached the end of their expected life and will continue to fail at an increasing rate. Cast iron service lines pose a different set of problems as failures are more likely to occur during weather extremes. An experienced repair crew continues to be a plus, as these individuals routinely display their ability to safely and quickly restore service to Laboratory customers. This crew's expertise was highlighted this year as two critical tie-ins were made when the main 24-inch line was relocated for the SNS construction. This line is ORNL's only water supply and any impairment or outage on the line must be kept to a minimum. ORNL forces worked with SNS personnel to develop plans that would expedite the tie-in process and keep the required service outages to less that 12 hours. The ORNL craft crews displayed their expertise in front of a group of onlookers that included SNS and contractor personnel, as well as a representative from the DOE/State of Tennessee Oversight Office. All were impressed with the degree of professionalism displayed and the speed and orderly manner in which the work progressed. The outages, originally expected to last 12 hours or more, were reduced to less than 8 hours each, thus minimizing the probability that they would impact ORNL operations and research activities.

The lack of accurate as-built documentation on underground utility systems and facilities continues to be a problem. Excavation permits can only serve to inform and protect operating and maintenance personnel if a review has identified all known interferences. The current status of both as-built information and the Area Atlas does not allow us to quickly and easily provide personnel with the information needed to safely perform their jobs. Area Atlas sheets must be updated to incorporate all known data. An initiative is underway that should improve this situation. A contractor is currently surveying the Sanitary Sewer System as part of an SNS support project. This survey will give us accurate, as-built information on much of this system. Another concept being discussed is to use Global Positioning System (GPS) technology to develop as-built information. The current concept has operations and maintenance personnel using GPS devices to locate water valves and fire hydrants during normal operations and underground lines and structures during repair activities. This information will be fed into a database to allow the development of an accurate picture of ORNL's underground systems. It is recognized that this approach will take years to provide information on the entire system, but it does hold a great deal of promise as this technology further develops.

Steam Distribution System

Two potential problem areas still exist on the steam system: the central portion of the Laboratory between Third and Fifth Streets and the singular line to the facilities in Melton Valley have not been upgraded. The changing mission and eventual decommissioning of facilities in the central area of the Laboratory may make an upgrade of this part of the system unnecessary. If many of these old facilities are demolished or otherwise removed from the property list, steam service may not be required.

Facilities in Melton Valley are expected to be in operation for the foreseeable future and an upgrade of their steam supply will be needed within the next 15 years to ensure reliability. We are monitoring developments in this area to determine the best course of action. It is possible that a number of smaller boiler systems serving one or two buildings or processes may be the most economical means of providing continuing service. This will be evaluated by a contractor currently beginning work on an Energy Saving Performance Contract for ORNL.

Compressed Air

The compressed air production system is one of the most modern of all the systems operated by the Steam Plant with the exception of the air dryers. These desiccant-type dryers, while still operating effectively, are over 40 years old. Repair and replacement parts are no longer available in most instances, and maintenance personnel are required to use their creativity on a more frequent basis when making needed repairs. A new 3000-cfm air dryer has been identified on the capital equipment list and should become a priority if we are to continue to consistently supply high-quality air to research customers at the Laboratory.

Sewage Collection and Treatment

The agreement with the City of Oak Ridge that allows us to send some of our sewage sludge to them for inclusion in their sludge land farming contract continues to be a positive. We hope that further sampling and system improvements will further reduce the amount of ground-based radiological contamination that is finding its way into the collection system and will allow us to eventually dispose of all the sludge generated at the plant in this manner.

The new computer model will be an important tool that can be used to identify plant and system improvements. While there are no plans to increase the population loading on the plant, the new facilities will concentrate population in areas not previously occupied. These impacts must be evaluated before any new facility comes on line to ensure that we can continue to operate our wastewater plant within permit parameters.

Natural Gas Distribution System

A project has been proposed to rehabilitate the underground portion of the natural gas system using trenchless technology. Because the gas lines run through some of the oldest areas of the Laboratory, it was thought that the cost associated with excavating and replacing the natural gas lines would be prohibitive. The proposed project will only excavate at valves and elbows along the line and will use an internal lining process to rehabilitate the steel pipe. New valves would then be added to complete the upgrade. Other than the Steam Plant, there are only a few users of natural gas at the Laboratory. Because of the limited use of gas by researchers and other processes at the Laboratory, it is suspected that obtaining funding for any upgrade of the system will be difficult. There is a limited amount of capital funding available in the Laboratory, and obtaining support for projects with limited application and benefit is difficult to justify.

Electrical Distribution

The SNS will continue to call upon ORNL forces to provide electrical support work. The line crew has a reputation for doing outstanding work and has given the SNS project first-class support thus far. It is expected that as the project progresses, ORNL forces will be called upon to perform quick-turnaround tasks suited to their capabilities.

Foster-Wheeler will be constructing a new waste packaging facility in the southern area of the Laboratory. ORNL electrical crews have already been working on upgrading electrical circuits in the area in preparation for this project and to support ongoing decontamination and decommissioning work at waste sites throughout the southern portions of the Laboratory. ORNL forces expect to be called upon to perform a substantial part of the electrical system upgrade work associated with this project as it is expected that the completed facility will use over 2 MW of power in their operations.

Bechtel-Jacobs and Waste Management Federal Services support work continues to be strong. A number of planned and ongoing waste and remedial action type projects have called upon ORNL electrical forces for support. It is expected that the volume of this work will decrease somewhat this year but will still remain an important part of the total mix.

ORNL continues to attempt to justify taking over operational responsibility for its 0901 Substation. This main substation provides power for all Laboratory operations and research activities. Its operation and maintenance have long been the responsibility of the Power Operations Group now located at the Y-12 National Security Complex. ORNL has always had responsibility for funding major maintenance at the substation, as well as funding all capital improvements. We pay Power Operations a fee based on their total cost per month apportioned to ORNL and based on our portion of the total power bill. We have long thought that ORNL is not getting a level of service commensurate with the amount of money being charged. This, coupled with the change of contractors at both ORNL and the Y-12 National Security Complex and the desire to reduce operating costs, may provide the impetus to allow ORNL operations and maintenance forces to assume responsibility for the substation.

The new organizational structure will create a very competitive environment for the quality workers in the division. Much of the electrical work being considered requires those craftspeople with the highest skill levels and best work ethic. We will be competing with many other groups for these quality workers. It may be difficult to get and keep some of the work we have been looking at within the customer divisions.

Roads and Grounds

This department will be challenged to meet expectations. A flat funding profile will combine with increases in the labor and fringe benefits rates, the space chargeback, and new materials and procurement taxes to reduce the resources available to perform assigned tasks. Employees are examining means of reducing the level of effort and associated costs, as well as identifying areas where direct charge for services can be justified. The number of acres of primary and secondary lawns will be reduced where it makes sense to do so. We will seek methods to improve the efficiency of our grounds maintenance personnel by examining standards provided by the Professional Grounds Management Society, R. S. Means, and the Navy and by keeping abreast of the most recent developments in grounds maintenance equipment and techniques. Supervisors will be asked to closely monitor current work practices to determine areas where improvements can be made and efficiency improved. Special attempts will be made to reduce the amount of hand trimming needed. Priorities must be established for all work to determine those tasks which must be performed and the level of

effort which should be applied in order to meet acceptable performance levels. A grounds maintenance study completed in 1983 is being reviewed to verify data and update it as needed and will be used to evaluate proposed changes in operations.

Another dry summer and fall this year have resulted in a kill-off of many decorative and ornamental trees and shrubs. Considerable effort will be required to cut down and remove these landscape items and replace them where they enhance Laboratory appearance.

The organization realignments may impact this department's ability to perform its work. Like other groups, it will be forced to compete for the quality workers. Grounds maintenance is performed year-round with little regard for the weather. This makes such work unattractive, and many individuals will resist working these jobs. Trying to man these tasks as we compete with other groups for a fixed work force will be a challenge.

4. COST DATA

The Annual Maintenance Work Plan cost elements are shown in Table 4.1. FY 2000 expense work cost data are actual cumulative labor, material, and effort costs for facilities at the ORNL site through September 2000.

Full-time equivalents (FTEs) are calculated on the basis of a standard chargeout rate and 1760 productive hours in a person-year. Data for FTEs includes only those employees in the P&E Division that charge to maintenance-type activities. Actual material costs comprised 3.2 percent of total expenditures. Although 193 FTEs represent the P&E Division support of maintenance-type funded activities, there were 648 employees in the division as of September 30, 2000. The balance of these employees are involved in Research Services, Fabrication, and Utilities. These activities are directly funded through customers who utilize these services. Capital-funded work consists of P&E effort costs charged to capital work.

Table 4.1. Annual Maintenance Work Plan cost elements ($ in thousands)

Cost elements	FY 2000 actual	FY 2001 budget
1. Expense-funded maintenance		
A. In-house work (FTEs)	180	183
B. In-house work effort ($)	14,954	15,736
C. Contracted ($)	0	0
Total ($)	14,954	15,736
2. Type of expense-funded maintenance		
A. Building Maintenance at ORNL Site		
1) In-house work (FTEs)	101	103
2) Corrective ($)	7,423	7,957
3) Preventive ($)	1,584	1,631
4) Predictive ($)	240	240
5) Other ($)	241	338
Subtotal ($)	9,488	10,166
B. Management and Support		
1) In-house work (FTEs)	79	80
2) Custodial ($)	2,629	2,265
3) Roads and grounds ($)	1,700	1,567
4) Other ($)	1,137	1,738
Subtotal ($)	5,466	5,570
Total ($)	14,954	15,736
3. Capital-funded work		
A. In-house work (FTEs)	13	13
B. Plant ($)	1,119	1,119
C. Capital equipment ($)	0	0
Total ($)	1,119	1,119
4. Maintenance Division total (1+3)		
A. In-house work (FTEs)	193	196
B. Expense and capital ($)	16,073	16,855

APPENDIX G

Waste Management and Environmental Restoration

WASTE MANAGEMENT AND ENVIRONMENTAL RESTORATION

G.1 WASTE MANAGEMENT

On February 1, 1999, Bechtel Jacobs Company LLC assumed responsibilities for waste storage, transport, and disposal at ORNL. Most of the functions previously performed by the ORNL Waste Management Operations Division transitioned to Bechtel Jacobs Company LLC.

To ensure that ORNL waste is properly characterized and certified to meet all requirements and to assist ORNL in getting its waste ready for receipt by Bechtel Jacobs Company LLC, ORNL established an organization called Laboratory Waste Services (LWS), which has two major groups: (1) Planning and Administration and (2) Waste Characterization and Handling.

The Planning and Administration Group focuses on day-to-day operations; strategic planning, including up-front waste management planning with new generators, such as the Spallation Neutron Source Division; the interface with Bechtel Jacobs Company LLC and its subcontractors; and waste management performance measurement. The pollution prevention and recycle position integrates and coordinates these functions for ORNL.

The Waste Characterization and Handling Group focuses on assuring that waste is adequately characterized, packaged, and certified for transfer to Bechtel Jacobs Company LLC or its subcontractors for treatment, storage, or disposal. In addition, they operate a consolidated 90-day area and schedule all waste transfer to Bechtel Jacobs Company LLC.

Another organizational element, the Waste Certification Office, is part of the Quality Services Division.

ORNL's wastes are managed in seven categories: conventional, low-level radioactive, transuranic, hazardous, mixed, toxic, and classified. This section discusses the sources of these wastes and the facilities for treatment, storage, and disposal.

G.1.1 Conventional Waste

Conventional wastes include sanitary/industrial wastes, sanitary sewage, process wastewater, and stormwater. Solid conventional wastes are regulated by the Tennessee Solid Waste Management Act.

Sanitary/Industrial Wastes. See Appendix I.

Sanitary Sewage Collection and Treatment. See Appendix I.

Process Wastewater. The collection system consists of a series of underground pipes where process wastewater flows from the source facility to a pumping station for transfer to the Process Waste Treatment Complex - either Building 3544 (for radiological treatment) or Building 3608 (for nonradiological treatment). At strategic points throughout the collection system, manholes are equipped with alpha and beta-gamma radiation monitors, pH monitors, and flow monitors that are continuously monitored at the Waste Operations Control Center (WOCC) to allow personnel to detect any unusual activity within the system. Wastewater goes to either the radiological or nonradiological

treatment process based on radiation limits monitored at these manholes. Wastewater going to radiological treatment is transferred to the storage tanks (two 350,000-gallon and one 1,000,000-gallon capacity each) at Building 2600. An underground pipe is used to transfer the wastewater to Building 3608 for water softening prior to its transfer to Building 3544 for radiological treatment.

Process Waste Treatment Complex - Building 3544. The process equipment installed for the Building 3544 operations was originally sized on a process water design flow rate of 200 gallons per minute (gpm). In early 1997, modifications were made to Building 3608 to relocate the water softening operation from Building 3544 to the spare clarifier at Building 3608. This modification allowed personnel to achieve treatment rates of 300-350 gpm at Building 3544. This modification was placed in service in the spring of 1997 after an extensive test and evaluation. The existing clarifier and filter press at Building 3544 were placed in standby for usage during maintenance of the system at Building 3608.

The process consists of three basic operations: precipitation, filtration, and ion exchange. The first two of these, together called head-end treatment, utilize conventional water-treatment equipment: a static in-line pipe mixer, a sludge-blanket type precipitator-clarifier, and pressure filters. The ion-exchange equipment is tailored to the process and based on criteria developed during the pilot plant operations. There is also the capability, when needed, to treat up to 180 GPM of wastewater through a chabazite zeolite resin for the removal of radioactive cesium.

Process Waste Treatment Complex - Building 3608. This facility was designed to treat process wastewater from the Process Waste Treatment Complex - Building 3544, 4500 Area, 2000 and 1505 areas, and the HFIR/REDC site for the removal of particulates, heavy metals, and organics, as well as to adjust the pH of the wastewater before discharge to White Oak Creek. Building 3608 was designed to segregate its incoming waste streams into two streams: one containing heavy metals and one not containing heavy metals. At the facility are two 325,000-gallon surge tanks: one receives heavy metals wastewater, and the other receives the nonmetals wastewater. The facility consists of the following unit operations: precipitation, filtration, air stripping, treatment through granular-activated carbon columns, and pH adjustment.

Building 3608 has the capacity to treat up to 760 gpm (1.1 Mgd) of wastewater. This facility is operated 24 h/day, 7 days/week. The plant is controlled using a computerized control system, which allows the operator to monitor and control the plant operations either from the Building 3608 control room or from backup control consoles at other waste management facilities which are manned 24 h/day, 7 days/week.

In late 1996, modifications were made to route process waste from the surge tanks at Building 2600 to Building 3608 for water-softening prior to treatment at Building 3544. This was done because of mechanical restrictions limiting the throughput of the existing water-softening process at Building 3544 to no more than 200 gpm. With the modifications to Building 3608, the water-softening throughput was increased to over 300 gpm; this reduced a significant throttle point in the process waste system operations. The modifications included installation of piping to allow the water from Building 2600 to bypass the metals tank at Building 3608 and go directly to the clarification process. One of the clarifiers was modified for water-softening operations. A new surge tank and feed pumps to transfer the softened water to Building 3544 for further treatment were also installed. The modifications were declared fully operational in the spring of 1997.

G.1.2 Liquid Low-Level Waste System

The Liquid Low-Level Waste (LLLW) system/facilities are located throughout ORNL–the LLLW storage tanks are located near the LLLW source buildings; the LLLW Evaporator Facility is located near Third Street, between Central and White Oak Avenue; and the Melton Valley Storage Tanks (MVSTs) and LLLW Solidification Facility are located in Melton Valley.

LLLW Collection Tanks

Bethel Valley. The ten collection tanks currently in service in Bethel Valley are fabricated of stainless steel and were all installed in the early 1950s. These tanks vary in capacity from 1000 to 4600 gallons. Most tanks are buried underground on a concrete saucer provided with a sump at its low point. A well extends to the surface of the ground in order to permit sampling and monitoring for the detection of leakage from the tank. Crushed stone is packed around the tank above the concrete saucer to the tank top. At least 5 ft of earth provides shielding above the tank top. A replacement tank for 2026A was placed in service in April 1996. This tank (F-1401) is double-contained in a stainless-steel-lined concrete vault with leak detection and meets all requirements of the Federal Facility Agreement (FFA) for the LLLW system.

Melton Valley. There are five underground collection tanks in Melton Valley that were designed and installed, somewhat later, similar to those in Bethel Valley. All are horizontal tanks and have capacities ranging from 10,000 to 15,000 gal. Tanks WC-20 and F-1800 are located in a stainless-steel-lined concrete vault. Only Tank F-1800 receives programmatic-generated waste; the other four tanks have been removed from service by the FFA for the LLLW system.

The HFIR LLLW tank, is a 13,000-gallon LLLW collection tank that was installed in 1961. This tank, which is installed below grade, is fabricated from 772-R-2 high-chromium steel and is encased in concrete. This tank was removed from service on November 30, 1997, when the Melton Valley LLLW CAT Line Item completed modifications to Building 7900 that allowed personnel to discontinue generation of LLLW.

The two 15,000-gallon collection tanks, T-1 and T-2 at Building 7567, were installed in 1962. They are all-welded vessels fabricated of type 304L stainless steel. Both of these tanks, which provide an intermediate hold-up point for liquids from the HFIR LLLW tank until they can be transferred to the LLLW Evaporator Facility in Bethel Valley, are buried directly in the ground on concrete saucers and are provided with dry wells for sampling and monitoring. Building 7567 also includes the transfer pumps used to transfer Tanks T-1, T-2, and WC-20 to the LLLW Evaporator Facility. These tanks no longer receive any programmatic-generated waste as of November 30, 1997.

In 1981, WC-20, a 10,000-gallon collection tank (located at Building 7569), was installed in Melton Valley to serve Buildings 7920 and 7930 (the REDC). This tank is fabricated of 304L stainless steel and is installed in a reinforced underground concrete vault which is lined with stainless steel to provide secondary containment. Before this tank was installed, the REDC was serviced by T-1 and T-2. This tank was replaced by F-1800 on September 30, 1997, and is no longer in active service.

Tank F-1800 (located at Building 7966) is a 10,000-gallon collection tank located in Melton Valley to serve Buildings 7920 and 7930 (the REDC). This tank is fabricated of 304L stainless steel and is installed in a reinforced underground concrete vault which is lined with stainless steel to provide secondary containment. This facility also contains transfer pumps and associated valving so that the tank's contents can be transferred to the LLLW Evaporator Facility in Bethel Valley through a double-

contained pipeline (also placed in service in September 1997). This facility meets all requirements of the FFA for the LLLW system.

Engineered Safeguards

The LLLW collection tanks are provided with liquid level measuring devices. Alarms indicating over-filling are telemetered to the WOCC, which is manned around the clock. Also, Tanks WC-20, F-1401, and F-1800 are provided with combustible gas analyzers.

With the exception of Tanks WC-20, F-1401, and F-1800, shielding and leak detection are provided by the earth fill and the presence of the concrete saucers and dry wells to collect any leakage. Tanks WC-20, F-1401, and F-1800 are doubly contained, and both the tank and secondary containment vault are provided with liquid level alarms. In all cases, the tanks are vented, either via off-gas systems or directly to the atmosphere, through HEPA filters.

LLLW Bottling and On-Site Transportation

As an alternative to the LLLW collection system utilizing a network of underground piping and tanks, LLLW is also transported by surface vehicles to the LLLW collection system for treatment. Bulk liquid wastes that are not transferred by pipeline are transported from the generating facility by tank motor vehicle to the collection header in the South Tank Farm for further transport by pipeline to the storage tanks and Building 2531 for treatment. Smaller quantities of liquid waste, such as those produced in some of the research laboratories, are bottled and transferred from the generating facility by motor vehicle directly to Building 2531 for treatment.

Vehicular Tanks. Two tanks are presently in use. The first is a 1,000-gallon flatbed-mounted tank operated by Waste Management Federal Services personnel to transport up to 800 gallons of LLLW to the LLLW collection system, where it is gravity drained to the hard-piped system. The second tank is the Building 3074 dumpster tank which is owned by the Plant and Equipment (P&E) division. Waste Management Federal Services empties this tank as requested by P&E division personnel.

Bottled Waste. Small quantities of LLLW are routinely transferred from the generators' facilities to the LLLW evaporator facility in a DOT Specification 7A Type A Bottle Package System which consists of a 2.5-gallon thick-walled reusable polyethylene bottle with a 20-gallon drum overpack.

Bethel Valley Evaporator Service Tanks

The Bethel Valley Evaporator Service Tanks (BVESTs) store evaporator concentrate and dilute radioactive liquid low-level waste. The tanks have undergone modification in preparation for a demonstration in BVEST W-21. The sludge in BVEST W-21 was mobilized using AEA Technology's fluidic pulsed jet mixing process. Cleaning of Tanks C-1, C-2, W-22, and W-23 has been completed.

LLLW Evaporator System

Two 600-gal/h evaporator systems, housed in Building 2531, are used to concentrate the LLLW. The first of these was put into operation in 1965 and the second in 1979 (the vessel was replaced in 1994 due to deterioration of the internal steam coils). The original evaporator is served by a 4400-gallon feed tank (A-1). The newer evaporator is fed directly from one of the evaporator service tanks (normally W-21 or W-22). Both evaporator installations consist of an evaporator vessel, a vapor filter, a water-cooled condenser, and a condensate catch tank. With the exception of the feed and the

condensers, the equipment in both systems is identical. The overheads from the evaporator vessels are condensed and receive treatment at the Process Waste Treatment Complex - Building 3544 for the removal of radiochemicals from the evaporation process. The 50,000-gallon evaporator storage tanks are used to store the LLLW concentrate until it can be transferred to the MVSTs.

Melton Valley Storage Tanks

Storage capacity for the concentrated LLLW has been provided by eight 50,000-gallon storage tanks installed in two underground vaults located adjacent to the LLLW Solidification Facility in Melton Valley (Building 7830, also called the Melton Valley Storage Tanks). The tanks are contained in two concrete vaults with stainless steel liners and leak detection instrumentation.

Construction of additional storage capacity for the concentrated LLLW has recently been completed with the turnover on November 13, 1998, of Building 7856 (Melton Valley Storage Tanks Annex) to Liquid and Gaseous Waste Operations Project (LGWOP) personnel. This facility, which was placed in service on December 3, 1998, after undergoing a DOE-ORO Readiness Assessment, provided an additional six 100,000-gallon storage tanks installed in individual vaults located southeast of the existing MVSTs (Building 7830). The tanks are contained in individual concrete vaults with stainless steel liners and leak detection instrumentation, which were constructed by the Melton Valley Storage Tanks - Capacity Increase Project.

Principal Process

The LLLW system at ORNL collects, neutralizes, concentrates, and stores aqueous radioactive waste solutions from various sources at the Laboratory. The Waste Acceptance Criteria (WAC) administratively limits the wastes added to the LLLW system to a total radionuclide concentration of the ingestion dose equivalent of 2 Ci/gal ^{90}Sr. The sources of these waste solutions are "hot" sinks and drains in R&D laboratories, radiochemical pilot plants, and nuclear reactors located in both Bethel and Melton valleys. With the exception of some facilities that do not contain radioactive operations, virtually all of the buildings at ORNL are serviced by this system.

The waste solutions are discharged from the source buildings to ten collection tanks, one such tank being located convenient to each building. The waste solutions, which accumulate in these collection tanks, are periodically transferred to either Tank W-21 or W-22, two of the five 50,000-gallon stainless steel storage tanks located at the LLLW Evaporator Facility. Other generating facilities are connected directly to the collection system. Tanks W-21 and W-22 are connected directly to the LLLW Evaporator systems, and their contents are transferred on a batch basis to the evaporator facility for volume reduction.

At the evaporators, the aqueous waste is routinely concentrated by a factor of 20 to 35. The radioactive concentration of the condensate is less than the feed solution concentration by a factor of 10E4 to 10E5. Evaporation is achieved by the use of steam coils located in the bottom of the evaporator vessel. The evaporators are operated in a semicontinuous manner. Raw waste is transferred by steam jet to an evaporator, and boildown proceeds at a rate of 50 lb/h/ft^2 of surface area. During this period, more raw waste is automatically sent to the evaporator at a rate controlled by the level in the evaporator vessel. Condensate from the evaporator is directed to the Process Waste System. When the specific gravity of the concentrated waste reaches a value between 1.20 and 1.25, the evaporator is shut down. Its contents are cooled and then sent to one of the 50,000-gallon storage tanks for interim storage.

The concentrate stored at the evaporator facility is periodically pumped to the MVSTs or MVST Annex for long-term storage. Transfer from the LLLW Evaporator Facility to the MVSTs is through approximately 6000 ft of double-contained stainless steel pipe. This pipe is buried in a specially prepared bed of select clay and is cathodically protected.

In September 1997, a project between LGWOP personnel and AEA Technologies was begun to demonstrate the effectiveness of their sludge mobilization system in Tank W-22 at the Evaporator Service Tanks. The process consisted of using pulse jets to get the sludge layer into suspension, and then transferring the suspended sludges to the MVSTs after the process reached steady state. Tank W-22 was emptied of sludge by early calendar year 1998, and personnel then moved to Tank W-21, whose sludge layer was also removed by early March 1998. In mid-April, personnel mobilized to begin the sludge removal from Tank W-23. Due to a higher than expected suspended solids concentration, personnel were able to empty Tank W-23 in three transfers of sludge (this allowed personnel to complete the operation 2 weeks earlier than scheduled). The last transfer was completed during the first week of May 1998. Tanks C1 and C2 were emptied during February – March 1999.

In 1989 through 1995, the supernate layer in two of the MVSTs (Tanks W-29 and W-30) was transferred to the LLLW Solidification Facility, where a commercial vendor solidified the waste in a concrete waste form to provide additional storage capacity for future LLLW operations. During each campaign, approximately 50,000 gallons of LLLW supernate was solidified. The solidified waste was sampled and characterized in anticipation of approval to begin shipments to the Nevada Test Site (NTS) for final disposal. Interim storage was provided by transferring the solidified waste forms to the Solid Waste Operations Group. The first sixty of the solidified waste forms were shipped to NTS for disposal during FY 2000. At DOE-ORO direction, no further solidification campaigns are planned. Instead, personnel will be conducting several out-of-tank evaporation campaigns to increase the storage capacity for LLLW concentrate.

The Out-of-Tank Evaporation demonstration project performed in early 1996 at the LLLW Solidification Facility consisted of processing approximately 25,000 gallons of LLLW supernate through a portable evaporator system inside the facility to further reduce the volume. Since the demonstration in 1996, four additional out-of-tank evaporator campaigns were conducted in 1998. Approximately 10,000 to 12,000 gallons of liquid were evaporated from the supernate and transferred to the process waste tanker for further treatment. The evaporator concentrate was returned to the MVSTs for storage. This was begun as a joint demonstration project between EM30 and EM50.

An additional demonstration project performed in 1997 at the LLLW Solidification Facility consisted of processing approximately 25,000 gallons of LLLW supernate through resin columns for the removal of cesium in an attempt to reduce the exposure personnel would receive during other processing operations conducted at the facility. This was a joint demonstration project between EM30 and EM50.

Beginning in FY 1998, the operation of three joint EM 30 and EM 50 demonstration projects, Out-of-Tank Evaporation, Cesium Removal, and Solids/Liquid Separations were combined under the Wastewater Triad Project. LLLW processing operations were performed by the Wastewater Triad Project in FY 1998, FY 1999, and FY 2000. The Wastewater Triad operations provided additional volume reduction of LLLW concentrate in the MVSTs in order to create additional free space in the facility to support sludge consolidation activities as well as reducing radioactivity in the processed supernate. Fourteen Wastewater Triad campaigns were completed during the three year operational life, processing approximately 300,000 gallons of LLLW and creating over 100,000 gallons of additional free space.

G.1.3 Stack Ventilation 3039 System Description

The 3039 Stack Ventilation System, which was originally built in 1950, was extensively modified and upgraded in 1984 to increase its efficiency and reliability. In 1997 several of the cell ventilation blowers and the off-gas primary blower and backup fan were replaced to increase the system's reliability. Also in early 1997 a new scrubber solution tank and associated transfer equipment was installed that met requirements of the Federal Facility Agreement for the Liquid Low-Level Waste System.

The 3039 Stack Ventilation System consists of seven collection systems, each with its own underground and/or aboveground ducting, fans, and controls. Five of these are designed to handle the cell-ventilation waste streams from limited-access areas and hot cells. The other two systems are designed to handle the off-gas from process equipment and laboratory experiments. The Oak Ridge Research Reactor pressurized off-gas system is not active and has been disconnected from the 3039 Stack Ventilation System.

The 3039 stack is a 76.2-m (250-ft) high unreinforced radial brick masonry chimney. It has an acid-proof lining utilizing a special acid-proof brick. The stack is supported on a 50-ft diameter octagonal reinforced concrete footing, cast on bedrock with a varying thickness ranging from 11-ft to 17-ft. The fans and connecting duct to the stack are located near the stack to minimize the length of duct between the stack and the fans.

The interface between the 3039 Stack Ventilation System and the buildings served is either the building isolation valve or, if no isolation valve exists, the point at which the duct penetrates the wall of the building served. However, there are several buildings whose filter systems are located in a separate housing outside the building. In these cases, the external filter system and the building it serves are considered as an integrated unit and the interface with the 3039 Stack Ventilation system is where the duct penetrates the wall of the filter housing. Safe operation of the facilities upstream of the interface with the 3039 Stack Ventilation System is the responsibility of the facility operator. Because of the diversity of the activities carried out in the buildings that the system serves, any gaseous waste stream may contain transuranic radionuclides, fission products, and hazardous chemicals whose usage is controlled by ORNL.

Radioactivity and gaseous emissions can, therefore, enter the 3039 Stack Ventilation System only if it is contained in the process off-gas or the cell-ventilation gaseous waste streams. However, the building operators, as the waste generators, are responsible for keeping the amounts of radionuclides in the gaseous waste streams that discharge into the 3039 Stack Ventilation System to levels that will limit risks to the health and safety of the public and employees. This is accomplished through a combination of administrative controls, input controls, application of health physics procedures, and treatment (usually by high-efficiency particulate air [HEPA] filters) of the gaseous waste stream prior to discharge into the 3039 Stack Ventilation System.

Principal Process

The primary functions of the 3039 Stack Ventilation System are to safely and efficiently collect process off-gas and cell ventilation gaseous waste streams from various ORNL facilities, to monitor the streams for radionuclide and hazardous material contents, and to discharge the combined streams to the atmosphere at a central location. The system is designed to provide continuous, uninterrupted operation by utilizing installed backup auxiliary fans. Operators of the interfacing buildings are notified when abnormal operation of the 3039 Stack Ventilation System occurs. Supporting services

are furnished by various ORNL organizations and safety committees that provide health physics coverage, equipment maintenance, and safety oversight.

The 3039 Stack Ventilation System off-gas and cell-ventilation facilities include various cell-ventilation, off-gas scrubber, air, water, electrical, and waste systems. These are discussed in detail in the subsections that follow. Unless otherwise stated, system components, e.g., ducts and fans, exposed to the weather and/or corrosive gases are fabricated from stainless steel, typically 304-L.

Each collection system is provided with two fans for the air or off-gas transport through the system. The cell/off-gas fan is a direct drive motor unit and is used as the normal operating unit for the system. The other fan, a steam turbine unit, is employed as a standby. However, each week, for a 15-minute period, each electrically-driven cell ventilation unit is shut down and the turbine unit put into service. In addition, the electrically-driven off-gas unit is shut down and the turbine unit put into service each day for a 1-hr period.

Each system (with the exception of the 3042 system) is instrumented such that a loss of on-site electrical power will activate both the standby fan and a 750 kw diesel engine emergency generator. When the diesel generator reaches normal operating speed, the sequencing relays will automatically restart the electrically driven fans. The steam turbine-driven fans will then automatically reset to their standby condition when the negative pressure at the suction side of the fan returns to normal.

G.1.4 Solid Low-Level Radioactive Waste

Solid low-level waste (SLLW) is waste that contains radioactivity but is not classified as high-level waste, transuranic (TRU) waste, spent nuclear fuel, or by-product material as defined by DOE Order 435.1, *Radioactive Waste Management*. SLLW does not contain hazardous waste as regulated by the Resource Conservation and Recovery Act (RCRA) and as defined in 40 *CFR* 260-268, or polychlorinated biphenyl (PCB)-contaminated or PCB-detectable waste as regulated by the Toxic Substances Control Act (TSCA) and as defined in 40 *CFR* 761. DOE Order 435.1 and the Atomic Energy Act of 1954, as amended, provide the primary regulatory guidance and requirements for the management of SLLW. Waste Acceptance Criteria have been developed to address the storage, treatment, and disposal of SLLW, and an implementing procedure to effect the WAC is in place for SLLW.

SLLW is generated throughout ORNL and is characterized by the generator, with waste certification being accomplished through the combined efforts of the generator, LWS, and the Laboratory Waste Certification Official. SLLW is staged at the generating location until the waste is certified by ORNL and accepted by Bechtel Jacobs Company LLC. Bechtel Jacobs Company LLC determines the most suitable management option for all SLLW generated by ORNL. Based on the characteristics and certification of the waste, Bechtel Jacobs Company LLC may (1) store the waste in one of several storage facilities dedicated to SLLW; (2) utilize treatment options such as compaction and incineration offered by commercial treatment, storage, and disposal facilities (TSDFs) or in-house treatment options; or (3) ship the waste to an approved off-site disposal facility such as NTS or Envirocare.

Use of the Interim Waste Management Facility (IWMF) for on-site disposal of ORNL newly generated SLLW was suspended in 1998 pending completion of the Performance Assessment (PA) and Composite Analysis (CA) for the facility. The IWMF uses tumulus disposal technology to dispose of SLLW. The waste is packaged inside a concrete or steel cask, which is placed inside a tumulus vault, and any void space within the vault is filled with concrete grouting. The vault lid is sealed with a steel-reinforced concrete cover and stacked on a concrete tumulus pad. After the tumulus pad is

filled with vaults, it will be covered with a 5-ft-thick, multilayer gravel, clay, and earthen cap. The IWMF contains six tumulus pads, four of which are loaded. A drainage system and several monitoring stations were installed to test any water running off or beneath the pads. The first pad was constructed to accommodate 324 vaults, and each subsequent pad can accommodate 330 vaults. As of April 1999, four pads at IWMF were filled. Current plans call for loading the remaining two pads with legacy waste once the Low-Level Waste Disposal Facilities Federal Review Group approves the PA and CA. During FY 2000, ORNL generated approximately 844 m^3 of SLLW. Approximately 1498 m^3 of SLLW are projected to be generated in FY 2001 including approximately 654 m^3 of SLLW associated with the HFIR Cooling Tower Project.

LLW is currently stored in multiple facilities within Solid Waste Storage Area (SWSA) 5 and SWSA 6. By mid-2004, this activity will be consolidated in SWSA 5 because of the final capping and closure of SWSA 6. During FY 2001, the orphan boxes of legacy waste within ORNL proper will be addressed. Approximately 200 of these boxes were dispositioned in FY 2000.

G.1.5 Transuranic Waste

TRU waste is waste contaminated with alpha-emitting transuranium radionuclides (atomic number greater than 92) with half-lives greater than 20 years and concentrations greater than 100 nCi/g at the time of assay. The following radioisotopes meet these criteria and are managed as TRU: Am-241, Am-242m, Am-243, Bk-247, Cf-249, Cf-251, Cm-243, Cm-245, Cm-246, Cm-247, Cm-248, Cm-250, Np-237, Pu-238, Pu-239, Pu-240, Pu-242, and Pu-244. Waste Acceptance Criteria and an implementing procedure are in place for TRU wastes.

TRU waste is generated by a limited number of generators and facilities at ORNL. TRU waste is characterized by the generator, with certification being accomplished through the combined efforts of the generator, LWS, and the Laboratory Waste Certification Official. All TRU waste is currently stored in on-site storage facilities operated by Bechtel Jacobs Company LLC. Most of these facilities are RCRA-permitted and store some RCRA-contaminated TRU waste, as well as some RCRA-contaminated SLLW that exceeds the dose limits for Bechtel Jacobs Company's other RCRA-permitted storage facilities. A very small quantity of TRU waste is also PCB-contaminated. During FY 2000, ORNL generated approximately 25 m^3 of TRU waste, which was placed in on-site storage.

TRU storage facilities in SWSA 5 and 6 will be emptied and closed between 2001 and 2008, when the waste stream achieves steady-state. All of the existing inventory will be shipped to the Foster Wheeler processing facilities in Melton Valley.

G.1.6 Hazardous Waste

Hazardous waste is any discarded material that is not excluded by 40 *CFR* 261.4(a) and that is either listed in 40 *CFR* 261 Subpart D or that exhibits one or more characteristics identified in 40 *CFR* 261 Subpart C. RCRA, as amended by the Hazardous and Solid Waste Amendments of 1984 (HSWA), regulates the generation, storage, treatment, disposal, and transportation of hazardous wastes. RCRA also regulates the facilities that conduct these operations. The State of Tennessee, Tennessee Department of Environment and Conservation, is authorized to administer its own RCRA program in lieu of the federal program, except to the extent of newly issued HSWA provisions. The State program has authorization to regulate mixed waste and RCRA corrective actions as well and is authorized under the Tennessee Hazardous Waste Reduction Act of 1990.

Hazardous waste is a waste or surplus material with negligible value that may cause or significantly contribute to an increase in mortality or to an increase in serious reversible illness or pose a substantial present or potential hazard to human health or the environment when improperly stored, treated, disposed of, or transported. Hazardous wastes are defined in RCRA by specific source lists, nonspecific source lists, characteristic hazards, and discarded commercial chemical product lists. Characteristic wastes are those which exhibit the characteristics of ignitability, corrosivity, reactivity, or toxicity, as defined in 40 *CFR* 261.

Hazardous wastes are generated throughout ORNL and are stored in generator satellite accumulation areas or in (90-day) accumulation areas operated by the generator or LWS pending pickup by Bechtel Jacobs Company LLC. Bechtel Jacobs Company LLC determines the most suitable management option for all hazardous waste generated by ORNL. Based on the characteristics and certification of the waste, Bechtel Jacobs Company LLC may (1) immediately transport the waste to an off-site commercial TSDF for treatment and/or disposal, (2) store the waste in one of several storage facilities dedicated to hazardous and mixed waste pending off-site treatment or disposal, (3) detonate the waste in the on-site Chemical Detonation Facility, or (4) utilize other on-site treatment (e.g., silver recovery from photographic wastes). Waste Acceptance Criteria and an implementing procedure are in place for hazardous wastes. During FY 2000, ORNL generated approximately 32,700 kg of hazardous waste.

Hazardous waste storage is consolidated at the Bechtel Jacobs Company LLC accumulation area in the 7650 series buildings on Melton Valley Access Road. This waste type is considered to be at steady-state, which means that all generated waste is disposed of within one year.

G.1.7 Mixed Waste

Mixed waste is waste that contains both hazardous and radioactive components and must be managed to meet the requirements applicable to both. "Hazardous" in this instance refers to both those wastes regulated by RCRA and those PCB wastes with concentrations or sources greater than or equal to 50 ppm. Like hazardous wastes, mixed wastes are generated throughout ORNL and are stored in accumulation areas operated by the generator or LWS pending pickup by Bechtel Jacobs Company LLC. Bechtel Jacobs Company LLC determines the most suitable management option for all mixed wastes generated by ORNL. Based on the characteristics of the waste, Bechtel Jacobs Company LLC may store the waste in one of several storage facilities dedicated to hazardous and mixed waste, pending determination of suitable treatment, storage, and disposal option. Many of ORNL's mixed wastes are treated in the TSCA Incinerator at ETTP. This incinerator burns mixed wastes from ORNL, the Y-12 National Security Complex, ETTP, the Paducah Gaseous Diffusion Plant, the Portsmouth Gaseous Diffusion Plant, and other sites and facilities as directed by DOE. The resulting ash is treated, as required, and disposed of at Environcare of Utah.

Few commercial TSDFs are available to process or dispose of mixed wastes. Accordingly, ORNL was unable to eliminate its inventory of mixed waste via processing or disposal prior to the transfer of waste management operations responsibilities to Bechtel Jacobs Company LLC. Transfers of mixed waste inventories to ETTP were initiated by ORNL in FY 1997 and continued under Bechtel Jacobs Company LLC in FY 1999. Waste Acceptance Criteria and an implementing procedure are in place for mixed wastes. During FY 2000, ORNL generated approximately 640 kg of mixed waste.

By 2003, mixed waste storage will be performed in the same facility area as hazardous waste. If additional storage area is required the waste will be stored at ETTP.

G.1.8 TSCA Waste

PCB Waste. TSCA waste is waste regulated by the EPA Environmental Protection Division under TSCA. In accordance with 40 *CFR* 761, Subpart D, TSCA regulates PCB materials (wastes/ contaminated equipment) based on PCB concentration. PCB materials with < 50 ppm are minimally regulated; those with ≥ 50 ppm and < 500 ppm are moderately regulated; and those with ≥ 500 ppm are stringently regulated. TSCA also regulates PCB/radioactive wastes. The majority of ORNL's PCB/rad wastes are treated at the TSCA incinerator at ETTP; whereas, other PCB wastes are sent to commercial facilities within a year of generation. ORNL is also governed by the Oak Ridge Reservation/PCB/Federal Facility Compliance agreement. In addition, TDEC regulates the disposal of PCBs > 2 ppm in State sanitary landfills.

Asbestos Waste. TSCA also addresses the manufacturing, importing, and processing of asbestos and establishes requirements for asbestos abatement projects performed by government and State employees not covered by (1) the Asbestos Standard of OSHA, 29 *CFR* 1926.58, (2) an asbestos standard adopted by a state as a part of a plan approved by OSHA under Section 18 of the Occupational Safety and Health Act, or (3) a state asbestos regulation which the U.S. Environmental Protection Agency (EPA) has determined to be comparable to or more stringent than that established in 40 *CFR* 763.120. Since ORNL does not manufacture, import, or process asbestos, and since asbestos activities are covered by an approved Asbestos Standard, any waste with asbestos-containing material (ACM) is not regulated under TSCA. ACM is either managed as sanitary waste, SLLW, transuranic waste, TSCA/RCRA, or TSCA/RCRA mixed if the ACM has come into contact with such constituents. Accordingly, asbestos will be managed as a TSCA (PCB) waste only if it has come into contact with PCBs.

Waste Acceptance Criteria and implementing procedures are in place for TSCA (PCB) and asbestos wastes. These wastes are initially stored by generators until transfer to Bechtel Jacobs Company LLC for either on-site storage or off-site storage or disposal. PCB wastes received, treated, and disposed of during FY 2000 are included in the totals for hazardous and mixed wastes.

G.1.9 Classified Waste

Classified wastes are discarded materials whose analysis or review could reveal information withheld for reasons of national security. The management of such waste is governed by DOE Order 470. ORNL generates a minute amount of classified waste. Disassociation from source or use is sometimes used to declassify certain materials.

G.2 EFFLUENT MONITORING

Liquid effluents are regulated by ORNL's National Pollutant Discharge Elimination System (NPDES) Permit issued by TDEC. Receiving streams are monitored at designated locations for both radioactive and nonradioactive contaminants. Surface water samples are collected as part of the Clean Water Act (CWA) requirements and DOE orders. In addition, monthly surface water samples are collected to determine background contaminant levels before the influence of ORNL. These samples are collected at White Oak Creek headwaters above the locations of ORNL discharges to White Oak Creek. Fig. G.1 shows the locations of the various sampling points.

All process wastewater streams were routed to the Nonradiological Wastewater Treatment Plant (NRWTP) when it began operations in 1990. This made it possible to combine five permitted and

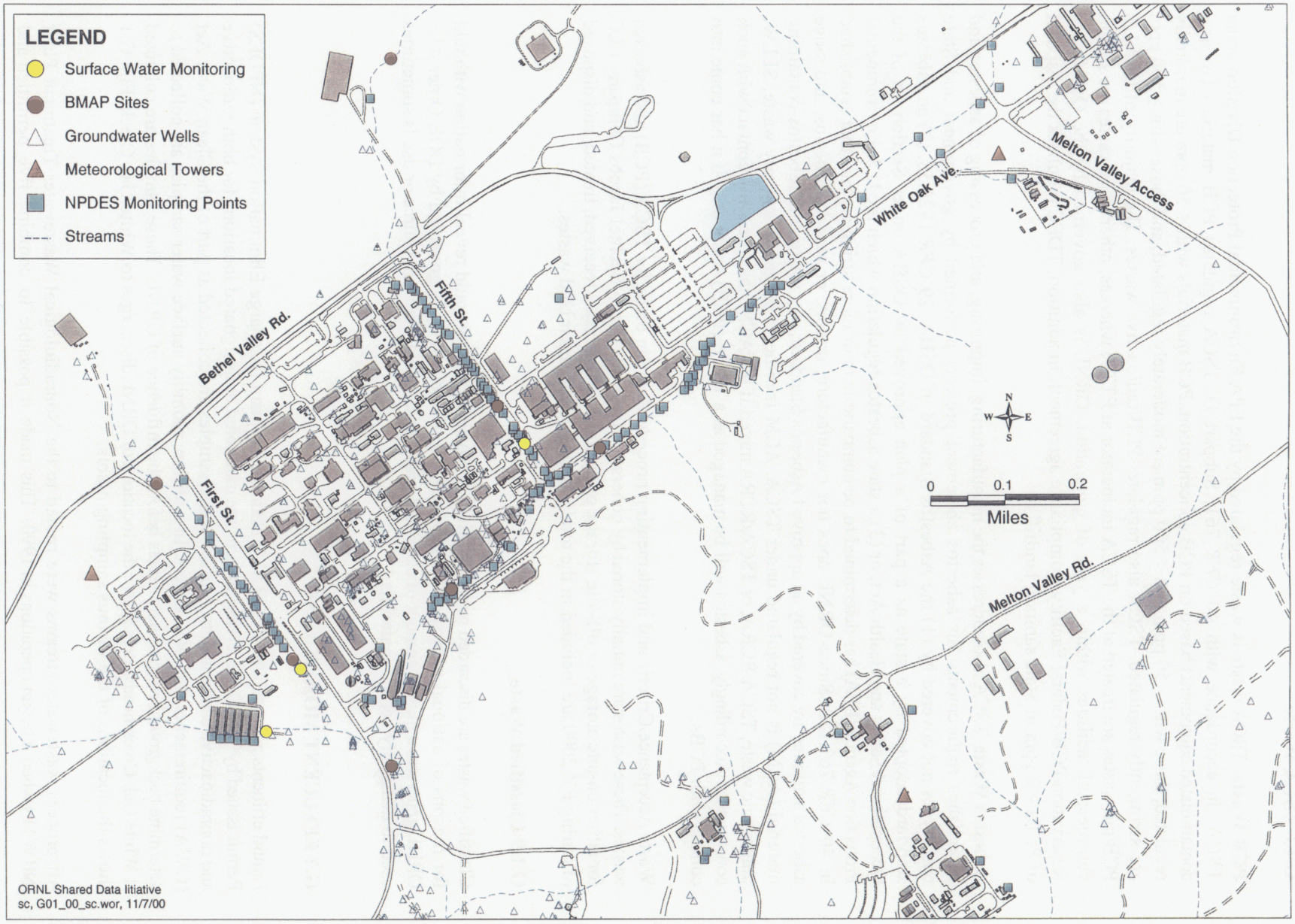


Fig. G.1. Environmental sampling locations.

monitored NPDES wastewater-discharge points into one monitored point. The NRWTP operated in total compliance with the ORNL NPDES Permit from 1990 to 1998. In 1997–1998, the NRWTP and the Process Waste Treatment Plant (PWTP) were reconfigured and combined to provide the Process Waste Treatment Complex (PWTC), which resulted in more effective, efficient treatment of ORNL process wastewaters. The PWTC has operated in essentially complete compliance with the ORNL NPDES Permit, with only a single permit limit exceedance recorded since 1998, giving an NPDES compliance rate of greater than 99%.

G.3 ENVIRONMENTAL RESTORATION ACTIVITIES AND ISSUES

The Oak Ridge Environmental Restoration Program is being performed by Bechtel Jacobs Company LLC as DOE's M&I contractor for environmental management activities in Oak Ridge. This will affect ORNL in three primary areas:

- reduction in ORNL direct scientific and support labor in project implementation;
- increased need to coordinate ORNL and Bechtel Jacobs Company LLC activities; and
- regulatory decision-making on long-term land use plans for major portions of the ORNL site.

Near-term impacts on research and support divisions have been experienced as DOE outsourced major components of the remediation program. Both the concerns related to increasing site activity coordination and the CERCLA decision-making process related to long-term land use designation for ORNL property need close scrutiny as Bechtel Jacobs Company LLC takes ownership of these issues.

EM50 remains under pressure from Congress and internal EM program managers to justify the value of past expenditures in technology development. ORNL has been one of the primary contributors in technology development and deployment over the past 8 years, and any significant reduction in technology funding will seriously affect the supporting research divisions. Successful execution of DOE's plans for facilities cleanup (documented in *Accelerating Cleanup: Paths to Closure*) will be dependent on the use of new and more cost-effective technologies. ORNL is working to maintain DOE support for the continuation of all phases of the EM technology development and demonstration being conducted through the Focus and Crosscut Areas, the EM Science Program, and the Accelerated Site Technology Deployment initiative for getting proven technologies into the field.

For the technology deployment work, Bechtel Jacobs Company LLC has been given the leadership role for technologies being deployed on its sites. This change in leadership will result in more need for the ORNL principal investigators to coordinate with Bechtel Jacobs Company LLC in proposing and implementing field activities.

G.3.1 Bethel Valley Watershed Record of Decision

The cleanup of the Bethel Valley Watershed, which includes the main ORNL site, is being conducted under CERCLA. Four regions have been established in the Bethel Valley Watershed based on area hydrology, the level and type of environmental management activities, and the knowledge that the end use of these regions may vary. These regions are

- Raccoon Creek Region (West of State Highway 95),
- West Region (from Highway 95 to the developed area of ORNL),
- Central Region (the originally developed area of ORNL), and
- East Region (the 7000 Area of ORNL).

In 2000, DOE submitted the Record of Decision for Interim Actions in Bethel Valley (BV ROD) to the regulators for review and approval as part of its CERCLA decision-making process for environmental remediation of the site. The BV ROD identifies the remediation goals for the Bethel Valley Watershed and all actions needed to meet these goals. The key issue to be addressed for the Bethel Valley Watershed is the environmental restoration strategy for the Central Region, encompassing the initial area of the site, which was developed beginning in 1943. This strategy will address decontamination and decommissioning of inactive laboratory facilities and reactors and disposition of contaminated soils and sediments. A groundwater remedy decision has been deferred except for selective source actions.

G.3.2 Gunite and Associated Tanks

The Gunite and Associated Tanks (GAATs) consist of six large tanks of 170,000-gallon capacity each and two smaller tanks of 42,500-gallon capacity, each containing residual quantities of mixed waste (radioactive and RCRA characteristic sludges; some tanks contain transuranic mixed waste). Most of the liquid and solid waste was removed in the 1980s, but a heel of sludge and other debris remained in the tanks. Additional contamination is also present in the tank walls and floors. This waste, as well as the equipment, structures, soil, and groundwater in the tank farms, represents a potential threat to human health and the environment. The GAAT Project is an interim remedial action (IRA) being performed under an FFA among DOE, EPA, and TDEC to remove the waste from the tanks. Stabilization of the tanks and associated piping, valve pits, etc. will be accomplished as part of another remedial action implementing the selected remedy in the BV ROD.

Tank waste removal has been completed. Over 400,000 gallons of waste slurry containing about 87,000 gallons of transuranic mixed waste sludge were transferred to the Melton Valley Storage Tanks where it will be treated in the Transuranic Waste Packaging Facility for shipment to the Waste Isolation Pilot Plant in New Mexico for disposal . Dismantlement of waste removal equipment and platforms is in progress. Stabilization, i.e. grouting, of the tank shells and associated piping, valve pits, etc., is scheduled for 2001.

G.3.3 Corehole 8

The Corehole 8 (CH8) Plume is the result of LLLW pipeline leaks at the inactive Waste Tank W-1A located in the North Tank Farm at ORNL. The historic pipeline leaks, discovered in the mid-1980s, have contaminated soil and groundwater adjacent to and beneath the tank and created the source for the CH8 Plume, which has spread east and west of the tank site.

Three actions have been taken over the past several years after discovery of radiological contaminant releases into First Creek at the western end of the ORNL plant site. The primary contaminants detected in the creek were ^{90}Sr and uranium isotopes. In 1995, a CERCLA removal action was initiated to collect and treat contaminated groundwater. A shallow interceptor and sump collection system was installed with the water being pumped back to a manhole for treatment at the ORNL PWTP. In early 1998, a shallow french drain collector was installed and two manholes were waterproofed to prevent infiltration into the storm drain system and ultimate release into First Creek. In 2000, extraction of contaminated groundwater was initiated from a well (Well 4411) that intercepts a portion of the plume. The extracted groundwater is being treated at the ORNL Process Waste Treatment Plant.

An additional CERCLA removal action has been initiated to stop further leaching of contaminants from the plume source into groundwater. The project will focus on remediating the contaminated soil,

Tank W1-A, and pipelines at the plume source leak site. This action is scheduled for completion in 2001.

Additional plume management, such as hydraulic control of the plume using pumping wells to control groundwater flow in the plume and slowly remove contaminants from the bedrock zone, will be addressed in the BV ROD.

G.3.4 Metal Recovery Facility Demolition

The Metal Recovery Facility (MRF) is a one-story, metal-sided building used as a pilot and small-scale nuclear fuel reprocessing plant between 1952 and 1960. Associated with the MRF are an exterior concrete canal; a small storage facility; and, interior to the facility, a dissolver pit and seven hot cells. The MRF was used primarily to recover fuel and other nuclear materials. The fuel reprocessing occurred in the building's seven hot cells; fission products were also separated out. The scope of this project is to remove the surface structure of the facility to the finish floor elevation. The walls of the dissolver pit, small storage building, and canal will also be removed to the finish floor elevation of the facility. The dissolver pit will be drained and decontaminated

G.3.5 Surface Impoundments Operable Unit Project

The Surface Impoundments Operable Unit is part of the Bethel Valley Watershed Central Region and consists of four impoundments designated A, B, C, and D. The impoundments received radioactive low-level liquid wastes generated during experiments and materials processing at ORNL. They contain radioactively contaminated sediments with the primary contaminants of concern being cesium, plutonium, cobalt, strontium, and americium. The selected remedy consists of the removal, treatment, and off-site disposal of sediments. Impoundments C and D were successfully remediated in 1998. Sediment was transferred from Impoundment A to Impoundment B in 2000. Impoundment A has been backfilled with rock and grout. Impoundment B sediment removal, treatment, and disposal will be completed in 2002.

G.3.6 Federal Facility Agreement Tanks Remediation

ORNL has a comprehensive program underway to upgrade the LLLW system to meet the FFA requirements. Those tank systems that do not meet the FFA requirements are required to be removed from service, characterized, and remediated. The FFA Tanks Remediation Project is responsible for sampling and analyzing the inactive tanks' contents, submitting these results in the Waste and Risk Characterization Data Manuals, maintaining the tanks in safe inactive condition, and remediating the tanks. As of the end of FY 1998, all LLLW tanks not meeting the FFA requirements for active service have been removed from service. The inactive tanks are remediated within the CERCLA framework: tanks with little associated risk are remediated as maintenance actions with regulatory agency concurrence, tanks with more associated risk are remediated as removal actions with agency concurrence, and tanks with more associated risk are remediated as removal actions.

A CERCLA removal action is currently in progress to remove the contents and remediate, by removal or grouting, 23 inactive LLLW storage tanks located in Bethel Valley and Melton Valley. Seven tanks (WC-1, WC-10, WC-11, WC-12, WC-13, WC-15, and WC-17) were remediated in 2000. Waste was removed and transferred to tank W-23 via a High Integrity Container and the tanks were grouted in place. The remaining sixteen tanks will be remediated in 2001.

G.3.7 ORNL Cooling Towers Demolition

Six ORNL cooling tower structures [HRE Cooling Tower (7554), Oak Ridge Research Reactor Heat Exchanger (3087), ORRR A/C Cooling Tower (3089), ORRR Cooling Tower #3 (Building 3103), Pool-Water Cooling Tower (3086), and BSR Cooling Tower (3117)] were demolished in 2000. Any associated basins will be cleaned and covered. The basins and any contaminated soil associated with the towers will be addressed in the BV ROD selected remedy.

G.3.8 Spent Nuclear Fuel Project

The objective of the ORNL Spent Nuclear Fuel (SNF) Project is to safely, reliably, and efficiently manage SNF that is stored on the Oak Ridge Reservation until it can be shipped off-site for disposal. SNF is being retrieved, repackaged, and certified for shipment to the Idaho National Engineering and Environmental Laboratory (INEEL). SNF retrieval and repackaging will be completed in 2001 and shipments to INEEL will be completed in 2002.

G.3.9 Melton Valley Record of Decision

The cleanup of the Melton Valley portion of the White Oak Creek Watershed, which includes most of the primary waste disposal units in Melton Valley, is being conducted under CERCLA. The Record of Decision for Interim Actions for the Melton Valley Watershed (MV ROD), documenting the selected remedy, was signed by DOE, EPA, and TDEC on September 21, 2000. This ROD addresses current contaminant releases and potential risk or hazard through a combination of remedial activities such as containment, stabilization, removal, treatment, monitoring, and land use controls.

G.3.10 Molten Salt Reactor Experiment

The MSRE facility operated from 1965 to 1969 to test the molten salt concept for commercial nuclear power reactors. During routine surveillance activities in 1994, it was noted that measured radiation levels in various areas throughout the facility were increasing. The source of radiation originated in the two fuel drain tanks and was being distributed throughout the off-gas system. A uranium deposit was also discovered in a charcoal bed that filtered the off-gas from the drain tanks. This condition could result in a potential criticality accident and possible radiation exposure to the on-site (MSRE) personnel.

Actions have been initiated under CERCLA to reduce and eliminate potential risks of a nuclear criticality accident or a release of reactive gases from the facility. The three activities to remediate these concerns are to (1) remove the migrating gases throughout the facilities off-gas system (begun in late 1997), (2) remove the uranium deposit from the Auxiliary Charcoal Bed (ACB), and (3) remove the fuel salt itself. An Interim ROD for the MSRE Fuel Salt Removal has been approved by TDEC and EPA. Removal of the uranium deposit is being implemented as a CERCLA removal action. Deposit equipment installation and testing has been completed and the deposit will be removed in 2001. Fuel salt removal design for major equipment has been completed, and equipment procurement is in progress. Equipment installation will be accomplished in 2001.

G.3.11 Old Hydrofracture Facility Site

The Old Hydrofracture Facility (OHF) site was used from 1964 to 1979 for permanent disposal of liquid radioactive waste in shale formations at depths >780 ft. Various facilities were required to support the waste disposal operations, including five underground tanks used for storage of the liquid

waste before mixing it with grout; surface structures for storing, mixing, and handling the grout/liquid waste mixture; and an impoundment (OHF Pond) and waste pit (T-4 Waste Pit) for emergency storage of liquid waste due to system failures. Operations were terminated in 1980 leaving approximately 50,000 gallons of transuranic waste in the five underground storage tanks. This waste has been removed and transferred to the MVSTs for processing and disposal. An additional CERCLA removal action was conducted in 2000 that stabilized the OHF Pond, the five storage tanks, and the T-4 Waste Pit. In addition to these actions, the sludge was removed from the Process Waste Sludge Basin (PWSB), placed in the OHF Pond, and stabilized along with the OHF Pond sediment. The PWSB was a PVC-lined basin constructed in 1975 and used between 1976 and 1981 for the storage and settlement of sludge produced by water-softening processes at the ORNL PWTP. Decontamination and decommissioning of OHF structures will be completed in 2001 as a CERCLA remedial action implementing the selected remedy in the MV ROD.

G.3.12 Hydrofracture Wells Plugging and Abandonment

Between the 1960's and mid-1980's, the process of deep injection of waste was used at the ORNL to dispose of radioactive liquids and sludges in mixtures of waste with portland cement-based grout and various additives. Two test, or experimental, injection wells were constructed along with boreholes and wells to observe the behavior of the injected grout in the injection zone bedrock. At these two sites, small quantities (tens of curies) of radionuclides were added to injected grout to make the grout sheets detectable using gamma detectors to log the bedrock to locate the thin grout sheets. The third and fourth injection wells were constructed for large scale waste disposal. More than 5 million gallons of liquid waste-grout mix containing approximately 1.4 million curies of activity were injected into artificially induced fractures in a shale formation at depths of 300 ft. to 1000 ft. All large-scale disposals were at depths greater than 780 ft. Contamination levels in hydrofracture monitoring wells have been reported as high as 97 million pCi/L gross beta which could potentially migrate up an unplugged well bore. To prevent this migration a CERCLA remedial action will be initiated in 2001 to plug and abandon the four injection wells and 107 associated monitoring wells. This remedial action implements the selected remedy for these wells as specified in the MV ROD.

G.3.13 Solid Waste Storage Area 4 Remediation

SWSA 4 was used for the disposal of solid low-level radioactive waste in trenches and auger holes from 1951 to 1959. There are also pipelines on the north side of SWSA 4 that were used for transporting liquid low-level waste to waste pits and hydrofracture facilities. The selected remedy for SWSA 4 agreed to by DOE, EPA, and TDEC in the MV ROD includes the installation of a multilayer cap to facilitate hydrologic isolation of the buried waste in SWSA 4 and Liquid Waste Pit 1. The cap will also cover the Experimental Pilot Pit Area and, potentially, the 7819 Decontamination Facility areas. Excavation of the Intermediate Holding Pond (IHP), also part of the MV ROD selected remedy, is included in this project. Prior to cap installation, existing facilities and equipment located within the cap footprint must be demolished to slab. The facilities and equipment included in this task consist of the Alpha Greenhouse Facility (7819), Decontamination Facility (7819), Pilot Pits Building (7811), Solid Waste Leaching Lysimeters (7811), and five shielded transfer tanks currently located in a shed by Building 7819. Demolition of the facilities and equipment will be completed in 2001. Excavation of the IHP will be initiated in 2001 and completed in 2002. SWSA 4 capping site preparation, including development of a borrow area and relocation of Lagoon Road, will be initiated in 2001. Capping of SWSA 4 will be completed in 2004.

G.4 TRANSURANIC WASTE PACKAGING FACILITY

This project will provide a facility in the Melton Valley area of ORNL for the processing, packaging, and shipment of transuranic wastes collected in the Melton Valley Storage Tanks and solid TRU storage facilities for off-site disposal.

G.5 HAZARDOUS MATERIALS WITHIN THE 500-YEAR FLOODPLAIN

Flooding on the ORNL site has not been a major problem. Brief summer storms have caused short-duration flooding of some parking areas and roads, but have had little impact on plant operations. The level of White Oak Creek governs flooding at ORNL. The creek's level is determined by the level of Watts Bar Lake, and the lake level can be controlled by dams operated by TVA. Thus, TVA can mitigate the consequences of heavy rainfall.

The 500-year flood, that flood expected to occur only once in 500 years or, equivalently, that flood which has a 1 in 500 chance (0.2%) per year of occurring, will have little impact on ORNL facilities. Table 3.7 lists those facilities located within the 500-year floodplain. It is important to note that none of the SWSAs lie within the 500-year floodplain. Moreover, none of the facilities designated by the SARUP as posing a moderate or high hazard, nor any of the facilities designated for decontamination and decommissioning (D&D), lie within the 500-year floodplain. The most serious impact would probably result from the flooding of the Sewage Treatment Plant.

Table G.1. ORNL facilities located within the 500-year floodplain

Building no.	Facility name
2521	Sewage Treatment Plant
3518	Process Wastewater Treatment Plant
4500-S	Central Research and Administration
5500	High Voltage Accelerator Lab
6008	Office/Lab Facility
6011	Computer and Telecommunications

Source: Derived from information provided by the TVA Floodplain Protection section, 1992.

Table G.2. Management and Integration (M&I) Contractor Facilities as of December 8, 2000

Building	Program	Description
00870	BV	Raccoon Creek Monitoring Station
01001	BV	SWSA 3 Burial Grounds
01554	BV	Contractor Land Fill
01562	BV	Scrap Metal Area
02624	BV	SWSA 1 Burial Grounds
03001	BV	Graphite Reactor Building (Including Storage Canal)
03002	BV	Filter House for Graphite Reactor (3001)
03003A	BV	Drain Tank South of 3003
03005	BV	Low Intensity Test Reactor
03009	BV	Bulk Shielding Reactor Facility (Pumphouse)
03010	BV	Bulk Shielding Reactor Facility (South)
03018	BV	Stack for Graphite Reactor (3001)
03019B	BV	High Radiation Level Analytical Facility
03023	BV	North Tank Farm
03026C	BV	Krypton-85 Enrichment Facility
03026D	BV	Metal Segmenting Facility
03028	BV	Alpha Powder Facility
03029	BV	Source Development Laboratory
03030	BV	Radioisotope Production Laboratory C
03031	BV	Radioisotope Production Laboratory D
03032	BV	Radioisotope Production Laboratory E
03033	BV	Radioactive Gas Processing Facility
03033A	BV	Radioactive Production Laboratory Annex
03038	BV	Radioisotope Laboratory
03038AHF	BV	Alpha Handling Facility
03038E	BV	Isotope Materials Laboratory
03038M	BV	Radioisotope Packaging and Shipping Facility
03042	BV	Oak Ridge Research Reactor (ORRR)
03075	BV	Decommissioned LITR Ponds
03083	BV	ORRR Neutron Spectrometer Station
03085	BV	ORRR Primary Pumphouse
03085A	BV	ORRR Demineralized Water Holding Tank
03085B	BV	ORRR Demineralized Water Holding Tank
03086	BV	ORRR Pool Cooling Tower
03087	BV	Heat Exchangers for ORRR (3042)
03089	BV	ORRR A/C Cooling Tower
03093	BV	Krypton Storage Cubicle
03098	BV	BSR Filter Facility
03099	BV	Storage Pad
03102	BV	ORRR Heat Exchanger Pit
03103	BV	ORRR Main Cooling Tower
03107	BV	ORRR 25-Meter Target House
03109	BV	ORRR Process Off-Gas Filter Pit
03110	BV	Cell Vent Filter for Radioisotope Area
03116	BV	Nitrogen Storage Building North Tank Farm
03117	BV	BSF Cooling Tower
03117A	BV	Sulfuric Acid Tank
03118	BV	Radioisotope Production Laboratory - H Building
03119	BV	Heat Exchanger and Pumphouse
03126	BV	ORRR Normal Off-Gas Filter Pit
03139	BV	ORRR Cell Vent Filters

Table G.2. Management and Integration (M&I) Contractor Facilities as of December 8, 2000

Building	Program	Description
03140	BV	Cell Vent Filters for 3026
03505	BV	Metal Recovery Facility-Transfer Canal and Dissolver Pit
03507	BV	South Tank Farm
03512	BV	Decommissioned Waste Holding Basin
03513	BV	Waste Holding Basin
03515	BV	Fission Product Pilot Plant
03517	BV	Fission Products Development Laboratory
03524	BV	Equalization Basin
03535	BV	Filter Enclosure in South Tank Farm
03539	BV	190 Pond #1 Remediated Site
03540	BV	190 Pond #2 Remediated Site
03547	BV	Cell Vent Roughing Filter for 3517
03548	BV	Cell Vent Filter for 3517
04003	BV	SWSA 2 Burial Grounds
04507	BV	High Level Chemical Development Lab
04556	BV	High Level Chemical Development Lab Filter Pit
06556A	BV	Office Trailer-Put into PRISM, Never C or M+E25
06556B	BV	Office Trailer
06556C	BV	Contractor Trailer
06556D	BV	Contractor Trailer
06556G	BV	Contractor Trailer
06556J	BV	Close Support Lab - Sample Preparation
06556K	BV	Close Support Lab - Counting Facility
06556L	BV	Close Support Lab - Special Techniques
06556M	BV	Close Support Lab - Sample Kit Preparation
06556R	BV	Office Trailer - 2 Person
06556ST1	BV	Contractor Trailer
06556ST3	BV	Contractor Trailer
06556ST4	BV	Contractor Trailer
06556ST5	BV	Contractor Trailer
06556ST6	BV	Contractor Trailer
06556ST7	BV	Contractor Trailer
06556ST8	BV	Contractor Trailer
06556ST9	BV	Contractor Trailer
06556T	BV	Contractor Trailer
07025	BV	Tritium Target Preparation Facility
07078A	BV	Office Trailer
07078B	BV	Office Trailer
07078C	BV	Office Trailer
07078D	BV	Office Trailer
07078E	BV	Conference Room/Kitchen
07078F	BV	Office Trailer
13822	BV	Helium Tank
	BV	Contaminated Soil, 7002A
	BV	Fan House Graphite Reactor (3001) (Fan Rm only 3003 - including inactive filter and duct areas)
	BV	Inactive LLLW Collection/Storage Tank WC-1, 3037
	BV	Thorium Storage Silos area soil, 7019
07700	CR	Tower Shielding Facility
07701	CR	Tower Shielding Handling Pool
07702	CR	Control House
07703	CR	Hoist House

CROET Leased (CR); Watershed Projects (MV and BV); Waste Disposition (WD); Waste Operations (WO)

Table G.2. Management and Integration (M&I) Contractor Facilities as of December 8, 2000

Building	Program	Description
07704	CR	Control House 2
07705	CR	Pumphouse
07706	CR	Cooler
07707	CR	Battery House
07708	CR	Butler Building
07716	CR	Tower Shielding Pool Pump & Filter House
07750	CR	Septic Tank TSF, Manhole
07751	CR	Sentry Post 22, TSF
00807	MV	CS-137 Tagged Area for Rad. Runoff Studies
00814	MV	Trailer in 0800 Area
00816	MV	Cesium Plots Study Area
00830	MV	White Oak Creek Embayment Structure
00853	MV	White Oak Creek Below Dam
00857	MV	Goat Building in 0800 Area
07500	MV	HRE Reactor Building
07502	MV	Waste Evaporator
07503	MV	MSRE Reactor Building
07503A	MV	LLLW Tank at MSRE
07509	MV	MSRE Office Building
07511	MV	MSRE Filter Pit
07512	MV	MSRE Blowers and Stack
07513	MV	MSRE Cooling Tower
07514	MV	MSRE Supply Air Filter House
07554	MV	HRE Cooling Tower
07555	MV	MSRE Diesel Generator House
07556	MV	HRE Settling Pond
07557	MV	HRE Absorber Pits
07558	MV	Waste Evaporator Loading Pit
07559	MV	HRE Charcoal Absorber Valve Pit
07560	MV	LLLW Collection and Storage Tank
07561	MV	HRE Decon Pad
07562	MV	LLLW Collection and Storage Tank
07563	MV	Circulator Pump Pit (for Building 7500)
07602	MV	Integrated Process Demonstration Facility
07658	MV	Closed Contractor's Landfill
07659B	MV	Reactive Chemicals Disposal Area
07659C	MV	Soil Injection of Radioactive Gas
07700A	MV	Big Beam Shield
07700B	MV	Outside Storage Area
07711	MV	Process Waste Basin
07720	MV	Tower Shielding Civil Defense Facility
07759	MV	Cesium 137 Forest Research Area
07800	MV	SWSA 4 Burial Ground
07802	MV	SWSA 5 (South) Burial Ground
07802A	MV	Seep C Collection and Treatment System
07802B	MV	Seep D Collection and Treatment System
07802C	MV	Deep Monitoring Well #1
07802D	MV	Deep Monitoring Well #2
07802F	MV	Radiation Monitoring Equipment Storage
07805	MV	Chemical Waste Pit #1
07806	MV	Chemical Waste Pit #2
07807	MV	Chemical Waste Pit #3

CROET Leased (CR); Watershed Projects (MV and BV); Waste Disposition (WD); Waste Operations (WO)

Table G.2. Management and Integration (M&I) Contractor Facilities as of December 8, 2000

Building	Program	Description
07808	MV	Chemical Waste Pit #4
07809	MV	Chemical Waste Trench #5
07810	MV	Chemical Waste Trench #6
07811A	MV	Pilot Pits Experiment Area
07813	MV	White Oak Creek Dam
07818	MV	Chemical Waste Trench #7
07819	MV	Decontamination Bldg. And Shielded Transfer Tank Shed
07821	MV	Emergency Waste Basin - Melton Valley
07822	MV	Solid Waste Storage Area 6
07822A	MV	WAG 6 Explosive Detonation Trench
07822B	MV	Fissile Disposal Wells
07822C	MV	Low Range Silos (Inactive)
07822D	MV	High Range Silos (Inactive)
07822E	MV	Hill Cut Disposal (inactive) Test Facility
07822F	MV	Tumulus I (Inactive)
07822G	MV	Tumulus II (Inactive)
07822H	MV	Asbestos Silos (Inactive)
07831D	MV	SWSA 5 Storage Pad
07833	MV	Alpha Greenhouse Facility (transfer effective 2/1/00)
07835	MV	Process Waste Sludge Basin, WAG 5
07846	MV	White Oak Lake
07852	MV	Old Hydrofracture Facility
07852A	MV	Old Shale Hydrofracture Pond/Pits
07881	MV	Post #24
07906	MV	Retention Pond B - HFIR
07907	MV	TRU Pond A
07908	MV	TRU Pond B
02660	WD	Waste Operation Support Facility
07507	WD	Hazardous Waste Storage Facility
07507W	WD	Mixed Hazardous Storage Pad
07572	WD	CH-TRU Waste Storage Facility
07574	WD	NFS Waste Storage Facility
07651	WD	Clean Used Oil Storage Pad
07652	WD	Hazardous Waste Storage Facility
07653	WD	Chemical Waste Storage Facility
07654	WD	Long-Term Hazardous Waste Storage Facility
07659	WD	Leaking Gas Cylinder Area
07661	WD	7661 Electrical Distribution Building
07662	WD	7662 Emergency Generator
07666	WD	Environmental Emergency Response (transfer effective 2/1/00)
07666A	WD	Hazardous Waste Area Support Trailer
07667	WD	Chemical Detonation Facility
07668	WD	Mixed Waste Storage Facility
07670	WD	HWOG Equip Storage Facility
07802N	WD	SWSA 5 North Trench Retrievable TRU Storage
07810A	WD	Interim Non-Reg Waste Storage Facility
07822A	WD	SWSA 6 High Range Disposal Wells
07822J	WD	Radioactive Solid Waste Staging and Storage Pad
07823	WD	LLW Staging/Storage Facility
07823A	WD	Underground Storage Facility Wells, TT1-TT8
07823B	WD	Temporary Waste Storage
07823C	WD	Temporary Waste Storage

CROET Leased (CR); Watershed Projects (MV and BV); Waste Disposition (WD); Waste Operations (WO)

Table G.2. Management and Integration (M&I) Contractor Facilities as of December 8, 2000

Building	Program	Description
07823D	WD	Temporary Waste Storage
07823E	WD	Temporary Waste Storage
07823F	WD	SWSA 5N Storage Shed
07824	WD	Waste Exam and Assay Facility
07824A	WD	WEAF Support Facility
07826	WD	TRU Drum Storage Facility
07827	WD	Shielded Dry Well Facility
07829	WD	Shielded Dry Well Facility
07830A	WD	Hazardous Waste Storage Tank
07831	WD	Field Office and Compactor Facility
07831A	WD	SLLW Storage Building
07831C	WD	SLLW Storage Shed
07834	WD	TRU Drum Storage Facility
07841	WD	Contaminated Equipment Storage Yard
07842	WD	Temporary LLW Storage Facility
07842A	WD	LWSP II Solid Waste Storage Pad
07842B	WD	SWSA 6 Temp Storage Facility
07842C	WD	SWSA 6 Temp Storage Facility
07847	WD	Vehicle/Personnel Monitoring Station
07855	WD	Concrete Cask Storage Facility
07855A	WD	SWSA 5 Equipment Tent
07876	WD	Health Physics Office Trailer
07878	WD	CH-TRU Waste Storage Facility
07878A	WD	Temporary Storage Facility
07878B	WD	Equipment Storage Facility
07879	WD	TRU/LLW Staging Facility
07883	WD	RH-TRU Bunker
07934	WD	CH-TRU Waste Storage Facility
02026A	WO	LLLW Collection Tank at 2026 (Inactive)
02032	WO	Manhole 240 Monitoring Station
02034	WO	Manhole 95 Monitoring Station
02099	WO	MCS for Building 2026
02101	WO	Health and Hygiene Change House
02508	WO	INST Trailer for Sludge Mobilization
02531	WO	Radioactive Waste Evaporator
02532	WO	Waste Storage Cooling Pumphouse (inactive)
02533	WO	Cell Vent Filter Pit (inactive)
02534	WO	Off-Gas Filter Pit (Inactive)
02535	WO	Cooling Tower
02537	WO	Evaporator Service Tanks and Control Room
02539	WO	Cooling Tower
02568	WO	Cell Vent & Off-Gas Filter, Facilities for 2531, 2337
02600	WO	Bethel Valley Storage Tanks
02649	WO	Transported Waste Receiving Facility
02650	WO	Evaporator Chemical Shed
02651	WO	2600 Area Emergency Generator
02657	WO	Manhole 243 Monitoring Station
02658	WO	F-4005 Monitor Station
03002A	WO	Drain Tank South of 3003 (Inactive)
03039	WO	Central Radioactive Gas Disposal Facility
03082	WO	Data Concentrator #2
03092	WO	Off-Gas Scrubber

CROET Leased (CR); Watershed Projects (MV and BV); Waste Disposition (WD); Waste Operations (WO)

Table G.2. Management and Integration (M&I) Contractor Facilities as of December 8, 2000

Building	Program	Description
03105	WO	LGWOD Health Physics Office
03106	WO	4500 Area Filters
03125	WO	3039 Stack Area Emergency Generator
03127	WO	LGWOD Storage Building
03130	WO	Waste Operations Control Center
03133	WO	BV Valve Box 1a
03145	WO	LLLW Storage Building
03151	WO	Manhole 25 (inactive) Monitoring Station
03154	WO	Manhole 112, Monitoring Station
03155	WO	Manhole 114 & 234 Monitoring Station
03158	WO	North Monitoring Building (Inactive)
03159	WO	South Monitoring Building
03502B	WO	Data Concentrator #4
03518	WO	Neutralization Plant
03518A	WO	LGWOD Spare Parts Trailer
03544	WO	Process Waste Treatment Complex
03544B	WO	Filter Press Building for PWTC
03594	WO	Waste Operations Storage Building
03608	WO	Process Waste Treatment Complex
03613	WO	Diversion Box Monitoring Station
03614	WO	Manhole 190 Monitoring Station
03615	WO	Manhole 235 Monitoring Station
03616	WO	Manhole 149 Monitoring Station
03617	WO	Manhole 229 Monitoring Station
03618	WO	Pumping Station Tanks WC-10, 11, 12, 13, 14 (Inactive)
03620	WO	Hot Off Gas Collection Tank F2175
03622	WO	Contaminated Tool Crib
07505	WO	CPAF Contractors Headquarters
07506	WO	Contractor Shop
07567	WO	Central Pumping Station Tanks T1 and T2
07569	WO	LLLW Collection Tank WC-20 (Inactive)
07582	WO	LGWOD Spare Parts Facility
07802E	WO	Sludge Test Removal Tank (Inactive)
07830	WO	Melton Valley Storage Facility
07853	WO	LGWOD Storage Building
07856	WO	MVST Capacity Increase Project
07857	WO	IWMF Drainage & Collection System and Biol. Freezers
07860	WO	New Hydrofracture Facility, Including T-14 (Inactive)
07863	WO	General Storage for Building 7860
07863A	WO	LGWOD General Storage Shelter
07863B	WO	LGWOD General Storage Shelter
07863C	WO	LGWOD General Storage Shelter
07877	WO	LLLW Solidification Facility
07882	WO	Emergency Generator for 7877
07886	WO	Interim Waste Management Facility
07887	WO	Solid Liquid Separations Unit
07919	WO	HFIR, TRU, and Turf Manhole Monitoring Station
07922A	WO	Data Concentrator #6 for WOCC DAS
07935	WO	Equip Cleaning Facility
07952	WO	Melton Valley Process Waste Pumping Station
07961	WO	Melton Valley Collection Tanks
07966	WO	LLW Collection Tanks, 7920 and 7930

CROET Leased (CR); Watershed Projects (MV and BV); Waste Disposition (WD); Waste Operations (WO)

Table G.2. Management and Integration (M&I) Contractor Facilities as of December 8, 2000

Building	Program	Description
BV COLLECTI	WO	Collection Header and Valve Boxes
LLW COLLEC	WO	LLLW Collection/Transfer System
LW INTEM	WO	Intervalley Transfer Line
	WO	Building 3019 to C-2 Valve Pit
	WO	Cell Vent Header Sump (4th and Central)
	WO	Cell Vent Header Sump (5th Street)
	WO	F-2110 Pump Station
	WO	HFIR Tank
	WO	HFIR, TRU, TURF, MH Monitoring Station, 7919 (no buildings)
	WO	MH-208
	WO	MH-208 Diversion Box
	WO	Numerous Manholes in Process Waste System (no buildings)
	WO	OHF VB
	WO	Process Waste Junction Box (N of 3513)
	WO	Process Waste Pumping Station (4001)
	WO	Pumping Station 1
	WO	South Parking Lot Valve Box (LLLW)
	WO	South Parking Lot Valve Box (PW)
	WO	Valve Box 1
	WO	Valve Box 2
	WO	Valve Box 2A
	WO	W-16, 17, 18 Tank Area
	WO	W-6 Valve Box
	WO	WC-12 Tank Area
	WO	WC-19
	WO	WC-2 Pump Pit and Collection Tank
	WO	WC-3 Tank Area
		4501 Mercury Contaminated Soil
		4508 Mercury Contaminated Soil
		Abandoned Burn Pit
		Abandoned Sanitary Waste Pipeline and Septic Tank North of Bldg. 7910
		Aircraft Reactor Experiment Surface Impoundment
		ARE Contaminated Tool Storage
		Bethel Valley Active and Inactive Wells
		Bldg. 3503 Mercury Contaminated Soil
		Bldg. 3592 Mercury Contaminated Soil
		Building 7819 Septic Tank
		Buried Scrap Metal Area
		BV Collection Header & Valve Boxes
		C-14 Allocation in White Oak Pine Trees
		C-14 Allocation in White Oak Trees
		C-14 Allocation in Woody Biomass Plantation Species
		C-14 Efflux in Yellow Poplar Stand
		C-14 Maintenance-Respiration Study
		C-14 Sucrose Inoculation of Oak and Pine Trees
		Ca-45 Tagged Forest
		Ca-45 Tagged Soil and Vegetation
		Ca-45 Tagged Trees
		Co-60 and Mn-54 Animal Study
		Contaminated Soil (3001, 3019)
		Contaminated Surfaces & Soil from 1959 Explosion, 3019
		Contamination at Base of 3019 Stack

Table G.2. Management and Integration (M&I) Contractor Facilities as of December 8, 2000

Building	Program	Description
		Contractor Spoils Area - Melton Valley, W-SW of 7900
		Corehole 8
		Cr-51 Contaminated Grass Plots
		Cs-134 Contaminated Lichens and Mosses
		Cs-134 Contaminated Oak Trees
		Cs-134 Contaminated Persimmon Tree
		Cs-134 Contaminated Pine and Oak Seedlings
		Cs-134 Contaminated Soybean and Sorghum
		Cs-134 Contemned Grasses
		Cs-134 Tagged Trees
		Cs-137 Bagged Leaves Study
		Cs-137 Contaminated Forest Floor
		Cs-137 Contaminated Forest Understory
		Cs-137 Contaminated Meadow
		Cs-137, Co-60 Contaminated Forest Area (includes Chestnut Ridge Eastern & Western Areas)
		Cs-137, Fe-59 Contaminated Animal Trees
		Decontamination Area (near WAG 5)
		Drainage 1, 2 in WAG 5
		Drainage 3 next to WAG 5
		Filter House/Isotope Area, Ductwork (3110 area)
		Filter Pit (Fission Product Development Lab) Soil Contam.
		First Creek Planting and Riparian Corridor
		Former Waste Pile Area (S. of NRWTP)
		FPDL LLLW Transfer Line 3507 area
		FPPP Contaminated Soil
		H3 Contaminated Trees
		HFIR Cooling Tower Surface Impoundment
		Hg-197 Tagged Stream
		Hg-203 Tagged Stream
		Homogeneous Reactor Experiment Fuel Wells
		Hydrofracture Experimental Site #1, HFS1
		Hydrofracture Experimental Site #2, HFS2
		Hydrofracture Experimental Site #2, Soil Contamination HFS2A
		Inactive LLLW Collection Tank T-30, 4507 area
		Inactive LLLW Collection/Storage Tank, W-19
		Inactive LLLW Collection/Storage Tank, W-20
		Inactive LLLW Collection/Storage Tanks, TH-1
		Inactive LLLW Collection/Storage Tanks, TH-2
		Inactive LLLW Collection/Storage Tanks, TH-3
		Inactive LLLW Collection/Storage Tanks, WC-15
		Inactive LLLW Collection/Storage Tanks, WC-17
		Inactive OHF Waste Storage Tank T1
		Inactive OHF Waste Storage Tank T2
		Inactive OHF Waste Storage Tank T3
		Inactive OHF Waste Storage Tank T4
		Inactive OHF Waste Storage Tank T9
		Interim Decontamination Bldg. Tanks (ST1, ST2, ST3, ST4, St5) 7819 area
		Leak in Line Between Pit 3 and Trench 6
		Leak in Transfer Line from Decon Fac. And Pit 1
		Leak in Valve Pit North of Trench 7
		LLLW Collection Tank, Building 3013

Table G.2. Management and Integration (M&I) Contractor Facilities as of December 8, 2000

Building	Program	Description
		LLLW Collection Tanks, 4501-P
		LLLW Collection Tanks, H-209
		LLLW Collection Tanks, T13, 7860
		LLLW Collection Tanks, W-11
		LLLW Collection Tanks, W-12
		LLLW Collection Tanks, WC-4
		LLLW Collection Tanks, WC-5
		LLLW Collection Tanks, WC-6
		LLLW Collection Tanks, WC-7
		LLLW Collection Tanks, WC-8
		LLLW Collection Tanks, WC-9
		LLLW Line from Valve Box to OHF
		LLLW Line Leak Site, Gauging Station SWMU, 200' West of WOC Gauging Station
		LLLW Line Leak Site, Trench 6 SE of SWMU, 150' of Trench 6 (Between Pit 3 and Trench 6)
		LLLW Line Leak Site, Trench 7 Access Road, 200' N. of Trench 7
		LLLW Line North of Lagoon Road
		LLLW Lines & Leak Sites - 3503, Ground Contamination
		LLLW Lines & Leak Sites - 3518 West
		LLLW Lines & Leak Sites - 7500 Area
		LLLW Lines & Leak Sites - 7920 Ditch Line
		LLLW Lines & Leak Sites - Abandoned Line Central Ave. area
		LLLW Lines & Leak Sites - Bldg. 3028
		LLLW Lines & Leak Sites - Bldg. 3092 Area
		LLLW Lines & Leak Sites - Bldg. 3525 to a Sump
		LLLW Lines & Leak Sites - Bldg. 4508
		LLLW Lines & Leak Sites - E. of 2531
		LLLW Lines & Leak Sites - Lagoon Rd. & Melton Valley Dr.
		LLLW Lines & Leak Sites - Melton Valley Drive & SWSA 5 Access
		LLLW Lines & Leak Sites - Melton Valley Transfer Line
		LLLW Lines & Leak Sites - ORR Water Line
		LLLW Lines & Leak Sites - S. of 3020
		LLLW Lines & Leak Sites - Sewer Near 3500
		LLLW Lines & Leak Sites - SW Corner of 3019
		LLLW Lines & Leak Sites - Underneath 3026
		LLLW Lines & Leak Sites - Underneath 3047
		LLLW Lines & Leak Sites - Underneath 3515
		LLLW Lines & Leak Sites - Underneath 3550
		LLLW Lines & Leak Sites - W. of 3082
		LLLW Lines & Leak Sites - West of Melton Valley Pumping Station
		LLLW Lines & Leak Sites -E. of 3020
		LLLW Lines & Leak Sites General Isotopes area
		LLLW Lines & Leak Sites N. of 3019
		LLLW Lines & Leak Sites NW of SWSA 1
		LLLW Lines & Leak Sites-Between W5 and WC-19
		LLLW Lines & Leak Sites-Between WC-1 and W-5
		LLLW Lines and Leak Site - OHF Contam. Soil (Bldg. 7852 Hydrofracture Injection)
		LLLW Lines and Leak Site -OHF, Release of Grout
		LLLW Lines and Leak Sites, Bldg. 7920 and MV Pumping Station Area
		Melton Valley Active and Inactive Wells

Table G.2. Management and Integration (M&I) Contractor Facilities as of December 8,.2000

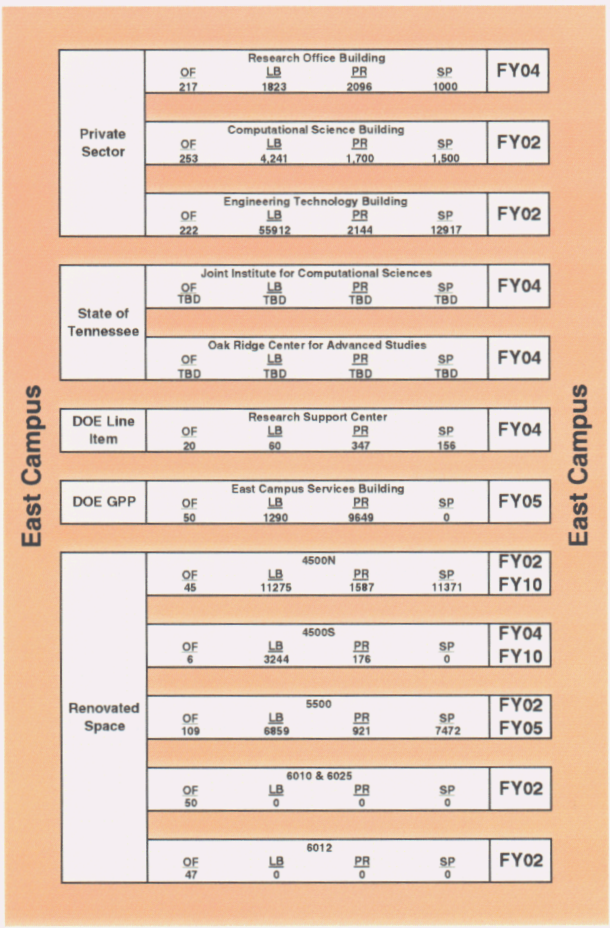
Building	Program	Description
		Monitoring Stations 1 and 3 (SWSA 6)
		MSRE Storage Well
		Municipal Sewage Sludge Application Site XF1226
		Na-22 Contaminated Soil
		NHF Grout Sheets
		Oak Ridge Research Reactor Decay Tank Rupture Site
		OHF Grout Sheets
		Old Hydrofracture Injection Well
		Old Landfill (NE edge of SWSA5)
		PWSB Pipeline from PWSB to Process Waste Treatment Plant
		Rb-86 Contaminated Plants
		Soil at HRE Decontamination Pad/She
		Soil Contamination HF S1A
		SWSA 6 TVA Easement
		Tank F501
		Tc-95 Uptake Studies
		Tc-95m and I-131 Contaminated Pasture
		Tc-95m Contaminated Soil and Plants
		Tc-99 & Np-237 Contaminated Soil Lysimeters, Plutonium
		Transfer Canal & Dissolver Pit, contaminated soil near 3505
		Trash Area East of HRE Parking Lot
		Underground Exhaust Ducts Soil Contamination 3001-3003
		WAG 4 Sr-90 Seeps
		Waste Storage Tank, TH-4
		Waste Valve Pit (HRE) for Tank 7562
		Well Drillers Steam Cleaning Area
		West End Dump Site
		WOC Floodplain Soils & Sediments
		Zn-65 Tagged Red Oak Seedlings

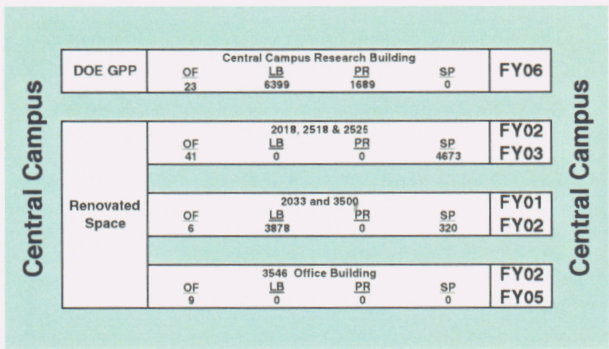
APPENDIX H

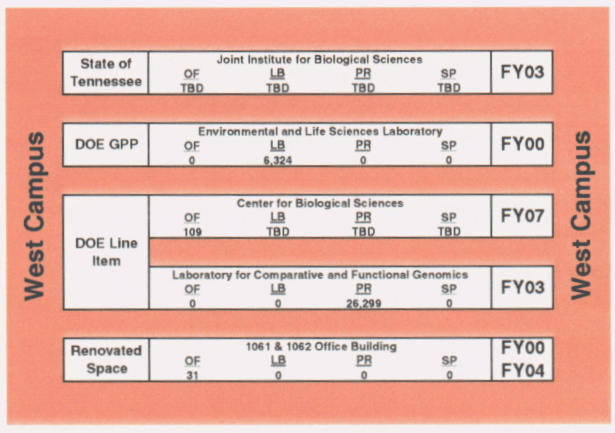
Consolidation Summaries

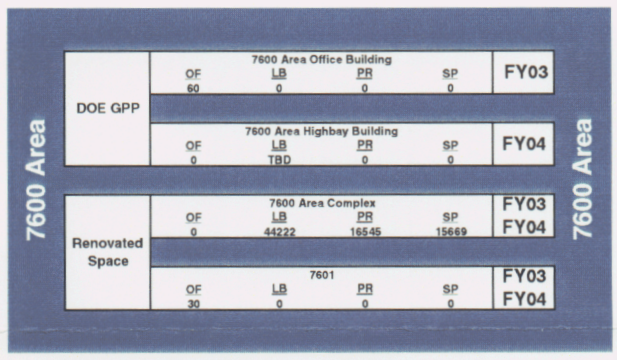
Table H.1. Master consolidation summary.

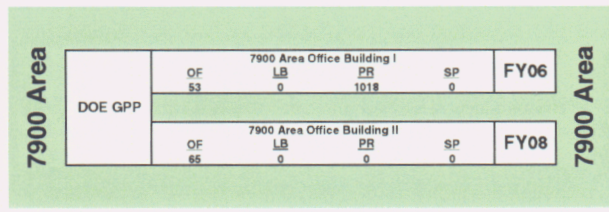
Building	Div #	Division Name	Type	# or SF	Building	Campus	Move Date
1000	X006	Research Reactors	OF	2	Research Office Building	East	FY04
	X024	Quality Services	OF	6			
	X035	Environmental Protection & Waste Services	OF	4			
	X036	Office of Safety & Health Protection	OF	12			
	X037	Business & Information Services Directorate	OF	51			
	X040	Engineering	OF	26			
	X054	Computing, Information & Networking	OF	1			
			PR	300			
	X056	Environmental Management Program	OF	5			
	X058	Facilities and Operations Strategic Planning	OF	8			
	X064	Contracts & Procurement	OF	27			
	X079	Office of Small & Minority Business Outreach	OF	4			
	X083	Facilities Revitalization Project	OF	4			
2000	X018	Solid State	LB	4601	4500N	East	FY01
			OF	2			
			SP	300			
	X024	Quality Services	LB	610	3017 Now, 5500 Building In Future	East	FY02-FY05
			OF	4			
			SP	3992			
2001	X024	Quality Services	OF	2			
2008	X038	Office of Radiation Protection	LB	994	5500	East	FY02-FY05
			OF	5			
			PR	240			
2011	X021	Plant & Equipment	OF	12	2525	Central	FY03
			SP	2030			
2013	X021	Plant & Equipment	OF	6			
	X024	Quality Services	OF	10	5500	East	FY02-FY05
			SP	3480			
	X038	Office of Radiation Protection	OF	1			
2019	X018	Solid State	PR	800			
2024	X018	Solid State	LB	1350	4500N	East	FY01
			OF	1			
	X022	Office of Nuclear Safety	LB	236	3017 Now, 5500 Building In Future	East	FY02-FY05
			OF	3			
	X024	Quality Services	OF	16			
2506	X021	Plant & Equipment	OF	23	2018, 2518 & 2525	Central	FY02
			SP	2643			
	X023	Health Services	OF	3	4500N	East	FY02
	X036	Office of Safety & Health Protection	OF	1			
2652A	X018	Solid State	OF	1	5500	East	FY02-FY05
	X038	Office of Radiation Protection	LB	520			
			OF	6			
2652B&C	X038	Office of Radiation Protection	LB	95			
			OF	11			
3003	X018	Solid State	LB	3702	Central Campus Research Building	Central	FY06
			OF	14			
			PR	1689			
3019A	X003	Chemical Technology	LB	3044	Function Goes Away		
			OF	5			
			PR	4801			
			SP	942			
	X021	Plant & Equipment	OF	2			
			SP	147			
	X038	Office of Radiation Protection	OF	2			
3036	X057	Laboratory Logistical Services	OF	2	Research Office Building	East	FY04
			PR	3700			
3037	X003	Chemical Technology	OF	17	4500N	East	FY03
	X024	Quality Services	OF	1	5500	East	FY02-FY05
	X038	Office of Radiation Protection	OF	2			
3080	X018	Solid State	LB	1455	Central Campus Research Building	Central	FY06
3100	X003	Chemical Technology	PR	535	4500N	East	FY02
3115	X018	Solid State	OF	9	Central Campus Research Building	Central	FY06
	X015	Energy Division	LB	1242			
3503	X003	Chemical Technology	LB	590	4500N	East	FY03
			OF	4			
			PR	252			
			SP	96			
3504	X009	Instrumentation & Controls	LB	533	2033 and 3500	Central	FY04
			OF	2			
			SP	1000			
	X026	Laboratory Protection	OF	5	Research Support Center	East	FY04
	X038	Office of Radiation Protection	LB	1080	5500	East	FY02-FY05
			OF	1			
3508	X009	Instrumentation & Controls	LB	2702	2033 and 3500	Central	FY01
			OF	5			
			SP	320			
	X034	Technical Support Section I&C	LB	576			
			OF	1			
3525	X011	Metals & Ceramics	LB	2962	Lab Wide Hot Cell Consolidation Study Required		
			OF	7			
			PR	2110			
	X038	Office of Radiation Protection	OF	2			
3543	X009	Instrumentation & Controls	LB	600	3500	West	FY04
3550	X036	Office of Safety & Health Protection	LB	3038	5500	East	FY02-FY05
			OF	25			
			PR	681			
	X038	Office of Radiation Protection	LB	286			
			OF	3			
4500N	X010	Computational Physics & Engineering	OF	30	Computational Science Building	East	FY02
			PR	1686			
	X012	Computer Science & Mathematics	OF	17			
			PR	275			
	X015	Energy Division	OF	52	Engineering Technology Building	East	FY02
			LB	1290			
			PR	1449			
	X054	Computing, Information & Networking	OF	10	6012	East	FY02
			LB	680			
	X002	Physical & Computational Sciences	OF	5	Computational Science Building	East	FY02
	X003	Chemical Technology	OF	5	3546	Central	FY03
	X020	Executive Offices	OF	3	Research Support Center	East	FY04
			PR	347			
	X022	Office on Nuclear Safety	OF	2	3546	Central	FY03
	X025	DOE Site Office	OF	2	Research Support Center	East	FY04
	X036	Office of Safety & Health Protection	OF	2	5500	East	FY02-FY05
	X038	Office of Radiation Protection	OF	1			
	X095	SAMS/SAIC	OF	2	3546	Central	FY03
4500S	X054	Computing, Information & Networking	PR	8200	East Campus Service Building	East	FY05
	X012	Computer Science & Mathematics	OF	8	Computational Science Building	East	FY02
			PR	2613			
5000	X026	Laboratory Protection	LB	60	Research Support Center	East	FY04
			OF	7			
			SP	156			
	X037	Business & Information Services Directorate	OF	1			
	X038	Office of Radiation Protection	OF	2			
6003	X013	Physics	OF	37	6010 & 6025	East	FY02
6010	X010	Computational Physics & Engineering	OF	1	Computational Science Building	East	FY02
	X012	Computer Science & Mathematics	LB	3351			
			OF	25			
			PR	1495			
			SP	1500			
6011	X012	Computer Science & Mathematics	OF	4			
6025	X010	Computational Physics & Engineering	LB	536			
			OF	50			
	X012	Computer Science & Mathematics	LB	210			
			OF	25			
			PR	62			
6026A-G	X010	Computational Physics & Engineering	OF	12	5500	East	FY02-FY05
	X035	Environmental Protection & Waste Services	OF	18	6012	East	FY02
	X054	Computing, Information & Networking	OF	17	6010 & 6025	East	FY02
	X057	Logistical Services	OF	7			
	X064	Procurement	OF	5			
	X067	Contracts	OF	1			
6556E,Q,S	X021	Plant & Equipment	OF	4	7000 Area	East	FY02
7964 A-G	X006	Research Reactors	OF	53	7900 Area Office Building I	7900 Area	FY06
			PR	1018			
	X018	Solid State	OF	22	7900 Area Office Building II	7900 Area	FY08
	X025	Special Requirements	OF	13			
7965 A-C	X003	Chemical Technology	OF	30			
9102-1	X016	Engineering Technology	OF	22	National Transportation Research Center	Off Site	FY01
9102-2	X016	Engineering Technology	OF	18	Engineering Technology Building	East	FY02
9104-1	X016	Engineering Technology	PR	615			
			PR	788			
9108	X016	Engineering Technology	OF	34	National Transportation Research Center	Off Site	FY01
9201-2	X002	Physical & Computational Sciences	OF	2	Engineering Technology Building	East	FY02
	X010	Computational Physics & Engineering	OF	2			
	X019	Fusion Energy	LB	44,222	7600 Area Highbay Building	7600 Area	FY04
			OF	30	7601	7600 Area	FY03-FY04
			OF	60	7600 Area Office Building	7600 Area	FY03
			PR	16,545	7600 Area Complex	7600 Area	FY03-FY04
			SP	15,669			
	X037	Business Management	OF	1	Engineering Technology Building	East	FY02
	X040	Engineering	OF	1			
9201-3	X007	Spallation Neutron Source	OF	1			
	X009	Instrumentation & Controls	OF	1			
	X016	Engineering Technology	LB	26,113			
			OF	50			
			PR	663			
			SP	6,057			
	X024	Quality Services	OF	3			
	X036	Office of Safety & Health Protection	OF	2			
	X037	Business Management	OF	2			
	X038	Office of Radiation Protection	OF	1			
	X065	Energy & Engineering Sciences	OF	6			
9204-1	X010	Computational Physics & Engineering	OF	3			
	X016	Engineering Technology	LB	26,638			
			OF	54			
			PR	78			
			SP	6,860			
	X021	Plant & Equipment	OF	1			
9204-3	X003	Chemical Technology	LB	5,644	4500N	East	FY02
			OF	16			
			PR	58,985			
			SP	9,355			
	X038	Office of Radiation Protection	OF	1			
	Y035	Environmental Protection & Waste Services	SP	1,620			
9210	X001	Life Sciences	LB	6,324	Environmental & Life Sciences Laboratory	West	FY00
			OF	30	1061 & 1062	West	FY03
			PR	26,299	Laboratory for Comparative & Functional Genomics	West	FY03
9211	X001	Life Sciences	OF	1	1061 & 1062	West	FY00
9224	X001	Life Sciences	LB	3,244	4500S	East	FY01
			OF	6			
			PR	176			
9401-1	X016	Engineering Technology	LB	3,161	Engineering Technology Building	East	FY02
1060 Commerce	X001	Life Sciences	OF	107	Center for Biological Sciences	West	FY07
	X054	Computing, Information & Networking	OF	55	Research Office Building	East	FY04
111 Union Valley	X031	Technology Transfer & Economic Development	OF	34	Research Office Building	East	FY04
	X085	Legal	OF	10			











KEY	
OF	Number of Offices Required
LB	Laboratory Space (SF)
PR	Process Space (SF)
SP	Shop Space (SF)

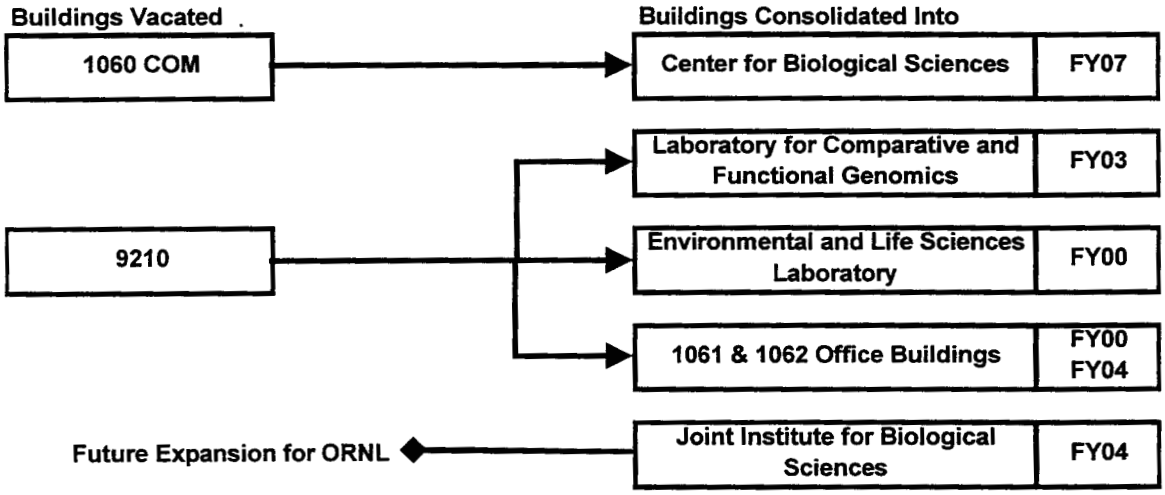


Fig. H.1. West Campus consolidation summary.

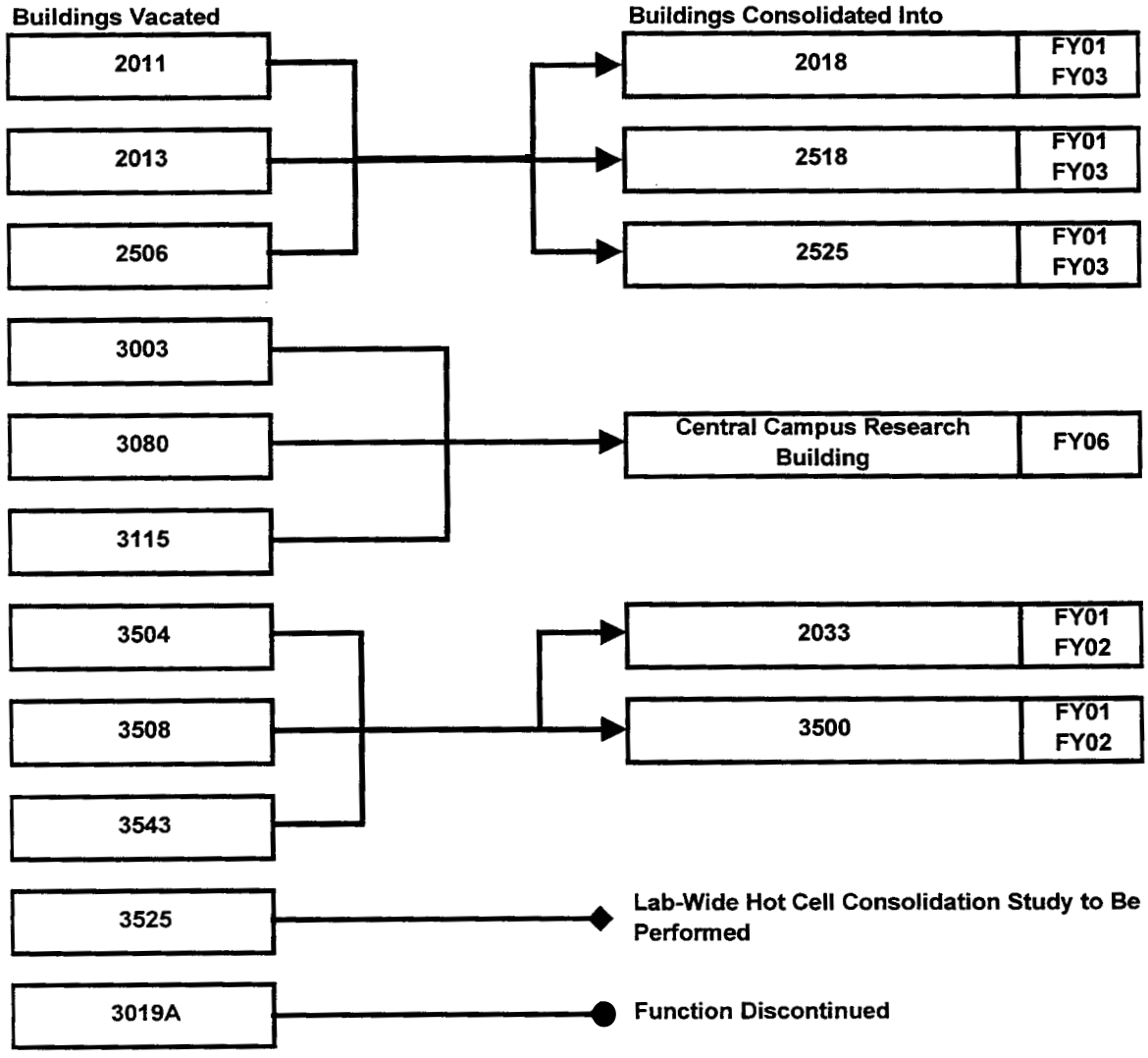


Fig. H.2. Central Campus consolidation summary.

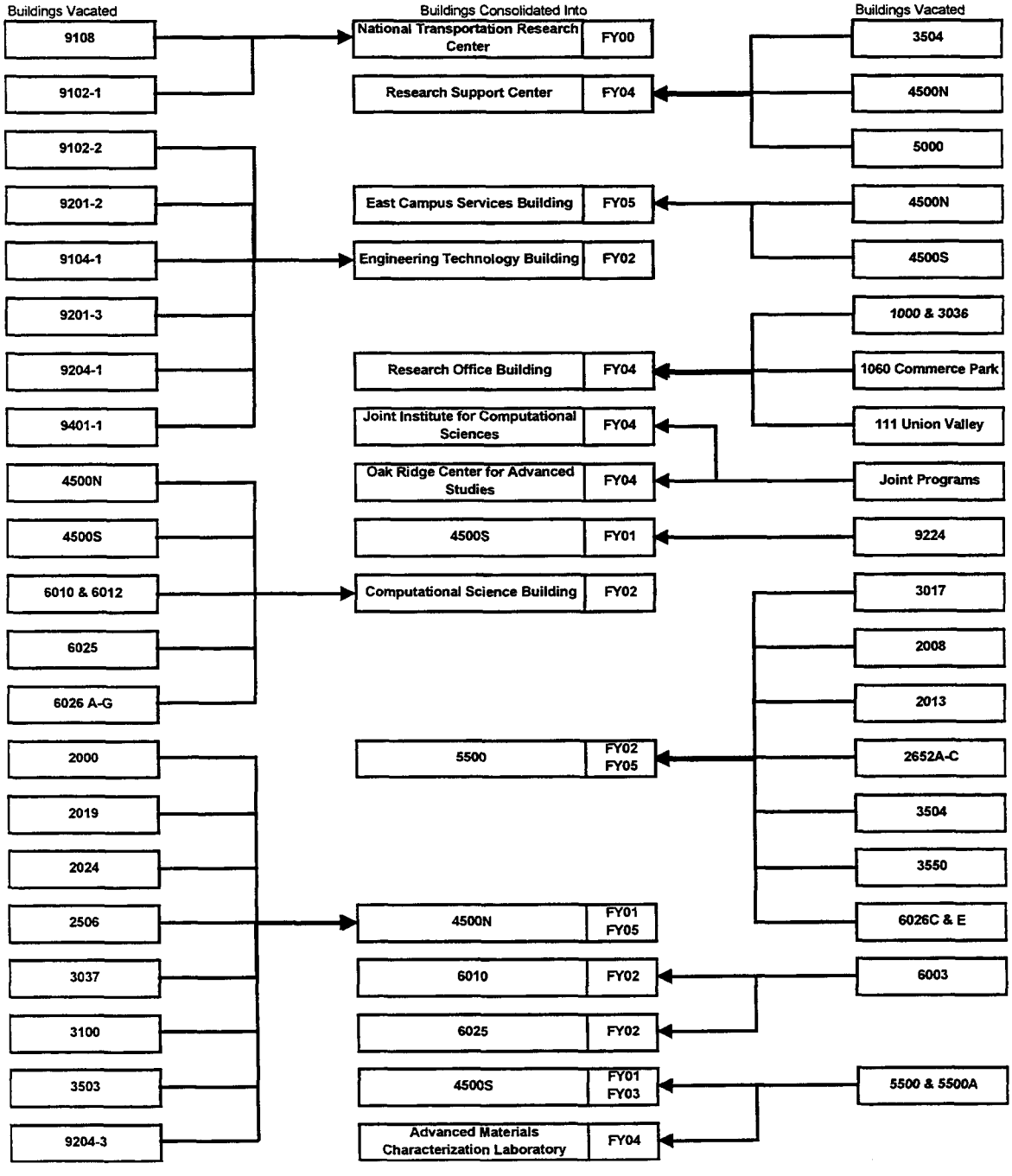


Fig. H.3. East Campus consolidation summary.

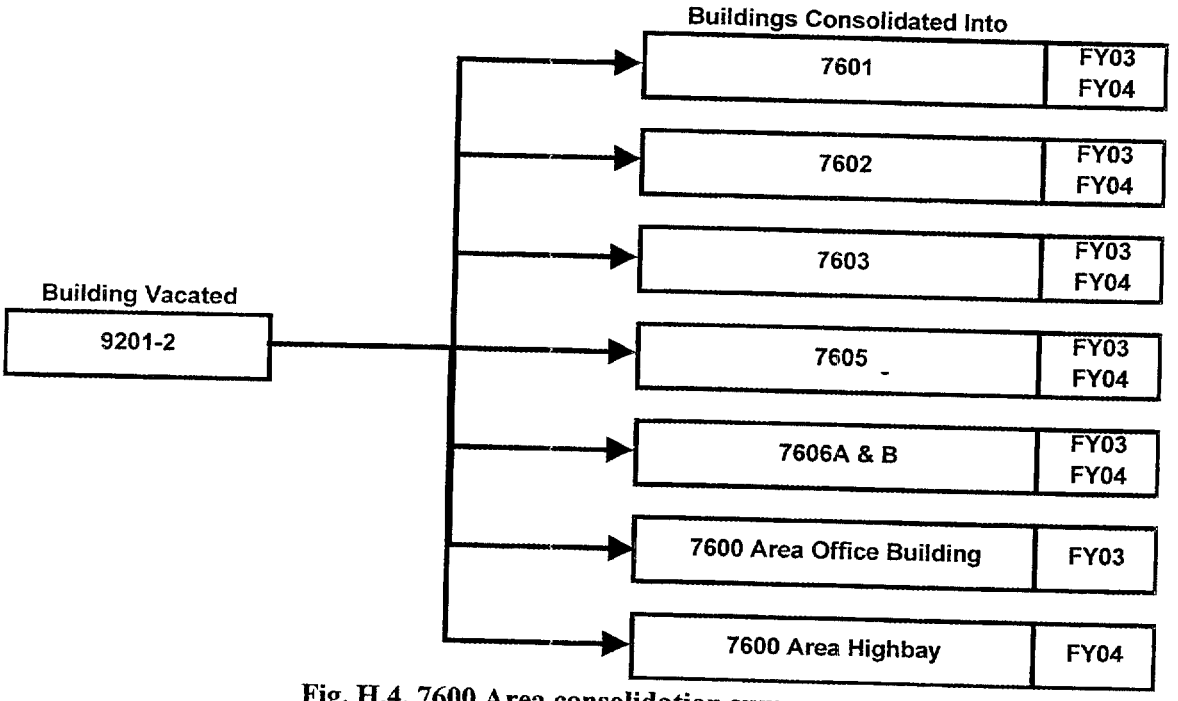


Fig. H.4. 7600 Area consolidation summary.

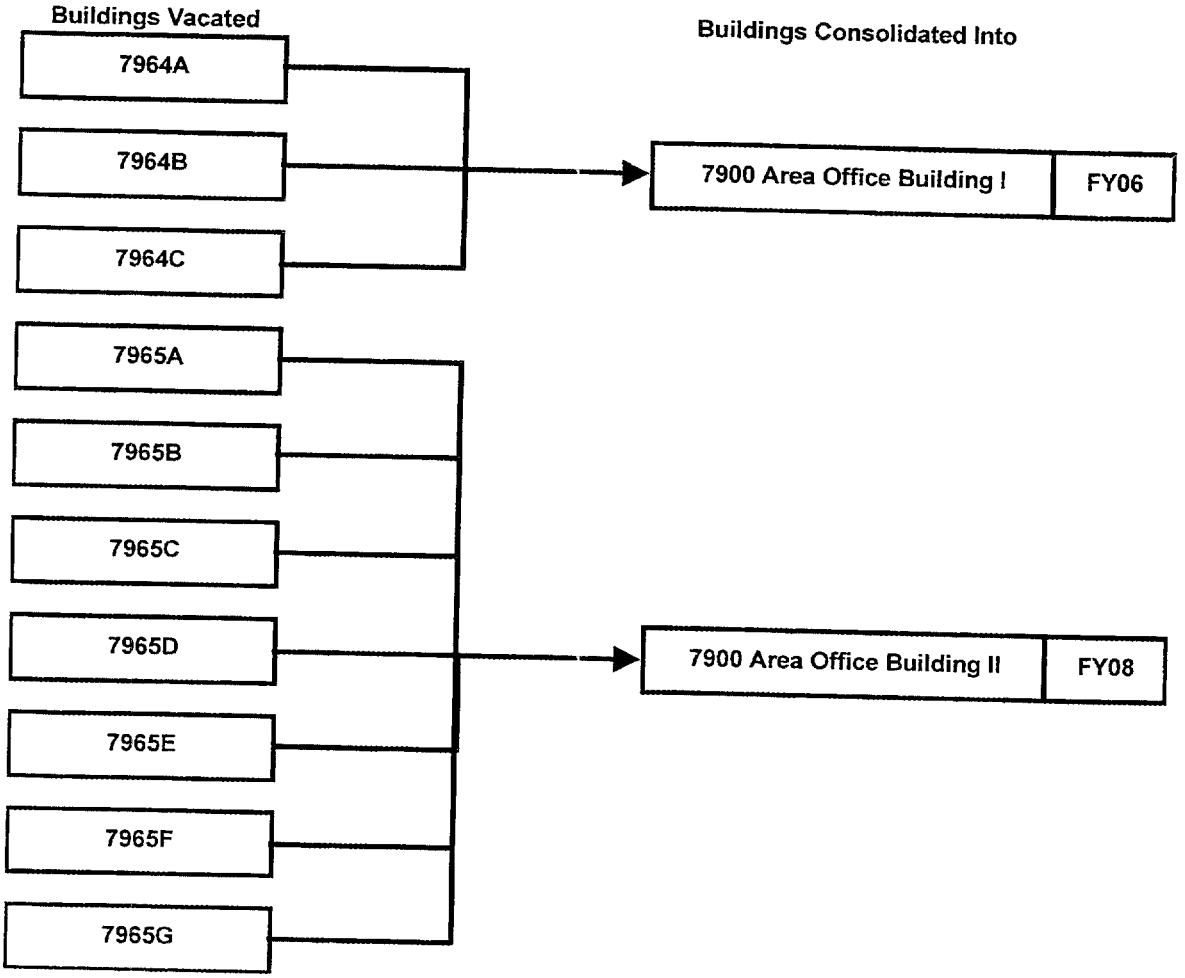


Fig. H.5. 7900 Area consolidation summary.

APPENDIX I

Detailed Descriptions of Utility Improvements

Electricity

Electrical power needed to operate ORNL facilities at both the X-10 and Y-12 Sites is supplied by high-voltage transmission lines from the Tennessee Valley Authority (TVA) power grid. The 161-kV primary power system serving the Oak Ridge Reservation (ORR) is an integral part of the TVA power grid; therefore, system design, operation, and maintenance must be compatible with the rest of the TVA system. The Power Operations Group located in the Y-12 Facilities Maintenance Organization has responsibility for coordinating operations and activities on the distribution grid and for operating and maintaining the main substations serving each individual site. ORNL is assessed a portion of the total power operations charge based on the percentage of the total power used by all three sites in Oak Ridge to pay for the service provided by the Power Operations Group. ORNL remains responsible for providing any additional funding that is necessary for major maintenance to the substation as well as monies needed for capital improvements. Electrical power used at ORNL is fed from the TVA network through two feeders. One feeder is approximately 8 miles long and extends from the K-27 substation at the East Tennessee Technology Park (ETTP) Site; the other is about 6 miles long and feeds from the Elza Substation located at the Y-12 Site. Each line is rated at 161 kV and is capable of supplying ORNL with approximately 110 MW. Transformers at the main substation at Building 0901 reduce the 161 kV to 13.8 kV. Current capacity of the feeders is sufficient to accommodate virtually any facility or program that may be located at ORNL, but the substation will need to be upgraded if total energy usage at the Laboratory increases significantly.

Eight 13.8-kV feeders distribute power to facilities throughout the Laboratory, where transformers further reduce the voltage to usable levels. Five secondary 2.4-kV substations, a 2.4-kV distribution system, switchgear, and numerous facility transformers complete the primary electrical distribution system that provides power to ORNL facilities. Fig. I.1 is a diagram of the primary electrical distribution system. One area which has changed in the past year is the extension of ORNL's 13,800-volt Feeder No. 264 into the Spallation Neutron Source (SNS) Area. ORNL forces constructed a new 8000-foot-long temporary electrical feeder into the construction area to provide power to SNS construction forces. This new line can provide up to 9 MW of power to the site and will be the primary source of electricity to the SNS until a new 161-kV to 13.8-kV substation is constructed for the SNS.

The system includes 32 miles of overhead distribution lines, 4 miles of underground cable, 20 medium voltage distribution switchgear assemblies, and over 200 facility transformers. Transformer installations range in size from 10 to 7500 kVA and range between 1 and 55 years old. The system has a maximum capacity of 80 MW, but practical guidance limits current capabilities to approximately 40 MW. The present electrical load averages less than 20 MW for much of the year.

Many of the most critical operations and facilities are equipped with gasoline- or diesel-powered generators. These standby generators automatically start up to provide essential power to allow functions associated with environment, safety, health, quality, and infrastructure (ESHQ&I) to continue unaffected during power outages. They are a key component of safety systems designed to protect the public from the materials and hazards present on ORNL grounds.

The oldest sections of the ORNL electrical system were built in the early to mid-1940s, and the age of the system is rapidly becoming a major problem. A number of projects have been completed that have greatly improved the safety and operability of the electrical distribution system. Two Line Item projects have been proposed to improve and modernize additional segments of the electrical system. One has been funded, and design work is beginning. This project will correct identified deficiencies and problems on a long overhead feeder, installing redundancy at the 4509 Substation, reworking bus-ties in the research complex, and installing additional meters to allow for improved efficiency. The second project, currently being proposed

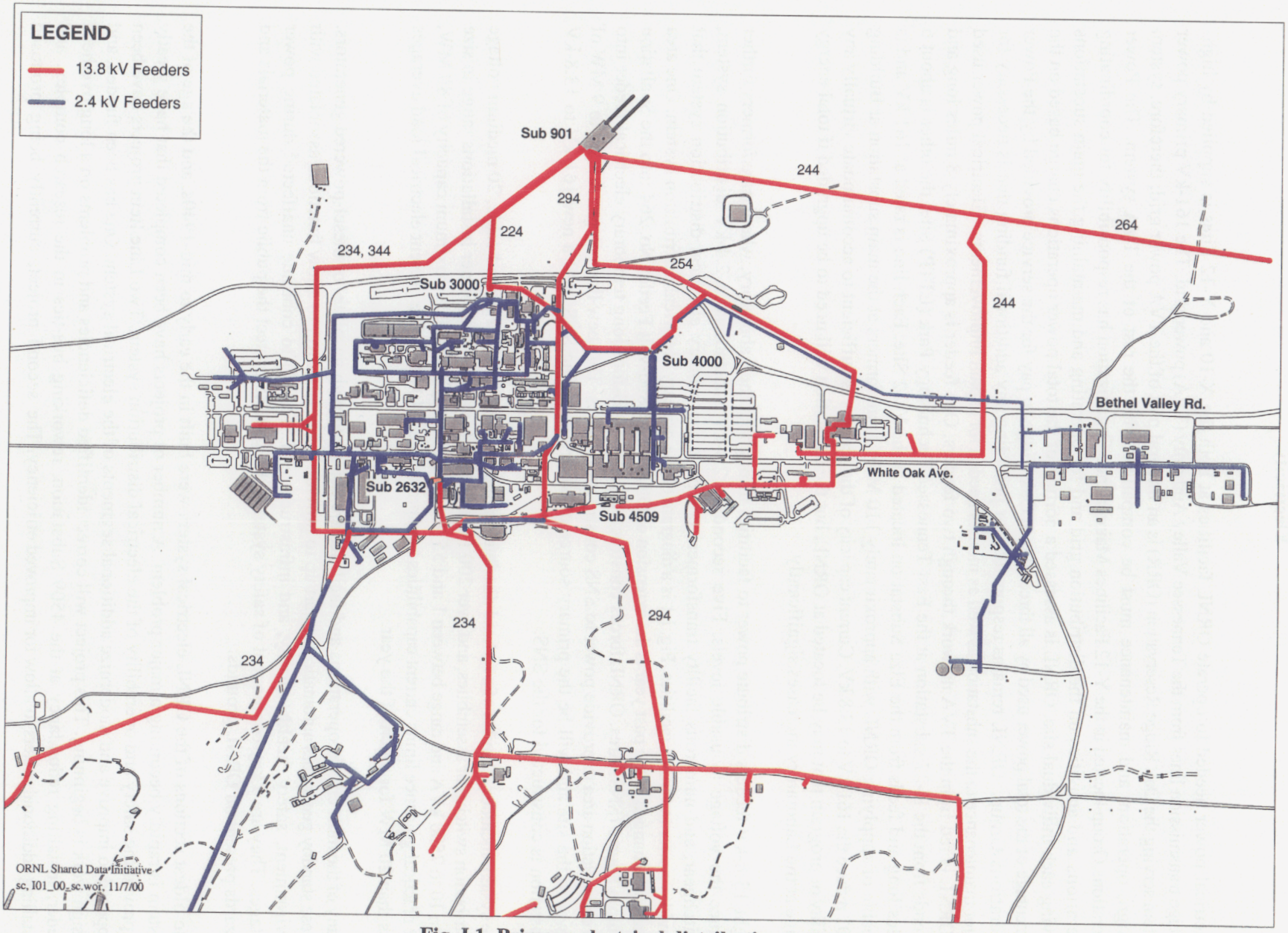


Fig. I.1. Primary electrical distribution system.

as an FY 2004 Line Item, will upgrade the existing 2400-V distribution grid to 13,800 V and will make other safety and operational reliability improvements to the primary electrical distribution system, which will result in a distribution system capable of serving the needs of the ORNL research community in the future.

General plant project (GPP) and general-purpose equipment (GPE) needs have also been identified and are in the planning base. The projects involve replacing oil-filled circuit breakers in the main substation with new SF6 units obtained from reindustrialization efforts at ETTP, replacing and rebuilding facility service entrances, changing out old unsafe switchgear, and replacing transformers at substations throughout ORNL. The electrical distribution system, while beginning to show signs of age, continues to provide reliable service to all customers in the Laboratory. If recommended improvements are completed, the system will easily support ORNL operations and facilities safely and reliably well into the next century.

Compressed Air

Compressed air powers all of ORNL's major pneumatically operated control systems. Loss of the air supply would disable many experimental programs and processes, as well as many building ventilation systems. Safety-related systems that are actuated or controlled using compressed air are designed to fail in the safe shutdown mode upon loss of air pressure. Safety-related systems may also have backup air compressors or large accumulators to provide a sufficient volume of compressed air to complete a safe shutdown of operations.

Clean, dry, instrument-quality, 100 pounds per square inch, gage (psig) compressed air is produced at the steam plant for customers in the Bethel Valley area by one or more of six air compressors. In addition, a single diesel-powered air compressor is used in emergency situations such as power outages or when maintenance or breakdowns on the other compressors require their use. Four air receiver tanks, three prefilter units, and two air dryer systems operate in conjunction with the air compressors to provide a clean, reliable supply of compressed air to ORNL. Compressors 1 and 2 are old electric reciprocating piston air generators acquired for use when the Laboratory was built in 1943. The No. 1 air compressor is a late 1930s model, and the No. 2 air compressor has been dated to 1917. Each compressor can provide 900 cubic feet per minute (ft^3/min) of compressed air at the nominal delivery pressure of 100 psi. The No. 3 air compressor is an 1100-ft^3/min rotary piston unit that was installed at the plant in 1960. It has a dual-drive capability using either electricity or steam to provide power. The Nos. 5 and 6 air compressors are relatively new, oil-free, rotary screw type compressors. The No. 5 compressor is rated at 2000 ft^3/min and is the primary air supplier for ORNL. It was installed in 1987, totally rebuilt in 1994, and underwent a slightly less intensive overhaul in the summer of 1997. Although operating hours are approaching 100,000, the machine has been well maintained and is considered to be in good condition. The No. 6 air compressor was installed in 1991 and can produce 900 ft^3/min. It has logged in excess of 5000 operating hours and is in excellent condition. A new 3000-scfm oil-free air compressor was completed in FY 1999. This new unit has become the primary air producer for the Laboratory, with the other, older units assuming a backup position. This unit is capable of providing all of ORNL's current compressed air needs without help from other units and will allow us to remove the two oldest reciprocating compressors from service. ORNL's compressed air load typically runs between 2400 and 2800 ft^3/min, day and night, and the various compressors are operated to suit the demand and to allow for maintenance on the equipment.

A new 1000-kW diesel generator was added in 1996 to provide emergency backup power to the Nos. 5 and 6 air compressors. The generator gives the steam plant added capabilities by being able to supply compressed air to customers during electrical outages. A new 4000-ft^3/min air dryer has been identified in the infrastructure plan to replace aging units at the plant. If funded, the addition of this new equipment will further enhance and guarantee reliable production of compressed air at ORNL.

The compressed air produced at the plant is distributed to customers in the Bethel Valley area through an arterial looped underground and aboveground piping system (Fig. I.2). The compressed air distribution system in the eastern area of the Bethel Valley complex was replaced in conjunction with the replacement of the steam distribution system in 1989. The steam lines and compressed air lines were placed in concrete trench ducts with easily removable concrete lid sections. The outward appearance of the new trenches is like that of sidewalks and, in fact, some of the trenches actually replaced sections of sidewalks in some areas. Replacement of the west end distribution system was completed in 1998. Again, aboveground portions of the steam and air distribution systems were placed in concrete trench ducts to enhance overall Laboratory appearance, improve system reliability, and provide for easy access should maintenance be required.

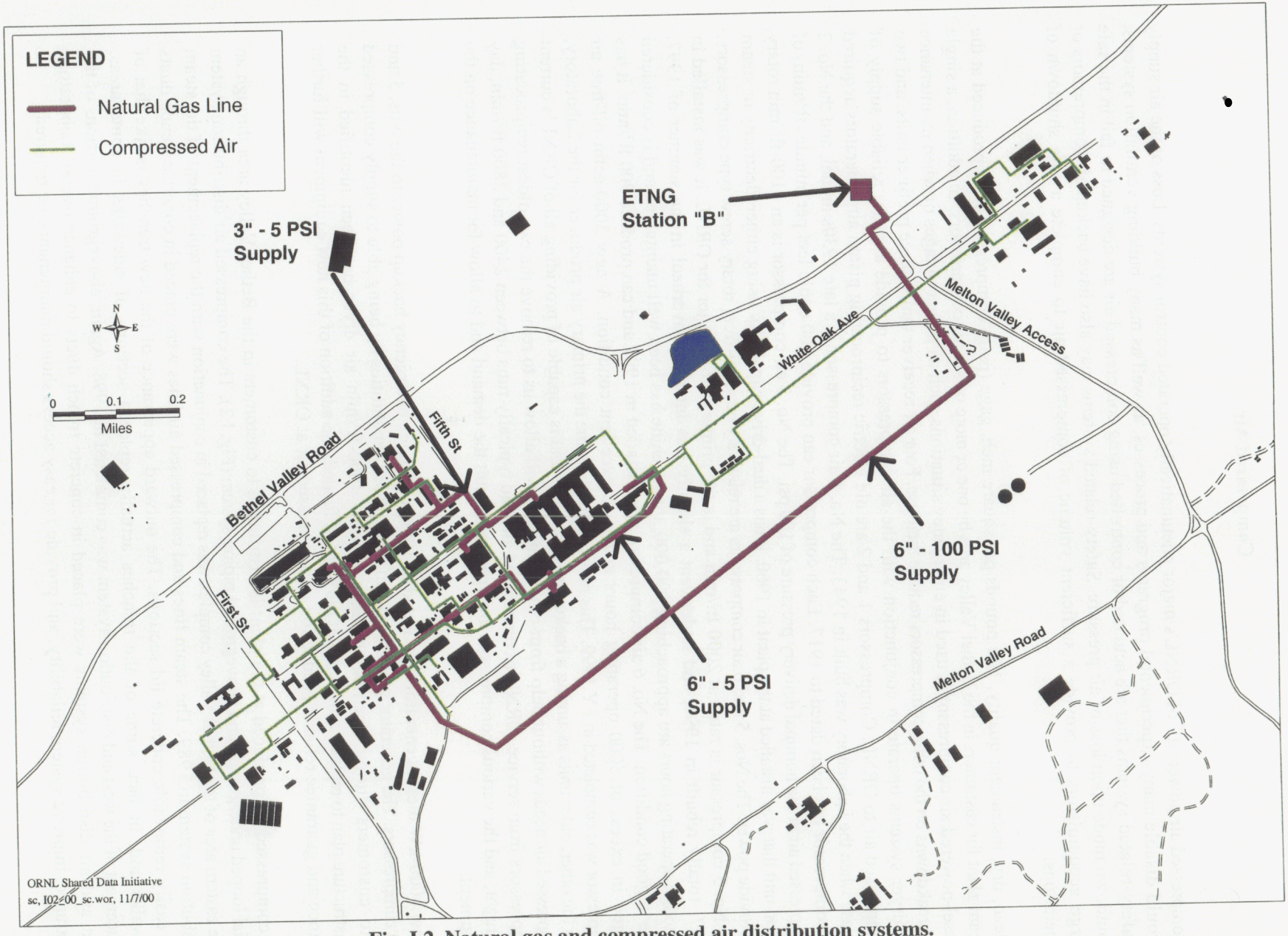


Fig. I.2. Natural gas and compressed air distribution systems.

Underground compressed air and steam lines in the old central section of the Bethel Valley site will not be replaced in the same manner because (1) many facilities in the area are inactive with only small portions of the buildings supporting operations, (2) plans are in place to decommission many of the facilities, and (3) much of the soil in the area is contaminated with chemical and radioactive materials which would make trenching a complicated and expensive operation.

Natural Gas

The El Paso Energy/East Tennessee Natural Gas Company (ETNGC) supplies natural gas to ORNL. This company owns, operates, and maintains the main line and the three pressure-reducing stations that make up the supply system to the ORR. DOE has delegated managing responsibility for this commodity to the Power Operations Department located at the Y-12 National Security Complex. This responsibility includes maintaining flow conditions within the supply contract limitations. No current supply limitations impact ORNL operations as the system is designed with more capacity than what is now demanded. However, contractual agreements do limit the amount of gas ORNL can demand. Under the current contract, ORNL can demand 1500 decatherms (1500 mcf) without incurring a penalty charge.

The ORNL natural gas tap is at Metering Station B, located north of Bethel Valley Road at the Melton Valley Access Road intersection. Natural gas from the ETNGC main is reduced to 100 pounds per square inch (psi) at the metering station and passes through an orifice flange where ORNL responsibility begins. Fig. I.2 is a diagram of the natural gas distribution system. The 6-in. ORNL supply line runs south to a tee where a 2-in. line branches off to supply gas to the 7000 Area reducing station. Gas pressure is reduced at the station to 10 psi for distribution to user facilities in the 7000 Area. Pressures are further reduced at each individual user facility according to the needs of that facility.

The gas supply for the remainder of ORNL runs southward from the tee for approximately 1000 ft before emerging from the ground. It then turns west and runs aboveground for approximately 7500 ft along the north side of Haw Ridge until it reaches the steam plant.

At the steam plant there are seven pressure reducers at Reducing Station 2. Five of these reduce the 100-psi natural gas to 10 psi for use in the boilers in the steam plant. The other two reducers drop the pressure to 5 psi to supply the distribution grid which supplies gas to facilities located in the main ORNL Bethel Valley complex. The 5-psi distribution grid consists of approximately 3500 ft of 6-in., 3-in., and 1.5-in. steel pipe. Eleven buildings are connected to the distribution grid in Bethel Valley and, of these, only eight currently use natural gas for any purpose.

The natural gas system at ORNL was constructed in 1948 with the only significant improvement coming in 1969, when the 100-psi main line was relocated to the north side of Haw Ridge to remove it from highly populated research areas. This aboveground line is in good condition, having been sandblasted and recoated in 1987; it should be able to continue to provide safe and reliable service for the next 15 to 25 years if the protective coating system is maintained. The underground portions of the line in the main plant area are in fair condition. Cathodic protection on these lines has prevented corrosion of the pipe. Only two leaks have developed on this underground section in the last 15 years, but due to the increasing line age, more frequent leaks can be expected in the future. To ensure that future customers will have a reliable natural gas supply, major upgrades to the underground system should be initiated in the next 5 years. Options to consider include replacing some sections of the lines and valves and utilizing cured-in-place lining systems on other sections which are not easily or economically accessible. These actions would need to be funded through the GPP system but currently do not receive support because of the small number of users on the system. An alternative that will be investigated is the use of bottled systems at the individual user facilities. Usage patterns will need to be examined to determine the feasibility of this alternative as some facilities and users may be unable to adapt their operations to efficiently use bottled systems.

The SNS will be installing a tee off of the ORNL 6-inch, 100 psi line in Pit 1 located just south of Metering Station B. Natural gas service will be extended into the site to provide fuel for package boilers and other operational purposes.

Potable And Process Water

Water for ORNL is taken from the Clinch River south of the eastern end of the Y-12 National Security Complex and pumped to the water treatment plant located on the ridge northeast of the Y-12 Plant. The treatment plant is owned and operated by the City of Oak Ridge and can supply water at a potential rate of 24 million gal/day (Mgd) to two storage reservoirs with a combined capacity of 7 million gal. Water from the two reservoirs is distributed to the Y-12 Plant, ORNL, and the City of Oak Ridge.

Water to ORNL is provided via a single 24-in. line extending from the water plant and running approximately 7.5 miles across Chestnut Ridge into the ORNL plant site. This 24-in. line feeds the ORNL reservoir system, which consists of one 3-million-gal capacity concrete reservoir on the south slope of Chestnut Ridge and two 1.5-million-gal steel reservoir tanks on Haw Ridge. These reservoirs provide the reserve capacity necessary to support ongoing day-to-day activities in ORNL facilities located in the Bethel and Melton valley areas. From these reservoirs, water flows by gravity into the plant distribution grid. The water is used for domestic, sanitary, fire protection, and process purposes. Water usage is approximately 2.5 Mgd on a winter day and 4 Mgd during the summer, though on a very hot day, water usage can approach 5 Mgd. A flow of 7 Mgd can be accommodated by the ORNL supply system under current operating conditions. Loss of the single supply line from the water plant, or any activity that would cause loss of the reserve capacity of one of the reservoirs, could impact ORNL operations within a short period.

The 3-million-gal water storage reservoir on Chestnut Ridge is constructed of reinforced concrete and is in poor condition. Major spalling has occurred inside the reservoir on the roof and support beams, and steel reinforcement is exposed and decaying. Minor exterior cracks have developed and have been healed by calcium deposits. The reservoir underwent a thorough internal and external inspection in 1997, and the evaluator recommended that extensive repairs be performed to ensure that the reservoir can remain functional. A proposed project to rehabilitate this reservoir was replaced with a GPP project that will construct an additional 1.5-million-gallon reservoir next to the concrete reservoir. Any major repair work performed on the existing reservoir would have required taking it out of service and draining it for an extended period. This situation would have forced ORNL to rely entirely on the two remaining reservoirs and the single supply line from the water plant and would have exposed it to the unacceptable risk of a water outage with the potential to shut down operations. The replacement project will construct an additional reservoir adjacent to the concrete reservoir and will allow operations personnel the flexibility to remove a reservoir from service for maintenance without impacting ORNL operations. The reservoir project has been funded, and design for the new structure is complete. Construction is expected to start in December 2000, with completion expected in the early summer of 2001.

The steel reservoir tanks on Haw Ridge were constructed in 1963 and are configured to normally provide reserve water capacity for ORNL operations located in Melton Valley (e.g., HFIR). Corrosion within the tanks necessitated replacing the steel roofs with aluminum dome-type structures in 1986. At that time, the tanks were also thoroughly sandblasted and corrosion-resistant coatings were applied to both the interior and exterior surfaces. These reservoirs were inspected internally and externally in 1997 and were judged to be in good condition. The only deficiency noted was a breakdown in the external coating system that was causing rust "blisters" to develop. Maintenance personnel stripped, wire brushed, and pressure washed the tanks in the summer of 2000 prior to applying a new polyurethane/epoxy paint that should prevent corrosion from recurring for at least the next 10 years.

A third reservoir serves facilities in a remote area of ORNL. A small 30,000-gal steel storage tank provides water to facilities at what was previously known as the Health Physics Research Reactor site. While the mission has changed in this area, the facilities continue to be occupied. This tank was inspected in 1997 and was judged to be in poor condition. Internal corrosion has occurred despite cathodic protection, and a new

coating system is needed. Discussions with fire protection and operations personnel indicate that this reservoir capacity may not be necessary any longer because the reactor has been shut down and moved. If capital funding can be obtained to replace a 1960s vintage fire pump serving the area, this reservoir may be removed from service and replaced with a smaller 2000-gal/day tank.

The water distribution system at ORNL (Fig. I.3) consists of approximately 100,000 ft of cast iron and steel pipe and 900 valves ranging from 2- to 24-inches in diameter, of which the process water segment constitutes a relatively minor part. Contamination of the potable water system is prevented by backflow preventers at the major take-off points and near the points of use on the process system. During the 1970s, the piping in the 7000 Area was upgraded from steel to cast iron.

Considering its age, the general condition of the water system is good, but some areas need improvement. Funding needs to be obtained to replace and upgrade the four major backflow preventer stations that supply water to the process water system. These stations are over 35 years old, and repair and replacement parts are no longer available for the backflow preventer valves. A GPP recently installed new motorized valves in the older sections of the system, but some older motorized valves and operators still exist and will need to be replaced with operating funds. The main line running east and west through the center of the Bethel Valley site has become brittle, and a major failure occurred in 1981 that was attributed to this embrittlement. Several improvements have been identified that would provide improved reliability, especially for fire protection, and would reduce the risk of flooding due to line breaks in low-lying areas. The Fire Protection Upgrade project, a line item proposed for funding in FY 2001, has recently undergone a major independent review, and it is hoped that monies to begin design will be forthcoming. In addition to addressing a number of fire protection issues, the proposed improvements will address the issues surrounding potential flooding of research facilities in the 6000 Area as a result of a failure of the 16-in. line passing through the site.

Two other Line Item projects are in the outyear planning base. These two projects address legacy-type problems associated with water lines running through the older process areas within the plant. The soil there is known to be contaminated with radioactive nuclides. Leakage *from* the pipes could leach radioactive material into groundwater and surface water. Leakage *into* the pipes could contaminate the potable water supply itself. A number of studies have been performed on these projects, and risk assessments resulted in the installation of additional valves to allow quick isolation of leaks in these areas. These two projects remain in the planning because of the necessity to consider plausible scenarios in order to ensure a safe water supply to employees at ORNL. These projects propose to replace the underground water system in contaminated areas with an aboveground water system. This is not considered to be a reasonable option for a number of reasons, including the fact that it would be unsightly, difficult to operate, and would not address all the issues surrounding the problem. Any construction activity in these contaminated areas is extremely expensive, and the proposed projects still cannot guarantee with a high degree of certainty that a leak will not occur. It is hoped that, with advances in trenchless technology, new methods of rehabilitating or replacing these lines will become available in the next few years, which will allow these areas to be addressed with a reasonable, cost-effective approach.

ORNL has adopted American Water Works Association (AWWA) guidance as one of it's guiding "Necessary and Sufficient Standards." The AWWA has recently published the results of a study on the "Impact of Wet-Pipe Fire Sprinkler Systems on Drinking Water Quality." The study indicates that the single check valve used for years on fire protection systems is not sufficient to completely protect public water supplies and recommends that reduced pressure zone backflow prevention devices be installed on all new sprinkler systems. Because of pressure, space, and supply problems, it does not recommend retrofitting existing systems. ORNL Fire Protection Engineering is currently evaluating this study and will likely include the AWWA recommendation in all future construction packages.

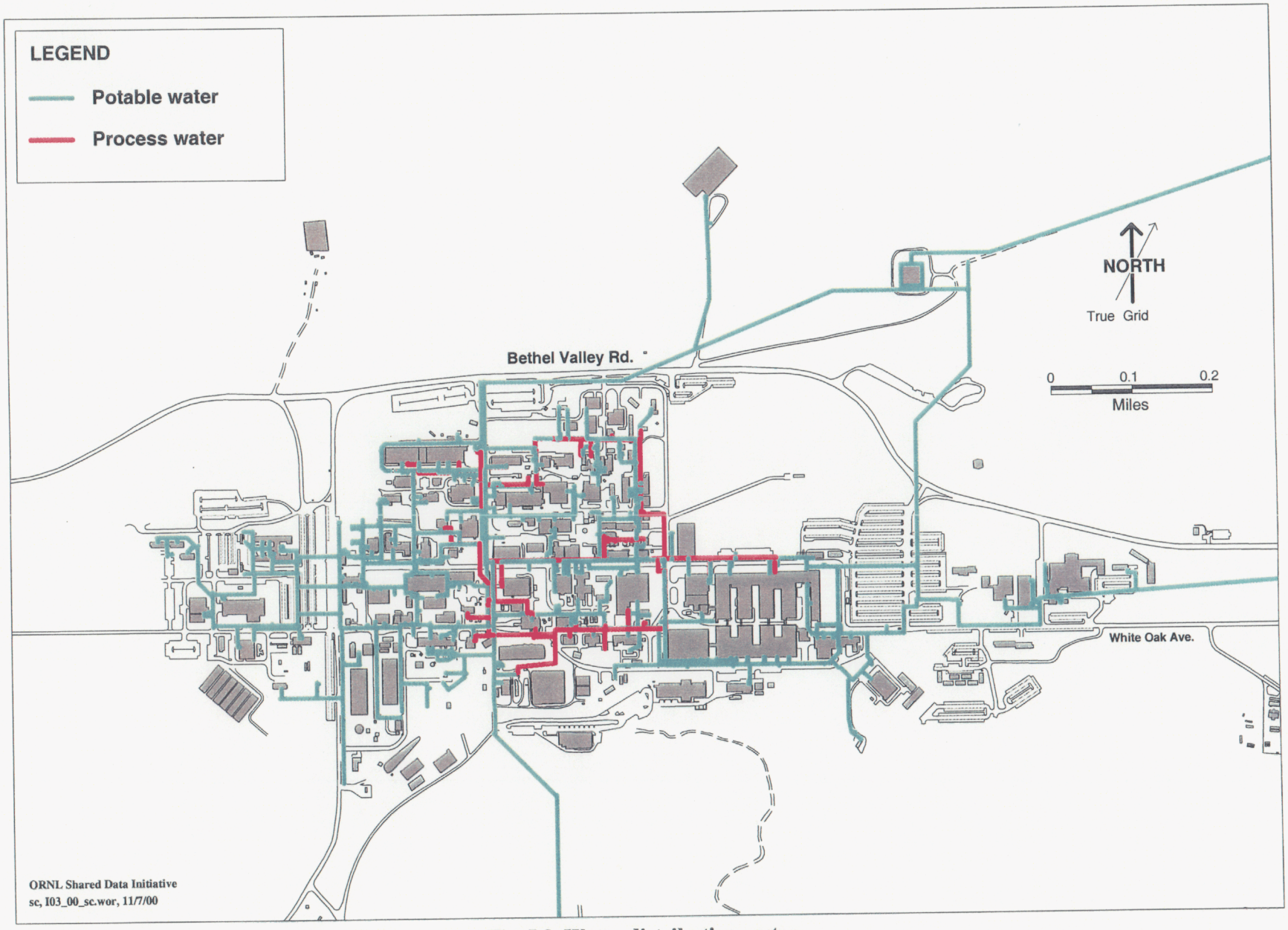


Fig. I.3. Water distribution system.

Industrial Gases

Industrial gases used at ORNL facilities are provided in refillable containers by vendors from the local area. These gases include nitrogen, argon, helium, acetylene, and other specialty or high-purity gases required for laboratory and industrial-type uses. Gas cylinders are received at Central Stores and are distributed to the various user stations as requested. Many facilities have gas manifold systems which allow distribution of the gases to many users throughout the facility, while other facilities rely on a system whereby individual users are responsible for their own gases. Liquid nitrogen is an important resource to many facilities throughout ORNL. Bulk liquid nitrogen is delivered to the Laboratory by a vendor and transferred to a bulk storage tank which delivers it to individual users, either into bulk storage tanks or transportable Dewars.

ORNL maintains a storage facility for compressed gas cylinders which is physically removed from adjacent buildings. Safety assessments have been performed on this facility which helped determine stocking levels of hazardous and flammable gases. Stocks of these types of materials are maintained in the facility at these minimum levels to help ensure minimal impact in the event of an accident.

Chilled Water

The Central Chilled Water System (CCWS), centered at Building 4509, provides chilled water used in the air-conditioning systems of 13 buildings in the central portion of ORNL (Fig. I.4). The three branches of the system serve (1) Building 4500N (less Wing 5), Buildings 4501 and 4505 and (2) Buildings 3500, 4500S, Wing 5 of 4500N, 4508, 4515, 5500, 5505, 5507, 5510, 5510A, and 6010. The system is comprised of 9 chiller units with an aggregate capacity of 8600 tons, 9000 feet of piping, 3 cooling towers, 324 fans, 47 chilled water pumps, and 10 tower water pumps. The chilled water system serves approximately 1 million square feet of floor area, including offices, laboratories, computers, and accelerators. Many of these applications require cooling, regardless of the weather.

Five of the nine CCWS chillers are less than 5 years old and utilize non-chlorofluorocarbon (non-CFC) refrigerants. They represent 5800 tons, or 67%, of the cooling capacity available. One 1000 ton CFC chiller is out of service, but effort is underway to secure funding to replace this chiller. The other three units have a combined total capacity of 1800 tons and are primarily used for backup of the newer chillers. Currently, the limiting variable is the capacity of the cooling towers. The Building 4510 cooling tower was rebuilt in 1997 and has a capacity of 4800 tons. The Building 4521 cooling tower was constructed in 1989 and has a 2000-ton capacity. A third tower, Building 4511, was built in 1959, is in extremely poor condition, and cannot be used. The two operating towers have a 6800-ton maximum capacity, which is less than the total cooling capacity available with the chillers. An extended outage on the Building 4510 tower will reduce the capacity of the chilled water to cool all 13 buildings in any season other than winter. Efforts are underway to secure funding to replace or rebuild the Building 4511 tower. When this tower is replaced, tower capacity will equal chiller capacity. The 8600 tons available is sufficient to provide reliable service to facilities and users at ORNL at this time. Additional cooling capacity will be necessary to provide sufficient capacity and redundancy if additional demand is created.

ORNL contains 34 additional self-contained chilled water systems, which are located within individual buildings that they serve (i.e., 2026, 2033, 6000, and 7900). These systems include 36 chillers, totaling 3958 tons capacity, with 13 cooling towers. Twenty-seven of ORNL's 45 chillers are less than 15 years old and utilize non-CFC refrigerants. Three CFC chillers have been converted to non-CFC refrigerants using operating funds, one has been abandoned, and four CFC refrigerant chillers remain operational.

A CFC chiller replacement project, initiated in FY 1994, has funded the replacement of 15 large CFC chillers with general-purpose equipment (GPE) funding. Funding for this program is planned through FY 2003 to replace the remaining CFC chillers and non-CFC chillers that are deteriorated or have leak rates frequently exceeding the allowable U.S. Environmental Protection Agency (EPA) limits (i.e., 3047E, 7910, 7603). Five of the 13 self-contained cooling towers are less than 15 years old. Appropriate funding is being sought to replace or repair cooling towers at Building 6001. Additionally, FY 2001 Laboratory Facilities HVAC Upgrade Line Item is underway to improve the chilled water system distribution and extend a new chilled water header to Building 4501.

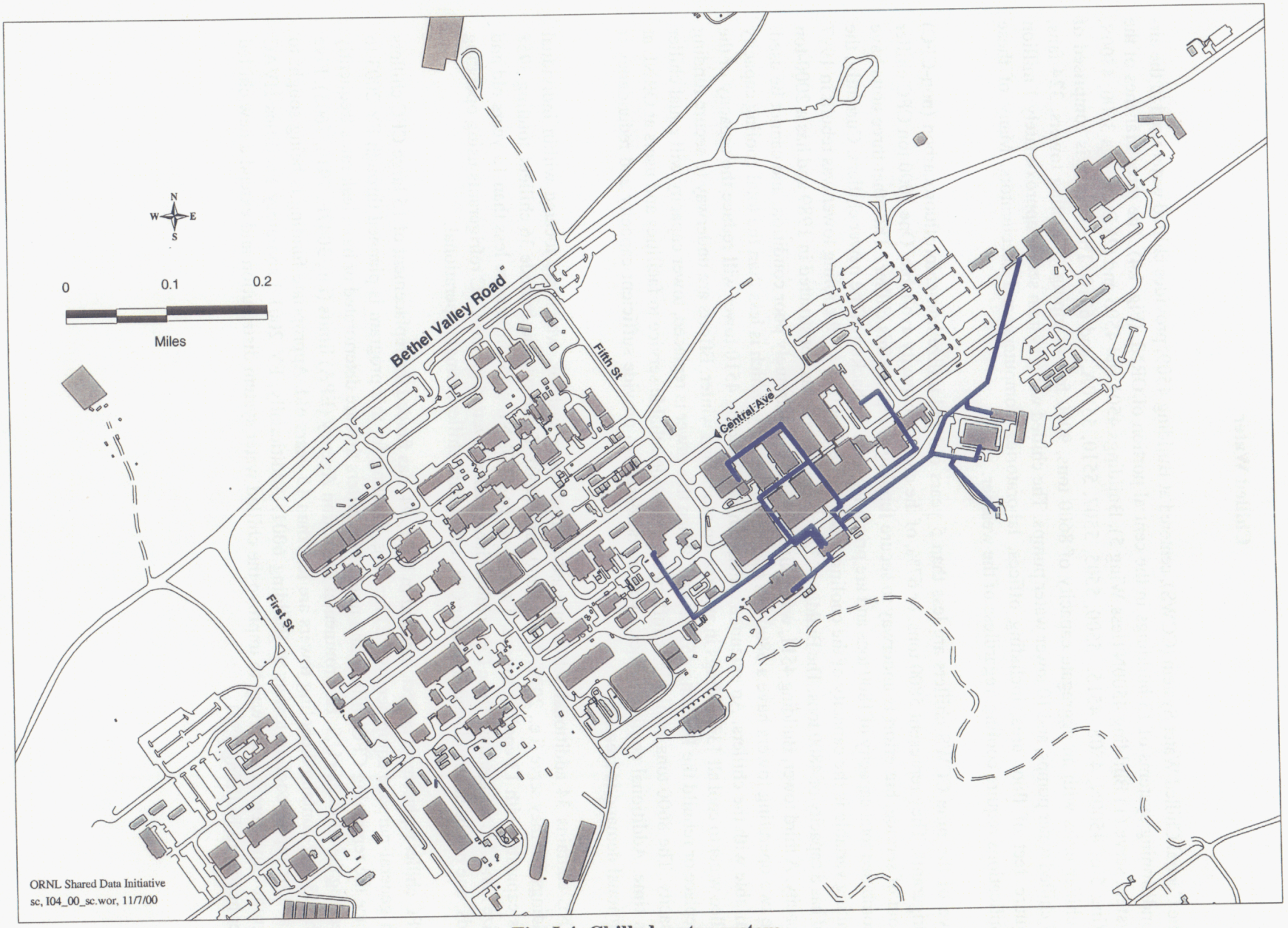


Fig. I.4. Chilled water system.

Steam

The steam production system consists of four dual-fuel boilers (using coal, gas, or oil) and two package-type boilers (which use gas or oil), all of which are housed in the steam plant (Building 2519). The total capacity of the six boilers is 405,000 lb/h of saturated steam at 250 psig. The Steam Plant supplies steam to the Bethel Valley facilities and the 7500 and 7900 areas in Melton Valley. The Steam Plant also houses the necessary auxiliaries, such as boiler feedwater pumps, induced- and forced-draft fans, water-softener systems, the fuel oil pumping system, the natural gas pressure-reducing station, and the coal-handling system. The coal-handling system is composed of 3 conveyors, a drawdown vibrating hopper, a tripper unit, 8 coal bunkers, and 16 coal feeders.

The steam plant was constructed in 1948 and underwent conversion from coal to natural gas/fuel oil in the early 1950s and from natural gas/fuel oil back to coal in the late 1970s. The conversion to coal as a primary fuel resulted in a reduction of capacity when using gas to fuel the boilers to make room for the coal equipment. The natural gas burners were relocated from the front of the boilers to the side. The side burner arrangement is very inefficient and reduces boiler capacity by approximately 60% compared to coal.

Oil can be utilized as a fuel for Boilers 5 and 6 but will be used only when natural gas availability has been restricted or when firing problems dictate the need to use fuel oil. Fuel oil is a very costly and dirty fuel to use. On-site storage of fuel oil was improved last year when a 250,000 gallon tank was added. Storage capacity now totals 320,000 gallons which is a sufficient volume to meet the needs of the Laboratory for over 3 weeks during the worst of weather conditions.

About 90% of the steam produced is used primarily for heating approximately 135 buildings, and the remainder is used for process steam. The process steam drives the emergency off-gas turbines in the 3039 stack areas if there are power outages. Other uses include heating water and drying clothes in the Decontamination Laundry; dish, pot, and pan washing in the cafeteria; and processes to support R&D activities throughout ORNL.

The steam distribution system (Fig. I.5) is sized to handle the total capacity of the six boilers. The system includes approximately 27,000 ft of piping involving approximately 360 major valves, 50 steam-regulating stations, and 70 steam pits. Steam is produced at 240 psig and routed from the northeast and southeast corners of the steam plant through an 8-in. line along Central and White Oak Avenues to form a loop around the Building 4500 complex. Steam lines to the 7000 Area are connected to the loop near Building 5505. A project to replace the steam and compressed-air lines in the eastern portion of the Bethel Valley complex, with new lines in concrete trench ducts, was completed in 1989. These trench ducts have easily removable concrete lids and, because they were set below grade in most areas, have the outward appearance of sidewalks. Work was essentially completed in 1998 on a similar upgrade of the western portions of the steam and air distribution system. New lines were installed in the below-grade pipe trenches, and 18 buildings were tied into the new looped system. Some additional minor demolition work on the old system remains to be done and will likely be performed using operating funds when resources allow. Other projects to upgrade the remainder of the steam distribution system in older areas of ORNL are being considered. To avoid disturbing contaminated soil in the old area of Bethel Valley, steam lines there will not be replaced by a trench system. An aboveground system would be the only option for replacing steam lines in the old area; however, the need for steam in the old area is expected to diminish as old facilities are closed and decontamination and demolition activities accelerate within the area.

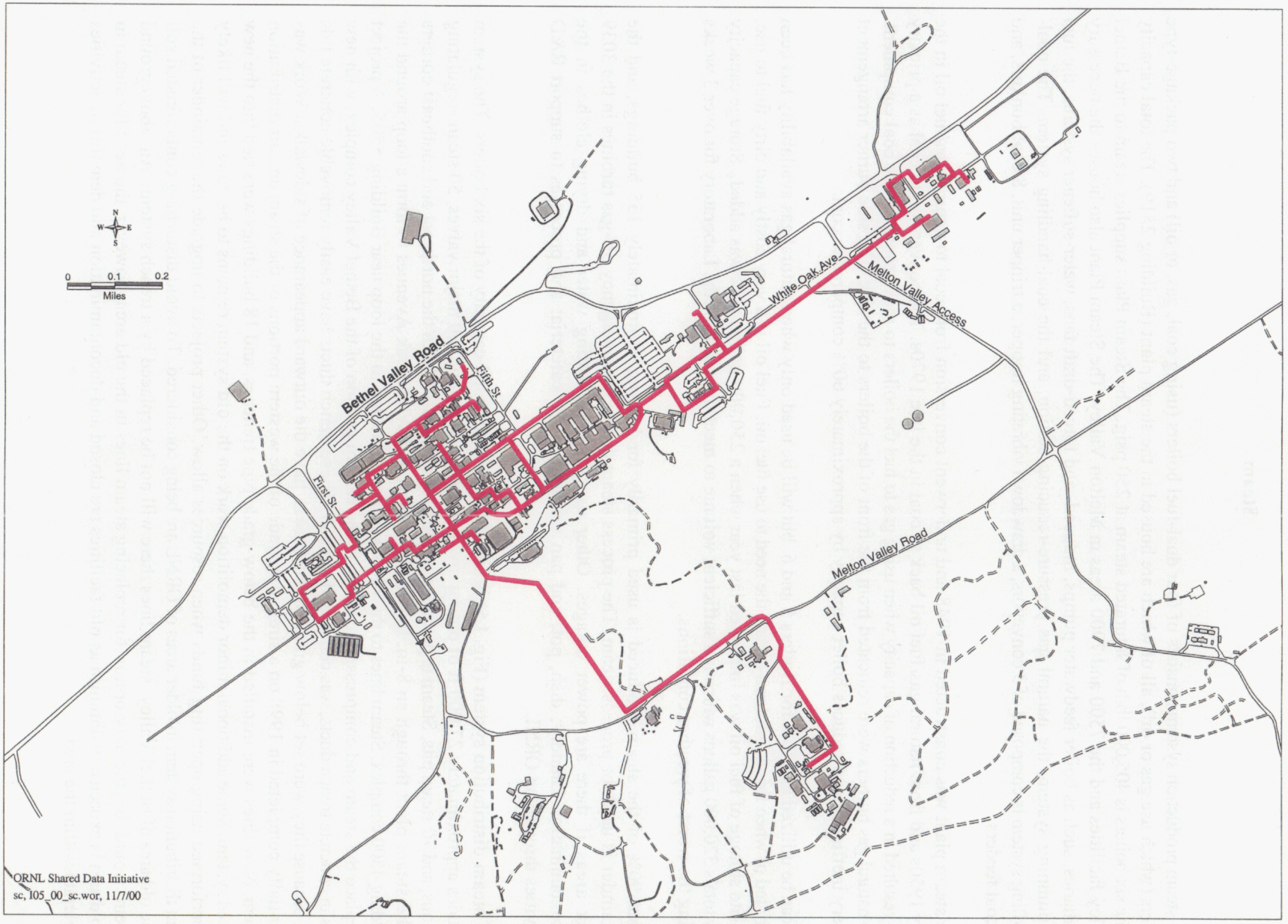


Fig. I.5. Steam distribution system.

No improvements are currently planned for the steam supply to facilities in the Melton Valley area, including the HFIR. If future funding allows, and programmatic requirements dictate, an additional feed line will be run from the steam plant and tied into the existing Melton Valley line at a point just north of the HFIR area. The addition of this new feed will allow maintenance outages to occur on the supply lines without affecting HFIR or other facility operations.

Condensate return lines have been installed during the upgrades to the east and west portions of the system. This condensate return system allows approximately 40% of the condensate generated to be fed back to the boiler feedwater system, thus improving the overall efficiency of the steam generation process.

While the steam plant remains reliable, the major equipment systems, including the boilers, have exceeded their useful design life. A steam plant study was completed that identifies replacement and upgrade projects that will be necessary if the plant is to continue to operate reliably and efficiently. It is doubtful that funding will be available in the foreseeable future to finance the construction of a new steam plant or to make any type of wholesale improvements to the steam generation system. Because of this, it appeared that a master plan needed to be developed to determine the least costly means to ensure continued operations. Many pieces of major equipment and a number of critical systems will need to be replaced in the next 10 years. The plan identifies these needs and will allow funding to be allocated to these projects in manageable portions. It is planned that natural gas will once again become the primary fuel. The adoption of this firing strategy will eliminate the need to upgrade systems such as the Coal Yard Runoff Facility, the electrostatic precipitator, coal-handling systems, and ash removal and disposal systems. The result should be relatively stable steam costs after the first few years of equipment and system close-out costs and significant capital cost avoidances from not having to repair and replace major coal-related systems.

A number of other projects are also underway or will be in the upcoming years. Funding will be allocated in the next couple years to replace the economizers on Boilers 1 and 4, after completion of a successful project which replaced the same components on Boilers 2 and 3 during the summer of 1998.

Projects aimed at upgrading Boiler 5 are being developed. This 100,000 lb/h package boiler is approaching 40 years of age and is in need of some improvements to ensure its reliability in the future. Proposed projects include replacing the economizer heat exchanger, replacing the burners, changing the setup from steam atomization to air atomization, upgrading and relocating boiler controls, and installing telemetry. These improvements, coupled with general maintenance-type activities, will return the boiler to first-class operating condition.

The East End Water Softener System softens boiler feedwater and serves as a backup to the primary West End Softener System. This old system was installed in 1963 and desperately needs upgrading. Currently designed to treat boiler feedwater to produce up to 100,000 lb/h of steam, its performance has degraded steadily over its years of use. The system needs to be replaced with a new unit designed to accommodate the normal maximum winter steam output in order to be an effective backup system.

The Boiler No. 6 project that was completed in September 1999 provided the key component in the coal-to-natural-gas-conversion strategy. Its addition gave the steam plant the capability to produce year-round steam loads without using coal. With this capability, ORNL will be able to rehabilitate the old coal boilers, one at a time, and convert them from coal stoker boilers to natural gas and fuel oil firing. The rehabilitation effort will include new steam tubes and drums, replacement of all refractory brick and insulation, and removal of all coal-handling equipment and replacement with a new fuel manifold system to allow maximum output from gas or fuel oil. Projects have been proposed to perform this upgrade over a span of years to ensure the steam plant remains viable well into the future.

While most of the projects proposed at the steam plant deal with maintaining the plant's ability to produce steam and compressed air, there are a number of other proposals directed at both the plant's and the Laboratory's long-term environmental compliance goals. Now that the steam plant has a total natural gas/fuel oil capability, the coal contracts have been terminated and coal inventories are being burned off. Projects to demolish and remove those physical systems that exist solely to handle coal, coal ash, and its other byproducts will become increasingly important. Once the coal is removed from the coal yard, steps will be taken to stabilize that area and return it to its original "green" state. When coal is no longer burned, precipitators used to remove coal particulates from the flue gas and the whole ash conveying and disposal system will no longer be needed and should be disconnected and removed. Coal-handling equipment in the steam plant itself will need to be removed to prevent future problems. The Coal Yard Runoff Treatment Plant, designed to process highly acidic wastewater from the coal yard, will no longer be needed once the coal yard has been shut down. The greatest benefit will likely be the greatly diminished potential for environmental incidents. Coal is a dirty fuel, requiring many systems and subsystems to operate cleanly and efficiently. The decision to convert the plant operation to natural gas may result in a period of higher steam costs while the various subsystems are closed out, but it is expected that because of the higher efficiency that is obtained by burning gas, coupled with less maintenance required on the equipment, the cost per Btu will drop to a comparable level and the laboratory will have avoided all the costs associated with coal system upgrades, environmental concerns and waste handling and processing.

Stormwater

The stormwater collection system consists of drainage ditches, catch basins, manholes, and collection pipes which convey stormwater, condensate, and cooling water flows to the receiving streams. White Oak Creek traverses the site and ultimately receives all the discharges from ORNL as well as normal flows from the four tributaries which feed it. Rainfall, snow-melt, and other authorized flows are directed to the gravity-drainage system which conveys the water from buildings, parking lots, streets, and roofs to specific outfalls. The collection system itself was installed in an unplanned manner over the years as ORNL developed and matured, which has resulted in the existence of 146 National Pollutant Discharge Elimination System (NPDES) Permitted stormwater outfalls discharging into the receiving streams. To comply with current stormwater regulations and ORNL's NPDES Permit, each of these outfalls must be periodically sampled and characterized to determine the makeup of the discharge stream and to ensure that it complies with permit requirements.

Significant effort must be expended to keep up with compliance-related issues associated with these outfalls and their discharges. During the last few years, three liquid-feed dechlorinators have been installed on outfall pipes that carry large volumes of once-through cooling water. Smaller, tablet-feeder dechlorinators have also been installed on numerous outfalls that convey smaller continuous or periodic flows of cooling water. Due to the strict in-stream chlorine concentration limits imposed on ORNL by the NPDES Permit, it is imperative that these wastewater streams are chlorine-free prior to their discharge.

A comprehensive storm drain survey was completed at ORNL in the summer of 1997. This survey was mandated by a court order that resulted from the Friends of the Earth vs DOE lawsuit. It consisted of a comprehensive survey of all pipes, sinks, and other connections to the storm drain system. Facility managers, subject matter experts, and members of the support services staff walked-down and dye-checked all the drains in 846 facilities, buildings, and other structures located within the ORNL Complex. The results of this survey are maintained in a central database, are updated annually, and continue to be used to eliminate inappropriate discharges into the stormwater system and to identify sources of once-through cooling water that can be treated, rerouted, or eliminated. Dechlorinators are being used to treat chlorinated discharges, but because of the costs involved in the maintenance and upkeep of these units, substantial efforts are being made to eliminate the source of the discharge itself. Through these efforts, it is hoped that compliance can be consistently achieved with a minimum of expense and effort.

Other efforts to improve the system are also being pursued. In many areas, pipe elevations and receiving stream flows had made it impossible to obtain representative samples of flows in the discharge pipes. Modifications have been made to many pipe systems to improve configurations and allow accurate sampling to take place. In other areas, sampling wells have been installed in the pipe itself to allow improved access to the pipe. In all areas, ORNL has adopted a "best management practices" approach as an economical and practical way to achieve compliance. A Stormwater Pollution Prevention Plan describing these practices is in place and serves as a guidance document to help identify potential problem areas and to recommend possible mitigating actions that can be taken to avoid permit noncompliances.

Construction activies at the Spallation Neutron Source have begun and contractors working on the project have instituted a proactive stormwater management approach. The entire 125-acre site has been ringed with silt fencing and straw bales, with special emphasis on drainage swales and runoff corridors. To assist in the long-term management of stormwater flows from the facility, two new stormwater retention ponds have been constructed. These ponds will collect stormwater flows and allow solid particles to settle out before the water is discharged.

Conventional Waste

Conventional wastes include sanitary/industrial wastes, sanitary sewage, process wastewater, and stormwater. Solid conventional wastes are regulated by the Tennessee Solid Waste Management Act.

Sanitary/Industrial Wastes

Sanitary/industrial waste consists of paper, garbage, wood, metal, glass, plastic, demolition and construction debris, sanitary and food wastes from cafeteria operations, sludge from water and air treatment, and other special wastes. The Y-12 National Security Complex Centralized Sanitary Landfill II is used for disposal of nonhazardous materials such as construction debris. Most other sanitary wastes can be sent to this Y-12 National Security Complex landfill also. During FY 1998, ORNL generated and disposed of 244,377 ft^3 of sanitary/industrial waste.

Sanitary Sewage Collection and Treatment

Sewage Collection. The sewage collection system (Fig. I.6) consists of over 32,000 ft of clay, cast iron, and polyvinylchloride (PVC) pipe ranging in size from 4 in. to 12 in. Access to this system is obtained through 194 brick and concrete manholes. The system itself has grown as ORNL has grown. The early parts of the system, located roughly between First Street and Fifth Street, were constructed in 1943 when ORNL was built and consists primarily of vitreous clay pipe with packed joints and manholes constructed entirely of brick. The rest of the collection system was constructed as the Laboratory grew and developed. The construction methods used in these areas reflect construction practices used when they were built, with some collection grid lines constructed from vitreous clay, concrete, cast iron, and PVC. Manhole construction also reflects this, as some are built entirely from brick, while others are part brick and part concrete, some are poured-in-place concrete, and the newer manholes reflect the current practice of using precast units.

In the early 1980s, a leak test was performed on the system which indicated areas where illegal taps had been made and where infiltration was a problem. The illegal taps were removed and restrictions placed to help prevent the recurrence of the problem. The survey also was used as the basis for the first general plant projects (GPPs) in the mid-1980s directed at lessening infiltration into the system. During 1984 and 1985, approximately 60% of the sewage collection grid lines 6 in. and larger were rehabilitated using a then-new process called Insituform. The Insituform process installs a new, joint-free liner inside the existing pipe, creating a slick, leak-free system. The success of this effort was immediate, with daily average flows falling from the 250,000 gallons per day (gpd) range to the 150,000 gpd range.

This proved not to be the ultimate solution to infiltration problems. Within a year after these lines were rehabilitated, volumes began to slowly increase. Investigation of the problem indicated that the groundwater flow which previously had been entering the pipe through open joints, cracks, and breaks was now flowing along the outside of the pipe and entering the system either through the manholes or through a section of pipe which had not been lined.

Because of this problem and other weaknesses identified in the sewage collection system, a Line Item project to upgrade the sanitary sewage collection system was initiated in the late 1980s and funded in 1993. This project successfully upgraded the entire collection system by installing cured-in-place lining in all sewer lines 6 inches and larger, sealing all manholes with a high-build polyurethane, and by making other improvements.

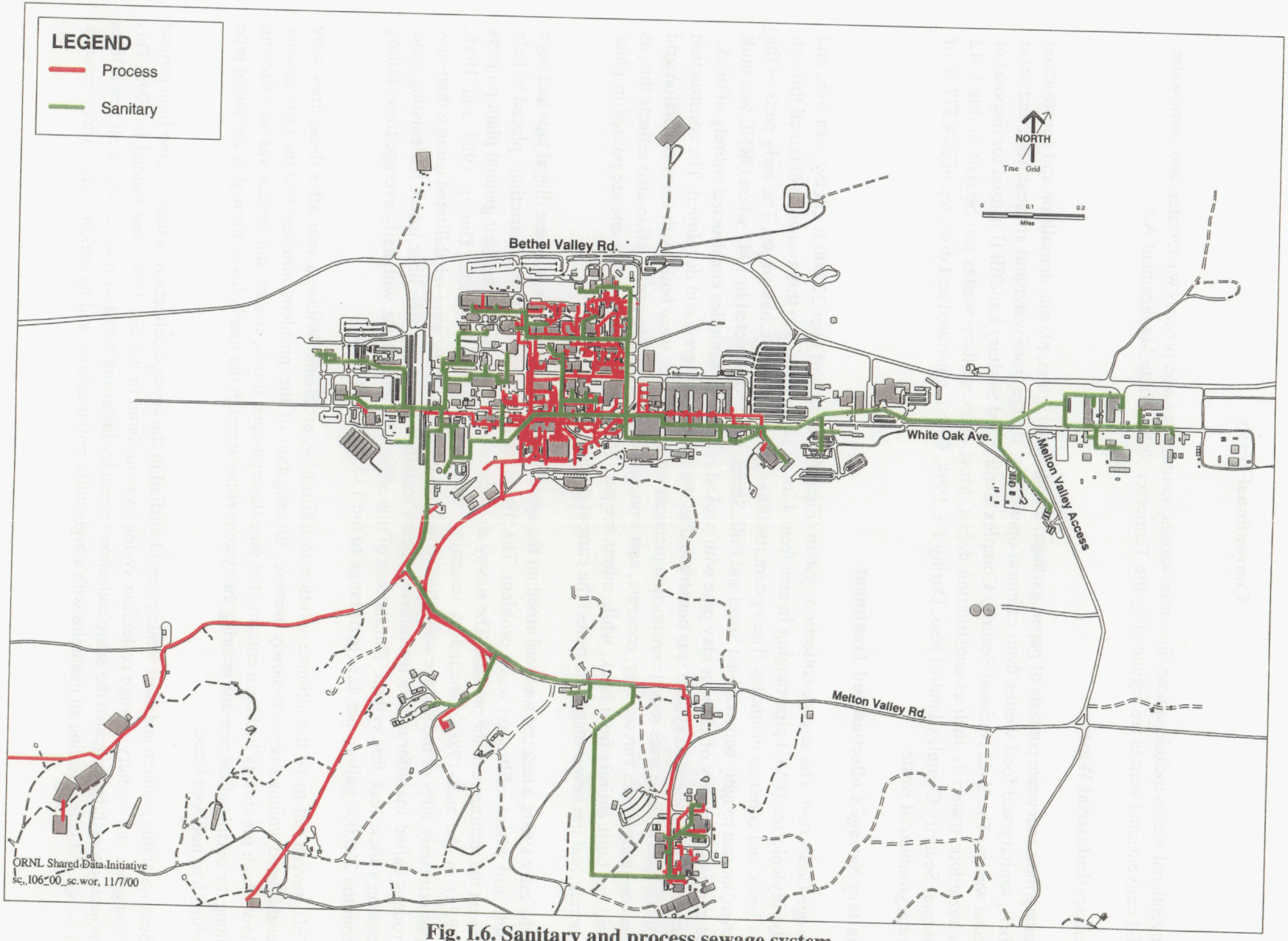


Fig. I.6. Sanitary and process sewage system.

Sewage Treatment. The ORNL Sewage Treatment Plant consists of a DAVCO 300,000-gpd packaged, extended aeration plant which provides primary and secondary treatment and a sand/gravel filter and disinfection chamber to provide tertiary treatment. The plant was constructed in 1985 and has performed continuously since that time. Treated flows averaged 181,000 gpd during FY 1998; 182,841 gpd in FY 1999; and increased to 190,215 gpd in FY 2000 primarily due to an increase in rainfall totals in the spring and early summer.

Efforts aimed at improving overall operations at the Sewage Treatment Plant continue with some notable successes. A portion of the digested sludge from the ORNL Sewage Treatment Plant is taken to the West End Treatment Plant in Oak Ridge where it is combined with sludge generated at the facility. The combined product is then disposed of through the sludge land farming contract the City of Oak Ridge has with DOE. The volume of sludge disposed of by this method is restricted due to limits on the amounts of specific contaminants, but the process is viewed as a significant step towards resolving disposal issues. Future efforts will concentrate on locating and eliminating sources of the contaminants in question, many of which may still be entering the system through sections of building service feeder lines that could not be sealed with the lining process used during previous projects. Sections of these lines may need to be excavated and rebuilt to prevent the infiltration from occurring.

The ozonator system has been installed at the Sewage Treatment Plant and is in operation. This system allows us to eliminate the use of chlorine as a disinfection agent on the effluent stream leaving the plant. When properly installed, maintained, and operated, ozone systems are an effective disinfection system and are gaining favor at plants throughout the country. The use of this system reduces the amount of chlorine in the receiving stream and will help ORNL meet its NPDES Permit compliance goals. The sewage analysis laboratory continues to be an important addition in maintaining efficient plant operation by allowing real-time monitoring of process parameters. The on-site analysis of the treatment process operating parameter tolerances have been tightened, resulting in a higher quality effluent. This year's NPDES audit, performed by the State, once again recognized the positive impact the creation of this lab has on plant operations.

Other ongoing activities at the Sewage Treatment Plant include continuing to find sources of infiltration and working with the various planning groups involved with the Spallation Neutron Source (SNS) and the Life Sciences Complex. These facilities and their associated processes will generate new flows into the Sewage Treatment Plant, and planning is in process to ensure that their needs will be accommodated in both the construction and operational phases of these projects. A new initiative funded jointly by the SNS and ORNL will create a computer model of the sanitary sewer collection system. The model will allow plant personnel to simulate flows from various areas at ORNL, thus allowing us to accurately plan for the various facility additions currently being proposed by ORNL leadership and supported by DOE. Because of the proposed locations of these new facilities, sewage system loading will be modified, and it may be necessary to adjust the timing and volumes of the various flows into the plant from the main sewage pumping stations located at Buildings 3501 and 4512 and in Melton Valley. While finding sources of rainfall-induced infiltration is always a priority, ORNL is also working to identify other sources of nonsanitary sewage flows in the system. Flows remain relatively constant throughout the day as well as on the weekends indicating that there are possibly still some once-through cooling water flows into the system or that there are a number of leaking flush valves in buildings that are contributing to the problem. The amount of water is small (less than 10 gpm) so finding the source(s) is extremely difficult, particularly if the flows are the result of multiple sources being combined.

Transportation Infrastructure

ORNL Main Site locations are accessible only by road. Remote areas of the site border the Clinch River, but no barge facility has been developed. Such a facility could be developed if future needs arise that will require moving large, heavy objects. ORNL has access to and has used two different barge facilities in the past; one at the East Tennessee Technology Park (ETTP) and the other at the Tennessee Valley Authority's Bull Run Steam Plant. Rail access is limited as well, as no tracks run to the ORNL Site. Access to rail service can be made either at the ETTP or at the Y-12 National Security Complex, both of which are served by a rail spur.

Motorized vehicle circulation at ORNL may be divided into two sectors: off-site and on-site. Off-site circulation consists of staff movements to and from work and between the various other Oak Ridge installations and offices on work assignments and for material pickup and delivery. Off-site roads include State Route 95 (White Wing Road), located approximately 1 mile to the west of the Laboratory's main complex, and State Route 62 and Scarboro Road, which provide access to the Laboratory and ORNL facilities at Y-12 from the east. Bethel Valley Road extends between Highways 95 and 62 by running approximately 8 miles through the center of the Oak Ridge Reservation (ORR) and is the main artery serving the Laboratory. Though Highways 95 and 62 run through the ORR, maintenance and emergency services on these roads is provided by the State of Tennessee and the City of Oak Ridge. Bethel Valley Road, on the other hand, is owned by the DOE and maintenance services are subcontracted. Security and emergency services are provided along Bethel Valley Road by the ORNL Plant site, DOE contract security, the City of Oak Ridge, or, as is often the case, a combination of these three entities. The State of Tennessee is considering routing a west interstate bypass around the Knoxville metropolitan area. A number of alternative routes are being considered, including one route across the ORR (Fig. 2.16).

On-site motor vehicle circulation consists of employee movement between and among work sites within ORNL and the delivery and pickup of materials, tools, and equipment used to support routine operations. In addition to walking, employees use cars and trucks, golf carts and bicycles to move among the widely dispersed facilities at the Laboratory. A paved bicycle trail extends from the west end of the plant to provide a safe and efficient way for cyclists to move about Laboratory facilities.

Principal roads serving ORNL's Bethel Valley Site are shown in Fig. 3.1. The main road is Bethel Valley Road, an east-west thoroughfare that provides access to the site and leads to all of the main parking lots. The road surface is poor and currently needs resurfacing from a point just west of the ORNL 7600 Area access road to just beyond the westernmost entrance to the Laboratory. The existing asphaltic surface is deteriorated and patches have failed. Potholes and "pulls," areas where the asphalt has lost adhesion with base surfaces, are common making for an uneven driving surface. It is planned at this point to repave this section of the road and make some minor improvements to enhance overall road safety, particularly at the new SNS Access Road and at the main plant entrance. A project to reroute Bethel Valley Road along the north side of the Laboratory was designed in the early 1980s and has received some renewed interest. The UT-Battelle facilities modernization plan is considering many areas for long-term development of a new Laboratory research campus. The 1980s proposal would relocate Bethel valley Road about 1/8 mile to the north of its existing location and would allow development of the new complex around the existing Swan Pond and in the area now occupied primarily by the East Parking Lot. A portion of the old section of road could then become an internal access road within the Laboratory. The plan has some merit in that it would allow the development of a new Laboratory entrance while moving the heavy truck and vehicular traffic away from ORNL facilities. However, it will be some years in the future before any such project could become a reality.

Completion of several construction and expansion projects has alleviated chronic parking problems experienced at the Bethel Valley facilities over the last couple years. Parking lot conditions, in general, are good. Most asphalt lots are holding up well but could stand a general re-striping to delineate parking spaces. Gravel lots typically serve to provide parking under overflow conditions, such as during the heavy guest and visitor months in the summer. These lots are well constructed and provide safe parking for employees but should be paved to meet the intent of ORNL's Stormwater Pollution Prevention Plan. Rains cause erosion and rutting in the gravel lots and the sediment picked up during rains is carried into the area's receiving streams. A number of proposals for new facilities have them located in what are now parking lots. The "Mouse House" is conceptually sited in the parking lot immediately west of Building 1000. Parking spaces displaced by this building will be relocated to a gravel lot located north and west of the building. The new research campus is proposed for different areas of what is now the East Parking Lot. Vehicles displaced from this lot will need to find spaces in an existing gravel lot located south of Building 6026 or in a new lot that will be constructed south of the 6000 Area of the Laboratory. The South Parking Lot is destined to be closed when funding is received for a new addition to the High Temperature Materials Laboratory (HTML). The parking to be displaced by this new building addition will be replaced by developing parking on top of the old surface impoundment structures now being filled and capped. Access to these new parking areas will need to be provided by constructing a new bridge across White Oak Creek in the area now occupied by the temporary sludge processing facility that will be removed once remediation work is completed on the ponds.

On-site transportation is provided by an arterial grid system of streets running through ORNL. North-south access is provided by numbered streets, starting with First Street at the west end of the plant and ending with Eighth Street in the east. The main east-west corridors are Central Avenue and White Oak Avenue. Most main routes have sidewalks running parallel to them to ease employee accessibility and improve safety. Sidewalk conditions throughout ORNL are considered good with only small sections needing repair or replacement each year. Vehicles used for casual transport, as well as those used to haul materials and make deliveries, utilize the same traffic grid, though traffic volumes are such that it is rare to have any problems.

The main roads in Melton Valley are Melton Valley Drive, Ramsey Drive, Melton Valley Access Road, Lagoon Road, and HPRR Access Road (Fig 3.2). These roads lead to the principal experimental facilities including the High Flux Isotope Reactor (HFIR), Robotics and Process Systems Complex and the Radiochemical Engineering Development Center, as well as to the numerous Solid Waste Storage Areas (SWSAs) and waste processing sites in the valley. Road conditions need to be improved on both Melton Valley Drive and Lagoon Road. Both roads predate ORNL and were designed only to provide access to the farm community that was in the area prior to 1943. Melton Valley Drive east of the HFIR entrance has not been paved or upgraded since the 1960s and has deteriorated significantly. The old asphalt surface has many cracks and irregularities, and subsurface drainage systems show signs of failing, causing areas of undermining of the base material. Traffic volumes, both vehicular and pedestrian, dictate that the road be realigned and leveled to provide a safe driving surface for employees and guests who must use it. Lagoon Road is similarly affected. Age and use, coupled with a poor initial design, make this road dangerous, particularly in wet weather. The road has many hills and curves and needs to be straightened and leveled to improve safety. The northern section of the road, extending from the Chemical Waste Area Access Road to Melton Valley Drive, runs adjacent to ORNL's Solid Waste Storage Area 4. This section of the road will be closed in FY 2001 while construction forces install a new cap and seal over the old burial ground area. Once the cap has been completed, an improved section of Lagoon Road will be constructed to provide vehicle access to the south areas of the Laboratory.

Copper Ridge has one main route, Gravel Hill Road, which connects the old DOSAR Facility and the Tower Shielding Facility to State Route 95. The road is a single-lane, unimproved gravel access road running along a power line right-of-way. Since the Tower Shielding Facility has been turned over to CROET for reindustrialization, access into the area by anyone other than a small group of utility service providers is being discouraged. The road will continue to be adequate for these users if properly maintained.

By far, the largest portion of off-site traffic circulation is generated by ORNL personnel commuting to and from work. The average commute of an ORNL employee working in Bethel Valley is about 35 miles. Peak traffic occurs between 6 and 8 a.m. with the arrival of workers at the site and between 3:30 and 5 p.m. with their departure. Minimal traffic delays are experienced during these peaks since work shifts are staggered, car and van pooling are practiced, and most deliveries to and shipments from ORNL are timed to avoid the rush hour. Road maintenance and the movement of heavy equipment or escorted shipments typically occur during the work day after traffic flow has subsided.

ORNL's Life Sciences facilities at the Y-12 Plant can be reached from Bear Creek Road at the North Portal, via Guard Portal 25 (Fig. 3.4). Second Street is the primary east-west corridor that runs in the vicinity of the other ORNL facilities. Most of the buildings can be accessed via Guard Portal 32. The main roads connecting the ORNL Main Site with the Y-12 Plant are Scarboro and Bethel Valley roads.

Heating, Ventilation, And Air Conditioning

The heating, ventilation, and air conditioning (HVAC) design in each building depends on the specific features of each building (e.g., the energy produced by equipment operated within the building and the likelihood of airborne contamination being released in the building). Animal labs, document storage rooms, large computer installations, and certain other instruments must be housed in an area with low temperature and relative humidity. Most of the older research buildings which contain exhaust hoods were designed for 100% outside air and operate very inefficiently. Freeze protection for these facilities must be monitored to preclude outages and avoid equipment damage. Most buildings in Bethel Valley are heated using steam from the central steam plant. Remote facilities in Melton Valley and Copper Ridge have electric heat. Away from the area served by the central chilled water system, air conditioning is provided by direct expansion (DX) units or self-contained water chillers. Facilities that require outside air ventilation use chillers for space and equipment cooling. Smaller facilities utilize packaged or split DX units, through-the-wall units of the type found in motels, or window units.

Ventilation exhaust systems in laboratories, hot cells, and other facilities prevent human exposure to toxic and radioactive fumes, gases, and particulates. Many of the ventilation systems that exhaust radioactive containment areas have been upgraded by replacing corroded mild steel ductwork with stainless steel ductwork. Exhaust stack linings are made from materials that are not easily susceptible to corrosion. Radioactive containment ventilation systems at ORNL may use chemical recombiners, liquid scrubbers, charcoal filters, and high-efficiency particulate air (HEPA) filters to remove radioactive contamination from the air, which is then released to the environment through an exhaust stack. Contaminated absorbers and filters are disposed of as low-level radioactive waste. Five of the six major exhaust stacks are equipped with emergency diesel-powered or steam-driven blowers, in addition to the electric blowers, to provide for continued building ventilation in the event of an electrical power outage. All of the exhaust stacks are monitored. Personnel working in containment areas are monitored and are provided the appropriate protection in the form of personal protective equipment or administrative controls. Some of the air monitoring equipment has local alarm capability, while others are alarmed both locally and at a central location in Building 3130 or at the Shift Superintendent's Office in Building 4512. A project was completed in FY 1997 which cleaned perchloric acid residue from ventilation hoods and ductwork.

Issues involving indoor air quality and "sick building syndrome" are becoming increasingly important and will impact ORNL operations in the future. Many of the facilities at ORNL are over 40 years old. Ventilation systems in the buildings were not designed to be easily cleaned or maintained and are now coated with dusts, molds, allergens, and other contaminants. Indoor Air Quality legislation is currently being considered for inclusion in the Occupational Safety and Health Act of 1970 (OSHA) safety and health standards. Should legislation be passed, ORNL may be required to upgrade or replace many of the building ventilation systems currently in use. Ductwork will need to be replaced or cleaned, humidification and dehumidification systems installed, and building air intakes relocated or otherwise modified. Even without the legislation, as a part of ORNL's efforts to provide a safe work environment, indoor air quality issues will continue to gain importance. It has been proven that there is a definite link between how well people feel and perform and the general overall "health" of the buildings in which they work and live. To avoid excessive liability, ORNL considers building health as an important component of its overall facility management strategy.

APPENDIX J

Detailed Listings of DOE-Funded Projects

Appendix J
Table J.1. New campus facilities/renovations
($ in 1000s)

ADS #	Title	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
S97D0043	LABORATORY - COMPARATIVE & FUNCTIONAL GENOMICS(LI)	2,500.0	10,000.0	1,400.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
A99D0056	RESEARCH SUPPORT CENTER (LI)	0.0	10,000.0	6,050.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AA0D0056	4500N, WING 4, LAB UPGRADES & RENOVATIONS	0.0	1,900.0	11,600.0	2,300.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AA0D0057	4500S, WING 1, LAB UPGRADES & RENOVATIONS	0.0	0.0	2,000.0	12,000.0	3,000.0	0.0	0.0	0.0	0.0	0.0	0.0
AA0D0095	4500N, WING 3, LAB UPGRADES & RENOVATIONS	0.0	0.0	0.0	1,750.0	14,000.0	3,000.0	0.0	0.0	0.0	0.0	0.0
AA0D0096	4500N, WING 2, LAB UPGRADES & RENOVATIONS	0.0	0.0	0.0	0.0	0.0	1,900.0	15,000.0	3,000.0	0.0	0.0	0.0
AA0D0098	4500S, WING 2, LAB UPGRADES & RENOVATIONS	0.0	0.0	0.0	0.0	2,100.0	12,500.0	3,400.0	0.0	0.0	0.0	0.0
AA0D0102	4500N, WING 1, LAB UPGRADES & RENOVATIONS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2,200.0	15,000.0	3,000.0	0.0
AA0D0103	4500S, WING 3, LAB UPGRADES & RENOVATIONS	0.0	0.0	0.0	0.0	0.0	0.0	2,200.0	13,000.0	3,800.0	0.0	0.0
AA0D0104	4500S, WING 4, LAB UPGRADES & RENOVATIONS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2,300.0	13,500.0	4,000.0
AA0D0058	EAST CAMPUS ELECTRICAL SYSTEMS UPGRADE (TEC=$300K)	300.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AA0D0071	7600 AREA OFFICE BUILDING (TEC=$2800K)	300.0	2,500.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
A99D0098	BUILDING 7602 HIGH BAY UPGRADE (TEC=$850K)	200.0	650.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AA0D0065	EAST CAMPUS INFRASTRUCTURE IMPROVEMTS (TEC=$4600K)	400.0	2,400.0	2,000.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AA0D0053	HFIR MAINTENANCE BUILDING	0.0	300.0	2,600.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AA0D0072	7600 AREA HIGHBAY BUILDING	0.0	500.0	4,000.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AA0D0073	RENOVATION 7605	0.0	0.0	500.0	2,500.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AA0D0077	CENTRAL CAMPUS RESEARCH BUILDING	0.0	0.0	0.0	400.0	4,100.0	0.0	0.0	0.0	0.0	0.0	0.0
AA0D0063	ADVANCED MATERIALS CHARACTERIZATION LABORATORY	0.0	400.0	4,400.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AA0D0078	HFIR HIGHBAY STORAGE	0.0	0.0	0.0	0.0	500.0	0.0	0.0	0.0	0.0	0.0	0.0
AA0D0064	EAST CAMPUS SERVICE BUILDING	0.0	0.0	375.0	4,000.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AA0D0068	WEST CAMPUS INFRASTRUCTURE IMPROVEMENTS	0.0	0.0	0.0	0.0	0.0	200.0	2,300.0	0.0	0.0	0.0	0.0
AA0D0070	5500 RENOVATION FOR ES&H FUNCTIONS	0.0	0.0	1,500.0	3,000.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AA0D0043	7900 AREA OFFICE BUILDING I	0.0	0.0	0.0	300.0	2,500.0	0.0	0.0	0.0	0.0	0.0	0.0
AA0D0079	7900 AREA OFFICE BUILDING II	0.0	0.0	0.0	0.0	0.0	300.0	2,500.0	0.0	0.0	0.0	0.0
A98D0087	CENTER FOR BIOLOGICAL SCIENCES (LI)	0.0	0.0	0.0	0.0	2,000.0	14,000.0	4,000.0	0.0	0.0	0.0	0.0
AA0D0044	BUILDING SCIENCE RESEARCH FACILITY (LI)	0.0	0.0	0.0	2,000.0	14,000.0	4,000.0	0.0	0.0	0.0	0.0	0.0
AA0D0050	COLD GUIDE HALL EXTENSION, HFIR	2,200.0	800.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AA1D0002	CENTER FOR NANOPHASE MATERIALS SCIENCES	0.0	0.0	2,000.0	14,000.0	9,000.0	0.0	0.0	0.0	0.0	0.0	0.0
AA1D0003	HFIR USER SUPPORT FACILITY	0.0	0.0	500.0	4,000.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total		**5,900.0**	**29,450.0**	**38,925.0**	**46,250.0**	**51,200.0**	**35,900.0**	**29,400.0**	**18,200.0**	**21,100.0**	**16,500.0**	**4,000.0**

Appendix J
Table J.2. Non-DOE-funded development projects
($ in 1000s)

ADS #	Title	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
AA0D0085	JOINT INSTITUTE FOR BIOLOGICAL SCIENCES (STATE)	0.0	2,000.0	6,000.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AA0D0086	JOINT INSTITUTE FOR COMPUTATIONAL SCIENCES (STATE)	1,500.0	4,500.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AA0D0087	OAK RIDGE CENTER FOR ADVANCED STUDIES (STATE)	800.0	4,000.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AA0D0088	JOINT INSTITUTE FOR NEUTRON SCIENCES (STATE)	8,000.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AA0D0089	WEST CAMPUS RESEARCH OFFICE BUILDING (PRIVATE)	0.0	0.0	0.0	0.0	0.0	0.0	5,000.0	8,000.0	0.0	0.0	0.0
AA0D0090	RESEARCH OFFICE BUILDING (PRIVATE)	0.0	0.0	5,000.0	8,000.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AA0D0091	COMPUTATIONAL SCIENCE BUILDING (PRIVATE)	1,500.0	13,500.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AA0D0092	ENGINEERING TECHNOLOGY BUILDING (PRIVATE)	1,500.0	13,500.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total		**13,300.0**	**37,500.0**	**11,000.0**	**8,000.0**	**0.0**	**0.0**	**5,000.0**	**8,000.0**	**0.0**	**0.0**	**0.0**

Appendix J
Table J.3. Utilities improvement projects
($ in 1000s)

ADS #	Title	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
C97D0071	FIRE PROTECTION SYSTEMS UPGRADE (KC) (TEC=$2750K)	500.0	800.0	800.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AA0D0016	BACKUP DIESEL GENERATOR FOR #6 BOILER (TEC=$250K)	250.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C98D0142	CONVERT STEAM PLANT BOILERS TO NATURAL GAS FIRING	0.0	600.0	600.0	600.0	600.0	0.0	0.0	0.0	0.0	0.0	0.0
A99D0048	HFIR COOLING TOWER REPLACEMENT (TEC=$4800K)	3,000.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
A99D0033	PRIMARY SUBSTATION SF6 BREAKERS (TEC=$1340K)	100.0	0.0	600.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
A98D0016	4511 COOLING TOWER REPLACEMENT	0.0	0.0	0.0	1,400.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C97D0089	MAINTENANCE SHOP ADDITION 4509	0.0	0.0	0.0	200.0	1,000.0	0.0	0.0	0.0	0.0	0.0	0.0
C97D0054	VENTILATION SYSTEMS, DUCTWORK, & FUME HOOD UPGRADE	0.0	0.0	0.0	500.0	1,500.0	2,300.0	2,000.0	2,000.0	2,000.0	3,000.0	3,000.0
S97D0056	#5 BOILER UPGRADE, ORNL STEAM PLANT	0.0	0.0	0.0	0.0	0.0	500.0	0.0	0.0	0.0	0.0	0.0
A98D0009	WATER SYSTEM UPGRADES, 1000 AREA	0.0	0.0	0.0	0.0	0.0	500.0	0.0	0.0	0.0	0.0	0.0
A99D0114	COAL STORAGE AREA RECLAMATION	0.0	0.0	0.0	0.0	0.0	500.0	0.0	0.0	0.0	0.0	0.0
A98D0010	WATER SYSTEM UPGRADES, 7600 AREA	0.0	0.0	0.0	0.0	0.0	1,200.0	0.0	0.0	0.0	0.0	0.0
S97D0020	RESTORE NATURAL GAS DISTRIBUTION SYSTEM	0.0	0.0	0.0	0.0	0.0	1,800.0	0.0	0.0	0.0	0.0	0.0
A98D0111	MOTOR CONTROL CENTER 5A	0.0	0.0	0.0	0.0	0.0	160.0	0.0	0.0	0.0	0.0	0.0
A98D0112	MOTOR CONTROL CENTER 5B	0.0	0.0	0.0	0.0	0.0	126.0	0.0	0.0	0.0	0.0	0.0
C97D0125	CFC PHASEOUT - CLEAN AIR ACT COMPLIANCE (KC)	0.0	0.0	0.0	600.0	0.0	587.0	0.0	0.0	0.0	0.0	0.0
A98D0119	HVAC HCFC 50-POUND REPLACEMENTS	0.0	0.0	0.0	0.0	0.0	250.0	400.0	0.0	0.0	0.0	0.0
A98D0115	TRANSFORMER FOR 4000 ELECTRICAL SUBSTATION	0.0	0.0	0.0	0.0	0.0	90.0	50.0	0.0	0.0	0.0	0.0
C98D0145	REPLACE EAST END WATER SOFTENERS - B 2519	0.0	0.0	0.0	0.0	0.0	0.0	800.0	0.0	0.0	0.0	0.0
C98D0178	REPLACE WEST END DE-AERATOR B 2510	0.0	0.0	0.0	0.0	0.0	0.0	210.0	0.0	0.0	0.0	0.0
C98D0179	REPLACE STEAM PLANT ECONOMIZERS	0.0	0.0	0.0	0.0	0.0	650.0	650.0	650.0	650.0	0.0	0.0
C97D0083	HVAC UPGRADES - GPE-TARGET	0.0	0.0	0.0	500.0	500.0	75.0	500.0	500.0	500.0	500.0	500.0
S97D0013	NEW 4000 SCFM AIR DRYER	0.0	0.0	0.0	0.0	0.0	760.0	0.0	0.0	0.0	0.0	0.0
S97D0051	HVAC UPGRADES - GPP - SUPPLEMENTAL	0.0	134.0	0.0	1,000.0	1,200.0	1,200.0	1,200.0	1,200.0	1,200.0	1,200.0	1,200.0
A00D0027	ELECTRICAL SERVICE UPGRADE - BUILDING 7601	0.0	0.0	0.0	0.0	0.0	0.0	115.0	0.0	0.0	0.0	0.0
C97D0069	UPGRADE ELECTRICAL SYSTEMS, 3019, 3025, 3500	0.0	0.0	0.0	0.0	0.0	0.0	475.0	0.0	1,050.0	0.0	1,000.0
C97D0070	UPGRADE ELECTRICAL SYSTEMS, 6000 AND 7000 AREAS	0.0	0.0	0.0	0.0	0.0	0.0	400.0	0.0	0.0	1,000.0	0.0
A98D0120	SOLID STATE STARTER FOR THE #3 AIR COMPRESSOR	0.0	0.0	0.0	0.0	0.0	0.0	151.0	0.0	0.0	0.0	0.0
S97D0023	EXTEND WATER MAIN - 7000 AREA	0.0	0.0	0.0	0.0	0.0	0.0	1,000.0	0.0	0.0	0.0	0.0
C98D0005	DISTILLED WATER MAKERS, 4500N AND 4500S	0.0	0.0	0.0	0.0	0.0	0.0	135.0	0.0	0.0	0.0	0.0
S97D0018	REPLACEMENT OF AIR COMPRESSORS - BLDG. 7603	0.0	0.0	0.0	0.0	0.0	0.0	350.0	0.0	0.0	0.0	0.0
A98D0116	TRANSFORMER FOR 2632 ELECTRICAL SUBSTATION	0.0	0.0	0.0	0.0	0.0	0.0	135.0	0.0	0.0	0.0	0.0
A98D0117	TRANSFORMER FOR 3000 ELECTRICAL SUBSTATION	0.0	0.0	0.0	0.0	0.0	0.0	135.0	0.0	0.0	0.0	0.0
S97D0032	WEST END STEAM UPGRADE COMPLETION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	250.0	0.0	0.0	0.0
A99D0067	#6 BOILER FEEDWATER PUMP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0
S97D0040	AUXILIARY SYSTEMS UPGRADES	0.0	0.0	0.0	0.0	0.0	0.0	250.0	0.0	0.0	0.0	0.0
C97D0057	UPGRADE CONDENSATE REMOVAL, ORNL STEAM DIST. SYS.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,100.0	0.0	0.0
A99D0066	NO. 5 BOILER ECONOMIZER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	700.0	0.0	0.0	0.0

ADS #	Title	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
A99D0065	20,000 GAL. SEWAGE SLUDGE STORAGE TANK	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0
S97D0024	INSTALL WATER METERS, ALL BUILDINGS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,500.0	0.0	0.0	0.0
A00D0025	RADIOACTIVE LIQUID WASTES COLLECTION/RECYCLE SYSTE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,250.0	0.0	0.0	0.0
A99D0068	#5 BOILER COMBUSTION AIR PREHEAT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0
A99D0069	#6 BOILER COMBUSTION AIR PREHEAT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0
Total		**3,850.0**	**1,534.0**	**2,000.0**	**4,800.0**	**4,800.0**	**10,698.0**	**8,956.0**	**8,450.0**	**6,500.0**	**5,700.0**	**5,700.0**

Appendix J
Table J.4. Other landlord GPP/GPE projects
($ in 1000s)

ADS #	Title	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
A99D0042	LAMBERT QUARRY SIGNAGE AND FENCING (TEC=$165K)	165.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
A00D0034	INTERNET FIREWALL (TEC=$94K)	94.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AA0D0084	OPEN CAMPUS IMPROVEMENTS	700.0	879.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AA1D0005	OPEN CAMPUS IMPROVEMENTS	371.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C98D0182	LDRD - GENERAL PURPOSE EQUIPMENT	70.0	160.0	278.0	300.0	307.0	300.0	300.0	300.0	300.0	300.0	300.0
A99D0097	SPINCOATER, DEVELOPER AND INSPECTION STATION	0.0	130.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
A99D0100	TUBE FURNACES AND PROCESS GAS HANDLING STATION	0.0	147.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
A99D0101	WET CHEMICAL ETCHING STATION	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
A99D0102	DRY CHEMICAL PROCESSING STATION	62.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
A99D0127	50-GHZ HIGH BANDWIDTH DIGITIZING OSCILLOSCOPE	0.0	58.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
A99D0129	33-MHZ TO 3-GHZ TIMING GENERATOR	0.0	68.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AA1D0004	CHEMICAL REUSE CENTER, BUILDING 7013	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
A99D0020	LAB EXPANSION-NANOSCIENCE METRLGY/INST (TEC=$1500)	600.0	600.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
A99D0022	NANODEVICE LASER SPECTROSCOPY SYSTEM	0.0	0.0	410.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
A99D0023	NANODEVICE CHARACTERIZATION EQUIPMENT	0.0	0.0	0.0	460.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
A00D0043	1503/1506 GREENHOUSE RENOVATN/SEISMIC (TEC=$1550K)	200.0	1,350.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
A99D0154	GPP/GPE MANAGEMENT RESERVE	500.0	800.0	1,000.0	700.0	1,000.0	870.0	591.0	1,100.0	720.0	1,100.0	1,100.0
AA0D0036	CELL 1 WINDOW REPLACEMENT, BLDG 3025E	0.0	225.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
A00D0040	DATA NETWORK LAYER 2 UPGRADES	0.0	500.0	750.0	750.0	750.0	750.0	750.0	750.0	0.0	0.0	0.0
C98D0051	FLUKE 5720A TESTER	0.0	59.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
A99D0115	RAMAN SPECTROPHOTOMETER	0.0	72.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
A00D0003	NEW EXTERNAL WEB SERVER (INFOSRV1)	0.0	375.0	127.0	135.0	143.0	151.0	161.0	0.0	0.0	0.0	0.0
A00D0021	40-INCH LARGE FORMAT PRINTER	0.0	34.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
A99D0062	REPLACEMENT FOR LIBRARY OPERATING SYSTEM COMPUTER	0.0	54.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
A99D0117	GRAPHICS AND PHOTOGRAPHIC COLOR MANAGEMENT SYSTEM	0.0	28.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
A00D0011	FIRE HEADQUARTERS RENOVATION	0.0	0.0	0.0	400.0	1,900.0	0.0	0.0	0.0	0.0	0.0	0.0
A99D0099	PHOTOMASK ALIGNER AND EXPOSURE SYSTEM	0.0	421.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
A99D0119	GRAPHICS AND PHOTOGRAPHIC DIGITAL VIDEO EQUIPMENT	0.0	25.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
A99D0120	PHOTOGRAPHIC SERVICES DIGITAL CAMERA	0.0	31.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
A98D0114	D7H SERIES BULLDOZER	0.0	0.0	0.0	400.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S97D0058	TRANSPORTATION AND PACKAGING FACILITY	0.0	0.0	0.0	500.0	2,600.0	0.0	0.0	0.0	0.0	0.0	0.0
A00D0017	BETHEL VALLEY ROAD IMPROVEMENTS	0.0	0.0	0.0	0.0	400.0	2,600.0	0.0	0.0	0.0	0.0	0.0
A99D0064	HIRSCH WORKSTATION ENCRYPTION SYSTEM	0.0	0.0	0.0	0.0	0.0	57.0	0.0	0.0	0.0	0.0	0.0
A98D0110	UPGRADE EAST END FEEDWATER SYSTEM B-2519	0.0	0.0	0.0	0.0	0.0	510.0	0.0	0.0	0.0	0.0	0.0
A00D0031	UPGRADE/REPLACE HOT CELL/OPER. AREA SUP. FANS/3047	0.0	0.0	0.0	0.0	0.0	750.0	0.0	0.0	0.0	0.0	0.0
AA0D0061	WHOLE BODY COUNTERS	0.0	0.0	0.0	0.0	0.0	290.0	0.0	0.0	0.0	0.0	0.0
A00D0023	PASSENGER BUS TO REPLACE 1980 MODEL	0.0	0.0	0.0	0.0	0.0	185.0	0.0	0.0	0.0	0.0	0.0
A99D0027	FLOW MONITORING STATIONS FOR LOW-FLOW VERIFICATION	0.0	0.0	0.0	155.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

ADS #	Title	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
AA0D0080	6010/6025 RENOVATION	0.0	0.0	0.0	0.0	1,000.0	0.0	0.0	0.0	0.0	0.0	0.0
A99D0161	ORNL SECURITY VIDEO SYSTEM UPGRADE	0.0	0.0	0.0	0.0	0.0	1,177.0	0.0	0.0	0.0	0.0	0.0
S97D0052	HFIR ENTRANCE ADDITION/EXPANSION	0.0	0.0	0.0	0.0	0.0	1,000.0	0.0	0.0	0.0	0.0	0.0
A98D0103	TRACK BRUSH CUTTER	0.0	0.0	0.0	0.0	0.0	160.0	0.0	0.0	0.0	0.0	0.0
A99D0035	DOSIMETRY SYSTEM UPGRADE	0.0	0.0	0.0	0.0	0.0	0.0	200.0	0.0	0.0	0.0	0.0
A00D0012	HAND-HELD THERMAL IMAGER	0.0	0.0	0.0	0.0	0.0	0.0	27.0	0.0	0.0	0.0	0.0
C98D0121	REPLACE FLEET VEHICLES (GPE)	0.0	0.0	0.0	300.0	0.0	0.0	300.0	500.0	500.0	300.0	300.0
AA0D0060	WHOLE-BODY COUNTING & TLD LABORATORY BUILDING	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,000.0	0.0	0.0	0.0
A98D0101	BACK HOE, MODEL 310D JOHN DEERE	0.0	0.0	0.0	0.0	0.0	0.0	77.0	0.0	0.0	0.0	0.0
P98D0249	REPLACE 1981 FIRE TRUCK	0.0	0.0	0.0	0.0	0.0	0.0	344.0	0.0	0.0	0.0	0.0
A99D0131	MICROWAVE SPECTRUM ANALYZER	0.0	0.0	0.0	0.0	0.0	0.0	94.0	0.0	0.0	0.0	0.0
AA0D0039	CELL 6 WINDOW UPGRADE, BLDG 3025E	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	180.0	0.0	0.0
AA0D0074	4500S BASEMENT RENOVATION, WEST END (M&C PROGRAMS)	0.0	500.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AA0D0076	RENOVATION OF 4515 (HTML)	0.0	0.0	0.0	900.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C98D0052	RETROFIT PACKAGES FOR LEBLOND LATHES	0.0	0.0	0.0	0.0	0.0	0.0	104.0	0.0	0.0	0.0	0.0
C98D0101	MICROWAVE SIGNAL GENERATOR	0.0	0.0	0.0	0.0	0.0	0.0	55.0	0.0	0.0	0.0	0.0
S97D0002	ADDITION TO BUILDING 6012	0.0	0.0	0.0	0.0	0.0	0.0	1,700.0	0.0	0.0	0.0	0.0
A00D0037	REPLACEMENT FOR SWS1 COMPUTER SYSTEM	0.0	0.0	0.0	0.0	0.0	0.0	40.0	0.0	0.0	0.0	0.0
A00D0041	SUN A1000 STORAGE ARRAY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	29.0	0.0	0.0	0.0
A00D0042	NETAPP F720	0.0	0.0	0.0	0.0	0.0	0.0	74.0	0.0	0.0	0.0	0.0
A99D0104	GIGABIT ETHERNET PROTOCOL ANALYZER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	0.0	0.0	0.0
AA0D0015	ELECTRON MICROPROBE	0.0	0.0	0.0	0.0	0.0	0.0	830.0	0.0	0.0	0.0	0.0
AA0D0002	LSS FIBER NETWORK FOR LERC DATA ACQUISITION SYSTEM	0.0	0.0	0.0	0.0	0.0	0.0	128.0	0.0	0.0	0.0	0.0
C98D0045	COLMAC HIGH-PRODUCTION SHIRT PRESS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0
C97D0078	ELEVATOR UPGRADE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,500.0	1,500.0	1,500.0	1,500.0
A00D0026	4-WHEEL DRIVE POLE SETTING TRUCK	0.0	0.0	0.0	0.0	0.0	0.0	225.0	0.0	0.0	0.0	0.0
C98D0105	SANITARY WASTE TRANSFER STATION	0.0	0.0	0.0	0.0	0.0	0.0	200.0	0.0	0.0	0.0	0.0
A00D0035	BACKUP TAPE ROBOT DEVICE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	275.0	0.0	0.0	0.0
C98D0079	PANTS PRESS, COLMAC HIGH PRODUCTION AUTOMATED UNIT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	77.0	0.0	0.0	0.0
A00D0013	KODAK DIGITAL SCIENCE DOCUMENT SCANNER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	56.0	0.0	0.0	0.0
A00D0038	SECURE-ID AUTHENTICATION SYSTEM UPGRADE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.0	0.0	0.0	0.0
A00D0014	HEALTH PHYSICS INFORMATION MANAGEMENT SERVER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	111.0	0.0	0.0	0.0
A99D0135	REPLACE FIRE PROT. RECORDKEEPING SYSTEM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	47.0	0.0	0.0	0.0
C98D0027	ATI-TDA-100A AUTOMATIC TESTER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	84.0	0.0	0.0	0.0
C98D0102	GAUGE BLOCK COMPARATOR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38.0	0.0	0.0	0.0
S97D0019	MELTON VALLEY ROAD UPGRADE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	400.0	2,700.0	0.0	0.0
C98D0082	100 KW ELECTRIC GENERATOR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	77.0	0.0	0.0	0.0
C98D0026	UPGRADE TO REMOTE VISUAL INSPECTION SYSTEM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	84.0	0.0	0.0	0.0
A99D0038	CONTINUOUS AIR MONITOR REPLACEMENT, BUILDING 3525	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0	0.0	0.0	0.0
C97D0104	ROAD AND PARKING LOT PAVING - ORNL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,000.0	500.0	500.0
A98D0091	HIGH RESOLUTION MASS SPECTROMETER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	757.0	0.0	0.0	0.0
A00D0036	DVD MEDIA SYSTEM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	53.0	0.0	0.0	0.0
A98D0089	DIGITAL RADIOGRAPHY	0.0	0.0	0.0	0.0	0.0	0.0	0.0	207.0	0.0	0.0	0.0
A98D0090	DIGITAL IMMERSION FLAW DETECTOR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.0	0.0	0.0	0.0
A98D0092	REAL TIME RADIOGRAPHY SYSTEM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	454.0	0.0	0.0	0.0
AA0D0047	MAIL PROCESSOR/ACCOUNTING SYSTEM	0.0	0.0	0.0	0.0	0.0	0.0	0.0	43.0	0.0	0.0	0.0

ADS #	Title	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
C98D0056	25 INCH CNC LATHE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	360.0	0.0	0.0	0.0
C98D0106	EDDY CURRENT EQUIPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	60.0	0.0	0.0	0.0
A98D0109	BRUSH CUTTING ATTACHMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	44.0	0.0	0.0	0.0
A99D0088	HEAVY EQUIPMENT SHED	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,250.0	0.0	0.0	0.0
AA0D0105	AUXILLARY EQUIPMENT (GPE)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,600.0	1,600.0
AA1D0001	COMPUTER NETWORK UPGRADES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1,000.0	4,600.0	9,000.0	4,000.0
AA1D0006	BUILDING 1061 MODIFICATION	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C97D0105	ORNL TECHNICAL SUPPORT BUILDING ADDITION, 4512	0.0	0.0	0.0	0.0	0.0	0.0	0.0	500.0	2,000.0	0.0	0.0
C98D0036	INDUCTIVELY COUPLED PLASMA/ATOMIC EMISSION SPECTRO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	134.0	0.0	0.0	0.0
Total		**2,962.0**	**6,616.0**	**2,565.0**	**5,000.0**	**8,100.0**	**8,800.0**	**6,200.0**	**11,547.0**	**13,500.0**	**14,300.0**	**9,300.0**

Appendix J
Table J.5. Other landlord line item projects
($ in 1000s)

ADS #	Title	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
C97D0106	ELECTRICAL SYSTEMS UPGRADE (LI)	5,543.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
A99D0018	FIRE PROTECTION SYSTEMS UPGRADE (LI)	584.0	3,620.0	1,716.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
A99D0017	LABORATORY FACILITIES HVAC UPGRADE (LI)	500.0	3,000.0	3,600.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
AA0D0017	MANIPULATOR REPAIR FACILITY (LI)	0.0	0.0	0.0	1,500.0	8,500.0	2,000.0	0.0	0.0	0.0	0.0	0.0
A98D0007	LABORATORY FAC VENT SYS UPGR-PHASE 1	0.0	0.0	500.0	2,500.0	4,000.0	3,000.0	0.0	0.0	0.0	0.0	0.0
AA0D0055	LABORATORY FAC VENT SYS UPGR-PHASE 2	0.0	0.0	0.0	0.0	0.0	1,000.0	3,500.0	4,000.0	0.0	0.0	0.0
C97D0061	POTABLE WATER SYSTEM UPGRADE I (LI)	0.0	0.0	0.0	1,000.0	4,000.0	2,000.0	0.0	0.0	0.0	0.0	0.0
C97D0062	POTABLE WATER SYSTEM UPGRADE II (LI)	0.0	0.0	0.0	0.0	0.0	1,000.0	4,000.0	2,000.0	0.0	0.0	0.0
AA0D0094	PRIMARY SUBSTATION UPGRADES, ORNL	0.0	0.0	660.0	4,250.0	2,115.0	0.0	0.0	0.0	0.0	0.0	0.0
Total		**6,627.0**	**6,620.0**	**6,476.0**	**9,250.0**	**18,615.0**	**9,000.0**	**7,500.0**	**6,000.0**	**0.0**	**0.0**	**0.0**

J.1 PHASE I PROJECTS (FY 2001–06)

J.1.1 Line Items – Phase I

Spallation Neutron Source (ADS S97D0046, FY 1999 LI)

The SNS is a new world-class experimental facility designed to meet the national need for neutron scattering and related research. The facility will be available to scientists from universities, from industry, and from other federal laboratories. The SNS will be equipped with an initial complement of advanced instruments for neutron beam research.

The facility will be built around a spallation neutron source. Combining the higher source power with improved experimental facilities will create a useful neutron flux significantly higher than is now available at any facility in the world. There will be beam lines for neutron scattering instruments or other neutron research equipment in experimental halls. The potential also exists for the development of entirely new lines of scientific research based on the enhanced capabilities that will be available in the SNS facilities.

The primary objectives in the design of the site and buildings for the SNS are to provide the optimal facilities for utilization of neutron beams and to address the mix of needs associated with the operating facility and the user community.

The objectives stated above are being met with a group of major structures which include an ion source, a linear accelerator, a klystron building, an accumulator ring, beam transport, and an experimental hall that includes detectors and instrumentation, and capabilities for remote servicing of the spallation targets. Also included on the site are facilities to support the needs of operations staff, technical support staff, and users.

In a related project, ORNL, The University of Tennessee (UT), and the State of Tennessee have initiated plans for a **Joint Institute for Neutron Sciences** (JINS). This facility will enhance the utility of the SNS and the High Flux Isotope Reactor (HFIR) by providing meeting facilities, offices, laboratories, a communication center, and housing for scientists and engineers from universities, industries, and the international research community. It will also be a focus for expanding neutron science R&D with UT, other regional universities, and industrial collaborators and will serve as an interface and economic development gateway for outside access to ORNL's neutron science facilities.

Electrical Systems Upgrade (ADS C97D0106, FY 2000 LI)

The ORNL electrical distribution system requires significant restoration and expansion to assure the continued operation in support of the research and operation missions of the Laboratory. Electrical components throughout the Laboratory are obsolete and increasingly dangerous to operate. Specific funded activities associated with this LI include

- *Overhead Feeders 244 and 264 Upgrade.* The 13.8-kV overhead feeders run from the ORNL Primary Substation to the 7600 Area Robotics and Process Systems Division facilities. The feeders serve the 6010 Oak Ridge Electron Linear Accelerator, the 6011 Computing and Telecommunications Facility, the 6012 Computer Science Research Facility, and the 5510

Analytical Mass Spectrometer Laboratory; they serve as a dual-feed to the 4509 and 2632 major 2.4-kV secondary substations within the Laboratory. The feeders will be completely rebuilt to ensure reliable continuation of service.

- *Electrical Metering System.* A computerized electrical metering system will be installed in the ORNL electrical distribution system. Electrical meters will be installed on major distribution feeders and on significant facilities throughout the Laboratory.

- *Building Electrical Service Entrance Upgrades.* Obsolete and inadequate switchgear, transformers, and conductors will be replaced at the main service entrances of Buildings 2519, 4501, 4500S, and 5500. New switchgear and cabling will be added to the bus ties in Buildings 4500N and 4500S.

- *Substation 4509 Improvements.* Secondary Substation 4509 will be upgraded by installing two new 13.8/2.4-kV, 7500-kV transformers, and new 2.4-kV switchgear to form a 13.8-kV primary selective arrangement and a 2.4-kV transformer and switchgear double-ended arrangement. Existing 13.8-kV switchgear "A" will be reinsulated and refurbished. A 13.8-kV primary selective system arrangement will be provided for two internal Building 4509 service transformers.

Laboratory for Comparative and Functional Genomics (ADS S97D0043, FY 2001 LI)

This project will construct the Laboratory for Comparative and Functional Genomics housing about 50,000 mice. The laboratory employs expertise in mouse genetics mutagenesis to generate and analyze mutations that add functional information to specific human DNA sequences. These mutant stocks are a matchless resource for advancing understanding of the complex mechanisms underlying the development and functioning of biological systems. In addition to space for 50,000 mice, the facility will provide ancillary laboratories for experimental breeding and necropsy activities, a specific pathogen-free design, 100% fresh air facility with 12 to 15 air changes per hour, temperature and humidity control, variable intensity lighting, an emergency power supply, a loading dock, "silent" low-frequency fire alarms, and vermin-proofed caulking and sealing.

The facility will be located on the ORNL reservation at the west end of the site, which will be convenient to researchers and guests without the concern over restricted access. The laboratory will be adjacent to the new Environmental and Life Science Laboratory, Building 1060, to Life Sciences Division Buildings 1061 and 1062, and convenient to the Environmental Sciences Division for cooperative research collaborations.

Fire Protection Systems Upgrade (ADS A99D0018, FY 2001 Landlord LI)

The following projects/tasks of the proposed upgrades are in support of the ORNL fire protection systems:

- Extend automatic wet-pipe sprinklers throughout offices, corridors, and under the attic floor slabs in Wings 1-4 of the Central Research and Administration Building (4500N). These specific areas are not protected with a fire suppression system.

- Replace numerous fire alarm control panels with modern fire alarm equipment and modify alarm device/evacuation horn circuits to utilize the full capability of the new control panels. Many fire alarm control panels and annunciators at ORNL are 30 to 40 years old and operate via antiquated technology (springs and shunts) which does not permit interface with modern fire detection and

fire alarm initiation devices. These older panels also do not perform self monitoring of fire alarm and evacuation horn circuits as required by mandated National Fire Codes, and replacement parts are not available to facilitate timely maintenance/repairs.

- Upgrade the Central Fire Alarm Receiving Station at the ORNL Fire Department Headquarters to replace antiquated equipment currently performing this vital function. This 20-year-old equipment monitors the condition of fire alarm systems and provides notification of fire alarm system activation for more than 200 buildings at the X-10 site. It is imperative that this equipment remain highly reliable and that replacement parts be readily available. As the equipment ages, replacement parts are more difficult to procure and maintenance costs increase, resulting in questionable reliability.

- Upgrade fire alarm system for Building 4505. The fire alarm upgrade includes the following: replace the shunt-trip type fire alarm annunciator panel; eliminate heat- actuated devices throughout the facility and replace with water flow switches for zone annunciation; and replace the horn panel in the east stairwell controlling all evacuation horns in the building.

- Upgrade fire alarm system for Building 4501. The fire alarm upgrade includes the following: eliminate one of two master fire alarm boxes (MFAB) which serve 4501; replace two shunt-trip type fire alarm annunciator panels adjacent to the two existing MFABs and an auxiliary annunciator panel near the sprinkler system risers in the basement; eliminate heat-actuated devices throughout the facility and replace with water flow switches for zone annunciation; and replace the horn panel in the east stairwell controlling all evacuation horns within the building.

- Replace the 55-year-old 16-inch underground water main in the 6000 Area of ORNL with approximately 7000 feet of new lines. Associated isolation valves, pressure reducing valves, hydrants, and valve pits will be installed with the new water main.

Laboratory Facilities HVAC Upgrade (ADS A99D0017, FY 2001 Landlord LI)

This project will upgrade HVAC systems that serve most of ORNL's major multiprogram research and related support facilities that have been in service for over 30 years and are in need of renovation, upgrade, or replacement due to age. This deteriorated condition is resulting in a growing number of repeated operational interruptions, prolonged equipment downtime, and increasing maintenance cost. Repair is often complicated by difficulty in finding replacement parts for units that are now obsolete. The interruptions are affecting experimental quality assurance for a significant number of the laboratories and are causing problems for supporting computer systems and service shops.

The scope of work will include (1) installation of primary/secondary central chilled water plant pumping system, 4509; (2) installation of 4501/4505 chilled water tie-in; (3) installation of chilled water coil inside 3500E air handler; (4) replacement of 4501 and 5500 air handlers; and (5) replacement of 4500S reheat system.

Computational Science Building (ADS AA0D0091, FY 2001 Private-Sector Facility)

The Computational Science Building will provide over 82,000 net square feet of state-of-the-art computer labs, offices, a petascale climate controlled supercomputer machine room to provide research space for the fastest growing mission area at ORNL. This facility is essential to accommodate the anticipated 50% staff and funding annual growth as well as maintain ORNL's standing as one of DOE-SC's premier computational facilities. The building will allow for consolidation of almost 300 research staff from six existing ORNL facilities and will result in over 50,000 square feet of usable

space being made available for ORNL-wide staff consolidation. ROI is anticipated to exceed 15% annually, with a payback of less than 10 years.

Engineering Technology Building (ADS AA0D0092, FY 2001 Private-Sector Facility)

The Engineering Technology Building will allow for the consolidation of the Engineering Technology Division staff and research operations from the ORNL facilities at the Y-12 National Security Complex to the main ORNL campus. Almost 170 staff will be housed at the ETC, with a net reduction of over 300,000 square feet of high-cost 40-year-old legacy facilities. State-of-the-art engine testing labs, wet/dry research labs, clean room, and high-bay space will provide continued growth opportunities for this important research division. Due primarily to the elimination of expensive Y-12 space, an ROI of almost 20% is expected, with a payback period of 6 to 7 years.

Research Support Center (ADS A99D0056, FY 2002 Landlord LI)

The Research Support Center will consist of a new multistory, multipurpose building of approximately 50,000 square feet. It will be located north of the Central Research complex and will house the core support service facilities required in support of the effective operation of a national research laboratory. The Research Support Center will serve as the cornerstone and focal point of the East Research Campus envisioned in the Facilities Revitalization Project. This building will be an attractive state-of-the-art facility with easy visitor access, reflective of the Laboratory's stature and as functionally flexible as possible. The location and synergy of the functions planned for this facility will provide valuable support and services for the nationally respected ORNL research community, visitors and guests, and DOE. This building will include an auditorium and conference center, cafeteria, visitor reception and control area, and support offices for approximately 50 occupants. Sustainable design features will be incorporated where practical. The estimated payback period for this project is 2 years.

4500 North and South Modernization Upgrades (Multiyear Landlord LI)

4500 North and South Modernization Upgrades – The proposed projects are integral parts of the new Facilities Revitalization Project (FRP) for revitalization of ORNL's research capabilities and infrastructure in support of the DOE-SC initiative to modernize their national laboratories. Consistent with DOE's approved Institutional Plan for ORNL, new laboratories, supporting offices, and the necessary support facilities are being proposed for construction as part of an integrated new campus environment in the area north and east of the 4500 North and South building complex. The 4500 North and South complex will be modernized to provide laboratory, office and support functions. The overall goals of this facilities revitalization initiative are to reduce the burdensome costs of maintaining the current inventory of 50+-year-old facilities, provide a safer environment for current staff to work in, and to ensure ORNL's ability to conduct world-class science in the 21st century including attracting and retaining world-class research scientists. The payback period is approximately 6 years. There are eight separate upgrade projects in these two facilities. 4500N (Wings 2,3, and 4) and 4500S (Wings 2 and 4) are in Phase I.

ORNL Primary Substation Upgrades (ADS AA0D0094, FY 2003 Landlord LI)

The ORNL Primary Substation Upgrades project will replace and restore components of the ORNL Primary Substation. It will replace an aged and inefficient power transformer, regulating transformer, and will replace the Bus No. 1 13.8-kV Oil Circuit Breakers (OCBs) with new metal-clad switchgear containing vacuum-insulated circuit breakers. The project will replace existing mechanical relays with advanced microprocessor-based protective relay systems. Grounding improvements will be provided

to improve the safety of the substation. Other aged and deteriorated components of the substation will also be replaced. This project is part of a phased infrastructure upgrade to restore the electrical distribution system serving ORNL. The ORNL primary substation is the only source of electrical power to the ORNL site. Most of ORNL's electrical distribution system was installed in the early 1940s and the mid 1960s. A phased upgrade of deteriorated and deficient electrical systems was started in the 1980s. Estimated return on investment for this project is 25.8% with a simple payback period of approximately 10 years.

Research Office Building (ADS AA0D0090, FY 2003 Private-Sector Facility)

The Research Office Building will provide over 80,000 square feet of space for consolidation of research and support staff from substandard space at ORNL and from various off-site leased buildings. A total of over 450 staff will be housed in this office-only building, with approximately 25% of that space reserved for staff from the 4500N and 4500S complex that will be temporarily dislocated from their offices during that multi-year laboratory rehabilitation. Considering the value of maintaining efficient operations during these renovations and the elimination of over 125,000 square feet of substandard space at ORNL, the ROI for this facility is expected to be in the 10 to 15% range, with a payback period of less than 10 years.

Center for Nanophase Materials Science (ADS AA1D0002, FY 2003 Programmatic LI)

The Center for Nanophase Materials Science (CNMS) will consist of a new multistory, multipurpose building of approximately 100,000 square feet. It will be located near the Spallation Neutron Source Complex and will house the core support facilities, offices, and laboratories necessary to ensure the mission of the CNMS. The location and synergy of the functions planned for this facility will provide valuable support and services to a broad user base of educational, industrial, and research organizations.

Since the late 1980s, there has been a recognized need to enhance U.S. capabilities and ensure its leadership in the synthesis of materials. The CNMS will integrate nanoscale research with neutron science, synthesis science, and theory/modeling/simulation, bringing together four areas in which the Unites States has clear national research needs. The CNMS will play an important role in elevating the U.S.-based neutron science R&D community to levels found elsewhere in the world and helping it assume a scientific leadership role in emerging research on nanoscale materials and processes. ORNL will become a world-class leader in CNMS-based research.

Manipulator Repair Facility (ADS AA0D0017, FY 2004 Landlord LI)

The Manipulator Repair Facility will provide a consolidated facility for hot cell manipulator repair and refurbishment in support of all of the ORNL hot cell operations. It will consist of approximately 20,000 square feet of clean and contaminated manipulator wash areas, a boot fabrication shop, and all necessary support facilities to support the repair and decontamination of master/slave and electromechanical manipulators. The facility will be sited to best service the primary users of manipulators and will include process and liquid low-level waste line tie-ins and HEPA filtration systems for contamination control.

Potable Water System Upgrade Phase I and Phase II (ADSs C97D0061 and C97D0062, FY 2004 and 2006 Landlord LIs)

The Potable Water System Upgrade, Phases I and II, will replace or refurbish aged water lines serving the primary research and support facilities in the central campus area of the Laboratory. The main

lines running along Central Avenue and the north side of the Building 3508/3517 area will be replaced in the first phase of the project, with the Lab facilities north of Central Avenue in the vicinity of First Street and the 3047 isotopes area. Because of the subsurface contamination concerns within the central campus, multiple technologies are being evaluated for this project, including standard below-grade pipe replacement, above-grade insulated piping, and in-situ lining of existing lines where appropriate and feasible. A preliminary estimate of return on investment is 10% with a payback period of 7 years.

Building Science Research Facility (ADS AA0D0044, FY 2004 Programmatic LI)

The 50,000-square-foot Building Science Research Facility will provide new facilities for about 60 professionals and their support staff. There are eight interior laboratories for material and component testing and outdoor space for several model building test sites. Four conference rooms and a video conference center will accommodate the heavy requirement for team research, for guest working sessions, and for visitor interactions. The facility will be outside the ORNL security perimeter to facilitate strong industry interaction. Existing buildings research facilities on site are limited. In the current research buildings (3114 and 3144) work is being interrupted as much as two to three times per week due to management requested tours. The stoppage is necessary because there is not enough room in the facilities to allow visitors to pass through without crossing into space where work safety is an issue. The support being given to the Federal Energy Management Program is being disrupted because staff supporting this program are located at several sites on the campus, and it is frequently difficult to even find meeting space. The assembly and laboratory curring of large test roofs and walls requires more space. The que for the guarded hot box has been backed up for more than 3 years. Frequently, sample preparation cannot be completed in time to avoid operational gaps in the hot box testing. A preliminary estimate of the payback period for this project is 7 years.

ORNL Center for Biological Sciences (ADS A98D0087, FY 2005 Programmatic LI)

The ORNL Center for Biological Sciences, a 50,000-square-foot facility with a modular complex of buildings, equipment, and supporting infrastructure to be located in the West Campus, will provide space for research programs for functional genomics, structural biology, proteomics, and systems biology. It will also provide staged facilities to house the Center for Biological Sciences user facilities. A preliminary estimate of payback for this project is 7 years.

Laboratory Facility Ventilation System Upgrade, Phase I and Phase II (ADS AA0D0055, FY 2006 Landlord LI, and ADS A98D0007, FY 2003 Landlord LI)

The Laboratory Facility Ventilation System Upgrades, Phases I and II, are projects that will modernize ventilation and exhaust systems in approximately 10 ORNL facilities totaling over 200,000 square feet of space. Ventilation and exhaust systems in many ORNL facilities are in serious need of upgrade to continue service at any level. Some laboratory areas are not used for research because of a lack of proper ventilation. Systems feature 35-year-old equipment applied in a 35-year old design concept. In many systems the exhaust ducting and filter housings are seriously corroded and have only a marginal future life expectancy. New exhaust fans, ducts, hoods
and an EPA-compliant stack are needed for compliance to regulations. The majority of these duct/housing units are contamination zones that will require closely controlled work conditions. A preliminary estimate of a payback period for this project is 7-9 years.

J.1.2 Major GPP/GPE Projects – Phase I

HFIR HB-4 Beam Line (ADS A99D0146, FY 1999 Programmatic GPP)

This proposed project will design, fabricate, and install neutron guides, mirrors, and shielding for four new beam lines at the HFIR facility. The new beam lines will be installed following the beryllium reflector changeout planned to begin in FY 2000.

The beam lines will be optimized for use with the new HB-4 beam tube and cold neutron source currently under design and construction. The resulting brighter beams will make it possible to provide a higher flux of neutrons on the experimental samples that are placed in the beams for study.

HFIR is operated as both an isotope production facility and as a user facility supporting a strong national research program using neutron scattering. To maintain competitive, forefront research capabilities, these user facilities must be improved to accommodate the changing experimental needs of the research community. The purpose of the new HB-4 beam line is to increase the available flux of cold neutrons delivered to the instruments and to increase the number of instruments that can be accommodated. Locations will be provided for at least two added facilities, a high resolution triple axis machine and a cold neutron test facility. The other instruments are already available but are installed at existing locations in the HFIR where the useful neutron flux on the experiments are very much lower (by a factor of up to 100) than will be provided by the beam lines to be installed in this project.

HFIR Cooling Tower Replacement (ADS A99D0048, FY 2000 Landlord GPP)

The existing HFIR cooling tower was constructed in 1965 to provide cooling water to facilities in the HFIR complex area. The cooling tower has exceeded its expected design life by many years. A new cooling tower will ensure the secondary reactor cooling water system remains available for the HFIR complex and will prevent future outages to repeatedly repair the cooling tower or replace it upon complete failure.

The proposed GPP consists of demolishing and disposing of the existing HFIR cooling tower (Building 7902) and constructing a new cooling tower on the same location. The demolition will consist of dismantling the treated wood and composite siding panels, riser piping, and piping header sections. The replacement tower will use the same basin (although not necessarily the same footprint) and will be constructed of rot-resistant, fire-retardant Factory Mutual Standard type materials.

Site preparation for the new tower will include cleaning and draining the existing basin and removing all unnecessary piping and conduit. Additional site preparations include improving an existing site access road and adding security fencing to allow construction crews free access to the cooling tower site. Maintenance and modifications to the basin will include providing structural support for the new tower and repairing cracks and structural defects in the basin.

The existing secondary coolant pumping station, water treatment facility for the secondary cooling system, cooling tower blow-down, and makeup supply water line will remain in place for reuse.

The old cooling tower has been demolished and the existing basin cleaned. Construction of the new cooling tower is scheduled to be completed by March 2001.

Laboratory Expansion for Nanoscience Metrology and Instrumentation (ADS A99D0020, FY 2000 Landlord GPP)

An upgrade to laboratory space in Building 3500 is proposed. The modifications in the east wing of Building 3500 will provide approximately 3000 square feet of additional usable modular clean room laboratory space and reconfigurable office space for the proposed Laboratory Expansion for Nanoscience Metrology and Instrumentation.

Rooms 7, 8, 9, and 10, located on the east side of Building 3500, currently house a small conference room, laboratories, and shop/storage areas. Modifications to these rooms will create usable space to accommodate a modular clean room and its associated services. The modifications will include replacement of the room's west wall, removal of the room's ceilings, and relocation of existing services. In addition, Room A-19 in Building 3500 will be converted from laboratory space to an electron microscope facility. The conversion will require modifications to the room HVAC system and possible foundation modifications for vibration isolation.

Neutron Science Support Building Extension (ADS A99D0147, FY 2000 Programmatic GPP)

The Neutron Science Support Building Extension will be an 80-foot extension to the south end of the Neutron Science Support Building. This project will provide space for use by the neutron sciences researchers at the HFIR facility. A Basic Energy Sciences Advisory Committee Review Committee has recommended that the cold neutron Small Angle Neutron Scattering (SANS) capabilities at the HFIR be expanded to accommodate an additional beam and another instrument and that both of these SANS machines be placed in a low background region more distant from the reactor than possible with the current facility. This building extension will provide the space needed to meet that recommendation, providing greatly enhanced capabilities for all programs that rely on small angle scattering experiments. Multiprogram demand for research at the HFIR is growing, and there is currently insufficient space to support all of these activities.

1.5-Million-Gallon Water Reservoir (ADS S97D0021, FY 2000 Landlord GPP)

This project will provide a new 1.5-million-gallon steal water reservoir adjacent to the existing 3-million-gallon No. 1 water reservoir. The concrete reservoir serves the Bethel Valley portion of the Laboratory and provides water storage capacity for both operational needs and fire protection purposes. Internal inspections are performed every 5 years to monitor and assess reservoir condition. Inspections indicate spalled concrete, corroding structural reinforcement, and cracks. The No. 1 reservoir must be drained and cleaned, structural repairs performed, and a new corrosion-resistant liner installed. Additional work must be performed on the exterior surfaces of the structure to help counter the effects of weather and age. The new 1.5-million-gallon steal reservoir will provide water to ORNL during the repair of the No. 1 reservoir and will provide additional capacity for Laboratory requirements. A design-build contract has been awarded for this project. State approval of the design drawing is expected in December 2000.

Primary Substation SF6 Breakers (ADS A99D0033, FY 2000 GPE)

This project will replace three existing 161-kV oil circuit breakers (OCBs) with three new surplus SF6 insulated breakers in the ORNL Primary Substation. An Option I in the contract would replace two incoming line breakers. Option I is not currently funded. The breakers to be replaced are the three power transformer primary breakers (874, 884, and 894). The work will include removal, transport, and disposition of the oil from the old breakers, removal of the existing OCBs and associated buswork, installation of new concrete pads, installation of the new SF6 breakers, reinstallation of

associated buswork connections, and installation of new control cables to the existing 0901 control building. The installation of the power transformer No. 3 breaker will require the removal of an existing switch support structure and foundations and the relocation of existing metering current transformers.

Dry Chemical Processing Station (ADS A99D0102, FY 2000 GPE)

As part of the microfabrication infrastructure for ORNL, this chemical processing station consists of units for plasma and chemical vapor based film deposition and etching. Units must process wafers in controlled atmospheres of high-purity gases under the combined influence of plasma generation, thermal activation, and e-beam or laser bombardment. Units needed include plasma-enhanced chemical vapor deposition, simple chemical vapor deposition, e-beam and thermal evaporation and sputtering, and plasma-driven chemical etching. Film deposition includes metal conductors, insulating passivation films, and amorphous and polycrystalline semiconducting films. Etching must accommodate selective etching of a wide variety of films and doped and undoped substrate bulk. Additional station equipment includes thermal treatment units to anneal damage to bulk and films resulting from various processing steps.

7603 High Bay Upgrade (ADS A99D0098, FY 2001 Landlord GPP)

This project will provide a needed upgrade to the high bay of Building 7602 to return a portion of an unused facility under EM40 into a vital ORNL work and research space. The project will involve covering the pit area with the fabrication and installation of pit cover blocks, removing and dispositioning of contaminated equipment, decontaminating floors and walls, and painting of surfaces.

Fire Protection Systems Upgrade (ADS C97D0071, FY 2001 Landlord GPP)

Fire protection systems at facilities within ORNL are increasingly demonstrating lack of reliability and degradation of system components relative to age and exposure to corrosive conditions. This project will provide the following improvements:

- Upgrade of fire sprinklers in the Central Research and Administration Building (4500S). This upgrade will include the extension of fire sprinklers into some areas not currently protected and interface modification between the sprinkler systems and the fire alarm systems.

Future year projects:

- Replacement of identified aged and failure-prone automatic preaction sprinkler system deluge valves with highly reliable automatic wet-pipe sprinkler system alarm valves in the High Voltage Accelerator Laboratory (5500), the High-Level Radiochemical Laboratory Building (4501), and the Experimental Engineering Building (4505).

- Replacement of identified aged and maintenance-intensive automatic dry-pipe sprinkler systems with reliable and effective automatic wet-pipe sprinkler systems in the General Stores, Shipping, and Receiving Complex.

- Upgrade 4500N Wing 5 alarm system and connect it to the 4500N alarm system.

- Upgrade antiquated fire alarm systems in the HFIR Building.

- Upgrade antiquated fire alarm panels in various ORNL buildings.

- Replace fire doors in 4500N between the wings and main corridors.
- Upgrade fire barriers in ORNL facilities. National Fire Codes and regional/DOE adopted building codes contain requirements to limit the spread of fire to a certain square foot area. The Life Safety Code requires physical separation in protected means of egress. Both code requirements must be met by installed fire barriers, which are rated by Underwriters' Laboratories, Inc. (UL) to withstand a fire for a time period (e.g., one-hour rated, two-hour rated, etc.). These two old, very large administrative and research facilities do not currently have required fire barriers in place.

- Install early warning smoke detectors to provide area protection in this laboratory and give early indication of an incipient fire to fire response forces. High-value robotics research is conducted at the CESAR Laboratory in Building 6010. High-value, one-of-a-kind robotics equipment and work stations in this densely populated laboratory create the potential for a fire loss exceeding $1 million.

- The manually operated gasoline engine driver and water pump in Pumphouse Number 7953 were installed in the early 1960s. This pump supplies fire protection and potable water to the DOSAR Site, which includes the Radiation Calibration Laboratory (7735), laboratories handling radioactive material in Building 7710, and Building 7709, the HPRR building currently being utilized for storage of unique one-of-a-kind replacement parts for the HFIR. Recent tests of the aged pump and pump driver resulted in a failure to operate. This project will replace the manually operated pumping system with an automatic starting pump along with updating the aged maintenance-intensive equipment with modern equipment.

- Install fire alarm system in Building 7604, which is used for storage of experimental and test equipment such as development hardware, computers, and instrumentation. A portion of the building is used periodically as a control room for experiments conducted in adjacent areas outside the building. No personnel are housed full time in this building, but some personnel enter the building on a regular basis as part of their responsibilities, particularly when there is experimental activity in the control room area. The building has no fire protection system other than portable fire extinguishers. This activity adds a fire protection alarm system to Building 7604. Fire and smoke detectors will be installed in Building 7604 and will be connected to an existing fire alarm system in adjacent Building 7601.

Lambert Quarry Signage and Fencing (ADS A99D0042, FY 2001 Landlord GPP)

Lambert Quarry is an ORNL responsibility located on the eastern border of Parcel ED-1. With increased usage of the areas surrounding the quarry (e.g., ED-1 development, DOE greenway), the ORNL Land and Facilities Use Committee recommended that the entire quarry area be signed and fenced, including gates at the two main access roads.

East Campus Electrical Systems Upgrade (ADS AA0D0058, FY 2001 Landlord GPP)

This ADS will provide the resources necessary to extend the existing 13.8-kV electrical feeder #254 into the new east end campus area and set transformer stations as needed to provide electrical service to the new facilities to be located there. For aesthetic purposes, the new electrical services will be run underground in a concrete ductbank and placed in an established utility easement that will be flexible enough to provide for future expansion within the area without requiring constant utility relocations.

East Campus Infrastructure Improvements (ADS AA0D0065, FY 2001 Landlord GPP)

This activity provides for the construction of infrastructure roads, parking, and common areas associated with the new East Campus development portion of the ORNL Facilities Revitalization Project. This infrastructure improvement will support the East Campus reconstruction by providing new or improved parking lots in the 4500N, 6026, 6000, and 3513 areas to replace the main ORNL parking lot that will be the site of new buildings and common areas. The project also provides for construction of associated new roads and the common areas (tree-lined landscaped quadrangle and entrance ponds) to the east of the ORNL Research Support Building line item. Approximately 0.75 miles of roads would be upgraded or replaced, 4 acres of pond area constructed, 15 acres of parking lots upgraded/constructed, and 0.5 acre of landscaped common area provided. In addition, a line of trees from the 7000 Area to the West Campus would be installed as part of this project. Any necessary utility relocations in the main parking lot area will also be accomplished on this project.

Open Campus Improvements – Badge Reader System (ADS AA0D0084, FY 2001 GPE)

This project will provide access control features that eliminate the need for perimeter fencing at ORNL, except at selected facilities. The present perimeter (fence) will be reconfigured to an access control system located closer to the resources being protected (building, room, etc.). Proximity cards and administrative means will be utilized for access control. This project will provide the necessary badge reader systems for Laboratory buildings.

7600 Area Office Building (ADS AA0D0071, FY 2001 Landlord GPP)

The Fusion Energy Division (FED) is an ORNL organization located at the Y-12 Plant on Bear Creek Road. For the past several years there have been several attempts to relocate the FED facilities to the ORNL site as a result of increasing costs to maintain old World War II structures in which the FED is presently located. Other reasons for leaving the Y-12 site are the access problems for foreign nationals into the Y-12 Plant, with which FED collaborates; legacies of contamination in the FED building; and increasing (and uncertain) mission burden at the Y-12 Plant. The most recent efforts for the Laboratory revitalization have placed the FED in the 7600 Area. The primary reason that the 7600 Area was selected for the FED is the availability of electrical power. FED requires 161-kV power distribution with 13.8-kV feeders for their basic infrastructure. The 7600 Area has this power available.

Currently, the relocation of FED personnel to the 7600 Area, in accordance with the ORNL Revitalization Program, indicates there are offices that would accommodate approximately 32 people, which indicates a shortage of approximately 60 offices. In an effort to move all personnel to the ORNL campus, a new office complex will be required in the 7600 Area to keep all FED personnel together to encourage the strong interaction between FED sections. This project will provide a multistory office building of approximately 18,000 square feet south of the 7601 office building.

Backup Diesel Generator for #6 Boiler (ADS AA0D0016, FY 2001 GPE)

Purchase/install diesel generator at Building 2519 to provide backup power to No. 6 Boiler. This project will be a turnkey job and provide 480V, 600 Amp service in the event normal power is lost.

Internet Firewall (ADS A00D0034, FY 2001 GPE)

Depending upon the speed/performance of equipment available at the time of purchase, this equipment will either be installed between ORNL and the Internet or in parallel to ORNL's current

connection to the Internet. In either case, the implementation of this equipment will immediately meet two needs: (1) to satisfy external reviewers/auditors and emerging requirements that require DOE sites to implement firewalls and (2) provide increased security for users/machines that have no need to serve information "to" the Internet. With the addition of this equipment, ORNL's cyber security tools will be further enhanced such that both the sharing and protection of data will become easier for ORNL staff.

Sewer System Upgrades, 7600 Area (ADS AA0D0054, FY 2001 Landlord GPP)

This project will extend the existing sanitary sewage collection system into the 7600 Area of the Laboratory. This area is currently served by a septic tank drain field system which limits population size to approximately 150 employees. Plans are underway to expand the mission in the 7600 Area by moving some programs now located at ORNL Y-12 facilities into a combination of new and existing facilities in the area. It is expected that population totals in the future could approach 500 employees, necessitating an upgrade to the sewer system.

The new sewer line will be a force main consisting of three sewage pumping stations and approximately 12,000 feet of interconnecting, ductile iron piping. The system will extend north and west of the 7600 Area and will run along Ramsey Drive and Melton Valley Drive to a connection point just west of the Molten Salt Reactor, Building 7503. Normal power to the new system will be provided from existing sources, but an emergency standby power system will need to be provided to ensure system operation during all operating conditions. Based on current 7600 population projections (about 150 employees), this project may be deferred pending increased needs.

Advanced Materials Characterization Laboratory (ADS AA0D0063, FY 2002 Landlord GPP)

The Advanced Materials Characterization Laboratory, a new 15,000-square-foot structure that will provide the high-quality environment required to optimize performance of sophisticated characterization equipment essential for the next generation of advanced materials R&D, will provide for the centralization of advanced materials structural characterization equipment. Electron microscopes, atom probe microscopes, and nanoindenter mechanical properties equipment are now housed in buildings that barely meet the manufacturers' requirements for optimum operation of this equipment. It is clear that the current buildings will not allow ORNL to maintain state-of-the-art instrumentation for the next generation of this equipment.

HVAC Upgrades (ADS S97D0051, FY 2002 Landlord GPP)

This project provides the installation of new HVAC systems and replacements of deteriorated air conditioning components which provide environmental control for Laboratory facilities. A prioritized listing of activities included in this project is maintained by the P&E Division. All equipment on this list has exceeded its life expectancy. Replacing these deteriorated components will improve air conditioning reliability and reduce operating and maintenance cost.

HFIR Maintenance Building (ADS AA0D0053, FY 2002 Landlord GPP)

The current HFIR maintenance shop is contained in Building 7910, which is also an office building. The shop is about 3500 square feet. This building was built in 1963. The maintenance facilities are not adequate to maintain and support reactor operation in the manner required by today's standards. The reactor is expected to operate another 30 years, and the operating components must be maintained, replaced, and upgraded. The current facility is not adequate to do this work. Improve-

ments are needed to resolve concerns with adequate control of materials, records storage, materials storage, and housekeeping. These concerns deal with adequate controls of equipment and documentation necessary to ensure safe operations and shutdown. A new 10,000-square-foot maintenance facility will be constructed west of the HFIR Reactor Building.

7600 Highbay Building (ADS AA0D0072, FY 2002 Landlord GPP)

The Fusion Energy Division (FED) is an ORNL facility located at the Y-12 Plant on Bear Creek Road. For the past several years there have been several attempts to relocate the FED facilities to the ORNL site as a result of increasing cost to maintain old World War II structures in which the FED is presently located. Other reasons for leaving the Y-12 site are the access problems for foreign nationals into the Y-12 Plant, with which FED collaborates; legacies of contamination in the FED building; and increasing (and uncertain) mission burden at the Y-12 Plant. The most recent efforts for the Laboratory revitalization have placed the FED in the 7600 Area. The primary reason that the 7600 Area was selected for the FED is because of the availability of electrical power. FED requires 161-kV power distribution with 13.8-kV feeders for their basic infrastructure.

Currently, the relocation of FED personnel to the 7600 Area, in accordance with the ORNL Revitalization Program, indicates there is as short fall in available laboratory space. In order to achieve the relocation of FED to the ORNL campus, a new highbay laboratory will be required in the 7600 Area to carry out current and future programs and projects. This project will provide a highbay facility with a bridge crane of approximately 8000 square feet.

1503/1506 Greenhouse/Seismic Renovation (ADS A00D0043, FY 2002 Landlord GPP)

This GPP is intended as a preferred alternative to two other GPP requests, Seismic Upgrades, 1506 (ADS A99D0055) and Renovation 1506 Greenhouses (ADS S97D0005). In response to a seismic evaluation driven by Executive Order 12941, it was found that Building 1506 was in the "Definitely Needing Repair (DNR)" category. This was based on the conclusion that a possible failure scenario has been postulated because of a lack of roof diaphragm action. The lack of a topping slab to ensure diaphragm action in the roof is the primary contributor to this postulation.

There are currently four greenhouses that are attached to the 1506 structure. They are nearly unusable as functional greenhouses, which makes it difficult to respond to recent sponsor research needs across several DOE Offices.

Given the seismic risk and the current conditions of greenhouses, this GPP request is aimed at moving all activities from 1506 to 1503, where modern laboratory space would be created, the existing spaces would be renovated to create a head house, and new greenhouse structures would replace the existing ones (the existing greenhouses at 1503 are no longer functional either).

The following tasks/activities are covered by this GPP request:

- Renovate 1503 conference room to accommodate two large laboratories currently in 1506. This will include construction of a new wall, electrical upgrades, installation of bench space, laboratory sinks, fume hoods, eyewash/shower units, etc.

- Modify other rooms in 1503 to accommodate activities currently housed in multiple 1506 instrument rooms.

- Convert the current maintenance shop in 1503 into a head house to support greenhouse operations.

- Demolish existing 1503 greenhouses and construct replacement units on existing foundations.

- Construct an addition to the south end of 1503 to house new environmental growth chambers and move select growth chambers from 1506 into modified spaces in 1505.

- Erect a large pre-engineered storage building in the lot south of 1503 to accommodate ESD sample and equipment storage needs.

- Move equipment essential to programmatic research needs from 1506 to the renovated 1503.

Data Network Layer 2 Upgrades (ADS A00D0040, FY 2002 GPE)

The data network at ORNL is a complex conglomeration of various routers, switches, bridges, hubs, and repeaters. It can generally be viewed as having three major components: the backbone (generally referred to as the routing or layer 3 hardware), Local Area Networks (LANs) (generally made up of bridges, workgroup switches, hubs, and repeaters - layer 2 hardware), and special servers, such as name servers (application servers such as mail and data servers are not included in this discussion). The backbone and most special servers are managed and operated completely by CIND; LANs are operated and managed by CIND or individual divisions, and/or departments, as they see fit. Devices managed by CIND are referred to as "public," while devices managed by individual divisions are referred to as "private." "Public" network devices are monitored, maintained and upgraded by CIND as funding is available based on a cost recovery process using fixed monthly rates. "Private" LANs are upgraded by divisions on their schedule, at their cost, and using hardware and software they select (sometimes at the direction of CIND). As a result, layer 2 hardware is a vast assortment of components— some the latest technology, some very obsolete.

As with many systems, the overall strength is only as strong as the weakest link. So it is with the security of the data network. If a system in a remote portion of the network is compromised, the entire network is put at an increased risk. In a shared media environment, a person can install a sniffer, or use sniffing software on his computer, and eavesdrop on conversations. Passwords can easily be compromised in this manner. A shared media environment exists at much of ORNL.

Recent advancements in networking technology have resulted in devices and techniques that allow the network to be protected at the switch port level. They also allow for the separation of users in the same geographical area into separate virtual networks. Exploiting these new features is critical to the overall cyber security posture of ORNL in the future. However, the current conglomeration of mixed technologies and hardware used in the network prevents this.

The last time significant funds were dedicated to a network rebuild was in 1992 when the current Fiber Distributed Data Interface (FDDI) hardware was procured and installed making up the backbone. In addition, in 1992 fiber optic cable was installed to allow for this FDDI backbone. Technology has leapfrogged and FDDI is now obsolete. Also, there has never been a major project funded to build or replace the layer 2 devices, which are the devices closest to the users.

Recent efforts have resulted in the installation of layer 3 gigabit Ethernet in a new backbone, which is nearing completion. This new backbone has been procured for the most part utilizing funds from "public" network users and, in fairness, is currently limited to use by divisions that are willing to pay

these rates. Due to funding constraints, deployment of new hardware is done in a fragmented, piecemeal way.

This capital request is for layer 2 networking devices to ensure that all edge devices provide the features necessary to implement cyber security techniques. New hardware procured as a result of this request will utilize switched technology and eliminate shared media devices at ORNL. Other features that may be deployed as a result of this request are global tagged Virtual Local Area Networks (VLANs) and automated blocking to ensure that unregistered users are not granted access to the network. Utilizing the latest layer 2 networking switches all the way to the edge of the network will allow management systems to be implemented that automatically provide certain registration information and block access to the network if the user refuses to provide the remaining required information. This will provide an increased level of security network-wide. This request includes hardware to improve the condition of the network to the edge of the entire network, both "public" and "private." This request also provides for the upgrade of network wiring where necessary to allow for the use of the latest hardware.

This project is a multiyear effort to replace wiring closet equipment and wiring at the "edge" of the ORNL data network to improve uniformity, which will allow some significant improvements in cyber security. The first year's request ($500K) will be used to pick an area of ORNL which has a high concentration of nonemployees and visitors *and* is in need of network improvements. Implementation in this area will be used as a "proof of principle" for security improvements and as a model for subsequent year efforts. Total cost of the project is $3.5M and would be implemented in 5 years. Of the $3.5M, $2.5M is equipment, $562K is rewiring contractor (e.g., USWest), $325K is ORNL labor, and the rest is miscellaneous.

4500S Basement Renovation, West End (ADS AA0D0074, FY 2002 Landlord GPP)

This activity will support the renovation of mechanical property laboratories (B50/54) on the ground floor, west end, of 4500S. These laboratories have been multiprogram-supported for many years with most equipment acquisitions dating back to major reactor development programs in the 1960s–70s. Recent activities involve many programs with a low level of support. Among the largest of recent sponsors has been the Japanese, a work-for-others program that ended mid-FY 2000. Therefore, there is no programmatic support available to fund this activity. This renovation recognizes the changes in the needs for funded programs at ORNL. The activity would support: consolidation of the mechanical properties equipment into approximately half of the existing space; disposal of the out-of-date and unused equipment; repair of the walls and ceilings as needed; removal of asbestos insulation of water pipes and insulation of all water pipes in the laboratory (lack of insulation is causing condensate to accumulate on the floors); painting the walls and the ceiling; and replacement/ addition of floor tiles as needed. Other laboratory equipment would be moved into the renovated space as part of the overall division's plan to consolidate activities centered on the 4500S west end.

New External Web Server (INFOSRV1) (ADS A00D0003, FY 2002 GPE)

This request is for a new external web server that will become part of the new external web server cluster. The external web server is getting more and more hits, and the CPU is running at or close to 100% utilization a large percentage of the time. This is the critical piece of computing infrastructure for ORNL's external web presence.

The current external web server is a single computer system with attached disk and tape storage subsystems. The proposed architecture would consist of two essentially identical computer systems

that are made to appear as if they were one system through the use of a smart switch. This switch would be the "traffic cop" for incoming connections from clients' web browsers. The switch would balance the load between the two servers by continually measuring responsiveness. If either server were to fail for any reason, the switch would immediately stop handing connections to that server. Until that server could be restored, the service might appear somewhat slower to clients, but it would continue operating. A second switch would be configured to provide redundancy in case the first switch failed. The two computer systems would each be configured with RAID-based disk storage subsystems to provide redundancy for the most common type of failure, a disk failure. Data would be replicated automatically from one computer's storage system to the other at regular intervals to maintain the single-system appearance to all clients.

Two Web proxy servers would also be set up in a redundant configuration. These proxy servers would satisfy security concerns about users browsing malicious Web sites and control access to Web servers on the corporate network.

5500 Renovation for ES&H Functions (ADS AA0D0070, FY 2003 Landlord GPP)

This activity involves the renovation of existing Building 5500, Rooms 125-127, 01-03C (all inclusive), and 05/05A to accommodate the Quality Services Division personnel, equipment, and laboratory apparatus and equipment for respirator fit testing, storage, and issue from the Operational Safety Services Division. Individual office space for 35 occupants will be needed. This activity would relocate personnel and equipment from Buildings 2013, part of 3550, and 3017 into Building 5500. Major renovation and construction activities are:

- Removal of existing equipment in Room 125 and erection of an office structure(s) (most likely two-story to conserve floor space) to accommodate 26–32 personnel, including renovation of electrical and other services needed for occupancy.

- Respirator inspection and test facility in Room 126. Included in the facility are provisions for automation of packaging processes and new mask testing apparatus.

- Respirator fit test, storage, issue, and training facility located in Rooms 125 and 126.

- Laboratory space, including hoods, laboratory benches, shielding, etc., in Rooms 01-03C, 05 and 05A.

- Shop space in Room 125 for relief valve testing, HEPA testing, and nondestructive testing. Needs include X-ray equipment, facilities with vaults, instrumentation, shielding, etc.

Relocation of Radioassay Laboratories and Supporting Functions. This activity involves moving the existing radioassay from substandard laboratories having obsolete laboratory equipment to newly renovated space in Building 5500 (second floor). The ORNL Radioassay Laboratory is accredited by the Department of Energy Laboratory Accreditation Program (DOELAP) and must retain the accreditation to perform personnel radiobioassay functions.

- Renovation of existing six laboratories in 5500 to meet DOELAP accreditation standards for radiobioassay functions.

- Renovation of existing space in 5500 to meet DOELAP accreditation of radioassay counting room standards.

- Renovation of office space in 5500 for radioassay technical staff to support DOELAP accredited functions.

- Renovation of conference room on second floor of 5500 for ES&H compliance training and other general laboratory uses.

East Campus Service Building (ADS AA0D0064, FY 2003 Landlord GPP)

This project involves the construction of a 20,000-square-foot multistory office building, the Central Services Building, to be built just north of 4500N at ORNL. This project will allow consolidation of photography, graphic arts, and duplication services, which currently are located in the basement area of 4500S, and relocation to a new facility that will more effectively and efficiently serve this mission at ORNL and will also provide needed space in the 4500S basement to allow the Metals and Ceramics (M&C) Division to vacate 5500 and consolidate their activities in this space. This new facility will also provide approximately 50 offices for staff that will be displaced by the planned construction efforts of the 4500N Line Item. The Central Services Building would be constructed on the current site of Building 5000.

Renovation of Building 7605 (ADS AA0D0073, FY 2003 Landlord GPP)

The Fusion Energy Division (FED) is an Oak Ridge National Laboratory (ORNL) facility located at the Y-12 Plant on Bear Creek Road. For the past several years there have been several attempts to relocate the FED facilities to the ORNL site as a result of increasing costs to maintain old World War II structures in which the FED is presently located. Other reasons for leaving the Y-12 site are the access problems for foreign nationals into the Y-12 Plant, with which FED collaborates; legacies of contamination in the FED building; and increasing (and uncertain) mission burden at the Y-12 Plant. The most recent efforts for the Laboratory revitalization have placed the FED in the 7600 Area. The primary reason that the 7600 Area was selected for the FED is the availability of electrical power. FED requires 161-kV power distribution with 13.8-kV feeders for their basic infrastructure.

Currently, the relocation of FED personnel to the 7600 Area, in accordance with the ORNL Revitalization Program, indicates there is as shortfall in available laboratory space. In order to achieve the relocation of FED to the ORNL campus, the refurbishment of existing Building 7605 will be required to keep all FED personnel together. Existing Building 7605 is an old corrugated steel-framed building currently occupied by the Salvaged Material Organization. In an effort to refurbish the building for FED use, a sprinkler system, rest rooms, overhead conveyance system (monorails), and reinforcement of the structure for overhead loads will be required. In addition, the structure will require cubicles for each laboratory.

HFIR User Support Facility (ADS AA1D003, FY 2003 Landlord GPP)

This project provides for a user support facility of approximately 20,000 square feet in the HFIR area. This will provide much-needed office, conference, and computer space for HFIR users and will permit the removal of several trailers currently utilized at the HFIR for this purpose.

Fire Headquarters Renovation (ADS A00D0011 FY 2004 Landlord GPP)

This project is to construct a new 3000-square-foot extension to the fire apparatus and ambulance parking bays, to renovate the fire alarm receiving and dispatching operations center, and to construct a 32-foot by 60-foot extension to the Building 2500 office wing.

The apparatus parking bay extension will permit the indoor parking of all emergency response apparatus/vehicles. It will also be sized to accommodate larger apparatus with increased capabilities that may be needed as ORNL operations and missions change. The apparatus bay extension also includes the following:

- Space to relocate the breathing air cylinder refilling equipment out of the current location in the fire extinguisher refilling shop. Relocating this equipment out of the dusty extinguisher refilling environment will significantly improve the longevity of air filtering and air compressing equipment.

- Space for a wash sink and cleaning area designated for cleaning ambulance and other emergency medical equipment only. Currently such equipment must be cleaned in general purpose sinks which produces the possibility of cross contamination and threatens equipment sanitation.

- An exhaust system specifically designed for this application and to discharge the exhaust of diesel engine fire trucks and ambulances outside the building. Starting and running these vehicles inside the building is a routine occurrence during vehicle checks, that occur twice a day at shift change. There is a potential health issue until such an exhaust system is installed.

- Desperately needed storage space for fire fighting turn-out gear, spare fire hose, and spare breathing air cylinders.

The renovation to the Fire Alarm Receiving and Dispatch Operations Center includes:

- Enclosed access from the Operations Center to the apparatus parking bays.

- Separation of the central station fire alarm-receiving equipment and dispatcher from the emergency responder ready area.

- Updated and more compact fire alarm receiving equipment console.

- Removal and replacement of existing asbestos floor tile.

- New ceiling tile, wall treatment, HVAC equipment, windows, etc.

The 2000-square-foot Office Wing extension to Building 2500 includes:

- The addition of about eight new offices, a new men's rest room, and a combination conference/ class room.

7900 Area Office Building I (ADS AA0D0043, FY 2004 Landlord GPP)

Research Reactors Division currently has 75 people housed in trailers. Several of these trailers were installed in 1987–89 and were used trailers when they were installed. Specifically, Trailers 7964A, 7964B, 7964D, 7964F, and 7964G have numerous recurring problems such as roof leaks, window leaks, HVAC unit malfunctions, mold, mildew, and rodent problems. Additionally, some of these units have deteriorated to the extent that they have serious odor problems associated with decaying facilities.

They were all intended to be temporary structures. The operating environment has changed significantly since 1987, and the level of staffing will probably never return to the pre-1988 level. An

office building is needed to revitalize the campus and the working conditions for the Research Reactors staff and the DOE HFIR site representatives.

Documents that are required by law to be maintained are currently being stored in 12 different locations. Some of these locations are trailers, and some consist of unairconditioned space when the requirements call for the space to be air conditioned. Radiographs of the HFIR vessel and systems and QA records are examples of documents not stored in compliance. Many of the records are required to be stored for the lifetime of the facility, which is projected to be 2035. Requirements also include maintaining all maintenance work packages as records. The proposed office building should include 3000 square feet for document control.

Central Campus Research Building (ADS AA0D0077, FY 2004 Landlord GPP)

This activity provides for the construction of a research building of approximately 14,000 square feet. This facility will house a number of research programs currently located in Buildings 2024, 3115, 3080, and 2019, which is affectionately known as the "rat" house. These very old high-maintenance buildings provide woefully substandard space for many high-profile research programs. Recently, at the signing of a license agreement between ORNL and American Superconductor Corporation (ASC), top officials from DOE Headquarters, ORO, ASC, and other prestigious guests did not tour the facilities in Building 3080, where much of the work was done. It was felt that this would cause "serious embarrassment to ORNL." The new facility will house multidivision programs supported by a number of agencies within the Office of Science (KC, EW, and EB) with direct ties to other national laboratories and industry.

Replace Cooling Tower 4511 (ADS A98D0016, FY 2004 Landlord GPP)

The 4511 cooling tower wooden structure is deteriorating at a rapid rate under dry conditions and becomes increasingly hazardous to maintain. This project will replace the cooling tower superstructure.

Building 4509 Maintenance Shop Addition (ADS C97D0089, FY 2004 Landlord GPP)

This project will construct an addition of approximately 2500 square feet to Building 4509, which houses the Air Conditioning Compressor maintenance activities for the Laboratory. The addition will allow space for maintenance personnel to work on major air conditioning units and support equipment. The addition will improve safe operations for maintenance personnel who work with gasses having potential significant hazards.

Flow Monitoring Stations for Low-Flow Verification (ADS A99D0027, FY 2004 Landlord GPP)

This project provides for the installation of permanent flow monitoring equipment at upper First and Fifth creeks in the ORNL main plant area. The equipment will be designed such that ORNL can collect continuous flow data at a point above ORNL wastewater discharges. The ORNL NPDES Permit currently includes stringent effluent limits for several outfalls on First and Fifth creeks with which compliance is difficult. These limits are based on conservative regulatory assumptions about baseline flow rates in these two ORNL receiving streams and have been appealed by DOE. A long-term flow record is expected to allow ORNL to verify or disprove flow rate assumptions on which NPDES Permit requirements are based. This will position DOE to propose and negotiate more realistic and achievable NPDES Permit requirements for discharges to these streams.

Transportation and Packaging Management Facility (ADS S97D0058, FY 2004 Landlord GPP)

This project will provide a one-story building 85 feet x 130 feet with 3400 square feet of space. The building will provide three managers' offices, 16 employee offices, a shipping area 30 feet x 20 feet, a loading dock, and a hazardous/nonhazardous and radioactive packaging area. The facility will provide space for packaging, quality assurance checks, and shipment which will comply with regulatory requirements.

The current operation for the transportation and packaging of facility materials occurs in three different locations. These facilities have levels of fixed contamination which will reduce potential exposure to personnel with the construction of the new facility.

Ventilation Systems, Ductwork, and Fume Hood Upgrade (ADS C97D0054, FY 2004 Landlord GPP)

Facility work will include activities to upgrade ventilation systems, filtration systems, interconnecting ducting, and equipment for fume hood and exhaust systems located in facilities at ORNL.

Deteriorated fume hoods and associated exhaust ductwork will be selectively repaired or replaced from hood to filter housing. Repairs will replace all corroded ductwork (with stainless steel or equivalent) and provide leakproof construction with gasketted flanged joints as required for installation/removal. Duct size will be standardized as 12-inch-diameter for hood service. Existing exhaust ductwork from fume hoods will be considered a contaminated material in all cases and will require strict conformance to local work procedures in its repair and/or replacement.

Fume hoods not previously replaced by interim improvements will be replaced with new fume hoods that conform with the new system concept. The intricate requirements for building airflow balance will be carefully considered in deciding the type of fume hoods and exhaust system arrangement to be employed. Variable-volume fume hoods (airflow regulated by sash position) provide a more appropriate application for these buildings than do auxiliary air hoods (as related to DOE 6430.1A, 1161-4, and 1161-5). Variable-volume fume hoods allow much less complication of controls and should require less total air volume to be heated and filtered (as supply and as exhaust) through the system's life.

Deteriorated HEPA filter housings will be replaced with new single-filter housings with prefilter space (thus allowing prefilter use to be optional). To achieve full airflow for an 8-foot Class II fume hood (1300 ft^3/min), two single-filter housings are required, using manifolding with interconnection to a single exhaust fan (or header connection). Specifically, these housings and fans will require stacking similar to that now practiced to conserve space. Unit modules will be standardized to use 24- by 24-inch prefilter elements and 24 x 24 x 11.5 inch HEPA filters. All new ductwork and filter housing will be made to conform with current regulations to allow its continued use in the future.

HVAC Upgrades (ADS C97D0083, FY 2004 GPE)

This project will replace deteriorated air conditioning components which provide environmental control for laboratory facilities. Job scope includes removal and replacement of old equipment and subsequent tie-in support. Many HVAC units are used for loads and purposes other than their original designs, resulting in many developing operational problems, which create occupant health hazards. The equipment listed in the scope of this project has exceeded its life expectancy. Replacing these deteriorated components will improve air conditioning reliability and reduce operating and

maintenance costs. The reliability of these HVAC systems is critical to proper operation of laboratory equipment (microscopes, lasers, etc.) and calibration of research apparatus.

Bethel Valley Road Improvements (ADS A00D0017, FY 2005 Landlord GPP)

This project will relocate 1.3 miles of Bethel Valley Road approximately 1000 feet to the north of its present location. It will be a lower-speed roadway containing three 12-foot lanes plus two 14-foot shoulders. The proposed relocation will reroute "through" traffic around an area proposed for near-term development of new facilities reducing the potential for public traffic to enter Laboratory roadways. The proposed relocation will eliminate the dangerous "S" turn located at the Laboratory's main entrance.

HFIR Highbay Storage Building (ADS AA0D0078, FY 2005 Landlord GPP)

HFIR warehouse storage for safety-related parts and equipment and nonsafety-related equipment is currently being stored in nine different locations, four of which are remotely located from HFIR. These remote locations are as follows: 3095, 7019, 7039, and 7709. Materials are also being stored in 7914, 7915, 7953B, and two tents located adjacent to 7917. Of these locations, 7709, 7915, and 7953B are conditioned space. HFIR safety-related equipment and parts must by law be stored in conditioned space. Buildings 7914 and 7915 were construction sheds that were used by the contractor when HFIR was built in 1963. They were temporary then. The two tents are an attempt to meet the need with no funding. Significant operational funds are expended every year moving material and parts between storage places to try to make room for something else that must be stored or in moving things to the reactor site so that they can be used.

A single building on-site with conditioned space would allow HFIR to meet the requirements and improve efficiency. Costs for riggers should be reduced. Currently, there 11,640 square feet of unconditioned warehouse space being used and 6,420 square feet of conditioned space being used. A minimum of 18,000 square feet is required for continued operation of HFIR for another 25 years.

6010/6025 Renovation (ADS AA0D0080, FY 2005 Landlord GPP)

This activity provides for the renovation of office and laboratory space in Buildings 6010 and 6025 to accommodate needs of Physics Division staff moving into the vacated space. Both buildings will require upgrading of computer access, including installation of twisted-pair connections to offices and laboratories. Both buildings will require modernization of conference rooms to enable utilization of modern projection techniques, and both buildings will require addition and/or renovation of laboratory space, ensuring adequate electrical power, water, and bench space. Specific issues to be addressed in 6010 include renovation of the present Center for Engineering Systems Advanced Research (CESAR) Laboratory space into laboratory space (and possibly some office space) appropriate for Physics Division needs, conversion of some office space back to laboratory space on the first floor, and increased women's rest room space (likely to be required). Originally, 6010 had only one floor and no light switches were installed in offices, so light switches should be added as appropriate. Painting will be required. In 6025, the central area of the building originally contained large office/laboratory space, which has been converted to offices. Renovation will include converting these offices back to appropriate laboratory/open space. There has been significant settling of the subsurface, with resulting cracks in the walls, particularly in the south end of the building, and these issues will need addressing. There is a small sub-basement, which contained a small neutron generator (no longer there), that was covered over during conversion to office space. This area needs to be located and may need attention. Air conditioning has often been a problem and needs to be reviewed

for adequacy, particularly in the central areas. Incidental maintenance will also be needed to ensure appropriate office space (unblocking of doors, patching of cracks, painting, etc.).

West Campus Infrastructure Improvements (ADS AA0D0068, FY 2006 Landlord GPP)

This activity provides for the construction of infrastructure roads, parking, and common areas associated with the new West Campus development portion of the ORNL Facilities Revitalization Project. This infrastructure improvement will support the West Campus reconstruction by providing new or improved parking lots north of the Building 1000, 1060, and 1505 areas to replace the primary parking lots that will be the site of new buildings and common areas. The project also provides for construction of associated new roads and the common areas (landscaped quadrangle) in the center of the West Campus. Approximately 0.2 miles of roads would be upgraded or replaced, 5.0 acres of parking upgraded/constructed, and 1.0 acre of landscaped common area provided.

7900 Area Office Building II (ADS AA0D0079, FY 2006 Landlord GPP)

This activity provides for the construction of an office facility in reasonable proximity to the Radiochemical Engineering Development Center (REDC) complex (Buildings 7920, 7230, etc.) to house in a more synergistic arrangement operational, engineering design, and divisional support personnel for the Radiochemical Technology Section (RTS) of the Chemical Technology Division. Current RTS candidate groups for relocation to the proposed facility are:

- RTS operations staff and support staff from the ORNL Radiological Protection, Instrumentation and Controls, and P&E Divisions who are currently housed in three trailers located just east of 7930. The approximate number of personnel is about 35.

- A staff of operations, engineering design, and divisional support that will be the core group for development of the Plutonium 238 production capability at ORNL. These staff are either widely scattered at ORNL or are not yet identified. The approximate number of personnel is 30–50.

- The staff of the RTS engineering group for radiochemical process and facility design. Most of this staff is currently located in Building 3037. The approximate number of personnel is 10.

Assuming standard allocation area for offices and space for reception, training facility, document center, rest rooms, a conference room, a canteen for meals (canteen could also serve HFIR and REDC operations personnel) and space for HVAC mechanical equipment and utilities, a building of at least 20,000 feet is needed.

Water System Upgrades, 1000 Area (ADS A98D0009, FY 2006 Landlord GPP)

This project will provide a needed infrastructure upgrade for the potable water system in the west end of the ORNL complex. This area is now supplied by a single feed of 6- and 8-inch water mains. This system will be inadequate for planned future development in this area and provides only marginal fire water supply to the area. This project will install approximately 3000 feet of 16-inch main to the west end of the ORNL complex, along with the associated pressure-reducing valves, isolation valves, fittings, hydrants, and valve pits.

Water System Upgrades, 7600 Area (ADS A98D0010, FY 2006 Landlord GPP)

This project will provide a needed infrastructure upgrade for the potable water system in the east end of the ORNL complex. Presently, there is only a single feed to the 7600 Area of ORNL where there

is major potential for a fire loss. Relocation of the Fusion and Engineering Technology facilities from Y-12 to this area is also planned for the future. This project will install approximately 9000 feet of 16-inch main to the 7600 Area at the far east end of the ORNL complex along with the associated isolation valves, fittings, hydrants, and valve pits.

HFIR Entrance Addition and Expansion (ADS S97D0052, FY 2006 Landlord GPP)

This project would improve the entry into the HFIR building to allow improved operational efficiencies. Two existing personnel entrances will be enhanced with addition of an entrance to the east side of the building adjacent to the truck air lock. The project will add a lobby with access controls and a parking area with a bus pull-out for improved services for visitors and guests.

Steam Plant No. 5 Boiler Upgrade (ADS S97D0056, FY 2006 Landlord GPP)

This project will upgrade the natural gas/fuel oil burners, combustion system auxiliaries, and boiler controls on the No. 5 boiler in the steam plant.

The No. 5 boiler was constructed and put into service in the early 1960s and has been in operation since that time. Burner and control technologies have advanced significantly, and an upgrade of the internal components in this boiler will increase its life expectancy and efficiency. As the ORNL Steam Plant makes a gradual shift from coal as a primary fuel to gas as a primary fuel over the next few years, an upgrade of this burner will be one of the necessary components to ensure a reliable steam supply for the Laboratory.

Restoration of the Natural Gas Distribution System (ADS S97D0020, FY 2006 Landlord GPP)

This project will restore the existing natural gas distribution grid located in the Bethel Valley area of the Laboratory. Restoration activities will include replacement of line segments, valves, and pressure regulators where warranted and will use trenchless technology techniques to rehabilitate pipe where these methods can be proven cost effective. All cathodic protection systems currently in use to prevent corrosion of the system will also be upgraded.

The natural gas piping system is a steel piping grid that provides gas to research facilities throughout the center portions of the Bethel Valley complex. It was constructed in 1948 and has been in continuous use since that time. While it has been largely trouble-free, design life has been exceeded, and it is expected to develop problems over the next few years. Given the serious nature of accidents caused by natural gas leaks, it is imperative that measures be taken to restore this system to "as-new" condition before degradation of piping and valves can cause a leak.

Coal Storage Area Reclamation (ADS A99D0114, FY 2006 Landlord GPP)

This project will involve the removal/disposal of any remaining coal, demolition of two coal conveyors, and revegetation of the coal storage area. Completion of this project will eliminate the source of possible NPDES violations.

J.2 PHASE II PROJECTS (FY 2007–11)

J.2.1 Line Items – Phase II

4500 North and South Modernization Upgrades. The proposed projects are integral parts of the new Facilities Revitalization Project (FRP) for revitalization of ORNL's research capabilities and infrastructure in support of the DOE-SC initiative to modernize their national laboratories. Consistent with DOE's approved Institutional Plan for ORNL, new laboratories, supporting offices, and the necessary support facilities are being proposed for construction as part of an integrated new campus environment in the area north and east of the 4500 North and South building complex. The 4500 North and South complex will be modernized to provide laboratory, office and support functions. The overall goals of this facilities revitalization initiative are to reduce the burdensome costs of maintaining the current inventory of 50+-year-old facilities, provide a safer environment for current staff to work in, and to ensure ORNL's ability to conduct world-class science in the 21st century including attracting and retaining world-class research scientists. The payback period is approximately 6 years. There are eight separate upgrade projects in these two facilities. 4500N (Wing 1) and 4500S (Wings 1 and 3) are in Phase II.

J.2.2 Major GPP/GPE Projects – Phase II (FY 2007–11)

Addition to Building 6012 (ADS S97D0002, FY 2007 Programmatic GPP)

The addition to Building 6012, the Mathematical Sciences Research Facility, will provide (1) space for additional computational science research staff members and (2) a ground-level laboratory that will provide direct access and adequate overhead clearance for several robot systems studied at the Center for Engineering Systems Advanced Research (CESAR). The total area of 6500 square feet will be divided into laboratory, office, and control room spaces.

The most rapidly growing R&D activities in Computing Sciences and Mathematics Division are informatics, networking, visualization, and cooperative intelligent systems. The growth and impact of these R&D efforts in recent years have created a critical space shortage that will halt future growth and threaten our ability to retain existing programs.

Extend the 7000 Area Water Main (ADS S97D0023, FY 2007 Landlord GPP)

This project will extend the existing water distribution grid into the area east of the Laboratory's 7000 Area. This area currently houses numerous material storage buildings as well as two research/materials processing facilities. Water service in the area is currently limited and is being provided by a single 8-inch steel line. The project will construct an 8-inch looped system in the area and will provide hydrants, as well as fire protection and potable and process service water, to customers in the area.

This area was known as the "Jones Camp" during construction of the Laboratory. Water service was provided to construction-related facilities in the area via an 8-inch temporary steel water line. This line is still in use and is the only source of water to the facilities currently located in this area. Corrosion inside this line has restricted its water-carrying capacity, and its ability to provide an adequate fire protection water supply is in question. Addition of a ductile iron looped main to replace this deteriorated system will allow continued operation of facilities in this area and will enhance fire protection capability.

Upgrade Electrical Systems (Buildings in the 3000, 6000, and 7000 Areas) (ADS C97D0069 and ADS C97D0070, FY 2007 Landlord GPPs)

This project will replace obsolete and inadequate switchgear and transformers at the main electrical service entrances of buildings in the 3000, 6000, and 7000 areas. These electrical devices are the control points for the main electrical systems in these facilities. Much of this equipment has been in service for 50 years and must be replaced to ensure reliable electrical service to the customers and provide a safe environment for building occupants, system operations, and maintenance personnel.

Sanitary Waste Transfer Station (ADS C98D0105, FY 2007 Landlord GPP)

This new facility will replace an existing facility, eliminating the need for a compaction trailer that is obsolete, deteriorating, and expensive to maintain. The new station will consist of a stationary compactor and roll-off type pans, which will be picked up, delivered to the landfill, and returned to ORNL.

Auxiliary Systems Upgrades (ADS S97D0040, FY 2007 Landlord GPP)

This activity will upgrade auxiliary systems for replacement or refurbishment of vertical turbines for circulation of cooling tower water and general facility vacuum pumps, condensate pumps, and sump pumps.

Replacement of the B 2519 East End Water Softeners (ADS C98D0145, FY 2007 Landlord GPP)

This project will consist of removal and disposal of the current water softener system and de-aerator tank, procurement and installation of a new water softener and tank, and procurement and installation of state-of-the-art control systems.

The East End Water Softener System consists of sodium and acid storage tanks, mixing tanks, and pumps. The system was installed in the early 1960s with a design life of 25 years. The system controls are obsolete, and the capacity is not sufficient for the capacity of the steam plant. The project will include replacement of the deaerator as well as the softeners and be of sufficient capacity to match the Steam plant capacity.

Install Water Meters (ADS S97D0024, FY 2008 Landlord GPP)

This activity will install water meters on service lines to major user facilities at the Laboratory. It is projected that approximately 75 meters will need to be procured and installed either at existing building service entrances or in meter pits located outside the facilities.

Accurate metering and billing for water use are necessary for efficient operations. Users of water are currently billed based on estimates developed for this purpose. By metering actual use and billing customers based on consumption, usage rates are expected to decline and operating efficiencies will be achieved.

Elevator Upgrades (ADS C97D0078, FY 2008 Landlord GPP)

This project will refurbish deteriorated elevators in the identified ORNL Facilities. The elevators are not reliable and have become continuously more expensive to maintain. Replacement of all the required mechanical elements on the elevators is needed: cab, rollers, platform sling, etc.

The impact of not accomplishing these elevator upgrades will be continued deterioration of elevators and thus the buildings/structures. This could lead to personnel injuries because of hazardous conditions for the general plant population. Elevators could become even more unreliable and continue to be expensive to maintain. Lack of maintenance funding could lead to violation of DOE Order 430.1A and other DOE orders, adverse impact on research activities because of inadequate elevators to move research equipment and personnel, and adverse public perception.

Melton Valley Road Upgrade (ADS S97D0019, FY 2008 Landlord GPP)

This project will remove the existing asphalt surface with alignment of the road both vertically and horizontally. This may entail modifying/extending existing drainage structures as well as installation of new drainage structures. This project would greatly reduce the maintenance required on this road and improve the safety of employees and visitors using it. It would also enhance development of the area.

Technical Support Building Addition, 4512 (ADS C97D0105, FY 2008 Landlord GPP)

This project will provide a new facility to house and protect the Technical Support Center (TSC), from which crisis management and support teams carry out coordinated emergency response activities. This item will provide funding to add a second floor on Building 4512 which will accommodate adequately sized quarters for the TSC, permit upgrading and automation of TSC equipment, and provide office space for the Emergency Preparedness Department. Completion of this project will assist ORNL in complying with DOE Order 151.1 plus the DOE Task Force Report on Compatibility of Emergency Operations Center Communications and Information Processing Systems.

West End Steam Upgrade Completion (ADS S97D0032, FY 2008 Landlord GPP)

This project will perform those activities necessary to complete the West End Steam System Upgrade. Included in the work will be insulation of the pits and demolition of old pits, pipe, and pipe supports.

Heavy Equipment Shed (ADS A99D0088, FY 2008 Landlord GPP)

This project will construct a new 40 x 60 x 12 foot sidewall storage shelter to protect heavy equipment such as backhoes, tractors, and lawn mowers from the elements. These equipment items are currently stored outside or in the existing high-sidewall storage shelter. The high sidewalls offer minimal protection from blowing rain or snow. The new shelter would have a lower profile and would protect these pieces of equipment from rain, snow, and sun.

Whole-Body Counting and TLD Laboratory Building (ADS AA0D0060, FY 2008 Landlord GPP)

The Internal Dosimetry and External Dosimetry programs at ORNL are mandated by the requirements of 10 CFR 835. One of the requirements is the continued maintenance of accreditation by the Department of Energy Laboratory Accreditation Program (DOELAP). As part of the Internal Dosimetry Program, the Whole-Body Counting Laboratory provides in vivo monitoring for ORNL workers and subcontractors. It includes whole-body counting, lung counting, and thyroid counting. The External Dosimetry Program utilizes thermoluminescent dosimeters (TLDs) for monitoring external exposures. The dosimeters include beta-gamma, neutron, and extremity dosimeters.

This GPP project ensures that the activities of the Whole-Body Counting Laboratory and the External Dosimetry Program (provided by the TLD Laboratory) will continue to be in compliance with regulatory requirements and maintain state-of-the-art capabilities.

A building of approximately 3000 square feet will be constructed adjacent to the current Whole-Body Counting Laboratory.

The building must be built around the existing Whole-Body Counting Laboratory Vault, which is a low-background shielded room constructed of 14-inch-thick pre-World War II battleship steel (ultra-low background) with inner dimensions of 10 x 10 x 10 feet. It will provide space for a reception area, offices, records storage, source storage, a control room for the counting room, an ultrasound room, and men's and women's change rooms.

Upgrade Steam Distribution Condensate Removal System (ADS C97D0057, FY 2009 Landlord GPP)

This project will install approximately 44 new steam condensate removal points and 36 new bypass valves on the existing steam distribution system. These improvement will enhance operability and operator safety while upgrading the steam system to current standards.

Road and Parking Lot Paving (ADS C97D0104, FY 2009 Landlord GPP)

This project will provide for paving of gravel parking lots which have been constructed in recent years. These lots include the HFIR area lot, the 2000 and 2001 lot, and other smaller areas which meet capitalization criteria for new paving.

APPENDIX K

Detailed Description of Security Improvements

The ORNL Laboratory Protection Division (LPD) has the overall responsibility for providing nuclear materials control and accountability, nuclear materials management, physical security, security planning, classified matter protection and control, a foreign national visits and assignments program, and visitor services to all ORNL organizations and operations. The objective of the LPD is to implement appropriate security measures needed to protect against events that may cause adverse impacts on national security, the environment, and the health and safety of Laboratory employees and the public, while maintaining an environment conducive to research and development and the efficient operation of the installation.

Under a prime contract awarded in September 1999, Wackenhut Services, Inc. - Oak Ridge (WSI-OR) provides selected security services at ORNL. Overall management of the Laboratory's security program, with the exception of the ORNL Protective force (PF), remains with ORNL.

K.1 ORNL PROTECTION STRATEGY

ORNL protection strategies establish concentric layers of increasing security measures, starting at the Laboratory's outer boundary and moving inward toward the site's special nuclear material and classified matter storage and handling facilities. This concept achieves a progressively higher probability of deterring or detecting hostile acts, as well as increasing difficulty and delay in perpetrating these acts as a potential adversary approaches the site's interior target areas. This concept relies on a graded approach to establish four types of security areas:

- **Material Access Area (MAA):** Area where Category I and II quantities of special nuclear material are processed, used, or stored. MAAs are located within a Protected Area, have additional access controls, intrusion detection, and are defined by physical barriers. Unescorted access to an MAA requires a "Q" clearance and special approval.

- **Protected Area:** Security area utilized to protect Category II quantities of special nuclear material and protected by physical barriers, such as walls and fences, and equipped with intrusion detection and access control systems. Unescorted access to a Protected Area requires a "Q" clearance and special approval.

- **Limited Area:** Security area established for the protection of classified matter and/or Category III quantities of special nuclear material. An "L" or" Q" clearance is required for unescorted access within these areas, which are generally located within buildings.

- **Property Protection Area (PPA):** Security area having boundaries identified with barriers and access controls established to protect government-owned property. Uncleared personnel with proper identification (a DOE photo-identification badge or ORNL Visitor Identification) may have unescorted access.

There are a minimal number of security areas at ORNL which house special nuclear material and thus require the designation of MAA , Protected Area, or Limited Area. Activating the intrusion alarm systems in these areas will initiate a tactical response from the ORNL Protective Force within a predetermined period. Special nuclear material located in ORNL facilities is provided a level of security commensurate with its quantity and attractiveness level. Additional perimeters and intrusion detection systems protect these few dispersed facilities; however, these barriers do not significantly inhibit land use or disrupt circulation.

Classified matter is stored and processed in Limited Areas at ORNL. Access to these areas is limited to "L"- or "Q"-cleared individuals with appropriate need-to-know or personnel accompanied by authorized escorts. Classified areas have been developed, when required, to support various classified projects using the "security island" concept. This concept ensures that only the physical space required for the classified work receives the necessary additional restrictions and increased level of protection.

Access Control. Most of ORNL is designated as a PPA. To enter a PPA, employees and visitors must wear identification badges, but they do not have to possess a security clearance. No classified matter may be stored in these areas, nor may classified subjects be discussed. PPAs are generally defined by chain-link fences or building perimeters. Access points are controlled by the ORNL PF or badge-reader-operated gates and turnstiles, or are administratively controlled by signage. Vehicular access to the main campus area during off hours (after 3:30 p.m.) is restricted to one portal. Access to secured areas during the off-shift can be coordinated with the ORNL PF.

Fencing and Other Barriers. The most common perimeter security barrier currently used at ORNL is chain-link fencing. When fencing is used without intrusion-detection devices, it has limited ability to detect unauthorized entry. A more effective physical barrier can be the walls of a building. Most wall materials are more solid and difficult to penetrate than the fence fabric; however, these materials must be carefully selected and properly designed when used as a security barrier.

Lighting. Protective illumination is provided to permit detection and assessment of potential adversaries and to reveal unauthorized persons.

Signs and Other Postings. Security signage is posted as required by DOE M 5632.1C-1, *Manual for Protection and Control of Safeguards and Security Interests,* at portals and along the site perimeter. Signage includes No Trespassing, Prohibited Articles, Subject to Search, and the Nuclear Material Rewards Act signs.

Over the course of FY 2001 and as part of an overall Laboratory Operational Improvement Project (OIP), a major reconfiguration of the security of the Laboratory will take place. This will involve opening up a portion of the Laboratory by the removal of some existing security fencing while concurrently moving access controls to building boundaries as opposed to the site perimeter boundary. This will result in an enhancement of overall site security to include the Laboratory's ability to better control the access of foreign national visitors and guest assignees at the site.

K.2 ORNL AT THE Y-12 NATIONAL SECURITY COMPLEX

The Y-12 National Security Complex also operates under a graded response and defense-in-depth security concept. All of the ORNL facilities at the Y-12 National Security Complex, with the exception of Building 9204-3, are located in the PPA. This access area comprises the eastern and the extreme western portion of the Y-12 Complex and contains security fences, gates, and portals that control access and prohibit movement of unauthorized persons into areas with higher levels of security.

Building 9204-3 is located within the Y-12 National Security Complex Protected Area. In this area, Security Police Officers from the Y-12 Protective Force and other internal controls are used to prevent access to classified matter and special nuclear material by unauthorized persons. A "Q" clearance is required for unescorted access to this area.

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