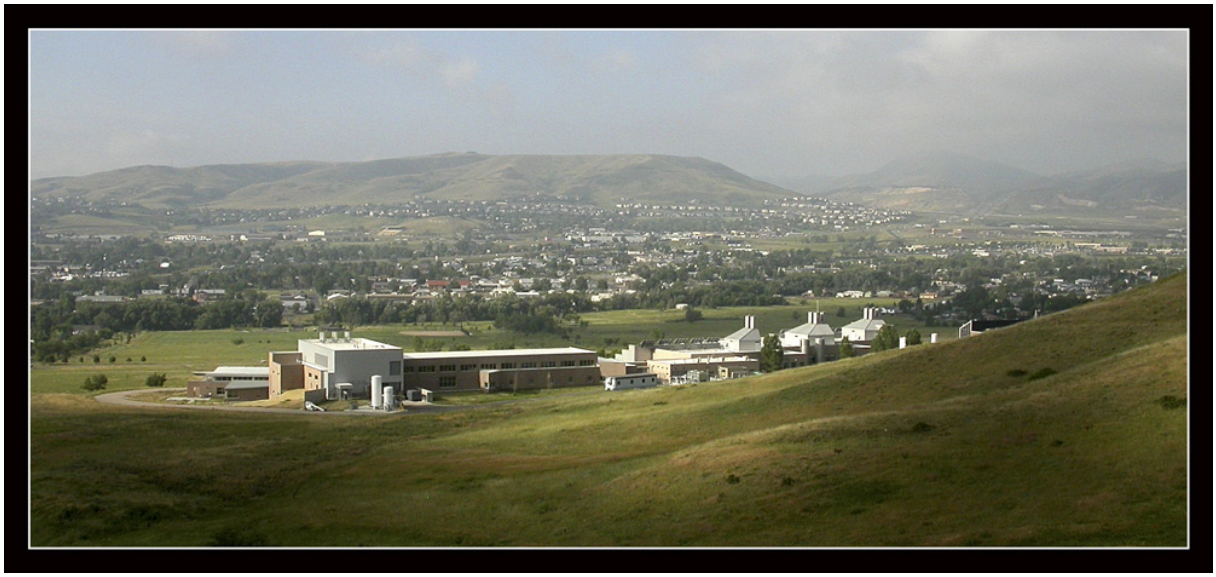
NATIONAL RENEWABLE ENERGY LABORATORY

ENVIRONMENTAL PERFORMANCE REPORT for 2007

(Annual Site Environmental Report per DOE Orders 231.1 and 5400.5)



Prepared by:
Environment, Safety, Health & Quality Office
National Renewable Energy Laboratory

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U.S. Department of Energy and is
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Cover Photo contributed by NREL Employee Steve Wilcox, 2007: View from South Table Mountain in Golden - facing Green Mountain, including the Science and Technology Facility and the Solar Energy Research Facility at NREL

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List of Acronyms

AFUF	Alternative Fuels User Facility
AFV	Alternative fuel vehicle
APEN	Air Pollution Emission Notice
AST	Aboveground storage tank
BMP	Best management practice
CDPHE	Colorado Department of Public Health and Environment
CEQ	Council of Environmental Quality
CFR	Code of Federal Regulations
CGP	Construction General Permit
CMS	Chemical Management System
CY	Calendar year
DBP	Disinfection byproduct
DOE	Department of Energy
DOE-GO	Department of Energy Golden Field Office
DSOC	District Shops and Operation Center
DWOP	Denver West Office Park
EA	Environmental Assessment
EERE	Office of Energy Efficiency and Renewable Energy
ELP	Environmental Leadership Program
EMS	Environmental management system
EO	Executive Order
EPA	Environmental Protection Agency
EPCRA	Emergency Reporting and Community Right-to-Know Act
ESH&Q	Environmental Safety, Health, and Quality
FEC	Federal Electronics Challenge
FEMP	Federal Energy Management Program
FTLB	Field Test Laboratory Building
FY	Fiscal year
GHG	Greenhouse gas
GRI	Global Reporting Initiative
gsf	Gross square foot
HAA5	Haloacetic acids
HABS	Historic American Buildings Survey
HAER	Historic American Engineering Record
IPM	Integrated pest management
ISM	Integrated safety management
ISMS	Integrated Safety Management System
ISO	International Organization for Standardization
IUF	Industrial User Facility
JSF	Joyce Street Facility
LEED	Leadership in Energy and Environmental Design
LEPC	Local Emergency Planning Committee
mg/L	Milligrams per liter
MRI	Midwest Research Institute

MSDS	Material Safety Data Sheet
NEPA	National Environmental Policy Act
NESHAP	National Emissions Standards for Hazardous Air Pollutant
NOI	Notice of intent
NPDES	National Pollutant Discharge Elimination System
NREL	National Renewable Energy Laboratory
NWTC	National Wind Technology Center
O&M	Operation and maintenance
ODS	Ozone-depleting substances
OTF	Outdoor Test Facility
PDU	Process Demonstration Unit
ppm	Parts per million
PV	Photovoltaics
PWSID	Public Water Supply Identification Number
RAA	Running annual average
RCM	Retro-commissioning measure
RCRA	Resource Conservation and Recovery Act
RFA	Rocky Flats Alluvium
RFHP	Renewable Fuel Heating Plant
REC	Renewable energy certificate
ReFUEL	Renewable Fuels and Lubricants Research Laboratory
RFA	Rocky Flats Alluvium
RQ	Reportable quantity
RSF	Research Support Facilities
RTD	Regional Transportation District
S&TF	Science and Technology Facility
SARA	Superfund Amendments and Reauthorization Act
SERC	State Emergency Response Commission
SERF	Solar Energy Research Facility
SERI	Solar Energy Research Institute
SHPO	State Historic Preservation Office
SIC	Standard industrial classification
SOP	Safe operating procedure
SPPP	Stormwater Pollution Prevention Plan
SRRL	Solar Radiation Research Laboratory
STM	South Table Mountain
TCPDU	Thermochemical Process Demonstration Unit
TPQ	Threshold planning quantity
TTHM	Total Trihalomethanes
WHF	Waste Handling Facility

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1. Introduction

The National Renewable Energy Laboratory (NREL) is the nation's premier laboratory for renewable energy research and development and a leading laboratory for energy efficiency research, with programs in wind energy, solar energy, plant and waste-derived fuels and chemicals, energy efficiency in buildings, geothermal energy, advanced vehicle design, hydrogen infrastructure, and fuel cells. Established in 1974, NREL began operating in 1977 as the Solar Energy Research Institute (SERI). It was designated a U.S. Department of Energy (DOE) national laboratory in September 1991 as the National Renewable Energy Laboratory. NREL conducts research primarily for DOE's Office of Energy Efficiency and Renewable Energy (EERE). In FY2007, Midwest Research Institute (MRI) and Battelle operated NREL under the oversight of the DOE Golden Field Office (DOE-GO).

1.1 Purpose

This report presents a summary of NREL's environmental protection programs and activities for 2007. It is organized according to the different environmental media (e.g., air, waste, ground water, etc.), and includes a brief summary of how the program is managed in that area, any permitting or notification efforts that have been completed during the reporting period or are ongoing, and activities that have occurred during the reporting period in that environmental area. A description of the environmental condition and features of NREL's sites is also included to provide a basis for the program overview.

This report is organized to present many of the elements of the Global Reporting Initiative (GRI) Sustainability Reporting Guidelines. It also incorporates DOE's most recent guidelines for the Annual Site Environmental Report, as required by DOE Orders 231.1 and 5400.5.

1.2 Background

NREL's mission is to develop renewable energy and energy efficiency technologies and practices, advance related science and engineering, and transfer knowledge and innovations to the private sector to address the nation's energy and environmental goals.

NREL fulfills its mission through technology portfolios; a brief description of each major technology area follows.

Basic Science: Fundamental research is conducted in the sciences that underlie NREL's renewable energy and energy efficient technologies.

Bioenergy: NREL currently has major programs in biomass-derived fuels (biofuels) and biomass-derived electricity (biopower), and projects in biomass-derived chemicals and materials.

Building Energy: NREL increases the use of energy efficiency technologies and expands the use of renewable energy technologies in the building sector by working to develop new, cost-effective, environmentally acceptable building equipment and envelope systems.

Computational Sciences: This area includes basic and applied research using high-performance computing and applied mathematics.

Distributed Power: Distributed power is modular electric generation or storage located near the point of use. NREL participates in the development of technologies, market structures, and policies that affect the incorporation of renewables and energy efficiency technologies in distributed power systems, maximizing the utilization of renewable energy and energy efficiency products. As a part of this initiative, NREL is involved in the development, design, and facilitation of the application of renewable and renewable/fossil hybrid distributed power systems in grid-connected applications.

Electricity Technologies: These technologies include renewable energy, hydrogen, and superconductivity technologies, as well as utility resources.

Energy Analysis: Research at NREL includes energy analysis for various programs and initiatives.

Hydrogen: NREL serves as a leader in renewable hydrogen production technologies. NREL also leads in the development of advanced storage and sensors, as well as in codes and standards development. Basic and applied research and material development using biology, physics, and chemistry enable and support the development of hydrogen production, storage, and end-use systems.

Measurements and Testing: NREL labs and facilities allow state-of-the-art testing on photovoltaic cells, building technologies, and wind turbines.

Photovoltaics: Photovoltaics (PV) enables the direct conversion of sunlight to electricity using solid-state materials. The National Center for Photovoltaics develops and deploys PV technology for the generation of electric power.

Renewable Energy Resources: Researchers develop resource information for solar, wind, biomass, and geothermal energy applications.

Renewable Thermal Technologies: These technologies generate power from heat or utilize heat from renewable resources. They include concentrating solar power, solar water heating, and geothermal heat and power.

Transportation: NREL works with industry to develop advanced vehicles and systems for transportation, and to develop viable vehicle systems that are integral to DOE transportation initiatives. NREL also works with energy companies and manufacturers of vehicles and engines to develop advanced motor vehicle fuels for improved energy and environmental performance. A systems approach is used to develop optimized engine management, fuel, and emission control technologies.

Wind Energy: Through the National Wind Technology Center (NWTC), NREL develops, improves, and demonstrates the viability of wind technology for electricity generation and facilitates its utilization throughout the world.

1.3 Site and Facility Description

NREL facilities occupy four separate locations in Jefferson County, Colorado, near the city of Denver, and one within the boundaries of the City and County of Denver. The four facilities in Jefferson County include the Denver West Office Park (DWOP), the South Table Mountain site (STM), the Joyce Street Facility (JSF), and the NWTC. The Renewable Fuels and Lubricants Research Laboratory (ReFUEL) is located within the city limits of Denver. The DWOP and STM sites are approximately two miles (3.2 km) east of Golden and 12 miles (19.3 km) west of central Denver. The NWTC is located near the intersection of Highways 93 and 128, between Boulder and Golden, and is approximately 15 miles (24.2 km) north of the STM site. The JSF is located at 6800 Joyce Street, about 5.5 miles (8.9 km) north of the DWOP and STM sites. The ReFUEL facility is located with the Regional Transportation District (RTD) District Shops and Operation Center (DSOC) at 1900 31st Street, Denver, about 12 miles east of the STM and DWOP sites. Figure 1.1 illustrates the locations of the STM, DWOP, NWTC, and JSF sites on a regional map. The location of the ReFUEL facility is shown on Figure 1.2. Figure 1.3 provides a more detailed map of the STM site and Figure 1.4 provides detail for the NWTC site.

The STM and NWTC sites are the two main sites where research operations are conducted and will be addressed separately in the discussion of environmental features. The DWOP is leased space used primarily for administrative functions and limited research activities. The JSF is also a leased space that is currently used for storage. The ReFUEL facility is a leased facility that consists of a small shop complex housed within the RTD/DSOC facility. NREL performs engine-testing activities pertaining to fuels and lubricants at the site.

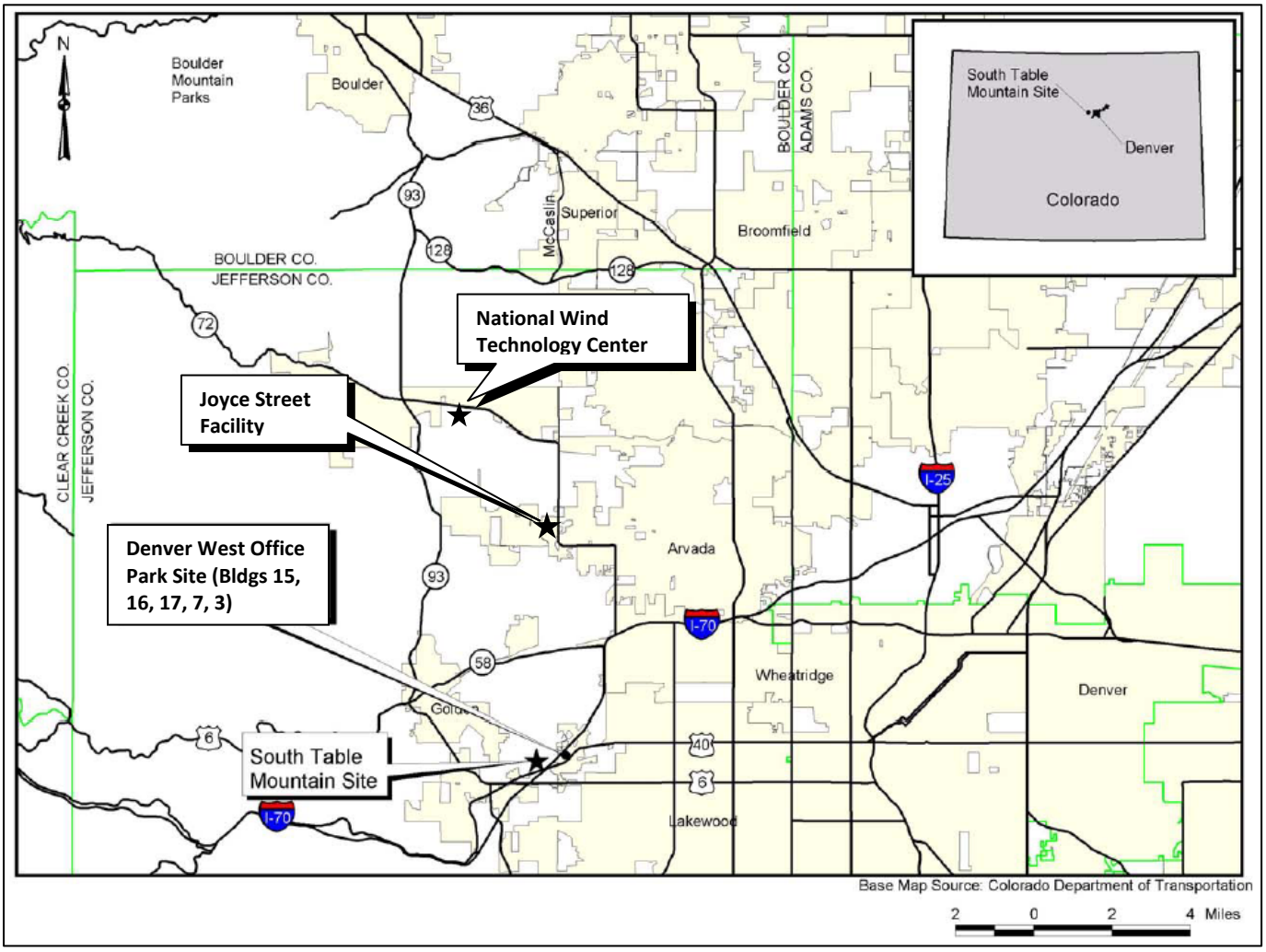

Figure 1.1. Regional map showing NREL locations in Jefferson County, CO

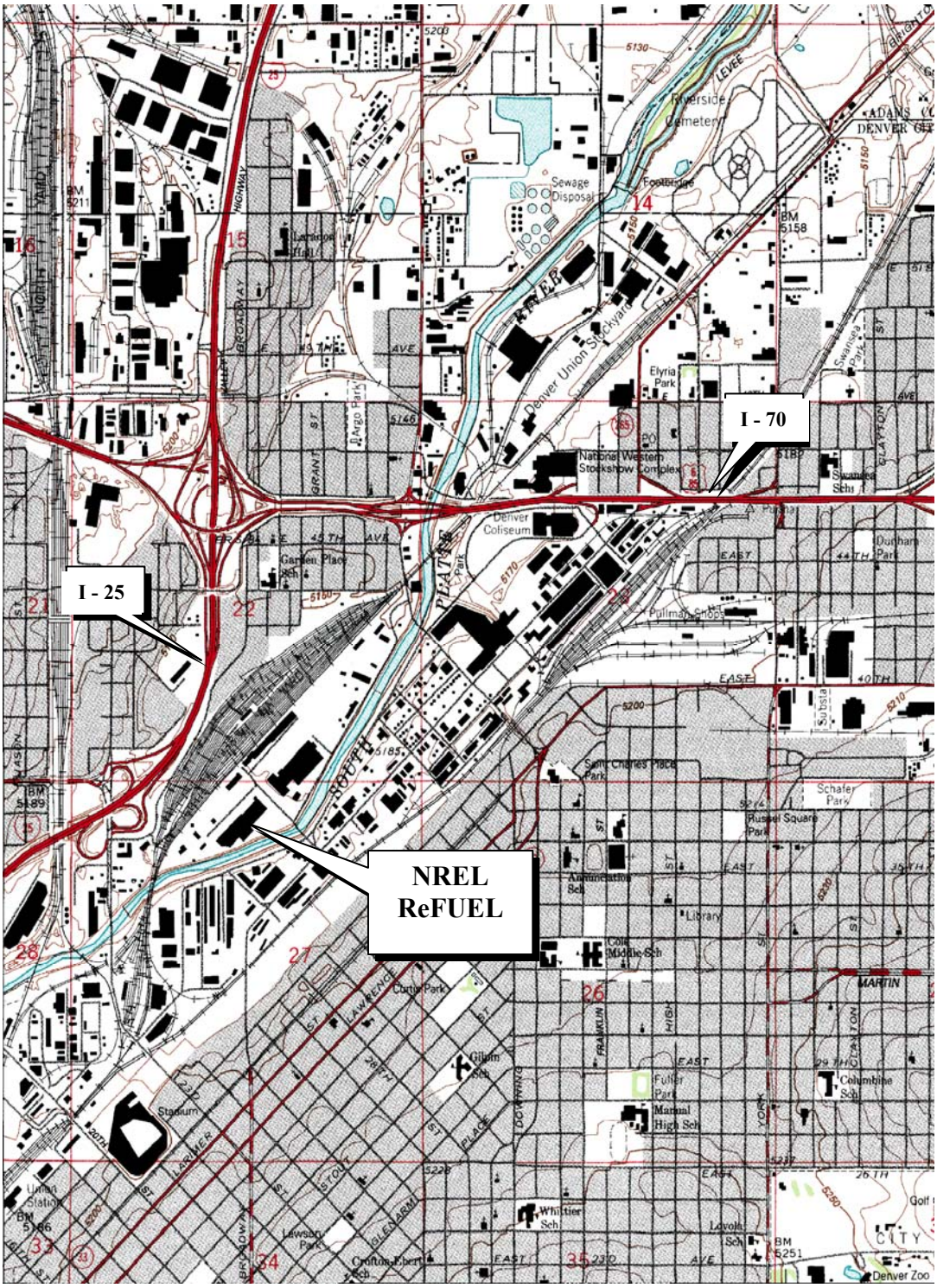

Figure 1.2. ReFUEL facility location map, located in Denver County, CO

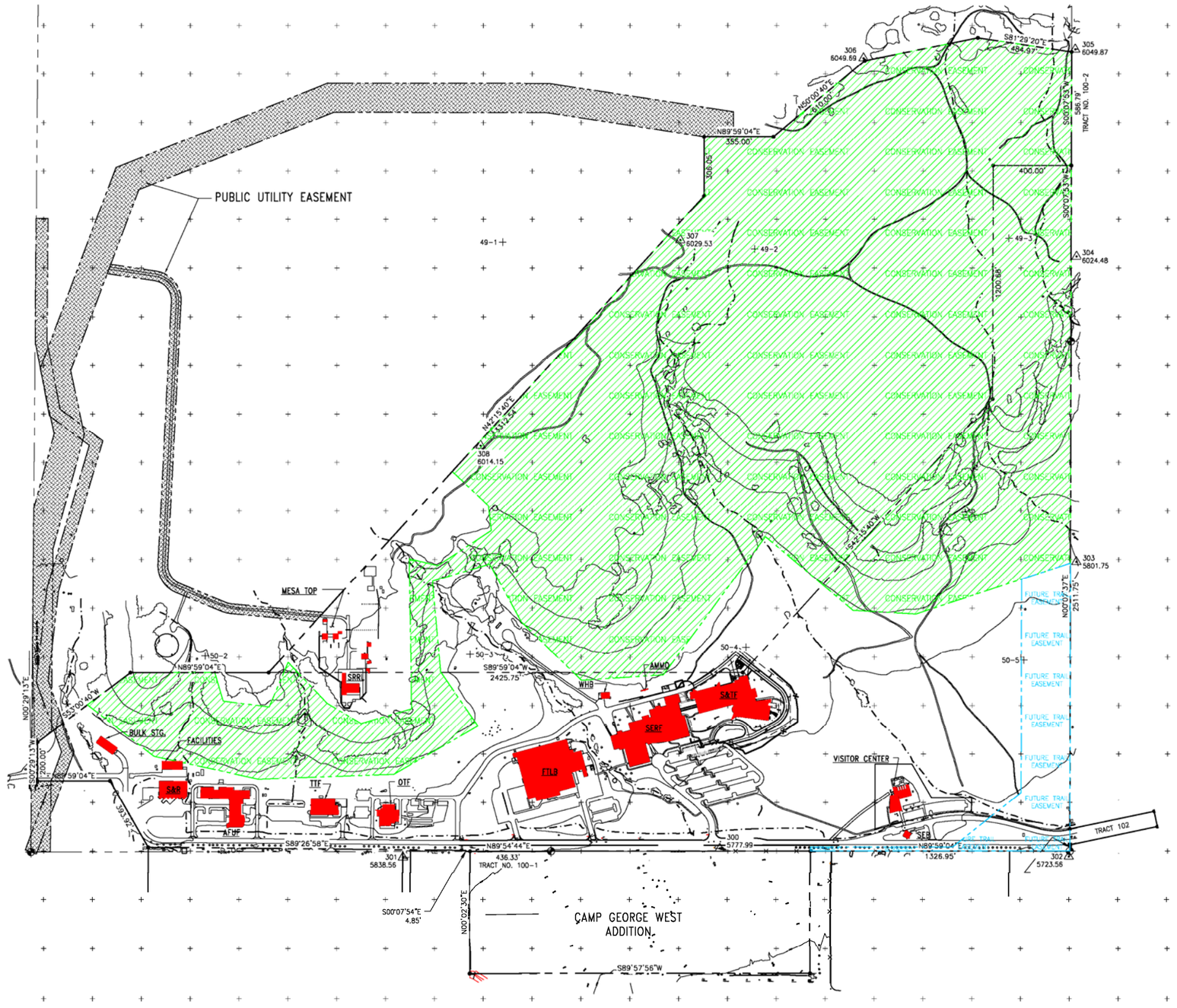

Figure 1.3. STM site detail

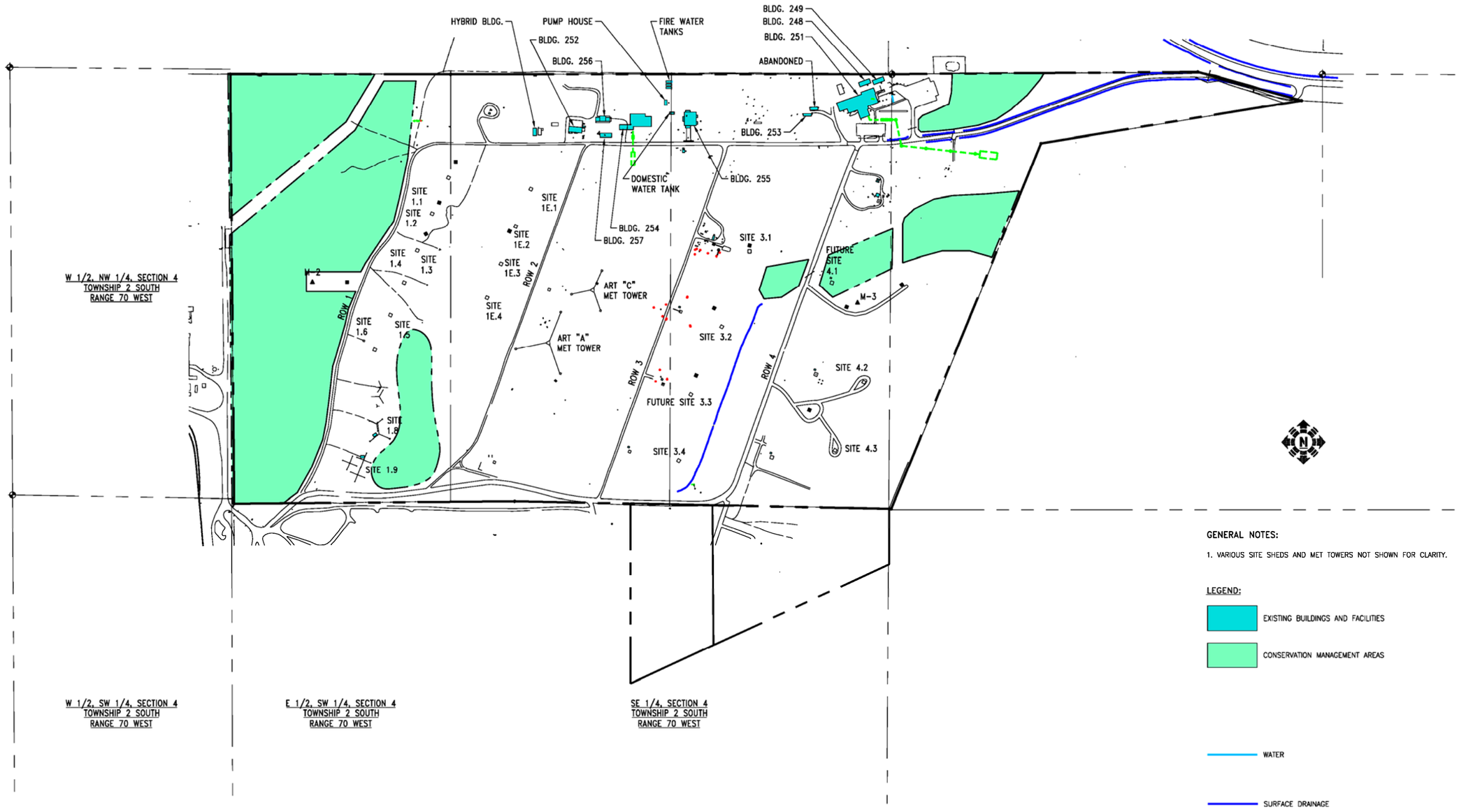

Figure 1.4. NWTC site detail

1.3.1 South Table Mountain Site

1.3.1.1 Geology, Soils, and Hydrogeology

The South Table Mountain (STM) site is a roughly triangular parcel of land occupying portions of the top, sides, and lower south-facing slopes of STM. STM is composed of sedimentary rocks below a basalt lava cap, which is quite resistant to erosion. The STM feature is a mesa that stands about 150 meters above the adjacent lowlands. The mesa was formed as weak sedimentary rocks surrounding the lava were eroded away, leaving the lava-capped mesa in relief. Below the lava caprock, the sedimentary rocks are part of the Denver Formation that consists of layers and lenses of claystone, sandstone, and conglomerate. Sedimentary rocks of the Arapahoe Formation underlie the Denver Formation.

Both the Arapahoe and Denver Formations are considered to be aquifers in portions of the Denver Basin. The Denver Formation underlies the areas on which most NREL construction has taken place. Groundwater on the STM site occurs primarily in the weathered and fractured silts and sands of the Denver Formation. There may also be some groundwater in the form of perched aquifers below the basaltic lava cap on the STM, and within the materials above the Denver Formation, which are largely the result of stream deposits. Groundwater flow on the site is in a southeasterly direction.

The soil covering the top of the STM is lavina loam. Loam is composed of a mixture of clay, sand, silt, and organic matter. The loam on the mesa top is a shallow, well-drained clayey soil. Soil on the upper side slopes of the STM is also a loam consisting of extremely stony soils with significant amounts of clay. Much of the remainder of the site, including the area designated for major development, has a deep, well-drained soil referred to as Denver clay loam. It consists of clayey material containing some calcium carbonate. There are also two smaller soil areas on the southwestern portion of the site, both of similar character to other site soils—cobbly clay loam and very stony clay loam.

1.3.1.2 Surface Water

About 90% of the surface drainage off the site, both from the mesa top and across the lower portions of the site, is in the southerly direction toward Lena Gulch (a tributary of Clear Creek). Surface water from two drainage ways on the easternmost portion of the site ultimately flows into Lena Gulch.

There is no permanent stream flow on the STM site. Only occasional flow derived from extended periods of precipitation, usually during the late winter and early spring, is found in the drainage channels with seasonal springs evident along some of the mesa slopes. There is one seep on the mesa top that is often active throughout much of the year, but the water infiltrates and evaporates quickly during the dry season.

1.3.1.3 Vegetation

Two primary vegetation types are present on the STM site: grasslands and shrublands. The most common plant communities on the STM site are mixed grasslands, composing more than 80% of the vegetation on the site. These communities are generally dominated by short- and mid-grass species. Two primary upland shrub communities occur on the STM site: mountain mahogany shrublands, found on the shallow soils of the mesa, and upland shrublands, occurring in drainages lacking active channels as well as drainages with associated wetlands. Field surveys have identified limited wetland/riparian areas along drainages. The wetland communities

identified on the STM site are a minor component of the total vegetation cover, accounting for less than 1% of the vegetation over an area of less than 0.3 ha (0.75 ac). Riparian shrub communities also occur adjacent to the emergent wetlands.

1.3.1.4 Wildlife

A wildlife survey was conducted on the site during 1986 and 1987, and additional surveys were done in 1999 over the Conservation Easement property. A survey to update the existing data began in 2004 and was completed in 2005 (see Section 5.11 for more detail). Mammals seen using the site during the surveys include mule deer, coyotes, gray foxes, red foxes, raccoons, long tailed weasels, striped skunks, spotted skunks, badgers, bobcats, mountain lions, rabbits, and yellow-bellied marmots. Seventeen species of birds have been observed on the STM site, along with two species of raptors: American kestrels and two nesting pairs of red-tailed hawks. Amphibian species and snakes are known to inhabit the area as well.

1.3.1.5 Land Use

The STM site is a 327-acre area predominantly bordered by open grassland zoned for recreation and light-commercial activity. Portions of the community of Pleasant View are located immediately to the south and west of the western portions of the STM site. Pleasant View has constructed a recreational park immediately south of the STM site. Offices, shops, and a tree nursery owned by the Colorado State Forest Service are located at the far western edge. Undeveloped state land and a Colorado State Highway Patrol pursuit driver-training track are located along the northwestern boundary of the STM site on top of the mesa. Jefferson County open space wraps around the northern and the eastern edge of the site. Portions of the DWOP and apartment homes lie to the east.

More than half of the STM site (177 acres) has been set aside in a conservation easement. No development is allowed on that land, with the exception of some existing utility easements and recreational trails to be established by Jefferson County Open Space. Trail development is planned for implementation in phases by the County, and was begun in 2004 (see Section 6.0 for more detail).

1.3.2 National Wind Technology Center

1.3.2.1 Geology, Soils, and Hydrogeology

The National Wind Technology Center (NWTC) site is located on a plain formed by stream deposits. The uppermost geological layer beneath the site is known as the Rocky Flats Alluvium (RFA). It is composed of cobbles, coarse gravel, sand, and gravelly clay. Below the RFA are the Laramie Formation, Fox Hills Sandstone, and Pierre Shale. These rock formations consist primarily of claystones with some siltstones. Unconfined groundwater flow occurs in the RFA toward the east/southeast, and small perched zones are common. Groundwater occurs as confined aquifers in the deeper bedrock formations (EG&G Rocky Flats, Inc. 1992).

The NWTC has a strongly developed soil defined as a very cobbly, sandy loam. The soil is characterized by a large amount of cobble and gravel in the soil volume, and subsoil dominated by clay (USDA 1995).

1.3.2.2 Surface Water

The area surrounding the NWTC site is drained by five streams: Rock Creek, North Walnut Creek, South Walnut Creek, Woman Creek, and Coal Creek. Rock Creek flows eastward and is

located southeast of the NWTC. North Walnut Creek and South Walnut Creek flow eastward into the Great Western Reservoir. Woman Creek drains eastward into Standley Lake. Coal Creek flows in a northeasterly direction across the City of Boulder open space north of the NWTC.

The majority of the NWTC drains into a tributary to Rock Creek. Some of the northern portions of the site drain into Coal Creek or its tributaries.

1.3.2.3 Vegetation

The NWTC is located in the transition area between the Great Plains and the Rocky Mountains (Plantae Consulting Services 2000). This location results in a flora that contains elements from both mountain and prairie ecosystems, and associations that represent residual tall grass prairie, short-grass plains, ponderosa pine woodland, and foothill ravine flora (Plantae Consulting Services 2000).

A vegetation study conducted between August 1999 and August 2000 identified 271 vascular plant species and defined five major habitat types on the NWTC site, including: seasonal wetlands/or ephemeral hydric soils, woodlands, shrublands, mixed grasslands, and disturbed areas.

Along the Northwestern ridge is a Ponderosa Pine woodland area. Vegetation found in this area includes woody species with an understory of grasses, forbs, and shrubs.

1.3.2.4 Wildlife

Prior to 1975, livestock heavily grazed the NWTC site, damaging a majority of the native vegetation. A wildlife survey was conducted in 1992 for the entire Rocky Flats Plant and buffer zone area, including the NWTC site. Signs or tracks of bears and mountain lions were identified. Other mammals known to feed at the site are mule deer, coyotes, desert cottontail rabbits, white-tailed jackrabbits, black-tailed jackrabbits, deer mice, prairie voles, and thirteen-lined ground squirrels. Approximately 20 different species of birds were sighted at or near the site. Raptor (birds of prey) surveys were conducted at the NWTC in 1994 and 1995, and identified seven raptor species on or in the vicinity of the site. An avian survey was also conducted in 2001 to 2002 (see Section 5.11). Although seldom seen, rattlesnakes, bull snakes, racers, and several other reptilian and amphibian species are known to occupy the area.

1.3.2.5 Land Use

The NWTC facility occupies a 305-acre area surrounded largely by open space and grazing land. The former Rocky Flats Environmental Technology Site land borders the NWTC to the southeast, and a sand and gravel mining and processing operation is located along the southern and western boundaries of the site. A blasting company also has a small installation along the western site boundary.

1.3.3 Denver West Office Park

The Denver West Office Park (DWOP) is a relatively flat, landscaped office complex occupied by a number of four-story buildings, parking lots, and common areas. NREL-leased facilities at the DWOP are located approximately in the geographic center of the development, with the exception of one NREL-leased facility just north of West Colfax. The DWOP is bordered on the south by commercial areas (West Colfax strip), on the west by the Pleasant View residential area, Camp George West facility, and the STM site. DWOP is within the City of Lakewood.

1.3.4 Joyce Street Facility

The Joyce Street Facility (JSF) is located in a commercial area surrounded by agricultural land, residential neighborhoods, and small businesses. It is currently used by NREL primarily as warehouse space only. Support activities and limited dry lab research activities are currently conducted at the facility, and there are no staff offices at JSF.

1.3.5 Renewable Fuels and Lubricants Research Laboratory

The Renewable Fuels and Lubricants Research Laboratory (ReFUEL) facility is used for research, testing, and support activities related to advanced fuels, engines, and vehicles to objectively evaluate performance, emissions, and energy efficiency impacts. The laboratory will also be used to evaluate and develop heavy hybrid electric vehicles.

The ReFUEL is a small shop complex housed within the RTD/DSOC facility. The RTD/DSOC facility occupies approximately 22 acres of land and serves as the primary maintenance facility for RTD's bus and light rail train systems. The area around the RTD/DSOC facility consists of commercial and light industrial development.

The site lies on relatively flat terrain with a slight gradient to the northwest. The general area is highly developed with concentrated industrial and commercial activities. Very little natural vegetated habitat exists onsite or in the immediate vicinity. There are trees and shrubs lining the South Platte River adjacent to the site's south, east, and northeast borders.

1.4 Site Environmental Conditions/Features

Photos for each site documenting the site features and development are included at the end of this section. Figures 1.5, 1.6, 1.7, and 1.8 show the STM and DWOP sites, and Figures 1.9 and 1.10 provide images of the NWTC site. The views on the STM site also illustrate the conservation easement property and the Camp George West property acquired in 1999.

1.4.1 Climate

The climate for the geographic region of NREL operations is classified as semi-arid, typified by limited precipitation, low relative humidity, abundant sunshine, and large daily and seasonal temperature variations.

The area experiences moderate precipitation, with an average annual rainfall of less than 50 cm (20 inches). Almost half of the annual precipitation occurs from March to June. Summer showers contribute 33% of the annual precipitation total. Precipitation begins to decrease significantly in the fall, and reaches the minimum during winter. Winter is the driest season, contributing less than 10% of the annual precipitation, primarily in the form of snowfall.

Spring is a season of unstable air masses with strong winds along the foothills and the Front Range. The highest average snowfall occurs in March, and the STM site can generally expect to experience at least one heavy snowstorm with totals exceeding 15 to 25 cm (6 to 10 inches).

The solar radiation (sunlight energy) of the region is excellent for outdoor research and testing of solar energy conversion devices and systems. Sunshine is abundant throughout the year and remarkably consistent from month to month, season to season.

Figure 1.5. STM site – west end of the site

Figure 1.6. STM site – east view

Figure 1.7. STM site – NW and mesa top view

Figure 1.8. STM site – Denver West Office Park

Figure 1.9. NWTC site – northwest view

Figure 1.10. NWTC site – NW view with research facilities

2. Compliance Summary

2.1 Laws and Regulations

2.1.1 Air Quality Protection

The Colorado Department of Public Health and Environment (CDPHE) administers the Clean Air Act implementing regulations for all point sources (facilities or other types of operations) in Colorado, under authority delegated by the U.S. Environmental Protection Agency (EPA). NREL is not a major source for air pollutants, but does hold two site-wide permits for particulate air emissions from construction, one air emissions permit for a pilot scale research project, and one air permit for the construction and operation of a woodwaste-fired heating plant. Detailed information about NREL's air quality protection program is provided in Section 5.1.

National Emissions Standards for Hazardous Air Pollutants (NESHAP) requirements specific to radiological emissions from DOE facilities are regulated by the EPA. Details are provided in Section 5.15.

During 2007, NREL had no air quality compliance issues.

2.1.2 Drinking Water Quality Protection

Drinking water quality is regulated for all public water suppliers in Colorado by the CDPHE, under authority delegated by the EPA. NREL purchases water that is delivered by truck to the NWTC, and holds a public water supply identification number to provide that water to NWTC site occupants. NREL has been conducting increased monitoring since the fourth quarter of 2006 for disinfection byproducts. Detailed information about compliance efforts is provided in Section 5.2.

In 2007, NREL had no drinking water compliance issues.

2.1.3 Groundwater Quality Protection

Colorado groundwater quality standards are established by the CDPHE. Permits for groundwater wells are issued by the state engineer's office. NREL has no known groundwater contamination and has obtained drilling permits for all of its monitoring wells. Detailed information about NREL's groundwater program is provided in Section 5.3.

In 2007, NREL had no groundwater compliance issues.

2.1.4 Wastewater

Wastewater from the majority of the STM Site and the Denver West Office Park flows into the Pleasant View Water and Sanitation District's (Pleasant View) system, and from there flows to the treatment plant at the Metropolitan Wastewater Reclamation District (Metro). The federal Clean Water Act and Colorado Water Quality Control Act regulations are administered at NREL's STM and DWOP via Pleasant View and Metro pretreatment program requirements. NREL's wastewater discharge policy is in conformance with Metro's discharge requirements. Wastewater at the NWTC site flows into two individual sewage disposal systems (septic and leach fields). These are regulated by CDPHE; inspection and permit issuance have been delegated by CDPHE to the Jefferson County Department of Health and Environment. There is also one individual sewage disposal system at the Solar Radiation Research Laboratory on the

mesa top at the STM Site. As is the case with NWTC septic systems, the mesa top system regulations are administered by Jefferson County. Additional detail about NREL's wastewater discharge program can be found in Section 5.4.

In 2007, NREL had no wastewater compliance issues.

2.1.5 Surface Water Quality Protection

The authority for implementing stormwater discharge regulations at federal sites in Colorado rests with the EPA. NREL falls under the EPA Construction General Permit (CGP) program for the STM and NWTC sites for stormwater discharge from construction activities. Permit coverage for individual NREL activities is obtained when permit thresholds are triggered based on factors such as acreage involved, slope, and soil characteristics.

At the STM, a Notice of Intent (NOI) was filed with the EPA in 2005 for the construction of a new research facility. This project was managed under the EPA's Construction General Permit program. Sufficient vegetative coverage was achieved in mid-2008 and a Notice of Termination for the permit was filed with the EPA.

At the NWTC, one small construction project was undertaken in 2007 that required a CGP. Sufficient vegetative coverage was achieved in mid-2008 and a Notice of Termination for the permit was filed with the EPA. Details of NREL's surface water protection program are provided in Section 5.5.

In 2007, NREL had no surface water compliance issues.

2.1.6 Waste Management

The Resource Conservation and Recovery Act (RCRA) established federal authority over hazardous waste. In Colorado, CDPHE administers hazardous waste regulations under authority delegated by the EPA. NREL holds five EPA generator identification numbers for each of its sites. NREL's waste management program is outlined in Section 5.6. Pollution prevention efforts at NREL are described in Section 5.9.

A hazardous waste management inspection was conducted by the EPA in September 2007 for the STM and DWOP facilities. EPA issued a warning letter for hazardous waste management deficiencies at the STM. The final report and follow-up actions are discussed in Section 5.6.

2.1.7 Storage Tanks

NREL has no underground storage tanks containing hazardous materials. Aboveground storage tanks (ASTs) that are larger than 660 gallons are regulated in Colorado by the Colorado Department of Labor and Employment's Oil Inspection Section. NREL has two tanks larger than 660 gallons on the STM site that are registered with the Colorado Department of Labor and Employment. Details about NREL's aboveground storage tank program are provided in Section 5.7.

No spills or releases from NREL's ASTs occurred during 2007.

2.1.8 Threatened and Endangered Species/Species of Concern

Wildlife is protected by a number of federal laws, including (but not limited to) the Endangered Species Act, the Migratory Bird Treaty Act, and the Golden and Bald Eagle Protection Act. The Endangered Species Act also protects threatened and endangered plant species. State laws also designate and protect rare or unique plants and animals. No threatened or endangered species or species of concern have been documented on NREL's sites. Details of NREL's wildlife and vegetation surveys are provided in Sections 5.10 and 5.11.

In 2007, NREL had no compliance issues regarding wildlife.

2.1.9 EPCRA Compliance and Prevention of Toxic Releases

Executive Order (EO) 13423 and DOE Order 450.1A outlines requirements for Superfund Amendments and Reauthorization Act (SARA) Title III, Emergency Reporting and Community Right-to-Know Act (EPCRA) compliance and Toxic Release Inventory reductions for DOE facilities. NREL maintains hazardous materials permits with West Metro Fire Rescue (West Metro) and provides chemical inventory information to West Metro for the STM site and Building 16 in the DWOP.

In 2007, NREL facilities had no releases exceeding the reportable quantity (RQ) of any material reportable under EPCRA. NREL did have quantities of three chemicals on site that exceeded the EPCRA threshold planning quantity for each chemical, so MSDS and Tier II reports were filed with the state and local emergency planning organizations and with the jurisdictional fire department.

As a research and development laboratory, NREL does not manufacture or process any materials on the SARA Section 313 list in excess of the 4,526-kg (10,000-lb) threshold planning quantity. And during 2007, the laboratory did not otherwise use any materials on the SARA Section 313 list in quantities exceeding the 4,526-kg (10,000-lb) threshold planning quantity. NREL's compliance with EPCRA requirements is detailed in Section 5.8.

NREL maintains an Emergency Management Policy (8-4) and supporting lab-level programs for credible on- site emergencies. Hazardous material releases are specifically identified as a credible emergency, and response procedures are in place. These procedures are routinely practiced by internal response groups and with external emergency response agencies.

2.1.10 Cultural Resources Protection

Various laws, including but not limited to, the National Historic Preservation Act and the Native American Graves Protection and Repatriation Act, protect cultural resources. NREL has two sites listed on the National Register of Historic Places (National Register) on its STM Site. There are no known eligible sites at the NWTC (see Section 5.14).

In 2007, NREL had no compliance issues regarding cultural resources.

2.2 DOE Order 450.1, Environmental Protection Program

DOE Order 450.1 required sites to implement Environmental Management Systems (EMS) by integrating them with the site's Integrated Safety Management System. Sites were required to have an EMS in place by December 31, 2005. The revised Order 450.1A requires that EMSs now be structured according to International Organization for Standardization (ISO) 14001

requirements by June 2009. NREL's implementation of its EMS is described in Section 4.0 of this report.

2.3 Executive Orders

2.3.1 Executive Order 13423, Strengthening Federal Environmental, Energy, and Transportation Management

On January 24, 2007, the President signed EO 13423. This Order requires all Federal agencies and departments to "conduct their environmental, transportation, and energy-related activities under the law in support of their respective missions in an environmentally, economically and fiscally sound, integrated, continuously improving, efficient, and sustainable manner" (72 FR 3919). DOE's senior management, with NREL's participation, has been working on a Transformational Energy Action Management (TEAM) Initiative to create and implement a plan intended to expedite meeting the EO requirements. NREL's progress in meeting this EO is located in Section 4.2.

2.3.2 Executive Order 11988, Floodplains Management

EO 11988 was implemented in support of the National Environmental Policy Act (NEPA), the National Flood Insurance Act of 1968, and the Flood Disaster Protection Act of 1973 to minimize the adverse impacts associated with development and modification of floodplains.

According to maps generated by the Jefferson County Department of Highways and Transportation as part of its urban drainage studies, NREL's STM site does not contain any floodplains, and no floodplains have been identified at the NWTC. As a Best Management Practice (BMP), however, all construction activities that may cross a drainage channel are designed to meet the 100-year flood control standards (designed to withstand the equivalent of a 100-year flood).

Actions with the potential for environmental impact that are undertaken by NREL at subcontractor facilities are assessed for potential impacts on floodplains and wetlands at those sites through the use of an environmental checklist.

2.3.3 Executive Order 11990, Wetlands Protection

Under EO 11990, each federal agency must provide leadership and take action to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands.

Limited wetland areas totaling less than 0.3 hectares (0.75 acres) occur on the STM site. These are narrow, linear wetlands supporting spikerush, baltic rush, sedges, bluegrass, hemlock, and field mint. Wetland areas at the NWTC are extremely limited in extent as well. These areas, along the site's eastern boundary, total less than 0.4 hectares (1 acre).

In 2007, NREL had no compliance issues regarding environment-related EOs.

2.4 Permit Summary

A table is provided in Appendix A that summarizes NREL's permits, registrations, and notifications.

3. Environmental Occurrences

Incidents with potential environmental implications during 2007 at the STM, NWTC, DWOP, and ReFUEL include the following:

3.1 Diesel Fuel Spill

On June 11, 2007, at the conclusion of fueling activities for a diesel emergency generator, the delivery truck operator improperly stored a delivery hose that subsequently discharged approximately five to 10 gallons of diesel fuel onto a paved parking area. A small amount of diesel fuel flowed off the pavement onto surrounding soil staining approximately 4 sq. ft. of soil to a depth of two inches. The fuel on the pavement was absorbed with spill control materials and the stained soil was removed. All materials were collected for offsite disposal at a properly permitted facility.

3.2 Hydraulic Fluid Spill

On December 23, 2007, a liquid nitrogen delivery truck was preparing to offload liquid nitrogen into one of NREL's storage tanks. Prior to beginning the material transfer process, a hydraulic line for the transfer pump ruptured releasing approximately three gallons of hydraulic fluid. The fluid was absorbed with spill control materials and collected for offsite disposal at a properly permitted facility.

4. Environmental Management System

4.1 Description

Environmental protection is a priority at NREL, as indicated by NREL's environmental policy:

NREL ENVIRONMENTAL POLICY STATEMENT

NREL exemplifies sustainability by maximizing efficient use of resources, minimizing waste and pollution, and serving as a positive force in economic, environmental, and community responsibility. To this end, NREL is committed to:

Economic Viability. Managing laboratory fiscal resources efficiently to meet applicable regulations and effectively accomplishing the Laboratory's mission, taking sustainability into consideration.

Environmental Stewardship. NREL is committed to sound environmental management that serves as an example to others and supports the laboratory's mission to protect natural resources through research, development, and deployment of renewable energy and energy efficiency technologies. To this end, NREL is committed to:

- **Pollution Prevention. . . .** Incorporating pollution prevention practices in research and support activities.
- **Continuous Improvement. . . .** Continuously improving the effectiveness of NREL's environmental management system (EMS).
- **Campus. . . .** Managing the impact on the environment caused by the placement and general design of NREL structures; maintaining, protecting, and restoring natural and landscaped environments to sustain natural and native ecological systems, both on and adjacent to NREL campuses.
- **Water. . . .** Reducing water consumption and managing water discharges from the site.
- **Electricity/Natural Gas. . . .** Reducing energy use in building designs and operations, within available funds; using cost effective renewable energy sources for remaining energy needs; and purchasing power generated by renewable energy sources.
- **Transportation. . . .** Reducing the impact of local NREL travel on the environment; reducing the use of fossil-based gasoline/diesel fuel for NREL onsite and local operations through the use of alternative fuel vehicles or hybrids; and increasing the use of video and teleconferencing to reduce the environmental impacts of air travel.
- **Materials. . . .** Reducing the use of materials and the creation of waste by reducing, reusing, and recycling materials needed for laboratory operations; increasing the purchase and use of environmentally sensitive products and products with recycled content.
- **Environmental Management. . . .** Providing an environment that promotes efficiency, effectiveness, and sustainability, and encourages the creativity and personal motivation required for excellence in scientific, engineering, technology development, and support functions.
- **Education/Communication. . . .** Informing and providing outreach to workers about sustainability activities, including a method for interaction and feedback; educating workers about participating and contributing to sustainable activities. . . ; informing workers and the public about NREL's environmental performance, including a method for interaction and feedback.
- **Compliance with Requirements. . . .** Complying with applicable federal, state, and other environmental requirements and exceeding those requirements, when feasible, by implementing environmental best management practices.

Public Responsibility. Working with local stakeholders to identify and implement collaborative projects to improve sustainability of the local community; educating others about sustainability through a variety of outreach mechanisms.

4.1.1 NREL's EMS and ISM System

NREL's Environmental Management System (EMS) implements NREL's environmental policy, and is a framework of policies and procedures that are integrated with NREL's normal management processes, combined with the environmentally sound daily work practices of the

Environmental Safety, Health, and Quality (ESH&Q) Office staff and personnel throughout the laboratory. Environmental protection must involve everyone at the lab in order for it to be effective. All activities conducted at NREL must comply with federal and state laws and regulations, and DOE requirements.

As a DOE-owned facility, NREL is required by DOE Order 450.1A to implement its EMS as part of an Integrated Safety Management (ISM) System. NREL's EMS incorporates the requirements of the International Standards for EMSs described by ISO 14001. It also meets the criteria of EO 13423, *Strenthening Federal Environmental, Energy, and Transportation Management*.

The Environmental Protection Policy (6-2) and 19 supporting laboratory-level environmental programs and procedures that define the NREL EMS have been coordinated and linked with the ISM Policy (2-1), the ESH&Q Policy (6-1), the supporting ESH&Q Policies (6-3 through 6-6), the Sustainable NREL Policy (2-7), and approximately 40 supporting lab-level safety and health programs and procedures. The EMS is further integrated with ISM via task specific procedures that flow down from the policies and programs, such as Safe Operating Procedures (SOP).

4.1.2 Notable 2007 Activities

In 2007, NREL continued progressing toward Colorado Environmental Leadership Program (ELP) environmental performance commitments. The Colorado ELP is a Colorado Department of Public Health and Environment (CDPHE) voluntary partnership between CDPHE and participating private and public Colorado facilities that recognizes environmental leadership and performance. In early 2004, NREL was accepted into the Colorado ELP. As a component of this program, NREL sets voluntary performance goals in an effort to further enhance environmental performance at the laboratory. NREL was the first laboratory to be accepted into Colorado ELP, and continued participation as a Gold-level Leader through 2007.

In August 2007, NREL voluntarily invited a third-party assessor to evaluate the EMS as a mentoring activity in association with other Colorado ELP gold leaders. The assessment was to serve as a gap analysis between the existing NREL EMS and the revised ISO 14001 – 2004 standard. While no final report was provided for the external assessment, verbal comments and a list of written observations were shared with NREL. NREL's plan for continuous improvements to the EMS was informed by the external evaluation, but was primarily developed from outcomes reviewed in the *Internal Quality Assurance Assessment Report*. This report was completed in August 2007, following an extensive internal assessment by NREL's Quality Assurance team. Implementation of the resulting plan for EMS continuous improvement was ongoing throughout FY2008.

4.1.3 Public Outreach

NREL hosted several public meetings to report on and discuss environmental performance and other issues. In 2007, the public was invited to the "Smart Energy Living" series of workshops at the NREL Visitors Center before and after the Denver Tour of Solar and Green Built Homes. More than 325 people attended and were given information on renewable energy and energy efficient technologies for their homes. NREL and DOE-GO also hosted a community meeting in late 2007, inviting community members to learn about NREL's 2008 outlook and current STM site development plans.

A series of "Power Lunches" open to the public are held monthly at the Visitors Center. In 2007, topics included advanced vehicle technologies, biofuels, solar technologies, energy efficient buildings, and climate modeling. In all, 14,125 people passed through NREL's Visitors Center.

In addition, the lab's public Web site, www.nrel.gov, features a "Sustainable NREL" link where the public can find copies of NREL's Sustainability Reports and an ESH&Q page for Annual Environmental Performance Reports.

Visits to NREL by elected officials are common. In past years, the laboratory hosted visits by President George W. Bush, congressional staffers, mayors, and many other local government leaders. Official visits in FY2007 included the Ambassador of Bahrain, the Ambassador to Azerbaijan, a member of the German Parliament, Minority Staff Director for the Senate Environment and Public Works Committee, White House Fellows, U.S. Senator Tom Harkin (D-IA) and Senator Ken Salazar (D-CO), among others.

Comments from NREL's stakeholders are encouraged. They are sometimes received through the outreach opportunities above, and may also be received via e-mail or telephone. Comments received relating to environmental stewardship, are incorporated into the EMS process, relayed to appropriate staff, and addressed as necessary.

4.2 Performance Indicators and Progress

4.2.1 2007 Environmental Objectives and Progress Toward Goals

Each fiscal year, in collaboration with DOE-GO, NREL develops environmental performance objectives for the upcoming year as part of the lab's One-Year Plan. The objectives to meet the goal of further enhancing Environmental Safety, Health, and Quality (ESH&Q) as a core value of the laboratory for fiscal year 2007 were to demonstrate:

- Effective leadership and prevention
- Effective response.

NREL has successfully completed the One-Year Plan targets set to meet the two objectives listed above. Some noteworthy achievements in FY2007 include:

- NREL completed a comprehensive evaluation of its Integrated Safety Management System (ISMS), including self-assessments and an independent review.
- NREL updated the Chemical Inventory System and completed the interface with other NREL business systems. This provides effective management of all chemicals at NREL and support emergency response capabilities with real-time chemical information.
- NREL enhanced its ability to respond to chemical spills by conducting two training exercises with combined participation of the West Metro Fire Rescue (West Metro) and NREL's emergency response team.
- NREL completed the Environmental Assessment (EA) process for the proposed Mesa Top PV, the Renewable Fuel Heating Plant (RFHP), and SolarTac projects on the STM.
- Regulatory compliance was evaluated through assessments and regulatory audits/inspections, such as:
    - U.S. EPA's hazardous waste audits of the STM and Denver West Office Park facilities in September 2007.

- NREL's EMS received a review of conformance and system effectiveness by NREL's Quality Assurance staff performed according to the ISO 14001 protocol.

More information on 2007 assessments is provided below in Section 4.3. Environmental programs, such as chemical management, waste management, and pollution prevention, are described in more detail in Section 5.

4.2.2 Colorado ELP Commitments (2007 – 2009)

The following multi-year commitments support the laboratory-wide ESH&Q objectives for both 2007 and the upcoming objectives for 2008.

4.2.2.1 Campus Planning

- NREL plans to truly "walk the talk" on our own campus and has made a tremendous start by achieving Leadership in Energy and Environmental Design (LEED) Platinum designation at the Science and Technology Facility (S&TF) in March 2007. NREL plans to strive for LEED Gold for all future building design and construction. For planning purposes, NREL developed a Grand Buildout Plan, including design of an approximately 220,000 gross square foot (gsf) Research Support Facilities (RSF). NREL's STM buildout plan calls for growing from 400,000 gsf to 1,100,000 gsf and from 450 occupants to 2,700 occupants.
- NREL expects to exceed the 3% FY2007 greenhouse gas (GHG) reduction required by the new federal EO 13423, Strengthening Federal Environmental, Energy and Transportation Management. This will be completed through the deployment of energy efficient and renewable energy technologies on-site at NREL and through the purchase of renewable energy certificates (RECs).
- NREL will apply for acceptance into the Federal Electronics Challenge (FEC), and anticipates completion of 19 projects in order to apply for the 2007 FEC Silver-level Award given jointly by the Office of the Federal Environmental Executive and the U.S. EPA.

Please see Section 5.9 for NREL's progress in areas of sustainable building design, GHG emissions, and application to the FEC.

As an indicator of NREL's environmental performance, Sustainable NREL and EMS staff supported NREL efforts to receive the following awards in FY2007:

- S&TF recognized as the first LEED platinum federal building – April 4, 2007 (only 28 other buildings in the world have achieved the LEED platinum designation);
- Chairman's Awards for NREL personnel for outstanding contributions as Labs21 team members (Note: Labs21 was awarded a Presidential Awards for Federal Energy Management);
- Continued recognition as a Colorado Environmental Leadership Program Gold-level Leader in Environmental Management (sponsored by CDPHE); and
- Continued recognition as a Climate Leader (sponsored by the EPA).

4.2.3 2008 Objectives

The environmental objectives developed by NREL in collaboration with DOE-GO are to meet the goal of advancing ESH&Q as a core value to protect the safety and health of NREL workers

and the community and to strengthen environmental quality. For FY2008, these environmental objectives are:

- Implementation of integrated safety, health and environmental management into laboratory operations/management systems;
- Effective response to laboratory challenges; and
- Response to ESH&Q issues.

Progress toward the 2008 objectives will be reported in the NREL 2008 Environmental Performance Report.

4.3 Assessment and Improvement

Periodic assessment and management review of NREL's EMS and its components provide verification that the EMS continues to be an effective tool to achieve and maintain compliance with regulatory and legal requirements, meet the established environmental goals of the laboratory, and maintain management support for NREL's environmental goals. Assessments and management reviews also provide for continuous improvement of the EMS.

There are three different types of assessments performed to evaluate the functionality of the EMS at NREL: EMS assessments, periodic compliance assessments, and third-party assessments.

A team of NREL staff generally performs assessments of NREL's EMS internally on a periodic basis. The scope of the assessments includes both the management of significant environmental aspects (areas where NREL activities have the potential for environmental effect, either positive or negative) and policy implementation. The team evaluates the EMS based on an appropriate set of criteria, such as ISO 14000 standards, Colorado Environmental Leadership Program standards, or other applicable environmental management standards.

Periodic compliance assessments are conducted of individual environmental programs to verify that the program, as written, meets all applicable legislative and regulatory requirements and that the program is implemented as intended (see Section 5.0 for examples). Improvements are developed and implemented as necessary, based on the results of each assessment.

In addition to compliance assessments of individual NREL environmental programs, NREL has management system review processes in place for regular reviews and updates of the set of policies, lab-level programs, and task specific procedures, including EMS policies and programs. NREL reviews its ESH&Q policies and laboratory-level procedures as needed, but at least every five years, making revisions as necessary. All SOPs are reviewed on an annual basis and are revised as necessary to help ensure the required controls are appropriate for the hazards present. Environmental hazards and controls are specifically called out in each SOP.

Periodically, external third-party assessments may be conducted by technical experts for specific components of NREL's environmental programs or for the EMS as a whole. These assessments are conducted on an as-needed basis.

4.3.1 2007 Assessment Activities

In August 2007, NREL's Quality Assurance team performed an independent assessment of the EMS that included a gap analysis with the ISO 14001:2004 standard (as compared with the 1996 standard on which NREL's EMS was based). Several recommendations for improvement were

identified as were gaps to be closed in order for NREL's EMS to meet the 2004 ISO standards. NREL has chosen to establish its EMS according to the ISO 14001 standard, although that was not required at DOE facilities until the DOE O 450.1A was issued in 2008. Improvements were implemented throughout 2008.

NREL's QA team performed a follow-up assessment of the EMS in August 2008. Additional recommendations for improvement were made. NREL plans to have gaps closed and improvements implemented so that the laboratory will meet the DOE O 450.1A requirements to have an ISO 14001:2004 compliant system by June 2009.

NREL plans to continue annual independent assessments of the EMS conducted by the NREL Quality Assurance assessment team to monitor performance of the system.

4.4 Sustainability and the Environmental Management System

NREL's mission has always focused on a sustainable energy future for our nation and the world. Sustainability is defined as meeting the needs of the present without compromising the ability of future generations to meet their needs, and involves the simultaneous and balanced pursuit of economic viability, environmental stewardship, and public responsibility.

The Sustainable NREL program was created to realize the vision of greater sustainability in NREL operations. It is an interdisciplinary initiative involving staff from numerous NREL centers and offices with the goals of maximizing efficient use of resources; minimizing waste and pollution; and serving as a positive force in economic, environmental, and public responsibility. Elements of the environmental stewardship component of Sustainable NREL include:

- Renewable energy solutions
- Sustainable green buildings, campus planning, and transportation
- Water, electricity, and natural gas use reduction
- Greenhouse gas emission reductions
- Reduce, reuse, recycle, and rebuy materials use
- Public responsibility / community outreach
- Environmental management.

Sustainable NREL carries out NREL's commitments to, among other things, reducing energy use in its building operations, designing energy efficient and environmentally sensitive new buildings, reducing water consumption, decreasing greenhouse gas emissions, minimizing the impact of local NREL travel on the environment, using less fossil-based fuel for local operations, incorporating renewable energy technologies into its on-site STM and NWTC operations, and creating less waste by reducing, reusing, and recycling materials for laboratory operations.

The EMS supports Sustainable NREL's goals by focusing on protecting the natural and cultural resources on and around NREL sites by:

- Reviewing NREL's potential for environmental impacts through emissions, discharges, waste generation, and land use.
- Conducting required permitting activities.
- Managing site natural resources so as to protect and preserve them in their natural character to the extent possible, while still fulfilling NREL's mission.

- Managing site cultural resources so as to document resources of significance and minimize disturbance whenever possible.
- Recommending and coordinating measures to minimize any potential impacts NREL's activities have on the environment.

There is synergy between Sustainable NREL and environmental protection activities of the ESH&Q Office as both address components of NREL's environmental footprint. Together, Sustainable NREL and the EMS form a single environmental program that is integrated with NREL's other management processes.

More detail is provided in this report about the following sustainability-related efforts at NREL:

- Pollution Prevention activities are discussed in Section 5.9.
- Sustainable landscaping is described in Section 5.10, Vegetation Management.

5. Environmental Programs

The overarching objective of NREL's EMS and its component programs is responsible stewardship of the environment on its DOE-owned sites, leased properties, and to the extent practicable, on subcontractor and partner sites. NREL strives to protect the natural environment by minimizing or eliminating any adverse environmental impacts resulting from NREL activities. The laboratory's EMS is integrated with other NREL management systems and applies to all research and operations activities. The EMS includes written environmental protection policy and program implementation documents. These are put into practice at all staff and management levels.

NREL's EMS includes components to address waste, air, water, site, natural and cultural resources, and land and soil issues, among others. Descriptions of the components of the EMS are provided in the following sections of this chapter; sections are organized by resource. Each section is composed of three areas of discussion: a summary of the environmental management of the resource, a discussion of any relevant permitting, and a summary of significant activities that have occurred throughout FY2007.

A summary of NREL's permits, registrations, and notifications are presented in Appendix A. These permits are discussed in the following relevant sections.

5.1 Air Quality Protection

5.1.1 Program Management

Management in this area is consistent with the following NREL programs: Environmental Permitting and Notification (6-2.1), Air Quality Protection (6-2.5), Ozone-Depleting Substances Management (6-2.6), and Particulate Emissions Control for Construction (6-2.14).

5.1.1.1 Criteria, Hazardous, and Non-Criteria Pollutants

The Clean Air Act and state of Colorado laws and regulations delineate several main categories for air pollutants:

- Criteria air pollutants (e.g., carbon monoxide, nitrogen oxides, sulfur dioxide, particulate matter, ozone, and lead)
- Non-criteria pollutants (e.g., ammonia, hydrogen sulfide, pesticides, organic compounds, metallic compounds, and corrosives)
- Hazardous air pollutants (e.g., includes organic compounds, metals, corrosives, asbestos, radionuclides, and pesticides)
- Ozone depleting substances (e.g., chlorofluorocarbons or "freons").

There are notification and permitting thresholds for criteria, hazardous, and non-criteria pollutants. The primary potential sources of these pollutants at NREL include boilers, emergency generators, experimental laboratory hoods, pilot scale research projects, and small pieces of equipment with gasoline or diesel engines. NREL maintains air emission inventories to track potential air emissions and identify whether notification and permitting could be required for a particular facility or activity. Fugitive particulate emissions from construction activities occurring on NREL's sites are also a potential source.

5.1.1.2 Ozone Depleting Substances

Facilities that service refrigeration equipment containing ozone-depleting substances (ODS) are required to file an annual notification with the CDPHE. EPA-certified technicians must service this equipment, and NREL has certified technicians on staff that perform this type of service.

Another requirement of the State's Chlorofluoro Carbon program is that all refrigeration equipment larger than 100 hp that uses ODSs be registered with CDPHE. NREL has a total of three chillers that are registered with CDPHE; two located at the Solar Energy Research Facility (SERF) on the STM Site, and one at the DWOP.

Halon-based fire suppression systems previously used at NREL were eliminated by 1999, with all supplies of Halon being transferred to other DOE facilities for "banking."

5.1.1.3 Street Sanding

CDPHE regulations require federal, state, and local government facilities to track street sanding in the wintertime, and to make efforts to minimize sand use. NREL complies with this requirement and files an annual sanding report with CDPHE. From October 2006 to May 2007, NREL used 20 tons of sand during 12 sanding episodes. NREL maintains 12.3 lane-miles of roads. From October 2007 to May 2008, NREL used 25 tons of sand during 22 sanding episodes, while continuing to maintain 12.3 lane-miles of road.

5.1.2 Permitting

Most potential sources of air emissions from NREL laboratory and facility operations in 2007 were small scale and did not require permitting. Permitting thresholds are generally 50, 500, 1,000, or 2,000 pounds, depending on the pollutant. Projected emissions for these sources were either below thresholds for air permitting or the state reviewed the operation and determined emissions to be negligible in terms of impacts to the environment.

Two site-wide permits for particulate emissions from construction activities have been issued to NREL by CDPHE. NREL has held such permits for a number of years. New site-wide permits were issued in February 2005 to replace previously held permits on which the time period of applicability had expired. One permit covers the STM site and the other covers the NWTC.

NREL also holds one air emissions permit for an experimental pilot process in the Field Test Laboratory Building (FTLB) on the STM Site. The permit was issued in 2000 for the operation of a thermal oxidizer emission control device for the experimental Thermochemical Process Demonstration Unit (TCPDU). An Air Pollution Emission Notice (APEN) update was filed with the Colorado Air Pollution Control Division in 2005.

5.1.3 2007 Activities

Two APENs were filed in early 2005, one for the STM and one for the NWTC, for overlot grading and associated construction activities to address fugitive particulate emissions. These APENs will expire in 2010. Significant activities not associated with routine maintenance or small construction projects identified in the APEN submission were evaluated on a case-by-case basis in 2007. It was not necessary to submit an updated APEN.

As required by CDPHE every five years, an APEN update was filed in May 2005 to update the information provided in the original APEN for TCPDU activities. There have been no significant changes to the operating parameters or air emissions of the TCPDU in the last seven years, including 2007.

In early 2007, NREL received initial approval from CDPHE's Air Pollution Control Division for the construction and operation of a woodwaste-fired boiler to provide building comfort heating for the STM campus. Construction was completed in the fall of 2008, and the equipment will become operational in late 2008.

5.2 Drinking Water

5.2.1 Program Management

Management in this area is consistent with the following NREL Programs: Drinking Water (6-2.3) and Environmental Permitting and Notification (6-2.1).

Drinking water is provided to NREL's STM and DWOP sites by a public water supply, Consolidated Mutual Water Company. Water to the Joyce Street and ReFUEL Facilities is also provided by a public water supply. NREL supplies drinking water to its NWTC by trucking in water from local public water supplies through a subcontracted water hauler. NREL stores the water on site in a buried 15,000-gallon storage tank and an above ground 2,000-gallon tank. The water hauler fills the 15,000-gallon tank, and water is pumped on demand to the 2,000-gallon tank where it is distributed to the Industrial User Facility (IUF), Building 251, and the hydrogen test pad on the west end of the site.

Disinfection boosting is performed at the NWTC using a chlorine disinfection system.

Monitoring for bacteria (total coliforms), chlorine levels, haloacetic acids and trihalomethanes (disinfection by-products), and lead and copper is performed at the NWTC according to the requirements of CDPHE. NREL qualifies for reduced lead and copper monitoring. Current state requirements for NWTC system monitoring are as follows:

- Bacteria – monthly
- Chlorine levels – weekly, or more frequently as needed
- Haloacetic acids (HAA5) – quarterly
- Total Trihalomethanes (TTHM) – quarterly
- Lead and copper – triennially

Samples are collected from three locations at the NWTC: Building 251, the IUF, and the hydrogen test pad. No coliforms were detected in any of the samples taken during 2007. Monthly reporting is provided to the state for the bacterial analyses.

Monitoring for lead and copper was completed as scheduled during the summer of 2002. All samples collected were well below the action levels. Sampling according to NREL's reduced monitoring plan with CDPHE was not to be required again until the summer of 2005; however, the state requested NREL collect lead and copper samples in 2004 and 2005. All lead and copper

levels were below action levels. No monitoring for lead and copper was required by CDPHE in 2007.

Chlorine residual monitoring of the NWTC drinking water system began with the installation of the chlorine disinfection system in 2000. Monitoring is performed to ensure the chlorine residual levels are detectable, with a target concentration of at least 0.2 mg/L of chlorine present to provide sufficient disinfection at the monitoring locations. Colorado requires that chlorine residual monitoring occur when collecting monthly bacterial samples. NREL monitors chlorine residual levels in the system on a weekly basis and also measures chlorine levels of drinking water that is delivered to the NWTC. Results are provided to the state on a monthly basis. Chlorine was present at appropriate levels in all samples collected in 2007. The running annual average of the maximum residual disinfectant level for CY2007 was 0.536 ppm.

If any treatment is performed on supplied drinking water, state regulation requires that a state-licensed operator supervise the treatment. NREL hires a subcontracted operator with a Class A license to supervise the disinfection and filtration operations and to perform the necessary sampling.

5.2.2 Permitting/Notifications

NREL has a registered Public Water Supply Identification Number (PWSID) issued by CDPHE for the drinking water it provides at the NWTC. This identification number does not require periodic renewal, but periodic testing and record keeping is required in connection with the PWSID. No identification is needed for NREL's STM, DWOP, JSF, or ReFUEL sites, as water is piped from a municipal supplier and NREL does not alter or treat the water in any way.

5.2.3 2007 Activities

In 2007, 211,570 gallons of potable water were delivered to the NWTC, an average daily consumption rate of 589 gallons per day. NREL conducted all required monitoring for 2007 and all reported results met drinking water standards. Bacteria were absent in all samples collected, and disinfectant was detected at all locations tested. The annual running average for chlorine residual was 0.536 ppm.

Plans to install an automated disinfection system, begun in 2006, were completed in 2007. This system is intended to overcome problems of excess chlorine added to the system at week's end in order to maintain residual levels over the weekends. Reducing residual chlorine levels will also reduce the potential for producing disinfectant byproducts, TTHMs, and HAA5s. Installation of the controller and probe was completed in 2007 and the system was brought on-line.

As reported last year, CDPHE notified NREL that the maximum contaminant level for total TTHMs had been exceeded in the annual sample collected in August 2006. As a result, quarterly monitoring for disinfection byproducts (DBP) was implemented in 2006 and continued throughout 2007. While only the maximum containment level for TTHMs was exceeded, state regulations require monitoring for HAA5s as well as TTHMs. The running annual average (RAA) for TTHMs in 2007 was 0.068 mg/L, below the maximum contaminant level of 0.080 mg/L and in compliance with the water quality requirement. The RAA for HAA5s was 0.034 mg/L, below the maximum contaminant level of 0.060 mg/L, also in compliance with the water

quality requirement. In order to return to an annual monitoring program for DBPs, the state regulations require that the RAA be below 0.060 mg/L and 0.045 mg/L for TTHMs and HAA5s, respectively. In 2007, water at NWTC was in compliance with all Colorado water quality requirements, but did not meet the threshold to drop back to annual disinfection byproduct monitoring, so the quarterly monitoring program will continue.

CDPHE's Water Quality Control Division conducted a formal Sanitary Survey of the NWTC drinking water system in 2008. The system was found to be in compliance with requirements. Three recommendations for improvement were identified during the survey. Details of this review will be provided in the 2008 report.

5.3 Groundwater Protection

5.3.1 Program Management

Management in this area is consistent with NREL's Groundwater Protection Program (6-2.4).

Because of the sensitive nature of the groundwater resource, NREL is careful to evaluate all outdoor projects to attempt to eliminate their potential to impact groundwater quality. If there are any materials used that could pose a potential ground water risk, the laboratory typically insists that safeguards to protect groundwater be established. Safeguards include, but are not limited to, secondary containment for equipment that could have the potential to leak oil, double wall tanks with leak detection for diesel fuel storage for NREL facilities' emergency generators, and bermed areas to contain experimental materials.

In 1990 groundwater characterization began on the STM site with the installation of a monitoring well network. Eight wells were installed at the base of the mesa slope. Four wells were installed upgradient of NREL development in order to provide an indicator that contaminants were not being transported onto the NREL site, and four wells were placed in a generally downgradient direction to verify that NREL activities had not adversely affected groundwater quality. Quarterly sampling was performed for five calendar quarters, followed by annual sampling for three years. There was no evidence of contamination found. In addition, routine follow-up sampling was done in 1997. Three of the initial eight wells were closed (in accordance with state requirements) due to construction activities in 1993, and a fourth was found to be inaccessible during the 1997 sampling, presumably also due to construction activity in the area. Therefore, follow-up samples were only collected from four of the original monitoring wells: three upgradient wells and one downgradient of NREL development. No evidence of contamination was found in the 1997 sampling.

NREL has not conducted groundwater monitoring at its leased DWOP site as there have been no activities that pose an unusual risk to groundwater quality. If NREL had reason to suspect a groundwater quality problem, the issue would be addressed with Denver West Management. DWOP management contracted with an engineering firm to conduct a groundwater monitoring study in 1988 adjacent to the NREL-leased buildings. Two monitoring wells were drilled. There were no detections of significant levels of contaminants.

The NWTC currently has no open or active groundwater wells. There was a water supply well that provided water to Building 251 when DOE's Rocky Flats Office operated the site. In 1993, NREL collected one round of water samples from this well and the associated water distribution and treatment system for the purpose of determining the most feasible alternative for water supply to the site. Based on the sampling results, it was determined that the maintenance and repairs required to make the existing well and treatment system effective were extensive, and there was an indication of the potential for trace organic compounds in the water. Therefore, when DOE's Golden Field Office assumed landlord responsibility for the site in 1993, the connection between the building and the well was severed. The water supply well was plugged and abandoned in accordance with state regulations by an NREL subcontractor in 1996. Potable water is currently transported to the site, as described in section 5.2. NREL has not done any other groundwater sampling at the site. Groundwater sampling will be conducted if future activities pose a risk to the groundwater quality.

There has been no groundwater study performed by NREL at the JSF, as NREL has not conducted any activities at the site that pose an unusual risk to ground water. All activities at the site are conducted inside the facility with the exception of routine deliveries and pick-up of inventory stored in the warehouse. No groundwater studies have been performed by NREL in proximity to the ReFUEL facility, as it is located in a heavily industrialized area and NREL has not had any releases to the environment that would pose a risk to groundwater.

There is currently no ongoing routine groundwater monitoring program on any NREL site because, with one exception, there have been no activities identified that currently or historically pose a significant risk to ground water. The one occurrence that had the potential to impact ground water was a diesel leak to the environment in June 1998 from a failed check valve on the PDU emergency generator aboveground storage tank at the Alternative Fuels User Facility (AFUF). The majority of contaminated soil was excavated and removed from the site for disposal at a permitted landfill. Three ground water monitoring wells were installed at the site in September 1998, one upgradient and two downgradient. No hydrocarbon contamination was detected in the ground water during the initial sampling of the three wells, or during follow-up sampling conducted in March and September 1999, and March 2000. These three monitoring wells were closed in 2006 in accordance with Colorado requirements.

5.3.2 Permitting

All groundwater monitoring wells installed by NREL at the STM site have been permitted with the Colorado Department of Natural Resources.

5.3.3 2007 Activities

In 2007, there were no new groundwater-related activities.

5.4 Wastewater Discharge

5.4.1 Program Management

Management in this area is consistent with NREL's Waste Management and Minimization Program (6-2.8).

The majority of wastewater from NREL's STM and DWOP facilities flows into the Pleasant View Water and Sanitation District's system, and ultimately to Metropolitan Wastewater Reclamation District's (Metro) treatment plant. There is a small septic system consisting of a tank and absorption field on the mesa top, serving the Solar Radiation Research Laboratory (SRRL), because there is no sewer line to the mesa top. Wastewater from the JSF and the ReFUEL facility also flows to Metro's treatment plant. The NWTC is not connected to a sewer system, but has two septic systems that include tanks and absorption fields for the treatment of wastewater.

It is NREL policy that hazardous chemicals are not to be discharged to the sewer system, and NREL staff is trained in this policy. In addition, NREL sites have design criteria for waste drains in lab areas to minimize the possibility of a hazardous material discharge. These criteria include measures such as secondary containment for any chemicals used near sinks in laboratory exhaust hoods, no floor drains in laboratory areas unless a specific need can be shown, and caps for any floor drains that are installed in lab areas. New research and operations activities as well as ongoing activities that undergo significant modifications are reviewed for their potential effect on wastewater character through NREL's risk assessment process.

5.4.2 Permitting

No permitting for the majority of NREL's wastewater discharges is required. NREL has no direct wastewater discharges to the environment at the DWOP, ReFUEL, or JSF, so no National Pollutant Discharge Elimination System (NPDES) permitting is necessary. NREL maintains three individual sewage disposal systems, two at the NWTC and one at the STM site. The remainder of NREL facility wastewater is discharged to Metro through the sanitary sewer system. NREL facilities are currently classified by Metro as non-industrial water users at these sites. As non-industrial users, NREL sites do not need a permit from Metro for sewer discharge, and monitoring for pollutants in wastewater is not required.

NREL maintains septic permits from Jefferson County (an authority delegated to the counties under a state of Colorado program) for the NWTC's IUF and Bldg. 251 septic systems, as well as for the SRRL facility on the STM site mesa top.

5.4.3 2007 Activities

In 2007, there were no new wastewater discharge activities.

5.5 Surface Water Protection (Stormwater and Erosion Control)

5.5.1 Program Management

Management in this area is consistent with the following NREL Programs: Stormwater Pollution Prevention for Construction Activities at the STM (6-2.15), Stormwater Pollution Prevention for Construction Activities at the NWTC (6-2.16), and Environmental Permitting and Notification (6-2.1).

Limited stormwater monitoring was conducted at the STM site during the summers of 1992 and 1993 to characterize surface water quality at NREL's existing level of activity at that time, and to confirm that NREL's activities were not adversely impacting stormwater quality on the STM site.

Sampling indicated that NREL's activities are not resulting in contamination of stormwater runoff.

No stormwater monitoring has been conducted at NREL's other sites. In 1998, surface water samples were taken in two drainages at the NWTC in connection with NREL's weed control efforts. No traces of the herbicide applied to weed-infested areas were detected in the water samples.

Outdoor research projects are reviewed during the planning stages, through NREL's NEPA and risk assessment processes, for potential impacts to surface water. Measures to prevent impacts are incorporated, as appropriate, into the design for each project. Such control measures could include secondary containment and bermed areas where chemicals will be used, or installation of a cover or roof to protect chemical use and storage areas from precipitation and adverse weather conditions.

Stormwater Pollution Prevention Plans (SPPP) have been written for construction activities on both the STM and NWTC (6-2.15 and 6-2.16, respectively). Erosion and sediment controls are implemented according to the plans, and periodic site inspections are conducted to verify that the controls are functioning properly and to identify any repairs to the erosion and sediment controls that are needed. Written reports are issued for each inspection, with corrective actions assigned to responsible staff when necessary. The SPPPs also require prompt revegetation of disturbed areas. Provisions of the SPPPs are implemented through coordination with NREL's construction subcontractors.

5.5.2 Permitting

NPDES notification for stormwater discharges on federal facilities in Colorado is under the jurisdiction of the EPA. In 2007, NREL was covered under the EPA's general permit for stormwater discharge associated with construction activities on the STM S&TF project. Both MRI, as operator, and DOE, as site owner, have filed NOIs for appropriate construction activities on the STM site. This permit was terminated in 2008 after sufficient vegetation coverage was achieved.

In May 2007, a small Quonset-type metal building was constructed at the NWTC for wind turbine blade preparation activities. Both MRI, as operator, and DOE, as site owner, have filed NOIs for this construction on the NWTC site. This permit was terminated in 2008 after sufficient vegetation coverage was achieved.

No permits are required for NREL's routine operations.

5.5.3 2007 Activities

NREL implemented numerous stormwater protection and erosion control practices, according to the SPPPs, throughout 2007 for small projects that did not require a NPDES construction general permit. Examples include, but are not limited to, practices at the RFHP construction site and PV shade structure at the Outdoor Test Facility (OTF), and other small projects disturbing soil.

5.6 Waste Management

5.6.1 Program Management

Management in this area is consistent with the following NREL Programs: Waste Management and Minimization (6-2.8) and Environmental Permitting and Notification (6-2.1).

Hazardous wastes are handled and disposed of according to the RCRA and the Colorado Hazardous Waste Act. NREL's waste primarily consists of a broad range of hazardous laboratory chemicals in small quantities. Wastes in solid or liquid form are collected in each laboratory or at each experiment site and prepared for off-site disposal by the NREL ESH&Q personnel.

Hazardous waste is transported to EPA-permitted facilities for treatment and disposal. In addition, NREL has a conservative waste management policy where materials that are not regulated by RCRA, yet pose a potential hazard, are collected and disposed of as non-hazardous materials at RCRA-permitted disposal facilities.

NREL facilities also generate small quantities of low-level radioactive wastes. This waste normally consists of personal protective equipment, disposable lab ware, scintillation fluids, and water-based liquids. Radioactive waste is shipped off-site for disposal on an as-needed basis.

5.6.2 Permitting

NREL has five separate sites that have the potential to produce limited quantities of hazardous waste in various amounts. Each of the five sites has a RCRA waste generator identification number issued by the state of Colorado. The STM location is classified as a "small quantity generator," generating less than 1,000 kg of waste per month. The other four sites—the Joyce Street Facility, the National Wind Technology Center, the Denver West Office Park and the ReFUEL facility—are classified as "conditionally exempt small quantity generators," generating less than 100 kg of waste per month.

5.6.3 2007 Activities

In CY2007, NREL shipped 27,321 pounds (12,393 kg) of hazardous waste, 11,716 pounds (5,314 kg) of non-RCRA regulated waste, and 12,178 pounds (5,524 kg) of universal waste for disposal and recycling from all five sites combined. Universal waste includes batteries, fluorescent light bulbs, and electronic equipment.

In 2007, no radioactive waste was generated or shipped for off-site disposal. Information regarding the types and quantities of radioactive materials used at NREL facilities is detailed in Section 5.16.

On September 20 and 27, 2007, two representatives from EPA Region 8 conducted RCRA site inspections of NREL's leased facilities in the DWOP and STM facilities. In addition to inspecting waste generation and storage areas, the inspectors also reviewed employee training records and the ESH&Q hazardous waste records. EPA had no findings for the DWOP facilities. The items noted by the EPA inspectors for the STM facilities resulted in the issuance of a warning letter on December 19, 2007.

The warning letter identified five findings and four issues of concern pertaining to container labeling and management, and formal agreements with local emergency response entities. The necessary corrective actions were identified and implemented, and the EPA subsequently closed the matter. Included in the corrective actions was the development of a Hazardous Waste Program Improvement Plan which outlined measures to be taken through the end of FY2008 to fortify hazardous waste management activities at NREL. The improvement plan activities will be discussed in the CY2008 annual report.

5.7 Storage Tanks (Underground and Aboveground)

5.7.1 Program Management

Management in this area is consistent with the following NREL programs: Aboveground Storage Tank Management (6-2.7) and Spill Prevention Control and Countermeasures (6-2.10). NREL does not have any underground tanks with hazardous materials.

NREL facilities store diesel fuel for emergency generators and ethanol from research activities in aboveground storage tanks. NREL's tank management program focuses on proper tank design, operation, and inspection to protect against spills and leaks. The program is designed to meet regulatory requirements and is more stringent in many areas than regulations require.

Several important mechanical and procedural safeguards have been incorporated into NREL's tank management program to prevent any accidental releases of diesel fuel from the storage tanks. Mechanical safeguards include overfill and spill protection as well as double wall tanks with sensors that result in an alarm if the inner tank wall is leaking. Procedural safeguards include written operating procedures and tank filling procedures. All tanks larger than 110 gallons are visually inspected at least once per month.

Due to the quantity of fuels stored on the STM, NWTC, and ReFUEL sites, a Spill Prevention Control and Countermeasures Plan is required. This plan describes the site topography and neighboring areas, and outlines the steps necessary to mitigate any spills or leaks of diesel fuel. To date, NREL has not had any off-site impacts related to tank activities.

5.7.2 Permitting

Aboveground tanks larger than 660 gallons require annual registration with the state of Colorado. Currently, only two tanks meet the registration threshold: the SERF emergency generator diesel storage tank and the Process Demonstration Unit (PDU) ethanol storage tank at the AFUF. Both are located on the STM site.

5.7.3 2007 Activities

An inspection of NREL's regulated ASTs was conducted by the Colorado Department of Labor and Employment's Oil Inspection Section in 2007 and no deficiencies were identified. No spills or releases from NREL's ASTs occurred during 2007.

5.8 Hazardous Materials Management

5.8.1 Program Management

Management in this area is consistent with the following NREL programs: Chemical Safety Program (6-4.6) and Asbestos Management Program (6-4.18)

No active or abandoned hazardous waste sites have been identified on any of the laboratory sites. Therefore, many sections of the Comprehensive Environmental Response, Compensation, and Liability Act do not apply to NREL facilities.

NREL facilities are subject to the emergency reporting requirements in Title III of the SARA, also known as the EPCRA. Section 302 of EPCRA requires a facility to notify the State Emergency Response Commission (SERC) that it is subject to emergency planning and notification requirements if any chemicals in the facility's inventory are stored in quantities greater than prescribed threshold planning quantities (TPQ). NREL facilities first became subject to planning and notification requirements in 1988.

EPCRA Section 304 requires facilities to immediately notify the Local Emergency Planning Committee (LEPC) if there is an accidental spill or release of more than the predetermined RQ.

In accordance with Section 311 and 312 of EPCRA, NREL provides Material Safety Data Sheets (MSDS) for chemicals that are stored on-site in quantities greater than TPQs, and provides inventory reporting for these same chemicals in the form of Tier I or Tier II reports to emergency planning and response groups.

When requested, NREL provides additional emergency response and reporting information to the Jefferson County LEPC, the SERC, West Metro Fire Protection District, and Rocky Mountain Fire Protection District. The Jefferson County LEPC uses hazard categories and threshold reporting quantities as defined by the Uniform Fire Code rather than those specified in SARA Title III, resulting in a larger number of individual hazard categories and lower reporting thresholds. NREL has been represented in the LEPC since its inception and is actively involved in the emergency planning concepts of SARA Title III with two acting members on the Jefferson County LEPC.

The laboratory is also subject to reporting requirements in the event of a release of an RQ of any hazardous substance listed by EPCRA. EPCRA Section 313 requires that a toxic chemical release inventory report (Form R) be filed with the EPA for any chemical that is manufactured, processed, or otherwise used in quantities exceeding TPQs. Although NREL is not a manufacturing facility and does not fall within any of the standard industrial classification (SIC) codes for which Section 313 reporting is required, EO 12856 requires all federal facilities to file a report, if applicable, regardless of SIC code. NREL has never manufactured, processed, or otherwise used chemicals on the 313 list in quantities exceeding TPQs, so has never had to report under Section 313.

Section 112r of the Clean Air Act regulates numerous toxic and flammable substances, and threshold quantities are established under Section 112r of the Clean Air Act. All thresholds are

100, 500, 2500, 5000, 10,000, 15,000, or 20,000 pounds, depending on the material. The threshold quantity applies to the quantity of substance in a single process, not at the facility as a whole. To date, NREL has not met the thresholds that trigger applicability of Section 112r.

NREL has a laboratory-wide chemical management system (CMS) that serves as a centralized chemical inventory as well as a tool for managing and reporting on chemicals used at the laboratory. Using an electronic bar-coding system, the CMS tracks chemicals from the point of receipt through end-use and disposal. The system also contains technical data and reporting information for many of the chemicals in the CMS database. Key functions of the system include:

- Providing current inventories by room, building, and/or site.
- Improving research efficiency and minimizing hazardous waste generation by allowing staff to determine if needed chemicals are already available on site prior to making chemical purchases.
- Providing quick access to chemical inventories and hazard information during emergency responses.
- Facilitating accurate and efficient reporting to external agencies (e.g., fire districts, LEPC, EPA, and DOE).

In 2006, an extensive wall-to-wall chemical inventory was conducted at all NREL facilities. At the same time, the chemical inventory software was upgraded to the current version and the program was mounted on a dedicated server. One of the features of the new software is wider user accessibility through the NREL intranet. Users may now access the database to review their chemical inventory or search for a chemical elsewhere at NREL.

In 2007, ESH&Q personnel provided special training sessions to acquaint laboratory personnel with the new features of the upgraded system and to demonstrate how to access the database and retrieve information most useful to them. The upgraded system also streamlined the reporting functions for existing chemical inventory reporting requirements, such as the 313 lists, and new requests for information, such as a 2007 inquiry from the Department of Homeland Security for information about specific chemicals at federal facilities. The upgraded chemical inventory system was able to meet the new requirements.

Asbestos surveys have been conducted in a number of NREL facilities: the Joyce Street Facility, Building 251 at the NWTC, Building 16, the STM Site, the AFUF (only older areas of the building), the FTLB, and the SRRL. No asbestos was found at the Joyce Street Facility and the AFUF. The other facilities have limited amounts of asbestos-containing material in areas such as floor tile, lab countertops, caulking and sealants, and roofing materials. Asbestos-containing materials are left undisturbed whenever possible. If renovation is planned that will disturb asbestos-containing material, then certified asbestos removal contractors are used and strict asbestos removal procedures are followed. An Asbestos Management Program is in effect for all NREL facilities.

5.8.2 Permitting

NREL obtains annual Hazardous Material Permits from West Metro Fire Protection District for the STM and DWOP sites. The permits are required by West Metro. NREL obtains permits for a

total of six buildings where hazardous materials are stored and/or used. Prior to issuing the permits, a representative from West Metro conducts a walk-through inspection of the entire STM site and DWOP.

5.8.3 2007 Activities

West Metro conducted a walk-through inspection of NREL's STM and DWOP facilities in the summer of 2007. Annual Hazardous Materials Permits for the six buildings were issued following the inspection. The CMS was used to provide complete chemical inventories for each facility to West Metro when applying for Hazardous Materials Permits in 2007. The CMS was also used to post individual laboratory chemical inventories on the ESH&Q website.

In 2007, NREL had three chemicals on site in quantities that exceeded the TPQs: sulfuric acid, hydrofluoric acid, and hydrogen selenide. The proper MSDSs and Tier II forms were submitted to state and local emergency response organizations, and the local fire department. In 2007, NREL facilities had no releases exceeding the RQ of any reportable material under EPCRA. As a research and development laboratory, NREL does not manufacture or process any materials, and during 2007, the laboratory did not use any materials on the Section 313 list in quantities exceeding the 4536 kg (10,000 lb) TPQ.

In December 2006, NREL conducted a risk assessment of select areas of Building 16 in the DWOP to assess the current health risk due to past laboratory work. Two locations were identified as having low levels of residual arsenic dust contamination. These locations had an arsenic concentration above the "allowable surface contamination level for office areas" of 20µg/100cm^2, but below the "allowable surface contamination level for manufacturing areas" of 100µg/100cm^2. In early 2007 NREL initiated a cleanup of the areas. Final sampling and analyses indicated all arsenic concentrations were below the limit of detection for the applicable analytical method.

5.9 Pollution Prevention and Sustainability

5.9.1 Program Management

Management in this area is consistent with the following NREL programs: Environmental Management (6-2), Sustainable NREL (2-7), and NREL's EMS description. A majority of the FY2007 activities discussed in this section were implemented by the Sustainable NREL Program and are grouped in the following categories:

- Waste minimization, recycling, and green purchasing
- Transportation
- Energy
- Renewable energy
- GHG emissions
- Water conservation
- Sustainable building design
- Technical assistance and outreach

5.9.2 Permitting

NREL has no permitting requirements applicable to Pollution Prevention and Sustainability management. NREL, as a DOE Government Owned – Contractor Operated facility, does set objectives to meet goals established by Federal Executive Orders, i.e. EO 13423, and the parallel DOE Orders, i.e. 450.1A and DOE 430.2B

5.9.3 2007 Activities

5.9.3.1 Waste Minimization, Recycling, and Green Purchasing

As a facility that focuses on the research, development, and application of renewable energy and energy efficiency technologies, NREL is committed to responsible environmental stewardship. A significant part of this effort is pollution prevention. NREL's Waste Management and Minimization Program outlines pollution prevention principles that are consistent with the EPA's hierarchy of preventing or reducing pollution at the source; recycling or reusing waste materials that cannot be prevented; and environmentally safe treatment and disposal of waste that cannot be prevented, recycled, or reused. Additionally, rebuying of recycled products is encouraged.

***Material Use Goals*:**

Executive Order 13423 Goal *Ensure that the laboratory reduces the quantity of toxic and hazardous chemicals and materials acquired, used, or disposed of by the laboratory; increase diversion of solid waste as appropriate; and maintain cost effective waste prevention and recycling programs.*

NREL Goal *Near Zero Waste (working to eliminate the laboratory's waste stream).*

Progress *NREL has a Chemical Management System that facilitates reducing the quantity of toxic and hazardous chemicals and materials acquired through sharing chemicals and redistribution of extra chemicals. Since FY 2003, NREL's non-recycled solid waste has decreased and recycled waste increased. NREL has implemented reduce, reuse, re-buy, and recycling activities.*

NREL's current pollution prevention program includes training on waste handling, waste minimization, and methods to eliminate releases to air, soil, or wastewater. In addition, the ESH&Q Office integrates pollution prevention awareness into NREL activities in a number of ways. The proposed use of chemicals in projects are evaluated prior to use during project planning reviews, Safe Operating Procedure reviews, and Readiness Verifications conducted according to NREL's Hazard Identification and Control Program (ESH 6-6.2). During these reviews, NREL staff evaluates opportunities for chemical substitution as well as methods of reducing the volume of chemicals used and waste streams generated.

The use of bankcards for chemical purchases has been another means of reducing the volume of chemicals purchased, stored, and disposed at NREL. Under the bankcard purchasing system, a small group of chemical users are given privileges to order chemicals directly from the vendor using their bankcards. Because bankcard purchasing expedites chemical purchases over conventional purchasing processes at NREL, users order only the chemicals required for use in the immediate future, knowing that additional quantities can be quickly acquired if needed. The ESH&Q Office reviews all chemical purchases made using the bankcards.

Recycling and reuse activities are important components of NREL's pollution prevention program. A crosscutting committee composed of staff from around the laboratory, and led by

Sustainable NREL, provides guidance and assistance regarding NREL's recycling program. As recommended by the EPA's comprehensive recycling guidelines, items currently recycled or reused include the following:

- Aluminum and tin cans
- Batteries
- Books, magazines, and newspaper
- Boxboard and cardboard
- Computer monitors
- Fluorescent bulbs
- Freon from refrigerator units
- Glass
- Laser printer cartridges
- Plastics (1 and 2 only)
- Scrap metal
- Transparencies
- Tyvek envelopes
- White and mixed paper
- Wooden pallets

Numerous central recycling locations are available for most recycling needs throughout NREL facilities. NREL also offers a chemical redistribution program where chemicals in original containers are made available to staff at NREL and other DOE facilities to be reissued for research activities at no cost. The NREL CMS is used for redistributing chemicals to new users. In addition, NREL implemented and maintains an office supply reuse center in DWOP. This center encourages NREL employees to select reusable office supplies prior to purchasing new items.

Since FY2003, NREL's solid waste quantity has decreased and NREL's recycled material quantity has increased. Data for some of the materials recycled by NREL during 2007 follow. Quantities listed are those entered into the DOE Pollution Prevention database, which tracks recycling and solid waste on a fiscal year (October 1 through September 30) basis.

Table 5.1. FY2007 Quantities of Some Recycled Materials at NREL

Recycled Material	Quantity*
Batteries	3,705 lbs
Fluorescent bulbs	710 lbs
Mixed metal	82,080 lbs
Commingled containers, cardboard, office and mixed paper	273,268 lbs
Electronic waste	7,763 lbs

* This list does not include all recycled materials as quantities are not tracked for all recycled materials.

Sustainable NREL coordinated a voluntary employee electronics recycling program in 2007. A local electronic recycling company collected over 4,100 lbs of electronic waste through the participation of 43 NREL employees.

NREL's green purchasing activities include purchasing office supplies through an online catalog featuring environmentally preferable (recycled content) products and specifying recycling and recycled-content specifications in subcontracts. NREL's procurement guidelines encourage staff to purchase green products whenever possible. In 2007, 100% of NREL's supply of uncoated printing and writing paper contained recycled content.

5.9.3.2 Federal Electronics Challenge (FEC)

The FEC is a partnership program that assists federal agencies and facilities to manage electronic products in an environmentally green manner. The FEC is managed by the EPA and the Office

of Federal Environmental Executive, and its goals align with EO 13423, "Strengthening Federal Environmental, Energy, and Transportation Management." This program targets three life cycles of electronic products: 1) acquisition and procurement; 2) operation and maintenance (O&M); and 3) end-of-life management.

In CY2007, NREL formed a team to apply for acceptance into the FEC. The core team consists of staff from Client Service, Sustainable NREL, and ESH&Q. The application submittal package was completed by the team prior to the January 31, 2008 deadline. Simultaneously, NREL applied for a 2007 FEC award based on activities completed to date. The award application was based on successful completion of 23 activities—13 "mandatory" requirements and 10 "optional" requirements for the Silver-level Award. NREL received notification of acceptance into the FEC in May 2008, and was presented with the 2007 FEC Silver-level Award in June 2008. A poster summary of the FEC program and NREL activities completed to receive this award is at: www.nrel.gov/docs/gen/fy08/43297.pdf . This poster was presented by NREL staff at the National Labs IT conference held in Chicago in May 2008. NREL's FEC team currently continues participation in monthly NREL FEC meetings and strives to continuously improve electronics management efforts.

5.9.3.3 Transportation

Petroleum and Alternative Fuel Use Goals

Executive Order 13423 Goal *Reduce fleet total consumption of petroleum products by 2% annually through the end of FY 2015 as compared to the FY 2005 baseline.*

Increase the total fleet fuel consumption that is non-petroleum-based by 10% annually.

Progress *In FY 2007, NREL exceeded the E.O. FY 2015 fleet petroleum use reduction goal of 20% by achieving 28.1 % reduction. In addition, NREL exceeded the goal of increasing the FY 2007 use of non-petroleum-based fuel by 10% by increasing its alternative fuels use by 26%.*

Transportation at the lab falls into three main categories: fleet vehicles, air travel, and employee commuting. NREL's transportation strategy focuses on the lab's fleet and supporting alternative transportation opportunities for employees. Figure 5.1 illustrates a percentage breakdown of transportation by mode.

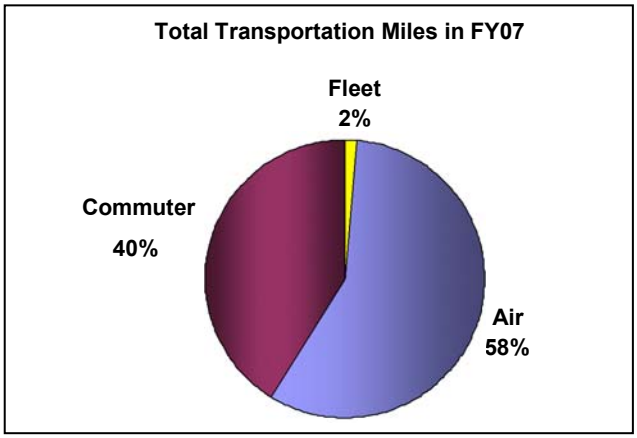

Figure 5.1. NREL transportation by mode in FY07

To describe the impact transportation has on the lab's CO_2 footprint, a calculation was done estimating the amount of CO_2 emitted into the atmosphere. Thirteen percent (13%) of NREL's total 2007 CO_2 footprint was due to transportation. This breakdown examines NREL's transportation impact and provides solutions to reduce transportation emissions.

NREL's fleet of 47 vehicles currently includes 35 alternative fuel vehicles (AFV) in their total fleet of 47 vehicles, representing almost 75% of NREL's total fleet. The use of AFVs decreased NREL's petroleum by 5,581 gallons in FY2007 and corresponds to a 28.1% decrease in petroleum consumption, exceeding the EO 13423 FY2015 goal of 20%.

Additionally, NREL has made a major commitment to the use of bio-based fuels in its fleet since 1997. Fifty-five percent (55%), or 26 vehicles of the 47 fleet vehicles, are fueled by E85 (85% ethanol). The fleet used 12,494 gallons of E85 in FY2007, more than 88% of the total fleet usage of 14,187 gas gallon equivalents of fuel. NREL is also actively exploring biodiesel use.

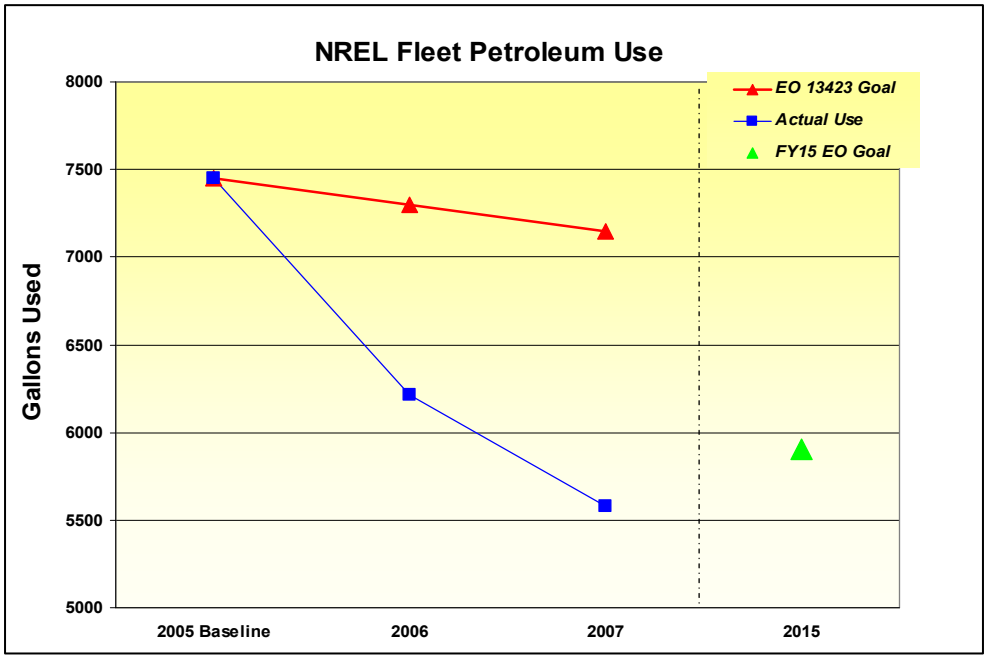

Figure 5.2. NREL fleet petroleum use

Fleet vehicles are only part of the transportation strategy at the laboratory. Sustainable NREL actively encourages alternative commuting for employees. NREL-sponsored programs that support the use of alternative transportation include:

- A free EcoPass for NREL employees in Colorado as part of their benefits package. This allows employees to use the RTD bus system free of charge.
- A shuttle service, which uses alternative fuel vehicles to reduce vehicle miles traveled between buildings in Golden, Colorado, between the STM and DWOP sites.
- An alternative work schedule policy, which allows employees to work varying schedules (with management approval), including four-day workweeks.

Biking and walking are also viable commuting options for some NREL employees. NREL has

showering facilities and locker rooms on-site. External biking programs, such as Colorado's Bike to Work Day, are also promoted. This year, 84 NREL employees registered in the event traveling more than 1,092 miles by bike and alternative methods, earning NREL the Business Challenge Winner – Class D award for Jefferson County.

Air travel is also a concern for NREL, representing 58% of the total miles traveled in FY2007. The laboratory has two offices: one in Golden, Colorado, and the one in Washington, D.C. Employees were able to decrease air travel back and forth from these two offices by utilizing video conferencing equipment. During FY2007, the use of video conferencing eliminated the need for 121 domestic air flights, totaling 336,300 air miles.

5.9.3.4 Energy

Energy Use Reduction Goal

Executive Order 13423 Goal *Beginning in FY 2006 improve energy efficiency through reduction of energy use intensity by 3% annually through the end of FY 2015 or 30% by the end of FY 2015 as compared to the baseline energy use in FY 2003.*

DOE TEAM Goal *To exceed the EO 13423 Goal.*

Progress *FY 2007 energy use was 90% lower than the FY 2003 baseline due primarily to the interim utilization of renewable energy certificates (RECs). This significantly exceeds the FY 2007 and FY 2015 reduction goals. NREL will exceed the FY 2015 goal in FY 2008 through the use of on-site renewable energy projects (exclusive of the use of RECs).*

The major sources of energy use at NREL are building operation (particularly the laboratory-type buildings) and process loads associated with laboratory testing facilities. All major laboratory buildings are metered for electric and natural gas use.

NREL manages its energy-use reduction activities through a comprehensive energy management plan. The primary activities include energy efficiency retrofits; sustainable, energy-efficient, new-building construction; use of on-site renewable energy; extensive use of site metering; energy-management control systems; peak demand management; and energy education.

All buildings constructed since 1990 have been designed to be highly energy efficient. As a result, the lab's primary energy use reduction opportunities are focused on designing and constructing energy efficient new buildings and maximizing the use of on-site renewable energy projects. The 71,000 sq. ft. S&TF, which went into initial operation in late FY2006, is a certified LEED platinum building featuring an aggressive energy efficiency design. This is also the first federal laboratory building to receive the LEED platinum rating.

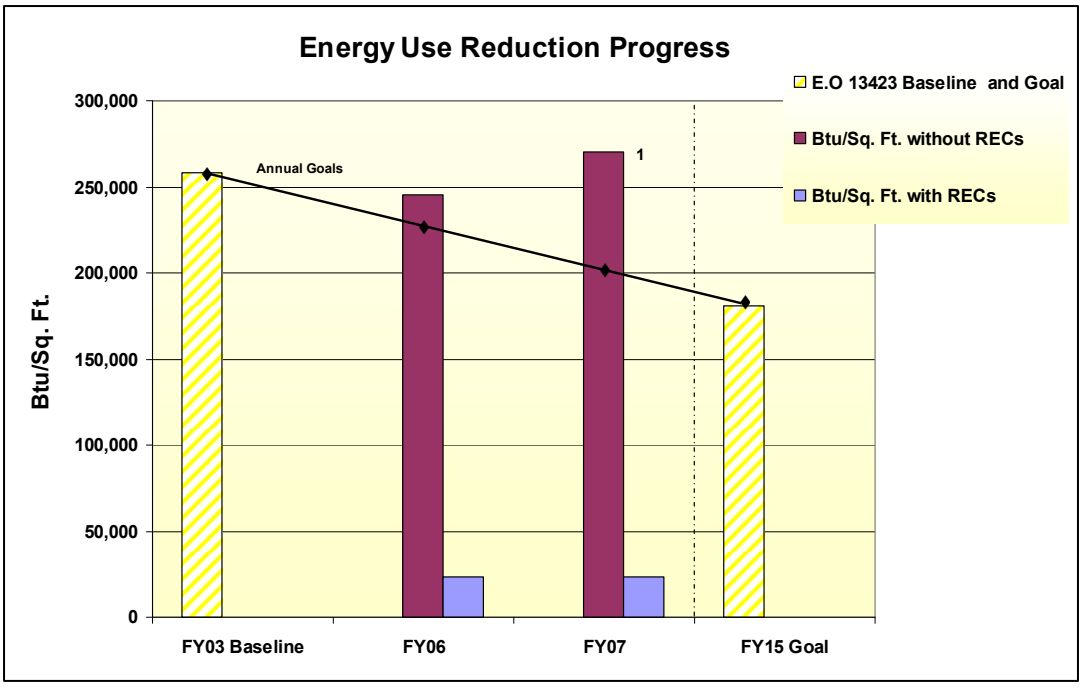

Figure 5.3. Energy use reduction progress

Comparing total NREL energy consumption in FY2007 to the FY2003 baseline, the energy consumption per gross square foot is 5% higher. This increase is attributable to: 1) the exceptionally cold 2006-2007 winter, and 2) the S&TF coming on line in late FY2006 at partial occupancy which resulted in artificially lowering the FY2006 energy use. In FY2007, the S&TF became fully operational and the energy data was for a full year. The total NREL energy consumption with RECs is 90% lower than the FY2003 baseline. Although NREL meets and far exceeds the DOE 430.2B goals in the interim with the purchases of RECs, NREL's long-term plan is to meet or exceed the energy reduction goal by first maximizing the use of on-site renewable energy, second, implementing highly energy efficient new construction buildings, and third, continuing to systematically implement energy retrofits.

5.9.3.4.1 Energy Efficiency Specifications for Renovations/New Construction

NREL has always emphasized significantly greater levels of energy efficiency in its DOE-owned facilities than the federal standards require. Energy efficiency criteria have been incorporated into the established NREL design standards and specifications for all construction projects. All new buildings must meet, at a minimum, LEED Green Building Rating System™ Gold criteria. In addition, all new laboratory buildings are designed according to the principles of the Laboratories for the 21st Century Program. See Section 5.9.3.8 for more information on NREL's sustainable building design.

5.9.3.4.2 Energy Retrofits

In August of 2007, NREL participated in a retro-commissioning study for the STM site with an energy consultant. The retro-commissioning study was financed through a cost-sharing effort between NREL and Xcel Energy. Xcel Energy is the local gas and electric utility company, which has a retro-commissioning program that helps finance the retro-commissioning investigation and report. The scope of the report was to provide the following:

- An Action Plan Report for improving and optimizing NREL's building O&M;
- Recommendations for capital improvements; and
- Project cost estimates and estimated energy savings for each retro-commissioning measure (RCM).

The study produced five RCMs with a total estimated project cost of $100,000; total estimated electrical energy savings of 908.2 MWh; and 10,269 Million BTUs of natural gas energy savings, resulting in an approximate 11% reduction of FY2007 energy consumption. The five RCMs have been added to NREL's energy efficiency project list and will be proposed for either a General Plant Project or minor construction funding.

5.9.3.5 Renewable Energy

Two new on-site renewable energy projects were approved in FY2007 for FY2008 operation. A renewable fuel (wood wastes) combustion boiler will displace approximately 75% of the laboratory's natural gas use and a 750 kW PV system will displace approximately 7% of the laboratory's electricity use.

NREL's goal is to exceed the federal requirement and to maximize its use of renewable energy. For energy that is produced onsite (direct energy use), the goal is to produce this energy with renewables. Examples of direct energy use are natural gas used for building heating and the laboratory's fleet vehicles. For energy that is produced offsite (indirect energy), the goal is to offset the related GHG emissions through the purchase of RECs.

Renewable Energy Use Goals

EPAct 2005 Goal *Consumption of renewable energy shall be 3% for each year from FY 2007 through FY 2009; 5% from FY 2010 through FY 2012; and 7.5% from FY 2013 forward of annual electric consumption.*

Executive Order 13423 Goal *At least half of the statutorily required renewable energy consumed each fiscal year shall come from "new" (post January 1, 1999) renewable sources.*

DOE TEAM Goal *To exceed the EO 13423 Goal*

Colorado ELP Goal *NREL expects to exceed the 3% FY2007 GHG reduction required by EO 13423.*

Progress *FY 2007 renewable energy use was 100% of annual electric consumption due primarily to the utilization of on-site renewable energy projects and the purchase of RECs. One hundred percent of the renewable energy consumed was from "new" renewable resources. These results significantly exceed the renewable energy generation and use goals.*

In FY07, electricity was generated by multiple photovoltaic projects. NREL has 46 kW of on-site PV that generates about 66,500 kWh of electricity each year. These photovoltaic panels are located at the SERF, the Site Entrance Building, the OTF, NWTC Site Entrance Building and Distributed Energy Test Facility, and remote applications including signs, walkways, and parking lighting.

The NWTC has approximately 1,600 kW of installed wind turbine capacity used for research purposes. When the turbines are running, the energy produced is used to offset simultaneous NWTC site electric energy use. The turbines produced over 45,800 kWh in FY2007.

Onsite renewable thermal energy sources include solar hot water systems, ventilation air preheat systems, and extensive use of passive solar heating and day lighting. In FY2007, these sources produced some 10.2 MMBtu.

NREL purchased 33,340 MWh of RECs through the Western Area Power Administration Federal Agency Master Purchase Agreement. The RECs purchased under this agreement are from "new" renewable energy projects derived from wind and biomass resources in California installed after January 1, 1999. From a GHG emissions standpoint, this REC purchase offsets 100% of NREL's comprehensive "carbon footprint," making the laboratory "carbon neutral."

5.9.3.6 Greenhouse Gas Emissions

Through the off-set purchase of RECs, and with regard to the total resources brought into, and the wastes generated and disposed of by the lab, NREL became "carbon neutral" in FY2006 in terms of CO_2 production. NREL continued its carbon neutral status in FY2007. Figure 5.4 represents NREL's CO_2 footprint.

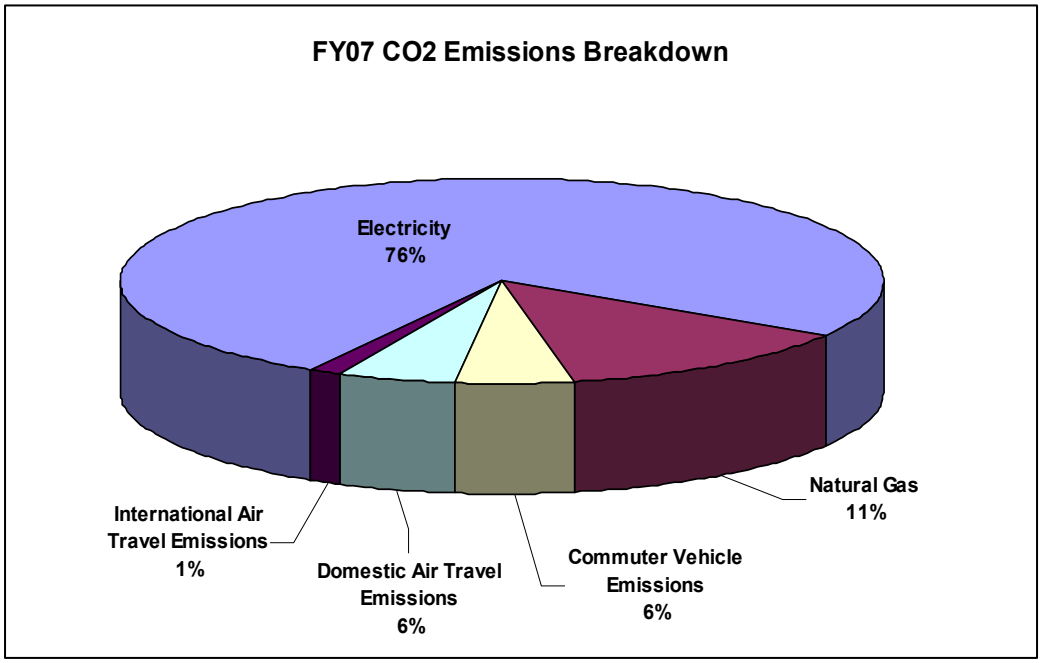

Figure 5.4. FY2007 Kg CO_2 emission breakdown

5.9.3.7 Water Conservation

Water Use Reduction Goal

Executive Order 13423 Goal *Beginning in FY2008, NREL will reduce water consumption intensity by 2% annually through the end of FY2015 or 16% by the end of FY 2015, relative to the baseline water consumption in FY2007.*

Progress *Based on a FY2007 water audit, NREL plans to implement measures to achieve 45% of the overall goal 16% reduction in FY2008. Measures to achieve an additional reduction of 45% of the overall goal reduction are planned to be implemented in FY2009. Reductions to achieve the balance of the overall goal are expected to be achieved through low-water use intensity features to be incorporated in new construction projects.*

Figure 5.5. Sustainable landscaping outside of NREL's Thermal Test Facility

The FY2007 water use baseline is 13.2M gallons or 28.7 gallons/sq. ft. Given this baseline, the FY2015 16% reduction goal of 2.1M gallons corresponds to 24.1 gallons/sq. ft. To identify water use reduction opportunities, NREL completed a site-wide water audit in FY2007. The audit identified reduction opportunities of 1.8 M gallons. Measures resulting in 0.9M gallon reductions are being implemented in FY2008. Measures resulting in an additional 0.9M gallon reduction are planned for implementation in FY2009. The low water use intensity design of planned new construction is expected to provide the balance of the reductions needed to achieve the FY2015 goal.

Water use data for the STM site is obtained from the water supply company, Consolidated Mutual Water. All of the facilities that require water on the STM site have dedicated water meters. There are also water sub-meters on all three cooling towers at the STM site.

The NWTC site is a remote site that has no wells or water supply. Public Water Supply water, primarily from Boulder, is delivered weekly to the NWTC, as described in Section 5.2. Currently, water usage at the NWTC is measured by the amount of water delivered to the site.

5.9.3.8 Sustainable Building Design

Sustainable Design and High Performance Buildings Goals

Executive Order 13423 *New construction and major renovations shall comply with the Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings.*

Fifteen percent of the existing building inventory as of the end of FY2015 will incorporate the sustainable practices in the Guiding Principles.

DOE TEAM Goal *DOE sites will achieve a LEED "Gold" rating on all new buildings.*

Colorado ELP Goal *NREL plans to strive for LEED "Gold" for all future building design and construction.*

Progress *All lab new construction complies with the Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings. As of FY2007, 13% of the NREL existing building inventory incorporates the sustainable practices in the Guiding Principles. NREL achieved a LEED platinum rating on its most recent new building, the S&TF.*

NREL's goal is that all new construction results in sustainable green buildings meeting or exceeding the Gold Level of the LEED standards.

In April 2007, the S&TF was the first federal building to receive the LEED platinum rating. Only 28 other buildings in the world achieved the LEED platinum designation by this time. The S&TF is a two-story, 71,000 sq. ft. laboratory used for collaborative renewable energy research with industry. It houses office and laboratories for 75 people. The building is designed to accelerate development and commercialization of promising new alternative energy technologies, such as solar hydrogen and energy efficiency technologies.

Figure 5.6. LEED platinum certified S&TF at STM

NREL's S&TF has received numerous awards, including: the 2006 Federal Energy Saver Showcase Award as part of the Federal Energy and Water Management Awards ceremony in Washington, D.C., the Jefferson County Commissioners' Award, the White House Closing the Circle Pollution Prevention Honorable Mention, and the DOE Pollution Prevention Star Award.

NREL's next new major construction effort, the Research Support Facilities (RSF), will be a 225,000 sq. ft. office building. The RSF will be a design-build project with an aggressive energy budget of 25,000 Btu/sq. ft. The RSF is also being designed at the LEED platinum level and as a net zero energy building.

5.9.3.9 Technical Assistance and Outreach

5.9.3.9.1 Outreach by Leadership

NREL staff developed a Sustainable Design Guide for Los Alamos National Laboratory. NREL Federal Energy Management Program (FEMP) staff has assisted in developing both Energy Management and Water Management Plans at NREL. In addition, NREL FEMP staff developed the Department of Commerce agency-wide energy plan and is in the process of assisting several other agencies in their energy planning processes. NREL researchers work with DOE, EPA, the U.S. Green Building Council, and others on a variety of assistance and outreach programs and activities related to energy and water use. Examples include standards development, conferences, classes and workshops, tours, publications, Web sites, and energy and water analysis software. NREL's activities in this regard can be surveyed through the most recent Institutional Plan or Performance Assessments, accessible on NREL's Web site (www.nrel.gov).

5.9.3.9.2 Outreach by Recognition

As a component of its outreach efforts to disseminate information regarding sustainability, NREL has received a number of awards. Examples of these awards are: CU Wirth Chair Award in Environmental and Community Development Policy and the DOE Departmental Energy Management Achievement Award: Effective Program Implementation – Sustainable NREL. In FY2007, Sustainable NREL and EMS staff supported NREL efforts to receive the following awards:

- S&TF recognized as the first LEED platinum federal building – April 4, 2007
- Chairman's Awards for NREL personnel for outstanding contributions as Labs21 team members. (Note: Labs21 was awarded a Presidential Awards for Federal Energy Management.)
- Continued recognition as a Colorado Environmental Leadership Program Gold-level Leader in Environmental Management (sponsored by CDPHE)
- Continued recognition as a Climate Leader (sponsored by U.S. EPA).

5.9.3.9.3 Internal and External Outreach

NREL has produced a number of publications with the goal of sharing the details of NREL's Sustainability Program with staff and the public. These include the *Sustainable Pioneer* and *NREL Now*, internal electronic publications; and an NREL sustainability report that is distributed both internally to NREL staff and to the public. Also, through NREL's internal outreach program, the laboratory has implemented a Web site with an enhanced suite of sustainability tools for employees. For example, some of the tools address alternative commuting, computer power management, and CO_2 emissions equivalents from employee activities and laboratory operations.

5.10 Vegetation Management

5.10.1 Program Management

Management in this area is consistent with NREL's Weed Management Programs for the STM and NWTC (6-2.12 and 6-2.13, respectively) and the Sustainable Landscape Design and Management Program (6-2.19).

NREL's basic philosophy regarding vegetation is to conserve the ecosystems on the site in their natural state as much as possible. There is some landscaping using non-native drought-tolerant species adjacent to some of the buildings, and even a few areas of bluegrass at the STM site. However, the native vegetation and natural character of the landscape is maintained over the majority of the site. Revegetation of areas to be left in their natural state following disturbance from construction or other outdoor activities is conducted using a native seed mix of grasses and forbs. These mixes are site-specific and are composed predominantly of native species that were originally present on the site before disturbance. Seed mix and revegetation procedures are outlined in NREL's Stormwater Pollution Prevention Programs for the STM and NWTC Sites. The use of native species is required at both the STM and NWTC whenever possible. When feasible, high-water demand species like Kentucky bluegrass are replaced with drought-tolerant native species.

The most recent vegetation survey of the STM was conducted between June 2001 and May 2002. Five general habitats were described on the STM site, comprising seven plant communities (Plantae Consulting Services, 2002). No rare or imperiled plant species were found on the site. Areas of mixed foothills shrublands (also called tall upland shrubland) were identified on top of the mesa within the conservation easement area. This natural community is listed as rare and imperiled by the Colorado Natural Heritage Program. No development will occur in the conservation easement area.

Figure 5.7. Frosted yucca

Courtesy Steve Wilcox

Eleven noxious weed species were located on the STM site. Four—Canada thistle, diffuse knapweed, field bindweed, and musk thistle—belong to Colorado's top 10 prioritized-for-control weed species.

A three-season vegetation survey of the NWTC site was performed between August 1999 and August 2000. The survey defined five general habitats on the NWTC site, comprising nine plant communities and 271 vascular plant species (Plantae Consulting Services, 2000). Figure 5.8 illustrates a portion of the NWTC site and shows the diverse vegetation mix present. No rare or imperiled plant species were found on the site. However, the survey identified a small area of xeric tallgrass prairie (defined as mesic mixed grassland in this study) located in the southwest corner of the NWTC. This natural community is listed as rare and imperiled by the Colorado Natural Heritage Program. This listing implies no legal designation or regulatory enforcement. It is so designated primarily for management purposes.

This area of the NWTC is not impacted by research or construction activities on the site.

Figure 5.8. Vegetation growth along the NWTC north fence

The survey identified 11 noxious weed species on the NWTC site. Five of these—Canada thistle, diffuse knapweed, field bindweed, musk thistle, and leafy spurge—are recognized as belonging to the top 10 prioritized weed species in Colorado. Based on the survey, recommendations were made to continue using a comprehensive weed management program, founded on an integrated pest management (IPM) philosophy.

The survey showed the native seed mix used for revegetation at the NWTC to be very successful in many areas of the site. NREL is continuing the use of this seed mix for revegetation at the NWTC.

Weed control efforts have been ongoing since 1997 at the NWTC and 1998 at the STM site. NREL uses an IPM approach that incorporates various types of weed control methods. Some of

these include mechanical practices (e.g., mowing), cultural (e.g., reclamation of disturbed areas), prevention (e.g., limiting or eliminating driving of vehicles off established roadways), and herbicide treatment. The effectiveness of control methods is periodically assessed. The use of multiple strategies for control has been successful in significantly reducing populations of diffuse knapweed and Canada thistle on the sites. The key aspect of the weed control program is to maintain flexibility to respond to the changes in weed populations from year to year.

In 1998, aerial herbicide application of Tordon 22K was conducted using helicopter application over about 200 acres of the NWTC to target diffuse knapweed. It was very effective in controlling the weed, and healthy stands of native grasses have proliferated with the decrease in weed competition. Since that time, infested areas of the NWTC have been treated with ground-applied herbicide.

Weed infestations at the STM site are much less severe than at the NWTC. Limited ground application of herbicides has been conducted at the STM since 1998.

NREL promotes the sustainable management of its government-owned land by practicing environmentally sound, cost-effective landscaping practices. These practices reduce adverse impacts to the natural environment while providing essential shade and cooling for indoor and outdoor spaces, and a more aesthetically appealing appearance for the sites. This commitment is implemented by a sustainable landscape design and management program.

5.10.2 Permitting

There is no permitting applicable to vegetation management, although there is a state weed law that requires property owners to control certain species of invasive weeds (e.g., diffuse knapweed). For application of certain types of herbicides designated as "restricted use" by the EPA, a certified applicator must be used.

5.10.3 2007 Activities

NREL routinely practices IPM using various weed control methods, as described in the previous section. These are implemented during the normal course of site operation. In addition to the reclamation, off-road driving restrictions, and other weed control methods, ground applications of herbicides occurred at the NWTC in the spring of 2007. Very limited herbicide application was conducted on the STM site in the spring of 2007, focusing primarily on areas adjacent to roadways and buildings. The spraying was performed using a four-wheel drive vehicle. Primary target weeds were diffuse knapweed, leafy spurge, Canada thistle, common teasel, and hoary cress at the NWTC. At the STM, target weeds were mainly diffuse knapweed and Canada thistle.

In 2006, the weed management plans for the NWTC and STM were consolidated into an integrated weed management plan. The 2006 plan describes the activities for weed management used in 2007. The approach used to integrate weed control activities will be expanded to the control of other pests at NREL facilities, ultimately resulting in an integrated pest management program.

A master plant list for NREL was compiled in FY2007. This list is based on information gathered during comprehensive vegetation surveys of the STM and NWTC completed in

FY2000-02 by Plantae Consulting Services. No formal field work has been completed since the FY2002 survey, but the list is updated as NREL ESH&Q staff become aware of species not on the list (see Appendix C).

5.11 Wildlife

5.11.1 Program Management

Wildlife habitat at the STM site is primarily grasslands, shrublands, and wetlands. The STM site provides vegetation types for a variety of wildlife species including birds, mammals, reptiles, and amphibians. The variety of vegetation types present on site attracts species that may use the site as year-round habitat, for breeding only, during migration, or as a winter habitat.

A wildlife survey was conducted on the STM site in 1987 and 2005, with follow-up verification surveys conducted in 1998 and 1999.

5.11.2 NWTC Site

Field research into avian use of the NWTC was conducted during 1994 and 1995 in an effort to identify potential impacts on birds from wind-turbine research. While several species of raptors, including red-tailed hawks, kestrels, and a great-horned owl were noted on the site, they were primarily transient in nature. The survey indicated that the NWTC appears to be used primarily for resting and hunting, although one pair of kestrels nested in an old concrete pole during the spring. Birds of prey of concern, such as eagles, generally fly in excess of 152 meters (500 ft.) over the site. No significant impacts to the birds from NREL activities were found during the survey.

A year-long monitoring project for birds and bats was initiated on the NWTC in early 2001. Standardized plot surveys were conducted to survey songbirds and raptors on the NWTC and adjacent, undeveloped areas. NREL also conducted systematic searches of turbines and meteorological towers on the NWTC to document avian mortality. The study was completed in July 2002. Salient findings of the study were as follows (Schmidt, E., *et al*., 2003):

- Abundances of individual raptor species on the NWTC site were similar to surrounding areas. However, the average number of species detected per count at the NWTC was nearly double that of surrounding areas in winter, the season when raptors are most abundant in the region. This difference is likely attributable to increased availability of perches at the site. Raptors flew and perched higher at the NWTC than in adjacent areas, again probably related to the wind turbines and other structures at the site.
- Only 1 of 46 bird species counted on grassland plots during this study differed in abundance between the NWTC and adjacent areas—the horned lark, which was about 16 times more common off site. This difference is attributable to cattle on Boulder Open Space, creating low-stature grasslands preferred by this species.
- Bird abundance and variety on the undeveloped southern portion of the NWTC site were generally similar to the developed areas, except for the relative scarcity of raptors on the undeveloped site, which probably was due to a lack of perches.
- The NWTC does not support a large diversity or abundance of bat species (possibly six species of bats use the site), but an area on the northwest side of the site, with trees close to a rocky outcrop, provides foraging and perhaps a roosting habitat.

No raptor carcasses were found during the 12-month survey of the NWTC except one American kestrel that had died before the study started. Bird mortality associated with the site appears to be minor. Extrapolating from four passerine (songbird) carcasses found during the searches, estimated annual bird mortality attributable to the NWTC was 24 individuals, all songbirds (Passeriformes). Most of these deaths were probably the result of collisions with support wires for the meteorological towers rather than the turbines themselves. No evidence was found of bat fatalities at the site.

5.11.3 STM Site

The most recent site-wide wildlife survey of the STM site began in April 2004 and was completed in June 2005. The objectives of the survey were to update existing data in light of expanded development of both the site and the surrounding area, and to develop best management practices for future construction projects to maximize protection for site wildlife.

The survey included large and small mammals, predators, migratory birds and raptors, upland game birds, and invertebrates identified on an opportunistic basis (i.e., only as they are found during other surveys). A listing of species observed during the year-long STM wildlife survey is attached as Appendix B. A summary of the survey results follows.

5.11.4 Permitting

Scientific collection licenses must be obtained from the Colorado Division of Wildlife for the small mammal trapping portion of the wildlife surveys. NREL has no other permitting requirements for this area of environmental management.

5.11.5 2007 Activities

In compliance with the Migratory Bird Treaty Act, surveys for ground-nesting birds were completed prior to activities that could adversely affect these species. Surveys were conducted during the nesting season, from mid-April through mid-September. If an active nest was found, a buffer zone was set up around the nest to avoid impacts to nests during site activities.

5.11.5.1 Migratory Birds and Raptors

Many species of migratory birds were observed on the STM site, with many of these species potentially nesting on site. Additionally, the STM site may provide important migration and winter habitat for migratory birds. For example, the American tree sparrow was only observed on site during winter surveys and the northern harrier was observed hunting on site only in the fall and winter. Several species were only observed during the fall, including blue jay, downy woodpecker, red-breasted nuthatch, loggerhead shrike, and rock wren, suggesting that these species may use the STM site as a stopover during migration. Habitat for migrating birds is important, as some of these species may migrate as far south as Central and South America. Several species of raptors were observed at the STM site and, two species were observed by both studies (1987 and 2004-2005) nesting on site; the red-tailed hawk and the American kestrel. Both of these species were observed hunting on-site during the 2004-2005 surveys, in addition to the Cooper's hawk. The NREL STM site provides habitat and a prey base of small birds and small mammals for these raptor species. Species such as the Swainson's hawk migrate thousands of miles each year, wintering as far south as Argentina, and returning to the western United States

and Canada to breed. Areas such as the STM site may provide a prey source for the Swainson's hawk and other species during migration.

5.11.5.2 Large Mammals

Mule deer at the STM site have been observed in all habitat types. Mule deer were often observed in the amphitheater drainage or in the tall shrubland on the slope. When approached on the mesa top, the mule deer tended to move away from the disturbance and into the amphitheater drainage.

Figure 5.9. Mule deer bucks

Courtesy Steve Wilcox

The tall shrubland vegetation type may provide important hiding cover for this species. Spring pellet group surveys resulted in nearly double the amount of pellet groups and plots of the pellet groups were observed in than fall surveys. This may suggest that winter use of the STM site by deer may be higher than summer use or that deer utilize different habitats on site for these periods as affected by the availability of habitats and the location of survey plots, although the single year of data is not sufficient to draw conclusions regarding seasonal variation.

5.11.5.3 Predators

Coyotes are one of the most widespread and adaptable carnivores in North America and occur at all elevation levels and in all ecosystems in Colorado (Fitzgerald, et al. 1994). Lagomorphs (rabbits) and rodents are an important part of the coyote's diet, both of which are abundant on the STM site. Evidence of predation on cottontail rabbits (i.e., entrails and fur) was observed during site visits. Coyotes may breed on the STM site as two potential dens were observed in two of the site drainages.

5.11.5.4 Small Mammals

Figure 5.10. Prairie dog (Cynomys ludovicianus) on the NWTC site

The deer mouse is the widest ranging and most common small mammal in North America (Fitzgerald, et al. 1994), and based on the 1987 and 2004-2005 survey data, it is also the most common small mammal on the NREL STM site. Deer mice can occur anyplace where cover occurs (Fitzgerald et al. 1994) and were observed in the four vegetation types sampled on the STM site. This species is a generalist and is known to exploit disturbed habitats. Mexican woodrats and prairie voles were more restricted than the deer mouse in the habitats they occupied on the STM site. Mexican woodrats are associated with rocky slopes and do not build dens away from rocky areas (Fitzgerald et al. 1994). This species is therefore limited as to where it can occur on the STM site.

Prairie voles are adapted to the grasslands, constructing burrows and runway systems throughout the grassland, essentially limiting this species to the short grass and mixed grass vegetation types on the STM site. All of these

species are active throughout the year. Winter surveys (2004-2005) were conducted during a warm weather trend, which may have contributed to the highest number of small mammals caught compared to the three other surveys.

At least one species, the black-tailed prairie dog, that was not present at the NWTC during the last survey made its appearance at the site in the 2006-2007 timeframe (See Figure 5.10).

5.11.5.5 Reptiles/Amphibians

Several rattlesnakes were observed on the STM site, more often in rocky areas, but also in the grassland. A rattlesnake den may be present in the rocks near the top of the mesa slope north of the Visitor's Center (near E-2-3) as four rattlesnakes were observed within a few feet of each other, one in the open and three in a rock crevice. Hibernation generally occurs in rock outcrops, with this species usually active from mid-April through late-September (Hammerson 1999).

Figure 5.11. Rare spotting of an Eastern Fence Lizard(Sceloporus undulatus) at the SRRL
Courtesy Steve Wilcox

Although only three species of reptiles and one species of amphibian were observed on the STM site, no specific survey methods were employed to identify or count these groups of wildlife.

To avoid or minimize disturbance to wildlife species on site, site-wide BMPs were developed as a result of this survey for consideration during ongoing normal site operations and future construction projects. The BMPs address migratory birds and raptors, mammals, all wildlife, and general site operations. They will be applied as appropriate to site activities and future site development.

5.12 Endangered Species/Species of Concern

5.12.1 Program Management

The Endangered Species Act provides for the designation and protection of wildlife, fish, and plant species that are in danger of extinction and preserves the ecosystems on which these species depend. For the purposes of site wildlife surveys, a species of concern is defined as those species protected under federal statutes, including the Endangered Species Act of 1973, as amended, the Bald Eagle Protection Act of 1940, as amended, and the Colorado Division of Wildlife list of endangered, threatened, and wildlife species of concern. Federal agencies are also required to abide by the Migratory Bird Treaty Act of 1918, as amended, but for this report, these species are not included as species of concern. For plant surveys, the Colorado Natural Heritage Program designation is also considered. Although this listing of rare species is not regulatory in nature, NREL uses it for management purposes.

No threatened or endangered species or candidate wildlife species for endangered designation or other sensitive species have been found on either the STM or NWTC sites during any site wildlife surveys. Likewise, no threatened, endangered candidate or other sensitive plant species were identified in any survey of the STM or NWTC sites, as there was no suitable habitat present for any of the sensitive species.

The vegetation survey at NWTC, conducted between August 1999 and August 2000, identified a small area of xeric tallgrass (defined in the survey as mesic mixed grassland) prairie located in the southwest corner of the NWTC site. This natural community is listed as rare and imperiled by the Colorado Natural Heritage Program. This listing implies no legal designation, but is made primarily for management planning purposes. This xeric tallgrass prairie area has been designated by NREL as a conservation management area. Most of the conservation management areas on the NWTC are formally designated as areas on which building will not occur. However, as the xeric tallgrass prairie is in the active turbine testing area, it is not reasonable to preclude all development on portions of the site inhabited by this plant community. Disturbance will be minimized on the area.

The STM site vegetation survey completed in May 2002 found no rare or imperiled plant species on the site, but areas of mixed foothills shrublands (also called tall upland shrubland) were identified along the top of the mesa within the conservation easement area. That natural community is listed as rare and imperiled by the Colorado Natural Heritage program. It is within a designated conservation easement area where no development will occur except trails being established by Jefferson County Open Space (see Section 6.0 for a trails discussion).

As reported in Section 5.11.3, a site-wide wildlife survey of the STM site has recently been completed. No species observed on the STM site during the 1987 or the 2004-2005 wildlife surveys were present on either agency's list. However, golden eagles were incidentally observed on the STM site (outside of raptor surveys) and are protected under the Bald Eagle Protection Act. Golden eagles were observed flying over the site and may use the site for hunting. No golden eagle nests or nesting activities were observed on the STM site.

5.12.2 Permitting

NREL has no permitting requirements for this area of environmental management.

5.12.3 2007 Activities

Figure 5.12. Eurasian collared dove at the STM

In 2007, the presence of the Eurasian Collared Dove (*streptopelia decaocto)* continued at NREL's STM. This invasive species, first spotted at STM in 2006 as a new avian species, had just begun to inhabit the Denver area at that time. The Colorado Division of Wildlife considers this species to be a threat to native avian species.

5.13 Wetlands/Floodplains

Limited wetland areas totaling less than 0.3 ha (0.75 ac) occur on the STM site in the drainage bottom located north of the Visitor's Center. These are narrow, linear wetlands supporting spikerush, baltic rush, sedges, bluegrass, hemlock, and field mint.

Wetland areas at the NWTC are extremely limited in extent as well. These areas, along the site's eastern boundary, total less than 0.4 ha (1 ac).

According to floodplain maps generated by the Urban Drainage and Flood Control District and adopted by the Jefferson County Department of Highways and Transportation, NREL's STM site does not contain any floodplains and no floodplains have been identified at the NWTC. As a best-management practice, however, all construction activities that may cross a drainage channel are designed to meet the 100-year flood control standards (designed to withstand the equivalent of a 100-year flood).

5.14 Cultural Resources

5.14.1 Program Management

Cultural resources are protected under Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended. Significant cultural resources are either eligible for, or listed in, the National Register.

Cultural resources are defined as any prehistoric or historic district, site, building, structure, or object considered important to a culture, subculture, or community for scientific, traditional, religious, or any other reason. Cultural resources can be divided into three major categories:

- Prehistoric and historic archaeological resources
- Architectural resources
- Traditional cultural resources.

Prehistoric and historic archaeological resources are locations where human activity measurably altered the earth or left deposits of physical remains (e.g., arrowheads, bottles). Prehistoric resources that predate the advent of written records in a region range from a scatter composed of a few artifacts to village sites and rock art. Historic resources may include campsites, roads, fences, trails, dumps, battlegrounds, mines, and a variety of other features.

Architectural resources include standing buildings, dams, canals, bridges, and other structures of historic or aesthetic significance. Architectural resources generally must be more than 50 years old to be considered for protection under existing cultural resource laws. However, more recent structures, such as Cold War facilities, may warrant protection if they manifest the potential to gain significance in the future.

A traditional cultural resource can be defined as a property that is eligible for inclusion in the National Register because of its association with cultural practices or beliefs of a living community that are rooted in the community's history, and are important in maintaining the continuing cultural identify of the community. Traditional resources may include archaeological resources, buildings, neighborhoods, prominent topographic features, habitats, plants, animals,

and minerals that Native Americans or other groups consider essential for the persistence of their traditional culture.

5.14.1.1 Site Surveys

Three formal surveys of historic and cultural resources have been performed on the STM site. These surveys were completed in 1980, 1987, and 2003. Two additional surveys of the Camp George West district involving the STM site have also been conducted.

As a result of these STM surveys, three historical sites were recognized as significant cultural resources that should be preserved. These sites include an open-air amphitheater (Figure 5.13), a stone bridge spanning a natural drainage channel adjacent to the amphitheater, and a stone and concrete ammunition bunker below the amphitheater site (Figure 5.14). The three structures were constructed during the Works Progress Administration era in the 1930s. Through NREL's efforts, these sites have been added to the National Register, with the amphitheater and stone footbridge listed together as a single site. NREL also participated in an interagency survey of STM and Camp George West to identify historic structures and sites eligible for nomination to the National Register. Figure 1.7 provides an aerial view of the amphitheater.

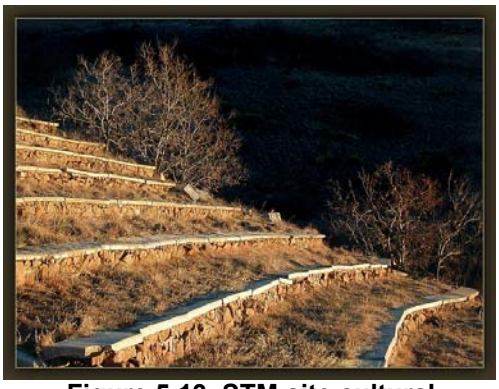

Figure 5.13. STM site cultural resource: amphitheater at the STM

Courtesy Steve Wilcox

The Camp George West Historic District, also listed on the National Register, includes the 25-acre parcel of NREL's site, south of the DWOP. Two types of historic archaeological resources (firing range lines and a low rock wall) have been identified on this parcel. These resources have been determined to contribute to the National Register eligibility of the Camp George West Historic District.

Figure 5.14. STM cultural resource: stone and concrete ammunition bunker at the STM

Courtesy Steve Wilcox

The Camp George West Historic District overlaps the NREL STM property by 25 acres. Two contributing resources occur within those 25 acres. Contributing resources are those features within a historic district that contribute to the district's overall eligibility for the National Register.

A 2003 cultural resource survey was conducted of the 25-acre parcel south of Denver West Parkway on the STM site. The survey confirmed the existence of the contributing features to the Camp George West Historic District occurring within the 25-acre parcel. The contributing resources are:

- Two firing lines located on the 25 acres. There are also firing lines located south of the NREL property on land owned by Jefferson County Open Space and proposed for development as the Camp George West Park.
- Portions of a low rock wall are also present on the 25 acres. There is also a rock wall located south of the NREL property.

DOE consulted with the State Historic Preservation Office (SHPO) regarding the significant resources located on the 25 acres. DOE and the SHPO subsequently entered into a Memorandum of Agreement where DOE agreed to perform further surveys to fully document the resources on the 25 acres prior to any development of the parcel.

In 2005, DOE-GO and NREL conducted documentation of the Camp George West firing range lines and low rock walls, which contribute to the Camp George West Historic District's eligibility to the National Register. The documentation resulted in Level II documentation from the Historic American Buildings Survey (HABS) and the Historic American Engineering Record (HAER) that consisted of mapping, photographs, and detailed description of the resources. The documentation was submitted using archival quality materials to the SHPO in late 2005.

In January 2006, the Camp George West Level II HABS/HAER documentation (originally dated August 2005) was revised to include field drawings of the "low rock wall" as requested by the Colorado SHPO. This was the final report submitted to the SHPO. It is on file with the Colorado SHPO and also at the DOE-GO and NREL offices.

Also in CY2006, a site survey for cultural resources was conducted in support of NREL/DOE EAs for the first of three site development projects (RFHP, and two potential solar field sites). The RFHP EA was completed in early summer 2007.

An archaeological survey of the NWTC site was conducted in support of the 1996 environmental assessment to supplement previous surveys so there were no gaps in cultural surveys on the site. No significant historical or archaeological resources were identified. However, the wooded ridge area on the west portion of the site was identified as a location with potential for cultural resources, so further testing or observation during excavation would be done should there be any future need for work in the utility corridor in the vicinity of the ridge.

5.14.2 Permitting and Requirements

NREL has no permitting requirements for this area of environmental management. In order to comply with cultural resource protection requirements, NREL instructs construction contractors at their site orientation that in the event they discover any evidence of cultural resources during ground disturbing activities at the STM or NWTC sites, they are to stop all work in the vicinity until a qualified archaeologist evaluates the significance of the find.

5.14.3 2007 Activities

There were no activities related to cultural resources in 2007.

5.15 National Environmental Policy Act (NEPA)

5.15.1 Program Management

Management in this area is consistent with NREL's NEPA Implementation Program (6-2.2).

As a federal agency, DOE is obligated to comply with NEPA by evaluating the potential for environmental impacts prior to conducting its activities. The Council of Environmental Quality (CEQ) issues regulations for compliance with the Act. DOE has also issued implementing regulations at 10 CFR that complement the CEQ requirements. DOE has written a site-wide EA for its activity at the STM Site and DWOP, and separate EAs for the NWTC and JSF activities.

NREL has established procedures, with the approval of the DOE-GO, to assist DOE in meeting their NEPA obligation. Proposed activities that will be conducted at NREL's five sites are evaluated for their potential environmental effects using the appropriate level of NEPA review, in conjunction with DOE-GO.

The NREL NEPA Handbook has been prepared to provide NREL project managers and procurement specialists with guidance on implementing the NEPA procedures, and training is provided to staff, as appropriate.

5.15.2 Permitting

NREL has no permitting requirements under NEPA.

5.15.3 2007 Activities

During 2007, numerous NEPA reviews of both onsite and offsite activities occurred through completion of NREL environmental checklists. As outlined in NREL's NEPA implementation procedures, these reviews were coordinated with NREL project managers, subcontracting staff, the NREL NEPA coordinator, and the DOE-GO NEPA Compliance Officer. NEPA requirements were also coordinated with future program planning (e.g., development of NREL's 2007 Grand Buildout Infrastructure Design) through interaction between NREL's ESH&Q Office director and NREL's technology program and project managers. Requirements were also coordinated through participation in the NREL management annual planning process and other reviews of proposed projects for the upcoming FY2008.

In CY2006, NREL began the EA process for three STM site development projects (RFHP, and two potential solar field sites). The EA was completed in early summer 2007, and a finding of no significant impact was issued.

In late 2007, NREL started the EA process for an STM site-wide EA supplement to address proposed construction and operation of the following: the RSF, infrastructure improvements, and upgrades to the Thermochemical User Facility and addition of a Thermochemical Biorefinery Pilot Plant. This EA supplement was completed in May 2008, with DOE issuing a finding of no significant impact.

5.16 Radiological Program

5.16.1 Program Management

Management in this area is consistent with the following NREL programs: Air Quality Protection (6-2.5), and Radiological Control (6-4.5).

All radioactive material at NREL facilities is handled according to NREL's Radiological Control Program. Elements of the program include a radiological control organization, a radiation safety policy and control manual, safe operating procedures, safe work permits, radiological control areas and postings, monitoring, training, and purchasing controls for radioactive materials.

There are no nuclear operations at NREL sites. All of NREL's radiation sources are used/stored in facilities located on the STM site. These include four x-ray diffraction machines at the SERF on the STM site. In addition, one laboratory at the FTLB, on the STM site, occasionally uses small quantities of radioisotopes for biological or chemical labeling.

The four x-ray diffraction machines located at the SERF are registered with the state of Colorado and are inspected every 2 years by a state-licensed surveyor. The surveyor inspects and certifies the x-ray machines and audits NREL's program for radiation safety in connection with operating the machines.

Monitoring of equipment and facilities for removable contamination is performed in the laboratories where radioisotopes are used. Wipe tests are performed on any laboratory surfaces that could have become contaminated by the radioisotope work at least monthly and more frequently if needed. These wipes are analyzed using a scintillation counter.

DOE Order 5400.5, "Radiation Protection of the Public and the Environment," established radiation emission limits for DOE facilities. Such emissions are also regulated by Section 112 of the Clean Air Act as implemented by 40 CFR 61, Subpart H, established by the EPA. According to 40 CFR 61, Subpart H, all DOE facilities, including NREL, must annually demonstrate compliance with the radionuclide emission limit to the ambient air not exceeding an amount that would result in any member of the public receiving an effective dose of 10 millirem per year or greater. No radioactive air-emission monitoring is conducted at NREL because of the extremely low usage of radioactive material. Therefore, NREL demonstrates compliance with the NESHAPs in 40 CFR 61, Subpart H, by utilizing the EPA's COMPLY computer model to determine the effective dose equivalent to the public.

All radioactive waste generated during NREL activities is classified as low-level waste. Waste from the STM site is temporarily stored at the Waste Handling Facility (WHF) until disposal is arranged at an offsite facility permitted to accept low-level radioactive waste.

5.16.2 Permitting

NREL does not have a radioactive materials license from the state of Colorado, as the laboratory is currently under DOE jurisdiction for radioactive materials handling.

5.16.3 2007 Activities

During 2007, no work involving the use of radioisotopes occurred. NREL maintains a small inventory of radioisotopes in the event these may be needed for various research activities. In 2007, the potential dose to the public was calculated as though the contents of all unsealed containers of stored radioisotopes were exhausted to the atmosphere. P-32 and S-35 waste that is stored in the WHF and has decayed past ten half-lives was not included in this calculation.

The distance from the source in the FTLB to the nearest potential receptor is 119 meters (fence line of nearest resident). For the WHF, the distance from the source to the nearest potential receptor is 311 meters.

According to the COMPLY computer model, the potential dose to the nearest member of the public was 0.011 millirem per year, well below the emission limit of 10 millirem per year, and NREL is in compliance with the NESHAP for radionuclides. Because the dose is calculated rather than measured, it represents a potential or estimated rather than an actual dose.

The resulting calculated off-site whole body doses are small, but are still likely overestimates of potential radionuclide doses. The COMPLY formula assumes that the entire quantity of the radionuclide in all open containers was released, and that the receptor raises and consumes all his/her own milk, meat, and vegetables at home. These assumptions are extremely conservative.

In 2007, there were no unplanned releases of radioisotopes.

6. Conservation Easement Lands

During 1999, DOE placed 177 acres of the STM site in a conservation easement. The purpose of the conservation easement is to preserve the natural character of the property, including its visual, biological, and recreational resources, especially in relation to the changing land uses adjacent to the NREL site and within the region.

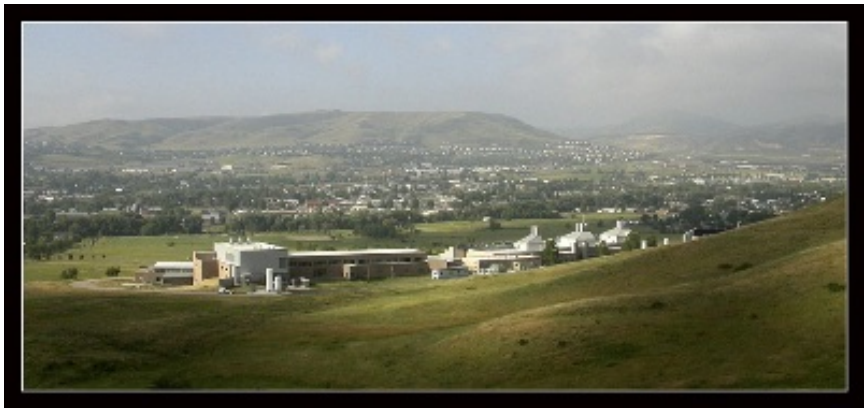

Figure 6.1. Conservation easement

Courtesy Stephen Wilcox

The goals of the easement are to:

- Retain, preserve, and protect natural, scenic, ecological, and historical aspects of the conservation easement property;
- Protect the ecosystem of the STM area and the sustainable habitat for diverse vegetation, birds, and terrestrial animals;
- Ensure the scenic and biological integration with adjoining open-space land;
- Prevent further industrial, commercial, or residential development of the conservation easement property; and
- Preserve the conservation easement property as natural open space.

A baseline inventory of the property was prepared in June 1999 to document the current condition of the easement property and to assess the conservation value of the property (Department of Energy, Golden Field Office, 1999). The baseline inventory includes a description of the geographical setting and adjacent property owners, access and use of the property by the public, and a description of the existing environmental conditions of the property (geology, hydrology, vegetation, wildlife, cultural resources). There are also photos incorporated into the report that document the condition of the property.

6.1 2007 Property Assessment

During 2007, there was no NREL activity on the conservation easement property having the potential to degrade the environmental condition of the property. Jefferson County Open Space conducted a site inspection during the summer of 2004; no degraded conditions or other environmental issues were found. Representative areas of the easement lands are shown in Figure 6.2, taken in 2006.

Jefferson County Open Space has the responsibility to establish and maintain formal trails on the conservation easement property. The trail plan calls for establishing trails in phases. The first phase began in 2004, with Jefferson County Open Space installing two trails from Denver West Parkway (near the NREL Site Entrance) to the mesa top. Routine trail maintenance occurred in CY2007. No additional trails were constructed in 2007.

Figure 6.2. STM mesa top facilities and surrounding conservation easement lands

Contacts for Feedback or More Information

We welcome your feedback and suggestions on this report and on NREL's efforts at sustainability and environmental stewardship. To provide comments or to obtain additional information about NREL's environmental and sustainability programs, please contact:

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Figure 6.3. Sunset over the Solar Energy Research Facility
Courtesy Jeff Carapella

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Operated for the U.S. Department of Energy
Office of Energy Efficiency and Renewable Energy
by Midwest Research Institute – Battelle

NREL-November 2008

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8. Appendices

Appendix A – Summary of NREL Environmental Permits, Registrations, Notifications delete the table and append the excel permit table.

Appendix B – Wildlife Species Observed on the South Table Mountain Site.

Appendix C – National Renewable Energy Laboratory Master Plant List – 2007
(referenced in section 10).

Appendix A

2007 Summary of NREL environmental permits, registrations, and notifications.

Table A.1. 2007 Summary of NREL Environmental Permits, Registrations, and Notifications

Type	Number	Permit or Reg Holder	Permit Type	Permit Description	Issuing Agency Name	Location Description	Expiration Date	Status
Permit	04JE1442L	DOE	Air	Air Emission Permit for Land Development (fugitive dust from construction activities)	Colorado Dept. of Public Health and Environment (CDPHE)	NWTC site	1/31/2010	Issued 2/7/2005
Permit	07JE0277	DOE	Air	Stationary Source Construction (RFHP)	CDPHE	STM	3/21/2012	Active
Permit	08JE0889L	DOE	Air	Air Emission Permit for Land Development (fugitive dust from construction activities)	CDPHE	STM site	9/1/2013	Issued 9/24/2008
Permit	37232	SERI	Groundwater Monitoring Well	Permit to Construct a Well (MW-1)	Colo. Div. of Water Resources	STM	N/A	Construction complete, permit number active until well is closed
Permit	37229	SERI	Groundwater Monitoring Well	Permit to Construct a Well (MW-2)	Colo. Div. of Water Resources	STM	N/A	Construction complete, permit number active until well is closed
Permit	37228	SERI	Groundwater Monitoring Well	Permit to Construct a Well (MW-3)	Colo. Div. of Water Resources	STM	N/A	Construction complete, permit number active until well is closed

Type	Number	Permit or Reg Holder	Permit Type	Permit Description	Issuing Agency Name	Location Description	Expiration Date	Status
Permit	37231	SERI	Groundwater Monitoring Well	Permit to Construct a Well (MW-4)	Colo. Div. of Water Resources	STM	N/A	Construction complete, permit number active until well is closed
Permit	37230	SERI	Groundwater Monitoring Well	Permit to Construct a Well (MW-5)	Colo. Div. of Water Resources	STM	N/A	Construction complete, permit number active until well is closed
Permit	99JE0400	NREL/DOE	Air	TCPDU air emissions	CDPHE	STM	5/1/2010	Initial approval issued 7/20/2000
Permit	817	NREL	Permit	Hazardous material storage and use permit	West Metro Fire Protection District	STF	Jul-2008	Issued 7/2008
Permit	818	NREL	Permit	Hazardous material storage and use permit	West Metro Fire Protection District	SERF	Jul-2008	Issued 7/2008
Permit	819	NREL	Permit	Hazardous material storage and use permit	West Metro Fire Protection District	WHF	Jul-2008	Issued 7/2008
Permit	820	NREL	Permit	Hazardous material storage and use permit	West Metro Fire Protection District	FTLB	Jul-2008	Issued 7/2008
Permit	821	NREL	Permit	Hazardous material storage and use permit	West Metro Fire Protection District	AFUF/PDU	Jul-2008	Issued 7/2008

Type	Number	Permit or Reg Holder	Permit Type	Permit Description	Issuing Agency Name	Location Description	Expiration Date	Status
Permit	822	NREL	Permit	Hazardous material storage and use permit	West Metro Fire Protection District	S/R	Jul-2008	Issued 7/2008
	823	NREL	Permit	Hazardous material storage and use permit	West Metro Fire Protection District	DWOP Bldg 16	Jul-2008	Issued 7/2008
Notification and Registrations	PWSID Number CO0230860	DOE	Drinking Water	Non-community supply of hauled water from a surface water source	CDPHE	NWTC site	N/A	N/A
Notification and Registrations	CO4890000017	DOE	Hazardous Waste	Notification of Regulated Waste Activity	CDPHE	DWOP	N/A	N/A
Notification and Registrations	CO3890090076	DOE	Hazardous Waste	Notification of Regulated Waste Activity	CDPHE	STM	N/A	N/A
Notification and Registrations	COD980805162	DOE	Hazardous Waste	Notification of Regulated Waste Activity	CDPHE	JSF	N/A	N/A
Notification and Registrations	COD983802448	DOE	Hazardous Waste	Notification of Regulated Waste Activity	CDPHE	NWTC	N/A	N/A
Notification and Registrations	COR000207563	DOE	Hazardous Waste	Notification of Regulated Waste Activity	CDPHE	ReFUEL	N/A	Issued Jan. 9, 2004
Notification and Registrations	001	DOE	Air: Ozone Depleting Substances	Registration of stationary appliances (1 SERF chiller)	CDPHE	SERF	N/A	Annual renewal due July 1

Type	Number	Permit or Reg Holder	Permit Type	Permit Description	Issuing Agency Name	Location Description	Expiration Date	Status
Notification and Registrations	002	DOE	Air: Ozone Depleting Substances	Registration of stationary appliances (1 SERF chiller)	CDPHE	SERF	N/A	Annual renewal due July 1
Notification and Registrations	N/A	DOE	Air: Ozone Depleting Substances	Facility Notification	CDPHE	STM, NWTC	N/A	Annual notification and fee due December 1
Notification and Registrations	1	DOE	Air: Ozone Depleting Substances	Registration of stationary appliance (chiller in DWOP)	CDPHE	DWOP	N/A	Annual renewal due July 1
Notification and Registrations	2873-001*	DOE	Above Ground Storage Tank	Registration of aboveground storage tanks	Colorado Dept. of Labor	STM--PDU Ethanol Storage Tank, SERF Emergency Generator Tank	N/A	Annual registration and fee, due April/May
Notification and Registrations	2873-002*	DOE	Above Ground Storage Tank	Registration of aboveground storage tanks	Colorado Dept. of Labor	STM--PDU Ethanol Storage Tank, SERF Emergency Generator Tank	N/A	Annual registration and fee, due April/May
Notification and Registrations	93000378	DOE	Historic Registration	National Register of Historic Places	National Park Service	Colorado Amphitheater	N/A	No expiration
Notification and Registrations	93000379	DOE	Historic Registration	National Register of Historic Places	National Park Service	Ammunition Igloo	N/A	No expiration

Type	Number	Permit or Reg Holder	Permit Type	Permit Description	Issuing Agency Name	Location Description	Expiration Date	Status
Notification and Registrations	AFP-CO-00255	DOE	Alcohol (not an environmental permit)	Alcohol Producer's Permit	Bureau of Alcohol, Tobacco, and Firearms	AFUF (PDU)	N/A	Annual renewal due July 1
Notification and Registrations	TF-CO-0331	DOE	Alcohol (not an environmental permit)	Industrial Alcohol User Permit	Bureau of Alcohol, Tobacco, and Firearms	NREL-wide	N/A	Annual renewal due July 1
Notification and Registrations	062008550086QS	MRI	Transportation	Hazardous Material Transportation	U.S. Department of Transportation	NREL-wide	6/30/2011	Three year renewal and fee
Notification and Registrations	85936	NREL	Registration	X-Ray Machine Certification Report	CDPHE	STM	Nov-2009	Active
Notification and Registrations	85937	NREL	Registration	X-Ray Machine Certification Report	CDPHE	STM	Nov-2009	Active
Notification and Registrations	85938	NREL	Registration	X-Ray Machine Certification Report	CDPHE	STM	Nov-2009	Active
Notification and Registrations	92056	NREL	Registration	X-Ray Machine Certification Report	CDPHE	STM	Nov-2008	Active
Permit	P15-07-00003	NREL	Permit	Surgarcane Bagasse	USDA APHIS	AFUF (PDU)	2/6/2010	Active

Appendix B

Common and Scientific Names of Wildlife Species Observed During Wildlife Surveys at the National Renewable Energy Laboratory South Table Mountain Site, Golden, Colorado.

Table B.1. Wildlife Species Observed at the National Renewable Energy Laboratory South Table Mountain Site, Golden, CO

COMMON NAME	SCIENTIFIC NAME
Reptiles	
Bull snake[1]	*Pituophis catenifer*
Plains garter snake	*Thamnophis radix*
Six-lined racerunner	*Cnemidophorus sexlineatus*
Tiger salamander	*Ambystoma tigrinum*
Western rattlesnake	*Crotalus viridus*
Birds	
American crow	*Corvus brachyrhynchos*
American kestrel	*Falco sparverius*
American robin	*Turdus migratorius*
American tree sparrow	*Spizella arborea*
Barn swallow	*Hirundo rustica*
Black-billed magpie	*Pica pica*
Black-capped chickadee	*Poecile atricapilla*
Black-crowned night heron	*Nycticorax nycticorax*
Blue jay	*Cyanocitta cristata*
Brewer's blackbird	*Euphagus cyanocephalus*
Brown headed cowbird	*Molothrus ater*
Bullock's oriole	*Icterus bullockii*
California gull	*Larus californicus*
Canada goose	*Branta canadensis*
Common nighthawk	*Chordeiles minor*
Common raven	*Corvus corax*
Common snipe	*Gallinago gallinago*
Cooper’s hawk	*Accipiter cooperii*
Dark-eyed junco	*Junco hyemalis*
Downy woodpecker	*Picoides pubescens*
European starling	*Sturnus vulgaris*
Flycatcher	*Empidonax sp.*
Golden eagle	*Aquila chrysaetos*
Great blue heron	*Ardea herodias*
Horned lark[1]	*Eremophila alpestris*
House finch	*Carpodacus mexicanus*
House sparrow	*Passer domesticus*
Killdeer	*Charadrius vociferous*
Lark bunting	*Calamospiza melanocorys*
Loggerhead shrike	*Lanius ludovicianus*
MacGillivray’s warbler	*Oporornis tolmiei*
Mallard	*Anas platyrhynchos*
Mountain bluebird	*Sialia currucoides*
Mourning dove	*Zenaida macroura*
Northern flicker	*Colaptes auratus*

COMMON NAME	SCIENTIFIC NAME
Northern harrier	*Circus cyaneus*
Osprey	*Pandion haliaetus*
Prairie falcon	*Falco mexicanus*
Red-breasted nuthatch	*Sitta canadensis*
Red-tailed hawk	*Buteo jamaicensis*
Red-winged blackbird	*Agelaius phoeniceus*
Rock dove	*Columba livia*
Rock wren	*Salpinctes obsoletus*
Say's phoebe	*Sayornis saya*
Sharp-shinned hawk	*Accipiter striatus*
Spotted towhee	*Pipilo maculates*
Swainson's hawk	*Buteo swainsoni*
Tree swallow	*Tachycineta bicolor*
Turkey vulture	*Cathartes aura*
Unidentified sparrow 1	-
Unidentified sparrow 2	-
Unidentified species	-
Unidentified warbler	-
Vesper sparrow	*Pooecetes gramineus*
Western kingbird	*Tyrannus verticalis*
Western meadowlark	*Sturnella neglecta*
Western scrub jay	*Aphelocoma californica*
White-crowned sparrow	*Zonotrichia leucophrys*
Mammals	
Black-tailed jackrabbit[1]	*Lepus californicus*
Bushy-tailed woodrat[1]	*Neotoma cinerea*
Coyote	*Canis latrans*
Deer mouse	*Peromyscus maniculatus*
Fox squirrel	*Sciurus niger*
Long-tailed weasel	*Mustela frenata*
Mexican woodrat	*Neotoma mexicana*
Mountain cottontail	*Sylvilagus nuttalli*
Mule deer	*Odocoileus hemionus*
Prairie vole	*Microtus ochrogaster*
Raccoon	*Procyon lotor*
Red fox	*Vulpes vulpes*
Western harvest mouse	*Reithrodontomys megalotis*
White-tailed jackrabbit	*Lepus townsendii*
Yellow-bellied marmot[1]	*Marmota flaviventris*

[1] Species observed during the 1987 survey, but not during the 2004-2005 surveys.

Appendix C

2007 master plan list for the National Renewable Energy Laboratory.

Table C.1. National Renewable Energy Laboratory Master Plant List, 2007

Family	Scientific Binomial	Common Name
Aceraceae - Maple Family	*Negundo aceroides*	Box elder
Aclepiadaceae - Milkweed Family	*Asclepias pumila*	Plains milkweed
Agavaceae - Agave Family	*Yucca glauca*	Yucca
Alliaceae - Onion Family	*Allium textile*	Wild onion
Alsinaceae - Chickweed Family	*Cerastrium strictum*	Mouse-ear
Alsinaceae - Chickweed Family	*Paronychia jamesii*	James' nailwort
Anacardiaceae - Sumac Family	*Rhus aromatica var. trilobata*	Skunkbrush
Anacardiaceae - Sumac Family	*Toxicodendron rydbergii*	Poison ivy
Apiaceae - Parsley Family	*Comiun maculatum*	Poison hemlock
Apocynaceae - Dogbane Family	*Apocynum cannabinum*	Indian hemp
Asclepiadaceae - Milkweed Family	*Asclepias incarnata*	Swamp milkweed
Asclepiadaceae - Milkweed Family	*Asclepias speciosa*	Showy milkweed
Asclepiadaceae - Milkweed Family	*Asclepias viridiflora*	Green flowered milkweed
Asparagaceae - Asparagus Family	*Asparagus officinalis*	Asparagus
Asteraceae - Sunflower Family	*Agoseris glauca*	False dandelion
Asteraceae - Sunflower Family	*Ambrosia psilostachya*	Western ragweed
Asteraceae - Sunflower Family	*Ambrosia trifida*	Giant ragweed
Asteraceae - Sunflower Family	*Arctium minus*	Common burdock
Asteraceae - Sunflower Family	*Artemisia biennis*	Sagewort
Asteraceae - Sunflower Family	*Artemisia dracunculus*	Dragon sagewort
Asteraceae - Sunflower Family	*Artemisia frigida*	Fringed sagebrush
Asteraceae - Sunflower Family	*Artemisia ludoviciana*	Prairie sagewort
Asteraceae - Sunflower Family	*Artemisia tridentata*	Big sagebrush
Asteraceae - Sunflower Family	*Aster porteri*	White aster
Asteraceae - Sunflower Family	*Aster sp.*	Aster
Asteraceae - Sunflower Family	*Brickellia eupatorioides*	Brickellia
Asteraceae - Sunflower Family	*Brickellia rosmarinifolia subsp. chlorolepis*	Brickellia
Asteraceae - Sunflower Family	*Carduus nutans*	Musk thistle
Asteraceae - Sunflower Family	*Centaurea diffusa*	Diffuse knapweed
Asteraceae - Sunflower Family	*Chrysothamnus nauseosus subsp. graveolens*	Rubber rabbitbrush
Asteraceae - Sunflower Family	*Cirsium arvense*	Canada thistle
Asteraceae - Sunflower Family	*Cirsium canescens*	Hairy thistle
Asteraceae - Sunflower Family	*Cirsium undulatum*	Wavyleaf thistle
Asteraceae - Sunflower Family	*Coreopsis tinctoria*	Plains coreopsis
Asteraceae - Sunflower Family	*Dyssodia papposa*	Fetid marigold
Asteraceae - Sunflower Family	*Erigeron colo-mexicanus*	Fleabane
Asteraceae - Sunflower Family	*Erigeron flagellaris*	Daisy fleabane
Asteraceae - Sunflower Family	*Gaillardia aristata*	Blanketflower
Asteraceae - Sunflower Family	*Grindelia inornata*	Rayless gumweed
Asteraceae - Sunflower Family	*Grindelia squarrosa*	Curlycup gumweed
Asteraceae - Sunflower Family	*Gutierrezia sarothrae*	Broom snakeweed
Asteraceae - Sunflower Family	*Helianthus annuus*	Common sunflower

Family	Scientific Binomial	Common Name
Asteraceae - Sunflower Family	*Helianthus pumilus*	Sunflower
Asteraceae - Sunflower Family	*Heterotheca villosa*	Hairy golden aster
Asteraceae - Sunflower Family	*Lactuca serriola*	Prickly lettuce
Asteraceae - Sunflower Family	*Lactuca tatarica subsp. pulchella*	Siberian lettuce
Asteraceae - Sunflower Family	*Liatris punctata*	Dotted gayfeather
Asteraceae - Sunflower Family	*Lygodesmia juncea*	Rush skeletonplant
Asteraceae - Sunflower Family	*Oligosporus pacificus*	Field sagewort
Asteraceae - Sunflower Family	*Onopordum acanthium*	Scotch thistle
Asteraceae - Sunflower Family	*Podospermum laciniatum*	False salsify
Asteraceae - Sunflower Family	*Ratibida columnifera*	Prairie coneflower
Asteraceae - Sunflower Family	*Ratibida tagetes*	Coneflower
Asteraceae - Sunflower Family	*Senecio integerrimus*	Grounsel
Asteraceae - Sunflower Family	*Solidago missouriensis*	Prairie goldenrod
Asteraceae - Sunflower Family	*Solidago mollis*	Soft goldenrod
Asteraceae - Sunflower Family	*Taraxacum officinale*	Common dandelion
Asteraceae - Sunflower Family	*Tragopogon dubius*	Goatsbeard
Asteraceae - Sunflower Family	*Xanthium strumarium*	Cocklebur
Boraginaceae - Borage Family	*Cynoglossum officinale*	Houndstongue
Boraginaceae - Borage Family	*Lithospermum incisum*	Narrowleaf gromwell
Boraginaceae - Borage Family	*Mertensia lanceolata*	Bluebells
Boraginaceae - Borage Family	*Onosmodium molle subsp. occidentale*	Marbleseed
Brassicaceae - Mustard Family	*Alyssum alyssoides*	Pale alyssum
Brassicaceae - Mustard Family	*Alyssum parviflorum*	Alyssum
Brassicaceae - Mustard Family	*Camelina microcarpa*	Small-seeded false flax
Brassicaceae - Mustard Family	*Descurainia pinnata*	Tansy mustard
Brassicaceae - Mustard Family	*Descurainia sophia*	Tansy mustard
Brassicaceae - Mustard Family	*Erysimum capitatum*	Western wallflower
Brassicaceae - Mustard Family	*Lesquerella ludoviciana*	Bladderpod
Brassicaceae - Mustard Family	*Physaria vitulifera*	Fiddle bladderpod
Brassicaceae - Mustard Family	*Sisymbrium altissimum*	Tumbling mustard
Brassicaceae - Mustard Family	*Thlaspi arvense*	Fanweed
Cactaceae - Cactus Family	*Coryphantha missouriensis*	Yellow pincushion
Cactaceae - Cactus Family	*Coryphantha vivipara var. vivipara*	Nipple cactus
Cactaceae - Cactus Family	*Echinocereus viridiflorus*	Hen-and-chicks
Cactaceae - Cactus Family	*Echinocerus triglochidialis*	Claret cup
Cactaceae - Cactus Family	*Opuntia fragilis*	Brittle cactus
Cactaceae - Cactus Family	*Opuntia macrorhiza*	Plains prickly pear
Cactaceae - Cactus Family	*Opuntia phaeacantha*	New Mexican prickly pear
Cactaceae - Cactus Family	*Opuntia polyacantha*	Plains prickly pear
Campanulaceae - Bellflower Family	*Campanula rotundifolia*	Common harebell
Caprifoliaceae - Honeysuckle Family	*Symphoricarpos occidentalis*	Western snowberry
Caryophyllaceae - Pink Family	*Vibernum lantana*	Wayfaring tree
Chenopodiaceae - Goosefoot Family	*Atriplex canescens*	Fourwing saltbush
Chenopodiaceae - Goosefoot Family	*Bassia sieversiana*	Kochia
Chenopodiaceae - Goosefoot Family	*Chenopodium album*	Common

Family	Scientific Binomial	Common Name
		lambsquarters
Chenopodiaceae - Goosefoot Family	*Chenopodium berlandieri*	Goosefoot
Chenopodiaceae - Goosefoot Family	*Salsola iberica*	Russian-thistle
Commelinaceae	*Tradescantia occidentalis*	Spiderwort
Convolvulaceae - Morning Glory Family	*Convolvulus arvensis*	Field bindweed
Crassulaceae - Stonecrop Family	*Amerosedum lanceolatum*	Yellow stonecrop
Cupressaceae - Cypress Family	*Sabina scopulorum*	Rocky mountain juniper
Cyperaceae - Sedge Family	*Carex brevior*	Sedge
Cyperaceae - Sedge Family	*Carex pensylvanica subsp. heliophila*	Sun sedge
Cyperaceae - Sedge Family	*Carex praegracilis*	Slender sedge
Cyperaceae - Sedge Family	*Carex sp.*	Sedge
Cyperaceae - Sedge Family	*Carex utriculata*	Sedge
Cyperaceae - Sedge Family	*Eleocharis elliptica var. compressa*	Spikerush
Cyperaceae - Sedge Family	*Eleocharis palustris*	Spike-rush
Cyperaceae - Sedge Family	*Scirpus sp.*	Bulrush
Dipsacaceae - Teasel Family	*Dipsacus sylvestris*	Teasel
Elaeagnaceae - Oleaster Family	*Elaeagnus angustifolia*	Russian-olive
Elaeagnaceae - Oleaster Family	*Shepherdia argentea*	Silverberry
Euphorbiaceae - Spurge Family	*Agaloma marginata*	Snow-on-the-mountain
Euphorbiaceae - Spurge Family	*Chamaesyce glyptopsperma*	Ridgeseed spurge
Euphorbiaceae - Spurge Family	*Poinsettia dentata*	Toothed spurge
Euphorbiaceae - Spurge Family	*Tithymalus brachyceras*	Spurge
Euphorbiaceae - Spurge Family	*Tithymalus montanus*	Spurge
Euphorbiaceae - Spurge Family	*Tragia ramosa*	Noseburn
Fabaceae - Pea Family	*Astragalus drummondii*	Drummonds milk vetch
Fabaceae - Pea Family	*Astragalus shortianus*	Milk vetch
Fabaceae - Pea Family	*Dalea candida*	White prairie clover
Fabaceae - Pea Family	*Dalea purpurea*	Purple prairie clover
Fabaceae - Pea Family	*Glycyrrhiza lepidota*	American licorice
Fabaceae - Pea Family	*Lathyrus eucosmus*	Elegant peavine
Fabaceae - Pea Family	*Lupinus argenteus*	Silver lupine
Fabaceae - Pea Family	*Medicago sativa*	Alfalfa
Fabaceae - Pea Family	*Melilotus officinalis*	Yellow sweetclover
Fabaceae - Pea Family	*Melilotus sp.*	Sweetclover
Fabaceae - Pea Family	*Oxytropis lambertii*	Lambert locoweed
Fabaceae - Pea Family	*Psoralidium tenuiflora*	Slimflower scurfpea
Fabaceae - Pea Family	*Thermopsis divaricarpa*	Prairie goldenpea
Fabaceae - Pea Family	*Vicia americana*	American vetch
Geraniaceae - Geranium Family	*Erodium cicutarium*	Filaree
Geraniaceae - Geranium Family	*Geranium caespitosum subsp. caespitosum*	Wild geranium
Grossulariaceae - Current Family	*Ribes aureum*	Golden current
Grossulariaceae - Current Family	*Ribes cereum*	Wax current
Helleboraceae - Hellebore Family	*Delphinium carolinianum subsp. virescens*	Prairie larkspur
Hydrophyllaceae - Waterleaf Family	*Phacelia heterophylla*	Scorpionweed
Hydrophyllaceae - Water-leaf Family	*Phacelia hastata*	Whiteleaf phacelia

Family	Scientific Binomial	Common Name
Juncaceae - Rush Family	*Juncus arcticus*	Rush
Juncaceae - Rush Family	*Juncus interior*	Rush
Juncaceae - Rush Family	*Juncus sp.*	Rush
Lamiaceae - Mint Family	*Mentha arvensis*	Fieldmint
Lamiaceae - Mint Family	*Monarda fistulosa*	Bee balm
Lamiaceae - Mint Family	*Nepeta cataria*	Catnip
Lamiaceae - Mint Family	*Scutellaria brittonii*	Britton's skullcap
Linaceae - Flax Family	*Adenolinum lewisii*	Wild flax
Loasaceae - Loasa Family	*Nuttalia nuda*	Blazingstar
Malvaceae - Mallow Family	*Malva neglecta*	Common mallow
Malvaceae - Mallow Family	*Sphaeralcea coccinea*	Scarlet globemallow
Nyctaginaceae - Four-o'clock Family	*Oxybaphus linearis*	Narrowleaf umbrellawort
Nyctaginaceae - Four-o'clock Family	*Oxybaphus nyctagineus*	Wild four-o'clocks
Oleaceae - Olive Family	*Fraxinus pensylvanica var. lanceolata*	Green ash
Onagraceae - Evening-primrose Family	*Epilobium brachycarpum*	Willowherb
Onagraceae - Evening-primrose Family	*Gaura mollis*	Gaura
Onagraceae - Evening-primrose Family	*Gaura parviflora*	Smallflower gaura
Papaveraceae - Poppy Family	*Argemone hispida*	Hairy poppy
Pinaceae - Pine Family	*Pinus edulis*	Pinon pine
Pinaceae - Pine Family	*Pinus ponderosa*	Ponderosa pine
Plantaginaceae - Plantain Family	*Plantago major*	Common plantain
Plantaginaceae - Plantain Family	*Plantago patagonica*	Woolly plantain
Poaceae - Grass Family	*Aegilops cylindrica*	Jointed goatgrass
Poaceae - Grass Family	*Agropyron cristatum*	Crested wheatgrass
Poaceae - Grass Family	*Agropyron intermedium*	Intermediate wheatgrass
Poaceae - Grass Family	*Agrostis stolonifera*	Redtop
Poaceae - Grass Family	*Andropogon gerardii*	Big bluestem
Poaceae - Grass Family	*Anisantha tectorum*	Cheatgrass
Poaceae - Grass Family	*Aristida purpurea*	Three-awn
Poaceae - Grass Family	*Bouteloua curtipendula*	Side-oats grama
Poaceae - Grass Family	*Bromopis inermis*	Smooth bromegrass
Poaceae - Grass Family	*Bromus japonicus*	Japanese brome
Poaceae - Grass Family	*Buchloë dactyloides*	Buffalograss
Poaceae - Grass Family	*Chondrosum gracile*	Blue grama
Poaceae - Grass Family	*Critesion jubatum*	Foxtail barley
Poaceae - Grass Family	*Dactylis glomerata*	Orchard grass
Poaceae - Grass Family	*Echinochloa crusgalli*	Barnyard grass
Poaceae - Grass Family	*Elymus canadensis*	Canada wild rye
Poaceae - Grass Family	*Elymus lanceolatus subsp. psammophilus*	Streambank wheatgrass
Poaceae - Grass Family	*Elymus trachycaulus ssp. trachycaulus*	Slender wheatgrass
Poaceae - Grass Family	*Festuca sp.*	Fescue
Poaceae - Grass Family	*Hesperostipa comata*	Needle-and-thread
Poaceae - Grass Family	*Lophopyrum elongatum*	Tall wheatgrass
Poaceae - Grass Family	*Muhlenbergia richardsonis*	Mat muhly
Poaceae - Grass Family	*Panicum capillare*	Witchgrass

Family	Scientific Binomial	Common Name
Poaceae - Grass Family	*Panicum virgatum*	Switchgrass
Poaceae - Grass Family	*Pascopyrum smithii*	Western wheatgrass
Poaceae - Grass Family	*Phleum pratense*	Common Timothy
Poaceae - Grass Family	*Poa compressa*	Canada bluegrass
Poaceae - Grass Family	*Poa pratensis*	Kentucky bluegrass
Poaceae - Grass Family	*Poa secunda*	Canby bluegrass
Poaceae - Grass Family	*Schedonnardus paniculatus*	Tumblegrass
Poaceae - Grass Family	*Schizachyrium scoparium*	Little bluestem
Poaceae - Grass Family	*Setaria viridis*	Green floxtail
Poaceae - Grass Family	*Seteria glauca*	Yellow foxtail
Poaceae - Grass Family	*Sorghastrum nutans*	Indian-grass
Poaceae - Grass Family	*Sporobolus cryptandrus*	Sand dropseed
Poaceae - Grass Family	*Sporobolus sp.*	Dropseed
Poaceae - Grass Family	*Stipa viridula*	Green needlegrass
Poaceae - Grass Family	*Vulpia octoflora*	Six-weeks fescue
Polemoniaceae - Phlox Family	*Ipomopsis aggregata subsp. candida*	Gilia
Polygonaceae - Buckwheat Family	*Eriogonum annuum*	Annual eriogonun
Polygonaceae - Buckwheat Family	*Eriogonum effusum*	Spreading wild buckwheat
Polygonaceae - Buckwheat Family	*Eriogonum flavum*	Yellow wild buckwheat
Polygonaceae - Buckwheat Family	*Eriogonum umbellatum*	Wild buckwheat
Polygonaceae - Buckwheat Family	*Persicaria maculata*	Lady's thumb
Polygonaceae - Buckwheat Family	*Pterogonum alatum*	Winged buckwheat
Polygonaceae - Buckwheat Family	*Rumex crispus*	Curly dock
Ranunculaceae - Buttercup Family	*Clematis ligusticifolia*	Virgin's bower
Ranunculaceae - Buttercup Family	*Ranculus abortivus subsp. acrolasius*	Buttercup
Rhamnaceae - Buckthorn Family	*Ceanothus fendleri*	Buckbrush
Rosaceae - Rose Family	*Cercocarpus montanus*	Mountain-mahogany
Rosaceae - Rose Family	*Crataegus macracantha var. occidentalis*	Western hawthorn
Rosaceae - Rose Family	*Drymocallis fissa*	Cinquefoil
Rosaceae - Rose Family	*Oreobatus deliciosus*	Boulder raspberry
Rosaceae - Rose Family	*Padus virginiana subsp. melanocarpa*	Chokecherry
Rosaceae - Rose Family	*Prunus americana*	Wild plum
Rosaceae - Rose Family	*Pyrus malus*	Apple
Rosaceae - Rose Family	*Rosa arkansana*	Prairie rose
Rosaceae - Rose Family	*Rosa woodsii*	Woods rose
Rubiaceae - Madder Family	*Galium spurium*	Cleavers
Salicaceae - Willow Family	*Populus deltoides*	Plains cottonwood
Salicaceae - Willow Family	*Populus x acuminata*	
Salicaceae - Willow Family	*Salix amygdaloides*	Peach-leaf willow
Salicaceae - Willow Family	*Salix exigua*	Sandbar willow
Salicaceae - Willow Family	*Salix fragilis*	Crack willow
Salicaceae - Willow Family	*Salix lutea*	Yellow willow
Santalaceae - Sandelwood Family	*Commandra umbellata*	Bastard-toadflax
Scrophulariaceae - Figwort Family	*Castilleja integra*	Indian paintbrush
Scrophulariaceae - Figwort Family	*Linaria genistifolia subsp.*	Dalmatian toadflax

Family	Scientific Binomial	Common Name
	dalmatica	
Scrophulariaceae - Figwort Family	*Penstemon virgatus*	Penstemon
Scrophulariaceae - Figwort Family	*Penstmon angustifolius*	Narrow beardtongue
Scrophulariaceae - Figwort Family	*Scrophularia lanceolata*	Figwort
Scrophulariaceae - Figwort Family	*Verbascum thapsus*	Common mullein
Scrophulariaceae - Figwort Family	*Veronica catenata*	Speedwell
Selaginellaceae - Little Club-moss Family	*Selaginella densa*	Little club moss
Solanaceae - Nightshade Family	*Physalis virginiana*	Virginia ground-cherry
Typhaceae - Cattail Family	*Typha angustifolia*	Narrow-leaved cattail
Typhaceae - Cattail Family	*Typha latifolia*	Common cattail
Ulmaceae - Elm Family	*Celtis reticulata*	Netleaf hackberry
Ulmaceae - Elm Family	*Ulmus pumila*	Chinese elm
Verbebaceae - Verbena Family	*Verbena bracteata*	Prostrate verbena
Zygophyllaceae - Caltrop Family	*Tribulus terrestris*	Puncturevine

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This report presents a summary of NREL's environmental protection programs and activities for 2007. It is organized according to the different environmental media (e.g., air, waste, ground water, etc.), and includes a brief summary of how the program is managed in that area, any permitting or notification efforts that have been completed during the reporting period or are ongoing, and activities that have occurred during the reporting period in that environmental area. A description of the environmental condition and features of NREL's sites is also included to provide a basis for the program overview.

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