

# **NATIONAL RENEWABLE ENERGY LABORATORY**

## **ENVIRONMENTAL PERFORMANCE REPORT for 2006**

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



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

NREL is a national laboratory of the  
U.S. Department of Energy and is  
Operated by Midwest Research Institute and Battelle

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*Cover Photo contributed by NREL Employee Ruth Baranowski, 2007: NWTC early morning view of double rainbows over the Flatirons*

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## 1 INTRODUCTION

The National Renewable Energy Laboratory (NREL) is a U.S. Department of Energy (DOE) national laboratory, and conducts research primarily for DOE's Office of Energy Efficiency and Renewable Energy (EERE). The Midwest Research Institute (MRI) and Battelle operate NREL under the oversight of the DOE Golden Field Office (GO). 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.

### *Purpose*

This report presents a summary of NREL's environmental protection programs and activities for 2006. 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.

### *Background*

NREL's mission: NREL develops renewable energy and energy efficiency technologies and practices, advances related science and engineering, and transfers 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.

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

*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.

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

*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.

*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.

*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, and environmentally acceptable building equipment and envelope systems.

*Hydrogen:* NREL serves as a leader in renewable hydrogen production technologies as well as in advanced storage and sensor development, and 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.

*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.

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

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

*Electricity Technologies:* These technologies include renewable energy, hydrogen, and superconductivity technologies, plus utility resources.

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

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

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



### 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 National Wind Technology Center (NWTC). The Renewable Fuels and Lubricants Research Laboratory (ReFUEL) is located within the city limits of Denver. The DWOP and STM sites are approximately 2 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. It is adjacent to the former DOE Rocky Flats Environmental Technology Site. The JSF is located at 6800 Joyce Street, approximately 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 31<sup>st</sup> 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. These two sites 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.

### 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 South Table Mountain and Denver West Office Park sites, and Figures 1.9 and 1.10 provide images of the National Wind Technology Center site. The views on the STM site also illustrate the Conservation Easement property and the Camp George West property acquired in 1999.

### Climate

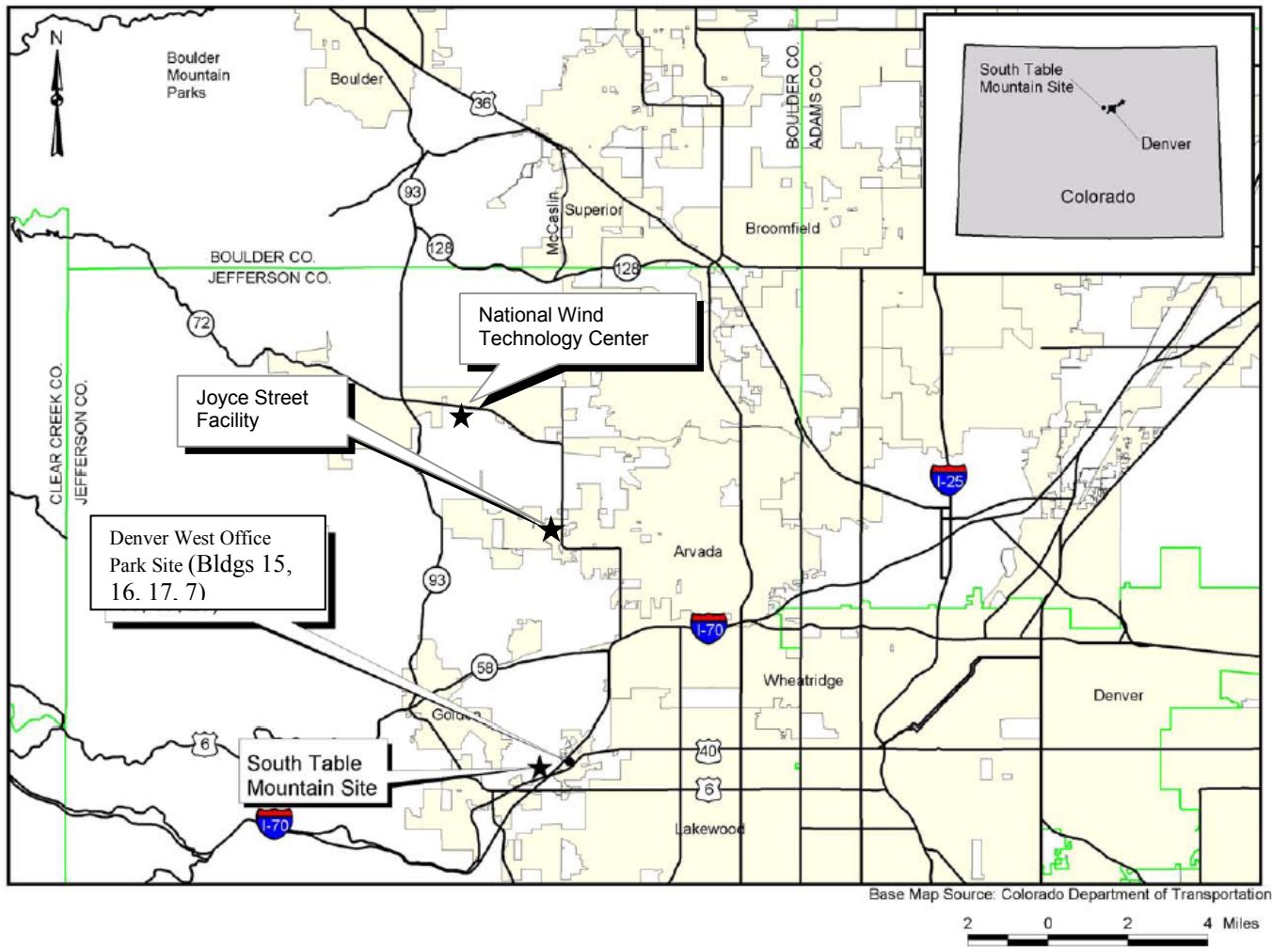
The climate for the geographic region of NREL operations is classified as semi-arid, typified by limited precipitation, low relative humidity, abundant sunshine, and large daily and seasonal temperature variations.

The area experiences moderate precipitation, with an average annual rainfall of less than 50 cm (20 in). 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 in.).

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 and season to season.



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



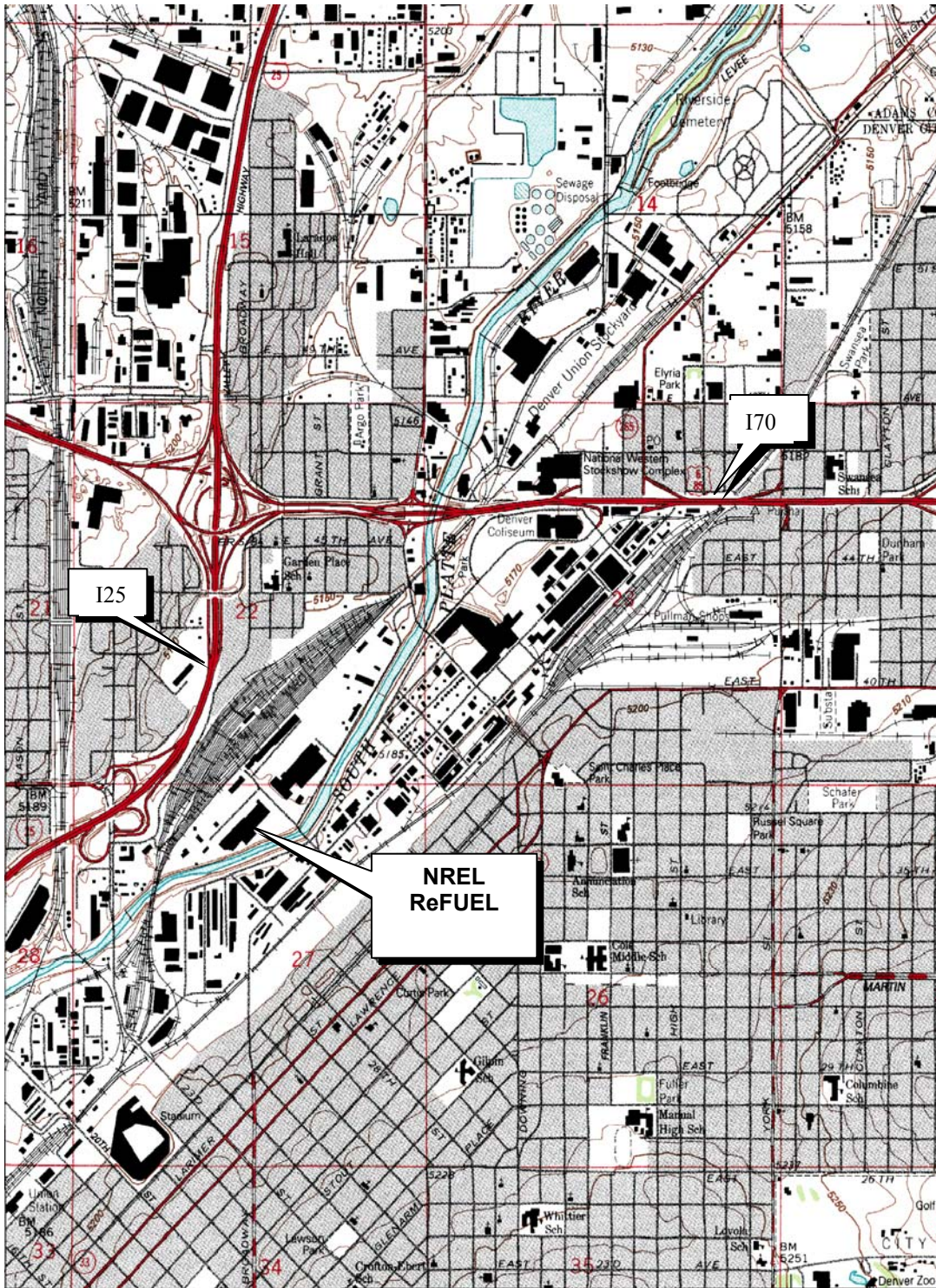


Figure 1.2. ReFUEL Facility Location Map, located in Denver County, CO.



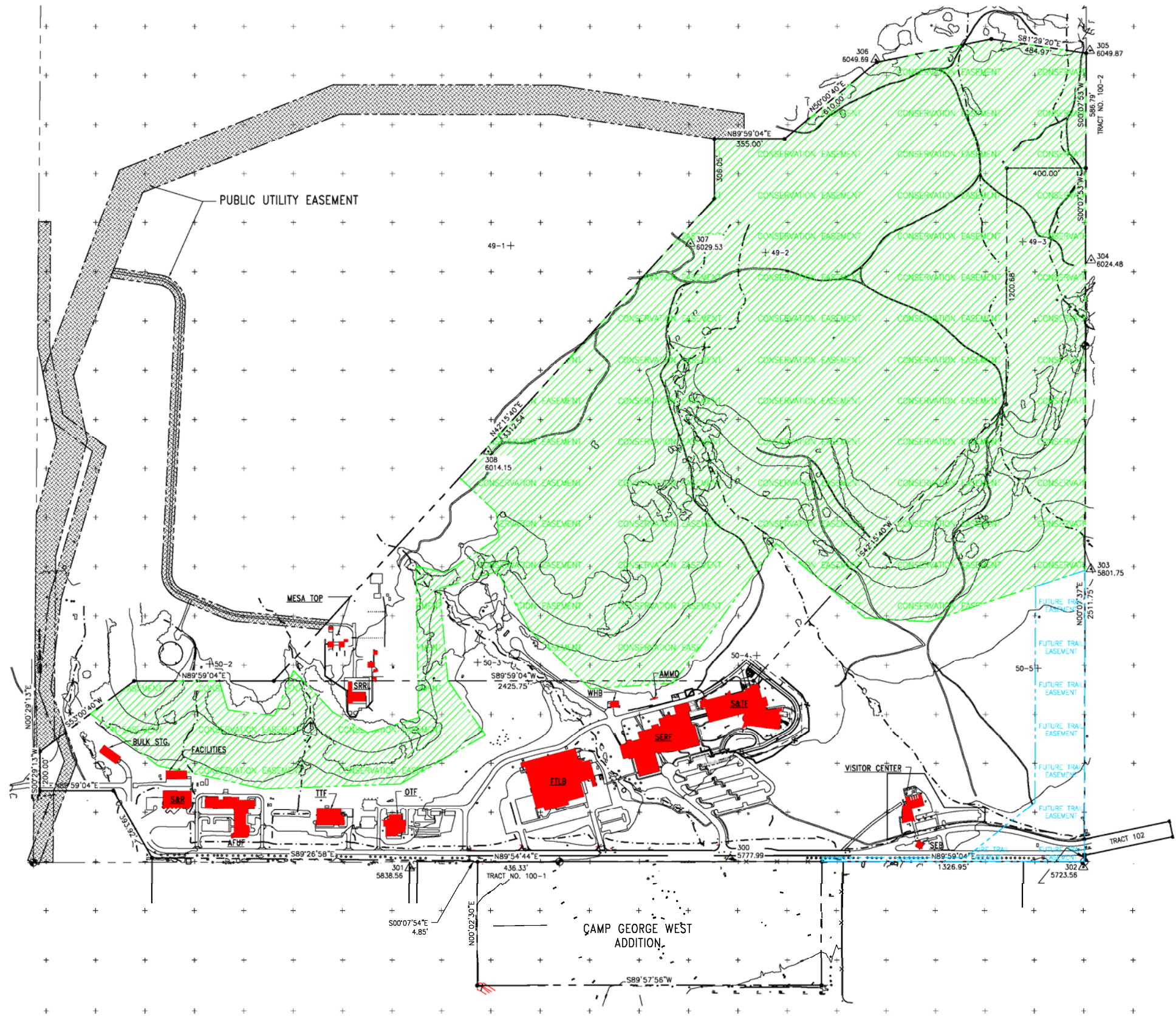


Figure 1.3. STM Site Detail.

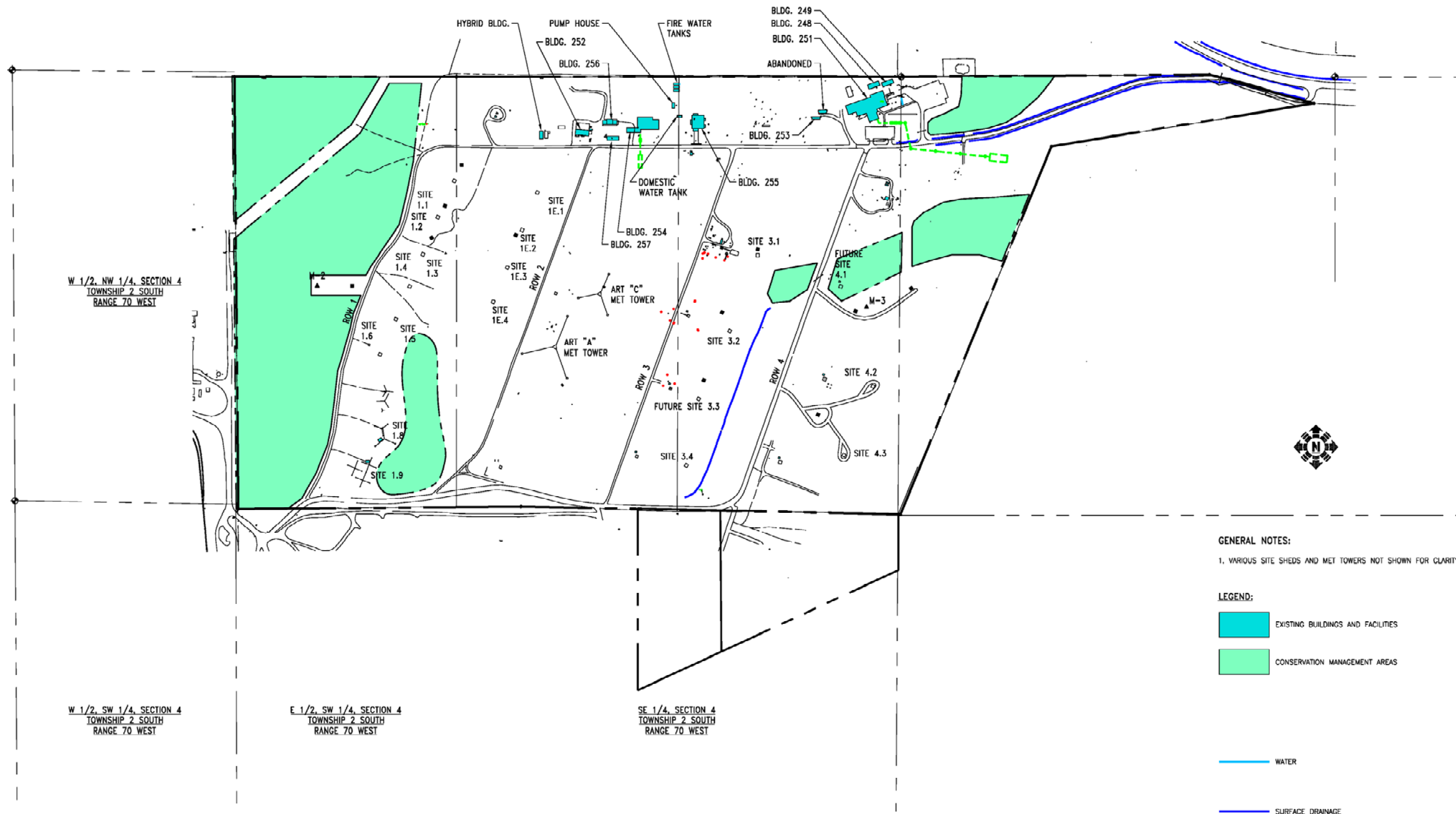


Figure 1.4. NWTC Site Detail.

## ***1.1 South Table Mountain Site***

### *Geology, Soils, and Hydrogeology*

The STM site is a roughly triangular parcel of land occupying portions of the top, sides, and lower south-facing slopes of South Table Mountain. South Table Mountain is composed of sedimentary rocks below a basalt lava cap, which is quite resistant to erosion. The South Table Mountain 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 South Table Mountain, 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 South Table Mountain is Lavina Loam. A 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 South Table Mountain 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.

### *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.

### *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. Recent 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.

### *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 new 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. NREL personnel have reported numerous sightings of snakes as well as a golden eagle. Amphibian species are known to inhabit the area as well.

### *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).

## **1.2 National Wind Technology Center**

### *Geology, Soils, and Hydrogeology*

The 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).

#### *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.

#### *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 Service, 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.

#### *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 5.10). Although seldom seen, rattlesnakes, bull snakes, racers, and several other reptilian and amphibian species are known to occupy the area.

### *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 Denver West Office Park***

The 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 DWOP are located approximately in the geographic center of the development. 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.

### ***1.4 Joyce Street Facility***

The 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. No support activities and only occasional research activities are currently conducted at the facility, and there are no staff offices at JSF.

### ***1.5 Renewable Fuels and Lubricants Research Laboratory***

The 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.



**Figure 1.5. South Table Mountain Site –West end of the site.**



**Figure 1.6. South Table Mountain Site – East view.**



**Figure 1.7. South Table Mountain Site – NW and mesa top view. The Colorado State Highway Patrol pursuit driver-training facility is located on the right side of the photo.**



**Figure 1.8. South Table Mountain 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*

#### *Air Quality Protection*

The Colorado Department of Public Health and Environment (CDPHE) administers 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 does not have a major source for air pollutants on site, but does hold two site-wide permits for particulate air emissions from construction and one air emissions permit for a pilot scale research project. Detailed information about NREL's air quality protection program is provided in Section 5.1.

National Emissions Standards for Hazardous Air Pollutants (NESHAPs) requirements specific to radiological emissions from DOE facilities are regulated by the EPA. NREL's potential emissions are calculated annually using a computer model, and are well below the threshold level. Details are provided in section 5.15.

*In 2006, NREL had no air quality compliance issues.*

#### *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.

#### *Groundwater Quality Protection*

Colorado groundwater standards are established by the Colorado Department of Natural Resources. That department also issues permits for groundwater wells. 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 2006, NREL had no ground water compliance issues.*

### *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 Metro Wastewater Reclamation District (Metro). Federal and State Clean Water Acts implementing wastewater discharge regulations are administered at NREL's STM and DWOP via Pleasant View and Metro 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 2006, NREL had no wastewater compliance issues.*

### *Surface Water Quality Protection*

The authority for implementing storm water 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 storm water discharge from construction areas. Permit coverage for individual NREL activities is obtained when permit thresholds are triggered based on factors such as acreage involved, slope, and soil characteristics.

During 2006, two small construction projects (less than 0.25 acres each) were undertaken at the NWTC. Neither of these projects required permitting. As a best management practice and to be consistent with NREL policy, an Erosion and Sediment Control Plan was developed for each project to address possible stormwater issues. At the STM, a Notice of Intent was filed with the EPA in 2005 for the 8.5 acre construction zone of the S&TF. This project was managed under the EPA's Construction General Permit Program. Vegetative coverage has not achieved 70% in an area adjacent to the facility due to foundation repair activities in spring 2007. A Notice of Termination is anticipated to be filed in mid-CY08. Details of NREL's surface water protection program are provided in Section 5.5.

### *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 ID 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.

*In 2006, NREL had no waste management compliance issues.* A hazardous waste management inspection by CDPHE was conducted in late August 2006. The final report and follow-up actions are discussed in Section 5.6.

### *Storage Tanks*

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

A state inspection of NREL's regulated ASTs was conducted in 2006. A field Violation Report was issued for insufficient tank grounding on one tank. The issue was satisfactorily resolved within one week. *No spills or releases from NREL's ASTs occurred during 2006.*

### *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, Migratory Bird Treaty Act, and 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 Section 5.11.

*In 2006, NREL had no compliance issues regarding wildlife.*

### *EPCRA Compliance and Prevention of Toxic Releases*

Executive Order (EO) 13148 outlines requirements for SARA Title III, Emergency Reporting and Community Right-to-Know Act (EPCRA) compliance and Toxic Release Inventory reductions for government 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 2006, 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, and during 2006, 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, including an Emergency Response Team Program (8-4.1), for credible on-site emergencies. Hazardous material releases are specifically called out 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.



### *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 on its STM Site. There are no known eligible sites at the NWTC. In 2007, the DOE Golden Field Office and NREL conducted cultural resource surveying associated with the Environmental Assessment (EA) for three site development projects on the NREL STM Site (see Section 5.14).

*In 2006, NREL had no compliance issues regarding cultural resources.*

## **2.2 DOE Order 450.1, Environmental Protection Program**

DOE Order 450.1 requires sites to implement Environmental Management Systems (EMSs) by integrating them with the site's Integrated Safety Management System. Sites were required to have an EMS in place by December 31, 2005. NREL's implementation of its EMS is described in Section 4.0 of this report.

## **2.3 Executive Orders**

### *Executive Order 13423, Strengthening Federal Environmental, Energy, and Transportation Management*

On January 24, 2007, the President signed Executive Order (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 has been working on a Transformational Energy Action Management (TEAM) Initiative to create and implement a plan designed to expedite attainment of the requirements imposed by the EO. Application of EO 13423's objectives will be discussed in NREL's 2007 Environmental Performance Report.

Although EO 13423 supersedes EO 13148 and EO 13201, the two superseded orders will be discussed here as they were in effect in 2006.

### *Executive Order 13148*

In March 2000, EO 13148, Greening the Government Through Leadership in Environmental Management was issued, requiring that all Federal agencies ensure that environmental accountability is integrated into day-to-day decision making and long-term planning processes. In February 2001, DOE issued a notice (DOE N 450.4) outlining requirements for DOE contractors under EO 13148. NREL's compliance with these requirements is explained below.

Specific requirements under EO 13148 require federal facilities to develop and implement environmental management systems, comply with environmental regulations, report as required under EPCRA, reduce the release and use of toxic chemicals, practice pollution prevention, reduce the use of ozone-depleting substances (ODSs) by

maximizing the purchase and use of safe alternatives, and implementing sustainable landscaping practices to reduce adverse impacts on the environment.

Details of NREL's Environmental Management System (EMS) and information on the environmental programs that implement the EMS are provided in Sections 4.0 and 5.0, respectively. Compliance with environmental regulations at NREL, including EPCRA is described in Section 2.1, above. ODS and alternative use at NREL are outlined in Section 5.1, and sustainable landscaping is discussed in Section 5.10.

*Executive Order 13201, Greening the Government Through Waste Prevention, Recycling, and Federal Acquisition*

NREL enters data on its recycling and affirmative procurement (environmentally preferable purchasing) activities into DOE's pollution prevention web-based database on an annual basis. A discussion of NREL's pollution prevention and sustainability activities can be found in Section 5.9.

*Executive Order 11988, Floodplains Management*

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.

*Executive Order 11990, Wetlands Protection*

Limited wetland areas totaling less than 0.3 ha (0.75 ac) 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 ha (1 ac).

*In 2006, NREL had no compliance issues regarding environment-related Executive Orders.*

## **2.4 Permit Summary**

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

### 3 ENVIRONMENTAL OCCURRENCES

There were three incidents with environmental implications during 2006 at the STM and NWTC sites reported through ORPS.

#### ***Offsite Wildland Fire in Proximity to the NREL NWTC***

A wildland fire started near the intersection of Colorado State Highways 72 and 93 in the evening of January 10, 2006. At the time, the origin of the fire was approximately 2.5 miles southwest of NREL's NWTC. Due to high winds (30 – 60 mph) experienced overnight, the fire grew to approximately 2700 acres by 06:00 (MTZ) the morning of January 11, 2006. By that time, more than 175 firefighters from 25 separate fire agencies were working to contain the fire. At 08:00 (MTZ), the NREL Facility Manager determined that due to existing conditions and National Weather Service predictions for high winds, the fire posed a potential threat to assets at the NWTC. Notifications were initiated per ORPS requirements. The fire was 80% contained by 10:00 (MTZ) and was determined to no longer pose a threat to the NWTC by fire authorities. On scene estimates indicate that the fire approached within 1-mile of the NWTC. Site evacuation was not necessary. There were no NREL injuries or property damage.

#### ***Wildland Fire East of NREL NWTC***

A wildland fire burned an estimated 1600 acres near the former DOE RFETS site Sunday, April 2, 2006. The fire was discovered at approximately 13:30 (MTZ) and is believed to have started at a point approximately 1.2 miles east of the NREL NWTC. The fire was fanned by high winds gusting between 30-50 mph, according to the National Weather Service. Prevailing winds pushed the fire to the east/southeast, away from the NWTC. Approximately 100 firefighters from multiple agencies battled the fire. Authorities evacuated 135 homes by 16:00 hours (MTZ) and the fire was 100% contained by 18:00 (MTZ). Preliminary reports indicate that the fire started at an electrical utility pole located in a field south of Colorado State Highway 128, approximately 1.2 miles east of the NWTC. There were no NREL injuries or structural damage attributed to the fire.

#### ***SERF Above-Ground Storage Tank Field Violation Report***

An inspector from the Colorado Department of Labor and Employment, Division of Oil and Public Safety arrived on the NREL STM Site on Friday, April 28, 2006 to conduct an unannounced inspection of state regulated above-ground storage tanks (ASTs). NREL has two ASTs regulated by the State of Colorado; one empty 6,000 gallon ethanol tank, located at the AFUF Process Development Unit, and one 800 gallon fuel tank to support an emergency generator for the SERF. The state inspector, accompanied by the SERF Building Area Engineer, indicated that, based on a visual inspection, the 800 gallon fuel tank may not have been sufficiently grounded, and issued a Field Violation Report. The tank is a flat tank; the emergency generator sits on top of the tank as a single unit. State inspections conducted in 1997, 1998, and 1999 did not identify a grounding non-compliance with either regulated tank. They found the ASTs to be installed in accordance with the Colorado regulation pertaining to grounding that requires that, "All equipment such as tanks, machinery and piping, where an ignitable mixture may be present, shall be bonded or connected to a ground." NREL has conducted previous visual inspections of

the tank and generator system that specifically evaluated the grounding adequacy. Based on these inspections, it appeared to the NREL inspector that the tank was properly grounded by metal-to-metal contact with the generator, and was therefore in compliance with the Colorado State AST regulations. An additional ground was added to the tank.

Other environmental issues and actions in CY2006 include the following:

***Voluntary Self Assessment Conducted on the SERF Storage Tanks***

As a standard operating procedure, all tanks larger than 110 gallons are visually inspected at least once per month. In addition, during CY2006, the NREL inspector conducted self assessments on the storage tanks at the STM - SERF.

***Increased Monitoring due to Exceedance of TTHMs MCL***

On October 12, 2006, CDPHE notified NREL that the annual result for total trihalomethanes (TTHM) exceeded the applicable maximum contaminant level (MCL), and required an increase in monitoring from an annual sample to quarterly samples. The result for the sample collected in August 2006 was 0.082 mg/L; the MCL is 0.080 mg/L. CDPHE wrote that “NREL must increase monitoring from yearly to quarterly monitoring beginning in the fourth quarter of 2006 for both disinfection byproducts (TTHM and HAA5).” While the haloacetic acid (HAA5) result had been within the applicable MCL, the CDPHE program required increased monitoring for both sets of disinfection byproducts. NREL immediately directed the operator to collect quarterly samples for TTHMs and HAA5s. The first sample was collected in November 2006, and the results were below the applicable MCLs. Collection of the quarterly samples will continue in 2007.

***State of Colorado RCRA inspection of STM Site***

In August of 2006, two representatives of the Colorado Department of Public Health and Environment (CDPHE) conducted an RCRA inspection of the South Table Mountain facilities. In addition to inspecting waste generating areas in labs, the waste handling facility, and the newly opened Science and Technology Facility, the inspectors also reviewed employee training records and the ESH&Q hazardous waste records. The items noted by the CDPHE inspectors were minor in nature and no enforcement actions were taken as a result of the visit. All identified issues have been corrected.

## 4 ENVIRONMENTAL MANAGEMENT SYSTEM

### 4.1 Description

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

#### ***1 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.

### 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 Environment, Safety, Health & 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 450.1 to implement its EMS as part of an Integrated Safety Management (ISM) System. The Environmental Management Policy (6-2) and 19 supporting laboratory-level environmental programs that define the NREL EMS have been coordinated and linked with the ISM Policy (2-1), the ES&H Policy (6-1), the supporting ES&H Policies (6-3 through 6-6), the Sustainable NREL Policy (2-7), and approximately 40 supporting lab-level safety and health programs. 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).

### *Notable 2006 Activities*

In 2006, NREL continued progressing toward our NEPT/CELP environmental performance commitments. In early 2004, NREL was accepted into the EPA National Environmental Performance Track (NEPT) Program and the Colorado Environmental Leadership Program (CELP). The NEPT program is a national voluntary partnership between the EPA and participating private and public U.S. facilities that recognizes environmental leadership and performance; the CELP program is a similar state-level voluntary partnership. As a component of these programs, each year NREL sets voluntary performance goals in an effort to further enhance environmental performance at the laboratory. NREL was one of the first two DOE national laboratories to be accepted into NEPT. NREL decided to forego additional participation in the NEPT program beyond CY2006, and will reapply for continued participation and recognition in the State of Colorado's CELP. CY2006 progress is discussed in detail in Section 4.2.

In August 2007, NREL voluntarily invited a third-party auditor to assess the EMS. The assessment served as a gap analysis between the existing NREL EMS and the revised ISO 14001 – 2004 standard. Discussion of the report will occur in the CY2007 Environmental Performance Report.

### *Public Outreach*

The National Renewable Energy Laboratory (NREL) hosted several public meetings to report on and discuss environmental performance and other issues. In 2006, the public was invited to a Smart Energy Living Expo at the NREL Visitors Center on June 10. More than 750 people attended and were provided with information on renewable energy and energy efficient technologies for their homes. Fifteen vendors showcased a variety of energy products. The DOE-sponsored "Energy Hog" conducted shows for kids and parents along with other activities for families.

NREL and DOE's Golden Field Office (GO) hosted a Community Meeting on Nov. 14, inviting community members to learn about the Laboratory's 2007 outlook and site

development plans. More than 90 community members attended and toured NREL's newest building, the Science and Technology Facility (S&TF). Copies of presentations made by NREL Deputy Director Bill Glover and GO's Assistant Manager for Laboratory Operations Jeff Baker were made available online.

A February 2006 community newsletter announced construction on the S&TF had moved inside and construction was 85 percent completed. The May 2006 community newsletter announced construction was almost complete and a ribbon cutting ceremony was planned for July.

A special Web site was maintained by the Public Relations Office, providing the community with periodic updates on S&TF construction. A phone number was also set up to provide construction updates and to allow members of the community to relay any concerns they might have about the project.

A series of "power lunches" open to the public are held at the Visitors Center. In 2006, topics included advanced vehicle technologies, residential solar, and climate change. In all, approximately 15,488 people passed through NREL's Visitors Center. All are required to sign in, and space is provided on the sign-in sheet for comments. Concerns about the lab's environmental performance are relayed to appropriate staff.

In addition, the lab's public website, [www.nrel.gov](http://www.nrel.gov), features a "Sustainable NREL" link, where the public can find copies of NREL's Sustainability Reports.

Visits to NREL by elected officials are common. In past years, the laboratory has hosted visits by President George W. Bush, congressional staffers, mayors, and many other local government leaders. NREL hosted two breakfasts for Jefferson County government leaders in FY06, and no environmental performance issues were raised.

#### ***4.2 Performance Indicators and Progress***

##### *2006 Environmental Objectives and Progress Toward Goals*

Each fiscal year, in collaboration with the DOE Golden Field Office (DOE-GO), NREL develops environmental objectives for the upcoming year as part of the lab's One-Year Plan. For fiscal year 2006, the ambitious objectives were the following:

- Complete self-certification of EMS - ISM integration in conjunction with the Golden Field Office to meet the December 30, 2005 deadline as required by DOE Order 450.1, *Environmental Protection Program*.
- Conduct independent assessment of ISM implementation and develop gap analysis.
- Conduct evaluation of the lab-wide chemical inventory management system and identify improvements.
- Conduct validation of lab-wide chemical inventory.
- Evaluate and close-out open action items from previous Golden Office Surveillances.
- Participate in GO Surveillance Program.
- Demonstrate progress towards achieving NEPT goals.

- Support GO in conducting the environmental reviews associated with site build-out activities.

NREL has successfully completed each of the eight objectives listed above. Please see Sections 4.3, 5.0, and specifically 5.8 and 5.9 for additional information on assessments, environmental programs, and specifically chemical inventory, pollution prevention, and sustainability. The four NEPT goals for completion in CY2006 are stated below, with supporting progress noted in this Environmental Performance Report in Section 5.9 on Pollution Prevention and Sustainability.

Sustainable NREL and EMS staff worked together to compile pollution prevention data on waste generation, recycling, and green purchasing. In 2006, NREL received the following awards:

- Honorable Mention for the White House Closing the Circle Pollution Prevention Award.
- Federal Energy Saver Showcase Award for the S&TF.
- Jefferson County Commissioners' Award for Design Excellence – S&TF.
- U.S. EPA Climate Protection Award.

#### *National Environmental Performance Track Commitments*

NREL's performance commitments under the NEPT program are 3-year commitments, to be in place throughout NREL's 3-year participation in the program, from 2004 through the end of 2006. NREL's commitments are as follows.

*Commitment #1:* Reduce emissions of greenhouse gases by 10% from the 2002 baseline year.

NREL has met the Performance Track commitment of a 10% reduction in CO<sub>2</sub> emissions. The assumptions used for GHG emissions data are: 1) data reflects both NREL/DOE-owned and leased facilities, as reflected in NREL's data submitted to the EPA Climate Leaders Program, 2) electric, natural gas, commuter, air travel, fleet, solid waste, and water emissions were considered, 3) commitment to a 10% reduction in CO<sub>2</sub> emissions from the baseline, 4) data includes renewable energy credit (REC) offsets, and 5) the addition of the 71,000 sq ft S&TF required normalizing by square footage. In FY06, REC purchases offset the entire laboratory CO<sub>2</sub> footprint.

*Commitment #2:* Reduce water use by 20% from the 2002 baseline year.

NREL's original 2006 performance commitment was to reduce water use by 5%, in order to achieve a goal of 10,181,625 gallons. NREL extended its commitment to reduce water use further because NREL's water use was so low in FY2004. As it turned out, NREL's 2004 water used appeared to be low due to inaccurate billing of water consumption at the SERF from the water utility company. The SERF is approximately 45% of the overall water utility bill, and the FY04 SERF water values were determined through a combination of existing water sub-meters data and estimating the annual water consumptions at the evaporative coolers, irrigation system, and plumbing fixtures at the facility. FY05 numbers represent a more accurate view of yearly water consumption at the laboratory. In FY06, there was an 18% increase in water usage compared to the FY00 baseline water usage. As a result, NREL did not meet either the original NEPT goal or



the extended goal. The increase in water usage is due to the newly constructed S&TF coming on line in April 2006. The majority of the increase can be attributed to the S&TF cooling tower, evaporative coolers, and the irrigation system required to stabilize the site in accordance with the EPA storm water general permit. Water data is for NREL/DOE owned sites only, so a different normalizing factor is used compared to commitments where data includes both leased and owned facilities.

*Commitment #3:* Reduce emissions of carbon monoxide.

Carbon monoxide data for 2006 remained unchanged since the composition of NREL's fleet remained the same as in previous years. NREL continues to work with GSA to acquire more AFVs, but has so far been unable to obtain additional vehicles.

*Commitment #4:* Reduce total energy use by 3% from the 2002 baseline year.

While NREL did succeed in reducing our annual energy use in 2006 and we were very close to meeting our performance commitment, we ended up just short of the 3% reduction. The laboratory continues to actively investigate opportunities to reduce energy use and improve energy efficiency. The major sources of energy use are building operations and process loads associated with laboratory testing facilities. All major laboratory buildings are metered for electric and natural gas use. In addition, major loads are separately metered for electric use. Also, all future construction at NREL will strive for LEED Gold level.

**Table 4.1. Greenhouse Gas Emissions**

Greenhouse Gas Emissions (CO2 equivalent)					
	Baseline	Year 1	Year 2	Year 3	Performance Commitment
Calendar Year	2002	2004	2005	2006	2006
Tons/Year	23,322	23,150	8,346*	0*	20,990

\*Note: The goal in 2005 and 2006 was met through the purchase of Renewable Energy Certificates (RECs).

**Table 4.2. Water Use**

Water Use (Gallons per Year)					
	Baseline	Year 1	Year 2	Year 3	Performance Commitment
Calendar Year	2002	2004	2005	2006	2006
Gallons/Year	10,717,500	7,160,000*	10,200,000	14,951,000	8,574,000

\*Note: Meter information was incorrectly supplied by the water provider. Also note that 2006 data is higher due to one-time watering requirements of re-vegetation at the new STF site as well as other shakedown/ commissioning activities.

**Table 4.3. Total Energy Use**

Total Energy Use (mmBTU)					
	Baseline	Year 1	Year 2	Year 3	Performance Commitment
Calendar Year	2002	2004	2005	2006	2006
Actual Energy Use	104,303	99,928	105,356	101,808*	101,172
RECs Purchased	6,760	6,760	51,488	+51,000	
Net Energy Use	97,543	93,168	53,868	<51,000	

\* Note: The normalizing factor based on square footage changed in this year from 1.0 to 1.11

### *2007 Objectives*

Environmental objectives developed by NREL in collaboration with DOE-GO to meet the goal of further enhancing ESH&Q as a core value of the laboratory for fiscal year 2007 are:

- Effective leadership and prevention
- Effective response

Progress toward the 2007 goals will be reported in the NREL 2007 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, EPA National Environmental Performance Track 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 regular 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 as needed, but at least every five years, and makes 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.

### *2006 Assessment Activities*

In an effort to continuously improve the EMS integration with the ISM System in 2006, NREL conducted an independent assessment of the ISM System, including gap analysis. The resulting outcome has been that environmental processes are adequately integrated into the ISMS. Additionally, NREL continued implementation of an EMS database tool, allowing for electronic tracking of due dates for permits and other milestones, as well as proving a mechanism to consolidate elements of NREL's environmental management system.

Please recall that in December 2005, DOE conducted a follow-up surveillance to the 2004 self-assessment. This surveillance was on action plan progress and EMS integration with NREL's ISMS. There were no DOE findings as a result of the surveillance and no corrective actions were required. DOE found that NREL's EMS is integrated sufficiently with its ISMS, and certified the EMS as such for purposes of compliance with DOE Order 450.1, which required integration to be complete by 12-31-05.

Please also recall that in August 2005, representatives from the EPA Region 8 and the Colorado Department of Public Health and Environment (CDPHE) visited NREL to review the laboratory's commitment to the NEPT and CELP programs. During the site visit, the EPA and CDPHE were impressed with NREL's commitment to going beyond compliance in the areas of environmental performance and sustainability. The EPA found NREL's sustainability practices to demonstrate leadership, its public outreach program to be very strong, and its environmental management system to be sound and well documented. The EPA also provided NREL with recommendations for improvement.

As anticipated, implementation of the continuous improvements planned as a result of the 2004 self-assessment is a multi-year effort that continued in 2006. Progress has been made in implementing the improvements, as discussed earlier in this section.

In August 2007, NREL voluntarily invited a third-party auditor to assess the EMS. The assessment was conducted as a gap analysis between the existing NREL EMS and the

revised ISO 14001 – 2004 standard. Discussion of the report will occur in the CY2007 Environmental Performance Report.

#### ***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:

- Campus and Transportation
- Water, Electricity, and Natural Gas
- Reduce, Reuse, Recycle, and Rebuy
- Education and Communications 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 Environmental Management System (EMS) supports Sustainable NREL's goals. The EMS focuses 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.
- 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 synergism between Sustainable NREL and environmental protection activities of the ESH&Q Office in that both address different components of NREL's environmental footprint. Together, Sustainable NREL and the Environmental Management System, as

implemented by the ESH&Q Office, 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:

- Sustainable landscaping is described in Section 3.10, Vegetation Management.
- Pollution Prevention activities are discussed in Section 3.9, Pollution Prevention.

## 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 the year.

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).

#### ***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.

#### Ozone Depleting Substances

Facilities that service refrigeration equipment containing ozone-depleting substances (ODSs) 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 performs this type of service.

Another requirement of the State of Colorado's CFC 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."

#### Street Sanding

CDPHE regulations require federal, state, and local government facilities to track wintertime street sanding, and to make efforts to minimize sand use. NREL complies with this requirement and files an annual sanding report with CDPHE. During the period October 2005 to May 2006, NREL used 14 tons of sand during 7 sanding episodes. NREL maintains 12.3 lane-miles of roads. During the period October 2006 to May 2007, NREL used 20 tons of sand during 12 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 2006 were small scale and did not require permitting. Permitting thresholds are generally 50, 500, 1000, or 2000 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 areas 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 is in effect for the NWTC.

NREL also holds one air emissions permit for an experimental pilot process in the FTLB on the STM Site. The permit was issued in 2002. NREL has operated the thermal oxidizer emission control device for the experimental Thermochemical Process Demonstration Unit (TCPDU) located at the FTLB since the late 1980's,

under an exemption.. An Air Pollution Emission Notice (APEN) update was filed with the Colorado Air Pollution Control Division in 2005.

### *5.1.3 2006 Activities*

Two Air Pollution Emission Notices (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 2006. 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 six years, including 2006.

## **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 the Boulder public water supply 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), 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 are as follows:

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



Samples are collected from three locations at the NWTC: Building 251, the IUF, and the hydrogen test pad (added in 2006).. No coliforms were detected in any of the samples taken during 2006. 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 2006.

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. The state 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 quarterly basis. Chlorine was present at appropriate levels in all samples collected in 2006. The running annual average of the maximum residual disinfectant level (MRDL) for CY2006 was 0.38 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 2006 Activities

In 2006, 176,095 gallons of potable water were delivered to the NWTC, an average daily consumption rate of 482 gallons per day. NREL conducted all required monitoring for 2006 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 0.38 ppm.

In October 2006, the Wind to Hydrogen project became operational at the NWTC. The project uses wind generated electricity to hydrolyze water, and to store the hydrogen produced. Water for this project is supplied by a newly constructed extension of the water supply system at the NWTC. Because the hydrogen test pad is now the furthest point in the system from the distribution tank, it was added as a monitoring point. The operating contractor began collecting samples for bacteria and chlorine at this location in October.

Plans to install an automated disinfection system continued in 2006. 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, trihalomethanes, and haloacetic acids. Installation of the controller and probe is scheduled to occur in 2007.

In October 2005, NREL initiated a review of the drinking water system operations and testing. These activities are subcontracted to qualified licensed operators. In August 2006, NREL replaced the operating contractor. Colorado regulations require that public water supply systems identify an Operator in Responsible Charge. Notification was provided to CDPHE identifying the new Operator in Responsible Charge along with his Class A certification.

On October 12, 2006, CDPHE notified NREL that the annual result for total trihalomethanes (TTHM) exceeded the applicable maximum contaminant level (MCL), and required an increase in monitoring from an annual sample to quarterly samples. The result for the sample collected in August 2006 was 0.082 mg/L; the MCL is 0.080 mg/L. CDPHE wrote that "NREL must increase monitoring from yearly to quarterly monitoring beginning in the fourth quarter of 2006 for both disinfection byproducts (TTHM and HAA5)." While the Haloacetic Acids (HAA5) result had been within the applicable MCL, the CDPHE program required increased monitoring for both sets of disinfection byproducts. NREL immediately directed the operator to collect quarterly samples for TTHMs and HAA5s. The first sample was collected in November 2006, and the results were below the applicable MCLs. Collection of the quarterly samples will continue in 2007.

### ***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 3 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 groundwater. 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 above ground storage tank at the Alternative Fuels User Facility. 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. Based on the results of these follow-up samples, no further samples will be collected.

### *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. Abandonment paperwork has also been filed with the State of Colorado for the three wells that were plugged in 1993.

### *5.3.3 2006 Activities*

In 2006, the three groundwater monitoring wells that were installed due to the PDU emergency generator aboveground storage tank leak were closed in accordance with state requirements.

## ***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 IUF septic system as well as for the SRRL facility on the STM site mesa top.

### 5.4.3 2006 Activities

*In 2006, there were no new wastewater discharge activities .*

## **5.5 Surface Water Protection (Storm Water and Erosion Control)**

### 5.5.1 Program Management

Management in this area is consistent with the following NREL Programs: Storm Water Pollution Prevention for Construction Activities at the STM, and Storm Water Pollution Prevention for Construction Activities at the NWTC (6-2.15 and 6-2.16, respectively)

Limited storm water 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 storm water quality on the STM site. Sampling indicated that NREL's activities are not resulting in contamination of storm water runoff.

No storm water 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 such 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.

Storm Water 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 allow for 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 storm water discharges on federal facilities in Colorado is under the jurisdiction of the Environmental Protection Agency (EPA). In 2006, NREL was covered under the EPA's general permit for stormwater discharge associated with construction activities on the STM S&TF project. Both Midwest

Research Institute, as operator, and DOE, as site owner, have filed Notices of Intent for appropriate construction activities on the STM and NWTC Sites. No permits are required for NREL's routine operations.

### 5.5.3 2006 Activities

*In 2006, there were no new surface water protection activities.*

## **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 Resource Conservation and Recovery Act (RCRA). NREL facilities' waste profile consists of a broad range of hazardous laboratory chemicals in small quantities. Chemicals in solid or liquid form are collected in each laboratory or at each experimental site. These wastes are periodically collected from the laboratories and prepared by the NREL ESH&Q Office for off-site disposal.

Treatment and disposal is conducted at EPA-permitted treatment, storage, and disposal facilities. In addition, NREL facilities have adopted a conservative waste disposal policy in which materials that are not regulated by RCRA, yet pose a potential hazard, are collected and disposed of as non-hazardous materials at an RCRA-permitted disposal facility.

NREL facilities also generate 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 materials. Each of the five sites has an RCRA waste generator identification number issued by the State of Colorado. The South Table Mountain location is classified as a "small quantity generator," generating less than 1000 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 2006 Activities*

In CY2006, from all five sites combined, NREL shipped 24,830 pounds (11,286 kg) of hazardous waste, 8,093 pounds (3,679 kg) of non-RCRA regulated waste, and 8,095 pounds (3,680 kg) of universal waste for disposal and recycling. Universal waste includes batteries, fluorescent light bulbs, and electronic equipment.

In 2006, 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 5.15.

## **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 for emergency generator and research use 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 it is more stringent than the regulations require in many areas.

Several important safeguards have been incorporated into NREL's tank management program to prevent any accidental releases of diesel fuel from the storage tanks. These safeguards include both mechanical safeguards, such as double wall tanks with sensors that result in an alarm if the inner tank wall is leaking, overfill and spill protection; and procedural safeguards, such as 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 diesel fuel stored on the STM, NWTC, and ReFUEL sites, a Spill Prevention Control and Countermeasures Plan is required to be in place. 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 registration with the State of Colorado, with the registration renewed annually. 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 Alternative Fuels User Facility (AFUF). Both are located on the STM site.

### 5.7.3 2006 Activities

A state inspection of NREL's regulated ASTs was conducted in 2006. A field Violation Report was issued for insufficient tank grounding on one tank. The issue was satisfactorily resolved within one week. No spills or releases from NREL's ASTs occurred during 2006.

## **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 (CERCLA) do not apply to NREL facilities.

NREL facilities are subject to the emergency reporting requirements in Title III of the Superfund Amendments and Reauthorization Act (SARA), also known as the Emergency Planning and Community Right-To-Know Act (EPCRA). Section 302 of these regulations 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 (TPQs). 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 reportable quantity (RQ).

According to Section 311 and 312 of EPCRA, NREL provides Material Safety Data Sheets (MSDSs) 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 Uniform Fire Code hazard categories and threshold reporting quantities rather than those specified in SARA Title III, resulting in a larger number of individual hazard categories and lower reporting thresholds. NREL has an active involvement in the emergency planning concepts of SARA Title III, in that the laboratory currently has two acting members on the Jefferson County LEPC, and has been represented since the LEPC's inception.

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, Executive Order 12856 requires all federal facilities to file a report, if applicable, regardless of SIC code.

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 500, 100, 2500, 500, 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, EPC, EPA, DOE).

To maintain the CMS database, a physical inventory of each lab and work area in which chemicals are used or stored is conducted periodically. Such an inventory was conducted in 2006. Seven contract employees worked from June through September updating the CMS with chemical hazard information and conducting a wall-to-wall inventory of laboratory chemicals.

NREL has not identified any areas within its facilities that contain residual contamination requiring special decommissioning. 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 the West Metro and are issued by building. 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 South Table Mountain Site and DWOP.

### 5.8.3 2006 Activities

West Metro conducted a walk-through inspection of NREL's STM and DWOP facilities in the summer of 2006. 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 2006. The CMS was also used to post individual laboratory chemical inventories on the ESH&Q website, which were updated monthly.

In 2006, 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 2006, NREL facilities had no releases exceeding the RQ of any reportable material under EPCRA.

In August of 2006, two representatives of the Colorado Department of Public Health and Environment (CDPHE) conducted a RCRA inspection of the South Table Mountain facilities. In addition to inspecting waste generating areas in labs, the waste handling facility, and the newly opened Science and Technology Facility, the inspectors also reviewed employee training records and the ESH&Q hazardous waste records. The items noted by the CDPHE inspectors were minor in nature and no enforcement actions were taken as a result of the visit.

As a research and development laboratory, NREL does not manufacture or process any materials, and during 2006, the laboratory did not use any materials on the Section 313 list in quantities exceeding the 4536-kg (10,000-lb) TPQ.

## **5.9 Pollution Prevention & Sustainability**

### **5.9.1 Waste Minimization, Recycling, and Green Purchasing (Purchasing Materials with Recovered Content)**

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.

The 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 chemical 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, manages NREL's recycling program. As recommended by EPA's comprehensive recycling guidelines, items currently recycled or reused at NREL include the following:

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

Fourteen 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 a materials reuse center in Building 16 in the Denver West facilities. This center encourages NREL employees to select reusable office supplies prior to placing purchase orders.

NREL has consistently decreased solid waste disposal since FY2003.

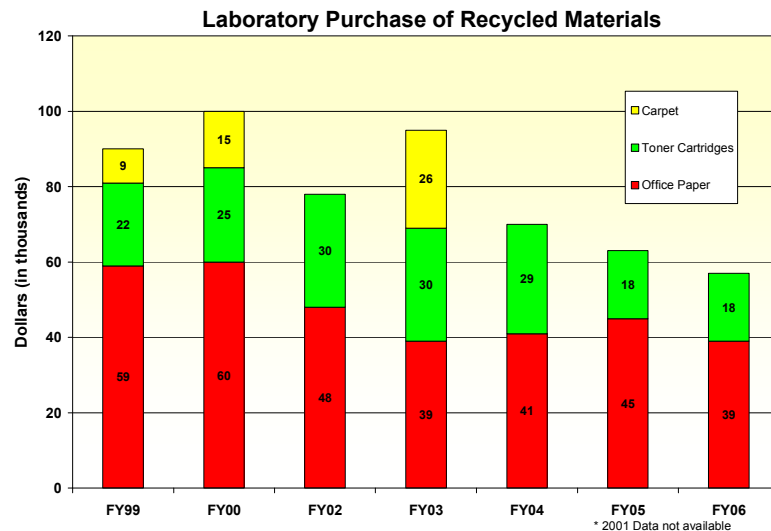
	FY03	FY04	FY05	FY06
Solid Waste	427,880	406,820	365,934	305,696
Recycled Material	236,128	180,636	164,488	214,000

Data for some of the materials recycled by NREL during 2006 follow. Quantities listed below are those entered into the DOE Pollution Prevention database, which tracks recycling on a fiscal year (October 1 through Sept. 30) basis. Data are for fiscal year 2006. Quantities are not tracked for all materials that are recycled; therefore, the list below does not include all recycled materials.

Recycled Material	Quantity
Batteries	5,717 lbs
Fluorescent bulbs	214 lbs
Mixed metal	11,160 lbs
Commingled containers, cardboard, office and mixed paper	214,000 lbs
Computer monitors	2,164 lbs

NREL has implemented multiple green purchasing activities including purchasing office supplies through an online catalog featuring environmentally preferable (recycled content) products. Green purchasing was integral to NREL's decision to

create an electronic purchase card system. The system tracks metrics on green purchases made at the laboratory and encourages staff to purchase green products whenever possible. In 2006, some of the products purchased containing recovered content included: carpeting, uncoated-printing paper, and toner cartridges. One hundred percent (100%) of NREL's supply of uncoated printing and writing paper contains recycled content. Recycled toner cartridges are available in the NREL stock room.



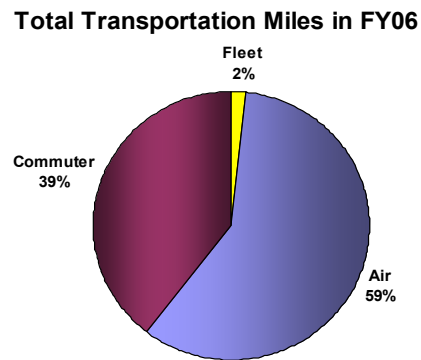
**Figure 5.1. Since 1999, 100% of all carpet, toner cartridges, and office paper purchased by NREL have contained recycled content.**

An additional recycling accomplishment at the laboratory in 2006 involved new construction activity. The Science and Technology Facility (S&TF) was completed in 2006. During design and construction, the target was to exceed the requirements for the Leadership in Energy and Environmental Design (LEED) Gold level. In March 2007, the S&TF received Platinum level certification, including points for materials management. At least 5% of the total value of materials used in the project contained recycled content, and at least 20% of the total value of the materials and products used were manufactured regionally within a 500-mile radius of NREL. The contractor recycled about 75% of the total waste from the project, including the following materials:

- Office and Mixed Paper: 46,000 lbs
- Asphalt: 38,400 lbs
- Scrap metals: 8,100 lbs
- Land Debris: 20,000 lbs
- Wood: 9,900 lbs
- Concrete: 17,300 lbs

### 5.9.2 Vehicles

Transportation at the laboratory falls into three main categories: fleet vehicles, air travel, and employee commuting. Figure 5.2 illustrates a percentage breakdown of transportation by mode. In an effort to describe the impact that transportation has on the footprint of the laboratory, a calculation was done illustrating the kilograms of CO<sub>2</sub> emitted into the atmosphere. Fifteen percent (15%) of NREL's total CO<sub>2</sub> footprint was due to transportation. This breakdown serves as a way to examine NREL's transportation issues and proactively provide solutions to reduce the impact of transportation.

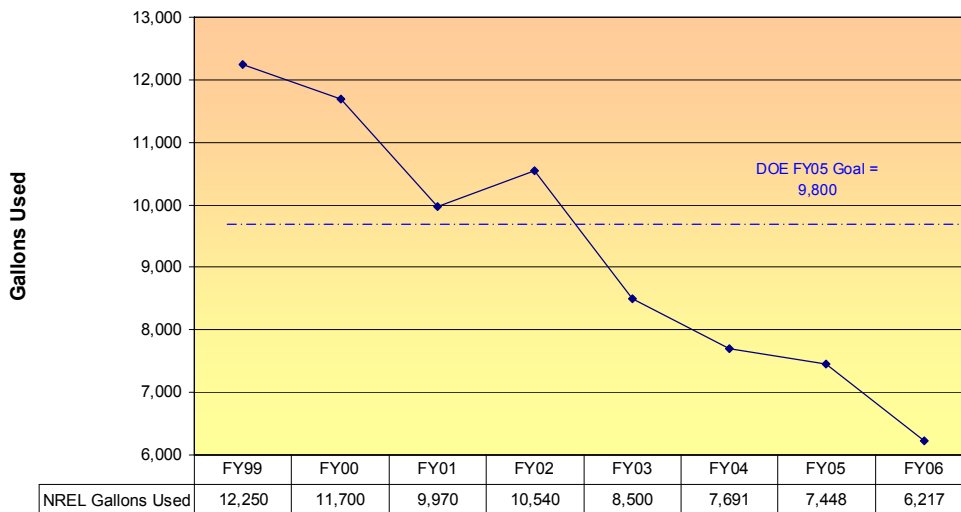


**Figure 5.2. NREL Transportation by Mode**

Sustainable NREL's Transportation strategy is directed by two Federal guidelines. The first, EPACT of 1992 states that 75% of the light duty vehicle (LDV) fleet shall be Alternative Fuel Vehicles (AFV). Secondly, Executive Order 13149 (Greening the Government through Federal Fleet and Transportation Efficiency, superseded in 2007 by E.O. 13423) and DOE compliance strategy for this Executive Order states that there shall be a 20% decrease of fleet petroleum use by 2005 as compared to a 1999 baseline. In order to meet these goals, NREL's fleet currently has 33 AFVs in their total fleet of 47 vehicles. This decreased NREL's petroleum use to 6,217 gallons in FY06. The fleet used 9,868 gallons of E85 in FY06 which is more than 70% of the total fleet usage of 13,975 gallons of fuel. The laboratory is converting its fleet to 100% AFVs as soon as possible, subject to their availability for leasing through the General Services Administration.



### NREL Fleet Petroleum Use



**Figure 5.3. NREL Fleet Petroleum Use**

For FY06, although NREL is actively using E85-fueled vehicles, biodiesel is also an option being explored. Currently, the nearest available biodiesel supplier is 10 miles away, making obtaining the fuel inefficient. Once there is a local biodiesel supply, NREL is considering plans to fuel a Kubota tractor, a Gradall lift, and a Ford 555 backhoe with biodiesel B20 fuel as a pilot project. Proximity of biodiesel suppliers to NREL is analyzed quarterly for changes.

Fleet vehicles are only part of the transportation initiative at the laboratory. Sustainable NREL also actively encourages alternative commuting for employees. In the spring of 2005, employees received an on-line survey regarding their commuting habits. 132 of the 384 respondents use alternative modes of commuting. Sustainable NREL anticipates updating this survey, in FY08.

Walk	4%
Carpool	10%
Bike	15%
Bus	17%

While these numbers are strong, there are ways to improve them. For instance, NREL offers free bus passes to all full-time employees and provides a free shuttle service using alternative-fueled vehicles. NREL also works actively with the Denver Regional Council of Governments to provide employees with carpool and vanpool resources.

Biking and walking are also viable commuting options for NREL employees living within a reasonable proximity and the laboratory wants to make these easy options for all who choose them. NREL has showering facilities, locker rooms, and bike lockers on-site. Bike vests were given to our bike commuters for an added measure of safety. External biking programs are also promoted such as Colorado's Bike to Work Day in June 2006. NREL employees increased

registered participation in the event by over 20% versus last year. As of 2006, 84 NREL participants registered traveling over 1,092 miles by bicycle.

Air travel is also a concern for NREL, representing 59% of the total miles traveled in FY06. The laboratory has two offices, one in Golden, Colorado and the other in Washington, DC. Employees were able to decrease air travel back and forth from these two offices by utilizing videoconferencing equipment. In FY06 alone, the use of video conferencing mitigated the need for 121 domestic air flights, totaling 336,300 air miles.

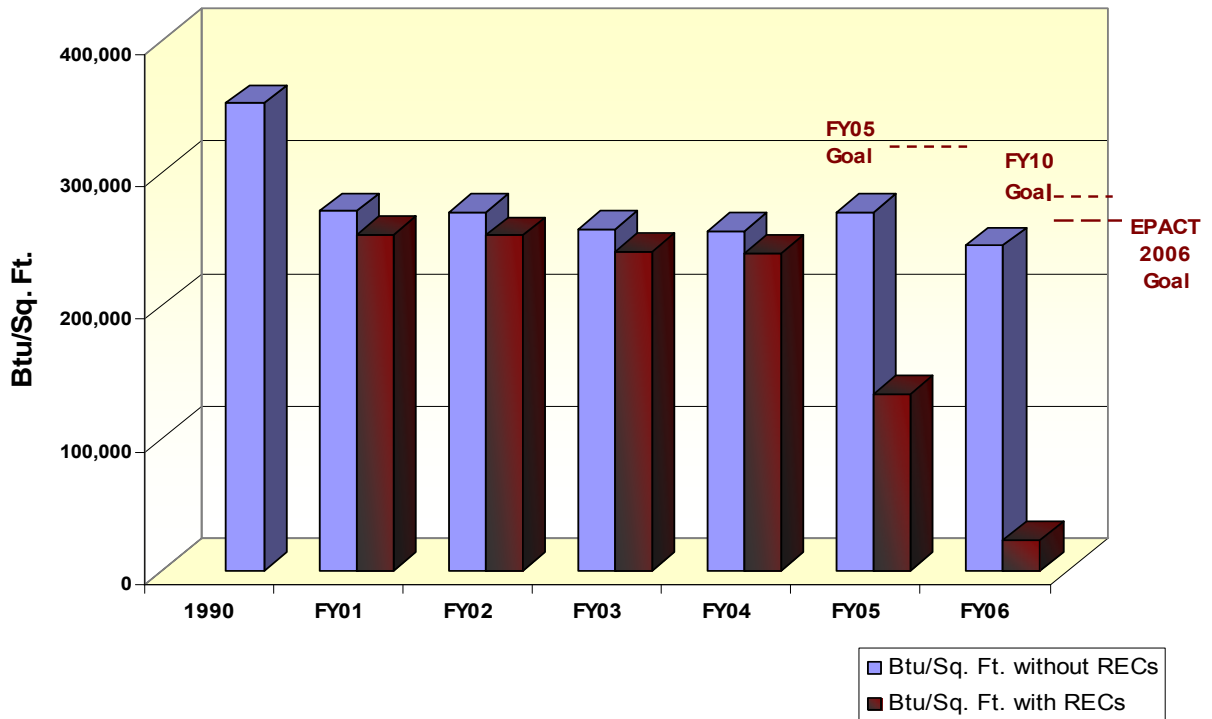
### *Energy*

The federal requirement for NREL's energy use in FY05 is a 5% energy-use reduction by 2005 and a 10% reduction by 2010, as compared to a 1990 baseline. Through energy efficiency retrofits, energy efficient new construction, implementation of renewable energy projects, energy education, and the purchase of renewable energy certificates (RECs), NREL has exceeded its goals and continues to actively pursue all cost-effective, energy-use reduction opportunities (refer to Figure 5.3). New goals have been established by the Energy Policy Act of 2005 (EPAAct 2005) that took effect in 2006.

The major sources of energy use 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.

### FY06 Energy Use Reduction Progress (Electricity/Natural Gas)



**Figure 5.4. FY06 Energy Use Reduction Progress (Electricity/Natural Gas)**

The baseline is the average for all DOE Laboratories and Industrial Facilities in 1990. For NREL, this baseline is 352,540 BTU/SF and has been applicable to NREL facilities since 2002.

Table 5.1 includes the FY 1990 baseline and summarizes the total energy consumption per gross square foot for NREL facilities, which includes both the South Table Mountain and National Wind Technology Center sites.

**Table 5.1. Energy Consumption**

	BTU/GSF
FY1990 BASE YEAR	352,540
FY2001 TOTAL NREL (DOE-owned)	271,247
FY2002 TOTAL NREL (DOE-owned)	270,495
FY2003 TOTAL NREL (DOE-owned)	257,887
FY2003 TOTAL NREL (w/ Renewable Energy Certificates)	240,525
FY2004 TOTAL NREL (DOE-owned)	256,650
FY2004 TOTAL NREL (w/ Renewable Energy Certificates)	239,289
FY2005 TOTAL NREL (DOE-owned)	325,408
FY2005 TOTAL NREL (w/ Renewable Energy Certificates)	133,253
FY2006 TOTAL NREL (DOE-owned)	245,498
FY2006 TOTAL NREL (w/ Renewable Energy Certificates)	23,129

NREL completed an energy survey in FY2007. The report will be discussed in the CY2007 Environmental Performance Report.

#### Energy Efficiency Specifications for Renovations/New Construction

NREL has always emphasized significantly greater levels of energy efficiency than federal standards with all of its DOE-owned buildings. The goal is to reduce energy use by 30% compared to the federal standard reference for building systems at 10 CFR 434. 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, Leadership in Energy and Environmental Design (LEED) Silver criteria, established by the U.S. Green Building Council. In addition, all new laboratory buildings are designed according to the principles of the Laboratories for the 21<sup>st</sup> Century Program. See the “Sustainable Building Design” section below for more detailed information.

#### Computer/Monitors Purchasing.

NREL Information Services (IS) provides a standard hardware list of recommended Energy Star products for PC and MAC computers, monitors, and peripherals. Staff is encouraged to purchase Energy Star hardware items through the "Basic Ordering Agreement" (BOA) contracts. Supplier's websites provide energy information for standard products. Flat panel monitors that use significantly less energy than standard monitors have been added to NREL's standard supply list, and are the priority purchase recommendation.

#### Printers and Copiers

Networked printers are configured automatically to enter a low-power mode of 15-45 watts or less after a period of inactivity (this time period differs with models). Seventy-one (71) duplex modules were purchased in FY 2001 and installed on network printers configured to default duplexing. Users can control one-sided printing through the applications print feature. All copiers are Energy Star rated.

### 5.9.3 Renewable Energy

#### Use of Renewable Energy

The federal requirement is that annual electric use includes renewable energy use at the 3% level for each year from 2007 to 2009, 5% from 2010 to 2012, and 7.5% from 2013 forward.

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 renewable energy certificates (RECs).

NREL makes use of on-site renewable energy sources for its direct energy use. On-site electric generation sources include photovoltaics and wind. The National Wind Technology Center (NWTC) has approximately 1,600 kW of installed wind turbine capacity used for research purposes. When the turbines are running, the energy that they produce is used to simultaneously offset NWTC site energy use. In FY06, wind and PV sources generated approximately 130 MWh.



In FY06, electricity was generated by multiple photovoltaic projects. These photovoltaic panels are located at the SERF, the Site Entrance Building, the Outdoor Test Facility, NWTC Site Entrance Building and DER Test Facility, and remote applications including signs, walkway and parking lighting.



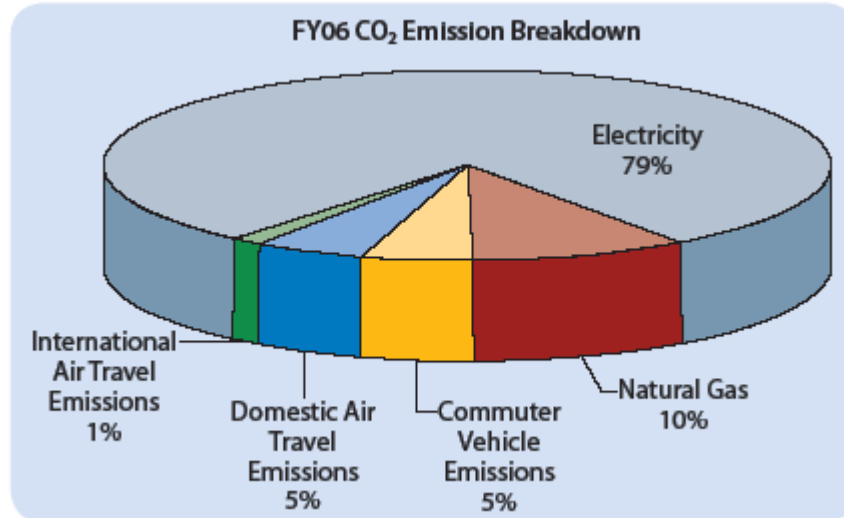
On-site renewable thermal energy sources include solar hot water systems, ventilation air preheat systems, and extensive use of passive solar heating and day lighting. In FY06, these sources produced some 10 MMBtu. A project to displace 75% of the laboratory's natural gas use by the 2007/8 heating season is currently being developed.

NREL exceeds the federal requirements through the use of onsite renewable energy and REC purchases. This purchase positioned NREL as the leader among the national laboratories in the use of RECs for offsetting GHG emissions. In FY06, the laboratory made REC purchases to offset its entire CO<sub>2</sub> footprint to meet its goal of being "carbon neutral."

#### 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 laboratory, the laboratory became "carbon neutral" in FY06 in terms of CO<sub>2</sub> production.

The updated figure representing NREL's CO<sub>2</sub> footprint is shown in Figure 5.5.



**Figure 5.5. FY06 Kg CO<sub>2</sub> Emission Breakdown**

#### 5.9.4 Water Conservation

NREL made progress by systematically implementing life-cycle, cost-effective, water-use reduction measures. Since 2003, six best management practices (BMPs) have been implemented. These BMPs include educating staff about water conservation, xeriscaping, low-flush toilets, waterless urinals, retrofitted faucets and showerheads, cooling-tower management and distribution audits, and leak detection and repairs.

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. Boulder Public Water Supply water 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.

The water use for all NREL sites is estimated and summarized in Table 5.2. NREL's total water use was up significantly in 2006, impacted partially by the S&TF coming online in 2006.

**Table 5.2. Water Consumption**

	Million Gallons per Year (MGY)
FY2000 (BASE YEAR – TOTAL NREL)	12.6
FY2001 – TOTAL NREL	11.1
FY2002 – TOTAL NREL	10.7
FY2003 – TOTAL NREL	9.6
FY2004 – TOTAL NREL	8.4
FY2005 – TOTAL NREL	10.2
FY2006 – TOTAL NREL	15.7

NREL completed a water survey in FY2007. The report will be discussed in the CY2007 Environmental Performance Report.

#### *5.9.5 Sustainable Building Design*

In the second half of 2006, NREL completed construction of the Science and Technology Facility (S&TF), a two-story, 71,000 sq. ft. laboratory research building to be 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.

Construction began on the S&TF in early 2005. The facility received Platinum Level LEED certification in March of 2007. Its projected energy cost reduction is 50% better than the requirement for federal facilities (10 CFR 434). The S&TF was a Laboratories of the 21<sup>st</sup> Century (Labs 21) Pilot Partner Project; a program sponsored by the EPA and DOE. The labs 21 design principles were used in the S&TF design.



**Figure 5.6. L.E.E.D. Platinum certified S&TF at STM**

NREL's goals for the S&TF were to:

- Build a state-of-the-art facility that meets research needs and is a model of sustainable design
- Develop and implement aggressive energy savings
- Achieve a LEED Gold rating
- Minimize the building's footprint on the land (its impact on natural flora and fauna)
- Preserve views of the surrounding vistas

The completed S&TF meets the established goals and expresses concepts of sustainable design such as: design and siting, increased energy efficiency, reduced operating costs, environmentally preferable building materials, indoor environmental quality, and resource conservation,

NREL's S&TF received the 2006 Federal Energy Saver Showcase Award as part of the Federal Energy and Water Management Awards ceremony in Washington, D.C. The award recognizes buildings that incorporate comprehensive energy management and stand out as exceptional models of energy efficiency, innovation, and sustainable design. The S&TF is expected to use 41 % less energy than conventional construction, saving the laboratory \$96,000 per year. An efficient ventilation system with variable-air-volume supply and exhaust, coupled with heat recovery, low-flow fume hoods, evaporative cooling, and an efficient central plant contribute to the savings. The building also incorporates 27% local or regional building materials. Over 75% of the construction water was recycled. In addition, the building has a storm water detention system, xeriscaping, and low-flow water fixtures to reduce water consumption.

In addition to the new S&TF, several of NREL's other buildings, including the Thermal Test Facility (TTF) and the SERF are models of energy efficiency. The SERF's annual energy costs are 40% below that of a similar building designed to meet federal energy standards, and the TTF operates on 63% less energy than a building designed to meet the Federal Energy Code. The TTF building received a 2002 Federal Energy Saver Showcase Award.

NREL staff designed the NWTC Site Entrance Building (SEB) in-house. The building was designed to be a near-zero energy building; its systems are fully monitored. The NWTC SEB is 16' x 10' and uses NREL technologies to reduce the power demand of the building. Such technologies include: daylighting, passive solar heating, good thermal envelope, natural ventilation through the windows, low-e windows, overhangs for shade control, a Trombe wall, occupancy and daylight sensors, high-efficiency lighting with dimming fixtures, and the use of energy efficient flat screen computer monitors. These technologies, along with a roof mounted 768 W photovoltaic array and two 1000 W wind turbines, reduce the amount of electricity drawn from the utility grid and feed excess electricity produced back to the grid.



### *5.9.6 Technical Assistance and Outreach*

#### *Outreach by Leadership*

NREL staff developed a Sustainable Design Guide for Los Alamos National Laboratory. NREL 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, websites, 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 website ([www.nrel.gov](http://www.nrel.gov)).

#### *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 2005, Sustainable NREL received a White House Closing the Circle Honorable Mention and a DOE Pollution Prevention Star Award.

#### *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 NREL 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, as part of Sustainable 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<sub>2</sub> emissions equivalents from employee activities and laboratory operations.

## **5.10 Vegetation**

### *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 natives that were originally present on the site before disturbance. Seed mix and revegetation procedures are outlined in NREL's Storm Water Pollution Prevention Programs for the STM and NWTC Sites. The use of native species is required at both the STM and NWTC whenever feasible. When possible, replacement of high water demand species, like Kentucky bluegrass, with drought-tolerant species is encouraged.



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 Stephen Wilcox

Eleven noxious weed species were located on the STM site. Four of these belong to Colorado's top ten prioritized-for-control weed species. These four include Canada thistle, diffuse knapweed, field bindweed, and musk thistle.



**Figure 5.8. Noxious Weed**  
Courtesy Stephen Wilcox

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 5.10 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 5.9. Flower at STM**  
Courtesy Stephen Wilcox



**Figure 5.10. Lush vegetation growth along the NWTC north fence line**

The survey identified 11 noxious weed species on the NWTC site. Five of these are recognized as belonging to the top-ten prioritized weed species in Colorado: Canada thistle, diffuse knapweed, field bindweed, musk thistle, and leafy spurge. 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 using ground application with

herbicide. More information regarding 2006 herbicide application is provided in Section 5.10.3.

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. In 2005, one of NREL’s Site Operations staff attended training and became a certified applicator of restricted use pesticides. Herbicides and pesticides applied by NREL staff are applied by the certified applicator or under his supervision, according to regulatory requirements.

#### *5.10.3 2006 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 2006. Very limited herbicide application was conducted on the STM site in the spring of 2006, 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 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.

On January 19, 2006, a Pesticide Applicator- Routine Inspection was conducted by a representative of the Colorado Department of Agriculture. The routine inspections cover office records, notification and posting, storage, disposal, equipment, and supervision. The inspector identified a minor issue with posting the pesticide storage area. The Facility Maintenance Building, NREL’s designated

pesticide storage location, was posted with proper signage shortly after the inspection. No other issues were noted by the inspector.

## 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 winter habitat.

A wildlife survey was conducted on the STM sites in 1987. Follow-up verification surveys were conducted in 1998 and 1999. A new site-wide wildlife survey was completed in 2005.

#### 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 m (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.

#### STM Site

A 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 (see section 5.11.3).

#### 5.11.2 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.

#### 5.11.3 2006 Activities

Nest surveys for ground nesting birds were conducted prior to the construction project that began during nesting season.

#### Migratory Birds and Raptors

Many species of migratory birds were observed on the STM site, with many of these species potentially nesting on site. In addition, 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 seasons. Several species were only observed during the fall season including downy woodpecker, red-breasted nuthatch, blue jay, 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.

#### 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 5.11. Mule Deer**  
Courtesy Dean Levi

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 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.

#### 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 on site in two of the site drainages.



### Small Mammals

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 anywhere 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.

### 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). 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 at STM. Some of the STM Site wildlife species are shown on the photos in Figures 5.11 through 5.15.

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.





**Figure 5.12. – Coyote eating a jackrabbit at STM. Photo courtesy of Stephen Wilcox.**



**Figure 5.13. Rattlesnake rests in the leaf litter Figure 5.14. A bull snake and a rabbit.**



**Figure 5.15. STM Site wildlife. “Bucky”, on STM (left), courtesy of Stephen Wilcox. In the photo on the right, two thistle bees are captured on film - by Stephen Wilcox.**



**Figure 5.16. STM Site wildlife. A long-tailed weasel peaks out from underneath the CNG cylinders on the STM site (left). . . In the photo on the right, a rare sighting of an amphibian; a tiger salamander.**

## **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 vegetation survey completed on the STM site 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 planned trails being established by Jefferson County Open Space (see Section 6.0 for a discussion of trails).

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 2006 Activities

In 2006, the presence of a new avian species was recorded at STM – the Eurasian Collared Dove (*Streptopelia decaocto*). This is an invasive species that has just begun to inhabit the Denver area. The Colorado Division of Wildlife considers this species to be a threat to native avian species, and allows the unlimited take of Eurasian collared doves during regular dove season and during a special dove season in the winter. NREL has not taken any birds in 2006.



**Figure 5.17. Eurasian collared dove (*Streptopelia decaocto*) at STM**

### **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 of Historic Places (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.



**Figure 5.18. STM cultural resource. Stone and concrete ammunition bunker at STM. Photo courtesy of Stephen Wilcox.**

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 identity of the community. Traditional resources can 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.

Three formal surveys of historic and cultural resources have been performed on the STM site. These surveys were completed in 1980, 1987, and 2003 (see Section 5.14.3 for more detail about the 2003 survey). 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, a stone bridge spanning a natural drainage channel adjacent to the amphitheater, and a stone and concrete ammunition bunker below the amphitheater site (see Figure 5.18). The three structures were constructed during the Works Progress Administration (WPA) era in the 1930s. Through NREL's efforts, these sites have been added to the National Register of Historic Places (National Register), with the amphitheater and stone footbridge listed together as a single site. NREL also participated in an interagency survey of South Table Mountain 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, while Figure 5.19 captures a ground-level view.



**Figure 5.19. STM Site cultural resource. Amphitheater at STM.**  
Photo courtesy of Stephen 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 Denver West Parkway. Two types of historic archaeological resources (firing range lines and a low rock wall) have been identified on that parcel. These resources have been determined to contribute to the National Register eligibility of the Camp George West Historic District.

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.

Should any evidence of cultural resources be discovered at any time during ground disturbing activities at the STM or NWTC sites, NREL will stop all work in the vicinity until a qualified archaeologist evaluates the significance of the find.

#### *5.14.2 Permitting*

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

#### *5.14.3 2006 Activities*

##### *Background Information*

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 resources 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 as follows:

- 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 Officer (SHPO) regarding the significant resources located on the 25 acres. DOE and the SHPO subsequently entered into a Memorandum of Agreement in which DOE agreed to perform further surveys to fully document the resources on the 25 acres prior to any development of the parcel.

In 2005, the DOE Golden Field Office 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 of Historic Places. The documentation resulted in Level II HABS/HAER documentation that consisted of mapping, photographs, and detailed description of the resources. The documentation was submitted using archival quality materials to the State Historic Preservation Officer in late 2005.

#### *2006 Update*

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.

Additionally in CY2006, a site survey for cultural resources was conducted in support of NREL / DOE's EA for the first of three site development projects (RFHP, and two potential solar field sites). The RFHP EA was completed in early summer 2007, and will be discussed in the CY2007 Environmental Performance Report.

### **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 Environmental Assessment (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 Golden Field Office (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 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 2006 Activities*

During 2006, 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 (GO NCO). 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 2006 year.

In April 2006, NREL completed and issued an updated "NREL NEPA Environmental Review Handbook". This handbook includes NEPA background and criteria, categorical exclusions, a NEPA worksheet, an environmental checklist, and instructions for the checklist.

Additionally, in CY2006, NREL began the EA process for three projects (RFHP, and two potential solar field sites). The EA was completed in early summer 2007, and will be discussed in the CY2007 Environmental Performance Report.

### **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 Field Test Laboratory Building (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.

U.S. Department of Energy (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 U.S. Environmental Protection Agency (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 mrem/yr 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 National Emission Standards for Hazardous Air Pollutants (NESHAP) 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 2006 Activities

During 2006, no work involving the use of radioisotopes occurred. In 2006, 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 Waste Handling Facility 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 m (fence line of nearest resident). For the WHF, the distance from the source to the nearest potential receptor is 311 m.

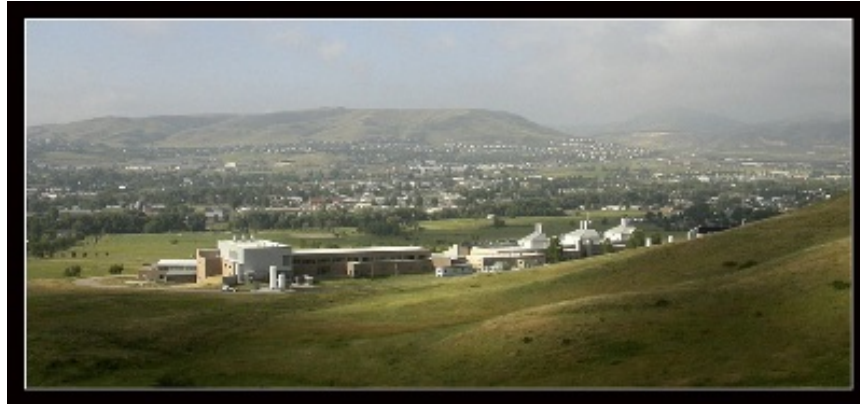
According to the COMPLY computer model, the potential dose to the nearest member of the public was 0.016 mrem/yr, well below the emission limit of 10 mrem/yr, and NREL is in compliance with the NESHAP for radionuclides. Because the dose is calculated rather than measured, it represents a potential or 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 2006, 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 South Table Mountain 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.

### *2006 Assessment of the Property*

During 2006 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 the photo below, 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 CY2006. No additional trails were constructed in 2006.



**Figure 6.2. STM Site 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:

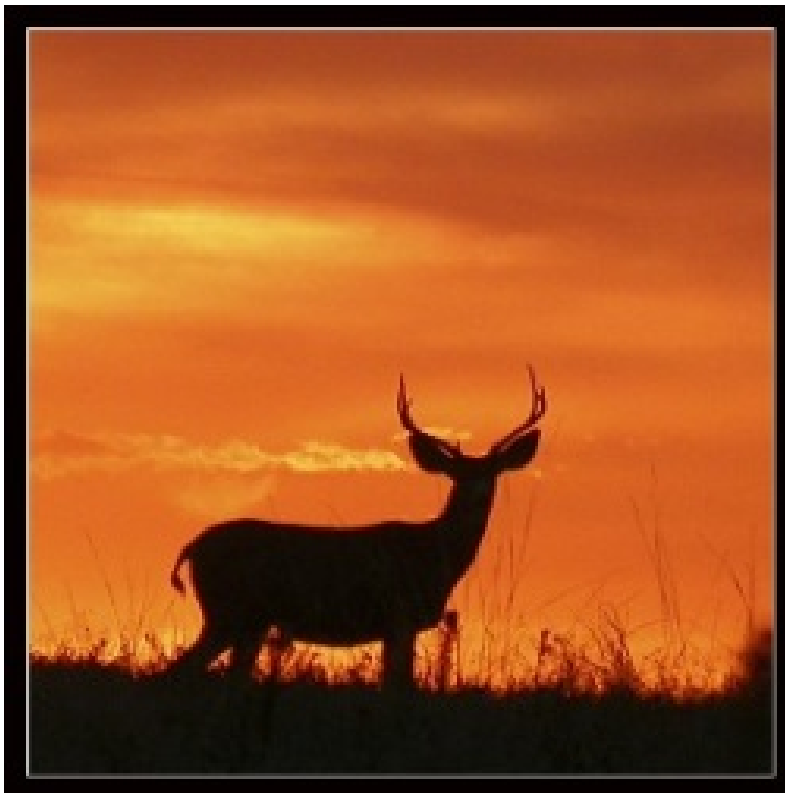
Maureen Jordan  
Senior Environmental Scientist  
[maureen\\_jordan@nrel.gov](mailto:maureen_jordan@nrel.gov)  
303-275-3248

Frank Rukavina  
Director, ESH&Q  
[frank\\_rukavina@nrel.gov](mailto:frank_rukavina@nrel.gov)  
303-275-3220

National Renewable Energy Laboratory  
1617 Cole Boulevard, Golden, Colorado 80401-3393  
303-275-3000 – [www.nrel.gov](http://www.nrel.gov)

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NREL- September 2006



**Figure 6.3. Site wildlife at sunset**  
Courtesy Stephen Wilcox

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## **8 APPENDICES**

Appendix A – Summary of NREL Environmental Permits, Registrations, Notifications

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



**APPENDIX A – SUMMARY OF NREL ENVIRONMENTAL PERMITS, REGISTRATIONS, NOTIFICATIONS**

Tracking Number	Permit or Registration Number	Permit or Reg. Holder	Permit Type	Permit Description	Issuing Agency Name	Location Description	Status/ Expiration Date	Reporting Required
<i>Permits</i>								
1	04JE1442L	DOE	AIR	Air Emission Permit for Land Development (fugitive dust from construction activities)	Colorado Dept. of Public Health and Environment (CDPHE)	NWTC	01/31/2010 (originally issued 3/1/2000)	None
2	04JE1443L	DOE	AIR	Air Emission Permit for Land Development (fugitive dust from construction activities)	CDPHE	STM	01/31/2010 (originally issued 3/1/2000)	None
7	37232	SERI	Groundwater Monitoring Well	Permit to Construct a Well (MW-1)	Colo. Div. Of Water Resources	STM	Construction complete, permit number active until well is closed	None
8	37229	SERI	Groundwater Monitoring Well	Permit to Construct a Well (MW-2)	Colo. Div. Of Water Resources	STM	Construction complete, permit number active until well is closed	None
9	37228	SERI	Groundwater Monitoring Well	Permit to Construct a Well (MW-3)	Colo. Div. Of Water Resources	STM	Construction complete, permit number active until well is closed	None
10	37231	SERI	Groundwater Monitoring Well	Permit to Construct a Well (MW-4)	Colo. Div. Of Water Resources	STM	Construction complete, permit number active until well is closed	None
11	37230	SERI	Groundwater Monitoring Well	Permit to Construct a Well (MW-5)	Colo. Div. Of Water Resources	STM	Construction complete, permit number active until well is closed	None

Tracking Number	Permit or Registration Number	Permit or Reg. Holder	Permit Type	Permit Description	Issuing Agency Name	Location Description	Status/ Expiration Date	Reporting Required
12	214960 Closed	NREL/DOE	Groundwater Monitoring Well	Permit to Construct a Well (MW-11)	Colo. Div. Of Water Resources	STM	Well closed October 12, 2006. Permit number was active until well closed	None
13	214961 Closed	NREL/DOE	Groundwater Monitoring Well	Permit to Construct a Well (MW-10)	Colo. Div. Of Water Resources	STM	Well closed October 12, 2006. Permit number was active until well closed	None
14	214962 Closed	NREL/DOE	Groundwater Monitoring Well	Permit to Construct a Well (MW-09)	Colo Div. Of Water Resources	STM	Well closed October 12, 2006. Permit number was active until well closed	None
15	99JE0400	NREL/DOE	Air	TCPDU air emissions	CDPHE	STM	Initial approval issued 7/20/2000	None
16	20070617 through 20070623	NREL	Permit	Hazardous material storage and use permit	West Metro Fire Protection District	7 STM facilities (Bldg 16, WHF, SERF, S&TF, FTLB, AFUF, S&R)	July 2008	Annual fee, fire dept. inspection; new chemical inventory provided annually
17	P15-07-00003	NREL	BioSafety Permit	Sugarcane Bagasse	USDA - APHIS	STM	02/06/2010	None
18	PDEP-07-00222	NREL	BioSafety Permit	Wheat Streams	USDA - APHIS	STM	02/01/2008	None
19	PDEP-06-00178	NREL	BioSafety Permit	Oryza sativa leaves and stems	USDA - APHIS	STM	12/05/2007	None
<b>Notifications and Registrations</b>								
20	PWSID Number CO0230860	DOE	DRINKING WATER	Non-community Supply of hauled water from a surface water source	CDPHE	NWTC	N/A	Periodic chlorine residual; monthly Bacteriological; Periodic lead and copper monitoring

Tracking Number	Permit or Registration Number	Permit or Reg. Holder	Permit Type	Permit Description	Issuing Agency Name	Location Description	Status/ Expiration Date	Reporting Required
21	CO4890000017	DOE	HAZARDOUS WASTE	Notification of Regulated Waste Activity	CDPHE	DWOP	Update recommended every 3-5 years, or sooner if substantial changes in activity occur. Last update: 7/97	Annual fee to Colorado Hazardous Waste Commission
22	CO3890090076	DOE	HAZARDOUS WASTE	Notification of Regulated Waste Activity	CDPHE	STM	Update recommended every 3-5 years, or sooner if substantial changes in activity occur. Last update: 9/07	Annual fee to Colorado Hazardous Waste Commission
23	COD980805162	DOE	HAZARDOUS WASTE	Notification of Regulated Waste Activity	CDPHE	JSF	Update recommended every 3-5 years, or sooner if substantial changes in activity occur. Last update: 7/97	None
24	COD983802448	DOE	HAZARDOUS WASTE	Notification of Regulated Waste Activity	CDPHE	NWTC	Update recommended every 3-5 years, or sooner if substantial changes in activity occur. Last update: 7/97	None
25	COR000207563	DOE	HAZARDOUS WASTE	Notification of Regulated Waste Activity	CDPHE	ReFUEL	Issued Jan 9, 2004	None
26	001 and 002	DOE	AIR: OZONE DEPLETING SUBSTANCES	Registration of stationary appliances (2 SERF chillers)	CDPHE	SERF	Annual renewal due July 1	None
27	N/A	DOE	AIR: OZONE DEPLETING SUBSTANCES	Facility Notification	CDPHE	STM, NWTC	Annual notification and fee due December 1	

Tracking Number	Permit or Registration Number	Permit or Reg. Holder	Permit Type	Permit Description	Issuing Agency Name	Location Description	Status/ Expiration Date	Reporting Required
28	001	DOE	AIR: OZONE DEPLETING SUBSTANCES	Registration of stationary appliance (chiller in DWOP)	CDPHE	DWOP	Annual renewal due July 1	
29	2873-001 and 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	Annual registration and fee, due April/May	None
30	93000378	DOE	Historic Registration	National Register of Historic Places	National Park Service	Colorado Amphitheater	No expiration	None
31	93000379	DOE	Historic Registration	National Register of Historic Places	National Park Service	Ammunition Igloo	No expiration	None
32	AFP-CO-00255	DOE	Alcohol (not an environmental permit)	Alcohol Producer's Permit	Bureau of Alcohol, Tobacco, and Firearms	AFUF (PDU)	Annual renewal due July 1	Annual report due Jan 30
33	TF-CO-0331	DOE	Alcohol (not an environmental permit)	Industrial Alcohol User Permit	Bureau of Alcohol, Tobacco, and Firearms	NREL-wide	Annual renewal due July 1	None
34	N/A	NREL	Transportation	Hazardous Material Transportation	U.S. Department of Transportation	NREL-wide	Annual renewal and fee	None
35	85936	NREL	Registration	X-Ray Machine Certification Report	CDPHE	SERF	November 2007	None
36	85938	NREL	Registration	X-Ray Machine Certification Report	CDPHE	SERF	November 2007	None
37	92056	NREL	Registration	X-Ray Machine Certification Report	CDPHE	SERF	November 2008	None

Tracking Number	Permit or Registration Number	Permit or Reg. Holder	Permit Type	Permit Description	Issuing Agency Name	Location Description	Status/ Expiration Date	Reporting Required
38	85937	NREL	Registration	X-Ray Machine Certification Report	CDPHE	SERF	November 2007	None
39	COR10000F	DOE	Notice of Intent (NOI)	Stormwater Discharges Associated with Construction Activity Under an NPDES General Permit	EPA	S&TF	Active	None – monitoring is done and records maintained internally to ensure compliance
40	COR10000F	NREL/MRI	Notice of Intent (NOI)	Stormwater Discharges Associated with Construction Activity Under an NPDES General Permit	EPA	S&TF	Active	None – monitoring is done and records maintained internally to ensure compliance

## **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

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

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

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

<sup>1</sup>Species observed during the 1987 survey, but not during the 2004-2005 surveys.