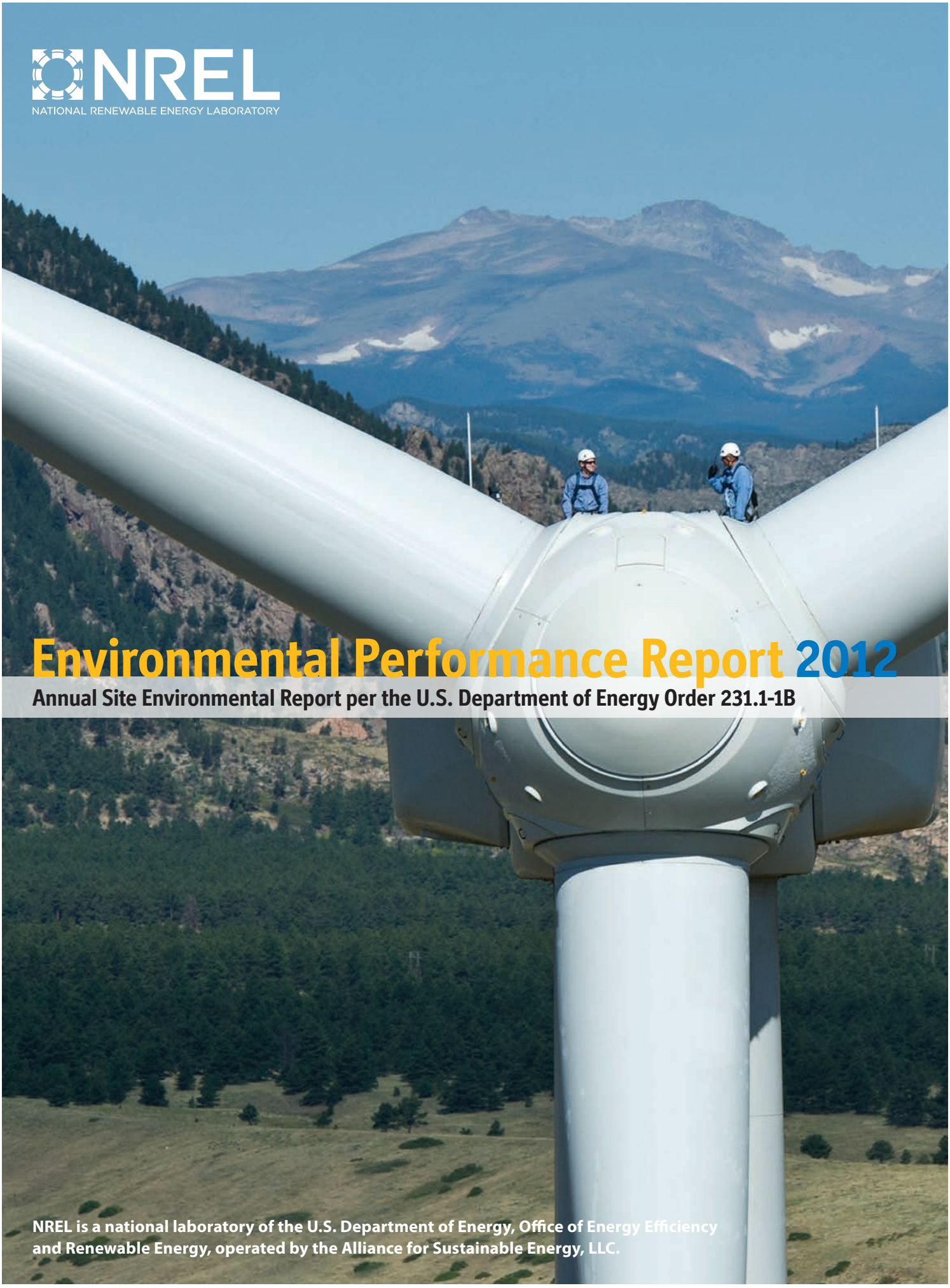
NREL
NATIONAL RENEWABLE ENERGY LABORATORY



# Environmental Performance Report 2012

## Annual Site Environmental Report per the U.S. Department of Energy Order 231.1-1B

NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.

Cover Photo: Aerial view of technicians working on a turbine at NREL's National Wind Technology Center.
*Photo by Dennis Schroeder, NREL 21869*



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## Contact Us

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

Maureen Jordan, Director, EHS
maureen.jordan@nrel.gov
303-275-3248

John Eickhoff, Environmental Manager
john.eickhoff@nrel.gov
303-275-3217

Kerry Masson, Director, Public Affairs Office
kerry.masson@nrel.gov
303-275-4083

This report and reports from prior years are available online at:
nrel.gov/ehsq/environmental_protection.html

National Renewable Energy Laboratory
15013 Denver West Parkway, Golden, CO 80401
303-275-3000
www.nrel.gov

# Nomenclature

APCD—Air Pollution Control Division of CDPHE
APEN—Air Pollutant Emission Notice
AST—Aboveground Storage Tank
AWS—Alternative Work Schedule

BMP—Best Management Practice

CCR—Colorado Code of Regulations
CDLE—Colorado Department of Labor and Employment
CDPHE—Colorado Department of Public Health and Environment
CELP—Colorado Environmental Leadership Program
CEQ—Council on Environmental Quality
CESQG—Conditionally Exempt Small Quantity Generator
CFR—Code of Federal Regulations
CGP—Construction General Permit
CMS—Chemical Management System
CNHP—Colorado Natural Heritage Program
$CO_2$—Carbon Dioxide
$CO_2e$—Carbon Dioxide Equivalent
CRADA—Cooperative Research and Development Agreement
CRS—Colorado Revised Statute
CSP—Concentrating Solar Power
CWA—Clean Water Act
CX—Categorical Exclusion

DBP—Disinfection Byproduct
DFD—Denver Fire Department
DNR—Colorado Department of Natural Resources
DSOC—District Shops and Operations Center
DOE—U.S. Department of Energy
DOE GSC—Department of Energy Golden Service Center
DOE O—Department of Energy Order
DOPS—Division of Oil and Public Safety of the Colorado Department of Labor and Employment
DWOP—Denver West Office Park
DWP/DWMB—Denver West Parkway/Denver West Marriott Boulevard

EA—Environmental Assessment
EERE—DOE Office of Energy Efficiency and Renewable Energy
EHS—Environment, Health, and Safety
EIS—Environmental Impact Statement
EMS—Environmental Management System
EPA—U.S. Environmental Protection Agency
EPCRA—Emergency Planning and Community Right-to-Know Act
ESA—Endangered Species Act
ESIF—Energy Systems Integration Facility
EO—Executive Order

FEC—Federal Electronics Challenge
FONSI—Finding of No Significant Impact
FTLB—Field Test Laboratory Building
FY—Fiscal Year

GHG—Greenhouse Gas
GHS—Globally Harmonized System of Classification and Labeling of Chemicals
GSF—Gross Square Feet
GWP—Global Warming Potential

HAP—Hazardous Air Pollutant
HMWMD—Hazardous Materials and Waste Management Division of CDPHE
hp—Horsepower
HPSB—High Performance Sustainable Buildings

IBRF—Integrated Biorefinery Research Facility
ISM—Integrated Safety Management
ISMS—Integrated Safety Management System
ISO—International Organization for Standardization

JSF—Joyce Street Facility

kg—kilogram
kW—Kilowatt

LEED—Leadership in Energy and Environmental Design
LEPC—Local Emergency Planning Committee
LOMR—Letter of Map Revision
LOS—Level of Service
LQG—Large Quantity Generator

MAP—Mitigation Action Plan
MBTA—Migratory Bird Treaty Act
MCL—Maximum Contaminant Level
MOU—Memorandum of Understanding
mrem—Millirem
MSDS—Material Safety Data Sheet
MW—Megawatt

NAAQS—National Ambient Air Quality Standards
NEPA—National Environmental Policy Act
NHPA—National Historic Preservation Act
NREL—National Renewable Energy Laboratory
NWTC—National Wind Technology Center
NESHAP—National Emission Standards for Hazardous Air Pollutants
NOI—Notice of Intent

ODS—Ozone Depleting Substance

PEMP—Performance Evaluation Measurement Plan
PM—Particulate Matter
PPA—Power Purchase Agreement
PUE—Power Usage Effectiveness
PV—Photovoltaic

RCRA—Resource Conservation and Recovery Act
ReFUEL—Renewable Fuel and Lubricants Research Laboratory
RFA—Rocky Flats Alluvium
RFHP—Renewable Fuel Heat Plant
RFP—Request for Proposal
RSF—Research Support Facility
RTD—Regional Transportation District

SARA—Superfund Amendments and Reauthorization Act
SDWA—Safe Drinking Water Act
SERF—Solar Energy Research Facility
SHPO—State Historic Preservation Officer
SITES—Sustainable Sites Initiative
$SO_2$—Sulfur Dioxide
SolarTAC—Solar Technology Acceleration Center
SPCC—Spill Prevention Control and Countermeasures
SQG—Small Quantity Generator
SSP—Site Sustainability Plan
SSPP—Strategic Sustainability Performance Plan
S&TF—Science and Technology Facility
STM—South Table Mountain
SWPPP—Stormwater Pollution Prevention Plan

TDM—Transportation Demand Management
TES—Thermal Energy Storage
TPQ—Threshold Planning Quantity
TTB—Alcohol and Tobacco Tax and Trade Bureau of the U.S. Department of the Treasury

USACE—U.S. Army Corps of Engineers
USFWS—U.S. Fish and Wildlife Service

VOC—Volatile Organic Compound

WHF—Waste Handling Facility

# NREL Environmental Performance Report 2012

## Table of Contents

# Executive Summary

## Purpose

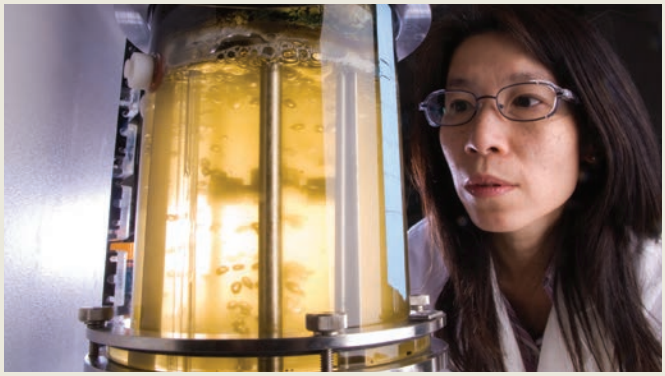
The National Renewable Energy Laboratory's (NREL) Environmental Performance Report provides a description of the laboratory's environmental management activities for 2012, including information on environmental and sustainability performance, environmental compliance activities and status, and environmental protection programs, highlights, and successes.

The purpose of this report is to ensure that DOE and the public receive timely, accurate information about events that have affected or could adversely affect the health, safety, and security of the public or workers, the environment, or the operations of DOE facilities. This report meets the requirements of the Annual Site Environmental Report and is prepared in accordance with the U.S. Department of Energy (DOE) Order 231.1B, *Environment, Safety and Health Reporting*.

## Environmental and Sustainability Performance

The laboratory is committed to environmental stewardship, pollution prevention, compliance with environmental requirements, and continual improvement in environmental protection and sustainability performance.

NREL's Environmental Management System (EMS) implements a framework of policies, procedures, and programs that integrates environmental protection into daily work practices. The EMS is structured based on a plan-do-check-feedback continual improvement framework depicted in the graphic, and is implemented as part of an Integrated Safety Management System.

NREL researchers are studying microalgae as a potential source of biofuels. *Photo by Pat Corkery, NREL 16312*

## About NREL

NREL is the principal research laboratory for DOE's Office of Energy Efficiency and Renewable Energy (EERE). The laboratory also conducts research for the Office of Science and the Office of Electricity Delivery and Energy Reliability. The laboratory is managed for EERE by the Alliance for Sustainable Energy, LLC, a partnership between MRIGlobal and the Battelle Memorial Institute.

NREL is the only national laboratory solely dedicated to advancing renewable energy and energy efficiency technologies from concept to commercial application. The laboratory's innovations, analysis, and expertise have enabled the emergence of a U.S. clean energy industry and led to numerous success stories from across the laboratory. The laboratory's 327-acre South Table Mountain main campus in Golden, Colorado, is a living model of sustainable energy. The laboratory also operates the National Wind Technology Center (NWTC).

NREL develops renewable energy and energy efficiency technologies and practices, advances related science and engineering, and transfers knowledge and innovations to address the nation's energy and environmental goals. The laboratory's research and development achievements have helped shape clean-energy alternatives for powering our homes and businesses, and the nation's transportation infrastructure. NREL's science and technology teams span the full spectrum of innovation, from fundamental science and market-relevant research to systems integration, and testing and validation.

## Continued ISO 14001 Certification Demonstrates Commitment to Environmental Leadership

In 2012, the laboratory maintained International Organization for Standardization (ISO) 14001:2004 certification of its environmental management system. In July, a team of external auditors conducted an independent assessment of the policies, procedures, tools, and roles and responsibilities used in environmental management. The assessment verified that the laboratory continues to meet the requirements of the ISO 14001 standard and demonstrates our commitment to environmental stewardship.

Each year, the laboratory sets measurable objectives and targets for environmental improvement through the NREL environmental management system planning process. Goals are established in the Performance Evaluation Measurement Plan, Site Sustainability Plan, and Colorado Environmental Leadership Program.

Progress through the course of the year on each of these goals is tracked using an online software tracking system and results are reported annually.

## Sustainability

Sustainability is integral to both our research and operations and we are committed to demonstrating federal leadership in sustainability and continuously improving performance. Sustainable NREL, an interdisciplinary initiative involving staff from across the organization, fosters environmental and social responsibility, working to establish the laboratory as a global model for sustainability.

Each year, Sustainable NREL develops a Site Sustainability Plan to report on steps taken to meet the national and DOE sustainability objectives and outline plans for the upcoming year. The laboratory has currently identified 20 objectives to enhance sustainability and continues to make significant progress toward these objectives.

## Environmental Compliance and Monitoring

NREL is subject to many federal, state, and local environmental laws and regulations, as well as executive orders, DOE orders, and memoranda of understanding with government agencies. Unlike many DOE facilities, NREL does not conduct work involving nuclear materials and does not have legacy radiological or other contamination issues associated with past nuclear weapons production or research activities; therefore, NREL facilities do not conduct regular radiation or other monitoring.

The laboratory continued its excellent record of environmental compliance in 2012. No violation notices were received from any regulatory agency and all required permits were received or renewed, required registrations were completed, and required notifications and reports were submitted.

There was one spill at the NWTC which required reporting to the state during 2012. An open valve located within the elevated nacelle of a wind turbine leaked approximately 90 gallons of synthetic lubricant oil. No contamination of a waterway occurred and the spill was remediated.

In August 2012, a sample collected from the NWTC drinking water system indicated the Maximum Contaminant Level (MCL) was exceeded for haloacetic acids, a class of disinfection byproducts. Increased monitoring has indicated that haloacetic acids levels have been consistently below the MCL since this single exceedance.

### ENVIRONMENTAL MANAGEMENT PROGRAMS

The laboratory continues to meet or exceed compliance requirements and strives to make continual improvements in environmental management. Major environmental program areas include:

- Air quality protection, including air permitting, ozone-depleting substance management, and greenhouse gas emissions monitoring
- Water quality protection, including construction stormwater management, drinking water monitoring, and preventing unallowable sanitary sewer system discharges

- Hazardous materials and waste management, including pollution prevention, spill response, proper storage, use, and disposal of hazardous chemicals and materials, as well as planning, permitting, and reporting regarding use and emissions of such materials
- National Environmental Policy Act reviews
- Natural and cultural resources protection, including wildlife, vegetation, protected species, wetlands, and cultural resources management.

## Prestigious Environmental Sustainability Awards Received

The laboratory received several important recognitions in 2012 for its environmental and sustainability accomplishments. NREL received a DOE Sustainability Award for its "Comprehensive Energy Management Plan." DOE Sustainability Awards highlight environmental sustainability projects and programs within the DOE complex that reduce environmental impacts, enhance site operations, reduce costs, and demonstrate excellence in pollution prevention and sustainable environmental stewardship.

The laboratory received a DOE Green Buy Program Gold Award for purchasing 17 products in five different categories, achieving DOE's Green Buy leadership goal.

NREL also achieved the Platinum-level Federal Electronics Challenge (FEC) Award. FEC is a partnership program between the Office of the Federal Environmental Executive and the U.S. Environmental Protection Agency (EPA). The FEC recognizes federal facilities that voluntarily lead in the area of green electronics purchasing, management, and recycling.

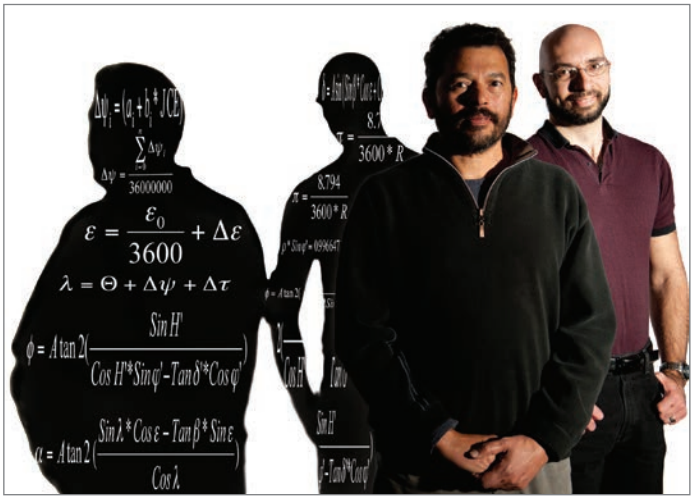
# 1 Introduction

## 1.1 PURPOSE

This report presents a summary of NREL's 2012 environmental management activities, including:

- Environmental protection programs
- Environmental and sustainability performance
- Environmental compliance activities and status
- Environmental management highlights and successes.

This report incorporates the U.S. Department of Energy's (DOE) most recent guidelines for the Annual Site Environmental Report, as required by DOE Order (DOE O) 231.1B, *Environment, Safety, and Health Reporting*.




NREL researchers developed the Solar Position Algorithm now used by solar trackers, orchard growers and movie-camera makers, among others. *Photo by Dennis Schroeder, NREL 18600*

## 1.2 OUR MISSION

NREL's mission is focused on advancing the energy goals of DOE and our nation. This focus is captured in the mission statement:

> *NREL develops renewable energy and energy efficiency technologies and practices, advances related science and engineering, and transfers knowledge and innovations to address the nation's energy and environmental goals.*

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

- **Basic science.** Fundamental research is conducted in the sciences that underlie NREL's renewable energy and energy efficient technologies.
- **Bioenergy.** NREL currently has major programs in biomass-derived fuels (biofuels) and biomass-derived electricity (biopower), and projects in biomass-derived chemicals and materials.
- **Building energy.** NREL increases the use of energy efficiency technologies and expands the use of renewable energy technologies in the building sector by working to develop new, cost-effective, environmentally acceptable building equipment and envelope systems.
- **Computational sciences.** This area includes basic and applied research using high-performance computing and applied mathematics.
- **Distributed power.** Distributed power is modular electric generation or storage located near the point of use. NREL participates in the development of technologies, market structures, and policies that affect the incorporation of renewable and energy efficiency technologies in distributed power systems, thus maximizing the utilization of renewable energy and energy efficient products. NREL is involved in the development, design, and facilitation of the application of renewable and renewable/fossil hybrid distributed power systems in grid-connected applications.
- **Electricity technologies.** Research is conducted to support electricity technologies which include renewable energy, hydrogen, and superconductivity technologies, as well as utility resources.
- **Energy analysis.** Research at NREL includes energy analysis for various programs and initiatives.
- **Hydrogen.** NREL is a leader in renewable hydrogen production technologies and the development of codes, standards, and advanced storage and sensors. Basic and applied research and material development using biology, physics, and chemistry enable and support the development of hydrogen production, storage, and end-use systems.
- **Measurements and testing.** NREL laboratories and facilities allow state-of-the-art testing on photovoltaic (PV) cells, building technologies, and wind turbines.
- **PV.** PV enables the direct conversion of sunlight to electricity using solid-state materials. The National Center for Photovoltaics develops and deploys PV technology for the generation of electric power.

- **Renewable energy resources.** Researchers develop resource information for solar, wind, biomass, and geothermal energy applications.
- **Renewable thermal technologies.** These technologies—including concentrating solar power (CSP), solar water heating, and geothermal heat and power—generate power from heat or utilize heat from renewable resources.
- **Transportation**. NREL works with industry experts to develop advanced vehicles and transportation systems. NREL also works with energy companies and manufacturers of vehicles and engines to develop advanced motor vehicle fuels for improved energy and environmental performance.
- **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.

NREL's STM campus. *Photo by Dennis Schroeder, NREL 21788*

## 1.3 SITE AND FACILITY DESCRIPTION

NREL facilities occupy four separate locations in Jefferson County, Colorado, near Denver, and one location in the City and County of Denver. These include:

- National Wind Technology Center (NWTC)
- South Table Mountain (STM) site
- Denver West Office Park (DWOP)
- Joyce Street Facility (JSF)
- ReFUEL (located in Denver).

The STM and NWTC sites are the two main sites where research operations are conducted; these will be addressed separately in the discussion of environmental features. DWOP is leased space used primarily for administrative functions and limited research activities. The leased JSF space is primarily used for storage. The ReFUEL facility is a leased space that consists of a small shop complex housed within the Regional Transportation District (RTD) District Shops and Operations Center (DSOC) facility in Denver. Laboratory staff also conduct work at additional locations as needed, for example at the Solar Technology Acceleration Center (SolarTAC) described below.

### SOUTH TABLE MOUNTAIN (STM) SITE

The STM site is the main research center for NREL—nearly 80% of the laboratory's staff have their offices and laboratories there. The STM site is approximately two miles (3.2 km) east of Golden and 12 miles (19.3 km) west of central Denver.

#### Land Use

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, a mesa that stands about 492 feet (150 meters) above the adjacent lowlands. South Table Mountain is composed of sedimentary rocks below a basalt lava cap, which is quite resistant to erosion.

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. 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 DWOP and apartment homes lie to the east.

A red-tailed hawk in front of the Education Center at NREL's STM campus. *Photo by Dennis Schroeder, NREL 22325*

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 (for more detail, see section 11 Conservation Easement Lands).

## Geology, Soils, and Hydrogeology

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 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. 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.

A new stormwater detention pond controls the flow of runoff from much of the STM site and serves as an important local habitat. *Photo by Dennis Schroeder, NREL 23195*

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, comprising 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 drain-

A variety of wildlife can be seen around campus, including mule deer. This group still has velvet on their antlers. *Photo by Brent Nelson, NREL 23904*

ages with associated wetlands. Field surveys have identified limited wetland and 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 hectares (0.75 acres). Riparian shrub communities also occur adjacent to the emergent wetlands. A vegetation survey of the STM site was conducted in 2010 (for more information, see section 10.3 Vegetation Management).

### Wildlife

Several comprehensive wildlife surveys have been conducted on the site, starting with the original study in 1987. Additional surveys were done in 1999 for the conservation easement property. Surveys to update existing data were completed in 2005 and in 2011 (see section 10.1 Wildlife Management for more information).

Mammals identified during the surveys included mule deer, coyotes, gray foxes, red foxes, raccoons, long-tailed weasels, striped and spotted skunks, badgers, bobcats, mountain lions, rabbits, yellow-bellied marmots, and various smaller mammals. More than 50 species of birds have been recorded on the STM site by the formal wildlife surveys and supplemental employee observations. A number of raptor species have been recorded at or above the STM site, especially during spring migration. Two raptor species are resident at the site: American kestrel (*Falco sparverius*) and red-tailed hawks (*Buteo jamaicensis*). Reptiles and amphibians inhabit the area as well. Most notably, the western diamond-backed rattlesnake is routinely encountered around the campus area.

## NATIONAL WIND TECHNOLOGY CENTER (NWTC)

The NWTC is the main facility for NREL's wind turbine technology research. Located on the Jefferson-Boulder County border just east of the foothills of the Rocky Mountains, the NWTC has abundant wind resources that are critical for the variety of projects conducted at the site. 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.

### Land Use

The NWTC facility occupies a 305-acre area surrounded largely by open space and grazing land. The Rocky Flats National Wildlife Refuge 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. State Highway 128 borders the NWTC to the north; Boulder County open space lies to the north of the highway.

Aerial view of NREL's NWTC. *Photo by Lee Jay Fingersh, NREL 22073*

### 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.[1]

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.

### Surface Water

The area surrounding the NWTC site is drained by five streams: Rock Creek, North Walnut Creek, South Walnut Creek, Woman Creek, and Coal Creek. Rock Creek flows eastward and is located southeast of the NWTC. North Walnut Creek and South Walnut Creek flow eastward into the Great Western Reservoir. Woman Creek drains eastward into Standley Lake. Coal Creek flows in a northeasterly direction across the City of Boulder Open Space north of the NWTC.

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

[1] EG&G Rocky Flats, Inc. (1992). Rocky Flats Plant Site Environmental Report, January Through December 1992. Golden, Colorado.

## Vegetation

The NWTC is located in the transition area between the Great Plains and the Rocky Mountains[2]. 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[3].

Vegetation surveys conducted at the site have identified 271 vascular plant species and defined five major habitat types on the NWTC site, including: xeric mixed grasslands, pine woodlands, shrublands, wetlands, 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. The most recent vegetation survey was completed in 2011 (for more detail, see section 10.3 Vegetation Management).

## Wildlife

Prior to 1975, livestock heavily grazed the NWTC site, damaging a majority of the native vegetation. DOE prepared a biological characterization inventory in 1992 for the entire Rocky Flats plant, including the NWTC site which was part of the no-activity buffer zone of the Rocky Flats plant at the time. 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 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 completed in 2002 and updated in 2011 (for more information, see section 10.1 Wildlife Management). Although seldom seen, rattlesnakes, bull snakes, racers, and several other reptilian and amphibian species are known to occupy the area.

## DENVER WEST OFFICE PARK (DWOP)

DWOP is approximately two miles (3.2 km) east of Golden and 12 miles (19.3 km) west of central Denver. 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 in approximately the geographic center of the development. DWOP is bordered on the south by commercial areas (West Colfax strip), and on the west by the Pleasant View residential area, Camp George West facility, and the STM site. DWOP is within the City of Lakewood.

## JOYCE STREET FACILITY (JSF)

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; there are no staff offices at JSF. Support activities and limited dry laboratory research activities are currently conducted at the facility. The JSF is located at 6800 Joyce Street, about 5.5 miles (8.9 km) north of DWOP and STM sites.

## RENEWABLE FUELS AND LUBRICANTS LABORATORY (ReFUEL)

ReFUEL 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 is also used to evaluate and develop heavy hybrid electric vehicles.

Hybrid vehicle fuel economy and emission tests are conducted at NREL's ReFUEL facility. *Photo by Jack Dempsey, NREL 17222*

ReFUEL is a small shop complex housed within the RTD DSOC at 1900 31st Street, Denver, about 12 miles east of the STM and DWOP sites.

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 southern, eastern, and northeastern borders.

[2,3] Plantae Consulting Services (2000). Vegetation Survey, NREL National Wind Technology Center. Boulder, Colorado.

The SolarTAC test facility in Aurora, Colorado. *Photo by Dennis Schroeder, NREL 19110*

## ADDITIONAL LOCATIONS

Laboratory staff also conduct work at additional locations as needed. One such location is SolarTAC, operated by MRIGlobal, located near Denver International Airport northeast of the intersection of East 26th Avenue and North Hudson Road in Aurora, Colorado. SolarTAC is a partnership of solar equipment manufacturers, research organizations and electric utilities that want to make use of a real-world outdoor site to develop, test, validate or showcase solar products. Approximately 33 miles east of the STM site, the 74-acre facility provides users with readily accessible land and all the necessary infrastructure and resources needed to rapidly and economically install their technologies. NREL currently leases several acres at the site. The primary projects currently being developed by NREL include:

- Concentrator PV (CPV) Demonstration. This system will demonstrate and quantitatively compare performance of CPV systems installed in Japan and the Unites States.
- Thermal Energy Storage (TES) Test Facility. This facility will provide a pilot-scale TES demonstration project.

## 1.4 SITE ENVIRONMENTAL CONDITIONS/ FEATURES

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

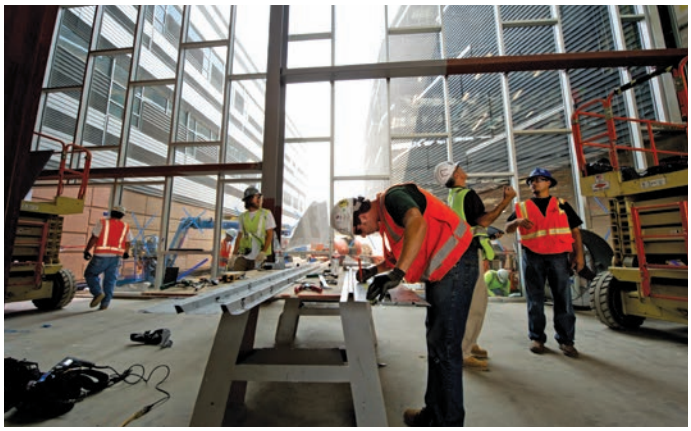
The area experiences moderate precipitation, with an average annual rainfall of less than 50 cm (20 inches). Almost half of the annual precipitation occurs from March to June. Summer showers contribute 33% of the annual precipitation total. Precipitation begins to decrease significantly in the fall, reaching 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 to10 inches).

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

# 2 Significant Activities in 2012

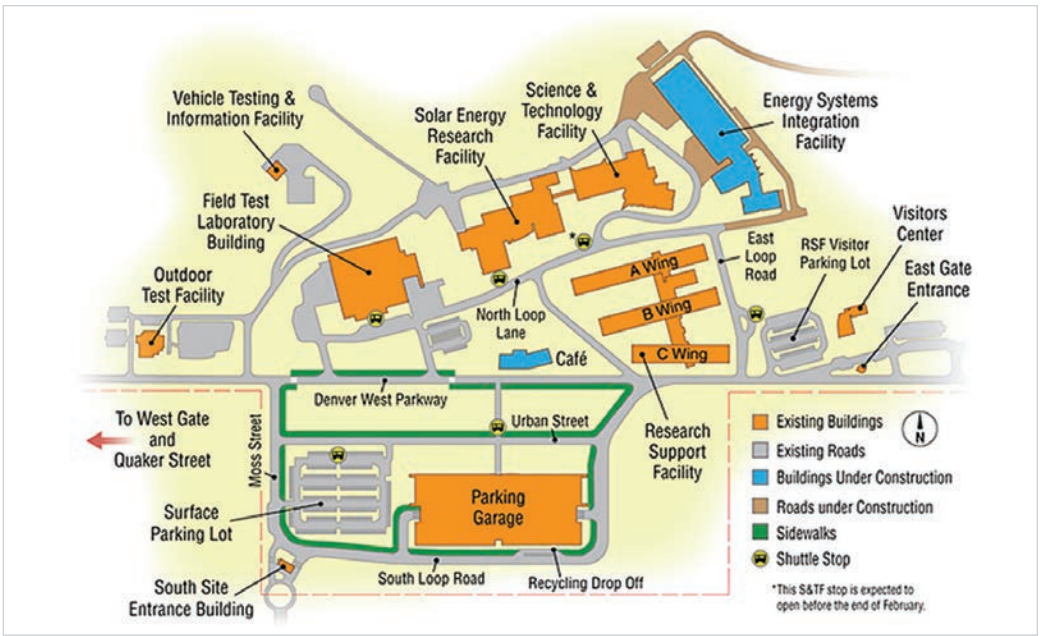
In 2012, there was significant construction activity on the STM and NWTC campuses. Several major and minor construction projects were underway throughout the year. From concept to design to occupancy, environmental stewardship is integrated into construction project management to deliver world-class energy performance and environmentally sensitive and sustainable buildings.



NREL's Energy Systems Integration Facility during construction.
*Photo by Dennis Schroeder, NREL 22119*

## 2.1 MAJOR AND MINOR CONSTRUCTION PROJECTS

- Construction of a new 1,800-space parking garage was completed in early 2012. The garage meets the parking needs of the increased number of staff located at the STM site that were recently relocated from leased space at the Denver West Office Park (DWOP).
- A new south entrance to the STM site was completed, including a site entrance building designed to achieve LEED Platinum certification. The design of the south entrance improves traffic flow by redirecting much of the traffic from the east entrance, alleviating traffic pressure on Denver West Parkway.
- Construction of the Energy Systems Integration Facility (ESIF) was completed in late 2012. The 183,000-ft$^2$ building houses about 200 researchers and has been submitted for LEED Platinum certification. The building will support:
  - High-performance computing at the one-half petaflop scale
  - State-of-the-art electric systems simulation and visualization
  - Component and systems testing at megawatt-scale power
  - Integration of functioning systems with utility system simulations for real-time, real-power evaluation.
- Construction of a stormwater detention basin was completed to improve stormwater management from STM site development.




Map of STM main facilities.

- Additional smaller projects completed or underway included:
- Construction of a cafeteria at the STM site was completed.
- Improvements to Denver West Parkway were initiated.
- Improvements to fire suppression systems were initiated at the Integrated Biorefinery Research Facility and west end of the STM campus.

- At SolarTAC, construction of the Thermal Energy Test Site was completed and work on the Regional Test Center was started.

The new South Site Entrance Building on NREL's STM campus is energy efficient, constructed mostly with recycled materials and features a passive cooling tower. *Photo by Dennis Schroeder, NREL 23232*

## 2.2 INTEGRATED ENVIRONMENTAL STEWARDSHIP IN CONSTRUCTION MANAGEMENT

NREL designs and builds new facilities using an approach that integrates planning, design, and construction. An interdisciplinary team collaborates on each project beginning with planning and selection of design, continuing through construction. This integrated approach allows the laboratory to achieve mission needs while addressing environmental, health, safety, and community considerations.

The new cafeteria at the STM campus. *Photo by Paul Schwabe, NREL 23714*

### PROJECT PLANNING AND DESIGN

Environmental management staff participate in an interdisciplinary team from a project's initiation and continuing through construction. These staff assist with the development and review of Requests for Qualifications and Requests for Proposals (RFPs), facilitate the inclusion of environmental requirements into project designs, and monitor proposed changes throughout the project to confirm

Construction of the new Energy Systems Integration Facility. *Photo by Dennis Schroeder, NREL 22670*

potential environmental impacts are considered. Some examples of sustainable design features used in recent projects include:

- Producing energy onsite. New construction is designed to take advantage of the sun's rays by using angled roofs and awnings that can support photovoltaic (PV) panels in optimal conditions. The RSF was designed to be a net-zero energy building, using only energy produced onsite. To help the RSF achieve the goal to produce as much energy onsite as used by the building, a 1.6 megawatt (MW) PV system was installed on the building and adjacent covered parking areas using a power purchase agreement (PPA) with Sun Edison and Xcel Energy.
- Heating and cooling strategies. Passive design allows buildings to stay cool in summer and warm in winter. Radiant heating and cooling use water as the cooling and heating medium instead of forced air. For example, 42 miles of piping course through the RSF carrying water for radiant heating and cooling. Waste energy from the data center is reused to maximize building heating. Evaporative cooling systems supplement passive cooling.
- Underfloor ventilation. Demand-controlled, dedicated outside air systems in the RSF provide fresh air supplied via a raised floor distribution system.

The new stormwater detention pond regulates the flow of runoff from the STM campus and improves water quality. *Photo by Dennis Schroeder, NREL 23189*

- Occupant-controlled windows. Operable windows in the RSF help reduce the use of air conditioning and give employees considerable control over their own comfort. When outdoor air conditions are temperate, employees are notified by automated systems on their computers that it's okay to open windows. Building control systems automatically operate remaining windows when optimum conditions are met.
- No- and low-volatile organic compound (VOC) materials. Only products that produce no or low amounts of VOCs are used in building interiors to maintain excellent air quality for inhabitants. Because employees spend most of their working hours indoors, the quality of indoor air is important for employee health and wellbeing. To ensure that no- and low-VOC products are used, products are selected from reputable, certified product label systems such as Green Seal, EcoLogo, and the EPA's WaterSense program.
- Daylighting and lighting management. NREL strives to design buildings that utilize natural lighting to the extreme, resulting in tremendous energy savings, as well as health and wellness benefits for occupants. External lighting using timers, motion-sensors, and downward-facing, covered lights also minimize light pollution impacts on neighbors.
- Wildlife-friendly design. Selection of wildlife-sensitive features helps minimize the impacts of buildings to birds and other animals. For example, the parking garage atrium, stair towers, and bus shelters have glass with specialized glazing designed to prevent bird collisions. NREL also carefully considers wildlife movement patterns and works to preserve existing travel zones. Wildlife-friendly perimeter fencing, for instance, allows wildlife to travel freely across property boundaries.
- Site sensitive drainage and vegetation. Design teams incorporate low-impact design elements to retain stormwater onsite through infiltration. Features such as bioswales, vegetated filters, and porous pavers and asphalt encourage stormwater and snowmelt to seep into the soil instead of running off. Native and drought-resistant vegetation and a smart irrigation system automatically adjust landscape watering based on plant needs and daily local weather conditions. Native plants are used because they are adapted to the local climate, can thrive without additional watering once established, and are beneficial to other native species.

## ENVIRONMENTALLY RESPONSIBLE CONSTRUCTION PRACTICES

During construction, involved staff participate in weekly construction team meetings, monitor performance criteria, and provide ongoing feedback to the project team regarding environmental management. Some examples of environmentally responsible construction practices include:

- Pre-construction review of project plans. Staff conduct a pre-construction orientation with the project team to review the environmental elements of the project plan.
- Plan of the day. On a daily basis, subcontractors submit a "plan of the day" to the prime contractor the day before any work is performed. The prime contractor evaluates all plans for potential environmental and safety hazards and communicates these plans with all subcontractors on the job site.
- Stormwater controls. Erosion and sediment controls, proper chemical storage and fueling procedures, and good housekeeping practices are implemented during construction. Regular inspections by contractors and periodic site inspections by NREL staff are conducted to verify that the implemented controls are functioning properly. Any repairs are documented on an inspection report; prompt actions are required to correct any noncompliant conditions.
- Keeping wildlife safe. Prior to commencing construction, biologists conduct surveys for nesting birds and have the authority to delay construction or instruct workers to avoid sensitive areas if necessary until young birds fledge the nest. Areas with planned construction are mowed in the weeks prior to construction to discourage birds from nesting. When snakes are encountered they are safely relocated away from active construction areas.

The parking structure on NREL's STM campus includes 3,632 photovoltaic panels installed on the roof and the south façade. The panels produce up to 1.15 megawatts of power. *Photo by Dennis Schroeder, NREL 21635*

- Waste reduction, reuse, and recycling. Construction contractors at NREL regularly divert close to 90% of their waste by recycling and reusing materials. Contractors are encouraged to retain materials onsite whenever possible to reduce transportation costs, fuel use, greenhouse gasses, and other air emissions. For example, excess excavated dirt is often used as fill onsite and may be shared between projects on campus. Instead of transporting excavated rock off-site, it's used in gabion retaining walls as an attractive landscaping feature.
- Minimizing and cleaning up spills. NREL specifies that new or like-new equipment must be used during construction onsite to minimize the potential for drips, leaks, and spills of fuel, oil, and hydraulic fluids. When spills do occur, contractors are instructed to quickly stop the source, control spilled material, and contact NREL to monitor cleanup activities.
- Dust control. Contractors must control dust to minimize impacts to neighbors and adjacent habitats. Water trucks are used to spray down dust prone areas, driving speeds are limited, and excavation during high winds is restricted.

# 3 Environmental Management System

NREL's Environmental Management System (EMS) provides effective environmental stewardship and minimizes the environmental impacts of laboratory activities and operations. The EMS is a framework of policies, procedures, and programs that integrates environmental protection into daily work practices. The laboratory's EMS efforts:

- Protect and enhance the vegetation, wildlife, and natural resources of the laboratory sites
- Prevent pollution
- Comply with environmental requirements
- Encourage continual improvement in environmental protection and sustainability performance.

While the EMS is managed by the Environment, Health, and Safety (EHS) Office, environmental protection must involve everyone at the laboratory to be effective. The EMS is implemented as part of a DOE-required Integrated Safety Management System (ISMS). The ISMS systematically integrates safety and environmental protection into management and work practices at all levels to protect the public, the worker, and the environment.

NREL's EMS is certified to the ISO 14001:2004 standard for environmental management systems. ISO 14001 is a globally recognized standard that defines the structure of an organization's EMS to improve its environmental performance. ISO 14001 requires an organization to identify potential environmental impacts and establish controls needed to minimize impacts, to monitor and communicate environmental performance, and to establish a formal process for continually improving the system.

ISO 14001:2004 Certified

## 3.1 ENVIRONMENTAL MANAGEMENT SYSTEM STRUCTURE

The EMS is structured based on a plan-do-check-feedback continual improvement framework described below and depicted in the graphic.

NREL conducts an annual review of its activities that could potentially affect the environment. The laboratory's significant environmental aspects for 2012 were:

- Air emissions
- Surface water or groundwater emissions
- Wastewater releases
- Waste generation and management
- Resource use or conservation (energy, water, land, biological, cultural)
- Community.

Each of these aspects is addressed by the environmental management system.

## PLANNING

- Environmental policy. NREL states its commitments to the environment through this overarching policy. The policy commits specifically to:
- Environmental stewardship
- Pollution prevention
- Compliance with legal requirements and voluntary commitments
- Continual improvement of environmental and sustainability performance.
- Environmental aspects. NREL's environmental aspects are those activities, products, or services that have the potential to interact with the environment. The significance of an identified aspect is determined by assigning a frequency of occurrence and a severity. Using this method, EHS staff review potential impacts to the environment annually and activities in the EMS are prioritized by the identified significant aspects. NREL also utilizes a robust hazard identification and control process as part of its ISMS to manage environmental risks.
- Legal and other requirements. NREL maintains a formal process to identify regulations and standards that are necessary and sufficient to address specific environmental hazards, including federal laws and regulations, state and local requirements, executive orders, and DOE requirements.
- Objectives and targets. Regular planning of activities and programs are necessary to achieve NREL's environmental goals. The EHS Office and Sustainable NREL plan, implement, monitor, and report on environmental stewardship goals and actions to generate continual improvement (for more details, see section 3.2 Performance Indicators and Progress).

## IMPLEMENTATION

- Structure and responsibility. NREL policies and procedures establish roles and responsibilities for environmental management within the organization.
- Competence, training, and awareness. NREL verifies that workers are competent on the basis of education, training, or experience and implements a robust environment, health, and safety training program.
- Communication. NREL provides a number of avenues for communication between the laboratory and the community, such as community meetings, lunch-and-learn events, public-facing websites, periodic newsletters, and mailings. NREL tracks and responds to all environmentally related concerns through the Public Affairs Office. Internal communication regarding environmental issues is provided via intranet sites, newsletters, emails, meetings, posters, trainings, and personal interaction with EHS workers.

An Earth Week nature walk along Lena Gulch. *Photo by Dennis Schroeder, NREL 20508*

- Operational control. NREL plans and manages operations and activities in line with its environmental policy and objectives. Staff continually identify and review activities that could impact the environment, and engineering and administrative controls are put in place to minimize or avoid impacts to the environment.
- Document and record control. Policies and procedures ensure that the current, correct versions of documents are available for use and that records are maintained to meet requirements.

## CHECKING AND CORRECTIVE ACTION

- Monitoring, measuring, and evaluating compliance. NREL monitors key activities, tracks performance and progress toward environmental objectives, and conducts periodic assessments of compliance with legal requirements.
- Internal assessment. NREL periodically conducts assessments to verify that its EMS is operating as intended. A formal system for tracking corrective and preventive actions supports continual improvement of the management system (for details, see section 3.3 Assessment and Improvement).

## 2012 Highlights and Achievements

- In 2012, NREL maintained its ISO 14001:2004 certification. In July, a team of external auditors conducted an independent assessment of the policies, procedures, tools, and roles and responsibilities used in environmental management. The assessment verified that the laboratory continues to meet the requirements of the ISO 14001 standard and demonstrates our commitment to environmental stewardship.
- Several internal assessments of environmental management programs were conducted and identified areas for continual improvement (for details, see section 3.3 Assessment and Improvement).
- The laboratory's policies and procedures for managing its EMS and its ISMS were combined to eliminate redundancy, reduce unnecessary procedures, and better coordinate management of the systems.
- The 2011 version of this report was redesigned to improve communication with external stakeholders and the general public regarding environmental compliance and leadership in environmental management.

### MANAGEMENT REVIEW

- Management Review. NREL conducts regular management reviews of the EMS so that executive management can provide feedback and direction to the environmental management of the organization.

### 3.2 PERFORMANCE INDICATORS AND PROGRESS

Each year, measurable objectives and targets for environmental improvement are set. Goals are set through several mechanisms including:

- Performance Evaluation Measurement Plan (PEMP). Each fiscal year, in collaboration with the DOE Golden Service Center, performance objectives are developed for the upcoming year.
- Colorado Environmental Leadership Program (CELP). As a member of CELP, NREL voluntarily sets three-year goals for environmental improvement. Each year, progress toward these goals is reported to the state.
- Site Sustainability Plan (SSP). For 2012, Sustainable NREL developed an SSP to establish sustainability performance commitments for 2012 and document activities in support of Executive Order (EO) 13514 requirements. Results of the 2012 plan are presented in the next chapter of this report.

Goals are owned by individuals and groups throughout the laboratory, including the EHS Office and Sustainable NREL. Progress through the course of the year on each of these goals is tracked using an online software tracking system and results are reported annually. Some examples of performance for 2012 are described in the 2012 Environmental Objectives and Achievements table.

For Fiscal Year 2013, NREL's environmental and sustainability objectives under the PEMP are:

- Maintain a safe and healthful workplace based on identified and managed risks
- Further ISM through development of improved management systems
- Further leadership in sustainable science and laboratory operations.

### 3.3 ASSESSMENT AND IMPROVEMENT

Assessments are key to supporting the continual improvement of environmental management. Periodic assessment of the EMS and its components provide assurance 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 demonstrate to ourselves and others that we are "walking the talk."

There are three different types of assessments performed to evaluate the functionality of NREL's EMS:

- Internal assessment. Staff perform regular internal assessments of the EMS against the ISO 14001 standard. The scope of internal assessments includes both the management of significant environmental aspects (areas where NREL's activities have the potential for environmental effects, either positive or negative) and policy implementation.
- External assessment. Periodically, external third-party assessments may be conducted by technical experts for specific components of environmental programs or for the EMS as a whole. These assessments are conducted as a part of continual improvement efforts and to maintain ISO certification.

## 2012 ENVIRONMENTAL OBJECTIVES AND ACHIEVEMENTS

| Goal Type | 2012 Objectives | 2012 Achievements | Objective Met? |
|---|---|---|---|
| PEMP | Maintain a safe and healthful workplace based on identified and managed risks. | • EHS procedures enhanced as part of continual improvement.<br>• Coordinated activities with Jefferson County to improve off-site stormwater discharge.<br>• Inspections conducted for registered/ permitted equipment to verify items are installed as ordered.<br>• Weekly environmental walks and construction project team participation drove strong environmental performance (stormwater, spill control, wildlife protection, etc.). | Yes |
| PEMP | Further Integrated Safety Management (ISM), which includes environmental stewardship, through development of improved management systems. | • Completed internal EMS assessments of two environmental programs: EPCRA Reporting and Ozone-Depleting Substances (ODS) Management.<br>• Completed all corrective actions and 12 opportunities for improvement from 2011 ISO/OHSAS certification assessment.<br>• Maintained ISO 14001 and OHSAS 18001 certifications. | Yes |
| CELP | To reduce the impacts of employee commuting by reducing individual vehicle miles travelled and to implement a traffic mitigation plan for the STM site—including Alternative Work Schedules (AWS) and telecommuting. | • Throughout 2012, traffic monitoring and intersection analysis indicated that NREL-generated traffic volumes and levels of service remained within acceptable levels.<br>• The completion of the new south entrance and roadway from South Golden Road to the STM site in May 2012 decreased traffic volumes accessing the east and west entrances and reduced NREL's traffic impacts at nearby off-campus intersections.<br>• NREL offers incentives for employees to participate in alternative commuting options such as access to mass transit, vanpool discounts, preferred parking for carpool/vanpool vehicles, rideshare coordination, and bicycle and pedestrian infrastructure (bicycle maintenance stations, bicycle parking, extension of sidewalks, etc.). | Yes |
| CELP | To support NREL's long-term goal of achieving a net-zero energy campus by seeking to reduce electricity use per square foot by 3% per year, starting with a 2008 baseline. | • In 2012, NREL exceeded its goal of 3% per year reduction in energy use per square foot. The reduction was largely due to the addition of a new wing to the Research Support Facility (RSF) which increased square footage with only a small increase in site energy consumption. | Yes |
| CELP | To implement measures at the RSF to seek certification in the Sustainable Sites Initiative (SITES) Pilot Program on Landscaping Green Certification for Sustainable Landscaping. | • Based on lessons learned from previous re-vegetation efforts, landscaping plans for current construction projects were adjusted to optimize plant establishment, withstand difficult shading and snow conditions, and deter animal browsing while providing wildlife habitat (i.e., spaces for nesting birds, plants for pollinators such as hummingbirds, and protective cover for other species).<br>• A "snow push map" was developed to ensure that snow and deicer materials would be pushed to areas where on-site vegetation would not be adversely impacted.<br>• A weed identification handbook was prepared to assist maintenance personnel in identifying weeds to be hand-pulled from newly landscaped areas. | Yes |

- Evaluation of compliance. Periodic internal environmental compliance evaluations are conducted to verify that activities meet all applicable legal and other requirements. Improvements are developed and implemented as necessary based on the results of each evaluation.

## 2012 ASSESSMENTS

In 2012, a number of assessments were conducted, allowing NREL to focus on finding areas of continual improvement, improve program effectiveness, and make substantial environmental performance improvements.

The following assessment activities took place in 2012:

- Internal assessments. In January 2012, an internal assessment was conducted of the laboratory's Emergency Planning and Community Right-to-Know Act (EPCRA) reporting. Scheduled interviews were conducted and reviews of relevant procedures and records were completed. One opportunity for improvement was identified and has been addressed.

  In February 2012, an internal assessment was conducted of the laboratory's Ozone-Depleting Substances (ODS) Program. Scheduled interviews were conducted and reviews of relevant procedures and records were completed. Four non-conformities with program requirements and five opportunities for improvement were identified. Corrective actions in the areas of record control and operational control were implemented to address each non-conformity.

- Evaluations of compliance. In May 2012, an internal evaluation of compliance was conducted to verify compliance with environmental legal and other requirements applicable to the laboratory across a sampling of activities and programs for 2011.

  The review included compliance with federal, state, and local regulatory deliverables and DOE requirements including permits, equipment registrations and certifications, reports, and notifications. The review also evaluated NREL's completion of requirements by environmental program area, including requirements for inspection, monitoring, training, certifications, etc. Environmental areas reviewed included:
  - Construction Stormwater Management
  - EPCRA Reporting
  - ODS Management
  - EMS
  - Environmental and Sustainability Management
  - Regulated Waste
  - NEPA.

  Three areas of potential non-compliance with regulatory requirements were identified and have been addressed, including late payment of hazardous waste fees for the STM, incomplete records of service for equipment containing 50 or more pounds of ODSs, and failure to complete several hazardous waste satellite accumulation area inspections.

- External assessments. In 2012, NREL maintained its certification under ISO 14001. In July, the laboratory received a third-party surveillance assessment to confirm continued conformance with the standard. The assessment was conducted by a team of auditors and included visits to a sampling of the lab's facilities, interviews with staff at all levels of the organization, observations of processes in place, and reviews of documents and records. The assessment resulted in two findings and several opportunities for improvement. Corrective actions have been completed to address deficiencies in document control and record control.

## 3.4 2012 AWARDS AND RECOGNITION

In 2012, NREL received several awards and recognition of its environmental and sustainability achievements including:

- DOE Sustainability Award
- DOE Green Buy Program Gold Award
- Federal Electronics Challenge (FEC) Platinum Award
- CELP Gold-level Leader.

## DOE SUSTAINABILITY AWARD

In 2012, the laboratory received a DOE Sustainability Award for its nomination "Comprehensive Energy Management Plan." DOE Sustainability Awards highlight environmental sustainability projects and programs within the DOE complex that reduce environmental impacts, enhance site operations, reduce costs, and demonstrate excellence in pollution prevention and sustainable environmental stewardship.

## DOE GREEN BUY PROGRAM GOLD AWARD

In 2012, NREL received a DOE Green Buy Program Gold Award for purchasing 17 products in five different categories, achieving DOE's Green Buy leadership goal.

## FEC PLATINUM AWARD

In 2012, the laboratory achieved the platinum-level FEC Award. FEC is a partnership program between the Office of the Federal Environmental Executive and the EPA. The FEC recognizes federal facilities that voluntarily:

- Purchase greener electronic products
- Reduce impacts of electronic products during use

- Manage obsolete electronics in an environmentally safe way.

Learn more about this voluntary program at the FEC website at http://www.epa.gov/fec/.

## CELP GOLD-LEVEL LEADER

In 2012, NREL maintained its status as a CELP Gold-level Leader. CELP is a voluntary partnership between the Colorado Department of Public Health and Environment (CDPHE) and participating private and public Colorado facilities, and is intended to recognize environmental leadership and performance.

In early 2004, NREL was the first laboratory accepted into CELP as a Gold-level Leader and has maintained this leadership level ever since. As a component of CELP membership, the laboratory's voluntary environmental performance goals, described above, further enhance operations and performance at the laboratory. CELP recognizes facilities that voluntarily:

- Exceed regulatory requirements
- Implement EMS (which focus on incorporating environmental considerations into normal management processes and improving internal environmental management effectiveness)
- Work closely with their communities
- Establish three-year goals focusing on measurable results.

Learn more about this voluntary program at the CDPHE CELP website: http://www.colorado.gov/cs/Satellite/CDPHE-DEHS/CBON/1251583700741.

## Benefits of NREL's EMS

**Mission.** NREL's EMS supports the organization's overall mission and improves effectiveness by systematically addressing environmental opportunities and risks, ensuring compliance with regulations, and implementing voluntary commitments to achieve superior performance.

**Environmental and sustainability performance.** While the laboratory benefits as an organization from each of the efforts highlighted here, the larger benefit is in reduced impacts to the quality of the air, water, land, and to the flora and fauna that share the campus and community.

**Reduced risk.** NREL's Hazard Identification and Control Program incorporates environmental risk assessment.

**Cost savings.** Cost savings are realized through energy efficiency projects, new renewable energy installations, and waste reduction and recycling. Any avoided impact represents cost savings, specifically in the event of spills and accidents.

**Environmental awareness.** Staff are made aware of the potential environmental impacts from their work activities through the NREL Now internal newsletter, postings on the NREL intranet, new employee orientation and activity specific trainings, policies and procedures, management communications, Sustainable NREL communications, and special events such as Staff Awards (an annual employee recognition event), Earth Day, and Bike 2 Work Day.

**Empowered individuals.** Staff are empowered to reduce the lab's environmental footprint by participating in programs and events for recycling single-stream materials, batteries, electronic equipment, and shredded paper, as well as a composting program. For example, staff at the RSF support the energy efficiency goal for the building by reducing their energy use in the office.

**Organizational culture and operations.** NREL strives to maintain a high level of awareness in the laboratory around safety, health, and environmental responsibilities. This is accomplished through a variety of means, including regular communications from executive management. In addition, daily EHS interaction with lab and operations staff at the ground level in trainings, inspections, and risk assessments drives awareness.

**Community relations.** The laboratory works to improve community relations by responding to and tracking all community input through phone calls, email, community meetings, and soliciting feedback from stakeholders through the NEPA process. NREL takes proactive measures to engage the community with public tours, newsletters, and mailings to neighborhoods surrounding its facilities.

**Cooperative conservation.** NREL regularly works with stakeholders to improve the community. For example, with the growth of the STM site, NREL monitors traffic to minimize impacts to the surrounding community.

# 4 Sustainability

Sustainable NREL is a long-standing laboratory program that fosters environmental and social responsibility, working to establish the lab as a global model for sustainability. Sustainable NREL advocates for all executive orders, federal regulations, DOE orders, and goals related to sustainable facility operations. The program also executes specific goals to reduce impacts on the community and environment, and provides technical expertise to organizations within the lab. Sustainable NREL provides leadership within the federal government and the community by actively mentoring and collaborating with other organizations to move sustainability into a new paradigm. NREL's campus is a living laboratory that showcases new technologies, design practices, and operating behaviors. In all campus development, opportunities to integrate energy efficiency and renewable energy, high-performance buildings, and sustainable transportation options are sought. On-site deployment of technologies developed by NREL researchers is also emphasized.

## 2012 Highlights and Achievements

- NREL completed construction of four new high performance sustainable buildings and three on-site renewable systems in FY 2012.
- Achieved LEED (Leadership in Energy and Environmental Design) Platinum certification from the U.S. Green Building Council for the new wing of the net-zero energy Research Support Facility (RSF)
- Completed the net-zero energy parking garage designed to the LEED Platinum rating
- Completed the net-zero energy Southern Site Entrance Building (SSEB); LEED Platinum certification anticipated
- Completed the cafeteria; LEED Gold certification anticipated
- Deployed new on-site renewable energy systems including:
  - 15.28 kW PV array on rooftop of the SSEB
  - 408 kW PV array on rooftop of the new wing of the RSF
  - 1130 kW PV array on rooftop and southern façade of the parking garage.

NREL offers secure electronics recycling and document shredding/recycling for NREL employees during Earth Week. *Photo by Dennis Schroeder, NREL 18885*

NREL integrates sustainability into its EMS. Technical experts from Sustainable NREL and the EHS Office work together regularly to improve operations and implement programs, including:

- Site sustainability and pollution prevention data tracking and reporting to DOE
- Sustainability and environmental management planning


Composting food waste at the cafeteria. *Photo by John De La Rosa, NREL 24352*

- Measurement and tracking of environmental objectives, targets, and actions
- Pollution prevention assessments and improvements
- Awareness and engagement of staff and community members.

## 4.1 SITE SUSTAINABILITY PLANNING

Executive Order (EO) 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*, specifies environmental sustainability performance goals for federal agencies. DOE O 436.1, *Departmental Sustainability*, implements the requirements of the executive order for DOE. Each year DOE prepares a Strategic Sustainability Performance Plan (SSPP) that describes how the department will meet the requirements of EO 13514 and DOE O 436.1. Each DOE facility must then develop an annual SSP. Each site's plan is used to report on steps taken to meet the national and DOE sustainability objectives and also outlines plans for the upcoming year.

The following content has been extracted from NREL's SSP for Fiscal Year (FY) 2013. The full report is located online at www.nrel.gov/sustainable_nrel/.

### SITE MANAGEMENT VISION

NREL is a state-of-the-art laboratory that supports innovative research, development, and commercialization of renewable energy and energy efficiency technologies that address the nation's energy and environmental needs. Fundamental to the laboratory's mission is a commitment to sustainability—operating in a manner that balances environmental, economic, and social values in the delivery of the mission. At NREL, sustainability is integral to both research and operations. The laboratory is committed to demonstrating federal leadership in sustainability, working to continuously improve performance, and leading by example.

### MAJOR PLANNING ASSUMPTIONS, ISSUES, FUNDING STRATEGIES

In recent years, NREL has experienced robust growth. In FY 2003, the lab's population was 1,132 and building square footage was 405,367. In FY 2012, the lab's population was 2,447 and building square footage was 946,625, as reported in the Consolidated Energy Data Report. The percentage increase was 116% for population and 134% for building square footage. Although NREL is experiencing growth, in the current economic climate it is unclear if this trend will continue. While there is no new construction line item funding identified at this time, planning activities are being conducted so that the laboratory is positioned to accommodate future growth through the construction of new high-performance buildings, energy efficiency retrofits, and renewable energy systems that take advantage of alternative financing mechanisms, including power purchase agreements, energy savings performance contracts, partnerships with energy service companies, and cooperative research agreements. NREL continues to review the use of overhead funds, cost savings reinvestment, and leveraging of alternative financing methods for retrofits or new projects.

Aerial view of the RSF. *Photo by Dennis Schroeder, NREL 21794*

## 4.2 2012 SSPP GOAL PERFORMANCE

The following table summarizes each of DOE's SSPP goals and NREL's performance status. For more specific information, please refer to the full SSP referenced.

## NREL'S PERFORMANCE STATUS TOWARD DOE SSPP GOALS

| SSPP Goal # | DOE SSPP Goal | NREL Performance Status in FY 2012 |
|---|---|---|
| 1.1 | 28% greenhouse gas (GHG) reduction from sources such as heating, cooling, and electricity use by FY 2020 from a FY 2008 baseline. | On Track: Reduced emissions 84% from the 2008 baseline (including renewable energy certificates). |
| 1.2 | 13% GHG reduction from sources such as air travel and commuting by FY 2020 from a FY 2008 baseline. | Challenge: Emissions from these sources increased 12% from the 2008 baseline. To support NREL's mission, air travel is necessary. While on a per capita basis, NREL will meet the reduction goal; the absolute reduction from the 2008 baseline will be challenging due to population growth. |
| 2.1 | 30% building energy use per square foot reduction by FY 2015 from a FY 2003 baseline. | On Track: Decreased 29% since 2003. |
| 2.2 | Energy and water audits. | Goal Met: Performed energy and water audits on three buildings that represent 50% of total site energy use in FY 2012. |
| 2.3 | Individual buildings or processes metering for 90% of electricity (by October 1, 2012); for 90% of steam, natural gas, and chilled water (by October 1, 2015). | On Track: 100% of NREL's electricity, hot and chilled water was metered in FY 2012. In addition, 95% of natural gas was metered in FY 2012. |
| 2.4 | Energy efficient cool roofs, unless uneconomical, for roof replacements. | Goal Met: 59% of NREL campus has cool roofs, an 11% increase from FY 2011. |
| 2.5 | 15% of existing buildings greater than 5,000 gross square feet (GSF) are compliant with the federal green building standards by FY 2015. | On Track: 18% of buildings meet federal green building standards. |
| 2.6 | All new construction, major renovations, and alterations of buildings greater than 5,000 GSF must comply with federal green building standards and where the work exceeds $5 million, each are LEED – New Construction Gold certification or equivalent. | Goal Met: Received LEED Platinum certification for the new wing of the RSF. |
| 2.7 | 7.5% of annual electricity consumption from renewable sources by FY 2013 and thereafter (5% FY 2010 – FY 2012). | Goal Met: 18.8% of NREL's total power comes from on-site sources. |
| 3.1 | 10% annual increase in fleet alternative fuel consumption by FY 2015 relative to a FY 2005 baseline. | On Track: Alternative fuel use has grown 135% since 2005. |
| 3.2 | 2% annual reduction in fleet petroleum consumption by FY 2020 relative to a FY 2005 baseline. | Challenge: Overall petroleum fuel usage has grown 55.9% since 2005 with a slight decline in FY 2012. Disposition of low-mileage, alternative fuel vehicles to meet the Secretary's vehicle reduction goal increased petroleum use. Lack of E85 fueling stations in proximity to the NWTC makes using alternative fuels a challenge at that site. |
| 3.3 | 100% of light duty vehicle purchases must consist of alternative fuel vehicles by FY 2015 and thereafter (2000-2015). | Not Applicable: No light-duty vehicles purchased in FY 2012. |

## NREL'S PERFORMANCE STATUS TOWARD DOE SSPP GOALS

| SSPP Goal # | DOE SSPP Goal | NREL Performance Status in FY 2012 |
|---|---|---|
| 3.4 | Reduce fleet inventory of non-mission critical vehicles by 35% by 2013 relative to a FY 2005 baseline. | Goal Met: To date, NREL has reduced fleet inventory by 8 vehicles. This reduction represents 100% of the planned fleet reduction of non-mission critical vehicles. |
| 4.1 | 26% potable water intensity (gallons per gross square foot) reduction by FY 2020 from a FY 2007 baseline | Challenge: Reduced water intensity by 30% from FY 2007 baseline. To make ESIF the world's most energy efficient data center, a large amount of water will be needed for cooling, offsetting electricity use. |
| 4.2 | 20% water consumption reduction of industrial, landscaping, and agricultural water by FY 2020 from a FY 2010 baseline. | Not Applicable: NREL does not use industrial, landscaping, and agricultural water. |
| 5.1 | Divert at least 50% of non-hazardous solid waste, excluding construction and demolition debris, by FY 2015. | On Track: Diverted 81% of campus waste from landfill. |
| 5.2 | Divert at least 50% of construction and demolition materials and debris by FY 2015. | On Track: Diverted 88 % of construction waste from landfill. |
| 6.1 | Procurements meet sustainability requirements and include sustainable acquisition clause (95% each year). | On Track: Finalized and implemented a general procurement policy, as well as small purchase and purchase request procedures.<br>Hosted a series of meetings to increase the visibility of green office-supply product selection with staff and provided education on preferred purchasing procedures.<br>Collaborated with NREL's preferred office supply company to host a green office supply fair featuring new product vendors and technologies for staff.<br>Implemented the green cleaning janitorial contract campus wide and conducted audits. |
| 7.1 | All data centers are metered to measure energy efficiency by FY 2015. | On Track: The RSF data center measures monthly energy efficiency. |
| 7.2 | Maximum annual weighted average energy efficiency rating (Power Usage Effectiveness) of 1.4 by FY 2015. | On Track: Energy efficiency rating for the RSF data center is 1.13. |
| 7.3 | Electronic Stewardship – 100% of eligible PCs, laptops, and monitors with power management actively implemented and in use by FY 2012. | Goal Met: Power management is enabled on 100% of devices. |
| 8.0 | Innovation and Government-wide support – site-specific objectives. | Goal Met: Enhanced the RSF "behavior agent" software program which collects information on employee comfort.<br>Entered into discussions to establish a power purchase agreement to obtain power from a 30 MW off-site wind farm.<br>Continued outreach to encourage knowledge sharing with federal agencies and local governments (NASA, DOE, GSA, and City of Lakewood).<br>Hosted more than 40,000 visitors to the RSF, showcasing energy efficiency in design and management; provided workshops to commercial industry and other government agencies. |

# 5 Compliance Summary

NREL is subject to many federal, state, and local environmental laws and regulations, as well as executive orders and U.S. Department of Energy (DOE) orders, and memoranda of understanding with government agencies. NREL continues its excellent record of environmental compliance.

In 2012, NREL received no violation notices from any regulatory agency. All required permits were received or renewed, required registrations were completed, and required notifications and reporting were submitted.

There was one spill at the National Wind Technology Center (NWTC) which required reporting to the state during 2012. An open valve located within the elevated nacelle of a wind turbine leaked approximately 90 gallons of synthetic lubricant oil. No contamination of a waterway occurred and the spill was remediated.

In August 2012, a sample collected from the NWTC drinking water system indicated the Maximum Contaminant Level (MCL) was exceeded for haloacetic acids, a class of disinfection byproducts. Increased monitoring has indicated that haloacetic acids levels have been consistently below the MCL since this single exceedance.

The table titled Federal, State, and Local Environmental Laws and Regulations Applicable to NREL includes a brief description of the statute or regulation and how compliance requirements were met this year. More detailed information for each area of compliance is found in the referenced sections of this report. For information on required permits, registrations, and notifications, see Appendix C.

## FEDERAL, STATE, AND LOCAL ENVIRONMENTAL LAWS AND REGULATIONS APPLICABLE TO NREL

| Report Sections | Regulatory Program Description | Compliance Status and Highlights | Regulator & Requirement |
|---|---|---|---|
| Air Quality | The Colorado Department of Public Health and Environment (CDPHE) administers the Clean Air Act implementing regulations for all point sources (facilities or other types of operations) in Colorado, under authority delegated by the U.S. Environmental Protection Agency (EPA). Several main categories for air pollutants are regulated: criteria air pollutants, non-criteria pollutants, hazardous air pollutants (HAPs), and ozone-depleting substances.<br><br>EPA regulation 40 CFR 82, Protection Of Stratospheric Ozone, requires that servicing records must be kept for appliances containing more than 50 pounds of Class 1 or 2 ODS refrigerant.<br><br>CDPHE regulations require federal, state, and local government facilities to track street sanding in the wintertime, and to minimize sand use with the goal of reducing particulate pollution in the Denver area.<br><br>EPA regulations require that certain facilities which emit GHG emissions track and report the amount of those emissions. Reporting and permitting of GHGs is required under the EPA Prevention of Significant Deterioration regulation, Title V Tailoring Rule, and the EPA GHG Mandatory Reporting Rule. | All program activities were in compliance with requirements.<br><br>NREL did not exceed any air permit standard or other air regulatory requirement at any facility.<br><br>Completed an evaluation of NREL's compliance with the EPA and the Air Pollution Control Division (APCD) of CDPHE permitting and emissions control requirements. It was confirmed that NREL is in compliance with all Colorado and EPA permit requirements and that all facilities and individual permitted equipment items are classified as minor sources.<br><br>Obtained an air permit for a standby electrical generator necessary for the newly constructed Energy Systems Integration Facility (ESIF). Performed emission testing and submitted necessary forms to the APCD to convert construction permits to final air permits for two emergency generators and an ammonia scrubber and particulate baghouse. Five Air Pollutant Emission Notices were filed with the APCD for the planned installation of permit exempt sources at ESIF, Solar Technology Acceleration Center (SolarTAC), and National Wind Technology Center (NWTC) Building 258. Annual emission fees for all existing permits were submitted to the APCD.<br><br>All required registrations were completed for equipment containing ozone-depleting substances. NREL facilities servicing refrigeration equipment were registered. Confirmed that all NREL refrigeration service personnel have obtained the EPA and Colorado required training and certification.<br><br>The required annual street sanding report was provided to the APCD and Jefferson County.<br><br>Evaluated NREL's 2012 Carbon Dioxide Equivalent ($CO_2e$) and greenhouse gas (GHG) emissions. The GHG inventory shows that GHG emissions are below the threshold for EPA reporting and permitting rules. The laboratory's $CO_2e$ inventory for EPA reporting purposes is 6,962 U.S. tons (6,316 metric tons) for the South Table Mountain (STM) site and 167 U.S. tons (151 metric tons) for the NWTC site. GHG emissions for the STM were 6,904 U.S. tons (6263 metric tons) and 166 U.S tons (151 metric tons) for the NWTC. | EPA:<br>40 Code of Federal egulations (CFR) 82<br><br>CDPHE:<br>5 Colorado Code of egulations (CCR) 1001-18, Reg. 16 |

## FEDERAL, STATE, AND LOCAL ENVIRONMENTAL LAWS AND REGULATIONS APPLICABLE TO NREL

| Report Sections | Regulatory Program Description | Compliance Status and Highlights | Regulator & Requirement |
|---|---|---|---|
| Drinking Water Quality | The Safe Drinking Water Act (SDWA) establishes minimum drinking water standards and monitoring requirements for drinking water supplies. Drinking water quality is regulated for all public water suppliers in Colorado by CDPHE, under authority delegated by the EPA.. | The NWTC drinking water system is subject to the regulatory requirement. In 2012, the Maximum Contaminant Level (MCL) was exceeded for haloacetic acids, a class of disinfection byproducts (DBPs). The annual sample collected in August measured 69.4 ppb, which exceeded the maximum of 60 ppb. In such circumstances, the state requires increased monitoring; sample frequency was increased to quarterly, starting in October and continuing into 2013. Monitoring has since indicated that haloacetic acids levels have been consistently below the MCL since this single exceedance. Prior to this single exceedance, the NWTC had not exceeded any of the SDWA's MCLs in the past five years.<br>All other monitored parameters in 2012 met applicable SDWA requirements.<br>The state conducted a sanitary survey of the drinking water system in 2012 and found no non-conformities with program or regulatory requirements. Several recommendations for program improvements were made, each of which is being addressed. | EPA:<br>40 CFR 141–149<br>CDPHE:<br>5 CCR 1003-1 |
| Ground-water Quality | Colorado groundwater quality standards are established by CDPHE. Permits for groundwater wells are issued by the Colorado Department of Natural Resources (DNR). | There are no compliance activities associated with the NREL Groundwater Program. There is one closed-loop geothermal system at the STM Solar Radiation Research Laboratory installed in 2009 and another at the South Site Entrance Building installed in 2012. The installations were completed in accordance with state requirements.<br>NREL currently has five permitted monitoring wells at the STM site. The wells are not currently used for monitoring activities. | CDPHE:<br>5 CCR 1002-41<br>2 CCR 402-7 |
| Surface Water Quality | Construction-related stormwater discharge regulations are administered by the EPA at federal facilities in Colorado.<br>Non-federal facility construction-related stormwater discharges in Colorado are regulated by the Water Quality Control Division of CDPHE. | All program activities were in compliance with requirements.<br>Permit coverage was obtained under the new 2012 EPA CGP for six construction projects at STM, and two at the NWTC. In addition, one EPA Low Erosivity Waiver was obtained at the STM site for a project constructed during low precipitation months. Two permits were terminated in 2012.<br>State stormwater permits were obtained for construction of two new experimental research projects at the SolarTAC site. Because these projects exist off federal property, rather than EPA permits, Colorado Discharge Permit System construction stormwater permits were required.<br>Construction sites received periodic monitoring from local regulatory officials; no non-compliances were noted. | EPA:<br>40 CFR 122.26<br>CDPHE:<br>5 CCR 1002-61<br>Reg. 61 |

## FEDERAL, STATE, AND LOCAL ENVIRONMENTAL LAWS AND REGULATIONS APPLICABLE TO NREL

| Report Sections | Regulatory Program Description | Compliance Status and Highlights | Regulator & Requirement |
|---|---|---|---|
| Wastewater Management | The federal Clean Water Act (CWA) and Colorado Water Quality Control Act regulations apply to wastewater management at NREL's STM and Denver West Office Park (DWOP). The Metro Wastewater and Reclamation District manages wastewater for much of the Denver metro area, receiving wastewater from a number of smaller wastewater districts, including the Pleasant View Water and Sanitation District.<br><br>Inspection and permitting of individual sewage disposal systems have been delegated to Jefferson County by CDPHE. | All program activities were in compliance with requirements.<br><br>The laboratory worked with the Pleasant View District on several large-volume discharges related to construction activities. Water lines included in new construction must be sanitized prior to use and these lines were disinfected and the water used in that process was discharged with Pleasant View's approval. Large flows over small time periods can be problematic to sanitary collection systems, so the laboratory worked with the district to minimize potential impacts to their system. | EPA:<br>40 CFR 122-136<br><br>CDPHE:<br>5 CCR 1002-31 |
| Hazardous Materials Management | Executive Order (EO) 13423 outlines requirements for Superfund Amendments and Reauthorization Act (SARA) Title III, EPCRA compliance, and Toxic Release Inventory reductions for DOE facilities.<br><br>Annual hazardous material permits are required by West Metro Fire Rescue for the STM and DWOP sites. ReFUEL, located within the City and County of Denver, is subject to the Denver Fire Dept. Hazardous Materials Information System requirements, including permitting, inventory, and annual inspection. | All program activities were in compliance with requirements. There were no releases of hazardous materials requiring reporting.<br><br>In early 2012, NREL submitted a Tier II report to CDPHE for reporting year 2011, identifying diesel fuel, petroleum oil and sulfuric acid in lead-acid batteries. Toxic Release Inventory reporting under EPCRA was not required by NREL for reporting year 2011.<br><br>West Metro Fire Rescue conducted an annual hazardous material inspection and issued permits for all major research facilities on the STM site. The inventory of materials at the ReFUEL facility was provided to the Denver Fire Department. | EPA:<br>40 CFR 355, 370, 372 |
| Regulated Waste Management | The Resource Conservation and Recovery Act established requirements for the management of regulated waste. In Colorado, CDPHE administers waste regulations under authority delegated by the EPA. | All program activities were in compliance with requirements.<br><br>NREL holds five EPA hazardous waste generator identification numbers, one for each of its sites. All regulatory notifications were updated and applicable waste generator fees were paid for five NREL facilities in calendar year 2012.<br><br>Despite three calendar months of hazardous waste generation at volumes totaling more than 1,000 kilograms per month between July and September 2012, the STM facility downgraded its waste generator status from a Large Quantity Generator to that of a Small Quantity Generator in October 2012. Four NREL facilities are categorized as conditionally exempt small quantity generators.<br><br>The laboratory submitted the required Resource Conservation and Recovery Act Biannual Hazardous Waste Report to CDPHE HMWMD in March 2012. | 40 CFR 260—280<br><br>CDPHE:<br>6 CCR 1007-3 |
| Above-ground storage Tank Management | ASTs are regulated in Colorado by the Colorado Department of Labor and Employment (CDLE) Oil Inspection Section under the Colorado AST regulation 7 C.C.R. 1101-14. Colorado requires that ASTs 660 gallons or larger be permitted prior to installation and registrations submitted annually. | All program activities were in compliance with requirements.<br><br>No spills or releases from NREL's ASTs or related fueling activities occurred.<br><br>Two AST installation permits were obtained. | CDLE:<br>Division of Oil and Public Safety (DOPS) Storage Tank Regulations, 7 C.C.R. 1101-14 |

## FEDERAL, STATE, AND LOCAL ENVIRONMENTAL LAWS AND REGULATIONS APPLICABLE TO NREL

| Report Sections | Regulatory Program Description | Compliance Status and Highlights | Regulator & Requirement |
|---|---|---|---|
| Spill Prevention and Response | Spill prevention, control, and countermeasures (SPCC) plans are required by EPA and Colorado regulations for facilities that meet certain oil storage criteria. In general, a facility must have an SPCC plan if the facility stores more than 1,320 gallons of oil or where a spill has the potential to enter waters of the United States. | All program activities were in compliance with requirements.<br>SPCC plans for the STM and NWTC sites were revised to address changes to equipment and oil inventories.<br>One spill at the NWTC required reporting. An open valve located within the elevated nacelle of a wind turbine leaked approximately 90 gallons of synthetic lubricant oil in February 2012. No contamination of a waterway occurred and the spill was remediated.<br>In addition, thirty minor spills of diesel, lubricant and hydraulic fluids at STM and one at the NWTC occurred. The size of spills ranged from less than 0.1 gallon to 15 gallons. These spills totaled approximately 50 gallons at STM and 1 gallon at the NWTC. Each spill received immediate remedial action and did not result in any significant impact to the environment. The majority of these spills were construction related. | EPA:<br>Oil Pollution Prevention<br>40 CFR 112<br>CDLE:<br>DOPS Storage Tank Regulations, 7 C.C.R. 1101-14 |
| Radiological Materials and Waste Manage-ment | Emissions are also regulated by Section 112 of the Clean Air Act and implemented by the EPA. 40 CFR Part 61 established National Emission Standards for Hazardous Air Pollutants (NESHAPs), and, more specifically, Subpart H, sets such standards for radiological materials.<br>DOE O 458.1, Radiation Protection of the Public and the Environment cancelled DOE O 5400.5. This order establishes radiation emission limits for DOE facilities. | All program activities were in compliance with requirements. No planned or unplanned radiological releases occurred.<br>The effective dose equivalent to the public from NREL activities was 0.035 millirem (mrem) per year, far below the 10 mrem per year limit.<br>Small quantities of low-level radioactive waste were generated and are currently in storage awaiting off-site disposal. | EPA:<br>40 CFR 61,<br>Subpart H<br>DOE:<br>DOE O 5400.5<br>DOE O 458.1 |
| NEPA | NEPA requires that federal agencies determine environmental impacts of proposed federal actions and alternatives. DOE implements NEPA in 10 CFR 1021. | All program activities were in compliance with requirements.<br>Four hundred and twenty-five NEPA reviews were conducted for project activities on and off site during CY 2012. Of these, 15 NEPA checklists were completed for projects or activities with a potential for environmental impacts. For each of these, project funding and initiation of work was allowed to commence only after DOE reviewed the submittals and provided a signed NEPA determination which specified any needed mitigation actions required to avoid impacts. The remaining NEPA reviews in 2012 were completed using NEPA worksheets addressing 285 subcontracting activities, 26 cooperative research and development agreement partnerships, 27 interagency agreements with other federal agencies, and 72 on-site projects.<br>DOE revised its NEPA Implementing Procedures in 2011, including a modification of its list of categorical exclusions. To comply with these changes, NREL updated its NEPA procedures to include an updated list of categorical exclusions (CX) and to include additional CXs that can be selected on the NEPA worksheet.<br>A site-wide Environmental Assessment was initiated for proposed continued and enhanced operations at the NWTC. A supplemental EA for the RFHP was finalized in April 2012. | Council for Environmental Quality:<br>40 CFR 1500–1508<br>DOE:<br>10 CFR 1021 |

## FEDERAL, STATE, AND LOCAL ENVIRONMENTAL LAWS AND REGULATIONS APPLICABLE TO NREL

| Report Sections | Regulatory Program Description | Compliance Status and Highlights | Regulator & Requirement |
|---|---|---|---|
| Wildlife Management | The Migratory Bird Treaty Act (MBTA) of 1918 is the main driver for protection of migratory birds in the United States. The MBTA and amendments implements several treaties between the U.S., Great Britain, Mexico, Japan, and the former Soviet Union. The MBTA prohibits the taking, killing, or possession of migratory birds, nests, and eggs.<br><br>Under Colorado Revised Statute (CRS) 33-6-128: Damage or Destruction of Dens or Nests—Harassment of Wildlife, no wildlife dens or nests, young or eggs may be damaged or destroyed unless permitted by the Colorado Division of Parks and Wildlife and it is unlawful for any person to willfully harass wildlife including birds.<br><br>Under the "Memorandum of Understanding (MOU) between DOE and the USFWS Regarding Implementation of EO 13186, Responsibilities of Federal Agencies to Protect Migratory Birds" DOE agrees to integrate migratory bird conservation principles, measures, and practices into agency activities, and avoid or minimize adverse impacts on migratory bird resources and their habitats. | All program activities were in compliance with requirements.<br><br>No migratory birds were taken intentionally during the conduct of any of the laboratory's activities.<br><br>Bird-friendly glass windows were installed on the laboratory's new STM parking garage which opened in 2012. The glass in this structure is patterned with a 50% frit that appears etched but still allows for visibility. This special glass was installed on critical areas of glass breeze-ways and stairwells. This design should reduce the potential for bird collisions, lessening impacts on migratory birds.<br><br>Monitoring of mammalian predators at the STM and NTWC and bat monitoring at the NWTC began in 2012. Two motion detection cameras were installed at each campus and bat call monitoring equipment was installed at the NWTC. | U.S. Fish and Wildlife Service: MBTA 16 U.S.C. 703-712<br><br>Colorado Division of Parks and Wildlife: CRS 33-6-128<br><br>MOU between DOE and the U.S. Fish and Wildlife Service (USFWS)<br><br>EO 13186 |
| Endangered Species and Species of Concern | The Endangered Species Act (ESA) is intended to protect threatened and endangered wildlife and plant species and associated critical habitat. | All program activities were in compliance with requirements.<br><br>The USFWS lists nine species in accordance with the ESA as threatened, endangered, or a candidate for listing that could potentially occur in Jefferson County or Boulder County. Of these, several have the potential to occur on the STM or NWTC sites including the Preble's meadow jumping mouse, the Ute ladies' tresses orchid, and the Colorado butterfly plant. While the Preble's meadow jumping mouse does not occur on site, the USFWS mapped critical Preble's habitat within the upper reaches of Rock Creek, including a small area at the southeast corner of the NWTC. This area may not be disturbed without coordination with the USFWS.<br><br>NREL periodically conducts surveys for declining wildlife species and rare plants focusing on species that are federally protected, state protected, or otherwise considered imperiled or declining. In 2010 at STM and 2011 at the NWTC, surveys were conducted and no protected species were found at the STM or NWTC sites. | U.S. Fish and Wildlife Service: 50 CFR 17 |
| Vegetation Management | The Federal Insecticide, Fungicide, and Rodenticide Act regulates the use, storage, and disposal of herbicides and pesticides. For application of certain types of herbicides designated as "restricted use" by the EPA, a certified applicator must be used.<br><br>EO 13112, Invasive Species requires the control of invasive species at federal facilities. In Colorado, the Department of Agriculture Commissioner develops and implements state noxious weed management plans for three categories of weed species. Class A plants are targeted for eradication. Class B species are subject to management plans designed to stop their continued spread. Class C species are subject to plans designed to support the efforts of local governing bodies to facilitate more effective integrated weed management on private and public lands.. | All program activities were in compliance with requirements.<br><br>The application of restricted-use herbicides was conducted using certified applicators. This included treatment at the NWTC of approximately 200 acres in May and 82 acres in September, and at STM of approximately 23 acres in June and 6 acres in September. After several years of aggressive management, knapweed is nearly under control at the NWTC and Canada thistle, hounds tongue, and myrtle spurge are under control at STM.<br><br>Contractors and NREL workers doing landscape maintenance were required to compost landscaping waste, including weeds, to reduce the waste stream and to reduce the propagation of listed weeds. | EPA: 40 CFR 162—171(f)<br><br>EO 13112 |

## FEDERAL, STATE, AND LOCAL ENVIRONMENTAL LAWS AND REGULATIONS APPLICABLE TO NREL

| Report Sections | Regulatory Program Description | Compliance Status and Highlights | Regulator & Requirement |
|---|---|---|---|
| Wetlands and Floodplains | Under EO 11990, Wetlands Protection, federal agencies must provide leadership and take action to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands. Wetlands that meet certain soils, vegetation, and hydrologic criteria, are protected under the CWA Section 404, which is administered by the USACE.<br><br>Jefferson County requires approval of development proposed in floodplains within its jurisdiction.<br><br>Under 10 CFR 1022, Compliance with Floodplain and Wetlands Environmental Review Requirements, for projects that occur in floodplains or could affect wetlands, DOE must determine the potential impacts, document this in a floodplain and wetland assessment, and complete notices of availability to appropriate government agencies and interested parties, as well as make a public notification in the local area. | All program activities were in compliance with requirements.<br><br>None of the wetlands present at NREL facilities have been designated "jurisdictional" by the USACE. The STM and NWTC sites do not contain any floodplains. However, several actions were taken to maintain compliance with wetlands and floodplains requirements for the south entrance project, located off of DOE property.<br><br>Project completion notification was provided to the USACE by DOE to close out the Clean Water Act Section 404 permitting related to the permanent loss of 0.25 acres along Lena Gulch as a result of the STM southern access road construction. This loss was mitigated through acquisition of wetland banking credits through the South Platte Wetlands Bank in Brighton, Colorado.<br><br>With the completion of the STM southern access road, a final Letter of Map Revision was recorded officially changing county floodplain maps. | EO 11990<br><br>USACE: CWA Section 404<br><br>10 CFR 1022 |
| Cultural Resources | Cultural resources are protected under Sections 106 and 110 of the National Historic Preservation Act (NHPA). Federal agencies must establish preservation programs—commensurate with their mission and the effects of their activities on historic properties—that provide for the careful consideration of historic properties. Significant cultural resources are either eligible for, or listed in, the National Register of Historic Places. 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 other reason. NHPA is administered in Colorado by the Colorado SHPO. | All program activities were in compliance with requirements.<br><br>Two structures at the STM site are listed on the National Register of Historic Places. There are no known eligible structures at the NWTC.<br><br>Construction activities were completed on the parking structure, the café and the Energy Systems Integration Facility. During excavation of these projects, several items were unearthed and reviewed for cultural significance, though none were found to be of unique value.<br><br>In 2010, a Class III Cultural Resource Inventory was completed on the final configuration of the new south entrance to STM, which lies within the Camp George West Historic District. SHPO concurred that construction would impact a 500-yard firing line and a 600-yard firing line, both of which are contributing features of the Camp George West Historic District, and that impacts should be mitigated. In 2011, DOE established a memorandum of agreement with the SHPO to mitigate impacts to these features by installing an interpretive feature. In 2012, this feature was designed and approval was received from the Pleasant View Metropolitan District. The interpretive feature will be installed in Pleasant View Community Park in 2013. | Advisory Council on Historic Preservation:<br><br>36 CFR 60<br><br>36 CFR 63<br><br>36 CFR 79<br><br>36 CFR 800<br><br>16 U.S.C. 470 |

## FEDERAL, STATE, AND LOCAL ENVIRONMENTAL LAWS AND REGULATIONS APPLICABLE TO NREL

| Report Sections | Regulatory Program Description | Compliance Status and Highlights | Regulator & Requirement |
|---|---|---|---|
| EMS and Sustainability | Under EO 11990, Wetlands Protection, federal agencies must DOE O 436.1, Departmental Sustainability cancelled DOE O 450.1A, Environmental Protection Program and DOE O 430.2B, Departmental Energy, Renewable Energy and Transportation Management. The Order implements the objectives of EO 13423, Strengthening Federal Environmental, Energy, and Transportation Management, and EO 13514, Federal Leadership in Environmental, Energy, and Economic Performance, which direct federal agencies to conserve natural resources, reduce energy use, develop renewable energy, reduce GHG emissions, and manage buildings and transportation in a sustainable manner.<br><br>DOE O 436.1 requires that DOE develop a SSPP to ensure that the sustainability goals established in EO 13423 and 13514 are met. Individual DOE facilities must develop site specific SSPs designed to set goals for the coming year and discuss performance for the prior year.<br><br>DOE O 436.1 also requires that DOE facilities implement EMSs that are independently verified to meet the requirements of ISO 14001. | Each year, a SSP is developed to report on past performance and set goals for the coming year. These performance goals are integrated with the laboratory's EMS and progress is tracked throughout the year.<br><br>NREL's EMS has been registered to the ISO 14001:2004 international standard for environmental management systems since 2011. Annual assessments by the registrar verify that NREL meets the ISO standard and is continually improving performance. | EEO 13423<br><br>EO 13514<br><br>DOE:<br>DOE O 436.1<br><br>DOE O 450.1A<br><br>DOE O 430.2B |
| N/A | DOE O 231.1B, Environment, Safety and Health Reporting was implemented to assure that DOE receives timely, accurate information about events that have affected or could adversely affect the health, safety and security of the public or workers, the environment, or the operations of DOE facilities. The order requires that DOE facilities report specific site environmental information annually including environmental management performance, environmental occurrences and response, compliance with environmental standards and requirements, significant programs and efforts, and property clearance activities for property contaminated with radiological materials. | NREL reports annually via this Environmental Performance Report. | DOE:<br>DOE O 231.1B |
| Traffic | A Mitigation Action Plan (MAP), finalized in May 2008, was developed to address potential environmental impacts from changes in traffic at STM and to support an EA Finding of No Significant Impact (FONSI) for several projects at the laboratory. The MAP specifies the methods for implementing mitigation measures to ensure that the impacts of continued and expanded laboratory operations are not significant. The MAP requires that:<br><br>■ The Denver West Parkway/Denver West Marriott Boulevard (DWP/DWMB) intersection operates at a Level of Service (LOS) of D or better<br>■ The Quaker St. /South Golden Road intersection operates at a LOS of D or better<br>■ Traffic flow to and from the STM east entrance will be monitored semi-annually<br>■ Specific Transportation Demand Management (TDM) strategies be implemented as needed to ensure the traffic thresholds are not exceeded. Strategies include AWSs, expanded shuttle services, expanded carpools, encouraging walking and bicycling, increased use of the Quaker St. entrance, infrastructure improvements, and traffic flow control measures. | All program activities were in compliance with requirements.<br><br>TDM measures required by the MAP were continued in 2012.<br><br>Average PM peak hour traffic volume at the DWP/DWMB intersection was 335 vehicle trips. The monitoring periods were April 2012, August 2012, and December 2012. The MAP threshold of LOS D or better is equivalent to a maximum of 387 vehicle trips per hour entering or leaving the site at the east entrance at the afternoon rush hour.<br><br>PM peak hour LOS at the DWP/DWMB intersection was at LOS B, which does not exceed the MAP threshold of LOS D or better.<br><br>Average PM peak hour traffic volume at the Quaker St./South Golden Road intersection was 30 vehicle trips. The monitoring periods were April 2012, August 2012, and December 2012.<br><br>PM peak hour LOS at the Quaker St./South Golden Road intersection was at LOS B, which does not exceed the MAP threshold of LOS D or better. | DOE/EA-1440-S-I (May 2008) Traffic MAP |

# 6 Air Quality Protection

The Air Quality Protection program is intended to achieve a number of goals including minimization of all types of air emissions, tracking of air emissions from the larger on-site sources, confirmation that on-site sources have air permits as required, and meeting the U.S. Environmental Protection Agency (EPA) and Colorado air emissions and permitting requirements.

NREL's goal is to maintain its air emissions at a low level, maximizing air quality and minimizing permitting and compliance requirements. Minimizing air emissions creates direct health benefits to both surrounding neighbors and the Denver metropolitan area. In general terms, the more emissions a facility puts into the air, the more complex a facility's air permit must be. Such permits also require more extensive emission controls, tests, and reporting of emissions.

NREL environmental staff actively participate in project planning, safety evaluations, readiness verifications, and operations activities. This participation results in awareness of projects and planned air emissions while allowing staff to obtain the necessary regulatory approval for those emissions and maintain a current and accurate air emission inventory.


Standby electrical generator at the NWTC. *Photo by Larry Durbin, NREL 24490*

## PROGRAM MANAGEMENT

The EPA Clean Air Act requires specific permitting and emission controls when specific facility emission levels are exceeded or individual equipment sizes are reached. For example, a Title V air permit would be required if an NREL facility emission level were to exceed 100 tons per year for a criteria pollutant such as: nitrogen oxides (NOx), volatile organic compounds (VOCs), particulate matter (PM10), carbon monoxide (CO), or sulfur dioxide (SO2). Under that same regulation, a Title V permit would be required if a single HAP level exceeds 10 tons per year, or the total emissions of all HAP pollutants at one facility exceeds 25 tons per year.

The Colorado Air Pollution Control Division (APCD) requires reporting of HAP emissions at much more stringent limitations. The limitations vary for different HAPs based on their toxicity and the distance of the release from a facility property boundary. The reporting levels can vary from 50 to 5,000 pounds per year.

Air emission reporting in Colorado is required for an item of equipment that emits 1 ton per year or more of any criteria air pollutant. A Colorado air permit may be required if a piece of equipment emits as little as 1 ton per year of any criteria pollutant. The trigger level varies from 1 to 10 tons per year depending on the pollutant and whether the source is located in an attainment or non-attainment area for that specific pollutant.

### Criteria, Hazardous, Non-Criteria Pollutants, and ODS

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

- Criteria air pollutants—like carbon monoxide, nitrogen oxides, sulfur dioxide, particulate matter, respirable particulates (PM10 and PM2.5), ozone, and lead—have been issued National Ambient Air Quality Standards (NAAQS) by the EPA.

## 2012 Highlights and Achievements

- Updated the air emissions inventory, including new sources and the use of equipment specific emission factors where possible. This has resulted in a more accurate emission inventory.
- The procedure for managing ozone-depleting substances was updated.
- Provided hazardous air pollutant (HAP) emissions calculations and compliance guidance to researchers related to several small-scale photovoltaic laboratory research activities.

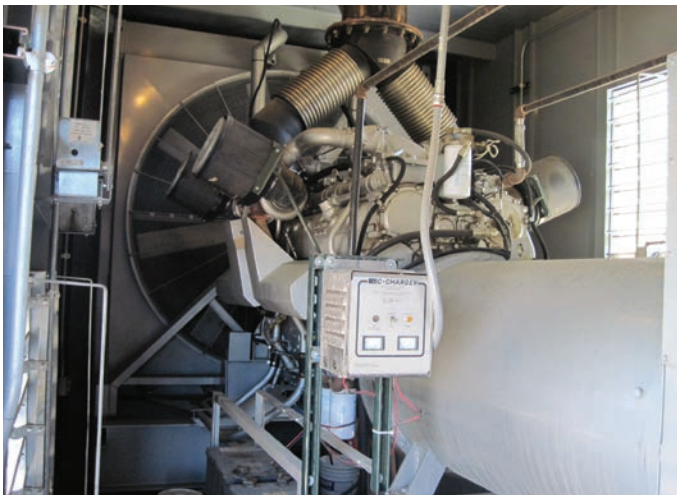
- Non-criteria pollutants—like ammonia, hydrogen sulfide, pesticides, certain VOCs classified as ozone precursors, metallic compounds, greenhouse gases (GHGs), and corrosives—are not associated with an EPA-specified NAAQS.
- HAPs which include a specific list of organic compounds, metals, corrosives, asbestos, radionuclides, and pesticides established by the EPA.
- Ozone-depleting substances (ODS) such as chlorofluorocarbons or "Freon" and hydro-chlorofluorocarbons that are being phased out of use in comfort heating and cooling systems and equipment.
- GHG compounds that contribute to global warming.

There are various Colorado and EPA notification, permitting and reporting thresholds for criteria, non-criteria, hazardous, and GHG pollutants. The primary potential sources of these pollutants at NREL include process heat boilers, process cooling systems, comfort heating and cooling systems, standby electrical generators, experimental laboratory hoods and ventilation systems, pilot- and large-scale research projects, and small equipment with gasoline or diesel engines. The laboratory maintains an air emission inventory to track potential air emissions and identify whether notification and permitting could be required for a particular facility or activity. Certain equipment and emissions are exempt from reporting and permitting by the Colorado Department of Public Health and Environment (CDPHE) APCD. The laboratory maintains several air permits issued by the CDPHE for "minor" sources, including standby electrical generators and pollution control systems at the South Table Mountain (STM) and National Wind Technology (NWTC) sites. All of these individual emission sources and each NREL facility are considered by the EPA and APCD to be minor sources with minimal permit and compliance requirements.

Fugitive particulate emissions from construction activities occur at the STM and NWTC sites. Particulate emissions from construction sites larger than 25 acres, or occurring for longer than six months, are subject to APCD fugitive particulate emissions permits. A fugitive emission permit is in effect for construction activity at the STM site; a fugitive particulate emissions permit is not currently needed for the NWTC.

## Permitting

Most sources of air emissions from NREL laboratory and facility operations in 2012 were of small scale and did not require permitting. While permitting thresholds may vary, depending on the pollutant, the APCD must be notified if more than 1 ton per year of one or more criteria pollutants is emitted from an individual item of equipment. Standby generators generally require permitting even if criteria emissions are less than 1 ton per year. Projected emissions for new sources were evaluated and air emission reporting and permitting was performed as required.



Standby electrical generator at the STM campus. *Photo by Larry Durbin, NREL 24488*

During 2012, NREL maintained 10 Colorado air permits. Six of these are for standby electrical generators, one is for the Renewable Fuels Heat Plant, two are for specific research activities, and one is for fugitive emissions from construction activities.

During 2012, NREL reported air emissions to the CDPHE APCD for five new sources which are air permit exempt but exceed the emission reporting threshold; Air Pollution Emission Notices (APENs) must be submitted to Colorado for these sources. These APENs must be maintained for the life of the equipment and must be renewed every five years. The sources include two research electrical generators moved from the NWTC to the Energy Systems Integration Facility (ESIF) at the STM site, a steam generator and steam super heater at the Solar Technology Acceleration Center (SolarTAC), and a small standby electrical generator for NWTC Building 258.

An evaluation of HAP emissions for NREL activities indicated that those emissions were well below all reporting and permitting threshold values. HAP emissions reporting and permitting trigger levels vary with the HAP compound, the height of the emission point, and distance of that point from the nearest property boundary. Those trigger levels can vary from approximately 50 pounds per year to more than 2,000 pounds per year. The ammonia emissions from

the Integrated Biorefinery Research Facility project are expected to meet the state threshold permitting requirement. Therefore, an air permit to install and operate an ammonia scrubber was obtained from CDPHE APCD in 2012.

### Ozone-Depleting Substances

EPA regulation 40 CFR 82, Protection of Stratospheric Ozone, requires that appliances and stationary appliances containing more than 50 pounds of Class I or II ozone-depleting substances (ODS) refrigerant must meet specific EPA record keeping, ODS recovery, and leak monitoring and repair requirements.

There are three categories of ODS registration and certification in Colorado (5 CCR 1001-19, Regulation 15, Control of Emission of Ozone Depleting Compounds):

- Facilities where maintenance activities are performed on refrigeration equipment containing ODS are required to file an annual notification with CDPHE.
- Technicians that service ODS-containing equipment must be trained to properly conduct that work through an EPA-certified training program. Workers completing that training are issued a training registration card.
- Refrigeration equipment larger than 100 horsepower (hp) containing ODS must be registered annually with CDPHE. Refrigeration equipment that uses non-ODS compounds are not required to be registered.

The laboratory has a total of three chillers that use more than 100 hp of compression, contain ODS compounds, and are thus registered with CDPHE—two located at the Solar Energy Research Facility on the STM site, and one at the Denver West Office Park. During 2012, NREL performed the necessary annual notification that maintenance activities occurred, renewed the registration for the three chillers, and confirmed that all technicians servicing ODS-containing equipment are EPA-certified.

The majority of refrigeration appliances at the laboratory either contain non-ODS refrigerants or use very small amounts of ODS refrigerants. The only appliances containing more than 50 pounds of ODS material are the three chillers previously mentioned. Operators of these chillers must maintain records of service for this equipment.

### Street Sanding

CDPHE regulations (5 CCR 1001-18, Regulation 16, Street Sanding Emissions) require federal, state, and local government facilities to track street sanding in the winter, and to minimize sand use. Sanding of roads followed by vehicle activity turns sand and gravel into finer particulates (PM10 or smaller) which can become airborne, significantly contributing to pollution in the Denver area. As these particulates contribute to breathing and health problems for susceptible individuals, the EPA and Colorado have issued regulations to minimize this source of air pollution.

NREL complies with the Colorado sanding requirements and files an annual sanding report with the CDPHE. During the 2010 – 2011 season, the laboratory stopped using sand and switched to deicer to maintain roadways. This practice was continued during the 2011 – 2012 season. The deicer used does not contain sand and minimizes fugitive particulate emissions from snow removal operations, contributing to improved air quality for neighbors and in the Denver metro region.

### GHG Emissions Tracking and Permitting

EPA regulations require that certain facilities emitting GHGs track and report the amount of those emissions. The purpose of this reporting is to better identify actual emissions of such gases across the United States and provide the EPA with data upon which to base future GHG regulations. The reporting and permitting of these emissions is required under the EPA Prevention of Significant Deterioration regulation, Title V Tailoring Rule (Tailoring Rule), and the EPA GHG Mandatory Reporting Rule. The Tailoring Rule requires air emission permitting of GHG emissions if $CO_2e$ emissions are greater than 100,000 U.S. tons per year. The Mandatory Reporting Rule requires annual GHG reporting to EPA if $CO_2e$ emissions are greater than 25,000 metric tons per year. Reporting and permitting of GHGs is not currently required for NREL facilities.

GHGs include $CO_2$, methane, nitric oxide, and many refrigerants including ODS chlorofluorinated hydrocarbons such as hydrofluorocarbons, perfluorocarbons, and certain other fluorinated gases including sulfur hexafluoride. For more information on how NREL is reducing its emission of GHGs, please see section 4 Sustainability.

## 2012 COMPLIANCE SUMMARY AND ACTIVITIES

Compliance with the wide variety of air permit and emission limitation requirements is an on-going and significant activity at NREL that is both necessary and challenging. The nature of experimental research may require significant changes in technical direction and equipment based on the results obtained during those experiments. Such changes may alter air emissions.

The following compliance activities were performed during 2012, assuring compliance with air regulations and improved implementation of the Air Quality Protection program:

- All program activities were in compliance with requirements.
- NREL did not exceed any air permit standard or other air regulatory requirement at any facility.
- Completed an evaluation of NREL's compliance with EPA and APCD permitting and emissions control requirements. NREL is in compliance with all Colorado and EPA permit requirements, and all facilities and individual permitted equipment items are classified as minor sources.
- Obtained an air permit for a standby electrical generator necessary for the newly constructed ESIF. Performed emission testing and submitted necessary forms to the APCD to convert construction permits to final air permits for two emergency generators and an ammonia scrubber and particulate baghouse. Five APENs were filed with the APCD for the planned installation of permit exempt sources at ESIF, SolarTAC, and NWTC Building 258. Annual emission fees for all existing permits were submitted to the APCD.
- All required registrations were completed for equipment containing ODS. NREL facilities servicing refrigeration equipment were registered and all refrigeration service personnel have obtained the EPA and Colorado required training and certification.
- Evaluated NREL's 2012 $CO_2e$ and GHG emissions. The GHG inventory shows that GHG emissions are below the threshold for EPA reporting and permitting rules. The laboratory's $CO_2e$ inventory for EPA reporting purposes is 6,962 U.S. tons (6,316 metric tons) for the STM site and 167 U.S. tons (151 metric tons) for the NWTC site. GHG emissions for the STM were 6,904 U.S. tons (6263 metric tons) and 166 U.S tons (151 metric tons) for the NWTC.
- The required annual street sanding report was provided to the APCD and Jefferson County.

# 7 Water Quality Protection

Water quality is critical to human health and the health of our natural ecosystems. At NREL, the focus of water quality protection is on four main areas:

- Drinking water
- Wastewater
- Groundwater
- Surface water.

## 7.1 DRINKING WATER

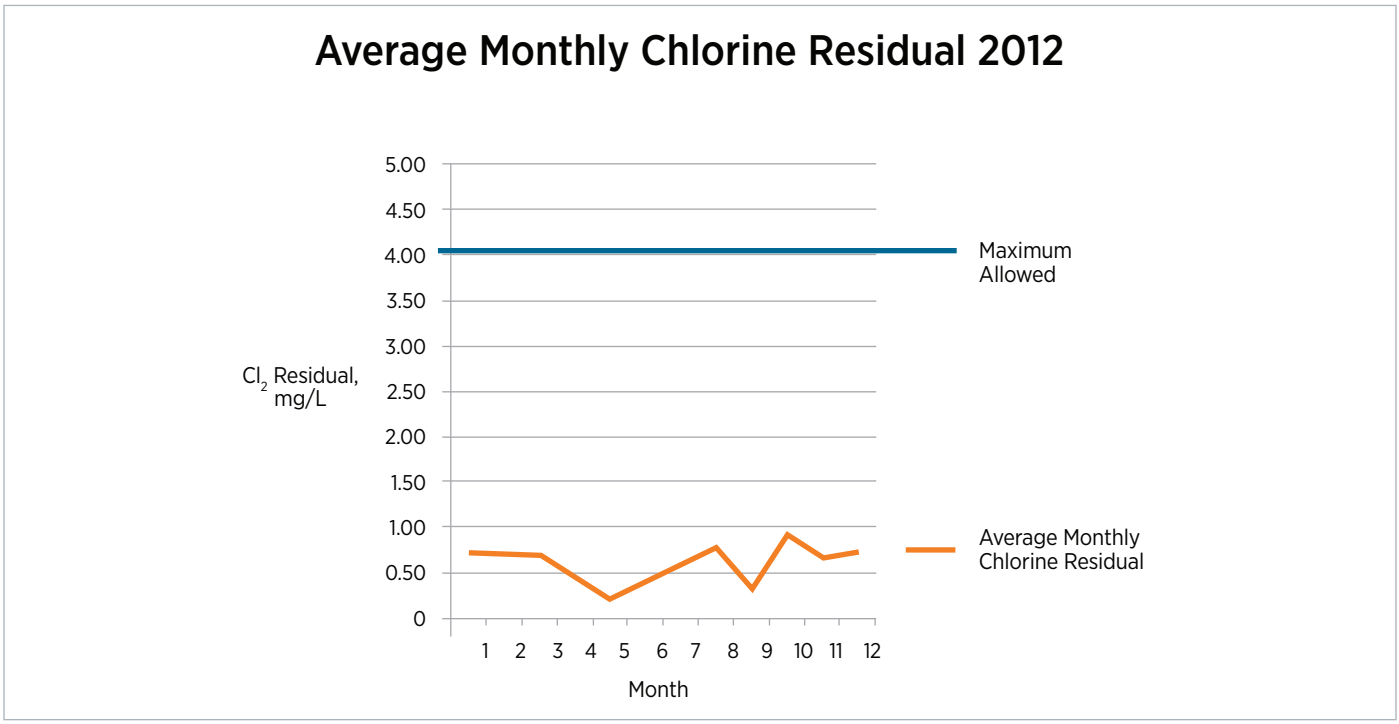
Due to its remote location, the National Wind Technology Center (NWTC) does not have access to a public drinking water supply. For this reason, NREL operates a drinking water distribution system at the NWTC, serving about 150 employees. Drinking water is purchased from local municipalities and transported by truck to the site, where it is transferred to a large holding tank with a capacity of 15,000 gallons. Water is pumped from the holding tank to a day tank where it is circulated around the site for use. There is no treatment of the water, but chlorine is added to boost disinfectant levels. The system is permitted by the State of Colorado, which requires monitoring for a number of parameters on an annual basis. The water is tested in the same ways municipal water systems are tested for residual chlorine levels, bacteria, disinfection byproducts, lead, and copper.

There are a number of organizations that can take credit for the success of the NWTC water system. NREL's Site Operations Office provides primary oversight for the

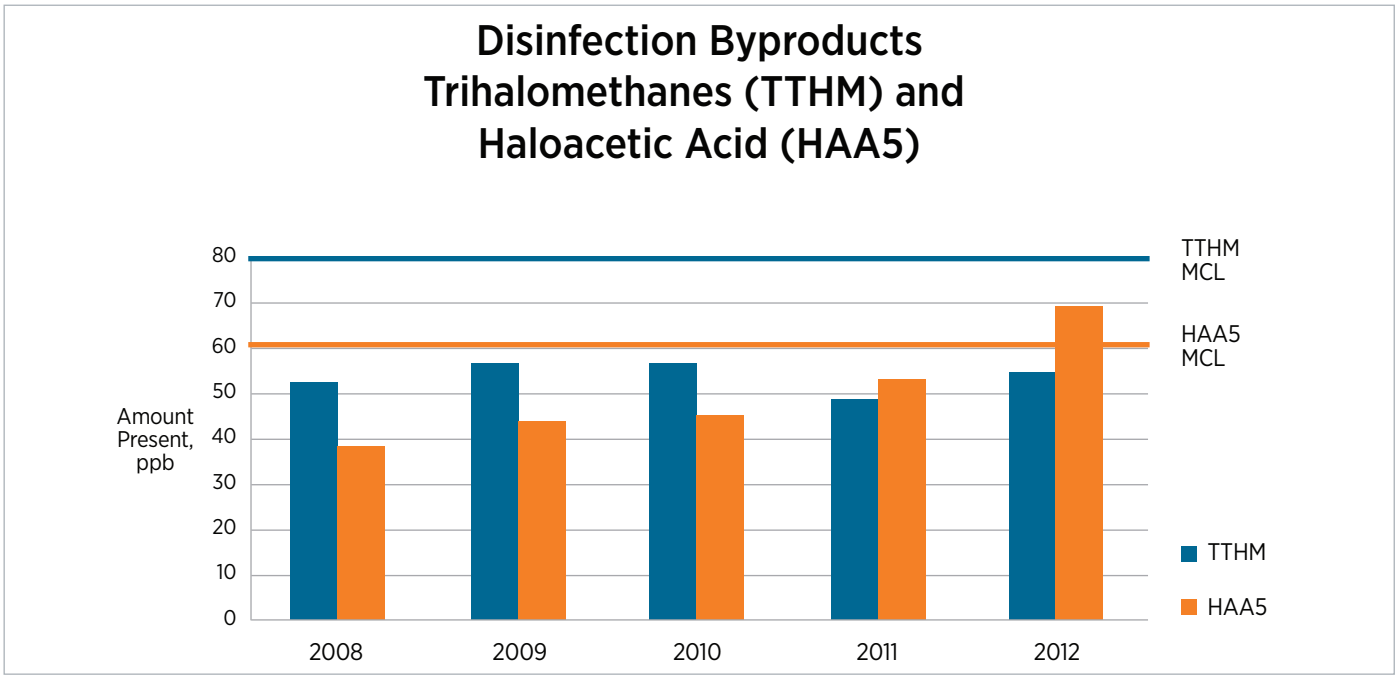
Low-flow faucets. *Photo by Christina Chase, NREL 20076*

### 2012 Highlights and Achievements

In 2012, 503,962 gallons of drinking water was safely provided to NWTC users.




Results of 2012 chlorine monitoring.




Results of 2012 DBP monitoring.

day-to-day operation of the system, aided by a state-licensed contract operator who visits the site weekly to check the details of the system operation and performance. The NREL Environment, Health, and Safety (EHS) Office assists Site Operations in tracking state requirements and completing required reports and managing contacts with regulators. NREL's management of the drinking water system is subject to assessments by the U.S. Department of Energy (DOE) and compliance inspections by the Colorado Department of Public Health and Environment (CDPHE).

## PROGRAM MANAGEMENT

As a public water system regulated by the State of Colorado, the NWTC water system must comply with the Safe Drinking Water Act (SDWA) and federal and state regulations based on the SDWA authority. The U.S. Environmental Protection Agency (EPA) has established allowable levels for drinking water constituents known as Maximum Contaminant Levels (MCLs), which can be found at Part 40 of the CFR Part 141. Colorado has adopted these MCLs into the Colorado Primary Drinking Water Regulations at 5 CCR 1003-1. These regulations establish the state's authority to regulate drinking water providers to assure safe, reliable water supplies, and to implement EPA's special rules.

The primary requirement is to test the water quality following a monitoring plan issued by the state each year. The plan identifies which tests are to be performed and at what frequency. Monthly tests are required for bacteria and disinfectant levels, while disinfection byproducts (DBPs) are sampled for once a year, and lead and copper are tested on a three-year rotating basis. The previous two figures show the results of the chlorine and DBPs monitoring for 2012.

## 2012 COMPLIANCE SUMMARY AND ACTIVITIES

- In 2012, the MCL was exceeded for haloacetic acids, a class of DBPs. The annual sample collected in August measured 69.4 ppb, exceeding the maximum of 60 ppb. In such circumstances, the state requires increased monitoring; sample frequency was increased to quarterly, starting in October and continuing into 2013. Monitoring has since indicated that haloacetic acids levels have been consistently below the MCL since this single exceedance. Prior to this single exceedance, the NWTC had not exceeded any of the SDWA's MCLs in the past five years.
- All other monitored parameters in 2012 met applicable SDWA requirements.
- The state conducted a sanitary survey of the drinking water system in 2012 and found no non-conformities with program or regulatory requirements. Several recommendations for program improvements were made and are being addressed.

## 7.2 GROUNDWATER

Groundwater protection in the West is particularly important because these resources are limited yet relied upon by increasing numbers of residents for water supplies. NREL's groundwater protection program is based on the

## 2012 Highlights and Achievements

- There were no spills or releases that impacted groundwater at any NREL site in 2012.
- Two monitoring wells, installed in the 1990s and closed in 2006, were removed to about 12 feet below surface level, making way for new water lines that were installed along the north side of the Integrated Biorefinery Research Facility (IBRF). In accordance with state requirements, the top of the remaining well casings were covered with pipe caps glued in place.

philosophy that the prevention of groundwater contamination is far better than remediation.

Both the STM and the NWTC sites are located at the western edge of the Denver Basin aquifer system that supplies water to urban, rural, and agricultural users along the Front Range of the Rocky Mountains in northeastern Colorado. The aquifers within the Denver Basin, which include the Dawson, Denver, Arapahoe, and Laramie-Fox Hills aquifers, form a layered sequence of rock in an elongated bowl-shaped structural depression.

The STM site overlies the shallowest portions of the Denver, Arapahoe and Laramie-Fox Hills aquifers. The NWTC site overlies the shallowest portions of the Arapahoe and Laramie-Fox Hills aquifers. The Dawson formation is the shallowest of the Denver Basin aquifers and is the one most relied upon by the groundwater users in the basin. The northern extent of the Dawson aquifer is located approximately 20 miles to the south and east of the STM site; consequently, wells drilled at either the STM site or the NWTC would not intersect the Dawson aquifer, nor would a source of contamination affect the groundwater quality in this aquifer.

Because of the sensitive nature of the groundwater resource, NREL carefully evaluates all outdoor projects to eliminate potential impacts to groundwater quality. If any materials are used that pose a risk to groundwater, the laboratory typically insists that safeguards to protect groundwater be established. Safeguards include, but are not limited to, secondary containment for equipment with the potential to leak oil, double-walled tanks with leak detection for diesel fuel storage of NREL facilities' emergency generators, and bermed areas, either temporary or permanent, to contain materials associated with construction activities or on-going research.

### PROGRAM MANAGEMENT

The State of Colorado regulates the installation of groundwater wells through the state engineer's office, requiring a permit for drinking water, groundwater monitoring, or geothermal installations.

There is one closed-loop geothermal system at the STM for the Solar Radiation Research Laboratory installed in 2009 and another at the South Site Entrance Building installed in 2012. The installations were completed in accordance with state requirements. There are currently five permitted monitoring wells at the STM site and none at the NWTC. There are currently no ongoing groundwater monitoring activities being conducted; however, these wells remain open for possible future use. Should the laboratory conduct activities that could impact groundwater, a monitoring program will be implemented and additional groundwater monitoring wells will be installed as needed.

### 2012 COMPLIANCE ACTIVITIES

There are no compliance activities associated with the Groundwater Program.

## 7.3 SURFACE WATER

NREL's Surface Water Protection program seeks to preserve the quality of receiving waters to which the STM and NWTC campuses discharge. These receiving waters include Lena Gulch at the STM site and Coal Creek and Rock Creek at the NWTC site. Water quality protection is accomplished through management of runoff emanating from active construction sites, inclusion of project design elements that promote infiltration and detention, and management of campus areas not under construction to minimize erosion and support infiltration.

Due to the continuing construction activity at both campuses, the focus of NREL's water quality protection

Stormwater best management practices in action at the STM site. *Photo by Genny Braus, NREL 24483*

## 2012 Highlights and Achievements

- Completed construction of the STM stormwater detention basin. The detention basin receives, detains, and passively improves the quality of stormwater runoff from a majority of the STM site. The basin also provides flood protection to an adjacent neighborhood and park facility by controlling the 100-year storm event peak flow leaving the STM site. The basin outlet structure is designed to control the release of stormwater to pre-development discharge levels.
- Developed a conceptual design for improvements to a large drainage swale that discharges to the STM stormwater detention basin. The improvements will include energy dissipation structures, reseeding, and addition of irrigation to enhance re-vegetation success and soil stability. As the swale is partly located off campus, design approval and permitting is required from the neighboring jurisdiction. The project is expected to be complete in late 2013.
- Modified NREL's stormwater program. In response to the EPA's new 2012 Construction General Permit, the laboratory modified its stormwater program by changing requirements for the frequency of post rain/snowmelt event inspections, deadlines for completion of best management practice (BMP) repair/replacement, and including planning documentation within the stormwater pollution prevention plan. These changes support compliance with the EPA stormwater regulation and improve the effectiveness of the stormwater program.
- Completed review of snow management procedures. A literature review was conducted on new deicing chemicals and possible modifications in the application of those previously used on the site. This information, together with a map indicating preferred snow piling locations to maximize infiltration, was incorporated into NREL's snow management practices for 2012.
- Incorporated low-impact design elements. All construction projects continue to incorporate low-impact design elements such as porous pavement, vegetated bioswales, and native vegetation.
- Completed NWTC drainage system improvements. Improvements to the drainage system were made at the NWTC as part of the 5-megawatt Dynamometer Expansion project, including the addition of riprap at two storm drain outfalls and placement of erosion control matting and seeding in a roadside drainage swale.

Stormwater erosion control matting at the cafeteria at the STM site. *Photo by Dennis Schroeder, NREL 22488*

program during 2012 has been managing construction site runoff which has the potential to impact rivers, lakes, ditches, and other waters of the United States. Sediment, debris, and chemicals transported to these water bodies via stormwater runoff can harm or kill fish and other wildlife either directly or by destroying aquatic and riparian habitat. High volumes of sediment can result in stream bank erosion and clogging of waterways.

Prior to construction, NREL implements an interdisciplinary planning and design process that involves National Environmental Policy Act reviews and approvals, and the assessment of design documents for potential impacts to stormwater and receiving waters. Design teams are encouraged to incorporate low impact design elements that promote infiltration and evapotranspiration. NREL continues to monitor final design documents and construction implementation to look for additional opportunities to reduce runoff quantity and enhance runoff quality.

Erosion and sediment controls, proper chemical storage, fueling procedures, and good housekeeping practices are implemented during construction according to the stormwater plans developed by contractors and reviewed by NREL EHS staff. Regular inspections by contractors and staff are conducted to verify that controls are functioning properly. Any repairs or modifications to the plans are documented on an inspection report; prompt actions are required to correct any noncompliant conditions.

Management of campus areas outside active construction sites minimizes erosion, supports infiltration of rain water and snowmelt, and prevents contamination of stormwater with hazardous materials. Vegetation and landscaping are maintained to prevent erosion. Infiltration of precipitation is achieved through detention basins and grassy swales, as well as design elements including porous pavement and

diversion of roof and perimeter drains to landscaped areas. In addition, dumpsters are kept covered, hazardous wastes are stored indoors or in covered areas, and seasonally campus roads and sidewalks are swept to reduce sediment and deicing materials.

## PROGRAM MANAGEMENT

The federal Clean Water Act (CWA), amendments, and implementing regulations in 40 CFR Part 122, apply to stormwater discharges from construction activities that disturb greater than one acre. As a federally owned facility, the EPA is the regulating authority for stormwater at NREL's campuses. For construction projects off federal property, such as at the SolarTAC facility, CDPHE National Pollutant Discharge Elimination System Program stormwater permits may be required. For construction sites on NREL property that disturb greater than one acre, a Notice of Intent (NOI) must be filed with the EPA to be covered under the Construction General Permit (CGP) and a site-specific Stormwater Pollution Prevention Plan (SWPPP) must be prepared.

The SWPPP implements both the requirements of the EPA's CGP and NREL-specific requirements at the laboratory. The SWPPP is developed by the subcontractor using an NREL-developed template that includes all required elements. The SWPPP must be signed and certified per EPA CGP signatory requirements and must be accepted by the EHS Office prior to filing NOIs.

While construction sites less than one acre are not regulated by the EPA and typically involve minimal disturbance within a short timeframe, these sites still have the potential to contribute pollutants to stormwater runoff. For these sites, NREL requires subcontractors to comply with basic elements of stormwater pollution prevention. Depending on the nature of the construction, contractors may be required to develop an abbreviated SWPPP documenting basic contact, project, and BMP information. A site-specific erosion and sediment control plan showing the locations of key site characteristics and BMPs may also be required.

Energy Independence and Security Act Section 438 requires agencies to reduce stormwater runoff from federal development projects to protect water resources. Agencies can comply using low-impact design elements such as porous pavers, cisterns, and bioswales, or retain stormwater runoff and release at predevelopment levels. In addition, Executive Order 13514, Federal Leadership in Environmental, Energy, and Economic Performance, sets requirements for efficient water use, reuse, and stormwater management. The laboratory's efforts to conserve water and preserve water quality through low-impact design are described above, with additional information provided in section 4, Sustainability.

## 2012 COMPLIANCE SUMMARY AND ACTIVITIES

- All program activities were in compliance with requirements.
- Permit coverage was obtained under the new 2012 EPA CGP for six construction projects at the STM site, and two at the NWTC. In addition, one EPA Low Erosivity Waiver was obtained at the STM site for a project constructed during low precipitation months. Two permits were terminated in 2012. For a list of all stormwater permits, see Appendix C.
- State stormwater permits were obtained for construction of two new experimental research projects at the SolarTAC site. Because these projects exist off federal property, Colorado Discharge Permit System construction stormwater permits, rather than EPA permits, were required.
- Construction sites received periodic monitoring from local regulatory officials; no non-compliances were noted.

Reseeding and mulching following construction activity at NWTC. *Photo by Genny Braus, NREL 24489*

## 7.4 WASTEWATER

The majority of wastewater from the STM and DWOP facilities flows into the Pleasant View Water and Sanitation District's (Pleasant View) system, and ultimately to the Metropolitan Wastewater Reclamation District's (Metro) central treatment plant. Wastewaters from the JSF and the ReFUEL facility also flow to Metro's treatment plant. There is a small septic system consisting of a tank and leach field on the mesa top at STM, serving the Solar Radiation Research Laboratory (SRRL), because there is no sanitary service to that area. The NWTC also lacks sanitary service, so the site has two septic systems that include tanks and leach fields for the treatment of wastewater.

## PROGRAM MANAGEMENT

Non-domestic wastewater discharges to the Metro District must comply with the district's rules and regulations, which incorporate a number of requirements of the CWA, specifically the provision of the Pretreatment Program. Pretreatment is the set of regulations applied to industries and commercial operations that generate non-domestic wastewaters with potentially high levels of pollutants that could have an impact on treatment facilities and the environment. NREL does not have any of the types of operations that CWA regulations have targeted, nor does the laboratory discharge a volume of water that would make NREL a Significant Industrial User, which would require a formal discharge permit from the Metro District. The discharge agreement in place for NREL gives the laboratory direction for using the system, and provides assurance to the Metro District that the laboratory-generated wastewaters are compatible with their requirements.

### 2012 Highlights and Achievements

While most of the wastewater discharged from NREL facilities is domestic, one facility occasionally discharges wastewater under an agreement with the Metro District. NREL minimizes non-domestic wastewater discharges, but when the sanitary system is the best option for waste management, NREL works with the districts to ensure that there are no adverse impacts to their facilities or the environment. The IBRF has pilot-scale operations that take cellulosic materials such as switch grass or corn stover and convert the cellulose to fermentable sugars that lead to ethanol production. These operations generate wastewater, which is discharged to the sanitary collection system. Several projects in 2012 generated such discharges, all of which met requirements for wastewater release.

It is NREL policy to comply with all requirements of Metro's Pretreatment Program, including the list of general prohibitions that protect the collection and treatment systems. The list of prohibitions includes hazardous materials, highly viscous substances, radioactive material, excessive oil and grease, and similar substances that could cause material harm to the sanitary system. NREL staff are trained in this policy. In addition, NREL sites have design criteria for waste drains in laboratory 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 laboratory 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.

## 2012 COMPLIANCE SUMMARY AND ACTIVITIES

- All program activities were in compliance with requirements.
- The laboratory worked with the Pleasant View District on several large-volume discharges related to construction activities. Water lines included in new construction must be sanitized prior to use and these lines were disinfected and the water used in that process was discharged with Pleasant View's approval. Large flows over small time periods can be problematic to sanitary collection systems, so the laboratory worked with the district to minimize potential impacts to their system.

# 8 Hazardous Materials and Waste Management

At NREL, responsible acquisition, use, and disposal of materials and wastes is critical to meeting our commitments to compliance, preventing pollution, and environmental stewardship. The laboratory seeks to purchase materials that are sourced responsibly and contain recycled content and lower-impact materials. Use of materials is thoughtfully controlled with internal procedures designed to limit health and environmental risks. Wastes are carefully managed and disposed of through select contractors. These elements, if mismanaged, have the potential to increase disposal costs, generate cleanup costs, and increase potential for spills and contamination. Areas of focus include:

- Hazardous materials management
- Regulated waste management
- Storage tank management
- Pollution prevention
- Radiological materials and waste management.

## 8.1 HAZARDOUS MATERIALS MANAGEMENT

As a major national laboratory, NREL has a variety of chemicals and materials, some of which are hazardous, for use in research activities. Hazardous materials are stored, used, and managed in a manner that is protective of laboratory personnel, the general public, and the environment. NREL has also taken steps to plan emergency responses in the event there is a spill or release of a hazardous material; these plans are coordinated with local emergency responders, such as the West Metro Fire Protection District and the Jefferson County Local Emergency Planning Committee (LEPC).

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 barcoding 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:


Diesel storage tank at the STM site. *Photo by Larry Durbin, NREL 24478*

- 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 onsite prior to making chemical purchases
- Providing quick access to chemical inventories and hazard information during emergency responses
- Facilitating accurate and efficient reporting to external agencies (e.g., fire districts, LEPC, EPA, and DOE).

Hazardous materials are rigorously managed, starting with the chemical inventory system that tracks chemical

### 2012 Highlights and Achievements

- In 2012, the Occupational Safety and Health Administration published new hazard communication requirements at 29 CFR 1910.1200, implementing the United Nations program called the Globally Harmonized System of Classification and Labeling of Chemicals (GHS). Employers are required to train all employees who work with chemicals on the components of the new GHS program. Training must be complete by December 2013. NREL introduced GHS during monthly chemical safety refresher courses throughout 2012, and in December, expanded the training to cover details of new label requirements, safety warnings, and revised safety data sheets. All lab employees will be trained by the deadline in 2013.

amounts, locations, and hazards. Each week, safety personnel receive a list of all chemicals and their hazards shipped to the laboratory for the previous week. Researchers and safety personnel ensure that chemicals are properly stored in locations suitable for any hazards, such as storing flammable materials in designated flammables cabinets. In addition to the measures taken to safely transport, transfer, and store these materials without releases to the environment, there are reporting requirements triggered by certain quantity levels.

## PROGRAM MANAGEMENT

NREL facilities are subject to the emergency reporting provision of the Emergency Planning and Community Right-to-Know Act (EPCRA), Section 302, which requires a facility to notify the State Emergency Response Commission (the Colorado Emergency Response Commission) if any extremely hazardous substances in the facility's inventory are stored in quantities greater than prescribed threshold planning quantities (TPQ). NREL facilities first became subject to planning and notification requirements in 1988.

EPCRA Section 304 requires facilities to immediately notify the LEPC if there is an accidental spill or release of more than the predetermined reportable quantity. In accordance with Section 311 and 312 of EPCRA, NREL provides MSDS for chemicals that are stored onsite in quantities greater than TPQs, and provides inventory reporting for these same chemicals in the form of a Tier II report to emergency planning and response groups.

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

The laboratory is also subject to reporting requirements in the event of a release of a reportable quantity 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 codes for which Section 313 reporting is required, Executive Order (EO) 12856, *Federal Compliance With Right-To-Know Laws and Pollution Prevention Requirements*, requires that all federal facilities file a report, if applicable, regardless of the standard industrial classification code. NREL has never manufactured, processed, or otherwise used chemicals on the 313 list in quantities exceeding TPQs, so has never had to report under Section 313.

NREL is also subject to permitting requirements through local jurisdictions. NREL obtains annual hazardous material permits from West Metro Fire Rescue for the STM and Denver West Office Park (DWOP) sites as required by West Metro Fire Rescue. 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 Fire Rescue conducts a walk-through inspection of the entire STM site and DWOP.

The ReFUEL facility is within the jurisdiction of the City and County of Denver and is subject to the DFD Hazardous Materials Information System requirements. The ReFUEL facility's inventory of listed materials, including various fuels such as biodiesel, must be reported to the DFD annually. The DFD inspects the facility and issues a hazardous materials permit.

## 2012 COMPLIANCE SUMMARY AND ACTIVITIES

In early 2012, NREL submitted a Tier II report to CDPHE for reporting year 2011, identifying diesel fuel, petroleum oil,

**2012 EPCRA REPORTING**

| EPCRA Section | Description of Reporting | Status |
|---|---|---|
| EPCRA Section 302-303 | Planning Notification | Not required |
| EPCRA Section 304 | Extremely Hazardous Substance Release Notification | Not required |
| EPCRA Section 311-312 | Material Safety Data Sheet/ Chemical Inventory | Yes |
| EPCRA Section 313 | TRI Reporting | Not required |

"Yes" indicates that the laboratory reported under the provision.

"Not required" indicates that the laboratory was not required to report under the provision (e.g., did not meet the threshold or did not have an extremely hazardous substance release).

and sulfuric acid in lead-acid batteries; see the following table for details.

- All program activities were in compliance with requirements. There were no releases of hazardous materials requiring reporting.
- West Metro Fire Rescue conducted an annual hazardous material inspection and issued permits for all major research facilities on the STM site.
- The inventory of materials at the ReFUEL facility was provided to the DFD.

## 8.2 REGULATED WASTE MANAGEMENT

NREL is committed to the appropriate management of regulated waste generated through its daily operations. Research and development activities and general facility operations create a variety of waste streams, including those containing toxic chemicals or metals. These wastes are handled, stored, and disposed of responsibly and within the parameters of state and federal regulations to minimize the potential for health and environmental impacts that could result from a release or improper disposal.

Research in such areas as photovoltaics, bioenergy, wind, transportation technologies, and energy storage use a vast range of chemical products that, in turn, generate hazardous and non-hazardous waste in the form of solids, liquids, and gases. Proper planning ensures that the resulting waste streams are reduced in volume and managed in an environmentally friendly manner.

Waste management and minimization efforts begin in the planning stages of all experimental and operational activities. Processes are evaluated based on the quantities and toxicities of products that will be brought onsite before an activity begins and lasting until material use is complete and it is ready for disposal. Hazardous materials proposed for use are also assessed for the potential substitution of less hazardous products, resulting in less hazardous waste streams.

### 2012 Highlights and Achievements

As a best management practice, NREL continued to manage all of its facilities to the more stringent Large Quantity Generator (LQG) status regulatory requirements, including personnel training, contingency planning, and container management.

Consolidation of select waste streams facilitates cost-effective disposal. *Photo by Bob Fiehweg, NREL 24482*

The handling of waste items always incorporates a high level of safety and environmental stewardship for NREL and its surrounding neighbors. Likewise, on-site waste management activities are conducted in a manner that will minimize potential effects on human health and the environment.

## PROGRAM MANAGEMENT

Regulated wastes are handled and disposed of according to the Resource Conservation and Recovery Act (RCRA) in Title 40 of the Code of Federal Regulations and implemented in the State of Colorado by CDPHE's Hazardous Materials and Waste Management Division (HMWMD) through the Colorado Hazardous Waste Act under 6 CCR 1007-3. Pursuant

Electronics waste collection. *Photo by Eric Schmitz, NREL 24484*

with 6 CCR 1007-3, Section 262.41, hazardous waste generators that met the criteria for a large quantity generator at any time during the year must have a Biennial Hazardous Waste Report completed on even-numbered years for the previous year's activities. Additional applicable regulatory requirements fall under the realm of Title 49 of the Code of Federal Regulations, *Transportation*.

NREL implementation of regulatory requirements with regard to waste management includes:

- Documented waste management and minimization program
- Annual training for all staff who generate waste
- Regular inspection and tracking of all waste containers
- Storage, packaging, shipment, and tracking until final disposition via a fully-permitted waste disposal or recycling facility
- Active monitoring of waste volumes to determine generator status
- Maintaining records that are generated through "cradle to grave" waste management activities per applicable federal and DOE records management protocols.
- NREL typically disposes of the following categories of waste:
- Hazardous waste (as defined by environmental regulations)
- Non-hazardous waste such as propylene glycol from building chillers or select pretreatment liquors from biomass processing, etc.; does not include municipal solid waste
- Universal waste such as mercury-containing light bulbs, lead-acid batteries, aerosol cans, and electronic waste such as circuitry, solder, display monitors, etc.
- Low-level radioactive waste. NREL generates this in small quantities in one designated laboratory and normally consists of personal protective equipment, disposable lab ware, scintillation fluids, and water-based liquids containing small amounts of low-level isotopes. Radioactive waste is shipped off-site for disposal as needed (for more information, see section 8.6 Radiological Materials and Waste Management).

A comparison of waste volumes generated in CY 2010, CY 2011, and CY 2012 is summarized above.

NREL maintains unique EPA identification numbers for each of its five facilities: STM, DWOP, NWTC, the Joyce Street Facility (JSF), and ReFUEL. Pursuant with state and federal regulations, annual generator notifications are made and applicable fees are paid to the HMWMD based on monthly volumes of hazardous waste that are generated at each facility. The three waste generator classifications are:

- LQG: generates ≥ 1,000 kilograms (kg) of hazardous waste in a calendar month (or > 1 kg of acutely toxic hazardous waste)
- SQG: generates > 100 kg but < 1,000 kg of hazardous waste in a calendar month (and < 1 kg of acutely hazardous waste)
- CESQG: generates < 100 kg of hazardous waste in a calendar month (and < 1 kg of acutely hazardous waste)

**COMPARISON OF FOUR WASTE CATEGORIES GENERATED AT NREL FACILITIES IN 2010, 2011, AND 2012 (LBS. NET WEIGHT)**

| | Hazardous Waste | Non-Hazardous Waste | Electronic Waste | Other Universal Waste |
|---|---|---|---|---|
| 2010 | 18,322 | 12,129 | 11,676 | 5,791 |
| 2011 | 20,557 | 6,156 | 29,549 | 3,539 |
| 2012 | 33,386 | 8,805 | 41,355 | 4,803 |

**2012 GENERATOR STATUS FOR NREL FACILITIES**

| Facility Name | 2012 Generator Status |
|---|---|
| STM | SQG/LQG |
| DWOP—Bldg. 16 | CESQG |
| NWTC | CESQG |
| JSF | CESQG |
| ReFUEL | CESQG |

The 2012 Generator Status for NREL Facilities table provides data for each NREL facility. Four out of five NREL facilities fall under the waste generator category of CESQG, generating minimal amounts of hazardous waste per calendar month. The STM site typically produces quantities of hazardous waste well within the category of SQG; however, due to pilot-scale research experiments, the STM site can episodically elevate to that of LQG in one or more months during the year.

NREL has a conservative waste management policy where select materials that are not regulated by RCRA, yet pose a potential hazard, are collected and disposed of as non-hazardous materials at EPA-permitted disposal facilities.

For example, non-hazardous, nanomaterial-bearing wastes are not RCRA-regulated, but due to the potential for health risk, these wastes are managed and disposed of via the same management methods used for hazardous waste. In a general order of preference, waste items are shipped offsite for final disposal via recycling, reclamation, treatment, incineration, and landfill.

## 2012 COMPLIANCE SUMMARY AND ACTIVITIES

- All program activities were in compliance with requirements.
- All regulatory notifications were updated and applicable waste generator fees were paid for five NREL facilities in CY 2012.
- The laboratory submitted the required RCRA Biannual Biennial Hazardous Waste Report for the STM site for reporting year 2011 to the CDPHE HMWMD in March 2012.
- Despite three calendar months of hazardous waste generation at volumes totaling more than 1,000 kg per month between July and September 2012, the STM site downgraded its waste generator status from LQG to SQG in October 2012.

## 8.3 ABOVEGROUND STORAGE TANK (AST) MANAGEMENT

Proper tank management prevents or minimizes the size of spills and leaks of fuels or oils, avoiding contamination of soils, surface water, groundwater, and drinking water. Spill avoidance saves money and time, and prevents impacts to the environment. Proper management of storage tanks supports the laboratory's commitments to environmental stewardship and pollution prevention.

The Aboveground Storage Tank (AST) Management Program applies to petroleum fuel tanks and is intended to:

- Minimize releases from tanks
- Confirm that safety features are present and functional
- Confirm that compliance requirements are met.

NREL minimizes the risk of underground soil and water contamination from storage tanks by utilizing only aboveground tanks where storage is required. Unlike underground tanks, aboveground installations provide access for regular visual leak inspections and allow for less costly repair and cleanup, should that be necessary.


New standby electrical generator and AST at the STM parking garage. *Photo by Larry Durbin, NREL 24487*

### 2012 Highlights and Achievements

- Governing procedures for AST management were updated to reflect revised regulations.
- AST and spill prevention and response training was provided by the EHS Office to all NREL personnel identified as having responsibility for operating and fueling ASTs, and those providing initial spill response. More than 30 NREL personnel attended these trainings.
- The NREL AST inventory was revised to reflect new, moved, and removed ASTs at all facilities.
- All tanks were reviewed to confirm adherence to recently revised regulations.

## PROGRAM MANAGEMENT

ASTs are regulated in Colorado by the CDLE's Oil Inspection Section under the Colorado AST regulation 7 C.C.R. 1101-14. Colorado requires that ASTs 660 gallons or larger be permitted prior to installation, be inspected by the CDLE following installation, and be registered within 30 days following commencement of use. EPA regulations require that ASTs be constructed and installed according to specific standards, be regularly inspected, that those inspections are documented, and that facilities meeting certain oil storage limits employ a Spill Prevention, Control, And Countermeasures (SPCC) plan to manage oil sources 55 gallons or larger. Those plans must include specific information, training requirements, and response and cleanup guidance

designed to minimize the number and size of spills while speeding the control and cleanup of spilled materials.

NREL facilities store diesel fuel for emergency generators and ethanol from research activities in ASTs. The AST Management Program focuses on proper tank design, operation, training, and inspection to protect against spills and leaks. The program is designed to meet, at a minimum, EPA and Colorado regulatory requirements.

Several important mechanical and procedural safeguards have been incorporated into the AST Management Program to prevent an accidental release of diesel fuel from the storage tanks. Mechanical safeguards include overfill and spill protection, double-wall tanks for diesel fuel equipped with sensors that result in an alarm if the inner tank wall is leaking, and exterior concrete containment structures for an ethanol storage tank and one single-wall diesel fuel tank. Procedural safeguards include written operating and tank filling procedures, monthly and annual inspections, and record keeping of inspection results. ASTs larger than 110 gallons are visually inspected monthly and all double-walled ASTs are inspected annually to confirm that there is no liquid in the interstitial space.

Staff participate in project planning, project safety evaluations, readiness verifications, and training activities. This participation supports:

- Awareness of planned ASTs and their contents
- Timely achievement of necessary regulatory approval for ASTs
- Maintenance of a current and accurate AST inventory
- Placement of spill cleanup supplies to assist timely response to spill events
- Planning of annual training activities
- Regular updates of facility SPCC plans.

Personnel who operate and manage ASTs are trained annually. This training is combined with SPCC training for individuals who are responsible for AST operation and maintenance, fuel or other liquid transfer activities, and emergency response to AST spills. This combined training informs NREL staff of the inventory of oil-containing equipment at each site, discusses inspection and response requirements, reviews the oil spill history of each site and discusses lessons learned, and covers recent changes in rules and regulations.

NREL maintains 13 ASTs at the STM site with a total capacity of 11,399 gallons; one AST at DWOP with a capacity of 500 gallons; and five ASTs at the NWTC with a total capacity of 1,056 gallons. Four ASTs at the STM are required to be registered with the DOPS, including a 6,000-gallon ethanol tank at the Integrated Biorefinery Research Facility, an 800-gallon diesel tank for a standby electrical generator at the Solar Energy Research Facility, a 660-gallon diesel tank for a standby electrical generator at the Research Support Facility, and an 883-gallon diesel tank for a standby electrical generator at the Energy Systems Integration Facility. These ASTs comply with Colorado and EPA requirements. There are no ASTs at the NWTC that need to be permitted or registered.


A 6,000-gallon ethanol tank at the IBRF on the STM campus.
*Photo by Larry Durbin, NREL 24477*

### 2012 COMPLIANCE SUMMARY AND ACTIVITIES

NREL maintained two ASTs at the STM facility during 2011 which were required to be registered, including a 6000g ethanol tank at the IBRF and an 800g diesel tank for an emergency generator at the SERF. Both of these ASTs have been in use at NREL for a number of years and comply with Colorado and EPA requirements. There are no ASTs at the NWTC which are required to be permitted or registered. It is anticipated that one or more additional ASTs requiring permitting and registration will be installed in 2012.

- All program activities were in compliance with requirements.
- No spills or releases from NREL's ASTs or related fueling activities occurred.
- Two AST installation permits were obtained.

## 8.4 SPILL PREVENTION AND RESPONSE

Spills of chemicals, fuels, and oils can result in contamination to soil, surface water, and groundwater, potentially causing damage to ecosystems, wildlife habitat, and human health. Comprehensive planning using spill prevention, control, and countermeasures plans can reduce spills and limit impacts when spills do occur.

The laboratory prepares for and continually improves spill response. Formal SPCC plans have been developed for three facilities. The plans are designed to minimize the number and size of spills, and speed the control and cleanup of spilled materials. Formal emergency notification and hazardous materials procedures are in place to provide additional support for spill response. Proper preventive planning and training minimizes the potential for spills, and advance preparation for spill response enhances the protection of our local water and ecological resources.

## PROGRAM MANAGEMENT

SPCC plans are required by the EPA and Colorado regulations for facilities that meet certain oil storage criteria. Federal regulations 40 CFR 110, regarding Discharge of Oil, and 40 CFR 112, regarding Oil Pollution Prevention, are implemented by the EPA. The CDLE implements the DOPS Storage Tank Regulations 7 C.C.R. 1101-14. In general, facilities that store more than 1,320 gallons of oil and have the potential for a spill to enter a water of the United States must have an SPCC plan. SPCC regulations require that any equipment or containers with the capacity to store 55 gallons or more of oil be included in the plan. The plan must address such items as:

- Topography and location of waterways
- Location and quantity of oil sources
- Possible transport mechanisms and pathway
- Spill scenarios and potential spill volumes
- Spill prevention and response training
- Spill notification procedures and contact information
- Emergency response plans.

### 2012 Highlights and Achievements

- Updated the SPCC plans for the STM and NWTC sites, including changes to equipment and oil volume inventory.
- More than 30 employees who manage and operate oil-containing equipment received an annual SPCC refresher training.
- Emergency notification and hazardous materials event notification procedures were updated to include a "short form" contact list in print and on flash drive to improve the portability of and access to spill response resources and contacts.

Due to the quantity of fuels stored on the STM, NWTC, and ReFUEL sites, an SPCC plan is required for each of these locations. NREL's SPCC plans are updated every three years, or whenever there is a significant change in regulations, operations, or equipment that renders the plan incomplete or inaccurate. This aggressive approach to spill prevention and control exceeds the EPA's requirement that SPCC plans be updated at least every five years.

NREL maintains an effective notification and spill reporting program and follows the procedures in the respective SPCC plans for spills that might occur at any facility. Spill response carts and caches are maintained at multiple locations, allowing response and cleanup activities to occur quickly. Given the potential for spill of hydraulic fluids and fuels at construction sites, construction contractors are also required to implement controls through Stormwater Pollution Prevention Plans for each major construction site on campus (see section 7.3 Surface Water).

SPCC training occurs annually for individuals who are responsible for AST operation and maintenance, fuel, or other liquid transfer activities, and emergency response to AST spills. This training is combined with training for AST operation and maintenance. This combined training educates staff on the inventory of oil-containing equipment at each site, discusses inspection and response requirements, reviews the oil spill history of each site and discusses lessons learned, and covers recent changes to rules and regulations.

Initial response to a vehicle fuel spill at the east entrance of the STM site. *Photo by Kurt Schlomberg, NREL 24485*

While in a given year the laboratory typically does not experience spills that require notification to the state, small incidental spills do occur on occasion. These are small,

incidental hydraulic system leaks, lubricant leaks, and fuel transfer spills during normal construction and maintenance activities and vehicle use. To assess the frequency of spill occurrences, a log of spills and clean-up responses is maintained. This record demonstrates that spills are generally small and infrequent, and the responses are adequate to prevent the spread of contamination. Lessons learned from the clean-up activities help improve future contingency planning.

### 2012 COMPLIANCE SUMMARY AND ACTIVITIES

- All program activities were in compliance with requirements.
- SPCC plans for the STM and NWTC sites were revised to address changes to equipment and oil inventories.
- One spill at the NWTC required reporting. An open valve located within the elevated nacelle of a wind turbine leaked approximately 90 gallons of synthetic lubricant oil in February 2012. No waterway contamination occurred and the spill was remediated.
- In addition, 30 minor spills of diesel, lubricant, and hydraulic fluids at the STM site, and one at the NWTC, occurred. The size of spills ranged from less than 0.1 gallon to 15 gallons. These spills totaled approximately 50 gallons at the STM and 1 gallon at the NWTC. Each spill received immediate remedial action and did not result in any significant impact to the environment. The majority of these spills were construction related.

## 8.5 POLLUTION PREVENTION

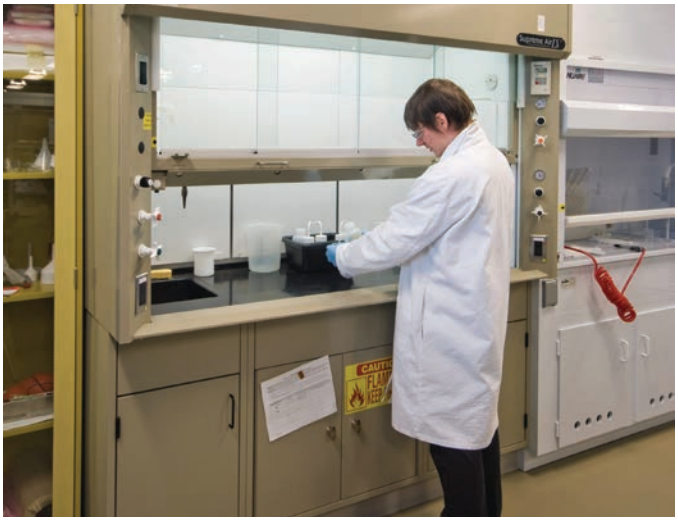
NREL actively seeks opportunities to prevent pollution, going above and beyond compliance requirements to reduce potential impacts to our environment. Pollution prevention can come in many forms and can reduce impacts from activities such as: using and storing fuel, petroleum products, and chemicals; laboratory chemical use; purchasing, recycling, and composting; employee commuting and travel; energy and water use; and building design and construction.

Examples of positive impacts of reducing pollution from NREL's activities include:

- Replacing toxic chemicals with safer alternatives where possible, reducing potential exposure to employees, the public, and local ecosystems
- Choosing bio-based and recycled-content products, reducing upstream impacts on natural systems
- Encouraging employees to telecommute, take alternative transportation, and supporting Web-based meetings, reducing traffic, air pollution, and health effects on surrounding communities
- Using sustainable, low-energy and low-water use designs for buildings, reducing GHG emissions and use of Colorado's limited water supplies.

NREL has made a formal commitment to pollution prevention through its laboratory-wide environmental protection policy (see section 3 Environmental Management System). NREL fulfills this commitment by implementing a variety of controls to reduce the potential environmental impacts of laboratory operations.

While the majority of NREL's environmental management programs were established to meet compliance requirements, many of these programs go beyond compliance requirements, continually improving environmental performance.



A researcher using some solvents in a chemical fume hood in one of the S&TF labs on the STM campus. *Photo by Pat Corkery, NREL 15436*

## 2012 Highlights and Achievements

- NREL achieved an estimated reduction of 337,580 pounds of equivalent carbon dioxide ($CO_2$) emissions annually by switching from sulfur hexafluoride ($SF_6$) to nitrous oxide ($N_2O$) for all fume hood testing.

  Sulfur hexafluoride is the most potent of the six commonly accepted GHGs, with a global warming potential (GWP) 23,900 times that of $CO_2$ when compared over a 100-year period. Sulfur hexafluoride is also extremely long-lived, is inert in the troposphere and stratosphere, and has an estimated atmospheric lifetime of 800 to 3,200 years.

  Nitrous oxide has been proven as a successful alternative tracer gas for testing fume hoods. With a GWP of 310, $N_2O$ produces far fewer GHG emissions than $SF_6$. Conducting a fume hood test using $N_2O$ results in roughly 33,758 pounds less of $CO_2$ equivalent emissions per test due to its significantly lower GWP, and 77 times less $CO_2$ emissions than if $SF_6$ is used.

- Sustainable NREL continued the Pollution Prevention Initiative Program, providing staff with the opportunity to submit their ideas on the reduction of waste, materials, water, air emissions, and energy use. The project ideas submitted by staff are being evaluated for feasibility and further consideration.

Electronic equipment dropped off by NREL employees is recycled as part of a regular recycling event. *Photo by Dennis Schroeder, NREL 20541*

## PROGRAM MANAGEMENT

DOE Order 436.1, *Departmental Sustainability*, implements the objectives of EOs 13423, *Strengthening Federal Environmental, Energy, and Transportation Management*, and 13514, *Federal Leadership in Environmental, Energy, and Economic Performance*, which direct federal agencies to conserve natural resources, reduce energy use, develop renewable energy, reduce GHG emissions, and manage buildings and transportation in a sustainable manner. DOE Order 436.1 also requires that DOE facilities comply with the Pollution Prevention Act of 1990 and support pollution prevention.

NREL's hazard identification and control process helps staff regularly identify opportunities to prevent pollution, and formal pollution prevention assessments are conducted to identify opportunities to reduce pollution and improve program effectiveness. In addition, resources are dedicated for sustainable operations and pollution prevention through the Sustainable NREL program. The Pollution Prevention Initiative Program provides staff with an opportunity to identify and implement new pollution prevention practices at the laboratory. Staff also provide suggestions and assistance to reduce environmental impacts and prevent spills

## 2012 COMPLIANCE SUMMARY AND ACTIVITIES

While there is no requirement to conduct pollution prevention assessments, the laboratory periodically conducts these assessments to identify opportunities to reduce pollution, reduce costs, and improve internal processes.

## 8.6 RADIOLOGICAL MATERIALS AND WASTE MANAGEMENT

NREL is involved in a wide range of research activities, some of which occasionally include investigations using radioactive materials. NREL uses several x-ray diffraction analytical techniques and occasionally uses small quantities of radioisotopes for biological labeling in research. All of the materials used at the laboratory have very low activity levels and are used in extremely small amounts. Unlike many DOE facilities, NREL does not conduct work involving nuclear materials and does not have legacy radiological contamination issues associated with past nuclear weapons production and research.

NREL has established strict protocols for equipment containing sources or for the use of radioisotopes in laboratory experiments through its Radiation Safety program. Some of these controls include:

- Confining work with radioisotopes to a single laboratory
- Monitoring equipment and facilities for removable contamination where radioisotopes are used

- Inspecting x-ray equipment regularly
- Assuring that future users are not at risk for receiving contaminated materials—no equipment used onsite will be surplused until background levels of radiation present are achieved.

## 2012 Highlights and Achievements

- Limited experiments were conducted involving carbon-14, a low-level radioactive isotope. The majority of the waste generated was comprised of scintillation fluids and minimal solid laboratory debris. Sealed sources are also used in tritium exit signs, gauging devices, and monitoring equipment check sources.
- In accordance with DOE Order 458.1, *Radiation Protection of the Public and the Environment*, an environmental radiation protection program was developed to document procedures that demonstrate compliance with applicable requirements.

## PROGRAM MANAGEMENT

Radiation emissions are regulated under Section 112 of the Clean Air Act as implemented by 40 CFR 61, Subpart H, promulgated by the EPA. 40 CFR 61 established NESHAPs, and, more specifically, Subpart H, sets such standards for radiological materials, known as Rad NESHAPs.

DOE Order 458.1, *Radiation Protection of the Public and the Environment*, cancelled DOE Order 5400.5. This order establishes radiation emission limits for DOE facilities.

These facilities, including NREL, must annually demonstrate compliance with the Rad NESHAP, which limits emissions to amounts that would prevent any member of the public from receiving an effective dose equivalent of 10 millirem (mrem) per year or greater.

No radioactive air emission monitoring is conducted at the laboratory because of the extremely low usage of radioactive material. Therefore, NREL demonstrates compliance with the Rad NESHAPs in 40 CFR 61, Subpart H, by using the EPA's COMPLY computer model (version 1.6) 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 until disposal is arranged at an off-site facility permitted to accept low-level radioactive waste. Internal procedures prohibit the clearance of property unless it has been decontaminated to background levels.

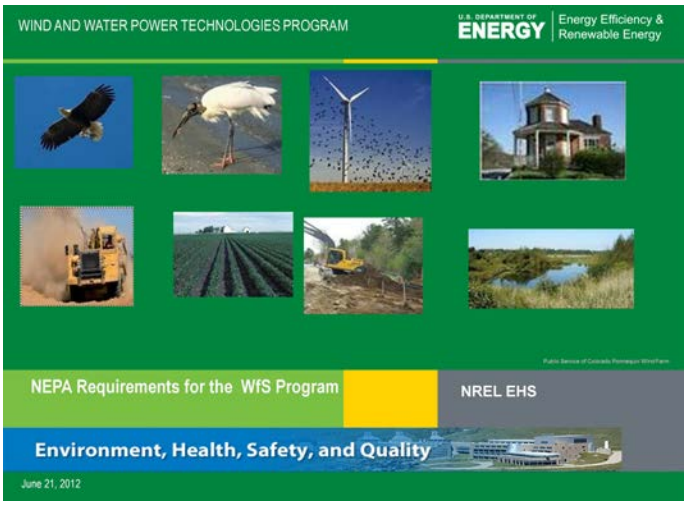
## 2012 COMPLIANCE SUMMARY AND ACTIVITIES

- All program activities were in compliance with requirements.
- The effective dose equivalent to the public from NREL activities was 0.035 mrem per year, far below the 10 mrem per year limit.
- Small quantities of low-level radioactive waste were generated and are currently in storage awaiting off-site disposal.
- No planned or unplanned radiological releases occurred.

# 9 National Environmental Policy Act

NREL's National Environmental Policy Act (NEPA) program provides a mechanism to consider potential environmental impacts in decision-making processes and promotes sustainable and environmentally responsible operations. Under the NEPA process (described below), staff conduct reviews of a wide range of activities prior to spending funds or commencing work.

A fawn rests beneath a solar panel at the NWTC. *Photo by Brenda Beatty, NREL 18234*




NREL staff provided a presentation to participants in NREL's national Wind for Schools program.

Examples of activities receiving a NEPA review include new or revised laboratory research, construction activities, cooperative research and development agreements (CRADAs) and other partnering arrangements, and feasibility studies or data analyses performed for other government agencies.

## 2012 Highlights and Achievements

- Provided extensive NEPA support in the preparation of proposals for DOE Funding Opportunity Announcements that support DOE's mission and the nation's energy objectives.
- Participated in outreach activities by discussing NEPA requirements and potential environmental impacts for participants in DOE's Wind for Schools program. Participants included representatives from several colleges and universities across the country who will in turn communicate environmental requirements and potential impacts to participating schools.

## PROGRAM MANAGEMENT

NEPA is a federal law that requires potential environmental impacts to be considered for activities with a federal connection, such as those using federal funds, property, facilities, equipment, and staff paid using federal funds. The Act requires that federal agencies integrate the NEPA process into their activities at the earliest possible time. Soon after NEPA was passed, the president's Council on Environmental Quality (CEQ) promulgated regulations (40 CFR Parts 1500-1508) implementing NEPA which are binding on all federal agencies. Subsequently, the U.S. Department of Energy (DOE) established NEPA Implementing Procedures (10 CFR 1021) which DOE (and NREL) use to comply with section 102(2) of the National Environmental Policy Act of 1969 [42 U.S.C. 4332(2)] and CEQ regulations for implementing the procedural provisions of NEPA (40 CFR parts 1500-1508). The DOE procedures supplement, and are to be used in conjunction with, CEQ regulations.

NREL has developed a NEPA procedure handbook to provide a mechanism to consider environmental factors in decision-making processes at the laboratory and to promote environmentally responsible decisions during project planning activities. The handbook provides NREL project managers and procurement specialists with guidance on implementing the NEPA procedures, and training is provided to staff, as appropriate.

The laboratory initiates NEPA reviews and supports the DOE Golden Service Center (DOE GSC) in making NEPA determinations before work begins. In accordance with DOE NEPA Implementing Procedures (10 CFR 1021), all NREL activities, other than routine office, laboratory, or research activities, must undergo a NEPA environmental review. The outcome of this review is considered the NEPA determination—a requirement before federal funds are expended, before a contract award can be made, and before project activities begin.

In most cases, proposed activities have either been evaluated in an existing site-wide Environmental Assessment (EA) or supplement or fall under a Categorical Exclusion (CX). A CX applies to activities that, based on agency experience, normally have no significant individual or cumulative effect on the quality of the human environment. Examples of DOE CXs include information gathering, data analysis, feasibility studies, bench-scale research and development, and minor interior modifications. The NEPA review is initiated by preparing either a NEPA worksheet or checklist.

## Worksheets

For activities where the potential for environmental impact does not exist, or for types of activities that have been previously analyzed in existing NREL site-wide NEPA documents, a NEPA worksheet is completed. The NEPA worksheet is a simple one-page form that lists the proposed project and documents the appropriate CX, NREL EA, or supplement that addresses the proposed work. Allowable types of projects include office work such as computer modeling or programming, data analysis, or preparation of educational materials; routine maintenance activities; minor interior modification of existing facilities; and bench-scale research and testing in an existing facility. For projects recorded on NEPA worksheets, the work can go forward upon receipt and review of the project information by NREL's Environment, Health, and Safety Office.

Lindsay Ranch with the National Wind Technology Center in the background. *Photo by Tom Ryon, NREL 24474*

## Checklists

For proposed projects where there is a potential for environmental impacts, a NEPA checklist is completed. The information included on the checklist helps the NEPA reviewer evaluate the potential environmental impacts of the project (e.g., use of hazardous materials; generation of hazardous waste or air emissions; ground disturbing activities; presence of floodplains, wetlands, endangered species, or critical habitats; potential for noise and visual impacts; etc.), and documents measures taken to avoid or minimize those impacts. Projects such as on-site construction, pilot-scale research and testing, installation of meteorological towers for wind resource assessments, and prototype deployment of renewable energy technologies are examples of projects that are typically reviewed using the NEPA checklist.

For a project recorded on a NEPA checklist, work may not commence until the DOE GSC has reviewed the submittal and provided a signed NEPA determination by a DOE NEPA Compliance Officer. The DOE GSC may include provisional language in the NEPA determination, which may limit the type of work that can be done until additional information is received, or which may specify the kind of mitigation actions that must be taken to avoid impacts.

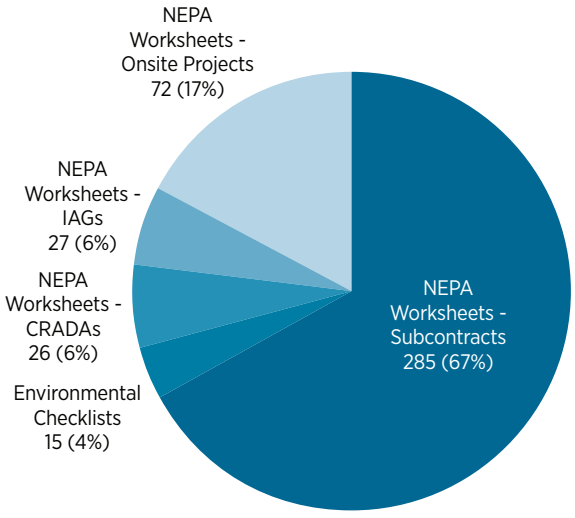
## Environmental Assessment

If the proposed action is not included in the description provided in the CXs established by DOE, or there are extraordinary circumstances (such as potential effects to environmentally sensitive areas or resources and public controversy), or the proposed action fits within a category of actions that DOE has determined to typically require an EA, then an EA must be prepared. The purpose of an EA is to determine the significance of the environmental effects and to look at alternative means to achieve the agency's objectives. An EA is prepared for classes of activities such as siting, construction, and operation of energy system demonstration actions including wind resource, hydropower, geothermal, biomass, and solar energy projects and operations. An EA provides sufficient evidence and analysis for determining whether to prepare an environmental impact statement (EIS). The EA provides an opportunity for public review and comment, and demonstrates compliance with NEPA when no EIS is necessary (i.e., it helps to identify better alternatives and mitigation measures). The EA also facilitates preparation of an EIS when one is necessary.

An EA provides a brief discussion of the need for the proposal, alternatives to the proposal, the proposed action, the environmental impacts of the proposed action and alternatives, and a list of agencies and persons consulted. The EA process concludes with either a Finding of No Significant Impact (FONSI) or a determination to proceed to preparation of an EIS. The FONSI documents the reasons why it has been concluded that there are no significant environmental impacts that would occur if the project or activities were implemented. The EA and FONSI can include mitigation measures or alternatives that would be desirable to consider and adopt even though the impacts of the proposal will not be "significant." Preparation of an EA requires a public review and comment period after the draft EA is prepared; DOE must consider all comments in the Final EA and document in the EA how each comment was addressed.

### Environmental Impact Statement

An EIS provides a detailed analysis of projects that the proposing agency views as having significant prospective environmental impacts. The EIS provides a discussion of significant environmental impacts and reasonable alternatives (including a No Action alternative) which would avoid or minimize adverse impacts or enhance the quality of the human environment. An EIS is also made available for public review and comment. As a final step, a Record of Decision is prepared which states the decision, the alternatives considered, including the environmentally preferred alternative, and discusses mitigation plans, including any enforcement and monitoring commitments. It should be noted that no NREL activities have required an EIS to date.




Summary of NEPA reviews conducted during CY 2012, by category.

## 2012 COMPLIANCE SUMMARY AND ACTIVITIES

- All program activities were in compliance with requirements.
- Four hundred and twenty-five NEPA reviews were conducted for project activities on- and off-site during CY 2012. Of these, 15 NEPA checklists were completed for projects or activities with a potential for environmental impacts. For each of the 15, project funding and initiation of work was allowed to commence only after DOE reviewed the submittals and provided a signed NEPA determination which specified any needed mitigation actions required to avoid impacts. The remaining NEPA reviews in 2012 were completed using NEPA worksheets addressing 285 subcontracting activities, 26 CRADA partnerships, 27 interagency agreements (IGAs) with other federal agencies, and 72 on-site projects.
- DOE revised its NEPA Implementing Procedures in 2011, including a modification of its list of categorical exclusions. To comply with these changes, NREL updated its NEPA procedures to include an updated list of CXs and to include additional CXs that can be selected on the NEPA worksheet.
- A site-wide EA was initiated for proposed continued and enhanced operations at the National Wind Technology Center and a supplemental EA for the RFHP was finalized in April 2012.

# 10 Natural and Cultural Resources Protection

NREL is committed to responsible stewardship of our natural ecosystems, native wildlife and vegetation, and important cultural resources. Natural resources at the South Table Mountain (STM) and National Wind Technology Center (NWTC) facilities are managed appropriately to ensure the laboratory's research needs are met while protecting native wildlife and vegetation. Responsible management not only benefits our environment, but also NREL employees and the surrounding community, and demonstrates the laboratory's leadership in the U.S. Department of Energy (DOE) and federal government as a whole. Management focuses on these key areas:

- Wildlife management
- Endangered species and species of concern
- Vegetation management
- Wetlands and floodplains
- Cultural resources
- Conservation easement lands.

## 10.1 WILDLIFE MANAGEMENT

The Wildlife Management Program promotes responsible wildlife and habitat management, and gathers information to better consider impacts to wildlife when implementing projects onsite. NREL is committed to responsible land stewardship and the proper management of wildlife populations into the future. Many surrounding landowners, including residential neighborhoods and Jefferson County Open Space, value the benefits of maintaining wildlife habitat and opportunities to observe wildlife. Proper wildlife management provides an important benefit to our community.

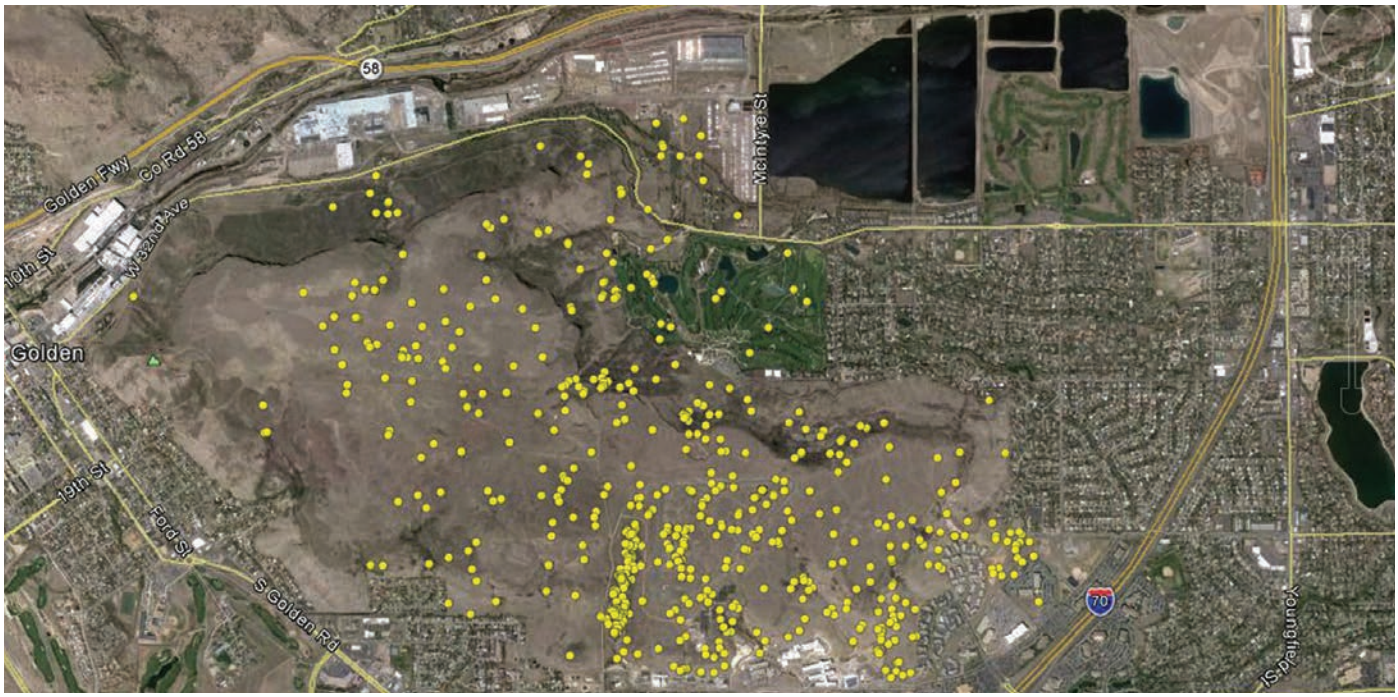
Elk just west of the STM campus on South Table Mountain. *Photo by Steve Wilcox, NREL 23860*

NREL biologists work with project managers and decision-makers as part of an integrated project team on construction projects to minimize impacts to wildlife and maintain habitat by avoiding sensitive areas and reclaiming lands once disturbance is complete.

A long-term objective is to maintain wildlife movement through the STM site by retaining linkages between the open space areas north of the site and Pleasant View Community Park, and Lena Gulch to the south. At the

### 2012 Highlights and Achievements

- NREL biologists partnered with the U.S. Department of Agriculture and the Colorado Division of Parks and Wildlife to trap and collar an adult male coyote (*Canis latrans*) in May 2012. This effort was part of a larger study to observe the behaviors of urban coyotes and develop management strategies to avoid or reduce harmful human-coyote interactions in the Denver metropolitan area. The collar was recovered in January 2013 and provided regular GPS points for the previous six months. A map of the GPS points is presented here. The collared coyote primarily stayed on top of South Table Mountain and used adjacent ravines. The coyote frequented the ravine adjacent to the mesa top access road just west of the STM site and infrequently visited the STM site via the middle drainage, crossing south through the site to Lena Gulch.
- Several bee swarms were found on campus. Two swarms naturally moved offsite, but a third, which settled into a building cavity to construct a new hive, was safely relocated by a professional beekeeper.
- Numerous rattlesnakes that posed a hazard to workers were relocated to nearby habitat on NREL sites.




Tracking of a collared coyote shows areas visited at South Table Mountain, including the NREL STM campus, over a six month period.

NWTC, ecologically sensitive areas are preserved within the site and linkages with surrounding open space areas are maintained. At both sites, periodic monitoring using wildlife surveys informs responsible management.

When control of pest wildlife species is necessary, a graded approach is used to humanely eradicate pests and minimize other potential impacts. Building design features and administrative controls are the first line of defense against pests. When these are not fully effective, additional controls are used. Pests are relocated whenever possible. When pests must be destroyed, mechanical methods are preferred over poisoning. When necessary, pesticides are selected to minimize secondary impacts.

## PROGRAM MANAGEMENT

Several federal laws, an executive order, and a Colorado statute comprise the regulatory framework for NREL's Wildlife Management Program.

The Migratory Bird Treaty Act (MBTA) of 1918 (16 U.S.C. 703-712; Ch. 128; July 13, 1918; 40 Stat. 755) is the main driver for protecting migratory birds in the United States. In the biological sense, a migratory bird is a bird that has a seasonal and somewhat predictable pattern of movement. Generally, this includes all native birds in the United States, except those non-migratory species such as quail and turkey that are managed by individual states as game species.

Under the MBTA, it is unlawful "by any means or manner to pursue, hunt, take, capture [or] kill" any migratory birds except as permitted by regulations issued by the U. S. Fish and Wildlife Service (USFWS). The term "take" is not defined in the MBTA, but the USFWS has defined it by regulation to mean to "pursue, hunt, shoot, wound, kill, trap, capture, or collect" any migratory bird or any part, nest or egg of any migratory bird covered by the conventions, or to attempt those activities.

The USFWS has developed a system of permits for activities that involve the take of migratory birds, including those governing scientific collection and bird banding, and lethal and non-lethal measures taken to prevent depredation of

Black-capped chickadee. *Photo by Bob Fiehweg, NREL 24479*

agricultural crops and to protect public health and safety. Existing migratory bird permit regulations authorize take for specific types of activities, such as collecting birds for scientific or educational purposes, or lethal control of birds damaging agricultural crops or other personal property. The USFWS does not authorize take resulting from activities such as forestry or agricultural operations, construction, or operation of power lines, and other activities where an otherwise legal action might reasonably be expected to take migratory birds, but is not the intended purpose of the action. Therefore, NREL property managers do not have a permitting option for their activities unless for scientific, educational, or property damage. Construction activities do not have permitting options.

In response to Executive Order (EO) 13186, *Responsibilities of Federal Agencies to Protect Migratory Birds*, the USFWS issued guidance identifying goals for federal program activities. The USFWS highlighted the need to identify means and measures to avoid and/or minimize potential for take of migratory birds, eggs, and active nests, including but not limited to:

- Project modification
- Time-of-year restrictions on vegetation clearing
- Avoidance of cavity trees, colonial bird nests, and other active nests
- Avoidance of nests of species of concern.

The USFWS also works to ensure that environmental analyses of federal activities under the NEPA or other established environmental review processes evaluate the effects of actions and agency plans on migratory birds, particularly on species of concern.

A doe with her days-old fawn at the STM site. *Photo by Dennis Schroeder, NREL 21043*

Wildlife is considered a state resource under Colorado law. Under Colorado Revised Statute 33-6-128: Damage or Destruction of Dens or Nests—Harassment of Wildlife, no wildlife dens or nests, young, or eggs may be damaged or destroyed unless permitted by the Colorado Division of Parks and Wildlife. It is unlawful for any person to willfully harass wildlife. This statute gives district wildlife managers the power to ticket offenders and enforce a similar provision to the MBTA and to protect mammalian wildlife species.

On August 1, 2006, a Memorandum of Understanding (MOU) was finalized between the USFWS and DOE regarding the protection of migratory birds. Under the MOU, DOE agrees to integrate migratory bird conservation principles, measures, and practices into agency activities, and avoid or minimize, to the extent practicable, adverse impacts on migratory bird resources and their habitats.

NREL's Wildlife Management Program was developed to implement measures to allow the laboratory to meet or exceed the regulatory requirements discussed and to minimize or avoid impacts to wildlife species and their habitats while achieving NREL's mission. Several activities occur periodically to achieve the program's intent:

- Monitoring
  - Prior to ground or vegetation disturbing activities conducted between March 15 and September 15, NREL biologists conduct a nesting bird survey. If nests are found, the area is closed with a proper buffer area until nestlings fledge.
  - Periodic surveys are conducted on a site-wide basis to document biological conditions at NREL facilities.
- Research Studies
  - Periodically, research studies are conducted to better understand the potential impacts of projects or site management.
- Vegetation Management
  - Areas that may be impacted by outdoor activities are surveyed and then mowed to reduce vegetative cover, discouraging bird nesting in that area.
- Project Reviews
  - Biologists conduct project reviews to assess potential impacts to avian species including consideration of window glazings to reduce bird collisions and timing construction activities to start before or after the nesting season.

Windows at the parking garage use fritted glass to prevent bird collisions. *Photo by Dennis Schroeder, NREL 22479*

- Coordination
  - Biologists coordinate with local, state, and federal agencies to improve wildlife management where possible.

These activities are conducted in concert with surveys for threatened and endangered species and habitats (see section 10.2 Endangered Species and Species of Concern). Because habitat is as much of a concern as the wildlife species themselves, program activities often overlap with vegetation management.

### Avian Use and Avian and Bat Mortality Surveys at the NWTC

To identify species or species groups that may be at risk from NWTC operations and development, NREL completed a year-long survey in 2011 to document avian use and to document bird and bat mortalities. Avian-use surveys included breeding bird surveys during the spring and summer, raptor migration surveys during the spring, and weekly avian site-use surveys (including raptors and non-raptors) over the entire year. Avian and bat mortality surveys were also conducted weekly over the entire year. In addition, wildlife surveys, including bat surveys were conducted during 2010 and 2011. Results from these surveys were discussed in the 2011 Environmental Performance Report: http://www.nrel.gov/docs/fy12osti/54980.pdf.

## 2012 COMPLIANCE SUMMARY AND ACTIVITIES

- All program activities were in compliance with requirements.
- Bird-friendly glass windows were installed on the laboratory's new STM parking garage which opened in 2012. The glass in this structure is patterned with a 50% frit that appears etched but still allows for visibility. This special glass was installed on critical areas of glass breeze-ways and stairwells. This design reduces the potential for bird collisions, lessening impacts on migratory birds.
- Monitoring of mammalian predators at the STM and NTWC and bat monitoring at the NWTC began in 2012. Two motion detection cameras were installed at each campus and bat call monitoring equipment was installed at the NWTC.

STM motion detection cameras confirmed track identifications during 2010-2011 baseline surveys: red fox (*Vulpes vulpes*), coyote, and striped skunk (*Mephitis mephitis*). Laboratory staff at the STM site reported several species in 2012 that hadn't been recorded in the last baseline survey including: great-horned owl (*Bubo virginianus*), black-capped chickadee (*Poecile atricapillus*), raccoon (*Procyon lotor*), western chorus frogs *(Pseudacris triseriata*), and elk (*Cervus canadensis*).

Bobcat at the NWTC caught with a motion-detection sensor and camera. *Photo by Tom Ryon, NREL 24504*

NWTC motion detection cameras recorded two mammalian predators, coyote and bobcat (*Felis rufus*), and one avian predator species, the great-horned owl.

Bat acoustic monitoring documented five species of bats over a 4-month period (March to April and September to October):

- Big brown bat (*Eptesicus fuscus*)
- Silver-haired bat (*Lasionycteris noctivagans*)
- Hoary bat (*Lasiurus cinereus*)
- Eastern red bat (*Lasiurus borealis*)
- Brazilian free-tailed bat (*Tadarida brasiliensis*).

## 10.2 ENDANGERED SPECIES AND SPECIES OF CONCERN

NREL manages its research- and facility-related activities to preserve and protect environmental quality and strives to practice good land stewardship at its facilities. The laboratory is committed to the protection of imperiled wildlife species and monitors for these species at its two main research sites: the STM and the NWTC.

Periodically, surveys are conducted for declining wildlife species and rare plants, including species that are federally or state protected, or otherwise considered imperiled or declining. Biologists also survey for potential habitat for these species. Should potential habitat be found, more targeted surveys may be conducted. These surveys identify the presence or absence of rare species or their habitats and aid in siting and planning new projects. While no protected or declining species have been detected at an NREL facility, appropriate steps would be taken should such a species be found.

### PROGRAM MANAGEMENT

The Endangered Species Act (ESA; 16 U.S.C. §1531-1544 as amended) provides for the designation and protection of wildlife, fish, and plant species that are in danger of extinction, and preserves the habitats on which these species depend. Federal agencies are required to abide by the ESA and ensure that their actions do not adversely affect species that are federally listed under the ESA as threatened, endangered, or candidate species.

### 2012 Highlights and Achievements

NREL monitored the USFWS listing of species as threatened, endangered, and candidates for listing. In 2012, the USFWS added the wolverine as a candidate for listing. While it is unlikely that NREL would have impacts affecting this sub-alpine animal, if the wolverine is listed as threatened, the laboratory may need to assess potential impacts of its activities on the species.

Bald eagles nest along Coal Creek and at Standley Lake north of the STM and are occasionally seen on lands adjacent to the NWTC. Sightings of eagles on the STM site or at the NWTC are very infrequent. *Photo by Tom Ryon, NREL 24481*

Additional federal and state laws and regulations protect wildlife, such as the Bald and Golden Eagle Protection Act. The Colorado Division of Parks and Wildlife identifies a list of endangered, threatened, and wildlife species of concern for Colorado. Furthermore, the Colorado Natural Heritage Program (CNHP) has a list of rare species that, while not regulatory in nature, is useful as it is the only designation besides the ESA that considers rare plants. The list of threatened, endangered, candidate species and species of concern (i.e., bald and golden eagles, state listed species, CNHP species) are all considered imperiled species and can be referred to as a group known as "Threatened, Endangered, or Species of Concern" species.

The USFWS lists nine species in accordance with the ESA as threatened, endangered, or a candidate for listing that could potentially occur in Jefferson and Boulder Counties combined. Of these species, several have the potential to occur on the STM or the NWTC sites, including the Preble's meadow jumping mouse, the Ute ladies' tresses orchid, and the Colorado butterfly plant. Periodic surveys are conducted for these three species to document their presence or absence on the STM or NWTC sites. While the Preble's meadow jumping mouse does not occur onsite, the USFWS mapped critical Preble's habitat within the upper reaches of Rock Creek, including a small area at the southeast corner of the NWTC. This area may not be disturbed without coordination with the USFWS.

NREL also considers other plant and animal species that may be state listed or generally in decline. Current information is obtained from both the Colorado Division of Parks and Wildlife and the CNHP. These two entities work together to track declining species and habitats throughout Colorado. Although not required by federal regulation, periodic

surveys are conducted for species that may occur at NREL sites, typically, every five years when baseline vegetation and wildlife studies are conducted. These baseline surveys are a vital part of NREL's NEPA program where impacts to natural resources from mission activities are assessed.

### 2012 COMPLIANCE SUMMARY AND ACTIVITIES

All program activities were in compliance with requirements.

## 10.3 VEGETATION MANAGEMENT

Native plants have evolved over long periods of time in harmony with the local climate and surrounding soil, growing in association with microorganisms and resident wildlife to create bio-diverse ecosystems. Through this evolution, native plants have developed defenses against pests and diseases specific to their locale. When non-native plants are introduced into an environment, they often overcome indigenous plants, attracting new types of pests and diseases, outcompeting native plants for nutrients and water, while also sometimes depriving wildlife of nutrients and shelter. Plants such as kochia (*Bassia scoparia*), Canada thistle (*Cirsium arvense*), Russian olive (*Elaeagnus angustifolia*), diffuse knapweed (Centaurea diffusa), dalmation toadflax (*Linaria vulgaris*), and myrtle spurge (*Euphorbia myrsinites*) are examples of non-native plants that can have destructive effects on natural habitats.

### 2012 Highlights and Achievements

- Based on lessons learned from previous re-vegetation efforts, landscaping plans for current construction projects were adjusted to optimize plant establishment, withstand difficult shading and snow conditions, and deter animal browsing while providing wildlife habitat (i.e., spaces for nesting birds, plants for pollinators such as hummingbirds, and protective cover for other species).
- A "snow push map" was developed to ensure that snow and deicer materials would be pushed to areas where on-site vegetation would not be adversely impacted.
- A weed identification handbook was prepared to assist maintenance personnel in identifying weeds to be hand-pulled from newly landscaped areas.
- To assist vegetation management activities at STM, a site-wide map was created showing current vegetation management status including recently seeded or landscaped areas, areas still under warranty with contractors for restoration, areas of weed infestation requiring control, and areas with established native vegetation.
- Identified areas where vegetation should be regularly mowed to reduce the risk of wildfire near buildings.

Mariposa lily (*Calochortus gunnisonii)* in the xeric mixed grassland at the NWTC. *Photo by Brenda Beatty, NREL 24475*

For these reasons, the focus of NREL's approach to vegetation management is:

- Conserve existing ecosystems in their natural state as much as possible
- Strive to replace disturbed vegetation with native species, or with adapted, but non-invasive species when necessary
- Implement a program of weed management to prevent the spread of noxious weeds and implement measures to control these species
- Implement a sustainable landscape design and maintenance program.

Approximately 60 acres of land within the NWTC site boundaries are managed as a conservation area. This includes on-site seeps and ephemeral drainages and ponds, native grassland habitat, and remnant tallgrass prairie. The purpose of conserving these areas is to avoid development to protect the site's natural resources.

Where removal of native vegetation cannot be avoided, reseeding is done using grass and forb seed mixes native

to the local area. A palette of native flowering plants, shrubs, and trees has been identified for use on both the STM and NWTC campuses to enhance ecosystem diversity and integrity. NREL staff continually evaluate and modify re-vegetation techniques as needed to promote healthy plant establishment.

To maintain the existing native vegetation and to ensure the success of re-vegetated areas, the laboratory has developed sustainable landscape management practices to:

- Minimize water use
- Reduce the need for pesticides and fertilizers
- Reduce maintenance costs
- Maximize ground cover to reduce soil erosion
- Establish a variety of habitats to support diverse wildlife
- Create an aesthetically pleasing landscape environment.

NWTC "flower show." *Photo by Bob iehweg, NREL 24473*

During construction of the Research Support Facility (RSF), NREL participated in the Sustainable Sites Initiative (SITES) two-year pilot program, a partnership of the American Society of Landscape Architects, the Lady Bird Johnson Wildflower Center at the University of Texas at Austin, and the United States Botanic Garden, along with a diverse group of other stakeholders. The purpose of this program is to develop the first national rating system for sustainable landscapes. While a green building rating system (LEED certification) for new and existing buildings currently exists, there is no similar rating system for landscaped environments.

RSF landscaping was designed and installed with sustainability in mind, and includes features such as native plantings, xeriscape principles appropriate for arid climates, and infiltration of stormwater to provide water and nutrients. The landscaping was designed so that the RSF would give the impression of "rising out of the prairie" instead of being a structure on the landscape.

NREL uses an integrated weed management approach that incorporates various types of weed control methods including mechanical practices (e.g., mowing or hand pulling), 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. The weed control program maintains the flexibility needed to respond to changes in weed populations from year to year. Periodic mapping of weed infestation areas assists in targeting weed control efforts.

NREL continues to refine and optimize this program with interdisciplinary participation, bringing together the expertise of biologists, landscape architects, water quality specialists, and maintenance staff.

Bee balm (*Monarda fistulosa*) at the NWTC. *Photo by Brenda Beatty, NREL 24476*

## PROGRAM MANAGEMENT

The Vegetation Management Program meets the requirements of EO 13112, *Invasive Species*, and the Colorado Noxious Weed Act, which require the control of invasive weeds.

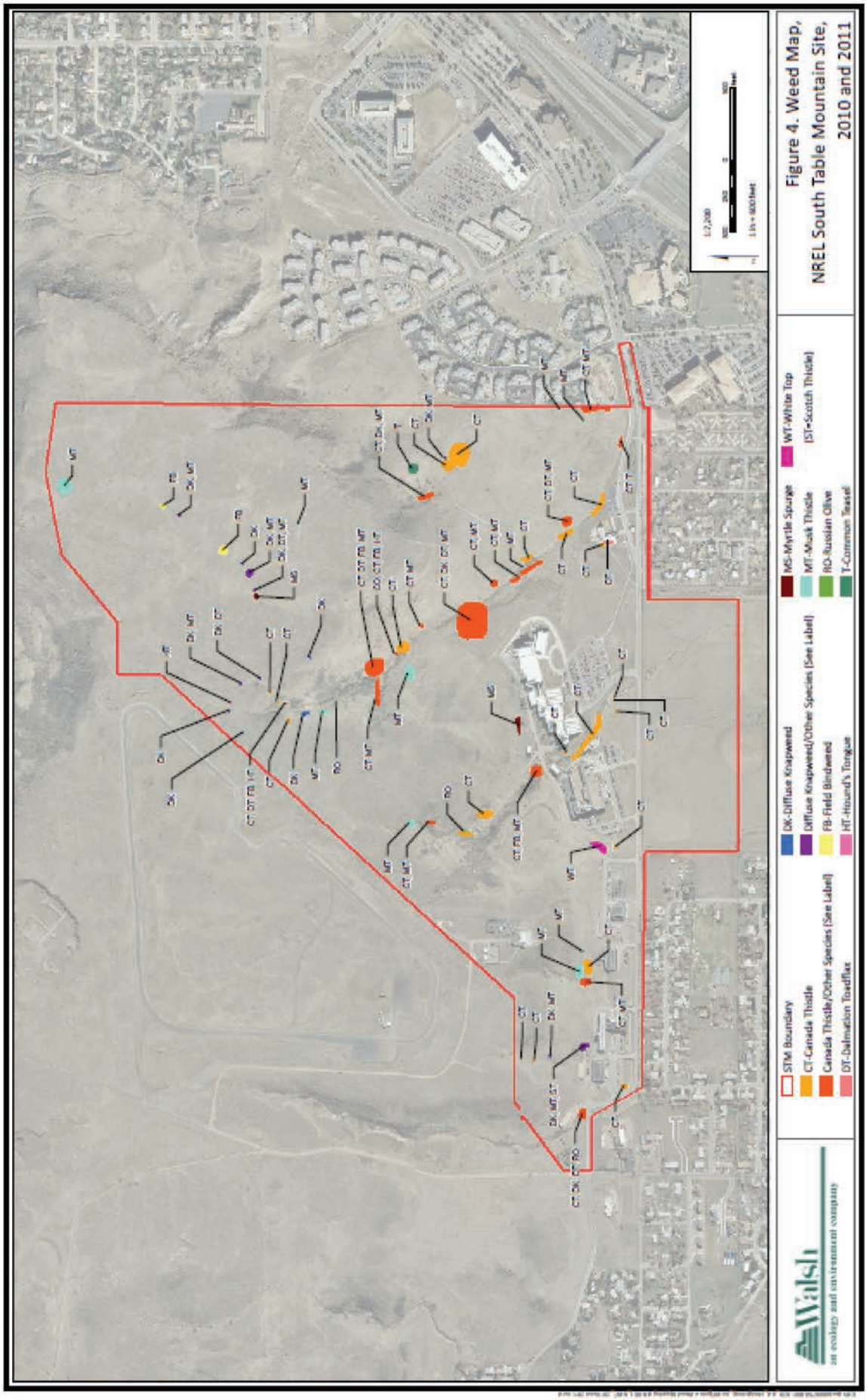
In Colorado, the Department of Agriculture Commissioner, in consultation with the state noxious weed advisory committee, local governments, and other interested parties, develops and implements noxious weed management plans for three categories of weed species:

- Class A species are targeted for eradication
- Class B species are subject to management plans designed to stop the continued spread of these species

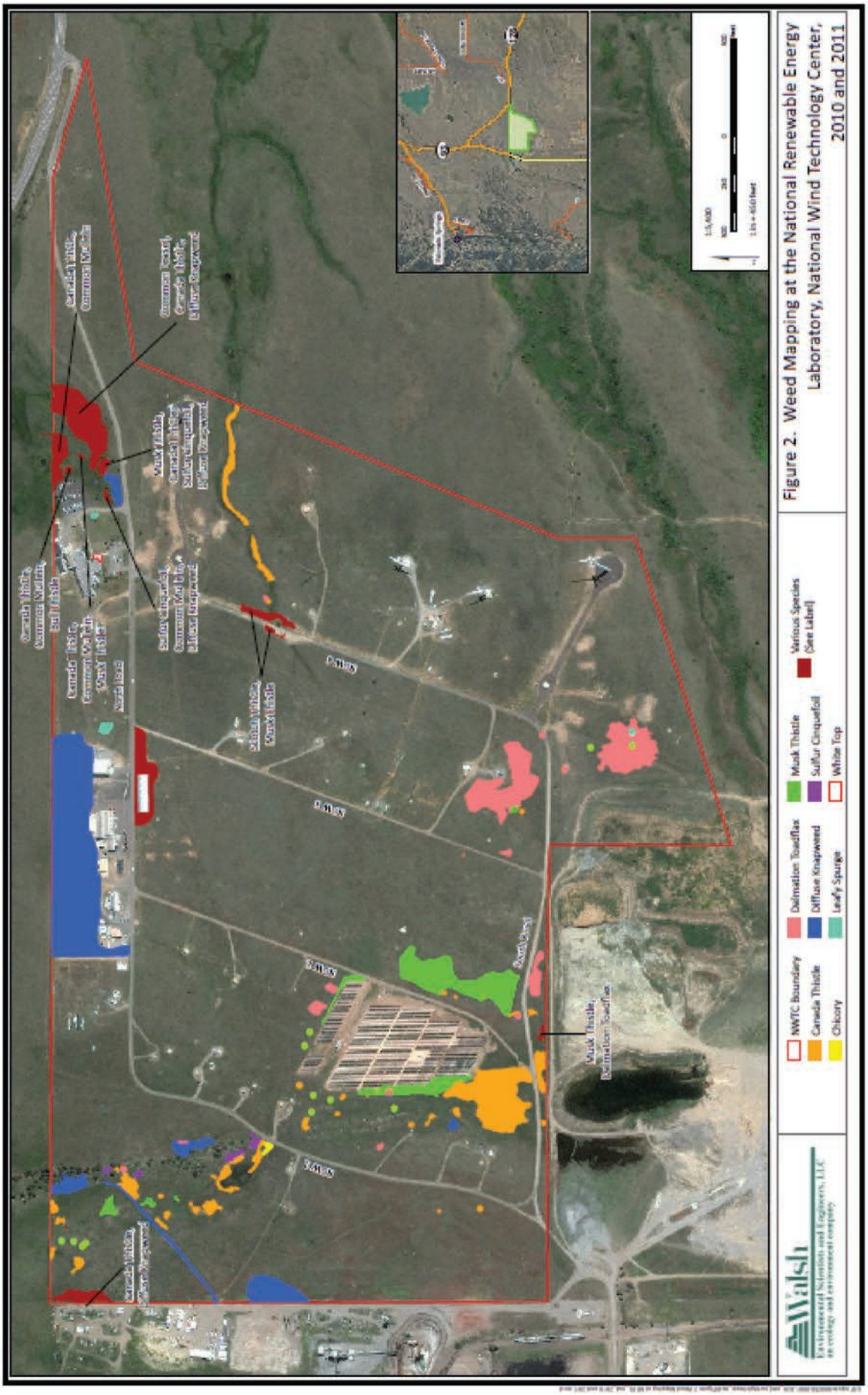
- Class C-listed species are managed by local governments, at their discretion. If they do choose to manage them, the state provides funding for certain programs.

The laboratory continues to address the control of these species using the integrated weed management approach described above. The weed maps below show the results of recent weed surveys at the STM and NWTC sites. These surveys are used to inform management and control of weeds at the sites and are conducted periodically (about every five years) to identify weed outbreaks.

The laboratory continues to address the control of these species using the integrated weed management approach described above. The weed maps below show the results of recent weed surveys at STM and the NWTC. These surveys are used to inform management and control of weeds at the sites. The table below lists noxious weed species at the STM and NWTC.




Weed survey results at the STM.




Weed survey results at the NWTC.

| NOXIOUS WEED SPECIES IDENTIFIED AT THE STM AND THE NWTC | | |
|---|---|---|
| Noxious Weed Class | Species Present at STM | Species Present at NWTC |
| Class A: | Myrtle spurge | None |
| Class B: | Canada thistle<br>Common teasel<br>Dalmation toadflax<br>Diffuse knapweed<br>Hoary cress (whitetop)<br>Hound's tongue<br>Musk thistle<br>Russian olive<br>Scotch thistle | Canada thistle<br>Chicory<br>Dalmation toadflax<br>Diffuse knapweed<br>Hoary cress (whitetop)<br>Leafy spurge<br>Musk thistle<br>Sulfur cinquefoil |
| Class C: | Field bindweed<br>Cheatgrass | Field bindweed<br>Cheatgrass |

### STM

No rare or imperiled plant species have been found at the STM site in recent surveys. Areas of mixed foothills shrublands (also called tall upland shrubland) have been identified at the STM site on top of the mesa within NREL's conservation easement area. This natural community is listed as rare and imperiled by the CNHP. No development will occur in the conservation easement area.

### NWTC

No rare or imperiled plant species were found on the NWTC site. However, the survey identified a small area of remnant tallgrass prairie (lumped in with xeric mixed grassland in the survey) located northeast of the SunEdison solar array. This natural community is listed as rare and imperiled by the CNHP. 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, and was specifically protected during construction activities associated with the installation of an eight-acre photovoltaic array.

For information on rare and imperiled plant species, see section 10.2 Endangered Species and Species of Concern.

The Federal Insecticide, Fungicide, and Rodenticide Act regulates the use, storage, and disposal of herbicides and pesticides. For application of certain types of herbicides designated as "restricted-use" by the EPA, a person with a certified applicator license must be used. Application of restricted-use herbicides is conducted in accordance with the regulation. NREL currently uses contractors for this type of application.

### 2012 COMPLIANCE SUMMARY AND ACTIVITIES

- All program activities were in compliance with requirements.
- The application of restricted-use herbicides was conducted using certified applicators. This included treatment at the NWTC of approximately 200 acres in May and 82 acres in September, and at the STM site of approximately 23 acres in June and six acres in September. After several years of aggressive management, knapweed is nearly under control at the NWTC and Canada thistle, hounds tongue, and myrtle spurge are under control at the STM site.
- Contractors and NREL workers doing landscape maintenance are required to compost landscaping waste, including weeds, to reduce the waste stream and to reduce the propagation of listed weeds.

## 10.4 WETLANDS AND FLOODPLAINS

Floodplains are land areas adjacent to rivers and streams that are subject to recurring inundation. Wetlands are lands that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support distinct soil types and plant communities. Wetland areas typically take the form of swamps, marshes, bogs and groundwater seeps and are frequently located within or adjacent to a floodplain.

Both wetlands and floodplains play a key role in providing floodwater storage, reducing flood flow rate, and filtering floodwater. The resulting enriched floodplain soils promote the growth of wetland and riparian vegetation that provide

Lena Gulch just south of the STM campus. *Photo by Tom Ryon, NREL 24486*

habitat for a rich diversity of terrestrial and aquatic plants and animals. NREL preserves the important natural functions of its wetlands and floodplains, thereby protecting the physical, biological and chemical integrity of receiving waters and riparian areas on and adjacent to the STM and NWTC sites.

NREL protects its wetlands and floodplains through several means:

- Periodic vegetation surveys and wetland delineations
- Mapping of wetland areas potentially affected by proposed construction
- Identification of potential impacts
- Coordination with other jurisdictions on the control of floodwaters leaving NREL sites.

## 2012 Highlights and Achievements

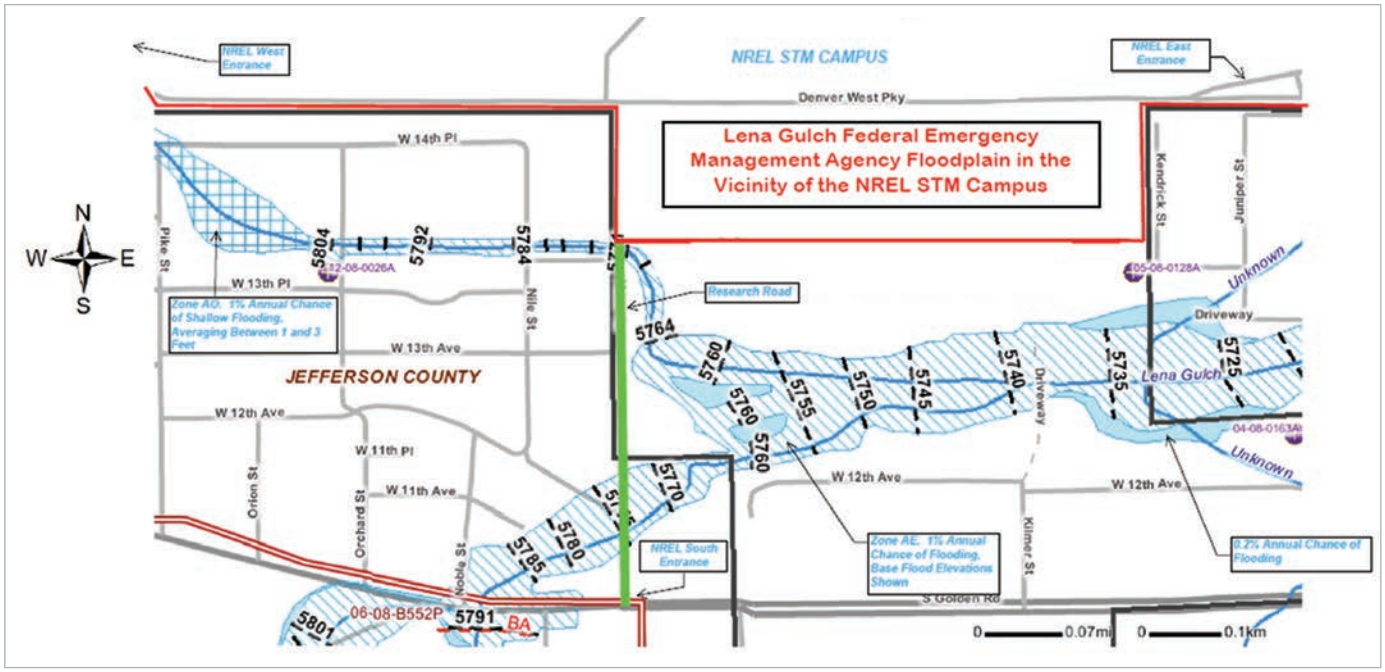
In support of ongoing wetland management, several wetland areas at the NWTC were delineated and the site vegetation map was updated to include the identified wetland areas and associated vegetation (see Appendix A).

### PROGRAM MANAGEMENT

Wetlands became regulated in 1972 when, under the CWA, the definition of Waters of the United States was expanded from only those waters capable of supporting interstate or foreign commerce (as defined under the Rivers and Harbors Act of 1899) to waters that also include tributaries to navigable waters, interstate wetlands, wetlands which could affect interstate or foreign commerce, and wetlands adjacent to other waters of the United States. Wetlands that meet certain soils, vegetation, and hydrologic criteria, are protected under the CWA Section 404, which is administered by the USACE, with program oversight provided by the EPA. Areas that do not meet the criteria above and do not fall within the jurisdiction of the Corps are not protected or regulated under Section 404. However, such areas may still perform wetland functions as described above and act as valuable ecologic components.

In 2009, the USACE visited the STM campus, after which they issued a jurisdictional determination stating that all drainages examined were considered upland swales and consequently are not regulated by the USACE. The jurisdictional determination—which is valid for a period of five years (through April 27, 2014)—allows NREL to perform work in the upland swales without a USACE permit. As stated above, a preliminary wetland assessment and delineation was jointly conducted with the USACE of the NWTC site. A formal delineation will be submitted to the USACE in 2013 to obtain a jurisdictional determination for the NWTC.

Counties typically map the 100-year floodplain boundaries within their jurisdiction and then develop regulations that control the type and amount of development within those areas. Jefferson County has no 100-year floodplain




Lena Gulch floodplain just south of the STM site.

The purpose of the stormwater detention basin is explained to NREL employees during a nature walk of Lena Gulch. *Photo by Dennis Schroeder, NREL 20505*

boundaries that affect the NWTC or STM sites. However, the new south entrance to the STM site, which was constructed on county and private property adjacent to the STM site, is located in the Lena Gulch 100-year floodplain. A Floodplain Development permit was required from Jefferson County and Urban Drainage and Flood Control District. NREL complied with floodplain development requirements, determined that the project would alter the floodplain, and submitted a Conditional Letter of Map Revision. When the project was completed, a final Letter of Map Revision (LOMR) was recorded officially changing county floodplain maps.

Federal regulation 10 CFR 1022, Compliance with Floodplain and Wetlands Environmental Review Requirements, establishes policy and procedures for discharging DOE's responsibilities under EO 11988, Floodplain Management, and EO 11990. For projects that occur in floodplains or have the potential to affect wetlands, DOE must determine the potential impacts to the floodplain or wetlands, document this in a floodplain and wetland assessment, and complete notices of availability to appropriate government agencies (e.g., federal emergency management organizations and state and local governments) and to persons or groups known to be interested in or potentially affected by the proposed floodplain or wetland action. For such actions, DOE must also distribute the notification in the area where the proposed action is to be located (e.g., by publication in local newspapers). After the consideration of public and agency comments, the process concludes with the preparation of a Floodplain and Wetland Statement of Findings.

## 2012 COMPLIANCE SUMMARY AND ACTIVITIES

- All program activities were in compliance with requirements.
- Project completion notification was provided to the USACE by DOE to close out the Clean Water Act Section 404 permitting related to the permanent loss of 0.25 acres along Lena Gulch as a result of the STM southern access road construction. This loss was mitigated through acquisition of wetland banking credits through the South Platte Wetlands Bank in Brighton, Colorado.
- With the completion of the STM southern access road, a final LOMR was recorded, officially changing county floodplain maps.

## 10.5 CULTURAL RESOURCES

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 other reasons. NREL identifies and protects cultural resources in several ways:

- Integrating cultural resource management into site activities and minimizing and/or mitigating impacts to historic properties.
- Implementing procedures to manage historic properties and to protect undiscovered cultural resources and artifacts.
- Periodically conducting surveys to document presence or absence of cultural or historic resources while considering project impacts to the human environment. When surveys reveal artifacts, staff work with the State Historic Preservation Officer (SHPO) to determine if the artifacts are eligible for consideration as cultural or historic resources.
- Construction contractor site orientation training informs workers that in the event they discover any evidence of cultural resources during ground-disturbing activities at the STM or the NWTC sites, workers are to stop all work in the vicinity until a qualified archaeologist evaluates the significance of the find.

Battalion officers at Camp George West. *Photo from the Jefferson County Historical Society*

The STM site has had a long history as a location with a variety of human uses over the decades. In 1903, the Colorado National Guard established the State Rifle Range at a location three miles east of Golden, Colorado. The site was designated as "Camp George West" in 1934, honoring civil war veteran and Golden business man, George West. This site became an integral part of Colorado National Guard

Firing line from Camp George West, relocated as part of the parking garage and south entrance project. *Photo from Robert Smith, NREL 25492*

activities throughout the first half of the 1900s. By the 1920s, the camp totaled 750 acres and many buildings were added throughout the 1930s and 1940s. During World War II, much of Camp George West was leased to the federal government for military training purposes. From the 1930s to the 1970s, several state entities took up residence at Camp George West, including the Colorado State Highway Patrol, the Colorado Law Enforcement Training Academy, and the Colorado Correctional Center. In 1981, more than 300 acres were transferred to the federal government for solar energy research purposes. An additional 25 acres were transferred to DOE in 2003. Today, the STM site totals 327 acres.

## PROGRAM MANAGEMENT

Cultural resources are protected under Sections 106 and 110 of the National Historic Preservation Act of 1966, as amended. Federal agencies must establish preservation programs—commensurate with their mission and the effects of their activities on historic properties—that provide for the careful consideration of historic properties. Significant cultural resources are either eligible for, or listed in, the National Register of Historic Places.

Cultural resources can be divided into three major categories:

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

### 2012 Highlights and Achievements

In 2012, DOE and NREL sponsored an open house at the STM, inviting the public to learn about research at the laboratory and its management. At the event, DOE and NREL answered questions and presented information on the laboratory's commitment to historical preservation and cultural resource management.

Ammo bunker constructed in 1940 at Camp George West. *Photo by David Parsons, NREL 06928*

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

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

A traditional cultural resource can be defined as a property that is eligible for inclusion in the National Register of Historic Places 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 may include archaeological resources, buildings, neighborhoods, prominent topographic features, habitats, plants, animals, and 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. Two additional limited surveys of the Camp George West District involving the STM site have also been conducted.

Three historical sites were recognized as significant cultural resources that should be preserved. These resources include:

- An open-air amphitheater
- A stone bridge spanning a natural drainage channel adjacent to the amphitheater
- A stone and concrete ammunition bunker below the amphitheater.

The three structures were constructed during the Works Progress Administration era in the 1930s. Through NREL's efforts, these structures have been added to the National Register, with the amphitheater and stone footbridge listed together as a single resource.

The Camp George West Historic District, also listed on the National Register of Historic Places, includes the 25-acre parcel of the STM site south of Denver West Parkway. Prior to NREL developing this parcel, a cultural resource survey identified two types of features associated with the historic district on the property: two firing lines (200-yard and 300-yard) and a low rock wall. These features were formally recorded in 2006 per an agreement with the SHPO, and the 200-yard firing line and low rock wall were then removed. The 300-yard firing line was salvaged and relocated in 2011 to an interpretative trail around the STM stormwater detention basin.

## 2012 COMPLIANCE SUMMARY AND ACTIVITIES

- All program activities were in compliance with requirements.
- Construction activities were completed on the parking structure, the café and the Energy Systems Integration Facility. During excavation of these projects, several items were unearthed and reviewed for cultural significance, though none were found to be of unique value.
- In 2010, a Class III Cultural Resource Inventory was completed on the final configuration of the new south entrance to STM, which lies within the Camp George West Historic District. SHPO concurred that construction would impact a 500-yard firing line and a 600-yard firing line, both of which are contributing features of the Camp George West Historic District, and that impacts should be mitigated. In 2011, DOE established a memorandum of agreement with the SHPO to mitigate impacts to these features by installing an interpretive feature. In 2012, this feature was designed and review and approval was provided by the Pleasant View Metropolitan District. The interpretive feature will be installed in Pleasant View Community Park in 2013.

# 11 Conservation Easement Lands

In 1999, the U.S. Department of Energy (DOE) granted a conservation easement for 177 acres of the South Table Mountain (STM) site to Jefferson County. The purpose of the 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.

The conservation easement lands are northeast of the new ESIF on the mesa slopes and top. *Photo by Dennis Schroeder, NREL 21829*

The goals of the easement are to:

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

Conservation easement area atop STM mesa. *Photo by Christina Chase, NREL 22071*

Local policies established by Jefferson County, Golden, and Lakewood reflect community sensitivity with respect to the visual qualities provided by natural resources in the STM area. Specifically, the Jefferson County General Land Use Plan (Land Use Plan) characterizes North and South Table Mountain as "unique landscapes," and states that "maintaining landscapes that have a unique visual quality" is a key to maintaining the quality of life in Jefferson County.

The conservation easement land is located on the mesa top, slope, and toe of STM. Vegetation includes grassland interspersed with shrubland communities, primarily in the drainages. Several seeps also occur throughout the area.

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[4]. 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 (including geology, hydrology, vegetation, wildlife, and cultural resources).

Jefferson County Open Space maintains formal trails on the conservation easement property. Two trails cross the easement, connecting Denver West Parkway (near the NREL site entrance) to the trails on the mesa top. NREL staff and the public use these trails daily.

## 2012 PROPERTY ASSESSMENT

During 2012, there was no NREL activity on the conservation easement property having the potential to degrade the environmental condition of the property.

[4] U.S. Department of Energy, Golden Field Office (1999). National Renewable Energy Laboratory (NREL) Site Conservation Easement Baseline Inventory. Golden, Colorado.

# 12 Traffic Management

The South Table Mountain (STM) site draws hundreds of commuter vehicles daily, as well as visitor and delivery traffic coming to and leaving the site. Traffic management for the site is important for minimizing negative impacts to traffic flow on Denver West Parkway (DWP) and in nearby neighborhoods and business areas. Reducing traffic also reduces noise and light pollution, vehicle emissions, fuel use, parking requirements, and road maintenance costs.

The laboratory works to reduce traffic by encouraging:

- Alternative modes of commuting, such as mass transit, ridesharing (carpool and vanpool), and bicycling
- Telecommuting one or more days per week
- Flexible shifts and alternate work schedules
- Teleconferencing, videoconferencing, and web-based tools for conducting meetings and trainings remotely.

Periodic traffic monitoring at the STM site provides information regarding total traffic volumes and peak hour vehicle trips. Baseline traffic levels were established in 2008 prior to moving increased numbers of staff into newly constructed buildings at the STM site. Since 2008, traffic has been monitored to measure changes in traffic volumes to better inform traffic management.

Intersection traffic analysis, referred to as Level of Service (LOS) analysis, has also periodically been performed to measure the impacts of NREL-generated traffic volumes on traffic flow at the nearby intersections of DWP/Marriott Boulevard (DWMB) and Quaker St./South Golden Road. The analysis is conducted to confirm that traffic flow at the intersections adjacent to NREL has not degraded to an unacceptable level. Monitoring will continue to be conducted as additional staff are relocated to STM.

## 2012 Highlights and Achievements

- The completion of the new south entrance and roadway from South Golden Road to the STM campus in May 2012 decreased traffic volumes accessing the east and west entrances. NREL's traffic impacts at the DWP/DWMB and South Golden Road/Quaker St. intersections were also reduced. Throughout 2012, traffic monitoring and intersection analysis indicated that NREL-generated traffic volumes and LOS remained within acceptable levels and continued to be insignificant.
- Construction of an additional right-turn lane at the DWP/DWMB intersection is slated to begin in early 2013. The turn lane will further improve capacity at the intersection, allowing for increased acceptable NREL-generated peak-hour traffic volume thresholds.

Aerial view of the new south entrance to the STM campus. *Photo by Dennis Schroeder, NREL 21814*

### PROGRAM MANAGEMENT

A Mitigation Action Plan (MAP), finalized in May 2008, was developed to address potential environmental impacts from

Bike-2-Work Day participants enjoy breakfast at the NREL Visitors Center. *Photo by Dennis Schroeder, NREL 19262*

changes in traffic at STM and to support an Environmental Assessment Finding of No Significant Impact for several projects at the laboratory. The MAP specifies the methods for implementing mitigation measures to ensure that the impacts of continued and expanded laboratory operations are not significant. The MAP requires that:

- The DWP/DWMB intersection operates at a LOS of D or better.
- The Quaker St./South Golden Road intersection operates at a LOS of D or better.
- Traffic flow to and from the STM east entrance will be monitored semi-annually.
- A report on the implementation and effectiveness of the STM traffic mitigation measures will be published in the NREL Annual Site Environmental Report.

The MAP also identified specific mitigation strategies to be implemented as needed to ensure that the traffic thresholds are not exceeded. These actions include transportation demand management (TDM) strategies such as alternative work schedules (AWS), expanded shuttle services, expanded carpools, encouraging walking and bicycling, increased use of the Quaker St. entrance, infrastructure improvements, and traffic flow control measures. The TDM measures implemented are described here.

### Alternative Modes of Commuting

- Eco Passes provided to employees encourage use of the RTD public transportation system. This includes unlimited RTD regional, express, local, light rail, and call-n-Ride services.
- Shuttle routes provide connections between NREL facilities in Golden and three regional RTD transit stations in Lakewood, Wheat Ridge, and Boulder.
- Incentive parking is provided for vanpools and carpools at the STM and Denver West sites.
- Vanpool subsidies are available for participants who commute in formal organized vanpools.
- Bike racks, bike lockers, and bicycle maintenance stations are in key locations on the STM site. Bike racks on shuttle vehicles permit staff to take their bikes with them when they commute or move between buildings.
- RideShare Connections intranet site allows staff to post and search listings for potential carpool and vanpool partners within NREL.
- Literature kiosks in key building locations provide shuttle and RTD schedules, bicycle maps, and telecommuting information.
- Information sharing events promote safe bicycling, rideshare (carpool and vanpool) and RTD services.

### Flexible Workplace Practices

Conferencing by video, telephone, and the internet as well as AWSs provide flexibility in how people work, saving staff time, energy, and money. An AWS policy allows employees to work varying schedules (with management approval), including four-day workweeks, reduces the miles driven by employees to and from the laboratory.

### Telecommuting

Telecommuting allows staff (with management approval) to work from home at least one day per week or occasionally as needed, reducing the days they commute to the lab. Laboratory-wide employee surveys have confirmed that adoption of this program has been very strong.

### Teleconferencing

The laboratory promotes and encourages use of teleconferencing and videoconferencing for meetings to decrease local vehicle trips and air travel.

## 2012 COMPLIANCE SUMMARY AND ACTIVITIES

- All program activities were in compliance with requirements.
- TDM measures required by the MAP were continued in 2012.
- Average PM peak hour traffic volume at the DWP/DWMB intersection was 335 vehicle trips. The monitoring periods were April 2012, August 2012, and December 2012. The MAP threshold of LOS D or better is equivalent to a maximum of 387 vehicle trips per hour entering or leaving the site at the east entrance at the afternoon rush hour.
- PM peak hour LOS at the DWP/DWMB intersection was at LOS B, which does not exceed the MAP threshold of LOS D or better.
- Average PM peak hour traffic volume at the Quaker St./South Golden Road intersection was 30 vehicle trips. The monitoring periods were April 2012, August 2012, and December 2012.
- PM peak hour LOS at the Quaker St./South Golden Road intersection was at LOS B, which does not exceed the MAP threshold of LOS D or better.

## Detailed Traffic Metrics and Results

Previously conducted traffic studies indicated that the greatest impact to traffic in the local area from NREL activities occurs between 4:30 p.m. and 5:30 p.m. This hour has been designated the PM peak hour. Video traffic surveillance was conducted during three weeks at three different times of the year (April, August, and December 2012). Traffic counts for the PM peak hour were compared against the MAP threshold. The MAP threshold indicates the amount of traffic that would cause degradation to the LOS at the DWP/DWMB intersection.

The table below shows the results of the traffic counts at the east, west and south entrances to the STM site in April, August and December 2012.

**2012 TRAFFIC COUNTS**

| Gate | PM Peak Hour Vehicles (in- and out-bound) | | | |
|---|---|---|---|---|
| | Apr-12 | Aug-12 | Aug-12 | Average |
| East Entrance (Denver West Parkway/Denver West Marriott Blvd.) | 441 | 278 | 285 | 335 |
| West Entrance (Quaker St./ South Golden Road) | 61 | 19 | 10 | 30 |
| South Entrance (South Golden Road/Research Rd.) | N/A | 170 | 167 | 169 |

The applicable traffic volume threshold identified in the MAP is 387 vehicle trips in the PM peak hour (from 4:30 p.m. to 5:30 p.m.) at the DWP/DWMB intersection. This threshold identifies the acceptable number of vehicle trips NREL can contribute to the intersection without causing significant degradation to flow. In 2012, PM peak hour traffic volume averages remained below the MAP threshold.

**PM Peak Hour Average = 335 vehicle trips**

In December 2011, LOS analyses were conducted at the DWP/DWMB and Quaker St./South Golden Road intersections indicating that both intersections were at LOS B and within the MAP allowed service levels (LOS D or better). Since these analyses were conducted, traffic volumes at both the east and west entrances to the STM site have decreased as a result of the opening of the south entrance and roadway. Further, results from the 2011 LOS analyses suggest that the NREL-generated PM peak hour traffic volume thresholds identified in the MAP could be adjusted upward to better reflect current area traffic conditions. The analyses indicate that PM peak hour traffic thresholds could be increased from 387 vehicle trips per hour to 747 trips per hour while still maintaining an acceptable LOS.

# Appendix A: Plant Communities at the STM and the NWTC

Vegetation surveys were not completed for the South Table Mountain (STM) and National Wind Technology Center (NWTC) sites in 2012; however, surveys were completed in 2011. Plant communities and species were identified for each of the sites at that time, and changes from similar surveys completed in 2000 are noted below.

## STM PLANT COMMUNITIES

The majority of vegetation at STM belongs to the grassland community type. Within that association, there are two distinct community types: short-grass grassland on the mesa top and mixed-grass grassland located on the slopes and toe area. Other mapped vegetation communities at STM include ravine shrubland, tall shrubland, short shrubland, and wetlands. The plant communities are described below and mapped as illustrated in the figure.

## SHORT-GRASS GRASSLAND

Short-grass grassland is found on the flat top of the mesa. The dominant grass species are blue grama (*Chondrosum gracile*), a native prairie species, and cheatgrass (*Anisantha tectorum*), a noxious weed. Populations of diffuse knapweed (*Acosta diffusa*) and Dalmatian toadflax (*Linaria genistifolia subsp. dalmatica*) are scattered throughout the whole community. These two noxious weeds comprise approximately 1% of the short-grass.

Alyssum (*Alyssum parviflorum*), an introduced species, is the dominant forb. Several species of prickly pear cactus (*Opuntia fragilis, O. macrorhiza, O. phaeacantha, and O. polyacantha*) occur throughout the short-grass mesa top, as well as hen-and-chicks (*Echinocereus viridiflorus*) and pincushion cacti (*Coryphantha missouriensis and C. vivipara var. vivpara*). Well-draining hillocks often support thick stands of needle-and-thread grass (*Hesperostipa comata*) and yucca (*Yucca glauca*). Some short shrubs such as rubber rabbitbrush (*Chrysothamnus nauseosus subsp.*), chokecherry (*Padus* virginiana), and skunkbrush (Rhus aromatica subsp. trilobata) occur infrequently in the short-grass area and concentrate along the rimrock areas. Several large hackberry trees (*Celtis reticulata*) are clustered at the very edge of the mesa top.

Historically, this short-grass grassland was probably dominated by blue grama grass and other short-grass species such as buffalo grass (*Buchloë dactyloides*), intermixed with the other species associations described above. However, this entire mesa-top area has become dominated by cheatgrass, an aggressive noxious weed. This weed is changing the appearance and general species composition of the area by apparently out-competing native plants.

## MIXED-GRASS GRASSLAND

The mesa slopes and toe areas on the STM site also support blue grama and cheatgrass, but are dominated by a mixed-grass species association of needle-and-thread grass and western wheatgrass (*Pascopyrum smithii*), with smaller amounts of big bluestem (*Andropogon gerardii*), side-oats grama (*Bouteloua curtipendula*), three-awn (*Aristida purpurea*), and green needle grass (*Nassella viridula*). As in the short-grass areas, a large number of forbs also occur in the mixed-grass grassland.

A few patches of anomalous vegetation occur within the mixed-grassland where subsurface water appears to be close to the surface. These areas support wide swaths of mat muhly (Muhlenbergia richardsonis). One is located on a southern-facing slope, near the eastern property boundary. The other is located on a southwestern-facing slope of the ravine north of the NREL Education Center, formerly known as the Visitors Center. This area is notable for a large population of poison ivy (*Toxicodendron rydbergii*), which grows in thickets of tall (one meter and larger) plants that have a woody, shrub-like growth form. A small number of plains cottonwood (*Populus deltoides*) saplings, skunkbrush, chokecherry, and snowberry occur in this patch as well.

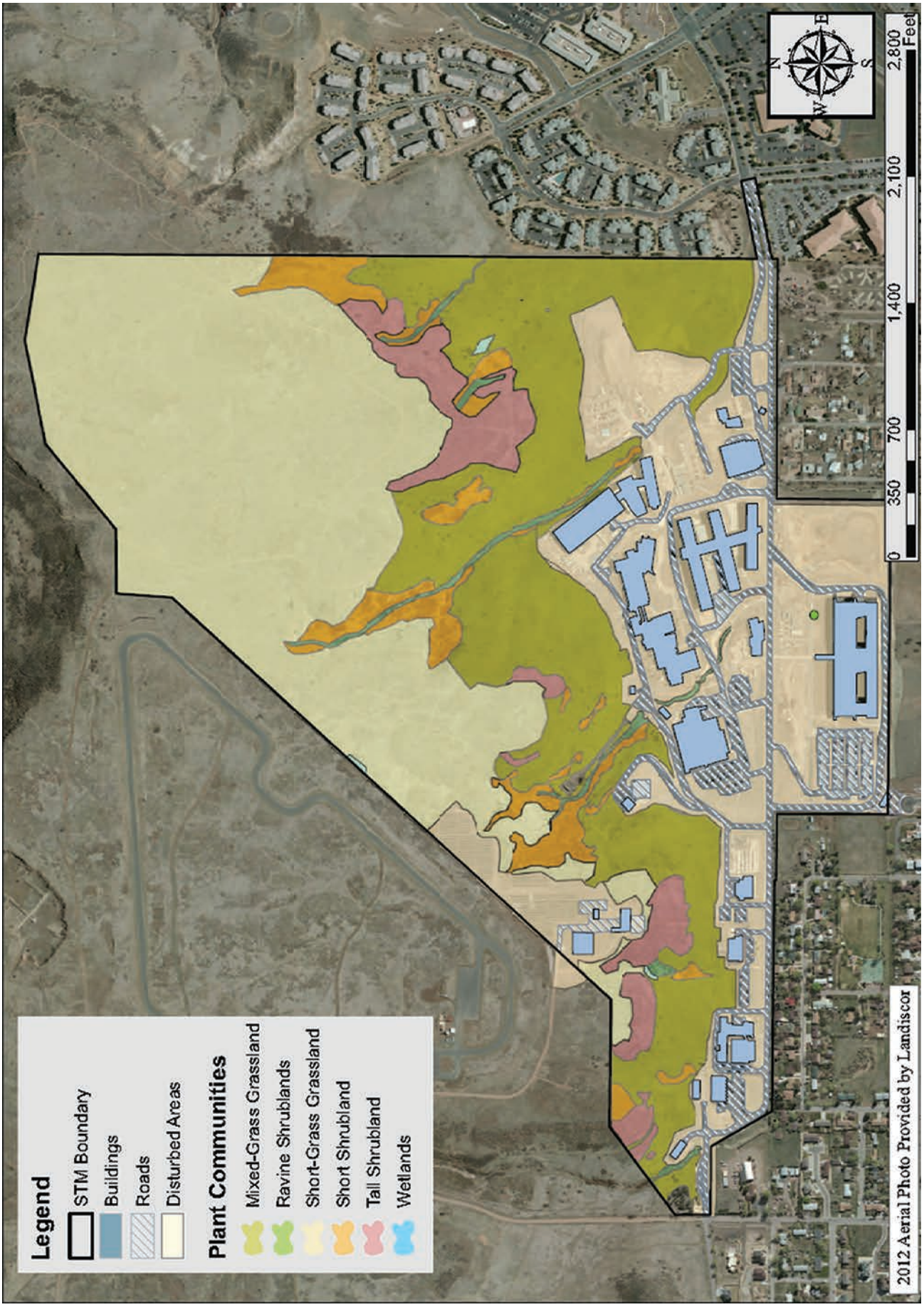
The mixed-grass areas grade into both the upland and ravine shrublands and contribute the majority of the understory in these areas. Some mixed-grass areas also blend into disturbed areas, where reclamation species such as crested wheatgrass (*Agropyron cristatum*) and smooth brome have been planted and have subsequently spread into the mixed-grass community.

## UPLAND SHRUBLANDS

Shrubland habitat occurs along the upper sides of ravines and on the steeper mesa slopes, becoming more prominent as elevation increases up to the top of the mesa. The upland shrubland habitat, which excludes the shrublands in the ravine bottoms, comprises tall shrubland and short shrubland communities very similar in overall composition but distinguished by the dominant species.

## TALL SHRUBLAND

The tall shrubland areas are defined by stands of mountain-mahogany (*Cercocarpus montanus*) that occur along the rim




STM land cover types surveyed in 2011. Note: Map updated in 2012 to reflect site building changes.

of the mesa, usually where volcanic cap rock is exposed, and on the upper mesa slopes below rimrock areas. The understory is notably sparse throughout this community, with a large amount of bare soil. Cheatgrass is the most common herbaceous species in these areas, intermixed with needle-and-thread grass, yucca, and many cacti.

## SHORT SHRUBLAND

The short shrublands occur on elevated flat areas amidst the surrounding grasslands, some of which appear to have experienced surficial disturbance in the past. These areas are distinctive because of their dominance by rubber rabbitbrush. The other common location for short shrublands is on the outer slopes of the ravines. Skunkbrush defines these and other short shrublands along the upper portions of the steepest slopes of the mesa.

These communities usually grade into the ravine shrublands along the drainage bottoms and the tall shrublands near the top of the mesa slopes. The short shrubland community also has a sparse understory of the same grasses and forbs as the tall shrub community.

## RAVINE SHRUBLANDS

Ravine shrublands are limited to the lower sides and bottoms of the drainages that cut down through the mesa slopes. These communities support a variety of shrubs such as skunkbrush, chokecherry, and wild plum (*Prunus americana*), often growing in dense, impassible thickets. A few plains cottonwoods and peach-leaf willow (*Salix amygdaloides*) trees occur at the top of the ravine channels and in other portions of the channel where the subsurface water table appears to be relatively high. A diverse herbaceous component is found in these drainages. In one instance near the southeast site boundary, a ravine shrubland grades into an ephemeral drainage at the toe of the mesa. This drainage is vegetated with grassland species and conducts only occasional surface water runoff.

## WETLANDS

Five very small communities on the STM site were found to support wetland vegetation. These communities were not examined for the soils and hydrology that would classify them as functioning wetlands; rather, they are noted only for their domination by wetland vegetation. These are limited to very small areas (less than half an acre in total). One is in a shallow swale at the mouth of the ravine at the southwestern corner of the project boundary where surface water and/or subsurface drainage have created a pocket of saturated soil. Species here include sedges (*Carex spp.*), rushes (*Juncus spp.*), bulrush (*Schoenoplectus sp.*), and peach-leaf willow. The second wetland could have formed as a result of past construction activities. This linear depression supports wetland vegetation along the central portion of the western site boundary, northeast of the photovoltaic array. Perhaps where equipment was once staged, this area appears to hold seasonal water for enough consecutive growing seasons to support some wetland vegetation including Arctic rush (*Juncus arcticus*), American speedwell (*Veronica americana*), and broadleaf cattail (*Typha latifolia*).

The wetland at the mouth of the ravine may no longer experience the hydrology that originally allowed these plants to establish there. In 2002, this plant community supported populations of cattails that were not observed in the 2011 survey.

Three small seeps are located on the hill slope between the Education Center and the public trail on the far eastern boundary of the site. These seeps are dominated with sedges, rushes, and Canada thistle (*Cirsium arvensis*).

A seventh wetland community that was observed by Plantae[5] no longer appears to support wetland vegetation. In 2002, cattail species near an old stock tank in the easternmost drainage appeared to have been supported by a pipe coming out of the hillside. Although the stock tank was observed in the 2011 survey, it appears the cattails have not persisted in the intervening years.

## DISTURBED/RECLAIMED

This habitat type comprises all of the areas at the site that have experienced surface disturbance to vegetation caused by human activities. These mostly occur on the perimeter of the buildings, roads, parking lots, and soil dumping areas. Most of these areas appear to have been re-vegetated and support a combination of native grassland plants, planted ornamental re-vegetation species, and native and introduced weeds.

## NWTC PLANT COMMUNITIES

The majority of the vegetation at the NWTC site belongs to the mixed-grass prairie association of the grassland formation. Mixed-grass prairie is defined by the presence of grass

[5] Plantae Consulting Services (2000). Vegetation Survey, NREL National Wind Technology Center. Boulder, Colorado.

[6] U.S. Department of Energy (1998). Environmental Assessment, Right-of-Way Easement for Public Service Company of Colorado at the South Table Mountain Site, Golden, Colorado. DOE/EA-1254.

[7] Plantae Consulting Services (2000). Vegetation Survey, NREL National Wind Technology Center. Boulder, Colorado.


NWTC land cover types surveyed in 2011.

species typical of the tall-grass or true prairie such as big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), and prairie dropseed *(Sporobolus heterolepis*), with species more typical of the short-grass prairie such as blue grama (*Chondrosum gracile*) and buffalo grass (*Buchlöe dactyloides*). Intermediate grasses (mid-grasses) such as the needle grasses *(Hesperostipa and Nassella spp.*), wheat grasses (*Pascopyron, Agropyron, Elytrigia, Elymus*, and *Thinopyrum spp.*), and blue grasses (*Poa spp.*) are also important constituents of mixed-grass prairie.

The grasslands at the NWTC fall into the xeric mixed grassland community type identified and classified primarily on available soils and soil moisture, reflected in xeric mixed grassland plant species assemblages.

A number of changes in vegetation patterns noted since the NWTC site was previously mapped (DOE 1998[6], Plantae 2000[7]) are discussed by specific plant community below.

The plant communities are described below and mapped as illustrated in the figure.

## XERIC MIXED GRASSLAND

Xeric mixed grassland is by far the largest and most widespread community type at the NWTC site. These areas do not have access to regular soil moisture (*xeric conditions*) and are dominated by typical short- and mixed-grass prairie species. This plant community includes a large variety of native grass species as well as a diverse forb component, typical of mixed grasslands. Dominant species noted include big bluestem, little bluestem, prairie dropseed, blue grama, and buffalo grass. Intermediate grasses (mid-grasses) such as the needle grasses, wheat grasses, and blue grasses are also important constituents of mixed-grass prairie. Species flowering in late spring include little bluestem, cheatgrass, sand lily (*Leucocrinum montanum*), wild iris (*Iris missouriensis*), Lambert locoweed (*Oxytropis lambertii*), mouse-ear (*Cerastium strictum*), western wallflower (*Erysimum capitatum*), and prairie golden pea (*Thermopsis rhombifolia*).

## WET MEADOW

Three locations support wet meadows[8] at the NWTC. One is south of the SunEdison solar array, the second is at the upper end of the Rock Creek tributary along Row 4, and the third is adjacent to the Building 251 east parking lot. A wet meadow is a type of grassland which transitions between mesic and hydric conditions (i.e., an ecotone between upland grasslands and wetlands). These areas support Arctic rush, Canada bluegrass (*Poa compressa*), red-top bent grass (*Agrostis stolonifera*), Canada thistle, western wheatgrass, common three-square (*Schoenoplectus pungens*), showy milkweed (*Asclepias speciosa*), and wild iris (*Iris missouriensis*).

## PONDEROSA PINE WOODLAND

One woodland habitat, defined by a single community of the ponderosa pine (*Pinus ponderosa*) woodland, occurs in the northwestern corner of the site along a granite outcrop. This small area supports a very diverse native plant community including common grassland and foothills species, as well as a number of introduced and noxious weeds. Dominant species include ponderosa pine (*Pinus ponderosa*), smooth bromegrass, crested wheatgrass, and green needlegrass (*Nassella viridula*). Species flowering in late spring include sand lily, western snowberry (*Symphoricarpus occidentalis*), groundsel (*Senecio sp.*), and wax current (*Ribes cereum*).

## UPLAND SHRUBLAND

A small upland shrub community is located to the southeast of the ponderosa pine woodland, where the same ridge arises to a lesser degree from the surrounding grassland community. This rocky ridge supports shrub species interspersed with grasses and forbs representative of the surrounding grasslands. Dominant species noted include western snowberry, Canada wild rye (*Elymus canadensis*), Canada bluegrass, Kentucky bluegrass (*Poa pratense*), and little bluestem. Species flowering in late spring include prairie goldenpea.

## PALUSTRINE EMERGENT WETLAND

Two wetlands on the site fall into the palustrine emergent category. The first is a linear depression on the southern side of the south road. This area appears to have developed as the result of soil excavation intercepting sufficient surface water runoff from the adjacent road to support sedge species (*Carex spp.*). A second wetland is located on the southern boundary in an area previously disturbed from the neighboring industrial activities. This wetland comprises a center of cattails (*Typha angustifolia*) surrounded by a stand of coyote willow (*Salix exigua*).

Two palustrine emergent wetlands were mapped in the mesic mixed grassland in the 2000 growing season. These areas appear to have dried considerably in the intervening 10 years. The small wetland pockets of cattails (*Typha spp.*) that occurred in the southern portions of this area are

[8] In the 2000 and 2011 surveys, wet meadows were identified as mesic mixed grassland. These areas were reclassified in 2012 as wet meadows due to an apparent change in vegetation and hydric conditions.

no longer present, apparently replaced by large stands of Canada thistle. Dead remnants of Baltic rush (*Juncus balticus*) can be found in the area litter (prior years' herbaceous vegetation). The dominant species noted was smooth bromegrass.

## HEADWATER WETLAND

Areas of headwater wetland occur along the two ephemeral drainages on the NWTC site. Both drainages occur in the northeastern portion of the site, one flowing east and one flowing north. Both show evidence of intermittent surface flow. The northern-most drainage is a tributary of Coal Creek and the second drainage is a tributary to Rock Creek.

Surface flow in the drainage to the northeast appears to be augmented by outflow from the groundwater seep wetland on the western bank. The second and larger drainage conducts surface flows through the center of the site off to the eastern fence line. The upper reaches of this drainage are a shallow grassland swale (also shown in the NWTC weed map). This channel deepens as it flows east across the site. At its eastern reaches, this drainage clearly intercepts subsurface water, although not in sufficient quantities to produce consistent surface flow. At the point where this drainage leaves the NWTC site, there is a human-constructed rock wall. Dominant species noted include Canada thistle, Baltic rush, curly dock (Rumex crispus), common evening-primrose (*Oenothera villosa*), smooth bromegrass, and western wheatgrass (*Pascopyrum smithii*).

## GROUNDWATER SEEP WETLAND

Two areas of groundwater seep wetland are located on the NWTC site. The first occurs west of the ponderosa pine woodland, in the northwestern portion of the site along the northern fence line. This area now includes more upland species than noted in 2000.

The second occurs over a very small area on the banks of the northern drainage. This community is a clearly demarcated area of primarily wetland plants amidst the surrounding grassland. Fifty plant species were identified in this community in 2000, many of which also occur in the headwater wetland to the south. Dominant species noted include sedges (*Carex sp.*) and rushes (*Juncus sp.*). Common teasel (*Dipsacus fullonum*) has invaded the northern drainage area. Species flowering in late spring include common teasel, showy milkweed (*Asclepias speciosa*), wild iris, field-mint (*Mentha arvensis*), and Canada thistle.

## SEASONAL POND

A seasonal pond and pond margin occur at the northwestern corner of the site, west of the southern terminus of the ponderosa pine woodland. This area appears to depend on an elevated spring and early summer water table for the hydric soil moisture conditions that support this community. Observers have noted that the pond depression often contains standing water in the spring and early summer in some years[9]. However, no standing water was observed in this area during the most recent survey. These drier soil conditions are reflected in a shift of dominant plant species in this community between the 2000 and 2011 surveys. Dominant species noted include curly dock, Canada bluegrass, smooth bromegrass, and Canada thistle.

### Disturbed

These plant associations reflect surface disturbance due to human activities on the site. These areas include roadsides, pad sites, parking lot perimeters, construction sites, and storage areas. Some of these areas have been revegetated and now include a combination of species from surrounding natural plant communities, reclamation species, and adventive (non-native) or ruderal (native or adventive, disturbance colonizer) species. Dominant species noted include smooth bromegrass and cheatgrass.

### Ornamental Trees/Shrubs

Disturbed areas around buildings have been planted with a combination of native and ornamental trees and shrubs. The trees include multiple species of junipers (*Sabina spp.*) and pines (*Pinus spp.*) interspersed with ornamental deciduous trees. Shrubs in these areas are mainly chokecherry (*Padus virginiana*) and rose (*Rosa spp.*) bushes.

[9] Plantae Consulting Services (2000). Vegetation Survey, NREL National Wind Technology Center. Boulder, Colorado.

# Appendix B: Wildlife Species Observed at the STM

The following are lists of common and scientific names of wildlife species observed at the STM and NWTC sites. The species for the NWTC were identified during surveys completed in 2011. The species listed for STM were observed by staff and/or observed in surveys completed in 1987, 2005, and 2011.

## WILDLIFE SPECIES AT THE STM*

| SPECIES COMMON NAME | SCIENTIFIC NAME | 1987 Survey | 2005 Survey | 2011 Survey |
|---|---|---|---|---|
| **BIRDS** | | | | |
| American crow | Corvus brachyrhynchos | | X | X |
| American goldfinch | Carduelis tristis | | | X |
| American kestrel | Falco sparverius | X | X | X |
| American pipit | Anthus rubescens | | | X |
| American redstart | Setophaga ruticilla | | | X |
| American robin | Turdus migratorius | X | X | X |
| American tree sparrow | Spizella arborea | | X | X |
| American white pelican | Pelecanus erythrorhynchos | | | X |
| Bald eagle** | Haleatus leucocephalus | | | |
| Barn swallow | Hirundo rustica | | | X |
| Black-billed magpie | Pica hudsonia | X | X | X |
| Black-capped chickadee | Poecile atricapilla | | X | |
| Black-crowned night heron | Nycticorax nycticorax | | X | |
| Black-headed grosbeak | Pheucticus melanocephalus | | | X |
| Blue-gray gnatcatcher | Polioptila caerulea | | | X |
| Blue jay | Cyanocitta cristata | | X | X |
| Brewer's blackbird | Euphagus cyanocephalus | X | | X |
| Brewer's sparrow | Spizella breweri | | | X |
| Broad-tailed hummingbird | Selasphorus platycercus | | | X |
| Broad-winged hawk | Buteo platypterus | | | X |
| Brown-headed cowbird | Molothrus ater | X | X | X |
| Bullock's oriole | Icterus bullockii | | X | X |
| Bushtit | Psaltriparus minimus | | | X |
| California gull | Larus californicus | | X | |
| Canada goose | Branta canadensis | | X | X |
| Cedar waxwing | Bombycilla cedrorum | | | X |
| Cassin's kingbird | Tyrannus vociferans | | | X |
| Chestnut-collared longspur | Calcarius ornatus | | | X |
| Chipping sparrow | Spizella passerina | | | X |
| Cliff swallow | Petrochelidon pyrrhonota | | | X |
| Common grackle | Quiscalus quiscula | | | X |
| Common nighthawk | Chordeiles minor | X | X | X |
| Common raven | Corvus corax | | X | X |
| Common snipe | Gallinago delicata | | X | |
| Cooper's hawk | Accipiter cooperii | | X | X |
| Dark-eyed junco | Junco hyemalis | | X | X |
| Double-crested cormorant | Phalacrocorax auritus | | | X |

## WILDLIFE SPECIES AT THE STM*

| SPECIES COMMON NAME | SCIENTIFIC NAME | 1987 Survey | 2005 Survey | 2011 Survey |
|---|---|---|---|---|
| **BIRDS** | | | | |
| Eastern kingbird | Tyrannus tyrannus | | | X |
| Eurasian collared dove** | Streptopelia decaocto | | | |
| European starling | Sturnus vulgaris | X | X | X |
| Golden eagle | Aquila chrysaetos | | X | |
| Grasshopper sparrow | Ammodramus savannarum | | | X |
| Great blue heron | Ardea herodias | | X | X |
| Green-tailed towhee | Pipilo chlorurus | | | X |
| Hepatic tanager | Piranga flava | | | X |
| Hermit thrush | Catharus guttatus | | | X |
| Horned lark | Eremophila alpestris | X | | X |
| House finch | Carpodacus mexicanus | | X | X |
| House sparrow | Passer domesticus | | X | X |
| House wren | Troglodytes aedon | | | X |
| Killdeer | Charadrius vociferous | X | X | X |
| Lark bunting | Calamospiza melanocorys | X | X | |
| Lark sparrow | Chondestes grammacus | | | X |
| Lazuli bunting | Passerina amoena | | | X |
| Lesser goldfinch | Carduelis psaltria | | | X |
| Loggerhead shrike | Lanius ludovicianus | | X | |
| MacGillivray's warbler | Oporornis tolmiei | | X | |
| Mallard | Anas platyrhynchos | | X | |
| Mountain bluebird | Sialia currucoides | X | X | |
| Mountain chickadee | Poecile gambeli | | | X |
| Mourning dove | Zenaida macroura | X | X | |
| Northern flicker | Colaptes auratus | X | X | |
| Northern goshawk | Accipiter gentilis | | | X |
| Northern harrier | Circus cyaneus | | X | |
| Osprey | Pandion haliaetus | | X | |
| Peregrine falcon | Falco peregrinus | | | X |
| Pine siskin | Carduelis pinus | | | X |
| Prairie falcon | Falco mexicanus | | X | |
| Red-breasted nuthatch | Sitta canadensis | | X | |
| Red-tailed hawk | Buteo jamaicensis | X | X | |
| Red-winged blackbird | Agelaius phoeniceus | X | | |
| Rock dove | Columba livia | | X | |
| Rock wren | Salpinctes obsoletus | | X | |
| Ruby-crowned kinglet | Regulus calendula | | | X |
| Sage thrasher | Oreoscoptes montanus | | | X |
| Say's phoebe | Sayornis saya | | X | |
| Sharp-shinned hawk | Accipiter striatus | | | X |
| Spotted towhee | Pipilo maculates | | X | |
| Swainson's hawk | Buteo swainsoni | | X | |
| Tree swallow | Tachycineta bicolor | | X | X |

## WILDLIFE SPECIES AT THE STM*

| SPECIES COMMON NAME | SCIENTIFIC NAME | 1987 Survey | 2005 Survey | 2011 Survey |
|---|---|---|---|---|
| **BIRDS** | | | | |
| Turkey vulture | Cathartes aura | | X | |
| Vesper sparrow | Pooecetes gramineus | | X | |
| Virginia's warbler | Oreothlypis virginiae | | | X |
| Violet-green swallow | Tachycineta thalassina | | | X |
| Western kingbird | Tyrannus verticalis | X | X | |
| Western meadowlark | Sturnella neglecta | X | X | |
| Western scrub-jay | Aphelocoma californica | | X | |
| White-crowned sparrow | Zonotrichia leucophrys | | X | |
| White-faced ibis | Plegadis chihi | | | X |
| White-throated swift | Aeronautes saxatalis | | | X |
| Yellow-breasted chat | Icteria virens | | | X |
| Yellow-rumped warbler | Dendroica coronata | | | X |
| **MAMMALS** | | | | |
| Black-tailed jackrabbit | Lepus californicus | X | | X |
| Bushy-tailed woodrat | Neotoma cinerea | X | | |
| Coyote | Canis latrans | X | X | X |
| Deer mouse | Peromyscus maniculatus | X | | X |
| Elk** | Cervus canadensis | | | |
| Fox squirrel | Sciurus niger | | X | |
| Long-tailed weasel | Mustela frenata | | X | |
| Mexican woodrat | Neotoma mexicana | | X | X |
| Mountain cottontail | Sylvilagus nuttalli | X | X | X |
| Mule deer | Odocoileus hemionus | X | X | X |
| Prairie vole | Microtus ochrogaster | X | X | |
| Raccoon | Procyon lotor | X | X | X |
| Red fox | Vulpes vulpes | X | | X |
| Striped skunk | Mephitis | | | X |
| Western harvest mouse | Reithrodontomys megalotis | X | X | X |
| Western spotted skunk | Spilogale gracilis | | | X |
| White-tailed jackrabbit | Lepus townsendii | | X | |
| Yellow-bellied marmot | Marmota flaviventris | X | | |
| **REPTILES AND AMPHIBIANS** | | | | |
| Bull snake | Pituophis catenifer | X | | X |
| Plains garter snake | Thamnophis radix | X | X | |
| Prairie lizard | Sceloporus undulatus | | | X |
| Racer | Coluber constrictor | | | X |
| Six-lined racerunner | Cnemidophorus sexlineatus | | X | |
| Tiger salamander | Ambystoma tigrinum | | X | X |
| Western rattlesnake | Crotalus viridus | X | X | X |
| Woodhouse's toad | Bufo woodhousii | | | X |

*No terrestrial arthropod genera of specific concern were detected during surveys in 2010.

**Species observed at a time other than in a survey.

# Appendix B: Wildlife Species Observed at the NWTC

## WILDLIFE SPECIES AT THE NWTC*

| SPECIES COMMON NAME | SCIENTIFIC NAME | 1996 Survey | 2003 Survey | 2011 Survey |
|---|---|---|---|---|
| **BIRDS** | | | | |
| American crow | Corvus brachyrhynchos | | | X |
| American goldfinch | Spinus tristis | | X | X |
| American kestrel | Falco sparverius | X | X | X |
| American pipit | Anthus rubescens | | | X |
| American robin | Turdus migratorius | | X | X |
| American tree sparrow | Spizella arborea | | | X |
| Bald eagle | Haliaeetus leucocephalus | | | X |
| Barn swallow | Hirundo rustica | | X | X |
| Black-billed magpie | Pica hudsonia | | X | X |
| Black-capped chickadee | Poecile atricapillus | | X | X |
| Blue-gray gnatcatcher | Polioptila caerulea | | X | |
| Blue jay | Cyanocitta cristata | | | X |
| Brewer's blackbird | Euphagus cyanocephalus | | X | X |
| Brewer's sparrow | Spizella breweri | | | X |
| Broad-tailed hummingbird | Selasphorus platycercus | | X | X |
| Broad-winged hawk | Buteo platypterus | X | | |
| Brown-headed cowbird | Molothrus ater | | X | X |
| Bullock's oriole | Icterus bullockii | | | X |
| Canada goose | Branta canadensis | | | X |
| Cedar waxwing | Bombycilla cedrorum | | | X |
| Chipping sparrow | Spizella passerina | | X | X |
| Cliff swallow | Petrochelidon pyrrhonota | | X | |
| Common grackle | Quiscalus quiscula | | X | X |
| Common nighthawk | Chordeiles minor | | X | |
| Common raven | Corvus corax | | X | X |
| Common snipe | Gallinago delicata | | | X |
| Cooper's hawk | Accipiter cooperii | X | | |
| Dark-eyed junco | Junco hyemalis | | | X |
| Double-crested cormorant | Phalacrocorax auritus | | X | |
| Downy woodpecker | Picoides pubescens | | | X |
| Eurasian collared-dove | Streptopelia decaocto | | | X |
| European starling | Sturnus vulgaris | | X | X |
| Ferruginous hawk | Buteo regalis | | X | X |
| Franklin's gull | Larus pipixcan | | | X |
| Golden eagle | Aquila chrysaetos | X | X | X |
| Grasshopper sparrow | Ammodramus savannarum | | X | X |

## WILDLIFE SPECIES AT THE NWTC*

| SPECIES COMMON NAME | SCIENTIFIC NAME | 1996 Survey | 2003 Survey | 2011 Survey |
|---|---|---|---|---|
| **BIRDS** | | | | |
| Gray catbird | Dumetella carolinensis | | | X |
| Great blue heron | Ardea herodias | | X | X |
| Great horned owl | Bubo virginianus | | | X |
| Green-tailed towhee | Pipilo chlorurus | | X | |
| Hairy woodpecker | Picoides villosus | | | X |
| Horned lark | Eremophila alpestris | | X | X |
| House finch | Carpodacus mexicanus | | X | X |
| Killdeer | Charadrius vociferus | | | X |
| Lark bunting | Calamospiza melanocorys | | | X |
| Lark sparrow | Chondestes grammacus | | X | |
| Loggerhead shrike | Lanius ludovicianus | | | X |
| Long-billed curlew | Numenius americanus | | | X |
| Mallard | Anas platyrhynchos | | X | X |
| Merlin | Falco columbarius | X | | |
| Mountain bluebird | Sialia currucoides | | X | X |
| Mountain chickadee | Poecile gambeli | | | X |
| Mourning dove | Zenaida macroura | | X | X |
| Northern flicker | Colaptes auratus | | X | X |
| Northern goshawk | Accipiter gentilis | X | | |
| Northern harrier | Circus cyaneus | X | X | X |
| Osprey | Pandion haliaetus | X | | |
| Peregrine falcon | Falco peregrinus | | X | X |
| Prairie falcon | Falco mexicanus | X | X | |
| Red-headed woodpecker | Melanerpes erythrocephalus | | | X |
| Red-tailed hawk | Buteo jamaicensis | X | X | X |
| Red-winged blackbird | Agelaius phoeniceus | | X | X |
| Rough-legged hawk | Buteo lagopus | X | X | X |
| Ruby-crowned kinglet | Regulus calendula | | | X |
| Sandhill crane | Grus canadensis | | | X |
| Savannah sparrow | Passerculus sandwichensis | | | X |
| Say's phoebe | Sayornis saya | | X | X |
| Sharp-shinned hawk | Accipiter striatus | X | | |
| Song sparrow | Melospiza melodia | | | X |
| Spotted towhee | Pipilo maculatus | | | X |
| Swainson's hawk | Buteo swainsoni | X | | X |
| Tree swallow | Tachycineta bicolor | | | X |
| Turkey vulture | Cathartes aura | X | X | X |
| Vesper sparrow | Pooecetes gramineus | | X | X |
| Western kingbird | Tyrannus verticalis | | X | X |
| Western meadowlark | Sturnella neglecta | | X | X |
| Wilson's warbler | Wilsonia pusilla | | X | |
| Yellow-rumped warbler | Dendroica coronata | | X | |

## WILDLIFE SPECIES AT THE NWTC*

| SPECIES COMMON NAME | SCIENTIFIC NAME | 1996 Survey | 2003 Survey | 2011 Survey |
|---|---|---|---|---|
| **MAMMALS** | | | | |
| Big brown bat | Eptesicus fuscus | | | X |
| Black-tailed prairie dog** | Cynomys ludovicianus | | | |
| Bobcat** | Felis rufus | | | |
| Coyote | Canis latrans | | | X |
| Deer mouse | Peromyscus maniculatus | | | X |
| Desert cottontail | Sylvilagus audubonii | | | X |
| Eastern red bat | Lasiurus borealis | | | X |
| Elk | Cervus canadensis | | | X |
| Fringed myotis | Myotis thysanodes | | | X |
| Hoary bat | Lasiurus cinereus | | | X |
| Masked shrew | Sorex cinereus | | | X |
| Meadow vole | Microtus pennsylvanicus | | | X |
| Mexican woodrat | Neotoma mexicana | | | X |
| Mule deer | Odocoileus hemionus | | | X |
| Myotis bats | Myotis sp. | | | X |
| Prairie vole | Microtus ochrogaster | | | X |
| Silver-haired bat | Lasionycteris noctivagans | | | X |
| Thirteen-lined ground squirrel | Spermophilus tridecemlineatus | | | X |
| Western harvest mouse | Reithrodontomys megalotis | | | X |
| **REPTILES AND AMPHIBIANS** | | | | |
| Boreal chorus frog | Pseudacris maculata | | | X |
| Bull snake | Pituophis catenifer | | | X |
| Woodhouse's toad | Bufo woodhousii | | | X |
| **TERRESTRIAL ARTHROPODS** | | | | |
| Aphrodite fritillary | Speyeria aphrodite | | | X |
| Cabbage white | Pieris rapae | | | X |
| Checkered white | Pontia protodice | | | X |
| Common wood nymph | Cercyonis pegala | | | X |
| Dainty sulphur | Nathalis iole | | | X |
| Gray hairstreak | Strymon melinus | | | X |
| Orange sulphur | Colias eurytheme | | | X |
| Western white | Pontia occidentalis | | | X |

*The 1996 study addressed only raptors. Mammals, reptiles, amphibians, or terrestrial arthropods were not the subject of a survey at the NWTC until the 2011 baseline survey.

**Species observed at a time other than in a survey.

# Appendix C: Environmental Permits, Registrations, and Notifications Applicable to NREL During 2012

## NREL'S ENVIRONMENTAL PERMITS, REGISTRATIONS, AND NOTIFICATIONS IN 2012

| Type | Location/ Description | Category | Issuing Agency | ID # | Permit or Registration Status |
|---|---|---|---|---|---|
| AST for petroleum storage | STM ESIF AST | Registration | DOPS | OFL6097 | Completed |
| AST for petroleum storage | STM PDU AST | Registration | DOPS | 2873-2 | Completed |
| AST for petroleum storage | STM RSF2 AST | Registration | DOPS | OFL6023 | Completed |
| AST for petroleum storage | STM SERF AST | Registration | DOPS | 2873-1 | Completed |
| Air | Laboratory-wide servicing of CFC-containing equipment | Notification | APCD | 647 | Completed |
| Air | DWOP CFC-containing stationary source | Registration | APCD | 647 | Completed |
| Air | STM SERF CFC-containing stationary source | Registration | APCD | 647 | Completed |
| Air | STM FTLB waste gas combustor | Permit | APCD | 99JE0400 | Active |
| Air | STM RFHP wood waste boiler | Permit | APCD | 07JE0277 | Active |
| Air | STM fugitive dust from construction activities | Permit | APCD | 08JE0889L | Active |
| Air | STM RSF diesel-fired standby electrical generator #1 | Permit | APCD | 10JE1400 | Active |
| Air | STM RSF diesel-fired standby electrical generator #2 | Permit | APCD | 11JE1303 | Active |
| Air | STM FTLB diesel-fired standby electrical generator | Permit | APCD | 10JE1630 | Active |
| Air | NWTC Site 4.0 diesel-fired standby electrical generator | Permit | APCD | 10JE1712 | Active |
| Air | STM parking garage diesel-fired standby electrical generator | Permit | APCD | 11JE1997 | Active |
| Air | STM ESIF diesel-fired standby electrical generator | Permit | APCD | 11JE3542 | Active |
| Air | STM IBRF scrubber and baghouse | Permit | APCD | 11JE1798 | Active |
| Alcohol | STM IBRF alcohol fuel production | Permit | TTB | AFP-CO-00255 | Active |
| Alcohol | STM tax-free alcohol use | Permit | TTB | TF-CO-0331 | Active |
| Drinking water system | NWTC drinking water system ID number | Registration | WQCD | CO0230860 | In Effect; Does Not Expire |
| Earth disturbance | STM stormwater detention basin grading permit | Permit | Jefferson County | 10-126950GP | Active |
| Earth disturbance | STM stormwater detention basin grading permit (berm) | Permit | Jefferson County | 10-106216GB | Closed |
| Earth disturbance | STM parking lot grading permit | Permit | Jefferson County | 10-127351GP | Active |
| Groundwater well | STM groundwater monitoring well MW-1 | Permit | DWR | 37232 | Active |
| Groundwater well | STM groundwater monitoring well MW-2 | Permit | DWR | 37229 | Active |

## NREL'S ENVIRONMENTAL PERMITS, REGISTRATIONS, AND NOTIFICATIONS IN 2012

| Type | Location/ Description | Category | Issuing Agency | ID # | Permit or Registration Status |
|---|---|---|---|---|---|
| Groundwater well | STM groundwater monitoring well MW-3 | Permit | DWR | 37228 | Active |
| Groundwater well | STM groundwater monitoring well MW-4 | Permit | DWR | 37231 | Active |
| Groundwater well | STM groundwater monitoring well MW-5 | Permit | DWR | 37230 | Active |
| Hazardous materials | STM WHF hazardous material storage and use permit | Permit | WMFR | 4976 | Active |
| Hazardous materials | STM SERF hazardous material storage and use permit | Permit | WMFR | 4982 | Active |
| Hazardous materials | STM S&TF hazardous material storage and use permit | Permit | WMFR | 4979 | Active |
| Hazardous materials | STM FTLB hazardous material storage and use permit | Permit | WMFR | 4977 | Active |
| Hazardous materials | STM IBRF hazardous material storage and use permit | Permit | WMFR | 4978 | Active |
| Hazardous materials | STM Shipping and Receiving hazardous material storage and use permit | Permit | WMFR | 4980 | Active |
| Hazardous materials | DWOP building 16 hazardous material storage and use permit | Permit | WMFR | 4981 | Active |
| Hazardous materials | ReFUEL hazardous material storage and use permit | Permit | Denver Fire Department | 32178 | Active |
| Hazardous waste | DWOP RCRA hazardous waste generator status EPA ID | Notification | HMWMD | CO4890000017 | Completed |
| Hazardous waste | STM RCRA hazardous waste generator status EPA ID | Notification | HMWMD | CO3890090076 | Completed |
| Hazardous waste | JSF RCRA hazardous waste generator status EPA ID | Notification | HMWMD | COD980805162 | Completed |
| Hazardous waste | NWTC RCRA hazardous waste generator status EPA ID | Notification | HMWMD | COD983802448 | Completed |
| Hazardous waste | ReFUEL RCRA hazardous waste generator status EPA ID | Notification | HMWMD | COR000207563 | Completed |
| Historic registration | STM amphitheater | Registration | NPS | 93000378 | In effect; does not expire |
| Historic registration | STM stone bunker | Registration | NPS | 93000379 | In effect; does not expire |
| Stormwater | NWTC pedestrian safety construction project | Permit | EPA | COR10ES2F | Terminated |
| Stormwater | NWTC pedestrian safety construction project | Permit | EPA | COR12A43F | Active |
| Stormwater | STM stormwater detention basin construction project | Permit | EPA | COR10EL5F | Terminated |
| Stormwater | STM stormwater detention basin construction project | Permit | EPA | COR12A36F | Active |
| Stormwater | STM ESIF construction project | Permit | EPA | COR10EH4F | Terminated |
| Stormwater | STM ESIF construction project | Permit | EPA | COR12A60F | Active |
| Stormwater | STM parking garage and south entrance construction project | Permit | EPA | COR10EE0F | Terminated |
| Stormwater | STM parking garage and south entrance construction project | Permit | EPA | COR12A61F | Active |

## NREL'S ENVIRONMENTAL PERMITS, REGISTRATIONS, AND NOTIFICATIONS IN 2012

| Type | Location/ Description | Category | Issuing Agency | ID # | Permit or Registration Status |
|---|---|---|---|---|---|
| Stormwater | NWTC dynamometer expansion construction project | Permit | EPA | COR10EP6F | Terminated |
| Stormwater | NWTC dynamometer expansion construction project | Permit | EPA | COR12A41F | Active |
| Stormwater | STM RSF II Construction Project | Permit | EPA | COR10E21F | Terminated |
| Stormwater | STM RSF II Construction Project | Permit | EPA | COR12A62F | Active |
| Stormwater | STM IBRF construction project | Permit | EPA | COR10DA6F | Terminated |
| Stormwater | STM IBRF construction project | Permit | EPA | COR12A64F | Active |
| Stormwater | STM west gate improvements construction project | Permit | EPA | COR10E08F | Terminated |
| Stormwater | STM vehicle test pad construction project | Permit | EPA | COR10E12F | Terminated |
| Stormwater | STM vehicle test pad construction project | Permit | EPA | COR12A63F | Active |
| Stormwater | NWTC site entrance construction project | Permit | EPA | COR10E06F | Terminated |

APCD - Air Pollution Control Division
AST – Aboveground Storage Tank
CFC - Chlorofluorocarbon
DFD - Denver Fire Department
DOPS - Division of Oil and Public Safety of the Colorado Department of Labor and Employment
DWOP - Denver West Office Park
DWR - Division of Water Resources
EPA - Environmental Protection Agency
ESIF - Energy Systems Integration Facility
FTLB - Field Test Laboratory Building
HMWMD - Hazardous Materials and Waste Management Division of CDPHE
IBRF - Integrated Biorefinery Research Facility
NPS - National Park Service
NWTC - National Wind Technology Center
PDU - Process Development Unit
RCRA - Resource Conservation and Recovery Act
ReFUEL - Renewable Fuel and Lubricants Research Laboratory
RFHP - Renewable Fuel Heat Plant
RSF - Research Support Facility
S&TF - Science and Technology Facility
SERF - Solar Energy Research Facility
STM - South Table Mountain
TTB - Alcohol and Tobacco Tax and Trade Bureau of the U.S. Department of the Treasury
WHF - Waste Handling Facility
WMFR - West Metro Fire Rescue
WQCD - Water Quality Control Division of Colorado Department of Public Health and Environment


National Renewable Energy Laboratory
15013 Denver West Parkway, Golden, CO 80401
303-275-3000 • www.nrel.gov

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