NREL
NATIONAL RENEWABLE ENERGY LABORATORY

Environmental Performance Report 2013

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: Feather reed grass used in landscaping in front of the ESIF at NREL's STM campus in Golden, CO.
Photo by Dennis Schroeder, NREL 27750

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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 GO—Department of Energy Golden Field Office
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
DWR—Colorado Division of Water Resources

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

FAA—Federal Aviation Administration
FDA— Food and Drug Administration
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

HAA5—Haloacetic Acids
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
LOS—Level of Service
LQG—Large Quantity Generator

MAP—Mitigation Action Plan
MBTA—Migratory Bird Treaty Act
MCL—Maximum Contaminant Level
MOA— Memorandum of Agreement
MOU—Memorandum of Understanding
mrem—Millirem
MSDS—Material Safety Data Sheet (replaced by SDS)
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
NESHAPs—National Emission Standards for Hazardous Air Pollutants
NOI—Notice of Intent
NPS—National Park Service

ODS—Ozone Depleting Substance
OHSAS—Occupational Health & Safety Advisory Services
OTF—Outdoor Test Facility

PM—Particulate Matter
PUE—Power Usage Effectiveness
PV—Photovoltaic

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

SARA—Superfund Amendments and Reauthorization Act
SDWA—Safe Drinking Water Act
SDS—Safety Data Sheet
SERF—Solar Energy Research Facility
SERI—Solar Energy Research Institute
SHPO—State Historic Preservation Officer
SITES—Sustainable Sites Initiative
SO_2—Sulfur Dioxide
SolarTAC—Solar Technology Acceleration Center
SPCC—Spill Prevention Control and Countermeasures
SPO—Sustainability Performance Office
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
WMFR—West Metro Fire Rescue
WQCD—Water Quality Control Division of CDPHE

EXECUTIVE SUMMARY

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 (STM) 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.

Photo: Researchers demonstrate the automated transfer chamber system to move samples between tools while maintaining vacuum using a mobile chamber. *Photo by Dennis Schroeder, NREL 24997*

PURPOSE

The National Renewable Energy Laboratory's (NREL's) *Environmental Performance Report* provides a description of the laboratory's environmental management activities for 2013, 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 U.S. Department of Energy (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 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 Figure E-1, and is implemented as part of an Integrated Safety Management System (ISMS).

Each year, the laboratory sets measurable objectives and targets for environmental improvement through the NREL environmental management system planning process. Goals are established through the Performance Evaluation Measurement Plan, Site Sustainability Plan (SSP), and

Figure E-1. NREL's continual improvement cycle.

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 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 NREL 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 to 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.

During 2013, NREL continued its excellent record of environmental leadership and sustainability performance. The following are some of the laboratory's key accomplishments:

- Achieved key short-term internal environmental and sustainability goals, and made progress toward long-term goals (see sections 3 and 4 for details).
- Received several awards and recognitions for environmental and sustainability accomplishments (see sidebar at the top of next column).
- Maintained International Organization for Standardization (ISO) 14001:2004 environmental management system certification.
- Maintained Colorado Environmental Leadership Program Gold-level Leader status, the highest level awarded by the state-sponsored program.

Prestigious Environmental Sustainability Awards Received

NREL received several important recognitions in 2013 for its environmental and sustainability accomplishments including:

- A DOE Green Buy Program Gold Award for purchasing 16 products in five different categories, achieving DOE's Green Buy leadership goal.
- A *Best Workplace for Commuters* recognition by the National Center for Urban Transportation Research.
- Environmental Protection Agency (EPA) Federal Green Challenge recognition both nationally and in Region 8 for green purchasing.
- A Platinum-level Federal Electronics Challenge (FEC) Award, issued by the the Office of the Federal Environmental Executive and the EPA, recognized the laboratory's leadership in green electronics purchasing, management, and recycling.

- Received LEED Platinum (Leadership in Energy and Environmental Design) certification from the U.S. Green Building Council for two new high-performance sustainable buildings, the Energy Systems Integration Facility (ESIF) and the NREL Café.
- Received SITES (Sustainable Sites Initiative) certification for sustainable landscape design and management.
- Enhanced campus "green infrastructure" by installing porous pavers to replace 800 feet (244 meters) of asphalt roadway at the STM campus, increasing stormwater infiltration.
- Initiated a radio frequency identification (RFID) chemical-inventory pilot project to improve hazardous materials management.
- Reduced overall hazardous and nonhazardous waste volumes significantly from the prior year.
- Prevented migratory bird collisions with glass bus shelters by adding a film visible to birds; shared the laboratory's experience in reducing impacts to migratory birds within DOE and among other federal agencies.
- Installed a public historical information display just south of the STM campus with information about the

former Camp George West site used by the Colorado National Guard throughout the first half of the 1900s.

- Reduced impacts of employee commuting by supporting alternative work schedules, telecommuting, and alternative commuting options such as access to mass transit, vanpool discounts, preferred parking for carpool/vanpool vehicles, ride-share coordination, and bicycle and pedestrian infrastructure.
- Reduced the laboratory's peak traffic impacts by constructing an additional right-turn lane in the eastbound direction at the intersection of Denver West Parkway and Denver West Marriott Boulevard near the STM campus.

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 does not conduct continuous radiation or radiological contamination monitoring.

The laboratory continued its excellent record of environmental compliance in 2013. 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. Actions were taken in two instances to correct circumstances that could lead to a violation.

A Compliance Advisory was received from the state when a required quarterly sample for haloacetic acids, a class of disinfection byproducts (DBPs), was not collected for the NWTC drinking water system. Although there was no impact to users, the laboratory posted a notification regarding the missed sampling event. Samples for the remainder of the year were collected according to schedule as required, and the results showed DBP levels well below the maximum allowed.

NREL is committed to protecting wildlife on campus and workers are encouraged to notify staff biologists of situations that could impact wildlife. Over several months, workers at the recently constructed ESIF reported several instances of birds colliding with the building's windows. An immediate interim solution was implemented by installing bird-visible decals on select windows. A long-term solution has been developed and is planned for implementation in early 2014.

NREL's Continued ISO 14001 Certification Demonstrates Commitment to Environmental Leadership

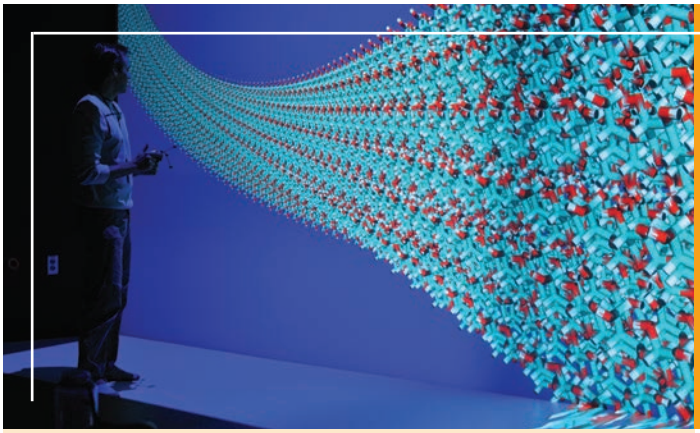
In 2013, the laboratory maintained ISO 14001:2004 certification of its environmental management system. A team of external auditors conducted an independent assessment of the policies, procedures, tools, and roles and responsibilities used in environmental management. The assessment verified that the laboratory continues to meet the requirements of the ISO 14001 standard and demonstrates our commitment to environmental stewardship.

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 (ODS) management, and greenhouse gas (GHG) 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 (NEPA) reviews
- Natural and cultural resources protection, including wildlife, vegetation, protected species, wetlands, and cultural resources management.

The laboratory continued to improve its environmental management and performance in 2013. A track record of excellent compliance with regulatory requirements and demonstrated leadership in environmental and sustainability management continued.



The Insight Center at NREL combines state-of-the-art visualization and collaboration tools to promote knowledge discovery in energy systems integration. *Photo by Denny Gruchalla, NREL 25944*

1 INTRODUCTION

1.1 PURPOSE

This report presents a summary of the National Renewable Energy Laboratory's (NREL's) 2013 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 Admin. Chg. 1, *Environment, Safety, and Health Reporting*.

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.

Sustainable landscaping at the RSF. *Photo by Robb Williamson, NREL 29509*

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)
- Renewable Fuel and Lubricants Research Laboratory (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 single high bay and small office area 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.

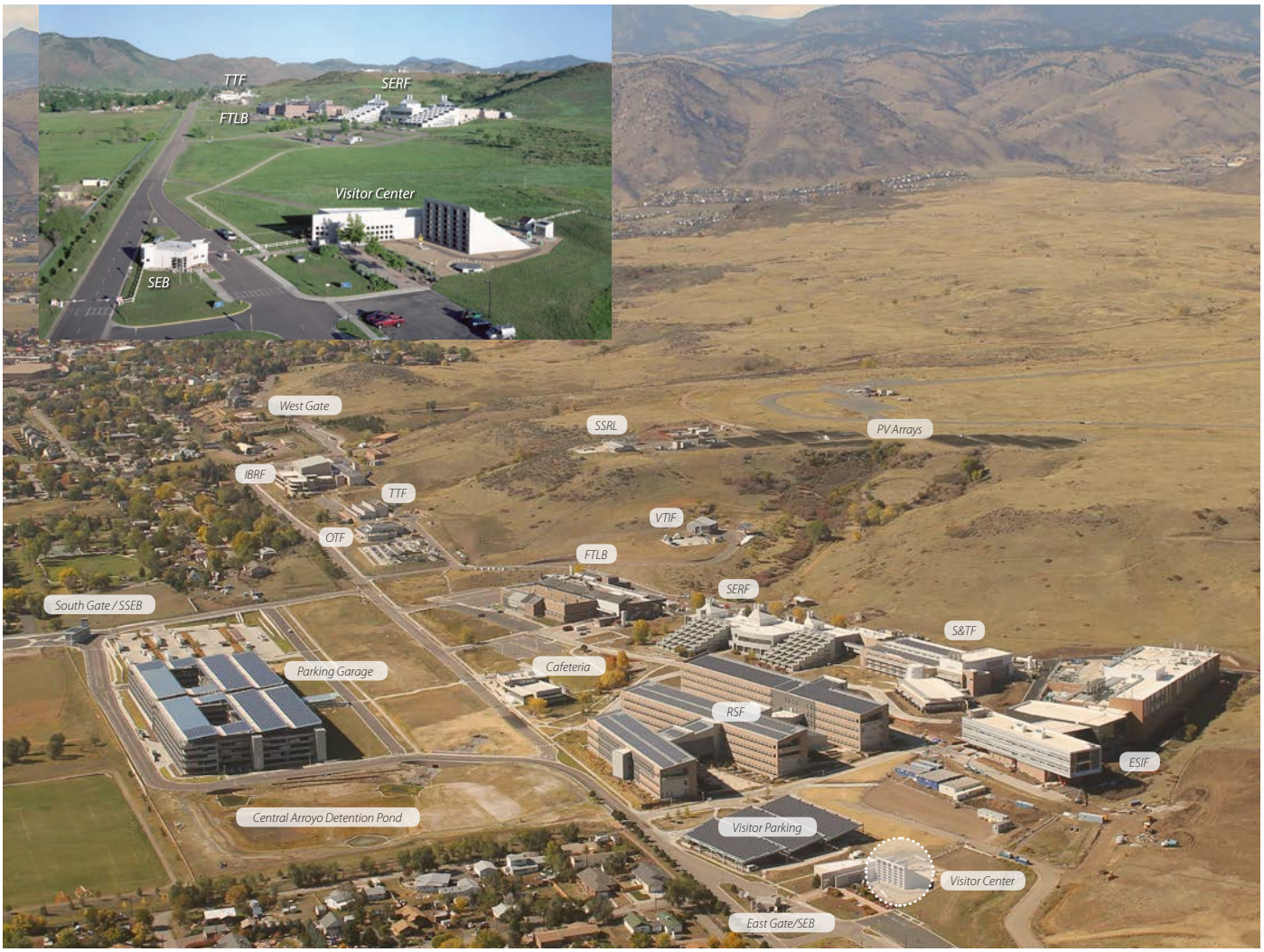
South Table Mountain Site

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 kilometers (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 (132 hectares) 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



NREL's STM campus today. Inset photo the STM campus yesterday. *Photo by Dennis Schroeder, NREL 23326. Inset photo by Warren Gretz, NREL 12568*

edge of the site. Portions of DWOP and apartment homes lie to the east.

More than half of the STM site (177 acres /72 hectares) 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.

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 drainages 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

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 (124-hectares) 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.

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.

National Wind Technology Center. *Photo by Dennis Schroeder, NREL 25869*

Surface Water

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

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

Vegetation

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

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

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

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 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 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 Fuel and Lubricants Research Laboratory

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.

ReFUEL consists of a single high bay and small office area housed within the RTD DSOC at 1900 31st Street, Denver, about 12 miles (20 km) east of the STM and DWOP sites.

NREL engineer blends fuel to be used for biofuels testing at ReFUEL. *Photo by Dennis Schroeder, NREL 22735*

The RTD DSOC facility occupies approximately 22 acres (9 hectares) 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 on-site 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.

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

CPV array at SolarTAC in Aurora, Colorado. *Photo by Dennis Schroeder, NREL 25538*

that want to make use of a real-world outdoor site to develop, test, validate, or showcase solar products. Approximately 33 miles (54 km) east of the STM site, the 74-acre (30-hectare) 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.
- Regional Test Center—This project is testing PV technologies through partnerships with manufacturers.

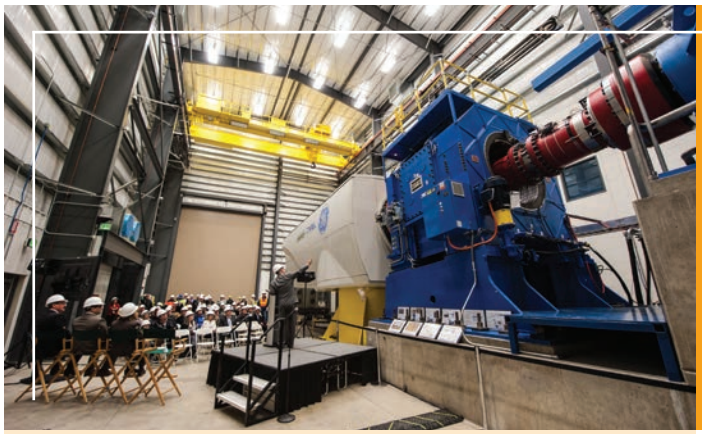
1.4 SITE ENVIRONMENTAL CONDITIONS/FEATURES

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 20 inches [50 centimeters (cm)]. 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 6 to 10 inches (15 to 25 cm).

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.



DOE and NREL dedicate the new Dynamometer Test Facility at the NWTC. One of the largest dynamometers in the world, the new facility will test wind turbine drivetrains with capacity ratings up to 5 megawatts.
Photo by Dennis Schroeder, NREL 28244

2 SIGNIFICANT ACTIVITIES IN 2013

In 2013, there was less construction activity on the STM and NWTC campuses than in the previous couple of years, though numerous minor construction projects were underway. 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.

2.1 CONSTRUCTION PROJECTS

Projects underway in 2013 included:

- Improvements to the onsite portion of Denver West Parkway, including installation of permeable pavers, were completed.
- Improvements to fire suppression systems were completed to enhance fire water supply to the western end of the STM campus.
- The dynamometer expansion project was completed at the NWTC.
- Work on the Regional Test Center at SolarTAC was completed.
- An additional right-turn lane was completed at the intersection of Denver West Parkway and Denver West Marriott Boulevard. Landscaping improvements were initiated at the Solar Energy Research Facility (SERF) and Science and Technology Facility (S&TF).
- An upgrade to the STM site-wide electrical system was begun.

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.

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 potential environmental impacts are considered. Some examples of sustainable design features used in recent projects include producing energy on-site to support net-zero energy use on campus; using passive solar design; using radiant heating and cooling; using underfloor ventilation; letting occupants open and close windows; using no- and low-volatile organice compound (VOC) materials and products selected from reputable, certified product label systems such as Green Seal, EcoLogo, and the EPA's WaterSense program; using daylighting and lighting controls; designing with wildlife in mind; and incorporating low-impact design elements to retain stormwater on-site through infiltration.

Environmentally Responsible Construction Practices

During construction, DOE and NREL 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, using a "plan of the day" to coordinate and control activities, implementation of stormwater controls prior to starting excavations, keeping wildlife safe, tracking waste diversion, minimizing and cleaning up spills, and controlling dust.

Composting and recycling reduce the laboratory's environmental footprint. *Photo by Dennis Schroeder, NREL 27221*

3 ENVIRONMENTAL MANAGEMENT SYSTEM AND POLLUTION PREVENTION

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.

The EMS is implemented as part of a DOE-required Integrated Safety Management System (ISMS) and involves all workers at the laboratory. The ISMS systematically integrates safety and environmental protection into

NREL's Environmental Aspects

NREL conducts an annual review of its activities that could potentially affect the environment. The laboratory's significant environmental aspects for 2013 were:

- Air emissions
- Surface water and 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 EMS.

ISO 14001:2004 Certified

NREL's EMS is certified to the International Organization for Standardization (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.

management and work practices at all levels to protect the public, the worker, and the environment.

The laboratory is continually working to reduce waste and prevent pollution, reducing its environmental footprint. Pollution prevention is implemented through the laboratory's EMS, the Hazard Identification and Control program, and the Sustainable NREL program.

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 Figure 1.

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, NREL's Environment, Health, & Safety (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 (EOs), and DOE orders.
- 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 3.3, Performance Indicators and Progress).

Figure 1. NREL's continual improvement cycle.

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

Facilities at NREL are designed to reduce waste and prevent pollution. The library in the RSF is designed with energy saving appliances and recycled materials. *Photo by Dennis Schroeder, NREL 23241*

Workers reduce pollution by substituting less hazardous chemicals whenever feasible. *Photo by David Parsons, NREL 04860*

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.

- 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 3.4, Assessment and Improvement).

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 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.

DOE O 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*, both of 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 O 436.1 also requires that DOE facilities comply with the Pollution Prevention Act of 1990 and support pollution prevention.

NREL has made a formal commitment to pollution prevention through its laboratory-wide environmental policy. 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. NREL's hazard

Reducing Pollution

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 greenhouse gas emissions and use of Colorado's limited water supplies.

identification and control process helps staff regularly identify opportunities to prevent pollution, and formal pollution prevention assessments are conducted periodically 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.

3.3 PERFORMANCE INDICATORS AND PROGRESS

- Each year measurable goals for environmental improvement are set. Goals are set through the following:
- Performance Evaluation Measurement Plan—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)—Sustainable NREL develops an SSP each year to establish sustainability performance commitments for the year and document activities in support of EO 13514 requirements. Results of the plan are presented in the next chapter of this report.
- Goals are owned by individuals and groups throughout the laboratory. Progress on each of these goals is tracked throughout the year and results are reported annually. Some examples of performance for the year are described in Table 1.

3.4 ASSESSMENT AND IMPROVEMENT

Assessments support the continual improvement of environmental management. Periodic assessment of the EMS and its components provides 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 NREL is "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.
- 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.
- 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.

2013 Assessments

In 2013, 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.

TABLE 1. 2013 ENVIRONMENTAL GOALS AND ACHIEVEMENTS

2013 Goals	2013 Examples	Goal Met?
Integrate environmental planning with NREL program and project planning	Identified lessons learned from the NWTC Environmental Assessment (EA) internal process and transferred these concepts to the STM EA. Modified the capital projects process to include an EHS review prior to funding determination by senior/executive management. Additionally, environmental risks are included as a risk category in a project template for use in assessing technical partnership project risks. Implemented "environment" as a standing item at the monthly construction project management group meetings.	Yes
Actively identify potential EHS risks and modify practices accordingly	Improved stormwater protection program performance across campus by including stormwater management requirements in construction specifications and requiring construction contractors to have proper stormwater protections in place prior to granting an excavation permit. Reduced the risk of migratory bird collisions and resulting deaths by retrofitting all existing glass bus shelters on campus by adding "CollidEscape" film. Shared the laboratory's expertise in reducing impacts to migratory birds by 1) nominating NREL's work on bird-friendly bus shelters and parking garage for the 2013 Presidential Migratory Bird Federal Stewardship Award, and 2) responding to numerous requests for information on bird-safe design from the public and stakeholders, including the Food and Drug Administration (FDA) and Federal Aviation Administration (FAA).	Yes
Maintain ISO 14001 and OHSAS 18001 certifications	Completed an annual third-party audit which verified the laboratory's continued conformance with the ISO 14001 and Occupational Health & Safety Advisory Services (OHSAS) 18001 management system standards. Completed corrective actions and opportunities for improvement from the prior year ISO/OHSAS surveillance audit. Improved procedures regarding assessments, corrective action management, and document control. Completed an internal audit of the Particulate Emission Control for Construction Program. Maintained EHS performance data on the NREL dashboard; senior managers across the lab use the dashboard as a tool for communicating EHS performance issues with their staff.	Yes
Reduce impacts of employee commuting by reducing individual vehicle miles travelled and to implement a traffic mitigation plan for the STM campus—including alternative work schedules and telecommuting	Throughout 2013, traffic monitoring and intersection analysis indicated that NREL-generated traffic volumes and levels of service remained within acceptable levels. NREL continues to offer incentives for employees to participate in alternative commuting options such as access to mass transit, vanpool discounts, preferred parking for carpool/vanpool vehicles, ride-share coordination, and bicycle and pedestrian infrastructure (i.e., bicycle maintenance stations, bicycle parking, extension of sidewalks, etc.).	Yes
To support NREL's long-term goal of achieving a net-zero energy campus, seek to reduce electricity use per square foot by 3% per year, starting with a 2008 baseline	NREL exceeded its goal of 3% per year reduction in energy use per square foot (from a 2008 baseline), reducing energy use from 277 to 183 kBtu/sq. ft. The reduction was due to the implementation of energy efficiency measures and construction of several highly energy efficient facilities.	Yes
Seek certification in the SITES—Pilot Program on Landscaping Green Certification for Sustainable Landscaping	NREL received the Sustainable Sites Initiative (SITES) Green Certification, with a score of three out of four possible stars. The laboratory expanded its initial goal to certify the Research Support Facility (RSF) and included two newly constructed projects, a stormwater detention area, as well as a parking garage and new site entrance building. Sustainable landscaping features include plants and trees that are Colorado native or adapted and non-invasive species, landscaping walls built from stone excavated on-site, pavers designed to allow stormwater to infiltrate and enhance water quality, and drip irrigation.	*Yes*

2013 Accomplishments and Highlights

- In 2013, NREL maintained its ISO 14001:2004 certification. 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.
- In 2013, the laboratory worked to enhance the integration of environmental and safety considerations into laboratory planning processes (see Table 1).
- The laboratory's multiple policies related to environment, health, and safety management were combined and streamlined to eliminate redundancy and improve the clarity of NREL's commitments. Related laboratory procedures were reorganized to match the new policy structure.
- NREL developed improved metrics for monitoring performance on environmental objectives and targets, training, and inspection completion.
- The laboratory improved laboratory procedures for assessments, corrective action management, and document control.
- NREL conducted several internal assessments of environmental management programs and identified areas for continual improvement (for details, see section 3.4, Assessment and Improvement).
- The laboratory completed two pollution prevention assessments regarding the potential to recycle used or broken PV panels and the potential to use biodiesel as a viable fuel in backup generators. In each assessment, it was determined that there was currently no feasible alternative.

The following assessment activities took place in 2013:

- Internal assessments—An internal assessment was conducted of the laboratory's Particulate Emission Control for Construction Program. Scheduled interviews were conducted, and reviews of relevant procedures and records were completed. Three opportunities for improvement were identified and have been addressed.
- Evaluations of compliance—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 the prior year. 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:
  - Emergency Planning and Community Right-to-Know Act (EPCRA) reporting
  - Ozone depleting substances management
  - EMS
  - Environmental and sustainability management
  - EHS inspections
  - National Environmental Policy Act (NEPA).

  Two areas of potential non-compliance with regulatory requirements were identified and have been addressed, including incomplete records of service for equipment containing 50 or more pounds of ozone-depleting substances (ODS), and disinfectant byproducts present in the NWTC drinking water supply above the applicable standard.
- External assessments—in 2013, NREL maintained its certification under ISO 14001. 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 three findings and several opportunities for improvement. Corrective actions are underway to address deficiencies in training, document control, and risk control.

3.5 2013 AWARDS AND RECOGNITION

In 2013, NREL received several awards and recognition of its environmental and sustainability achievements including:

- DOE Green Buy Program Gold Award
- Federal Electronics Challenge (FEC) Platinum Award
- Best Workplace for Commuters Award
- Federal Green Challenge Award
- CELP Gold-Level Leader.

DOE Green Buy Program Gold Award

NREL received a DOE Green Buy Program Gold Award for purchasing 16 priority product types, achieving excellence in sustainable acquisition.

FEC Platinum Award

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.

The FEC award program ended in August 2013. Going forward, the laboratory will seek recognition for its leadership in electronic stewardship through the EPA's Federal Green Challenge.

Best Workplace for Commuters

The laboratory was recognized as a Best Workplace for Commuters by the National Center for Urban Transportation Research.

Federal Green Challenge

NREL was recognized in the U.S. Environmental Protection Agency (EPA) Federal Green Challenge both nationally and in Region 8 for green purchasing.

Colorado Environmental Leadership Program Gold-Level Leader

NREL maintained its status as a CELP Gold-level Leader, the highest level awarded by the program. 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 focuses 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: 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 EOs, 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.

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

The ESIF received LEED Platinum certification.
Photo by Dennis Schroeder, NREL 25300

4.1 SITE SUSTAINABILITY PLANNING

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 EO 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) 2014. 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 execution of the mission. 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 FY 2013, staff (i.e., employees and subcontractors) increased 4% from FY 2012, and the laboratory's building square footage increased by 23%. While experiencing growth, in the current economic climate, it is uncertain if this trend will continue. While there are no new Congressional Line Item projects identified at this time, the laboratory is conducting planning activities so that it is positioned to accommodate future growth through the construction of new high-performance buildings, energy efficiency retrofits, and renewable energy systems

NREL's Cafeteria offers a precedent model for creating a high performing, low-energy consuming, and "state-of-the-art" example of efficient food service. The facility received LEED Platinum certification. *Photo by Dennis Schroeder, NREL 21698*

Worker plugs his electric vehicle into one of 36 charging stations in the STM parking garage, designed to LEED Platinum standards to maximize energy savings and environmental stewardship. *Photo by Dennis Schroeder, NREL 26671*

2013 Accomplishments and Highlights

Two new, high-performance sustainable buildings, the ESIF and the Café, achieved LEED (Leadership in Energy and Environmental Design) Platinum certification from the U.S. Green Building Council.

- NREL was recognized with several prestigious awards that acknowledged the laboratory's exemplary performance in sustainability (see section 3, Environmental Management System and Pollution Prevention)
- Laboratory staff developed an internal dashboard to present sustainability goal performance
- NREL initiated a site-specific climate change adaptation planning pilot project
- Laboratory staff developed a *Best Practices Guide* and template materials for the Sustainability Performance Office's (SPO) website for sustainability campaign development and communication for DOE sites and laboratories.

that take advantage of alternative financing mechanisms, including power purchase agreements, energy savings performance contracts, partnerships with energy service companies , and cooperative research and development agreements (CRADAs). NREL continues to review the use of overhead funds, cost savings reinvestment, and leveraged alternative financing to support new projects or retrofits on campus.

4.2 2013 SSPP GOAL PERFORMANCE

Table 2 summarizes each of DOE's Strategic Sustainability Performance Plan (SSPP) goals and NREL's performance status. For more specific information, please refer to the full SSP referenced.

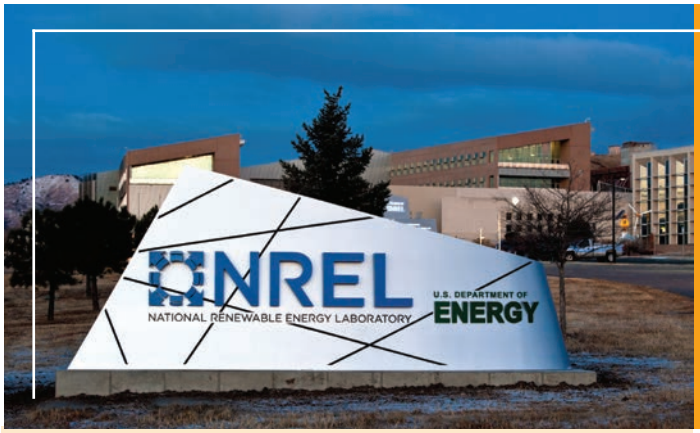
TABLE 2. NREL'S PERFORMANCE STATUS TOWARD DOE SUSTAINABILITY GOALS

SPP Goal #	DOE SSPP Goal	NREL Performance Status in FY 2013	Status
1.1	28% GHG reduction from sources such as heating, cooling, and electricity use by FY 2020 from a FY 2008 baseline (2013 target: 17%).	Emissions from energy use reduced 10% from the 2008 baseline (without RECs) and 31% from the 2008 baseline (including RECs).	On Track
1.2	13% GHG reduction from sources such as air travel and commuting by FY 2020 from a FY 2008 baseline (2013 target: 4%).	Emissions from sources such as transportation increased 11% from the 2008 baseline. The reduction on a per employee basis will be met, however meeting the absolute reduction from the 2008 baseline will be challenging due to increased staffing.	Not On Track
2.1	30% building energy use per square foot reduction by FY 2015 from a FY 2003 baseline.	Decreased over 50% since 2003.	On Track
2.2	Perform energy and water audits.	Performed energy and water audits on buildings representing 7% of total site energy use in FY 2013.	On Track
2.3	Individual buildings or processes metered for 90% of electricity (by October 1, 2012); for 90% of steam, natural gas, and chilled water (by October 1, 2015).	Replaced 13 NWTC electric submeters to increase data quality and added 27 new meters in the ESIF.	On Track
2.4	Energy efficient cool roofs, unless uneconomical, for roof replacements.	Cool roofs make up 69% of NREL's roof areas, a 43% increase from FY 2012.	On Track
2.5	15% of existing buildings greater than 5,000 GSF (465 gross square meters) are compliant with the federal green building standards by FY 2015.	NREL currently has four buildings (17%) compliant with federal green building standards. NREL performed assessments on five additional buildings this year.	On Track
2.6	All new construction, major renovations, and alterations of buildings greater than 5,000 GSF GSF (465 gross square meters) must comply with federal green building standards and where the work exceeds $5 million, each are LEED – New Construction Gold certification or equivalent.	The new OTF expansion project will incorporate federal green building requirements and achieve at least LEED Gold certification.	On Track
3.1	10% annual increase in fleet alternative fuel consumption by FY 2015 relative to a FY 2005 baseline.	Alternative fuel use has grown 145% since 2005.	On Track
3.2	2% annual reduction in fleet petroleum consumption by FY 2020 relative to a FY 2005 baseline.	Petroleum fuel usage has grown 73% since 2005.	Not On Track

Table 2 continued on page 28

TABLE 2. NREL'S PERFORMANCE STATUS TOWARD DOE

SPP Goal #	DOE SSPP Goal	NREL Performance Status in FY 2013	Status
3.3	100% of light duty vehicle purchases must consist of alternative fuel vehicles by FY 2015 and thereafter (2000-2015).	No light-duty vehicles purchased in FY 2013.	Not Applicable
3.4	Reduce fleet inventory of non-mission critical vehicles by 35% by 2013 relative to a FY 2005 baseline.	Vehicle reduction is complete. To date NREL has reduced its fleet by eight vehicles; 100% of remaining fleet vehicles are mission critical.	On Track
4.1	26% potable water intensity (gallons per GSF) reduction by FY 2020 from a FY 2007 baseline.	Water intensity is 16% less than the reduction goal.	On Track
4.2	20% water consumption reduction of industrial, landscaping, and agricultural water by FY 2020 from a FY 2010 baseline.	NREL does not use industrial, landscaping, and agricultural water.	Not Applicable
5.1	Divert at least 50% of non-hazardous solid waste, excluding construction and demolition debris, by FY 2015.	Diverted 77% of campus waste from the landfill in FY 2013.	On Track
5.2	Divert at least 50% of construction and demolition materials and debris by FY 2015.	Diverted 90% of construction waste from the landfill in FY 2013.	On Track
6.1	Procurements meet sustainability requirements and include sustainable acquisition clause (95% each year).	All construction and custodial contracts met sustainable acquisitions requirements.	On Track
7.1	All data centers are metered to measure energy efficiency by FY 2015.	The RSF and ESIF data centers measure monthly energy efficiency.	On Track
7.2	Maximum annual weighted average energy efficiency rating (i.e., Power Usage Effectiveness) of 1.4 by FY 2015.	The average energy efficiency rating for the RSF Data Center was 1.18.	On Track
7.3	Electronic Stewardship – 100% of eligible PCs, laptops, and monitors with power management actively implemented and in use by FY 2012.	Power management is enabled on 100% of devices.	Goal Met
8.1	20% of annual electricity consumption from renewable sources by FY 2020 (2013 target: 7.5%).	30% of NREL's electricity was generated on-site in FY 2013.	On Track



5 COMPLIANCE SUMMARY

NREL is subject to many federal, state, and local environmental laws and regulations, as well as EOs and DOE orders, and memoranda of understanding with government agencies. NREL continues its excellent record of environmental compliance.

In 2013, 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. Actions were taken in two instances to correct circumstances that could lead to a violation.

A Compliance Advisory was received from the state when a required quarterly sample for haloacetic acids (HAA5), a class of disinfection byproducts (DBPs), was not collected for the NWTC drinking water system. The laboratory posted a notification regarding the missed sample and the potential effects on users as required by the Compliance Advisory. DBP samples required for the remainder of the year were collected as required and the results showed DBP levels well below the maximum contaminant levels (MCLs).

Seventeen bird deaths occurred from collisions with windows from August to November at the recently constructed ESIF. The collisions involved 8 species, including 6 mourning doves, 6 songbirds, 2 pigeons, 1 magpie, and 2 unknown. An immediate interim solution was implemented by installing UV light-reflecting decals on select windows. A long-term solution is being developed and is planned for implementation prior to the 2014 migration season.

Table 3 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.

Photo by Dennis Schroeder, NREL 18573

TABLE 3. 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 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 EPA. Several main categories for air pollutants are regulated: criteria air pollutants, non-criteria pollutants, hazardous air pollutants (HAPs), and ODSs. EPA regulation 40 CFR 82, Protection Of Stratospheric Ozone, requires that servicing records must be kept for appliances containing more than 50 pounds (23 kilograms/kg) of Class 1 or 2 ODS refrigerant. 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. 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. NREL did not exceed any air permit standard or other air regulatory requirement at any facility. The laboratory filed Air Pollution Emission Notices (APENs) and air permits for eleven new or previously exempt air emissions sources. APENs were filed with the state for six previously exempt standby generators for which APENs are now required due to Air Pollution Control Division (APCD) rule change. These standby generators remain permit exempt. NREL reported air emissions to the state for five sources which are air permit exempt but exceed the emission reporting threshold; APENs are maintained with the state for these sources and are renewed every five years. An evaluation of HAP emissions indicated that emissions were well below reporting and permitting thresholds. All required ODS equipment registrations were completed. NREL facilities servicing refrigeration equipment were registered and all refrigeration service personnel maintain the federal and state required training and certification. The laboratory evaluated CO2e and GHG emissions and emissions were below the threshold for federal reporting and permitting rules. The required annual street sanding report was provided to the state and Jefferson County. An assessment of selected generators was performed to confirm compliance with state air permit requirements regarding run time. No deficiencies were identified.	**NAAQS** 40 CFR 50 **ODS** 40 CFR 82 and CDPHE CCR 1001-19, Reg. 15 **New Source Performance Standards** 40 CFR 60 **New Source Review, Prevention of Significant Deterioration** 40 CFR 51 **Title V** 40 CFR 70 and 71 **NESHAPs, HAP** 40 CFR 63 and CDPHE 5 CCR 1001-5, Reg. 3 **Permitting** CDPHE 5 CCR 1001-5, Reg. 3 **GHG** 40 CFR 98 and 40 CFR 51, 52, 70, 71 **Street Sanding** CDPHE 5 CCR 1001-18, Reg. 16
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.	A Compliance Advisory was received from the state when a required quarterly sample for haloacetic acids (HAA5), a class of DBPs, was not collected. The laboratory posted a notification regarding the missed sample and the potential effects on users as required by the Compliance Advisory. DBP samples for the remainder of the year were collected as required and the results showed DBP levels well below the MCLs. All other monitored parameters in 2013 met applicable requirements. 501,269 gallons (1,897,509 liters) of drinking water was provided to NWTC users.	EPA: 40 CFR 141–149 CDPHE: 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).	Submitted the Geothermal Well Construction and Test Report (Form GX-01) to the Colorado Division of Water Resources for the South SEB closed loop geothermal system. NREL currently has five permitted monitoring wells at the STM site. The wells are not currently used for monitoring activities.	CDPHE: 5 CCR 1002-41 2 CCR 402-2

TABLE 3. FEDERAL, STATE, AND LOCAL ENVIRONMENTAL LAWS AND REGULATIONS APPLICABLE TO NREL

Report Sections	Regulatory Program Description	Compliance Status and Highlights	Regulator & Requirement
Surface Water Quality	Construction-related stormwater discharge regulations are administered by the EPA at federal facilities in Colorado. 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. Permit coverage was obtained under the EPA Construction General Permit (CGP) for one new construction project at the STM site. Five permits for completed projects were terminated in 2013. Monthly stormwater inspections were performed for construction sites where federal permit coverage continues during the restoration phase of these projects. Weekly inspections occurred for construction sites with an active federal stormwater permit. State stormwater permits were maintained by subcontractors at two experimental research projects at the SolarTAC site. Successful revegetation, defined in the federal stormwater permit as vegetative cover equivalent to 70% of pre-disturbance cover, was achieved at four major construction sites. Carefully selected seed mixes and mulches together with weed management and temporary irrigation were instrumental in achieving the EPA criteria.	EPA: 40 CFR 122.26 CDPHE: 5 CCR 1002-61 Regs. 38, 61, 65, and 93
Wastewater Management	The federal Clean Water Act (CWA) and Colorado Water Quality Control Act regulations apply to wastewater management at NREL's STM and 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. Inspection and permitting of individual sewage disposal systems have been delegated to Jefferson County by CDPHE.	All program activities were in compliance with requirements.	EPA: 40 CFR 122-136 CDPHE: 5 CCR 1002-62 & 63
Hazardous Materials Management	EO 13423 outlines requirements for Superfund Amendments and Reauthorization Act (SARA) Title III, EPCRA compliance, and Toxic Release Inventory reductions for DOE facilities. 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 Department. Hazardous Materials Information System requirements, including permitting, inventory, and annual inspection.	All program activities were in compliance with requirements. In 2013, NREL submitted a Tier II report to the state and the Local Emergency Planning Committee (LEPC) for reporting year 2012, 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 2012. 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. In order to meet OSHA's new hazard communication requirements (29 CFR 1910.1200), NREL provided detailed training on the components of the newly adopted Global Harmonization System (GHS). Employers were required to train all employees who might be exposed to chemical hazards in the workplace on these requirements by December 1, 2013. NREL met that goal by providing classroom training for employees working in a lab. In addition to classroom training, more information on the GHS components were provided to workers on NREL's intranet site.	EPA: 40 CFR 355, 370, 372

Table 3 continued on page 32

TABLE 3. FEDERAL, STATE, AND LOCAL ENVIRONMENTAL LAWS AND REGULATIONS APPLICABLE TO NREL

Report Sections	Regulatory Program Description	Compliance Status and Highlights	Regulator & Requirement
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. All regulatory notifications were updated and applicable waste generator fees were paid for five NREL facilities. An assessment was conducted of the universal waste program, identifying no concerns, two findings, six opportunities for improvement and six noteworthy practices. Corrective actions have been implemented to close the findings and opportunities for improvement are being addressed.	EPA: 40 CFR 260— 280 CDPHE: 6 CCR 1007-3
Above-ground Storage Tank (AST) Management	ASTs are regulated in Colorado by the Colorado Department of Labor and Employment (CDLE) Division of Oil and Public Safety under the Colorado AST regulation 7 CCR 1101-14. Colorado requires that ASTs 660 gallons (2,498 liters)or larger be permitted prior to installation and registrations submitted annually.	All program activities were in compliance with requirements. No spills or releases from NREL's ASTs or related fueling activities occurred. A state inspection of registered ASTs was completed with no violations noted. One installation permit was obtained for a planned 1,000 gallon (3,785 liters) E-85 fleet vehicle fuel tank at the STM facility. One 2,500 gallon (9,463 liters) AST at the SolarTAC facility received a state installation inspection and was registered.	CDLE: Division of Oil and Public Safety (DOPS) Storage Tank Regulations, 7 CCR 1101-14
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 (4,997 liters) of oil or where a spill has the potential to enter waters of the United States.	All program activities were in compliance with requirements. An SPCC plan was developed and implemented for the SolarTAC facility. Workers who manage and/or operate oil-containing equipment received annual SPCC training. There were no reportable spills. Nine minor spills of diesel, lubricant, coolant, 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 (0.38 liters to 57 liters). The majority of these spills were the result of construction activities. Each spill received immediate remedial action and did not result in any significant impact to the environment.	EPA: Oil Pollution Prevention 40 CFR 112 CDLE: DOPS Storage Tank Regulations, 7 CCR 1101-14
Radiological Materials and Waste Management	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. DOE O 458.1, Radiation Protection of the Public and the Environment establishes radiation emission limits for DOE facilities.	All program activities were in compliance with requirements. No planned or unplanned radiological releases occurred. The effective dose equivalent to the public from NREL activities was 0.036 millirem (mrem) per year, far below the 10 mrem per year limit.	EPA: 40 CFR 61, Subpart H DOE: DOE O 458.1

TABLE 3. FEDERAL, STATE, AND LOCAL ENVIRONMENTAL LAWS AND REGULATIONS APPLICABLE TO NREL

Report Sections	Regulatory Program Description	Compliance Status and Highlights	Regulator & Requirement
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. Four hundred seventy six NEPA reviews were conducted for project activities on- and off-site during CY 2013. Updated the NEPA program to reflect the revised DOE NEPA implementing regulations and new classes of Categorical Exclusions. Progress continued on the site-wide Environmental Assessments (EAs) for the NWTC and STM sites, including completion of several activities such as internal scoping, public/agency scoping, and request for public comment.	Council for Environmental Quality: 40 CFR 1500–1508 DOE: 10 CFR 1021
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. 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. Under the "Memorandum of Understanding (MOU) between DOE and the U.S. Fish and Wildlife Service (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.	Seventeen bird deaths occurred from collisions with windows from August to November at the recently constructed ESIF. The collisions involved 8 species, including 6 mourning doves, 6 songbirds, 2 pigeons, 1 magpie, and 2 unknown. An immediate interim solution was implemented by installing UV light reflecting decals on select windows. A long-term solution is being developed and is planned for implementation prior to the 2014 migration season. One bird death, an American Crow, was reported at the NWTC during the year. Workers at the site are requested to report incidental observations of bird mortalities to environmental program staff who track this information.	U.S. Fish and Wildlife Service: MBTA 16 U.S.C. 703-712 Colorado Division of Parks and Wildlife: CRS 33-6-128 MOU between DOE and the U.S. Fish and Wildlife Service (USFWS) 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. 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.	U.S. Fish and Wildlife Service: 50 CFR 17

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TABLE 3. FEDERAL, STATE, AND LOCAL ENVIRONMENTAL LAWS AND REGULATIONS APPLICABLE TO NREL

Report Sections	Regulatory Program Description	Compliance Status and Highlights	Regulator & Requirement
Vegetation Management	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. 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.	All program activities were in compliance with requirements. Aggressive weed management continued. Knapweed is nearly under control at the NWTC and Canada thistle, hounds tongue, and myrtle spurge are under control at the STM site. In support of the goal to eliminate the A-listed noxious weed myrtle spurge from the STM site, the species was treated for the third consecutive year and the affected areas have been much reduced. At the NWTC, herbicides were applied to approximately 88 acres (35.6 hectares) in April, 42 acres (17 hectares) in June, and 88 acres (35.6 hectares) in September. At the STM site, approximately 16 acres (6.5 hectares) were treated in May-June, 2 acres (0.8 hectares) in July, and 9 acres 3.6 hectares) in September. The application of restricted-use herbicides was conducted using certified applicators.	EO 13112 EPA: 40 CFR 162—171(f)
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 U.S. Army Corp of Engineers (USACE). Jefferson County requires approval of development proposed in floodplains within its jurisdiction.	All program activities were in compliance with requirements. 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.	EO 11990 USACE: CWA Section 404 DOE: 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 requires that Federal agencies consult with the State Historic Preservation Office (Colorado Office of Archaeology & Historic Preservation) and other consulting parties for undertakings that may impact historic properties.	All program activities were in compliance with requirements. Two structures at the STM site are listed on the National Register of Historic Places. There are no known eligible structures at the NWTC. In June 2013, DOE and NREL completed an informational display as mitigation for impacts to the former Camp George West 500- and 600-yard small arms firing lines during the construction of the south access road to the STM campus in accordance with a 2011 MOA with the Colorado Office of Archaeology & Historic Preservation. The firing lines are considered contributing features of the Camp George West Historic District. The informational display is located off of Research Road in Pleasant View Community Park and is accessible to the public.	Advisory Council on Historic Preservation: 36 CFR 60 36 CFR 63 36 CFR 79 36 CFR 800 16 U.S.C. 470

TABLE 3. FEDERAL, STATE, AND LOCAL ENVIRONMENTAL LAWS AND REGULATIONS APPLICABLE TO NREL

Report Sections	Regulatory Program Description	Compliance Status and Highlights	Regulator & Requirement
EMS and Sustain-ability	DOE O 436.1, Departmental Sustainability 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. 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. 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. 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.	EO 13423 EO 13514 DOE: DOE O 436.1
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: 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: • The intersection of Denver West Parkway and Denver West Marriott Boulevard operates at a Level of Service (LOS) of D or better • The intersection of Quaker St. and South Golden Road operates at a Level of Service of D or better • Traffic flow to and from the STM east entrance will be monitored semi-annually • Specific Transportation Demand Management (TDM) strategies be implemented as needed to ensure the traffic thresholds are not exceeded. Strategies include alternative work schedules (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. Transportation Demand Management measures required by the MAP were continued in 2013. Average PM peak hour traffic volume at the intersection of Denver West Parkway and Denver West Marriott Boulevard was 307 vehicle trips. The monitoring periods were April 2013, August 2013, and November 2013. The MAP threshold of Level of Service 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.	DOE/EA-1440-S-I (May 2008) Traffic MAP

6 AIR QUALITY PROTECTION

NREL strives to minimize air emissions, tracks air emissions from the larger on-site sources, confirms that on-site sources have air permits as required, and meets federal and state air emissions and permitting requirements.

Minimizing air emissions creates direct health benefits for immediate neighbors to the laboratory and for those in the Denver metropolitan area. Reducing emissions also reduces the complexity of the facility's air permits and reduces associated emission controls, tests, and reporting requirements.

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

2013 Accomplishments and Highlights

- Updated the air emissions inventory, including new sources and the use of equipment-specific emission factors where available. This has resulted in a more accurate emission inventory and estimated nitrogen oxide (NO_x) emissions decreased due to this effort.
- Provided hazardous air pollutant (HAP) emissions estimates and compliance guidance to NREL research staff related to several small-scale research projects.
- Completed an evaluation of compliance with federal and state facility-wide permitting and emissions control requirements. All facilities and individual permitted equipment items remain classified as minor sources.

Solar Energy Research Facility. *Photo by Dennis Schroeder, NREL 21754*

emissions and maintain a current and accurate air emission inventory.

Program Management

The 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 (91 metric tons) per year for a criteria pollutant such as: NO_x, volatile organic compounds (VOCs), particulate matter (PM_{10}), carbon monoxide (CO), or sulfur dioxide (SO_2). Under that same regulation, a Title V permit would be required if a single HAP level exceeds 10 tons (9.1 metric tons) per year, or the total emissions of all HAP pollutants at one facility exceeds 25 tons (22.7 metric 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 (22.7 kg to 2,268 kg) per year.

Air emission reporting in Colorado is required for an item of equipment that emits 1 ton (0.9 metric tons) per year or more of any criteria air pollutant. A state air permit may be required if a piece of equipment emits as little as 1 ton (0.9 metric tons) per year of any criteria pollutant. The trigger level varies from 1 to 10 tons (0.9 to 9.1 metric tons) per year depending on requirements for the 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 (PM_{10} and $PM_{2.5}$), ozone, and lead—have been issued National Ambient Air Quality Standards (NAAQS) by the EPA.
- 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.
- ODSs such as chlorofluorocarbons or "Freon" and hydrochlorofluorocarbons that are being phased out of use in comfort heating and cooling systems and equipment.
- GHG compounds such as carbon dioxide, methane, nitrous oxide, and many man-made refrigerant gases that contribute to global warming.

There are various federal and state 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, bench- and pilot-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. The laboratory maintains several air permits issued by the state for "minor" sources, including standby electrical generators and pollution control systems at the STM, NWTC, and SolarTAC sites. All of these individual emission sources and each NREL facility are considered by the EPA and state 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 (10.1 hectares), or occurring for longer than six months, are subject to state fugitive particulate emissions permits. A fugitive emission permit is in effect for construction activity at the STM site.

Permitting

Most sources of air emissions from NREL laboratory and facility operations are small scale and do not require permitting. While permitting thresholds may vary, depending on the pollutant, the state 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 are evaluated and air emission reporting and permitting are performed as required.

HAP 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 (23 kg) per year to more than 2,000 pounds (907 kg) per year.

Ozone-Depleting Substances

EPA regulation 40 CFR 82, Protection of Stratospheric Ozone, requires that appliances and stationary appliances containing more than 50 pounds (23 kg) of Class I or II 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):

1. Facilities where maintenance activities are performed on refrigeration equipment containing ODS are required to file an annual notification with CDPHE.
2. 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.
3. Refrigeration equipment larger than 100 horsepower (hp) containing ODS must be registered annually with the state. 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 the state—two located at the SERF on the STM site, and one at the DWOP. NREL performs the necessary annual notification that maintenance activities occurred, renews the registration for the three chillers, and confirms 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 (23 kg) 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 (PM_{10} or smaller) which can become airborne, significantly contributing to particulate pollution in the Denver area. As these particulates contribute to breathing and health problems for susceptible individuals, the EPA and state have issued regulations to minimize this source of air pollution.

NREL complies with the sanding requirements and files an annual sanding report with the state. The laboratory uses only deicer to maintain roadways. 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.

Greenhouse Gas 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 carbon dioxide equivalent ($CO2_e$) emissions are greater than 100,000 U.S. tons (90,718 metric tons) per year. The Mandatory Reporting Rule requires annual GHG reporting to EPA if $CO2_e$ emissions are greater than 25,000 metric tons (27,557 U.S. tons) per year. Reporting and permitting of GHGs are not currently required for NREL facilities as emissions are below EPA reporting and permitting thresholds.

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

2013 Compliance Summary and Activities

- Program activities were in compliance with requirements. The laboratory did not exceed any air permit standard or other air regulatory requirement at any facility.
- The laboratory filed APENs and air permits for eleven new or previously exempt air emissions sources. APENs were filed with the state for six previously exempt standby generators for which APENs are now required due to APCD rule change. These standby generators remain permit-exempt.
- NREL reported air emissions to the state for five sources which are air permit exempt but exceed the emission reporting threshold; APENs are maintained with the state for these sources and are renewed every five years.
- An evaluation of HAP emissions at NREL indicated that emissions were well below reporting and permitting thresholds.
- All required ODS equipment registrations were completed. NREL facilities servicing refrigeration equipment were registered and all refrigeration service personnel maintain the federal and state required training and certification.
- The laboratory evaluated and concluded that $CO2_e$ and GHG emissions were below the threshold for federal reporting and permitting rules.
- NREL provided the required annual street sanding report to the state and Jefferson County.
- DOE performed an assessment for selected NREL generators to confirm compliance with state air permit requirements regarding run time. No deficiencies were identified.

Extraordinarily heavy rains filled the stormwater detention basin at the STM site in September 2013.
Photo by Dennis Schroeder, NREL 27735

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 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 (56,781 liters). 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 a monthly and 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.

NREL's management of the drinking water system is subject to assessments by DOE and compliance inspections by 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 EPA has established allowable levels for drinking water

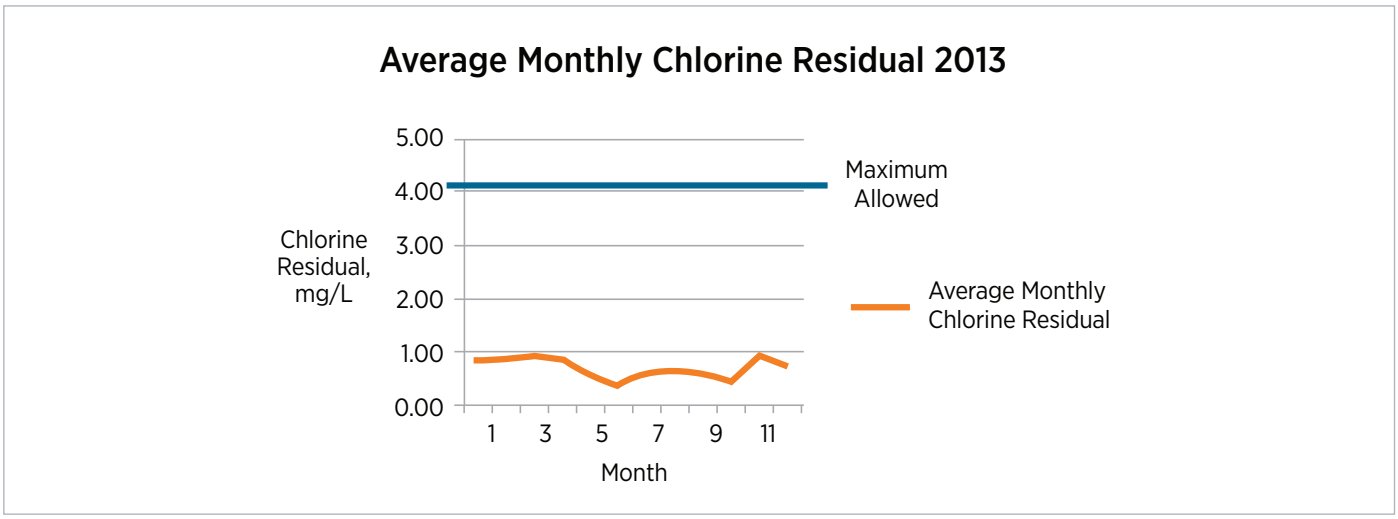


Figure 2. Results of 2013 chlorine monitoring.

constituents known as 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. Figures 2 and 3 show the results of the chlorine and DBPs monitoring for 2013.

2013 Compliance Summary and Activities

- A Compliance Advisory was received from the state when a required quarterly sample for haloacetic acids (HAA5), a class of DBPs, was not collected. The laboratory posted a notification regarding the missed sample and the potential effects on users as required by the Compliance Advisory. DBP samples for the remainder of the year were collected as required and the results showed DBP levels well below the MCLs.
- All other monitored parameters in 2013 met applicable requirements.
- 501,269 gallons (1,897,509 liters) of drinking water was provided to NWTC users.

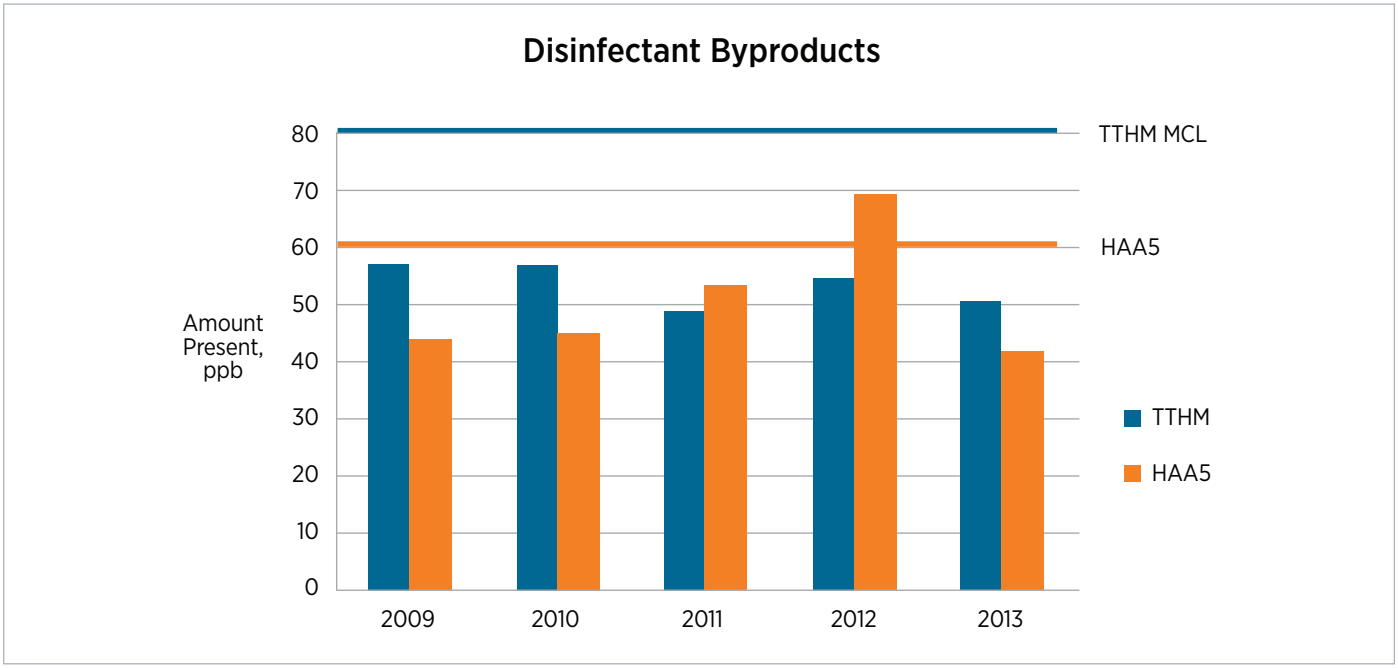


Figure 3. Results of 2013 DBP monitoring.

7.2 GROUNDWATER

Groundwater protection in the West is particularly important because these limited resources are relied on by increasing numbers of residents for water supplies. NREL's groundwater protection program is based on the 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 on by the groundwater users in the basin. The northern extent of the Dawson aquifer is located approximately 20 miles (33 km) 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 on establishing safeguards such as 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 ongoing research.

2013 Accomplishments and Highlights

There were no spills or releases that impacted groundwater at any NREL site in 2013.

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 are two closed-loop geothermal systems in operation at the STM Solar Radiation Research Laboratory and at the STM South Site Entrance Building. 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 would be implemented and additional groundwater monitoring wells would be installed as needed.

2013 Compliance Activities

- Submitted the Geothermal Well Construction and Test Report (Form GX-01) to the Colorado Division of Water Resources for the South SEB closed loop geothermal system.

7.3 SURFACE WATER

NREL's Surface Water Protection program seeks to protect the quality of nearby receiving waters to which the STM and NWTC campuses drain. 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 that flows across active construction sites, inclusion of project design elements that promote infiltration and detention, and management of campus grounds to minimize erosion and support infiltration.

Due to the continuing construction activity at both campuses, the focus of NREL's water quality protection program 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 NEPA 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 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, Colorado Discharge Permit System stormwater permits may be required. For construction sites on sites 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.

While construction sites less than 1 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 basic elements of the stormwater pollution prevention program are followed, including the development of 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 Best Management Practices (BMPs) may also be required.

2013 Accomplishments and Highlights

- NREL's STM campus stormwater-detention basin, which was completed in 2012, successfully detained and then slowly released the historic rainfall and runoff received in September 2013 without causing erosion or sedimentation to the adjacent and downstream neighborhood or park facility. The slow release rate also allowed for settling of sediment within the basin, thus removing urban pollutants typically bound to sediment, prior to its discharge to Lena Gulch.
- The laboratory developed final design documents 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 2014.
- NREL improved stormwater protection by enhancing stormwater program elements and construction specifications to better communicate requirements and responsibilities.
- The laboratory specified and installed porous pavers to replace 800 feet (244 meters)of asphalt roadway at the STM campus, increasing infiltration and decreasing runoff delivered to the STM stormwater detention basin. This low-impact design element will reduce maintenance and costs due to reduced stormwater infrastructure and maintenance needs.

Successful revegetation following construction disturbance. *Photo by Dennis Schroeder, NREL 27798*

The 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, EO 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.

2013 Compliance Summary and Activities

- Program activities were in compliance with requirements.
- Permit coverage was obtained under the EPA CGP for one new construction project at the STM site. Five permits for completed projects were terminated in 2013.
- Monthly stormwater inspections were performed for construction sites where EPA CGP permit coverage continues during the restoration phase of these projects. Weekly inspections occurred for construction sites with an active federal stormwater permit. State stormwater permits were maintained by subcontractors at two experimental research projects at the SolarTAC site.
- Successful revegetation, defined in the federal stormwater permit as vegetative cover equivalent to 70% of pre-disturbance cover, was achieved at four major construction sites. Carefully selected seed mixes and mulches together with weed management and temporary irrigation were instrumental in achieving the EPA criteria.

Resurfacing of Denver West Parkway with concrete pavers during the historic rainfall event of September 2013. *Photo by Dennis Schroeder, NREL 27635*

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 site 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 the STM site, serving the Solar Radiation Research Laboratory, 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 federal regulations have targeted, nor does the laboratory discharge a volume of water that would trigger requirement of 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.

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.

At the IBRF, a neutralization pit containing limestone is installed in the facility's discharge line that helps neutralize wastewater that may be somewhat acidic. This passive system is installed just upstream of the final discharge of the IBRF.

2013 Compliance Summary and Activities

Program activities were in compliance with requirements.

NREL biochemists discuss results of vials containing an enzymatic digestion assay of cellulose. *Photo by Dennis Schroeder, NREL 28876*

8 HAZARDOUS MATERIALS AND WASTE MANAGEMENT

At NREL, responsible acquisition, use, and disposal of materials and wastes are critical to meeting our commitments to compliance, preventing pollution, and environmental stewardship. NREL 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:

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

Hazardous materials are rigorously managed, starting with the chemical management system that tracks chemical amounts, locations, and hazards. Each week, safety personnel receive a list of the chemicals and their hazards that were shipped to NREL during 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.

2013 Accomplishments and Highlights

- The laboratory initiated a radio frequency identification (RFID) chemical-inventory pilot project with an initial focus on time-sensitive chemicals such as peroxide formers. This technology streamlines data collection by remotely detecting inventory data without physically scanning each item and reduces inventory errors.
- There were no releases of hazardous materials requiring reporting.

Program Management

NREL facilities are subject to the emergency reporting provision of the 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 Safety Data Sheets or SDS (per OSHA's new hazard communication requirements, the term SDS replaces MSDS or Material Safety Data Sheets) for chemicals that are stored on-site 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, 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 Section 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 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

TABLE 4. 2013 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	Reported
EPCRA Section 313	TRI Reporting	Not required

"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).

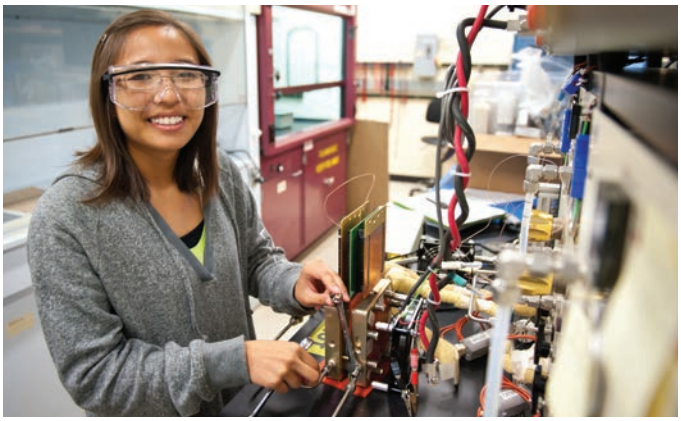
facility's inventory of listed materials, including various fuels such as biodiesel, must be reported to the DFD annually. The DFD inspects the facility and issues a hazardous materials permit.

2013 Compliance Summary and Activities

- All laboratory program activities were in compliance with requirements.
- In 2013, NREL submitted a Tier II report to state and the LEPC for reporting year 2012, identifying diesel fuel, petroleum oil, and sulfuric acid in lead-acid batteries; see Table 4 for details.
- 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.
- In order to meet OSHA's new hazard communication requirements (29 CFR 1910.1200), NREL provided detailed training on the components of the newly adopted Global Harmonization System (GHS). Employers were required to train all employees who might be exposed to chemical hazards in the workplace on these requirements by December 1, 2013. NREL met that goal by providing classroom training for employees working in a lab. In addition to classroom training, more information on the GHS components were provided to workers on NREL's intranet site.

8.2 REGULATED WASTE MANAGEMENT

Research and development activities and general facility operations create a variety of waste streams, including



NREL researchers reduce waste in the laboratory by substiting less hazardous chemicals whenever possible and ordering only what they need. *Photo by Dennis Schroeder, NREL 19438*

those containing toxic chemicals or metals. The laboratory is committed to the appropriate management of regulated waste generated through its daily operations.

These wastes are handled, stored, and disposed of responsibly to minimize the potential for health and environmental impacts that could result from a release or improper disposal.

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 on-site 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. On-site waste management activities are conducted in a manner that will minimize potential effects on human health and the environment.

2013 Accomplishments and Highlights

- Overall hazardous and non-hazardous waste volumes decreased significantly at NREL from the prior year (see Table 5), largely due to a reduction in pilot scale testing in the Thermochemical Process Development and at ReFUEL. Universal waste generation increased due to a site-wide energy efficient lighting retrofit.
- 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 those for personnel training, contingency planning, and container management.

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. Additional applicable regulatory requirements fall under the U.S. Department of Transportation Hazardous Material regulations in Title 49 of the Code of Federal Regulations. 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, diesel fuel, or select pretreatment liquors from biomass processing; does not include municipal solid waste, such as regular trash
- Universal waste such as mercury-containing light bulbs, lead-acid batteries, aerosol cans, and electronic waste such as computers, monitors, and research instrumentation containing electronic circuitry.

A comparison of waste generated is summarized in Table 5.

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

- LQG: generates ≥ 1,000 kg (220 lbs) of hazardous waste in a calendar month (or > 1 kg/2.2 lbs of acutely toxic hazardous waste)

TABLE 5. COMPARISON OF FOUR WASTE CATEGORIES GENERATED AT NREL FACILITIES [LBS. (KGS) NET WEIGHT]

	Hazardous Waste	Non-Hazardous Waste	Universal Electronic Waste	Other Universal Waste
2011	20,557 (9,324)	6,156 (2,792)	29,549 (13,403)	3,539 (1,605)
2012	33,386 (15,144)	8,805 (3,994)	41,355 (18,758)	4,803 (2,179)
2013	14,974 (6,792)	4,477 (2,031)	38,096 (17,280)	19,063 (8,647)

- Small Quantity Generator (SQG): generates > 100 kg (22 lbs) but < 1,000 kg (220 lbs) of hazardous waste in a calendar month (and < 1 kg of acutely hazardous waste)
- Conditionally Exempt Small Quantity Generator (CESQG): generates < 100 kg (22 lbs) of hazardous waste in a calendar month (and < 1 kg/2.2 lbs) of acutely hazardous waste).

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, yet pose a potential hazard, are collected and disposed of as non-hazardous materials at federally permitted disposal facilities. For example, non-hazardous, nanomaterial-bearing wastes are not federally 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, hazardous waste items are shipped off-site for final disposal via incineration, treatment, and landfill. Universal wastes are recycled or reclaimed.

2013 Compliance Summary and Activities

- Program activities were in compliance with requirements.
- All regulatory notifications were updated and applicable waste generator fees were paid for five NREL facilities.
- An assessment was conducted of the universal waste program, identifying no concerns, two findings, six opportunities for improvement, and six noteworthy practices. Corrective actions have been implemented to close the findings and opportunities for improvement are being addressed.

8.3 ABOVEGROUND STORAGE TANK 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
- Ensure compliance with tank design, operation, training, and inspection requirements.

NREL minimizes the risk of underground soil and water contamination from storage tanks by using 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.

Consolidated Utility Base Energy System is an integrated power electronic platform for a 60-kW PV-Battery-Diesel hybrid power system developed for the U.S. Army to provide power to Forward Operating Bases. *Photo by Dennis Schroeder, NREL 28837*

2013 Accomplishments and Highlights

- Annual AST training was provided to all laboratory personnel identified as having responsibility for operating and fueling ASTs.
- All tanks were reviewed to confirm continued adherence to recently revised regulations.

Program Management

ASTs are regulated in Colorado by the CDLE's Division of Oil and Public Safety under the Colorado AST regulation 7 CCR 1101-14. Colorado requires that ASTs 660 gallons (2,498 liters) or larger be permitted prior to installation, be inspected by the state following installation, and be registered within 30 days following commencement of use. 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 quantities employ a Spill Prevention, Control, And Countermeasures (SPCC) plan to manage oil sources 55 gallons (208 liters) or larger (see section 8.4, Spill Prevention and Response, for more information).

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 equipped with sensors that result in an alarm if the inner tank wall is leaking, and secondary containment for single-wall tanks. Procedural safeguards include written operating and tank-filling procedures, monthly and annual inspections, and record keeping of inspection results. ASTs larger than 110 gallons (416 liters) 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, tank inspections 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 and documentation of annual training activities.

Personnel who operate and manage ASTs are trained annually on AST program requirements including inspection and response requirements, spill history of each site and lessons learned, and recent changes in rules and regulations.

NREL maintains 15 ASTs at the STM site with a total capacity of 12,839 gallons (48,600 liters); one AST at DWOP with a capacity of 500 gallons (1,893 liters); five ASTs at the NWTC with a total capacity of 1,061 gallons (4,016 liters); and one 2,500-gallon (9,464-liter) AST at the SolarTAC

facility. Four ASTs at the STM and the SolarTAC AST are registered with the state. There are no ASTs at the NWTC that need to be permitted or registered.

2013 Compliance Summary and Activities

- All program activities were in compliance with requirements.
- No spills or releases from NREL's ASTs or related fueling activities occurred.
- A state inspection of registered ASTs was completed with no violations noted.
- One installation permit was obtained for a planned 1,000-gallon (3,785-liter) E-85 fleet vehicle fuel tank at the STM facility.
- One 2,500-gallon (9, 464-liter) AST at the SolarTAC facility received a state installation inspection and was registered.

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 four 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 CCR 1101-14. In general, facilities that store more than 1,320 gallons (5,000 liters) 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 (208 liters) or more of oil be included in the plan.

2013 Accomplishments and Highlights

The laboratory SPCC training course was updated to include new NREL facilities and revised SPCC plans.

The plan must address such items as:

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

Due to the quantity of oils stored at the STM, NWTC, ReFUEL, and SolarTAC sites, an SPCC plan is required for each of these locations. NREL's SPCC plans are updated every 3 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 5 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 equipment is maintained at multiple locations, allowing response and clean-up activities to occur quickly.

- SPCC training occurs annually for individuals who are responsible for oil-containing equipment and AST operation and maintenance. SPCC training is combined with AST training and educates staff on oil-containing equipment at each site, inspection and response requirements, the oil spill history of each site and lessons learned, and recent changes to rules and regulations.
- The laboratory typically does not experience spills that require notification to federal and state agencies. Small, incidental hydraulic system leaks, lubricant leaks, and fuel transfer spills may occur on occasion. Lessons learned from spill incidents and clean-up activities are used to improve management and spill response planning.

2013 Compliance Summary and Activities

- Program activities were in compliance with requirements.
- An SPCC plan was developed and implemented for the SolarTAC facility.

- Workers who manage and/or operate oil-containing equipment received annual SPCC training.
- There were no reportable spills. Nine minor spills of diesel, lubricant, coolant, 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 (0.39 to 57 liters). The majority of these spills were the result of construction activities. Each spill received immediate remedial action and did not result in any significant impact to the environment.

8.5 RADIOLOGICAL MATERIALS AND WASTE MANAGEMENT

NREL conducts a wide range of research and operational activities that incorporate the use of radiological materials. The laboratory occasionally uses small quantities of radioisotopes for biological labeling and electron microscopy staining. All of the radioisotopes have very low activity levels and are used in extremely small amounts. A number of sealed sources are present in analytical and process equipment, check sources, and emergency exit signs. 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 radiation generating devices, 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 small number of specific laboratories
- Monitoring equipment and facilities for removable contamination or sealed source leakage
- Assuring that future users are not at risk for receiving contaminated materials—no equipment used on-site is surplused until background levels of radiation present are achieved.

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 O 458.1, Radiation Protection of the Public and the Environment establishes radiation emission limits for DOE facilities. These facilities, including NREL, must annually demonstrate compliance with Rad NESHAPs, 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 Rad NESHAPs standards by using an EPA computer model (COMPLY Version 1.6) to determine the effective dose equivalent to the public.

All radioactive waste generated 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.

2013 Compliance Summary and Activities

- Program activities were in compliance with requirements.
- Small quantities of low-level radioactive waste were generated and are currently in storage awaiting off-site disposal.
- The effective dose equivalent to the public was 0.036 mrem per year, far below the 10 mrem per year limit.

What Is "*Effective Dose Equivalent*?"

To understand effective *dose equivalent*, you must first define *dose* and *dose equivalent*:

- **Dose** – a generic term to describe the amount of radiation a person receives.
- **Dose Equivalent** – a measure of the biological risk of the energy that the radiation deposited in tissue, which depends on the type of radiation and the tissues exposed. The units of dose equivalent are called rems, and a thousandth of a rem is called a millirem, abbreviated as mrem.
- **Effective Dose Equivalent** – the total of the dose equivalent to the organ or tissue multiplied by weighting factors applicable to each of the body organs or tissues that are exposed to radiation.

An average person in the United States receives about 310 mrem each year from natural sources and an additional 310 mrem from medical procedures and consumer products.

Maintenance work on a turbine at the NWTC. *Photo by Dennis Schroeder, NREL 26641*

9 NATIONAL ENVIRONMENTAL POLICY ACT

NREL's 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, staff conduct reviews of a wide range of activities prior to spending funds or commencing work.

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

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, DOE established

2013 Accomplishments and Highlights

- Provided training for workers participating in the laboratory's NEPA process. The training included information regarding the purpose of NEPA and implementing procedures.
- Continued to provide NEPA support in the preparation of proposals for DOE Funding Opportunity Announcements that support DOE's mission and the nation's energy objectives.

Scrub Jay at the South Table Mountain (STM) campus. *Photo by Bob Fiehweg, NREL 19582*

NEPA Implementing Procedures (10 CFR 1021) which DOE (and NREL) use to comply with Section 102(2) of the NEPA of 1969 [42 U.S.C. 4332(2)] and CEQ regulations. The DOE procedures supplement, and are to be used in conjunction with, CEQ regulations.

Under NEPA, federal agencies consider and document environmental factors in decision-making processes using one of the following methods:

- Categorical Exclusion (CX)
- Environmental Assessment (EA)
- Environmental Impact Statement (EIS).

Categorical Exclusion

Proposed activities may fall under a DOE 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.

Environmental Assessment

If the proposed action does not fit into a CX established by DOE, or there are extraordinary circumstances present (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. For DOE facilities, a site-wide EA can be developed which considers the potential environmental impact of site operations and future proposed development. An EA provides sufficient evidence and analysis for determining whether to prepare an EIS or not. 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.

Environmental Impact Statement

An EIS provides a detailed analysis of projects that have 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.

Aerial photo of the NWTC. *Photo by Dennis Schroeder, NREL 25929*

NREL Implementation of the NEPA Process

The laboratory initiates NEPA reviews and supports the DOE Golden Field Office (DOE GO) in making NEPA determinations before work begins. In accordance with DOE NEPA Implementing Procedures (10 CFR 1021), all NREL 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.

If proposed activities have not already been evaluated in an existing NREL site-wide EA or supplemental NEPA document, then further environmental review must be conducted. Potential environmental impacts of an activity are evaluated and measures are taken as needed to avoid or minimize those impacts. The level of review conducted is appropriate to the potential impacts of the proposed activity. A planned construction project, for example, receives a more rigorous review than routine office work.

2013 Compliance Summary and Activities

- Program activities were in compliance with requirements.
- Four hundred seventy six NEPA reviews were conducted for project activities on- and off-site during CY 2013.
- Updated the NEPA program to reflect the revised DOE NEPA implementing regulations and new classes of Categorical Exclusions.
- Progress continued on the site-wide EAs for the NWTC and STM sites, including several activities such as internal scoping, public/agency scoping, and request for public comment.

Aerial photo of the NWTC. *Photo by Dennis Schroeder, NREL 25908*

10 NATURAL AND CULTURAL RESOURCES PROTECTION

NREL is committed to responsible stewardship of its natural ecosystems, native wildlife and vegetation, and important cultural resources. Natural resources at the STM and NWTC facilities are managed appropriately to ensure its 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 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 on-site. NREL is committed to responsible land stewardship that supports wildlife. Many surrounding landowners, including residential neighbors 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.

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.

2013 Accomplishments and Highlights

- Informal monitoring of previously constructed facilities with bird-friendly design features has indicated these efforts have been successful. No bird fatalities have been observed.
- Continued retrofit of STM campus bus shelters with laminate to reduce the potential for bird collisions.
- Numerous rattlesnakes that posed a hazard to workers were relocated to nearby habitat on NREL sites.
- Monitoring of mammalian predators at the STM and NWTC sites continued in 2013. Data was collected from two motion detection cameras at each site. STM motion detection cameras confirmed continued use of the site by several species, including red fox *(Vulpes vulpes)*, coyote, and striped skunk *(Mephitis mephitis)*. NWTC motion detection cameras, once again, recorded two mammalian predators, coyote and bobcat *(Felis rufus)*, and one avian predator species, the great-horned owl.
- Acoustic bat monitoring at the NWTC documented four species of bats over a 5-month period (May to September) including the Big brown bat *(Eptesicus fuscus)*, the Silver-haired bat *(Lasionycteris noctivagans)*, the Hoary bat ***(Lasiurus cinereus)***, and the Brazilian free-tailed bat *(Tadarida brasiliensis)*.

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 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 that minimize secondary impacts.

The glass at the parking garage is bird-friendly with vertical frits to prevent collisions. *Photo by Dennis Schroeder, NREL 24898*

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) 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 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 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

When rattlesnakes are reported near pedestrian areas of the STM site they are relocated to safer areas. *Photo by Steve Wilcox, NREL 23924*

Bobcat at NWTC. *Photo by Jason Cotrell, NREL 24480*

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 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 NEPA or other established environmental review processes evaluate the effects of actions and agency plans on migratory birds, particularly on species of concern.

Wildlife is considered a state resource under Colorado law. Under 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. It is unlawful for any person to willfully harass wildlife.

The "Memorandum of Understanding (MOU) between the United States Department of Energy and United States Fish and Wildlife Service Regarding Implementation of EO 13186, *Responsibilities of Federal Agencies to Protect Migratory Birds*" (9/2013) formalizes DOE's commitments 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 nesting bird surveys are conducted. 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.

Project Reviews – Biologists conduct project reviews to assess and reduce potential impacts to wildlife.

Coordination – Biologists coordinate with local, state, and federal agencies to improve wildlife management. 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.

2013 Compliance Summary and Activities

- Seventeen bird deaths occurred from collisions with windows from August to November at the recently constructed ESIF. The collisions involved 8 species,

including 6 mourning doves, 6 songbirds, 2 pigeons, 1 magpie, and 2 unknown. An immediate interim solution was implemented by installing UV light reflecting decals on select windows. A long-term solution is being developed and is planned for implementation prior to the 2014 migration season.

- One bird death, an American Crow, was reported at the NWTC during the year. Workers at the site are requested to report incidental observations of bird mortalities to environmental program staff who track this information.

10.2 ENDANGERED SPECIES AND SPECIES OF CONCERN

NREL manages its research and operational 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.

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, and 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 on-site, the USFWS designated 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 impacted 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 5 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.

The USFWS lists five other species occurring in the Platte River watershed in Nebraska in accordance with the ESA as species that must be considered for projects in Colorado and Wyoming that may deplete water supplies to the Platte River system. These include three birds, the piping plover *(Charadrius melodus)*, the whooping crane *(Grus americana)*, and the least tern *(Sternula antillarum)*, a fish, the pallid sturgeon *(Scaphirhynchus albus)*, and a plant, the Western prairie fringed orchid *(Platanthera praeclara)*. For any NREL activities that may deplete water in the Platte River system, a consultation with the USFWS would be completed to determine potential impacts.

2013 Compliance Summary and Activities

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, out competing 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.

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

- 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 conservation areas.

Feather reed grass used in landscaping in front of the ESIF at NREL's STM site. *Photo by Dennis Schroeder, NREL 27750*

The laboratory limits development in and manages these areas to conserve specific features there including seeps, ephemeral drainages, ponds, native grassland habitat, areas supporting ancient soils (a soil structure in association with plant species forming a stable ecological community that is resistant to weed invasion), a small area designated as critical habitat for the Preble's meadow jumping mouse, an area of remnant tallgrass prairie, and a rocky outcropping supporting Ponderosa pine and shrublands.

On the STM campus, 177 acres are under a conservation easement with Jefferson County. The easement preserves the natural character of the property, including its visual, biological, and recreational 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:

- Provide supplemental water during seedling growth and establishment and minimize water use thereafter
- 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.

During construction of the RSF, NREL participated in the SITES 2-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 (i.e., 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 to landscape plants, and to recharge groundwater in the area. 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.

Program Management

Vegetation management consists of a number of programs and plans that meet the requirements of EO 13112, *Invasive Species*, and the Colorado Noxious Weed Act and support the laboratory's vegetation management approach.

The STM stormwater detention pond serves as an important local habitat that provides wildlife with food, water, shelter and safe areas to raise their young. *Photo by Michelle Slovensky, NREL 23403*

In Colorado, the Department of Agriculture Commissioner—in consultation with the Colorado 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.

2013 Accomplishments and Highlights

- NREL received SITES Program certification, achieving a three-star rating out of four, for the sustainable landscape design and management of the RSF and STM stormwater detention basin. In support of the certification, a Landscape Maintenance Plan was developed to coordinate and plan landscape maintenance responsibilities and activities across multiple groups at the lab. The plan establishes a campus landscape vision and directs landscaping maintenance and materials use supporting:
  - Plant stewardship
  - Invasive species management
  - Organic materials management
  - Soil stewardship
  - Water conservation
  - Stormwater management
  - Materials recycling and composting
  - Landscape maintenance equipment
  - Snow and ice management.
- A laboratory-wide "snow push map" was used 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 on campus.

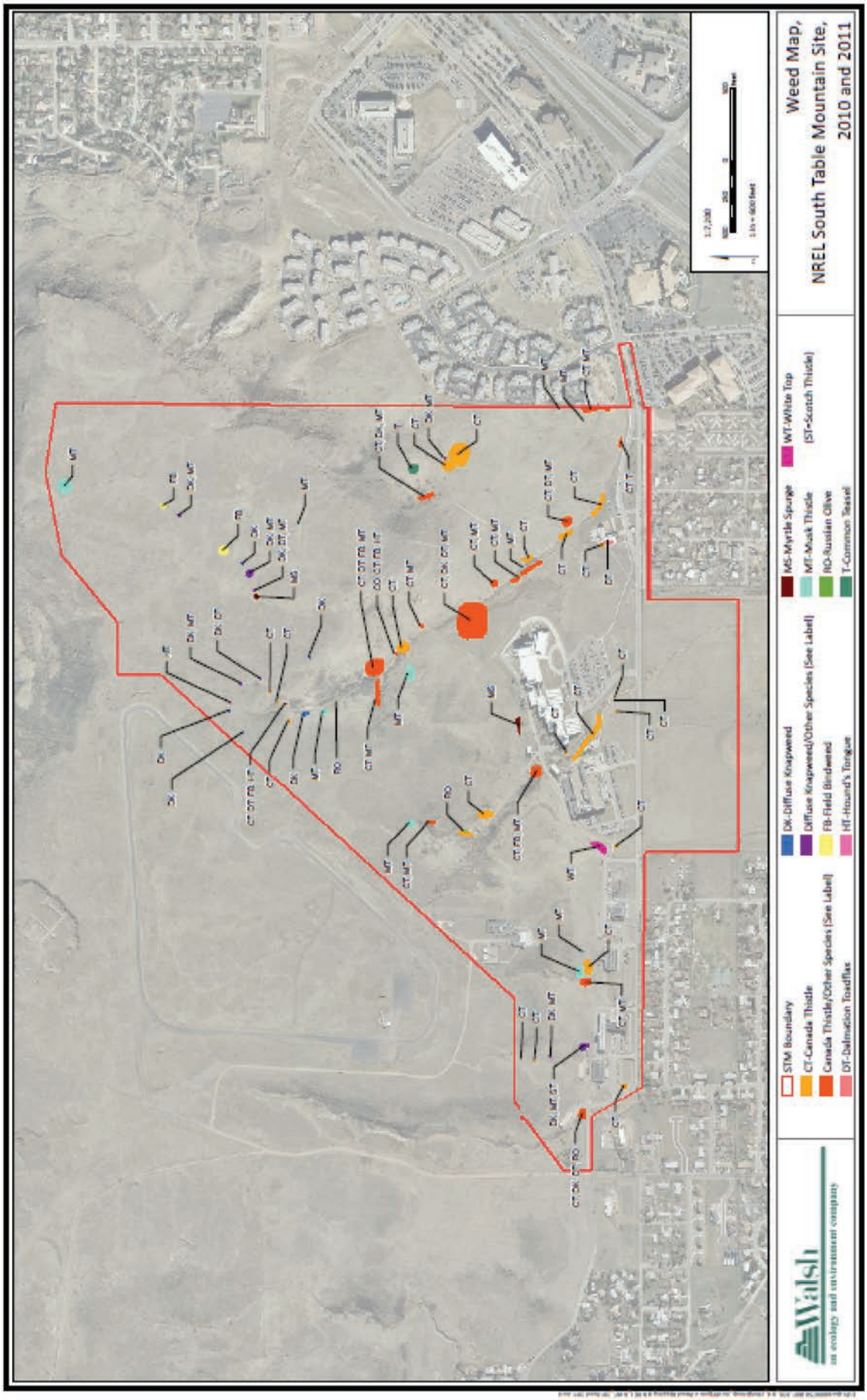


Figure 3. Weed survey results at the STM.

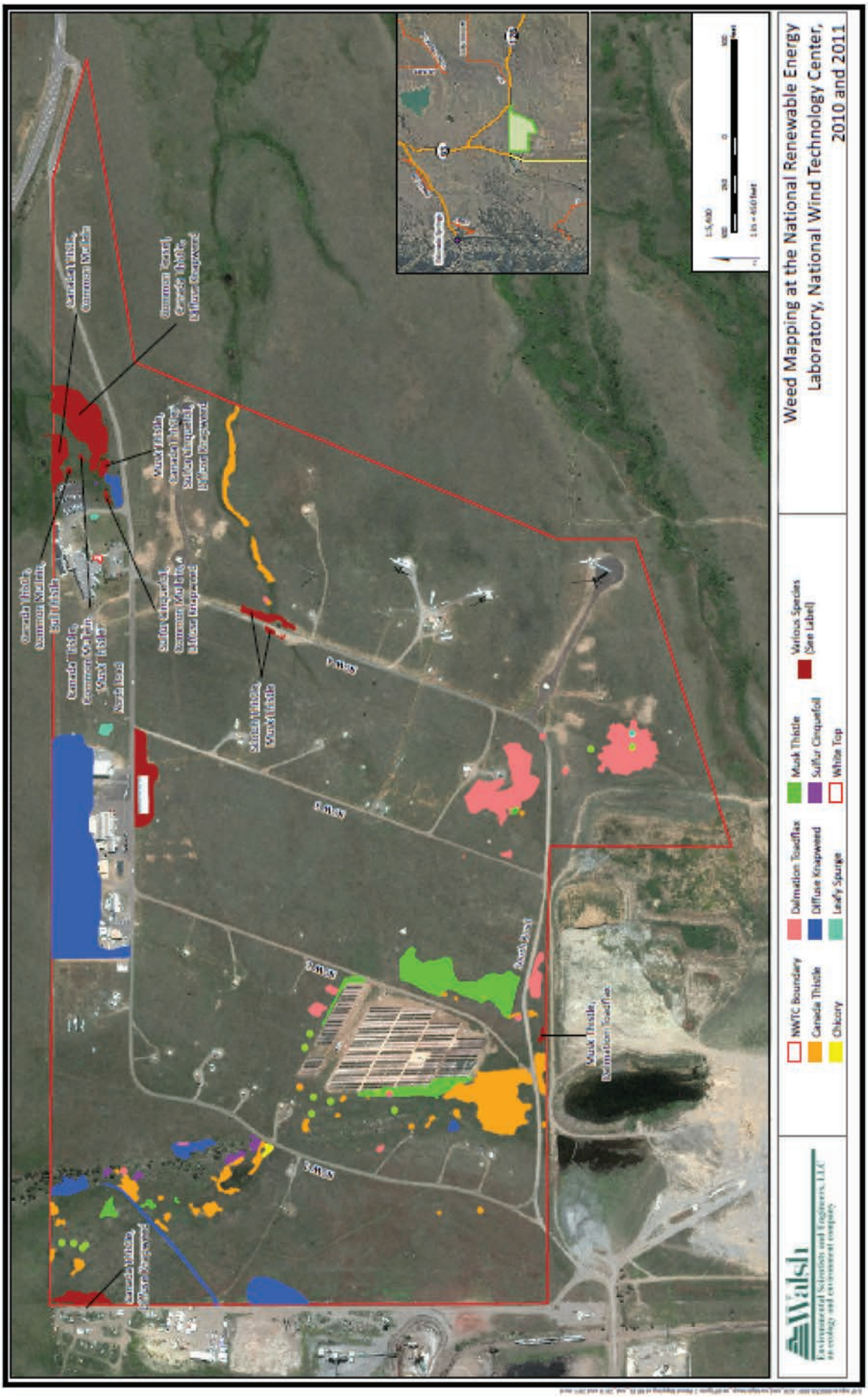


Figure 4. Weed survey results at the NWTC.

TABLE 6. 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 Common teasel Dalmation toadflax Diffuse knapweed Hoary cress (whitetop) Hound's tongue Musk thistle Russian olive Scotch thistle	Canada thistle Chicory Dalmation toadflax Diffuse knapweed Hoary cress (whitetop) Leafy spurge Musk thistle Sulfur cinquefoil
Class C:	Field bindweed Cheatgrass	Field bindweed Cheatgrass

The laboratory continues to address the control of these species using the integrated weed management approach described above. The weed maps in Figures 3 and 4 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 5 years) to identify weed outbreaks.

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.

2013 Compliance Summary and Activities

- Program activities were in compliance with requirements.
- Aggressive weed management continued. Knapweed is nearly under control at the NWTC and Canada thistle, hounds tongue, and myrtle spurge are under control at the STM site. In support of the goal to eliminate the A-listed noxious weed myrtle spurge from the STM site, the species was treated for the third consecutive year, and the affected areas have been much reduced. At the NWTC, herbicides were applied to approximately 88 acres in April, 42 acres in June, and 88 acres in September. At the STM site, approximately 16 acres were treated in May-June, 2 acres in July, and 9 acres in September.

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 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

The STM stormwater detention pond regulates the flow of stormwater from the STM campus to neighboring Lena Gulch, mimicking pre-development hydrology. *Photo by Dennis Schroeder, NREL 23189*

2013 Accomplishments and Highlights

Qualified laboratory staff reviewed wetland vegetation and wetland mapping (see Appendix A) for both the STM and NWTC campuses.

- Identification of potential impacts
- Coordination with other jurisdictions on the control of floodwaters leaving NREL sites.

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 that 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 are considered wetlands but do not fall within the jurisdiction of the USACE 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.

At the STM campus, the USACE issued a jurisdictional determination stating that all drainages examined are considered upland swales and consequently are not regulated by the USACE. The jurisdictional determination, which is valid for a period of 5 years through April 27, 2014, allows NREL to perform work in the upland swales without a USACE permit. At the NWTC, a preliminary wetland assessment and delineation was jointly conducted with the USACE. A formal delineation will be submitted to the USACE to obtain a jurisdictional determination for the site. Non-jurisdictional functional wetlands are considered valuable features, and the laboratory seeks to preserve these.

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 boundaries that affect the NWTC or STM sites.

2013 Compliance Summary and Activities

Program activities were in compliance with requirements.

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.

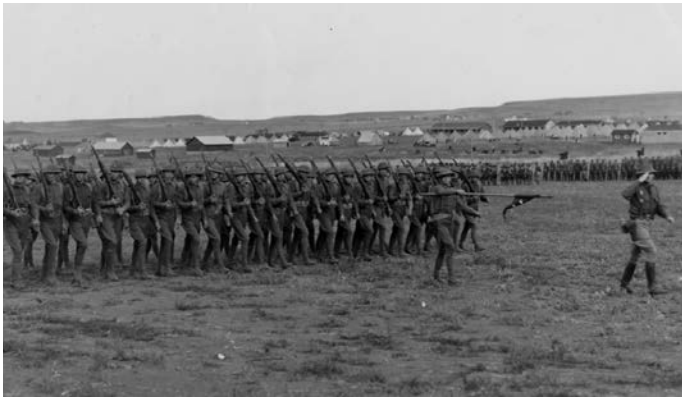
Cultural resources can be divided into three major categories:

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

Prehistoric and historic archaeological resources are locations where human activity measurably altered the earth or left deposits of physical remains (e.g., arrowheads, pottery, and 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



157th Infantry on Parade at Camp George West, 1934. *Used with permission from Denver Public Library.*

2013 Accomplishments and Highlights

In June 2013, DOE and NREL completed an informational display as mitigation for impacts to the former Camp George West 500- and 600-yard small arms firing lines during the construction of the south access road to the STM campus in accordance with a 2011 MOA with the Colorado Office of Archaeology & Historic Preservation. The firing lines are considered contributing features of the Camp George West Historic District. The informational display is located off of Research Road in Pleasant View Community Park and is accessible to the public.

Informational display at the former Camp George West small arms firing-line near the south entrance to the STM campus. *Photo by Tom Ryon, NREL 29508*

practices or beliefs of a living community that are rooted in the community's history, and is 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.

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 3 miles (4.8 km) 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 activities throughout the first half of the 1900s. By the 1920s, the camp totaled 750 acres (303 hectares) 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 (121 hectares) were transferred to the federal government for solar energy research purposes. An additional 25 acres (10.1 hectares) were transferred to DOE in 2003. Today, the STM site totals 327 acres (132 hectares).

Program Management

Cultural resources are protected under Sections 106 and 110 of the National Historic Preservation Act of 1966. 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.

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 and features.
- Implementing procedures to manage historic features 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 Colorado Office of Archaeology and Historic Preservation to determine if the artifacts are eligible for consideration as cultural or historic resources.
- Requiring construction contractors to provide workers with site orientation training that includes guidance on what to do in the event they discover any evidence of cultural resources during ground-disturbing activities. Workers are to stop all work in the vicinity until a qualified archaeologist evaluates the significance of the find.

Several formal surveys of historic and cultural resources have been performed on the STM site. As a result, three historical sites were recognized as significant

Historic amphitheater at the STM site. *Photo by David Parsons, NREL 06921*

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, lies south of the STM site.

2013 Compliance Summary and Activities

Program activities were in compliance with requirements.

11 CONSERVATION EASEMENT LANDS

In 1999, DOE granted a conservation easement for 177 acres (72 hectares) of the 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.

The goals of the easement are to:

- Retain, preserve, and protect the 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 and wildlife
- 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.

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

Conservation easement on South Table Mountain.
Photo by Christina Chase, NREL 22071

value of the property.[3] 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 east site entrance) to the trails on the mesa top. NREL staff and the public use these trails daily.

2013 Property Assessment

During 2013, there was no NREL activity on the conservation easement property having the potential to degrade the environmental condition of the property.

[3] 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 STM site draws hundreds of commuter vehicles daily, as well as visitor and delivery traffic entering and leaving the site. Traffic management for the site is important for minimizing negative impacts to traffic flow on Denver West Parkway 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, ride-sharing (e.g., 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 Denver West Parkway and Denver West Marriott Boulevard, as well as and Quaker St. and 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. Level of service is a qualitative measure of traffic flow based on the average delay per vehicle at an intersection. Typically, a LOS of "D" or better indicates acceptable operational conditions. Monitoring will continue to be conducted as additional staff are relocated to STM.

NREL work rides his recumbent bicycle after stopping for some food and drink on Bike-2-Work Day. Hundreds of NREL employees opted for two wheels instead of four.
Photo by Dennis Schroeder, NREL 26310

2013 Accomplishments and Highlights

The completion of an additional right-turn lane in the eastbound direction at the intersection of Denver West Parkway and Denver West Marriott Boulevard in July 2013 further improved capacity at the intersection, allowing for increased acceptable NREL-generated peak-hour traffic volume thresholds. Throughout 2013, traffic monitoring indicated that NREL-generated traffic volumes and LOS remained within acceptable levels.

Incentive parking is provided for vanpools, carpools, and green vehicles, such as no- and low-emission vehicles. *Photo by Dennis Schroeder, NREL 27807*

Program Management

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 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 intersection of Denver West Parkway and Denver West Marriott Boulevard operates at a LOS of D or better.
- The intersection of Quaker St. and South Golden Road operates at a LOS of D or better.
- Traffic flow to and from the STM east entrance will be monitored semi-annually.

A light rail train runs near the STM site. NREL shuttles provide a link for commuters from the train station to campus. *Photo by Dennis Schroeder, NREL 25928*

- A report on the implementation and effectiveness of the STM traffic mitigation measures will be published in this annual Environmental Performance 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 (AWSs), 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 below.

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 RTD transit stations in Lakewood and Wheat Ridge.
- Incentive parking is provided for vanpools and carpools at the STM and Denver West sites.
- Vanpool incentives 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, an 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 (e.g., 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 and reduces the miles driven by employees to and from the laboratory.

Telecommuting

Telecommuting allows staff (i.e., 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.

2013 Compliance Summary and Activities

- Program activities were in compliance with MAP requirements.
- TDM measures required by the MAP were continued in 2013.
- Average PM peak hour traffic volume at the intersection of Denver West Parkway and Denver West Marriott Boulevard was 307 vehicle trips. The monitoring periods were April 2013, August 2013, and November 2013. 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.

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 PM and 5:30 PM This hour has been designated the PM peak hour. Video traffic surveillance was conducted during three weeks at three different times of the year. 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 intersection of Denver West Parkway and Denver West Marriott Boulevard.

Table 7 shows the results of the traffic counts at the east, west and south entrances to the STM site in April, August and November 2013.

TABLE 7. 2013 TRAFFIC COUNTS

Gate	PM Peak Hour Vehicles (in- and out-bound)			
	April	August	Nov	Average
East Entrance (Denver West Parkway/Denver West Marriott Blvd.)	285	294	343	307
West Entrance (Quaker St./ South Golden Road)	0	18	13	10
South Entrance (South Golden Road/Research Rd.)	183	213	282	226

The applicable traffic volume threshold identified in the MAP is 387 vehicle trips in the PM peak hour (from 4:30 PM to 5:30 PM) at the intersection of Denver West Parkway and Denver West Marriott Boulevard. This threshold identifies the acceptable number of vehicle trips NREL can contribute to the intersection without causing significant degradation to flow. In 2013, PM peak hour traffic volume averages remained below the MAP threshold even with the permanent relocation of approximately 250 DOE staff members to the STM campus from off-site leased office space.

In 2013, PM peak hour traffic volume averages remained below the MAP threshold at 307 vehicle trips even with the permanent relocation of approximately 250 DOE staff members to the STM campus from off-site leased office space.

APPENDIX A:
PLANT COMMUNITIES AT THE STM AND THE NWTC

Vegetation surveys are periodically completed for the STM and NWTC sites with the most recent survey occurring 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 the STM site 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 the STM site include ravine shrubland, tall shrubland, short shrubland, and wetlands. The plant communities are described below and mapped as illustrated in Figure 5.

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

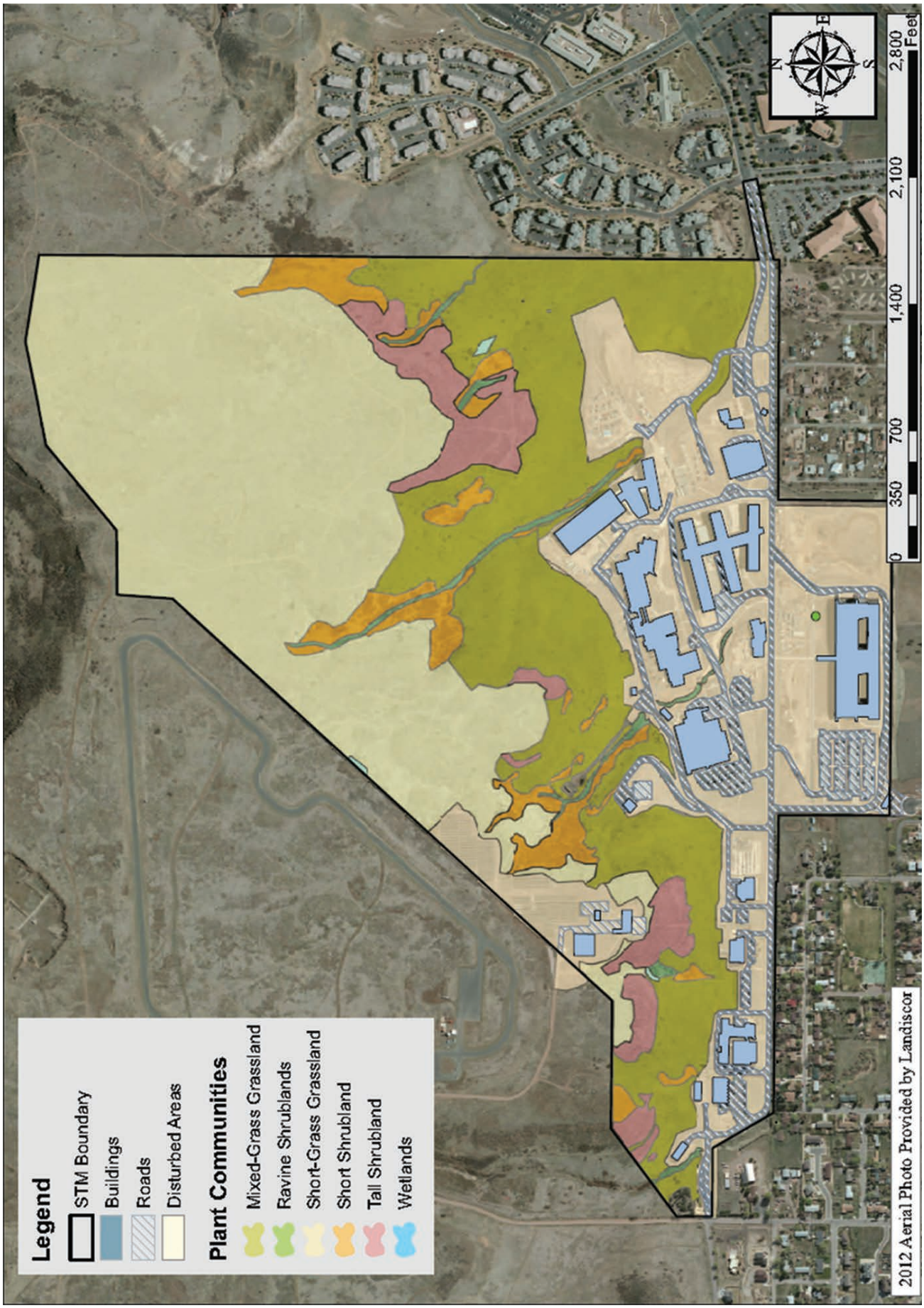


Figure 5. STM land cover types surveyed in 2011. Note: Map updated in 2012 to reflect site building changes.

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 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[4] no longer appears to support wetland vegetation. In 2002, cattail species near an old stock tank in the eastern-most 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 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[5], Plantae 2000[6]) is discussed below by specific plant community.

The plant communities are described below and mapped as illustrated in Figure 6.

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)*.

[4,6] Plantae Consulting Services (2000). Vegetation Survey, NREL National Wind Technology Center. Boulder, Colorado.

[5] 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.

Figure 6. NWTC land cover types surveyed in 2012.

Wet Meadow

Three locations support wet meadows[7] 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 that 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.

An isolated group of hawthorn *(Crataegus erthyropoda)* shrubs occurs along the western site boundary, within the NWTC site boundary. These trees are at the top of the slope and occur directly east of an active area of construction disturbance, which is outside the NWTC site boundary.

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 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.

[7] 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.

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, fieldmint *(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.[8] 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.

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

APPENDIX B:
WILDLIFE SPECIES OBSERVED AT THE STM AND THE NWTC

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.

TABLE 8. 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

Table 8 continued on page 80

TABLE 8. WILDLIFE SPECIES AT THE STM*

SPECIES COMMON NAME	SCIENTIFIC NAME	1987 Survey	2005 Survey	2011 Survey
BIRDS				
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
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	

TABLE 8. WILDLIFE SPECIES AT THE STM*

SPECIES COMMON NAME	SCIENTIFIC NAME	1987 Survey	2005 Survey	2011 Survey
BIRDS				
Sharp-shinned hawk	Accipiter striatus			X
Spotted towhee	Pipilo maculates		X	
Swainson's hawk	Buteo swainsoni		X	
Tree swallow	Tachycineta bicolor		X	X
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.

Table 8 continued on page 82

TABLE 8. 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
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

TABLE 8. WILDLIFE SPECIES AT THE NWTC*

SPECIES COMMON NAME	SCIENTIFIC NAME	1996 Survey	2003 Survey	2011 Survey
BIRDS				
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	

Table 8 continued on page 84

TABLE 8. 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 2013

TABLE 9. NREL'S ENVIRONMENTAL PERMITS, REGISTRATIONS, AND NOTIFICATIONS IN 2013

Type	Location/ Description	Category	Issuing Agency	ID #	Permit or Registration Status
AST for petroleum storage	STM ESIF AST	Registration	DOPS	19275-1	Completed
AST for petroleum storage	STM PDU AST	Registration	DOPS	2873-2	Completed
AST for petroleum storage	STM RSF2 AST	Registration	DOPS	2873-3	Completed
AST for petroleum storage	STM SERF AST	Registration	DOPS	2873-1	Completed
AST for petroleum storage	SolarTAC AST	Registration	DOPS	19325-1	Completed
Air	Laboratory-wide servicing of CFC-containing equipment	Notification	APCD	647	Active
Air	DWOP CFC-containing stationary source	Registration	APCD	647	Active
Air	STM SERF, 2 CFC-containing stationary sources	Registration	APCD	647	Active
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

Table 9 continued on page 86

TABLE 9. NREL'S ENVIRONMENTAL PERMITS, REGISTRATIONS, AND NOTIFICATIONS IN 2013

Type	Location/ Description	Category	Issuing Agency	ID #	Permit or Registration Status
Earth disturbance	STM stormwater detention basin grading permit	Permit	Jefferson County	10-126950GP	Active
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
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	COR12A43F	Terminated
Stormwater	STM stormwater detention basin construction project	Permit	EPA	COR12A36F	Terminated
Stormwater	STM ESIF construction project	Permit	EPA	COR12A60F	Active
Stormwater	STM parking garage and south entrance construction project	Permit	EPA	COR12A61F	Terminated

TABLE 9. NREL'S ENVIRONMENTAL PERMITS, REGISTRATIONS, AND NOTIFICATIONS IN 2013

Type	Location/ Description	Category	Issuing Agency	ID #	Permit or Registration Status
Stormwater	NWTC dynamometer expansion construction project	Permit	EPA	COR12A41F	Active
Stormwater	STM RSF II Construction Project	Permit	EPA	COR12A62F	Active
Stormwater	STM IBRF construction project	Permit	EPA	COR12A64F	Terminated
Stormwater	STM vehicle test pad construction project	Permit	EPA	COR12A63F	Terminated
Stormwater	STM SERF & STF Landscape Improvements/ Denver West Parkway Safety Enhancements (FTLB)	Permit	EPA	COR12AW4F	Active

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