4. ENVIRONMENTAL CONSEQUENCES AND MITIGATION MEASURES

Chapter 4 addresses primary, direct, induced, secondary and cumulative impacts of the Proposed Action and No Action Alternatives. Beneficial and adverse, on-site and off-site, construction, operation, and maintenance impacts are also described, as appropriate.

The following analyses focus on overall site development impacts resulting from a range of improvements and changes anticipated at NREL's STM and DWOP sites. The emphasis of these discussions is on the STM site because changes at the DWOP site do not involve construction but rather the additional use of existing, privately owned, and leased buildings, thereby limiting the potential for many kinds of environmental impacts. Specific impacts from individual improvements are provided, where appropriate, to clarify a unique environmental situation or consequence of a specific program element. The impact analyses presented in this chapter consider NREL's broad and extensive environmental commitments as described in Chapter 1, and refer to specific commitments, as appropriate, to characterize potential impacts and substantiate related impact findings.

4.1 LAND USE, PLANNING, PUBLIC POLICY, SOCIOECONOMICS

4.1.1 Land Use Impacts

NREL would lease approximately 35,500 square feet of additional office space at the DWOP site. Proposed uses associated with this additional space would be consistent with NREL's current use of the DWOP site, and limited construction activity would be expected for NREL's expansion within the existing business park. Consequently, the emphasis of the following discussion is on land use changes at the STM site.

The proposed improvements at the STM site would involve approximately 126,000 sf of office and laboratory space. The development associated with this increase would have minor on-site and off-site land use impacts as a result of converting undeveloped land to urban uses (laboratory space, roads and parking); these minor on-site and off-site impacts are discussed in more detail below. Future improvements at the STM site are anticipated in Zones 1, 3, 4, 5, and 6 (see Table 2.3). No improvements are proposed in Zone 2 (Conservation Area) or Zone 7 (Historic Resources).

Each improvement at the STM site would be subject to review by the NREL Design Advisory Board (DAB). The DAB process would address consistency of a proposed project with the results of the ongoing site planning effort leading toward the 25-Year General Development Plan and the applicable programs, policies, and procedures implemented by NREL at the STM site that are in place to avoid and/or minimize impacts from existing and future activities at the site. The ongoing site planning effort and the DAB process are expected to minimize any land use impacts from future improvements at the STM site.

New buildings and facilities would allow for increased research and development activities that would be generally consistent with existing uses. For example, the proposed S&TF would provide for PV research and expand activities currently conducted in the SERF. Proposed building designs would be consistent with existing on-site development and would be designed to avoid land use conflicts, compatibility issues, or other land use impacts such as nuisances (noise, odor, etc.). To minimize conflicts, NREL has established a building height limit of five stories and proposes setbacks from the edge of buildings to adjacent property lines. The only

improvement that is fully specified is the S&TF building in Zone 4 (see Chapter 2). In summary, the primary improvements would include:

- Several new buildings and research areas as well as associated access roads and parking areas.
- Several expansions of and/or modifications to existing buildings and facilities.
- A number of infrastructure and improvement projects.

These improvements, including the S&TF building, would add a total of approximately 126,000 [S1]sf of interior space at the STM site by 2008 (see Table 2.2) and increase the site's development density over time. However, this development density would not be out of scale with neighboring commercial development to the east.

As shown in Table 2.3, construction of new facilities and expansions and modifications to existing facilities would predominantly occur in Zone 3 West Campus, Zone 4 Central Campus, Zone 5 East Campus, and Zone 6 Camp George West Parcel. Each of these zones is located at or below the toe of South Table Mountain, away from sensitive mesa top and slope areas. Zones 3 and 4 are already highly developed. Facility construction, modification, and expansion within these zones would primarily involve infill development. Zones 5 and 6 are largely undeveloped.

As stated in Chapter 2 Proposed Action and Alternatives, plans illustrating various future land development concepts for the STM site have been developed, but these plans are not current and are not included as site planning assumptions. In 2002, NREL began a new site planning effort to develop a 25-Year General Development Plan for the NREL's sites (both STM and NWTC). The outcome of this effort will be a single unified vision for the STM site with flexibility enough to allow for adaptation so it continues to align with laboratory and program priorities as they change over time.

Based on the past plans and the flexibility that is anticipated from the 25-Year General Development Plan, key land use issues primarily relate to development in close proximity to: adjacent residential areas located south of Zone 3; residential areas east and west of Zone 6; the planned park located south of Zone 6; and the Camden Denver West condominiums located east of Zone 5.

Although development of Zones 3, 5, and 6 would increase the scale and intensity of office and research and development uses adjacent to residential areas, this would not result in land use impacts because proposed facilities would be consistent with existing facilities and the mix of residential and office-related land uses in the area. Additionally, with regard to Zone 5, preservation of the existing trail easement along the eastern boundary of the site would provide a substantial setback between STM site development and the Camden Denver West condominiums. It is not anticipated that development within Zone 6 would adversely affect recreational use at the planned park to the south, particularly considering that use of the park would likely be most intense during the evening and on weekends when the STM site would be least active.

Development within Zone 1 (Top of Mesa Buildable Area) is anticipated to include modifications of existing facilities, including expansion of the SRRL. The building expansion is expected to add 1,344 sf of space contiguous to the existing building. For perspective, if the perimeter of this addition were square, it would measure less than 40 feet on each side. Other changes in

Zone 1 could include the placement of different and/or additional outdoor renewable energy devices within the area designated for development. The SRRC expansion would be permanent, but the solar devices and associated equipment would be temporary or transient to some degree. The time frames for deployment of the devices and equipment would be defined by specific experiments and testing configurations.

Development of mesa top areas is discouraged by local government policy and has been the subject of community controversy. However, public policy and community controversy were the basis for the land transfer that resulted in the formation of the 176.78-acre Zone 2 Conservation Area and the decision to prevent development in Zone 7. For these reasons and because the only new development proposed on the 13-acres of Zone 1 is the SRRC expansion, the land use impact at buildout would be considered insignificant. Visual impacts from Zone 1 improvements are described in Section 4.5.

Growth inducement created by an enhanced facility and pressure for private sector ventures to locate in the immediate vicinity are not expected to be significant because the STM site would continue to provide on-site facilities for related private sector ventures, and because the growing office space capacity within the vicinity of the site could accommodate anticipated demand.

4.1.2 Compatibility with Applicable Local Plans, Policies, and Anticipated Future Development

Although the local government plans and policies are not applicable to federal lands such as the STM site, the following discussions compare the proposed development with local government zoning designations and characterize land use and planning issues that future on-site and off-site development may present.

The planned improvements would be considered office or research and development uses, which is inconsistent with the A-2 zoning designation placed on the site by Jefferson County. However, since the proposed uses are consistent with historical and anticipated uses of the site and given that local government policies do not apply to the site, this difference would not be considered a significant impact. In addition, it is anticipated that building setbacks, particularly within Zones 3, 5, and 6, would be generally consistent with local zoning standards and would provide adequate transitions between residential uses and new buildings. These setbacks will vary and will be determined during the site planning process and/or during the final design processes for individual buildings.

The conservation easement, as well as utility and trail easements throughout the site, will be preserved. Access via the trail easement corridor through the unsecured portions of the site between the mesa top and off-site residential and park areas will remain open to the public.

4.1.3 Social and Economic Impacts

Executive Order 12898, enacted by President Clinton in 1993, requires that each federal agency make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations.

The concentration of low-income persons in Census Tract 101 requires "environmental justice" issues to be considered and related findings to be made. In summary, these issues and

findings clarify whether disproportionate impacts on this population would occur as a result of the Proposed Action. The key issues include whether direct, significant, unmitigated and unavoidable adverse impacts would occur to this population and whether these or other impacts on this population would be considered disproportionate relative to impacts on other moderate-income or high-income populations. The findings are as follows:

- The Proposed Action does not create significant, unmitigated and unavoidable adverse impacts.
- The impacts of the Proposed Action on off-site residential areas are distributed evenly and equitably along the site's southern and eastern boundaries from infill development in Zones 3, 4, 5 and 6.
- No disproportionate impacts on the concentration of low-income households would occur since similar impacts would be expected in the neighborhoods south of Zone 3 and east of Zone 5.

The Proposed Action would have no direct impacts on minority populations because no off-site human health or environmental effects of the Proposed Action are anticipated, and because no concentrations of minority populations are located in the vicinity of the site.

The Proposed Action would have positive direct and indirect economic impacts because it would create jobs and involve substantial construction expenditures. A total of 359 new workers would be located at the STM and DWOP sites by 2008. These new jobs, as well as construction jobs and construction expenditures, would incrementally increase local housing demands and corresponding economic activity in the vicinity. These indirect impacts would not be considered significant given considerably larger economic forces and activities in the region, and would generally be considered beneficial by local governments pursuing economic development.

4.1.4 Impacts of the No Action Alternative

The No Action Alternative would allow existing on-site land uses, site development density and operations to remain unchanged. Fewer beneficial economic impacts would result because building construction would not occur and related job growth would be limited.

MITIGATION MEASURES

There are no significant impacts; therefore no mitigation measures are required.

4.2 TRAFFIC AND CIRCULATION

As described in Section 3.2, the following discussion is based on consultation with local governments and the information and findings presented in a Traffic Impact Study prepared by Felsburg Holt & Ullevig for the STM site in November of 2002 (NREL (FHU), 2002). However, it is important to note that the Traffic Impact Study analyzed possible short-term and long-term conditions different from those defined by the Proposed Action for this EA. In summary, the impact assessment in the Traffic Impact Study concluded that a total of 700 new workers could be located at STM while still maintaining acceptable levels of service at local intersections. However, this EA evaluates a total of 269 new workers at STM and 90 workers at DWOP in 2008. Larger numbers of new workers on either site by or beyond 2008 as too speculative at this time.

4.2.1 Trip Generation

Vehicle trip rates documented in the latest edition of the Institute of Transportation Engineer's (ITE) *Trip Generation* manual were used to estimate traffic generated by the Proposed Action. Since the NREL is a research facility, trip data associated with the ITE land use category for "Research and Development" was used to estimate project-generated traffic. The trip generation rate for this category is 2.77 trips per worker per day. This rate includes worker commute trips, other daily trips by workers and trips anticipated by others associated with the operation of the research and development use. Given this rate and the anticipated net increase of 269 new workers at the STM site by 2008, this portion of the Proposed Action would be expected to generate a total of 745 trips daily.

The 90 new workers in the DWOP would not be expected to generate a net increase in trips because the additional workers would be expected to occupy existing buildings at DWOP rather than new buildings. No new trips would be generated because the space to be used is already occupied and generating trips (see Section 4.2.2 for an assumption associated with re-directed trips between DWOP and STM).

Table 4-1 summarizes the daily and peak hour trips that would be generated by the Proposed Action.

Table 4-1. Trip Generation from the Proposed Action

Land Use Description	Daily Trips	AM Peak Hour Trips			PM Peak Hour Trips		
		In	Out	Total	In	Out	Total
Research & Development (269 New STM Employees)	745	99	16	115	11	99	110

4.2.2 Trip Distribution and Assignment

The vehicle trips shown in Table 4-1 were assigned to each of the intersections along Denver West Marriott Boulevard using directional distribution estimates. The distribution estimates were based on existing travel patterns along the study corridor. Travel patterns were determined from the existing turning traffic counts described in Section 3.2. The estimated distribution percentages are as follows:

Direction	Distribution
EAST - via Denver West Parkway	15%
EAST - via Interstate 70	30%
WEST - via Interstate 70	30%
SOUTH -via Denver West Marriott Blvd.	25%

Due to the likelihood that new DWOP workers would travel to the STM site due to business obligations more often than the workers they would displace, the trip generation figures representing movements between the two sites that are based on STM traffic alone may be slightly low.

Assuming 90 new workers at DWOP would generate approximately 249 new trips per day and 15 percent of those new trips would occur at peak hour, a total of approximately 37 peak hour trips would be expected. Clearly, some proportion of those 37 peak hour trips would be direct trips between DWOP and STM that did not occur before, but went elsewhere. It has been assumed that 15 percent of the 37 peak hour trips would be trips between STM and DWOP that did not occur before and the remainder would be trips typical of the previous office workers. Given these assumptions, six peak hour trips should be added to the STM trip generation distribution figures. Of these six trips, one-third of these peak-hour trips are assumed to change morning commute destinations and the balance of 4 would be direct trips between STM and DWOP. It can be assumed that these trips would be split evenly in terms of directions (inbound and outbound) and the A.M. and P.M. peak periods. These trips would be added to the network, but they would be relatively inconsequential and are not shown in Figure 4-1.

4.2.3 On-Site Circulation and Access Impacts

The trips generated by the Proposed Action and the planned construction would not change overall circulation or access with respect to the STM or DWOP sites. Existing ingress and egress routes to STM would be unchanged and would continue to be controlled by security gates. Minor changes to circulation patterns would be created by construction of the S&TF as shown in Figures 2-2 and 2-3. Ingress and egress routes throughout the DWOP site would remain open to the public and unchanged.

The additional trips from the Proposed Action would increase on-site parking requirements and vehicle use within and surrounding the STM site. Future development and related approval processes implemented at the STM site would address internal circulation and parking requirements as each project goes through final design. Primary on-site roads are expected to accommodate increased vehicle volumes without improvements.

The existing on-site parking that was constructed as part of the existing SERF would be utilized for required parking for the S&TF. The lack of new parking associated with the S&TF is not expected to create a parking shortage because sufficient parking is available and many of the S&TF workers are expected to be workers moving from overcrowded conditions in the SERF rather than new workers.

The S&TF would provide a vehicular turnaround at the northeast corner of the existing parking access drive and a new pedestrian sidewalk would provide access to the S&TF. These facilities are designed to accommodate anticipated on-site circulation and access requirements.

4.2.4 Future Traffic Volumes and Level of Service Impacts

To determine future traffic impacts of the Proposed Action, existing and future traffic volumes were considered. The following discussion characterizes future traffic volumes and then characterizes the impacts of project related trips.

INSERT FIGURE 4-1 2008 PROJECT GENERATED TRAFFIC VOLUMES HERE

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Trips on local roadways and through local intersections have increased recently due to the December 2002 opening of the Colorado Mills Mall. These volumes are expected to increase further in the future as a result of infill development and redevelopment in the vicinity. The Proposed Action would incrementally add to these local traffic volumes and would contribute incrementally to accidents in the vicinity. However, the contribution of the project to these impacts would be considered less than significant and no new accident hazards or risks would be added.

Two sources were primarily utilized to determine future traffic conditions in the study area. These sources included 1) the *Colorado Mills Development Traffic Impact Analysis*, Wells & Associates, March 2000, and 2) the *Denver West Housing Traffic Impact Analysis*, Felsburg Holt & Ullevig, March 1999 (NREL (FHU), 2002).

The Colorado Mills Mall development is a major retail center being constructed along the south side of West Colfax Avenue, between Denver West Marriott Boulevard and Indiana Street. The Colorado Mills Mall traffic study was an update to the *Denver West Shopping District Traffic Impact Analysis* (NREL (FHU), 2002).

The Denver West Housing development is a proposed residential project located along Denver West Circle (north of Denver West Parkway), and consists of both multi-family apartments and patio homes. The traffic study conducted for this development also accounted for the buildout of the office area along Denver West Circle, which was evaluated in the *Denver West Development Traffic Impact Analysis* (NREL FHU), 2002).

Neither the Colorado Mills Mall nor the Denver West Housing traffic impact studies assumed that the existing NREL site would be expanded in the future. Consequently, the total traffic volume forecasts obtained from these studies did not include any traffic growth associated with NREL's STM or DWOP sites. Therefore, the total traffic forecasts from these studies were used as "background" traffic (i.e., non-project related traffic volumes).

Future peak-hour traffic volumes for 2022 from the Traffic Impact Report assuming 700 new STM workers are presented in Figure 4-2. Figure 4-3 presents corresponding 2022 Levels of Service presented in the Traffic Impact Report considering 700 additional STM site workers. Under these 2022 conditions, LOSs are acceptable (LOS "C" or better). Consequently, traffic associated with the Proposed Action in 2008 would remain acceptable (LOS "C" or better) in all instances.

4.2.5 Accident Impacts

The Proposed Action would incrementally increase traffic volumes, but would not substantially increase accident rates due to congestion and would not create new traffic network conditions that would be expected to create hazards or increase accident potentials.

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INSERT FIGURE 4-2 2022 PEAK HOUR TRAFFIC VOLUMES ASSUMING 700 NEW STM WORKERS HERE

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INSERT FIGURE 4-3 2022 LEVELS OF SERVICE ASSUMING 700 STM WORKERS HERE

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4.2.6 Impacts of the No Action Alternative

The No Action Alternative would allow existing development and employee totals at the STM and DWOP sites to remain unchanged. Incremental impacts from site development associated with the Proposed Action on LOSs would be avoided. The existing circulation system and parking availability at the STM and DWOP sites are considered sufficient to meet current personnel levels without the proposed improvements that would occur under the Proposed Action.

MITIGATION MEASURES

There are no significant impacts; therefore, no mitigation is necessary.

4.3 AIR QUALITY

Air quality impacts are indicated by changes in the concentrations of atmospheric pollutants as a result of specified actions and their corresponding relationship to state and federal standards. This section discusses impacts to air quality from site preparation and construction at the STM site resulting from the Proposed Action and impacts resulting from emissions associated with subsequent site operations. The purpose of the air quality analysis is to provide a qualitative assessment of construction and operational impacts to air quality resulting from the Proposed Action rather than to define precise emission levels and corresponding mitigation measures. Consequently, modeling was not performed to precisely calculate future emissions.

NREL has an ongoing overall Air Quality Protection program, an Indoor Air Quality program, a Particulate Emissions Control for Construction program, a Local Exhaust Ventilation program, and a wide range of other programs that directly and indirectly contribute to avoiding, minimizing and mitigating air pollution emissions and associated impacts and risks. These programs are in place and would apply to all future improvements and activities at the STM and DWOP sites.

Emissions resulting from construction activities under the Proposed Action would be intermittent, and would not be expected to exceed ambient air quality standards or substantially impact regional air quality attainment status or progress. Based on proposed activities and operations, operational emissions resulting from new facilities and increased use of existing STM and DWOP facilities are expected to be insignificant.

4.3.1 Construction Impacts

During construction of the S&TF and other buildings and facilities, temporary and localized increases in atmospheric concentrations of NO_X, CO, SO_2, VOCs, and PM would result from exhaust emissions from worker's vehicles, heavy construction vehicles, and other machinery, equipment and tools. The construction perimeter of the S&TF would be approximately 700 feet (230 meters) from the nearest offsite residence. Other construction area perimeters would be closer, but those boundaries have not yet been defined.

Vehicle emissions are addressed by Colorado regulations for licensing and are not subject to other regulatory requirements. Air quality impacts would also result from airborne particulates (fugitive dust) arising from earthwork during site preparation and construction. New construction at the STM site would be conducted in phases; therefore, emissions of fugitive dust would not

be continuous. Under certain wind conditions, there could be incremental localized increases in particulate emissions at nearby downwind receptors. Because the wind direction is primarily from the southwest at the STM site, particulates would tend to drift to the northeast. Residences to the east of the site would be the most likely to be impacted by particulate emissions.

NREL's Particulate Emissions Control Plan would minimize impacts from the construction of improvements at the STM site. The plan is approved by the State and implements conditions contained in Permit Number 00JE0009L, the site-wide permit for the emission of particulates associated with land development. All construction operations would comply with the terms and conditions of that permit. Therefore, discontinuous particulate emissions associated with construction operations would remain within regulatory constraints and would not significantly impact nearby residences.

4.3.2 Impacts from New Equipment and Operations

Emissions resulting from new sources would contribute an amount of pollutants that would not significantly increase those emissions that are currently generated, significantly impact ambient air pollution concentrations, or adversely impact site workers or nearby residents. There would be no new major stationary sources or major modifications to existing operations associated with the Proposed Action.

New emissions sources could include alternative fueling stations, traditional and alternative fuel storage tanks, new or modified boilers, backup power units and laboratory hood vents, and various storage tanks. Emissions from the S&TF in Zone 4 would be from modifications to the SERF boiler, the boiler for hot water and the diesel fueled engine generator for emergency power.

The greatest aggregate amount of potential emissions currently generated at the site is 46.41 TPY of NOx. This quantity of NOx emissions is significantly lower than the 100-TPY potential-to-emit (PTE) threshold for Major Source designation. The future boilers, the generator, and any other equipment associated with new construction are unlikely to potentially approach the major source threshold for a criteria pollutant.

As described in Section 2.1.2, specialty gases will be piped through the S&TF and a dedicated gas storage room (Toxic Gas Room) would have cabinets to house gas cylinders. The cylinders would contain various gases including toxic, highly toxic and corrosive gases. The gases would be controlled and monitored within the building. The use of toxic, highly toxic and corrosive gases in the S&TF could increase the generation of HAPs emitted from the STM site depending on how these gases are used or through accidental release. However, the presence and use of these gases are not expected to contribute to HAPs emissions. Implementation of NREL's programs and the required controls and monitoring would adequate address adverse air quality impacts to NREL personnel and offsite receptors. Installation of toxic gas monitors in the S&TF would ensure personnel safety within and outside of the S&TF (see Section 4.10 Hazardous Materials and Wastes).

Consistent with Colorado regulations, NREL ES&H staff would evaluate emissions associated with all new emissions sources prior to their installation. Although impacts to air quality are not expected to be significant, NREL would comply with notifications and permitting strategies implemented by the State to minimize the impacts of its emissions.

Because the nature of site operations would not materially change with the implementation of the Proposed Action, no noticeable odors would be expected at offsite locations.

4.3.3 Impacts of the No Action Alternative

If the Proposed Action were not implemented, incremental air quality impacts of the Proposed Action would not occur. Existing emissions from on-site operations would remain at current levels.

MITIGATION MEASURES

There are no significant impacts; therefore no mitigation is necessary.

4.4 NOISE

Impacts resulting from increased noise levels are indicated by changes in the ambient noise levels as a result of specified actions. This section discusses impacts to the sensitive receptors from site preparation and construction at the STM and DWOP sites resulting from the Proposed Action and subsequent site operations. The purpose of this analysis is to provide a qualitative assessment of construction and operational impacts to ambient noise levels resulting from the Proposed Action rather than to define precise noise levels and corresponding mitigation measures. Consequently, modeling was not performed to estimate future noise levels. Estimates of noise levels presented in this section are based on the data presented in Section 3.2.

Construction noise under the Proposed Action would be intermittent during normal working hours over a period of five years from 2003 to 2008. Construction would cause temporary increases to the ambient noise level near the STM site. Noise levels associated with construction are most likely be the greatest during the next two years when the proposed S&TF building (STM's largest proposed structure) would be built. Noise levels associated with construction would continue intermittently thereafter, but would decrease in duration. Based on proposed activities, operational noise resulting from new facilities and increased use of existing NREL facilities are expected to be insignificant. The STM site maintains compliance with all regulations related to worker health and safety. Exposure to work-related sources of noise is regulated by OSHA under 29 CFR 1910.95. The requirements contained within this regulation would protect NREL staff from work-related hearing loss.

4.4.1 Impacts from Construction Noise

The Proposed Action would result in construction noise from heavy equipment operation, building of foundations and structures, earthwork, and trenching and utility installation. Expansion of the facilities at the STM site would not occur continually. Construction would be phased, resulting in intermittent generation of noise during daylight hours over a five-year period. Construction of the S&TF is expected to start first and take approximately 21 months. Exterior construction would be completed in approximately 10 to 11 months. Other improvements would be expected in Zones 1, 3, 4, 5 and 6 between 2003 and 2008.

Noise levels associated with increased vehicle traffic resulting from construction activities would be temporary and limited to the times when construction actually takes place. Construction vehicles would be able to access the STM site directly and avoid travel through nearby residential neighborhoods. Temporary increases in noise associated with construction traffic would produce a minor and inconsequential impact at nearby receptors near the southern boundaries of Zones 3, 4, 5 and 6 and the east end of Zone 5.

Construction operations could generate temporary noise levels up to 95 dBA measured at a reference level of 50 feet (15.5 meters) from the source (Salter, 2000). NREL could construct buildings, parking lots or other facilities at or within close proximity to their boundaries, but in key locations, such as east of Zone 6 and west of the Camden Denver West condominiums, there are trail corridors to prevent construction up to the site boundaries. The trail corridor west of the condominiums is 250 feet (33 meters) wide. The trail corridor at the eastern end of Zone 6 is approximately 30 feet (10 meters) wide. In addition, previous site planning efforts and anticipated plans provide setbacks between new construction and parcel boundaries.

Table 4.2 displays the reduction in noise intensity associated with a 95-dB construction-related source over increasing distances. Table 4.2 does not consider additional factors that contribute to the reduction of noise intensity, such as topography, weather conditions, and noise sources external to the STM site.

Table 4-2. Reduction of Sound Level Intensity of a 95-dBA (Construction-Related) Source and 75-dBA Source (Bus Idling) as a Function of Receptor Distance.

Distance in feet (meters)	Construction-Related dBA	Bus Idling dBA
50 (15.5)	95	75
100 (30.3)	89	69
200 (60.6)	83	63
250 (75.7)	81.5	61.5
300 (90.9)	80	60 (nearest receptor)
400 (121.2)	77	--
500 (151.5)	75.5	--
800 (242.4)	71	--

Although condominiums east of the STM site (Zones 2 and 5) are located approximately 50 feet (15.5 meters) from the site property line, a 250-foot (75.5-meter) trail corridor running north-south just inside of the eastern STM property line provides an additional buffer between construction on the STM site and the condominium residences. If development were to occur at the edge of the trail corridor, construction activities would be located approximately 300 feet (90.9 meters) away from the nearest residences to the east. It is possible, therefore, that construction activities could generate maximum noise levels estimated to be 80 dBA to those residents.

If development were to occur in Zone 5 (the southeastern portion of the STM site), it would probably take place north of the access road to the STM site. The access road roughly parallels the southeast site boundary from approximately 50 feet (15.5 meters) to 200 feet (60.6 meters)

from the site boundary. It is expected that construction would be located at least 300 feet (90.9 meters) from the nearest residences to the south. It is possible, therefore, that construction activities could generate maximum noise levels estimated to be 80 dBA to those residents. If bus service were increased to the STM site because of expanded operations, the service would continue to be limited to workday hours primarily during the day. Noise from a bus idling at the Visitor Center is estimated to be 60 dBA at the closest residences.

Construction of the S&TF in Zone 4 would be further from residential receptors than the previously discussed examples, so corresponding noise levels would be lower.

If development were to occur in Zone 6 (on the southernmost 25-acre STM parcel), the development would have the potential to cause increased noise level at the adjacent park. Noise levels at the future ball fields could be described as those of an "urban environment," and are estimated to range between 75 and 80 dBA when the fields are in use. Maximum construction noise levels at 300 feet (90.9 meters) are estimated to be approximately 80 dBA.

Although there are residences close (approximately 50 feet (15.5 meters)) to the southwestern STM property line, site property is already developed in this area near the STM site property line (Zone 3, or West Campus). Future construction in that area of the STM site would consist of infill development between existing buildings, and may be as close as 200 feet (60.6 meters) to the property line. Maximum construction noise levels at 250 feet (75.7 meters) are estimated to be approximately 81.5 dBA.

Although the steep slopes of South Table Mountain are dedicated as a conservation easement (Zone 2) and are not available for development, limited development may occur on the top of South Table Mountain in Zone 1. The nearest residences to Zone 1 are located to the south of the STM site near the southwestern property line. It is estimated that the residences are at least 800 feet (242.4 meters) away with an elevation difference of approximately 300 feet (90.9 meters), resulting in an approximate 850-foot (257-meter) displacement. It is estimated that construction activities could generate a maximum noise level of 71 dBA at these nearby receptors depending on the location of the activity in Zone 1. Noise levels generated beyond a direct line of sight between source and receptor would be reduced relative to those in direct view. Noise resulting from construction operations in Zone 1 is not expected to significantly impact the State Highway Patrol's training operations on their track, but it could temporarily disturb wildlife and recreation uses such as hiking on mesa top trails. However, neither impact would be considered significant due to the limited amount of construction that is expected, the temporary nature of that construction, and the availability of large areas of the mesa top for wildlife and hiking.

Although the ambient noise in the vicinity of the STM site results from traffic on nearby I-70, it is unlikely that highway noise would mask the noise associated with construction activities at the STM site, as perceived by the nearest residents. The STM site is approximately 1,400 feet (423 meters) from I-70 at its southeastern corner.

Although regulatory authorities from the City of Denver and the State of Colorado do not apply to the STM site, they can provide a reasonable (but not enforceable) basis with which to assess potential noise impacts. The Denver noise ordinance allows a sound pressure level of 80 dBA measured at the boundary of an industrial site (not necessarily undergoing construction activities). The state regulations limit noise from construction projects to 80 dBA measured 25 feet (8 meters) from the property line. The estimates of noise generated by construction

activities at various locations of the STM site suggest that the State and Denver noise limits may be slightly exceeded at the residences near the STM site if the maximum noise estimates that have been anticipated actually occur. Distances were estimated from maps and other mitigating factors (such as topography, wind direction, presence of intervening structures or vegetation) were not considered. Therefore, it is likely that construction noise generated at the STM site would actually be less than these estimates.

4.4.2 Impacts from Operational Noise

The impact of additional operational noise generation at the STM and DWOP sites is expected to be incidental and insignificant both within on-site buildings and at off-site receptors. Compliance with OSHA requirements for noise exposure is a site mandate; therefore, anticipated impacts on NREL staff would be minimized and mitigated. The use of machines, equipment and tools at the STM and DWOP sites would temporarily and incrementally increase typical operational noise. Most equipment and tool noise would be confined to the interiors of the site buildings. There may be incidental exterior noise generated by maintenance operations, onsite vehicle travel, and the addition of up to two small-scale wind turbines in Zone 3.

Noise associated with maintenance would be of short duration and is not expected to impact off-site receptors for extended periods. Anticipated noise levels from these sources would not be expected to be higher than those generated from construction activity sources and would likely be lower in some instances.

Up to two small-scale wind turbines may be installed in Zone 3. These turbines would generate noise during periods where the turbines would be used for research or demonstration purposes. Operation may be constant or intermittent and would depend on wind conditions. Noise levels from typical, modern, small-scale turbines such as the model that is currently approved, the Whisper H40, would not be expected to increase offsite noise levels at sensitive receptors substantially, nor would they create substantial onsite noise impacts for workers or visitors. Noise levels from operation of the wind turbine model that is expected in this location were analyzed in June of 2001 by NREL for the manufacturer in a study entitled: “Wind Turbine Generator System Acoustic Noise Test Report for the Whisper H40 Wind Turbine.” This work was performed under DOE’s small turbine field verification program. In summary, operation of two similar turbines operating at the same time would generate noise levels that are not much higher than ambient noise levels at off-site sensitive receptors in nearby neighborhoods. The relative difference with and without the turbines is expected to be inconsequential.

Incremental noise impacts at off-site receptors from additional vehicle trips to and from the STM site would increase vehicle noise (see Section 3.2). The increase in vehicle noise at the STM site would generally be highest during the A.M and P.M commute peak hours and would not be expected to be substantial due to low vehicle speeds and because the vast majority of traffic to and from the STM site during peak hour would not travel through or into the interior of nearby residential areas.

Noise generation from new workers at the DWOP site would not occur because new NREL workers and related trips are expected to replace other workers currently working in the DWOP who already generate similar trips.

The relationship between noise and wildlife is discussed in Section 4.8.

4.4.3 Impacts of the No Action Alternative

No "new" noise sources would be added to the STM site if the No Action Alternative were implemented. Off-site noise levels in the area would continue to be dominated by vehicle traffic on I-70.

MITIGATION MEASURES

There are no significant impacts; therefore no mitigation is necessary.

4.5 VISUAL QUALITY/AESTHETICS

4.5.1 Visual Impacts of Proposed Buildings, Test Facilities, and Other Site Features

The Proposed Action would modify existing facilities and add new features to the STM site that would increase development scale and density at the site, thereby increasing site visibility from numerous off-site vantage points. Although future changes might be noticeable from off-site vantage points, they would not be considered significant adverse visual impacts for the following reasons: 1) the new facilities and features would be reasonably consistent with existing development in the vicinity, 2) views of the mesa top and slopes would not be substantially altered from public vantage points, 3) views from primary public vantage points would not be blocked or substantially degraded, 4) development of the site and related infill of the property has been anticipated, and 5) final designs for new development would be subject to review by NREL's DAB and their recommendations would be followed to address visual and aesthetic impacts.

The following discussion describes potential visual impacts associated with the proposed S&TF facility, followed by a zone-by-zone description of potential impacts. Figure 4.4 presents photographs that characterize the potential visibility of existing and proposed buildings, solar facilities, and other site facilities and features from off-site vantage points. These photographs are presented at the end of Chapter 4.

Science and Technology Facility (S&TF)

The proposed plans and designs for the S&TF provide for a three-story, stand-alone building housing the photovoltaic research sector. Exterior building design features and materials would be similar to and compatible with those of the adjacent SERF. The new building will be located such that there will be a gap remaining between it and the SERF of approximately 78 feet (26 meters), the width of the existing utility easement located east of the SERF. The S&TF would have a comparable structural module, use the same exterior cladding and glazing materials, and be built immediately east-northeast of the SERF below the slope of South Table Mountain.

The S&TF building would be visible from local streets and homes in the Pleasant View neighborhood that are located at the STM site boundary and from distant vantage points at higher elevations to the south and west. The new building would change views of the site by converting grassland to developed land and by blocking certain views of a portion of the mesa slope from some vantage points. No new parking would be added, and therefore, this form of

lighting would not be included in this improvement. When completed, the new building would blend into the existing SERF building and appear to be an extension of the existing facility.

Mesa Top Development (Zone 1)

The SRRL, one of the existing mesa top buildings, would be expanded by 1,344 sf (half of the current square footage). Building heights are not expected to change in the future. These structures are visible from certain off-site locations. Rough exterior dimensions for the proposed expansion would be approximately 40 feet (12 meters) by 40 feet (12 meters). This expansion represents far less than one percent of the proposed STM development square footage.

The visual impact of this improvement and permanent or temporary deployment of solar research equipment that might occur would involve a minor net increase in visibility of mesa top development from off-site receptors. This visibility is generally defined in Figure 4.4, photo 2. Use of the westerly portion of Zone 1 for buildings or equipment would have the most noticeable impact because it would broaden the apparent development width of mesa top development from certain vantage points. Development in areas close to the existing facilities, especially to the north, would have lesser impacts of this type.

Interior and exterior lighting would be expected to increase, but the use of motion sensors and other mechanisms to reduce or eliminate visibility of lighting from off-site locations are proposed and would be expected to reduce lighting impacts to insignificant levels.

Zones 3 through 6

New facilities and additions to current structures would be dispersed throughout the lower portions of the STM site within Zones 3 through 6. The potential distribution of new development is presented in Table 2.3.

In addition to new facilities and structures, construction of new service roads and supplementary parking areas with night lighting would be required to support the increase in activity on the STM site. The ground level features would have a minimal visual impact on the visual characteristics of the STM site as the surrounding topography would block views of these features from most off-site vantage points.

New buildings, facilities (including up to two small-scale wind turbines and related ancillary facilities), and night lighting from parking areas and other sources in Zone 3 would be visible from homes located along West 14th Place and other vantage points. The wind turbine tower height would be 40 feet (13 meters) or shorter, depending on the selected turbine model. The tower and blades would be visible from off-site locations, but would not create a significant adverse impact because the likely site for the turbines would be within the photovoltaic test area where other research equipment is located. The turbines would not be expected to dominate views and over time would be screened by intervening future buildings relative to some offsite viewpoints.

The density of development in Zone 3 is expected to increase as undeveloped spaces are filled in over time. Views of the mesa slope from West 14th Place would be replaced by views of the new buildings and related facilities. These changes to views from private properties would not be considered significant visual impacts because this new development has been anticipated and would be consistent with the visual characteristics of nearby development. Most residents

in the Pleasant View neighborhood would not have direct views of these new improvements from their homes. These changes would be most visible to neighbors near NREL's east and south site boundaries.

Views of improvements in Zone 4 are likely to be the most visible from off-site vantage points and from vantage points near the southeast corner of the STM site. The S&TF would be located in this area along with the possibility of further development of facilities and building additions. These future developments would be highly visible as this area is located in the center of the STM site and can be viewed from two major highways and from vantage points in surrounding neighborhoods. These changes would be most visible to neighbors near NREL's east and south site boundaries. However, the infill development would be designed to reflect the current architecture and designs already present on the STM site and would not block views of the mesa slope from public vantage points. Views from the future Camp George West Park are discussed later with respect to Zone 6 development.

The Visitor Center, located at the main entrance to the facility (Zone 5), would be expanded to the north and/or west and new parking and night lighting would be added. The addition could double the present size of the Visitor Center. This expansion and other improvements in Zones 4 and 5 would substantively change views from residential vantage points in the immediate vicinity and along the western end of Denver West Parkway. In general, buildings of up to five stories could replace views of vacant land and some views of the mesa slopes from roads and private vantage points could be blocked depending on the final design of the proposed facilities. These changes to views from private properties would not be considered significant visual impacts because this new development would be consistent with the visual characteristics of nearby development. These changes would be most visible to neighbors near NREL's east and south site boundaries.

Future changes in Zone 5 could involve development up to the trail corridor boundary located approximately 250 feet (33 meters) west of the Camden Denver West condominiums. Construction of buildings (up to five stories) in this location and the intensification of development across Zones 3, 4, and 5 would substantially change views from these new residential vantage points depending on the final design of the proposed facilities. These changes to views from private properties would not be considered significant visual impacts because this new development would be consistent with the visual characteristics of nearby development. These changes would be most visible to neighbors near NREL's east and south site boundaries.

Views from Nile Street and Kendrick Street of Zone 6 would also change as a result of new STM development and future construction of lighted ball fields and other improvements associated with Camp George West Park. Buildings would replace undeveloped areas on the NREL property north of the park. South of the STM site, ball fields, including light standards for nighttime play on one centrally located field that are not part of the Proposed Action, would be added to the view.

Depending on the level of development and the final design of the future facilities that are constructed in Zone 6, views of the mesa slopes from adjacent residences and the future Camp George West Park could be blocked or disrupted. Some local residents may find the visual impacts of the new facilities are objectionable. However, these impacts would not be considered significant for previously mentioned reasons, and because the Camp George West

land was acquired in association with a mesa top land protection effort connected to local visual quality preservation policies.

4.5.2 Impacts of the No Action Alternative

The No Action alternative would leave overall site features and associated visual elements unchanged. Visual impacts of the Proposed Action would be avoided.

MITIGATION MEASURES

There are no significant impacts anticipated from the Proposed Action; therefore no mitigation is necessary.

4.6 WATER RESOURCES

Water resource impacts are typically indicated by degradation of the quality of surface water and/or groundwater or substantial changes to stormwater quantities and/or runoff rates. This section discusses potential impacts to surface water and groundwater from the proposed construction of new facilities at the STM site and the ongoing operation of existing and proposed STM facilities. In addition, this section addresses project impacts in relation to EO 11988, *Floodplain Management*. EO11988 directs all federal agencies to avoid, if possible, development and other activities in the 100-year base floodplain. Federal agencies are required to:

- Reduce the risk of flood loss;
- Minimize the impact of floods on human safety, health and welfare; and
- Restore and preserve the natural and beneficial values served by floodplains in carrying out agency responsibility.

EO 11988 requires agencies to avoid disrupting these areas whenever there is a practicable alternative, and to minimize any harm that might be caused by federal actions.

Sampling of surface water and groundwater and/or modeling were not performed in association with the preparation of this section.

4.6.1 Surface Water and Stormwater Impacts

Construction of the S&TF, doubling the area of the Visitor Center parking lot, and other infill project would increase impervious surface area, which could include increase quantities of stormwater conveyed off-site, increase runoff rates, and incrementally degrade surface water quality. Increased turbidity and quantities of various chemicals associated with automobiles, herbicide and pesticide use on the site would be expected. However, these impacts would be addressed by the following:

- NREL's state-issued NPDES permit to construct;
- Implementation of NREL's existing programs, policies, and practices aimed at minimizing impacts on water resources; and
- Implementation of planned improvements that are expected to include various options to enhance the efficient use of water.

Changes in the quantity of stormwater and runoff rates could incrementally impact localized flooding in Lena Gulch; however, implementation of SWPPP measures would minimize off-site drainage impacts as a result of development at the STM site. During the design process for the S&TF in Zone 4 and other projects, drainage structures will be designed on-site to prevent an increase in the flow rate of stormwater conveyed off-site. For example, the S&TF design would direct stormwater to the existing detention pond and landscaped areas. Other future projects may include modifications to existing stormwater management structures (intakes, channels and detention basins). Stream bank erosion, channel scouring, sedimentation of stream channels, displacement of aquatic organisms, and incremental degradation of water quality during and immediately after storms would thereby be prevented.

As new development occurs and vacant lands on the site are converted to urban uses, the use of automobiles would be expected to increase proportionately. Traces of petroleum products originating from leaking vehicles could be transported from the pavement off-site via stormwater. These contaminants could contribute to water quality degradation, but potential impacts would be considered insignificant relative to stormwater volumes and actual contaminant concentrations that could be transported off-site.

In the case of a spill or release of chemicals or hydrocarbons during construction or facility operation, existing BMPs and procedures associated with spill response and materials handling would minimize impacts to surface water. These procedures are defined in the NREL SPCC Plan for the STM site.

4.6.2 Groundwater Impacts

Impacts to groundwater from construction and operational activities at the STM site are expected to be minor. However, groundwater may be encountered during excavations for the S&TF in Zone 4, other portions of Zone 4 and in Zones 3 and 5. If groundwater occurs, it would be pumped from the excavation to a vegetated area rather than into drainage. The vegetated areas would act as filters to trap sediment and reduce impact associated with groundwater disposal.

As site development occurs, groundwater recharge would be incrementally decreased by the creation of additional impervious surface on the site. This loss would represent a small percentage of the total STM acreage and would not have meaningful consequences on recharge or groundwater availability in the vicinity. Groundwater would not be withdrawn in association with future site activities except to monitor groundwater quality, as necessary. Consequently, no significant impacts are expected to the unconfined aquifer of the Denver Formation.

In the case of a spill or release of chemicals or hydrocarbons during construction or facility operation, existing BMPs and procedures associated with spill response and materials handling would minimize subsurface impacts. These procedures are defined in the NREL SPCC Plan for the STM site.

4.6.3 Impacts of the No Action Alternative

The No Action Alternative would have no impacts to surface water, stormwater, or groundwater resources. Implementation of the No Action Alternative would preclude potential impacts resulting from improvements associated with the Proposed Action.

MITIGATION MEASURES

There are no significant impacts; therefore, no mitigation is necessary.

4.7 GEOLOGY AND SOILS

Impacts to geologic features and soils are indicated by the losses of their current usefulness and productivity. This section discusses the assessment of potential environmental impacts to geologic resources and soils during site preparation, construction, and operation of the expanded facility. Impacts to the geological and soil resources at the site resulting from the Proposed Action are expected to be insignificant.

4.7.1 Impacts to Geological Resources

Resources such as concrete aggregate, crushed rock, and asphalt would be required during construction at the expanded facility. These materials would be obtained from off-site commercial sources or may involve use of material from on-site excavations.

Excavation for new structures may occur below the alluvial surface at the STM site at the base of South Table Mountain. Although the alluvium can range up to 35 feet deep, minimizing the need to blast the Denver formation bedrock for construction purposes, major cuts and fills will likely be required for the S&TF and possibly other facilities as well. Excavation could conceivably go below the alluvium if reaching bedrock for stability is necessary.

Construction activities on the top of South Table Mountain would probably disturb the basalt layer that underlies the thin (approximately five inches) Lavina loam soil layer. Facilities proposed for the mesa top are of minimal size, research-oriented, and would probably not require blasting for their construction.

It is unlikely that construction of new facilities would increase landslide potential at the STM site in the future because there is no evidence of recent landslides on the south side of South Table Mountain, no on-site or off-site construction in the immediate vicinity of the STM site has caused slope instability, NREL construction proposals avoid steep slopes, and the steep slopes within the STM site are in the Zone 2 conservation area where no development is proposed or anticipated. Excavations at the base of the slope in Zone 4 for the S&TF and other possible improvements would apply the most current engineering design specifications to avoid slope stability impacts. Retaining walls are proposed on the north side of the construction area and are designed to maintain slope stability.

Although located in a Jefferson County “Designated Dipping Bedrock Area,” the STM site is situated above the Denver formation to the east near its steeply dipping western limb. Assuming that the dip of the Denver formation reflects the gradient of groundwater flow below the STM site, the Denver formation dips to the south/southeast at approximately three degrees.

Impacts resulting from expansive claystone layers within the Denver formation would be reduced by its relatively small dip and the presence of up to 35 feet (12 meters) of alluvial material above the bedrock; therefore impacts resulting from dipping bedrock are unlikely. There may, however, be impacts to new facilities built on the lower portion of the STM site from rockfall originating from potentially unstable slopes on the south side of the mountain. These rockfall impacts are avoidable with proper site planning and design.

There is no evidence that construction or operational activities, as described by the Proposed Action, would precipitate seismic activity in the vicinity of the site. The STM site is classified as being in Seismic Zone 1, an area of low seismic risk. Structures to be built on the STM site would meet the most current Uniform Building Code Standards appropriate for its designated seismic zone.

The impacts to land use, loss of vegetation and habitat are described in Sections 4.1 and 4.8. Impacts to water drainage and water erosion are described in Section 4.6.

4.7.2 Impacts to Soils

Topsoil would be removed and surface soil would be disturbed by construction activities. Excess soil would be removed from the STM site or redistributed on the site by the contractor. There would be some loss of soils due to the physical alteration of the existing soil profile. However, the nonproductive attributes of most of the site's soils preclude agricultural utility; therefore, the loss of these non-productive soils would be insignificant. NREL would import fill and/or topsoil, if necessary.

Most of the construction on the lower, southeastern portion of the STM site (Zones 4 and 5) would take place on Denver clay loam and Denver cobbley clay loam. These soils consist predominantly of clayey material predisposed to shrinking and swelling. Their inherent instability requires precautions to be taken during construction activities. Proper engineering design will be taken to minimize the effects of shrinking and swelling. Precautions could include backfilling structures with materials that have a low shrink-swell potential and installing surface and subsurface drains near building foundations. Road and building designs would compensate for the soils' low strength. The soil would be compacted before building begins. Maintaining adequate vegetative cover and avoiding construction near drainages would control erosion resulting from the soils' medium runoff potential. These soils exhibit a moderate tendency to be transported by wind. Erosion control proposals for the S&TF, common to NREL construction processes, include:

- "Feather in" grades to make them look more natural;
- Use of seeding and erosion control mats on all disturbed areas;
- Avoid extending grading beyond the designed grading ties; and
- Use sediment control devices at specified discharge points to accumulate sediment and prevent migration downstream.

Refer to Section 4.6 Water Resources for stormwater impact discussions.

The STM site has developed a fugitive dust plan for land development that addresses measures to be taken during construction activities to prevent impacts from transport of particulates.

The proposed site for the S&TF, within Zone 4, is a disturbed site that exhibits past dumping of construction debris and the deposit of excavated soil, which most likely occurred during construction of the SERF. The building would occupy the disturbed site, and it is intended that the site would be returned to natural grades by removal of the construction debris and fill soils, pending funding availability. Proposed grading for the S&TF generally falls within existing grades, except on the east side where doors at the basement and office levels exit the building. This area would require fills up to eight feet (2.4 meters) along the eastern elevation for the grading to tie into the slab elevation.

Construction on the southwestern portion of the STM site (Zone 3) would impact the Leyden-Standley-Primen stoney clay loam and a smaller area of Standley-Leyden Primen very stoney clay loam. These soils are not inherently suitable for use as building foundations; however, the STM site has constructed buildings previously on these soils after taking the proper engineering precautions. These soils are found on areas where the slope of the land is slightly greater, requiring construction designs to compensate for potential soil slippage. As with Denver clay loam and Denver cobbley clay loam, the shrink-swell potential and low strength can be overcome by using the measures described in the previous paragraph as well as other suitable techniques. The possibility of particle transport via the wind is slight (USDA, 1980). Although new buildings would be constructed between existing buildings, construction near several drainages that exist in that zone would be designed to minimize water erosion resulting from storm events. In addition, construction activities would be regulated by the site's NPDES stormwater permit. The conditions of the permit are implemented by NREL's "Stormwater Pollution Prevention Program for Construction Activities," which would minimize impacts to surface waters resulting from stormwater.

The area of steep slope on the south side of South Table Mountain (Zone 2) is set aside as a conservation easement. Therefore, there would be no impacts to the Leyden-Primen-Standley soil complex. The stability of the soils on the steep slopes would not be affected by construction activities.

Disturbance of the Lavina loam on top of South Table Mountain (Zone 1) would be limited to a small area for expansion of the SRRL, as described in the Proposed Action. The moderate-to-high shrink-swell potential and the shallow depth of the Lavina loam limits its natural suitability for construction purposes; however, the proposed facilities for this area would be small, research-oriented structures. Its shrink-swell potential can be overcome with proper engineering techniques similar to those described for the other soils at the STM site. Disturbing the soil as a result of construction activities could slightly increase the soil particles' ability to be transported by the wind. Erosion by water on mesa top construction sites would not be significant because the mesa top is relatively flat.

4.7.3 Impacts of the No Action Alternative

The No Action Alternative would result in no impacts to geological resources. Minor impacts to soil resources from ongoing site activities would be expected.

MITIGATION MEASURES

There are no significant impacts anticipated from the Proposed Action; therefore, no mitigation is necessary.

4.8 BIOLOGICAL RESOURCES

NREL has extensive programs, policies and practices designed to avoid, minimize and mitigate impacts to the biological resources of the site. These efforts range from the designation of a formal conservation easement covering sensitive locations, to detailed efforts to restore disrupted areas and control noxious weed invasion.

Despite these plans, policies, and practices, impacts to the biological resources at the STM site could occur in three ways:

1. Direct impacts, such as direct loss of individuals of a species or individual species;
2. Secondary impacts, such as loss of habitat and degradation of habitat quality; and
3. Cumulative impacts which include the additive impacts resulting from past, present, and planned future activities from the project or other reasonably foreseeable projects.

The direct and secondary impacts caused by construction or other disturbances can be either permanent or temporary.

4.8.1 Vegetation Impacts

If the Proposed Action is fully implemented, site development would occur in Zones 1, 3, 4, 5, and 6, with the majority of potential impacts to vegetation occurring in Zones 3, 4, 5, and 6. Site development will not occur in Zone 2 because it is a conservation easement area. In addition, no development would occur in Zone 7 in order to protect existing natural and cultural resources in this area.

Zone 2 contains the majority of the shrubland habitat at the STM site; therefore, impacts on this habitat type elsewhere are quite limited and would be considered insignificant. The primary impacts from new development would be direct, permanent loss of grassland habitat in Zones 4, 5 and 6. Quantification of these losses is not possible without detailed site plans for future development. However, the open grassland area, defined by the limits of grading would be lost. This direct loss of grassland habitat would not be considered significant because both shortgrass prairie and mixed-grass prairie lack formal and direct protection, and the isolated nature of this on-site grassland located within the boundaries of the STM site limits its habitat values. Additionally, 177 acres of the site have been preserved for conservation of prairie and associated habitats. Incremental losses of grassland would also impact wildlife (see Sections 4.8.3 and 4.8.4).

Land clearing, excavation and construction staging areas, such as those associated with the S&TF, would disturb site vegetation. These disturbed areas would have an increased susceptibility to noxious weed invasion. As stated in Section 3.8, noxious weeds such as Canada thistle, diffuse knapweed, musk thistle, houndstongue, field bindweed, common teasel, jointed goatgrass and dalmatian toadflax occur on the site and are found on either the list of the ten most widespread noxious weeds in the State of Colorado, or on Jefferson County's list of noxious weeds of concern. The potential spread of these species, as well as cheatgrass and the other 12 noxious weed species found at the STM site, into disturbed areas represents secondary impacts as a result of the Proposed Action. NREL has made efforts to combat noxious weed invasion. These efforts include implementation of a noxious weed management plan, which includes the use of a native grassland seed mix to be used in restoration areas after construction. Based on NREL's approach to noxious weeds, the Proposed Action's impacts would not be considered significant.

4.8.2 Wetland Impacts

Three (STM-1, STM-2 and STM-7) of the six wetlands found at the STM site are within the conservation easement area (Zone 2) up gradient from most of the areas to be developed under the Proposed Action (see Figure 3.9 in Section 3.8). Only three wetlands (STM-6, STM-10, STM-11) totaling 525 sf (0.01 acres) could be directly impacted as a result of the Proposed Action. Wetland STM-6 is located behind the SERF building in Zone 4 and may be impacted by infrastructure modifications or improvements, and/or maintenance activities. Wetland STM-10 is located in Zone 6 and may be impacted by site development in this area. Wetland STM-11 is located at the southeastern edge of Zone 5 and may be impacted due to road improvements and/or road maintenance. If wetland STM-11 is determined to be jurisdictional by the USACE, use of an existing nationwide permit may be necessary.

Potential secondary impacts from the Proposed Action to wetland resources may include runoff of sediments from nearby construction activities and the invasion of noxious weeds from construction/disturbed areas into wetland habitat. Due to their relative locations to the developments under the Proposed Action, these types of secondary impacts could only occur at wetlands STM-6, STM-7, and STM-10. If they do occur, such secondary impacts are likely to be insignificant to the wetland resource.

Loss or degradation of these wetlands may be avoided by site planning efforts, but if they are lost, they would incrementally contribute to cumulative losses of wetlands, which are protected habitats. However, the direct loss of 525 sf (0.01 acres) would be considered insignificant.

4.8.3 Wildlife Impacts

The Proposed Action would not significantly impact wildlife in the area because sensitive mesa top and slope areas will be preserved, and the lower portion of the site is isolated and does not provide habitat for protected species.

Impacts from the two wind turbines on birds (injury and/or mortality from flying through the rotors) is not expected to be significant because the rotor sweep area is rather small, the density of turbines is low, and there would be no guy wires.

New development would directly and indirectly impact some individual animals or plants and incrementally contribute to cumulative losses of mixed-grass and shortgrass prairie habitat. These habitat losses would directly impact indigenous small mammal and reptile populations, as well as grassland bird species. Wildlife impacts from grassland habitat losses would not be considered significant because grassland habitat has been protected on-site and off-site in the project vicinity as permanent undeveloped space (Zone 2), the isolated nature of the shortgrass prairie that would be lost, and the lack of documented protected species within this habitat (see Section 4.8.4).

Secondary impacts due to the loss of this grassland habitat would reduce the overall size of local hunting areas of resident mammalian and avian predators such as coyotes, fox, red-tailed hawks, and owls. In addition, loss of habitat in Zones 4 and 6 would reduce habitat connectivity for land-based animals between the conservation easement in Zone 2 and Lena Gulch, located just south of the site at Camp George West. Local populations of mule deer, coyotes, and other species that have relatively large foraging areas may be adversely affected by this loss in

habitat connectivity. Maintenance of undeveloped corridors between Zones 2, 4, and 6 would minimize this impact.

Secondary impacts to wildlife may also occur due to habitat degradation caused by noxious weed invasion and increased noise levels from vehicle travel, construction, maintenance and wind turbine operations (Bowles, 1995). Weed infestation can alter habitats enough to cause some species to lose cover or food sources important to their survival. Noise is another type of secondary impact that may affect wildlife; however, the incremental increases in noise associated with the Proposed Action are not expected to be significant, and resident populations of wildlife species are expected to habituate. Increased noise levels due to construction activities and wind turbine operations may temporarily influence wildlife distribution within the STM site.

4.8.4 Species of Concern Impacts

Potential impacts on species of concern that are likely to occur in the project area, or could possibly occur at STM, are described in the following discussion.

American Peregrine Falcon, Bald Eagle, and Ferruginous Hawk - All three of these avian predators could possibly occur within the project area as transients. The American peregrine falcon feeds primarily on birds. A reduction in the total grassland bird population at STM may have a very minor adverse impact on their overall prey base, but is not considered to be significant to the distribution or overall population of these falcons. No adverse impacts to the bald eagle will occur due to the fact that there are no known roosts or nests at the STM site, and no suitable foraging habitat of the bald eagle will be impacted. The Proposed Action may slightly diminish cottontail rabbit populations in the area, which may have a minor adverse impact to the prey base of the ferruginous hawk. However, this impact is considered to be insignificant due to the abundance of cottontail rabbits in Zones 2 and 7 and the surrounding area. In addition, because there are no prairie dogs at the site, no impacts will occur to this species, which is one of the ferruginous hawk's primary food sources. The Proposed Action is not expected to significantly contribute to the cumulative loss of habitat for these raptor species.

Black-Tailed Prairie Dog - Although appropriate habitat does exist at the STM site for black-tailed prairie dogs, no individuals or colonies were observed on site during the 2002 SAIC site visit. Therefore, no direct or secondary impacts to this species are anticipated under the Proposed Action. The Proposed Action is not expected to significantly contribute to the cumulative loss of habitat of the black-tailed prairie dog.

Preble's Meadow Jumping Mouse (PMJM) – On-site improvements and activities associated with the Proposed Action will not adversely affect PMJM populations or their habitat because no suitable PMJM habitat occurs at the STM site. The potential PMJM habitat located in Zone 3 at Drainage 7 is unlikely to be impacted by the Proposed Action. It is unlikely that PMJM will occur on the site or PMJM habitat will develop on the site because the drainages lack perennial water sources. The Proposed Action is not expected to significantly contribute to the cumulative loss of habitat of the PMJM.

Colorado Butterfly Plant and Ute Ladies'-tresses Orchid – Based on the 2001 survey of the site conducted by Plantae (NREL (Plantae), 2002), no Ute ladies'-tresses orchid or Colorado butterfly plants occur on the STM property. The ephemeral drainages at STM do not contain suitable habitat for the Colorado butterfly plant or the Ute ladies'-tresses orchid; therefore, the

undocumented occurrence of either species is unlikely. In addition, the ephemeral drainages primarily occur within Zone 2, the conservation easement area, which will not be developed. The Proposed Action will not adversely affect Ute ladies'-tresses orchid, Colorado butterfly plant, or their habitat. The Proposed Action is not expected to significantly contribute to the cumulative loss of habitat for these plant species.

4.8.5 Migratory Birds

The proposed activities could have an adverse affect on migratory birds and raptors that utilize the area. Antennas, wind driven turbines, and lighting may all have a negative affect on the birds by causing direct mortality and disrupting breeding, nesting, and foraging behaviors. In addition, nests may be disturbed during the construction phase, and less area will be available for nesting after the proposed development is completed. Measures presented below would mitigate potential impacts to migratory birds.

4.8.6 Impacts of the No Action Alternative

Under the No Action Alternative minimal direct, secondary, or cumulative impacts associated with ongoing operations would occur to the vegetative communities at STM. Ongoing weed management activities are expected to control existing noxious weed populations. Water resources supporting the small, isolated wetlands at the STM site are likely to remain constant.

The No Action Alternative would not affect individuals or habitats of the Ute ladies'-tresses orchid, Colorado butterfly plant or the PMJM.

MITIGATION MEASURES

NREL already employs various strategies to limit man-made disturbances to the natural environment. For example the Stormwater Pollution Prevention Program for Construction Activities (SPPPCA) requires reseeding temporarily disturbed areas with a native seed mix developed specifically for the STM site, and the use of Certified Weed Free Mulch. Other BMPs required under the SPPPCA include erosion control measures such as erosion control blankets, mulching, sediment basins, erosion bales, and silt fencing. NREL's SPCC program provides guidance on preventing and responding to spills of fuel and hazardous construction materials. NREL has also adopted a weed management program for the STM site, which has specifically targeted diffuse knapweed, Canada thistle, and dalmatian toadflax. Weed management at the STM site is adaptive and takes an integrated approach to the different methods available for weed control (e.g., education, prevention, reseeding, biological, mechanical, and chemical).

The following mitigation measure should be implemented to address potential impacts of the Proposed Action:

- As site development proceeds, NREL will consider site development alternatives that maintain habitat connectivity between Lena Gulch and Zone 2 (Conservation Easement) via undeveloped natural corridors.
- Construction areas and access roads should be fenced to limit disturbance to grassland habitat outside of the construction zone.
- If necessary, where water and maintenance requirements can be met, native shrub and tree species should be replaced if they are removed during construction activities.

- DOE will conduct a field survey of the site for migratory birds and raptors to update its existing data and establish general Best Management Practices (BMPs) for the STM site.
- When future construction may impact potential habitat for migratory birds, NREL will identify any appropriate field surveys to clarify impacts and develop customized BMPs to be applied during and after construction, if necessary. An example of a customized BMP may involve delaying construction until identified nests are no longer being used for the season.

The implementation of these measures is consistent with NREL's overall practices at the STM site and will be incorporated into NRELs environmental management policies and practices.

4.9 CULTURAL RESOURCES

Impacts to significant cultural resources can occur as a result of building or road construction, utility work, demolition, changes to a resource's setting, or use (including both noise and ground-disturbing activities). This section evaluates potential impacts to cultural resources within the STM and DWOP sites.

Section 106 of the National Historic Preservation Act of 1966 (as amended) requires agencies to consult with the SHPO when making determinations of eligibility and effect for cultural resources within or adjacent to a project. Consultation letters between DOE and SHPO are included Appendix C.

4.9.1 Impacts from Facility and Infrastructure Improvements

Archaeological Resources - No known significant archaeological resources occur within the STM or DWOP sites. Therefore, no impacts are anticipated as a result of the proposed action. However, Zone 6, the 25-acre parcel within Camp George West, has the potential for buried deposits and should be systematically tested prior to construction. Should any evidence of archaeological resources be discovered at any time during ground disturbing activities at the STM site, all work would stop in the vicinity until a qualified archaeologist completely evaluates the significance of the find according to criteria established by the National Register.

Architectural Resources - Two historic resources individually listed on the National Register exist on NREL STM property. In addition, the Camp George West Historic District overlaps the NREL STM property by 25 acres. Two contributing resources occur within those 25 acres. Contributing resources are those features within a historic district that contribute to the districts overall eligibility for the National Register. Improvements resulting from the Proposed Action have the potential to disturb contributing resources to the Historic District. No known cultural resources occur within the DWOP site and therefore no impacts are anticipated.

Ammunitions Igloo (5JF843) **-** The ammunitions igloo is listed on the National Register. It is located in Zone 7. NREL plans no new improvements in this zone. DOE in consultation with the SHPO has determined that no historic properties are affected.

Amphitheater and Foot Bridge (5JF842) - The amphitheater and footbridge are listed on the National Register, and are located in Zone 7. NREL plans no new improvements in this zone. DOE in consultation with the SHPO has determined that no historic properties are affected. If a separate plan to restore the amphitheater and footbridge is proposed in the future, it would be subject to a separate NEPA analysis.

Camp George West Historic District (5JF145*)* – As shown in Figure 3-9, the Camp George West Historic District includes the 25-acre parcel that was recently deeded to DOE and is referred to as Zone 6 on the STM site. Facility and infrastructure improvements are proposed in Zone 6. Segments of two contributing resources occur within Zone 6:

- Two firing lines (5JF145.66) - The Proposed Action would likely require removal of two firing lines located on NREL property. The firing lines located south of the NREL property would not be affected by the Proposed Action, but will be removed by others as part of the Camp George West Park improvements. DOE, in consultation with the SHPO, has determined that historic properties are adversely affected by the Proposed Action.
- Portions of a low rock wall (5JF145.68*)* - The Proposed Action would likely require the removal of portions of the low rock wall located on NREL property. The rock wall, located south of the NREL property, would not be affected by the Proposed Action, but will be removed as part of the Camp George West Park improvements. DOE, in consultation with the SHPO, has determined that historic properties are adversely affected by the Proposed Action.

Traditional Cultural Resources – No known traditional cultural resources occur within the STM or DWOP sites. Therefore, no impacts are anticipated as a result of the proposed action.

4.9.2 Impacts of the No Action Alternative

Under the No Action Alternative there would be no ground disturbing activities at the STM site, and any disturbance associated with ongoing operations would be expected to be minor and would be addressed by standard protocol and NREL procedures. Therefore, no historic properties are affected by the No Action alternative.

MITIGATION MEASURES

Consultation with the SHPO to develop final mitigation measures is ongoing. Consistent with Federal law (National Historic Preservation Act, Section 106 and 36 CFR 800.5 and 800.6, DOE and the State Historic Preservation Officer shall negotiate an MOA regarding requirements for identified cultural resources in Zone 6 (See Appendix C).

4.10 HAZARDOUS MATERIALS AND WASTES

Impacts resulting from increased use of hazardous materials and increased generation of hazardous waste are evaluated by examining the types and quantities of materials and wastes, as well as materials and waste management procedures. This section discusses impacts to hazardous materials usage and waste generation resulting from construction, and operational activities resulting from the Proposed Action. It is not possible to quantify the increased amount of hazardous materials that would be used in the future; however, it is likely that the kinds of hazardous materials used will remain substantially the same, consistent with the type of research performed at the STM and DWOP sites. The focus of this section is on the materials and waste management procedures employed by NREL at the STM and DWOP sites.

Increases in hazardous materials use and waste generation would be subject to NREL protocols and State of Colorado regulations. The hazardous waste generator status of the STM and DWOP sites is expected to remain the same; however, if the STM site generator status changes, appropriate changes in management procedures would be implemented in line with State regulations. New facilities and activities are not expected to increase the potential for accidental releases or spills because all existing programs, policies and practices associated with hazardous materials and waste would remain in place to apply to future improvements and activities associated with the Proposed Action. Impacts resulting from increased use of hazardous materials and increased waste generation are expected to be insignificant.

4.10.1 Construction Impacts

Construction operations would be temporary and would occur intermittently over a five-year period. These operations would not significantly increase the amounts or types of hazardous materials maintained at the sites or the amount of hazardous wastes generated at the sites.

In the case of a spill or release of chemicals or hydrocarbons during construction activities, existing BMPs and procedures associated with spill response and materials handling would minimize impacts to surface water. These procedures are defined in the NREL SPCC Plan for the STM site.

4.10.2 Operational Impacts

The Proposed Action would be expected to result in more site activity, potentially increasing the demand for hazardous materials over the current level. In addition, implementation of the Proposed Action could result in requests for the use of new hazardous materials. Hazardous materials would be stored in the newly constructed buildings covering a greater portion of the STM site. None of these issues is expected to be significant because:

- The nature of the research to be performed on the site is not expected to change substantially;
- Chemical manufacturing and processing is not proposed;
- Hazardous materials would continue to be handled centrally through NREL and tracked through the chemical inventory system;
- Waste minimization training and implementation would continue to ensure that the amounts of hazardous materials used on-site would be the least possible, consistent with research objectives;
- NREL's pollution prevention program and other efforts are expected to minimize the amount of hazardous waste generated at both the STM and DWOP sites;
- Substantial changes in hazardous materials usage would be reviewed by NREL's Hazard Identification and Control Program; and
- Stringent management and procedural practices will continue to be implemented at the STM and DWOP sites.

New storage tanks, including a liquid nitrogen storage tank and a hydrogen gas storage tank, all associated with the S&TF, would be constructed and managed in compliance with state, federal, and NREL tank requirements. In the case of a spill or release of chemicals or hydrocarbons during normal operations, existing BMPs and procedures associated with spill response and materials handling would minimize impacts to surface water. These procedures are defined in the NREL SPCC Plan for the STM site.

The proposed S&TF would include the use of several types of gases and fuels, including: liquid nitrogen, hydrogen gas, Silane, argon, and diesel fuel, as well as several types of specialty toxic, highly toxic, and corrosive gases. These latter gases would be stored in a Toxic Gas Room. Silane would be stored in a dedicated Silane storage area on the north side of the building. A toxic gas monitoring system based on that used at the SERF would be installed in the S&TF, with monitoring consisting of a minimum of two points in Laboratories 101, 109, and 110, the Toxic Gas Room, and the Silane bunker. A separate laboratory waste sewer line would connect to all sinks, floor drains, and service trenches in the laboratories, process areas, and service corridors (refer to Section 4.11.4). The potential for accidental release would exist, but would be mitigated to insignificant levels through construction specifications that address safety requirements and implementation of various existing environmental management programs that have been formally adopted by NREL.

Hazardous waste generation would be expected to increase at both the STM and DWOP sites as the quantities of hazardous materials used increases. The amount of hazardous waste generated at the STM site has allowed it to maintain its SQG status; however, the limit for a SQG was exceeded for one month in 1999 when NREL followed the requirements for the Large Quantity Generator (LQG) category. The amount of hazardous waste generated at the STM site over the past several years suggests that future activities would probably not cause the STM site to exceed the SQG limit of 2,20.5 pounds of hazardous waste generated in a single month; however, irregularities in hazardous waste generation amounts at STM reflect the types and kinds of experiments conducted at the site and may vary considerably. NREL procedures would require internal notification if exceedance of the SQG criteria were imminent. NREL would follow the LQG requirements if its SQG status were exceeded for any particular month. The impact of a generator status change is primarily procedural.

Based on the small amount of hazardous waste generated in past years, planned improvements and future activities are not expected to substantially increase the amount of hazardous waste generated at the DWOP site.

Non-regulated waste (ordinary refuse) quantities at the STM site have decreased significantly during the past few years due to proactive waste management and recycling programs. Non-regulated waste at the DWOP is virtually nonexistent. Non-regulated waste levels are expected to increase only slightly and in proportion to increased program activity and the higher number of NREL personnel on the sites. The increase in non-regulated waste would not affect current disposal agreements.

4.10.3 Impacts of the No Action Alternative

If the No Action Alternative were implemented, the quantities and types of hazardous materials and hazardous wastes associated with the site would remain consistent with current amounts.

MITIGATION MEASURES

There are no significant impacts; therefore, no mitigation is necessary.

4.11 PUBLIC SERVICES AND UTILITIES

The following discussion addresses the impacts of the Proposed Action on the capacity of public infrastructure and service providers. Stormwater issues are addressed in Sections 3.6 and 4.6 Water Resources. Broad energy issues are discussed in Sections 3.12 and 4.12 Energy Efficiency and Renewable Energy. Environmental impacts from the construction of new utility infrastructure are discussed throughout Chapter 4, as appropriate.

4.11.1 Electricity and Gas

The increased demand for electricity and gas by the proposed facilities at the STM site is not expected to be substantial with respect to Xcel Energy's overall capacity or local infrastructure. The new demand would not contribute substantially to peak period power demand and associated power generation capacities. However, all additional peak period power demand contributes incrementally toward the cumulative need for new power plants and/or power production and corresponding environmental impacts. These cumulative impacts would be offset by NREL's commitment to sustainability, which includes purchasing "green" power, extensive on-site energy conservation measures, and the potential energy efficiency and renewable energy technology benefits anticipated from the work performed at the STM site (see Sections 3.12 and 4.12 Energy Efficiency and Renewable Energy for related findings). For the proposed S&TF, most internal lighting would consist of a blending of natural and artificial light sources, with control systems including ambient and external light sensing to make this blending as efficient as possible. External lighting for the S&TF would be mostly relegated to ground mounted PV bollards similar to those at the SERF.

4.11.2 Telecommunications

The Proposed Action would improve and extend the on-site telecommunications infrastructure to support new research and development activities, facilities, and an increasing number of employees on the site. No off-site infrastructure requirements are needed and the capacity of local service would not be adversely impacted by the proposed improvements.

4.11.3 Domestic Water System

The Proposed Action would incrementally increase the demand for domestic water and would require modifications and upgrades to the on-site domestic water infrastructure. The capacity of on-site infrastructure would be adequate with contemplated improvements. The current water system would accommodate additional buildings and associated office areas and restroom facilities with the addition of an underground pipe that would be installed from new buildings to the nearest domestic water loop. This improvement would be included in individual building designs.

The long-term water system infrastructure and supplies of the CMWC is considered adequate to serve the site for the foreseeable future (Santangelo, 2003).

4.11.4 Sewage Service

The Proposed Action would increase demand on existing sewer infrastructure and treatment facilities associated with the Pleasant View Water and Sanitation District. The existing on-site system is considered adequate for current and anticipated future sewage needs. The capacity

of the Metro Wastewater Reclamation District's downstream treatment plant in Denver is adequate to accommodate regional sewage needs for the foreseeable future (Isom, 2002).

The S&TF would have two separate waste lines for sanitary waste and laboratory waste. The bathrooms, janitor's closet, mechanical equipment rooms, and break room would connect to the sanitary waste line. The laboratory waste line would connect to all sinks, floor drains, and service trenches in the laboratory, process areas, and service corridors. A sampling station for all lab waste would be installed on the laboratory waste line before it exits the building and ties into the sanitary line. Floor drains in all laboratories would be equipped with a plug or cap that would normally be closed. Due to NREL's "Zero Discharge" policy, acid resistant piping would not be required for the laboratory waste lines.

4.11.5 Emergency Response and Fire Protection

The new facilities and additional staff associated with the Proposed Action would incrementally increase demand for police, fire and ambulance services, but the increases would be considered minor given site use, on-site security, and anticipated needs for emergency service providers.

The Proposed Action would not increase the risk of wildfire on the site, but it would result in the installation of new facilities, equipment, and buildings, as well as the presence of additional people. The NREL Fire Protection Program currently addresses this and other fire risks. The Proposed Action includes fire hydrant requirements and new underground piping to protect new and existing facilities, buildings, equipment and personnel. The fire protection system for the S&TF would be designed to meet the requirements of NFPA 13 for an Ordinary Hazard, Group 2 area. No off-site infrastructure requirements would be needed, and the capacity of on-site and local infrastructure and service would not be disrupted by the proposed improvements or new demands for fire protection services (Abbink, 2002).

4.11.6 Impacts of the No Action Alternative

The No Action Alternative would limit demand growth for public services and utilities by retaining existing employment levels and operational activity at current levels. New facilities and modification and expansion of existing facilities would not occur. Incremental capacity impacts on existing service providers caused by the Proposed Action and the impacts of associated infrastructure improvements would be avoided.

MITIGATION MEASURES

There are no significant impacts; therefore no mitigation measures are necessary.

4.12 ENERGY EFFICIENCY AND RENEWABLE ENERGY

The Proposed Action has a complex impact on energy because it will increase on-site energy demand, generate small amounts of electricity for use on-site, and is expected to contribute substantially to nationwide, and possibly global, use of energy efficiency and renewable energy technology. Overall, the Proposed Action has a beneficial impact on energy efficiency and renewable energy. The following discussion addresses two primary energy impacts of the Proposed Action:

- Electricity Generation;
- Contribution Toward Energy Efficiency and Renewable Energy Technology.

The impacts of the Proposed Action on electricity and gas demand and associated infrastructure is discussed in Section 4.11, Public Utilities and Services.

4.12.1 Electricity Generation for the Site

The Proposed Action increases the potential for the STM site to provide electricity for a portion of its own needs. This is a beneficial impact of the Proposed Action; however, the possibility that the site could become a "power plant" by exporting more electricity than is imported on a sustained basis is extremely remote. The STM site is a laboratory designed for intermittent operations and temporary testing configurations. Given fluctuating and uncertain operational parameters, annual energy consumption is expected to exceed annual energy generation by a considerable margin during the life of the STM site. The STM site is not, and is not intended to become, a renewable energy generation plant or contribute power to the nation's energy grid.

4.12.2 Contribution Toward Energy Efficiency and Renewable Energy Technology

The Proposed Action is fully intended to make a substantial contribution to energy efficiency and renewable energy technology. The magnitude of these beneficial impacts could range from minor to globally significant depending on the technology achievements resulting from the Proposed Action and related efforts worldwide. Clearly, improvements in technology and corresponding cost-effectiveness since the mid-1970s have been substantial, and current energy pricing scenarios and research prospects indicate that further advances may be substantial.

New buildings are expected to include energy efficient designs and systems. For example, the most internal lighting on the S&TF would consist of a blending of natural and artificial light sources, with control systems including ambient and external light sensing to make this blending as efficient as possible. External lighting for the S&TF would be mostly relegated to ground mounted PV bollards similar to those at the SERF.

These direct benefits would also result in indirect and/or secondary beneficial impacts to the environment including, but not limited to, reduced air pollution as compared to emissions generated with conventional energy technologies.

4.12.3 Impacts of the No Action Alternative

The No Action Alternative would maintain the STM site's energy production capacity and energy consumption at current levels. Beneficial energy impacts and corresponding environmental impacts would still be anticipated, but these benefits would be less substantial than those associated with the Proposed Action.

MITIGATION MEASURES

There are no significant impacts; therefore no mitigation is necessary.

4.13 SUMMARY OF SECONDARY AND CUMULATIVE IMPACTS

Secondary impacts are those that are caused by a Proposed Action, but may occur later in time or farther removed in distance, relative to the primary impacts of the Proposed Action. “Cumulative impacts result from the incremental impact of the Proposed Action when added to other past, present, and reasonably foreseeable future actions" (40 CFR Section 1508.7).

This Site-Wide EA considers past, present and reasonable foreseeable short-term and long-term future actions on the STM and DWOP sites. In addition, it considers off-site factors and reasonably foreseeable off-site projects.

Existing development considered in the cumulative impacts analysis include: the construction of the STM facilities; the Colorado State Patrol driver training track facility on South Table Mountain; the surrounding residential, commercial, and government (Jefferson County Government Center and Camp George West) development in the area; and substantial infrastructure improvements such as I-70, C-470, and U.S. Highway 6. The past improvements aggregated together have substantially changed the native conditions of the site and surrounding area. Various impacts such as habitat fragmentation and disruption have occurred incrementally in the area and elsewhere over time. These developments and their impacts are the subject of individual reviews and approvals by government agencies over time. Two examples of regulatory processes associated with related impacts are protections under the Endangered Species Act for sensitive species such as PMJM and protections for wetlands under Section 404 of the Clean Water Act. Other processes are embodied in plans and policies adopted by local governments such as those associated with community plans and development regulation. These issues are discussed in Chapter 4 of this document.

Reasonably foreseeable off-site projects considered in the cumulative impacts analysis include buildout of Denver West Office Park and nearby properties, and secondary development associated with infill and redevelopment that would be anticipated now that the Colorado Mills Mall is open. These projects are not defined specifically at this time, but would be expected to include infill of commercial properties between the STM and DWOP site, commercial development along West Colfax Avenue and South Golden Road, further infill of residential properties in the vicinity of the STM site, and other development in various locations in the area.

Cumulative and secondary impacts are discussed in Sections 4.1 through 4.12, as appropriate. As stated in other locations within Chapter 4, the Proposed Action’s incremental contribution to these secondary and cumulative impacts would be insignificant and the No Action alternative would not contribute to these impacts.

The most important examples of secondary and cumulative impacts associated with the Proposed Action are as follows:

- Traffic congestion at the intersections along Denver West Marriott Boulevard;
- Regional and local air pollutant emissions;
- Noise impacts on Pleasant View neighborhoods;
- Development intensification;
- Increases in Lena Gulch stormwater flows;
- Habitat losses from development of natural areas;
- Demand for energy; and

- Beneficial impacts from improved alternative energy sources.

The following discussion explains why the incremental impact of each of the secondary and cumulative impacts is considered insignificant:

Traffic congestion at the intersections along Denver West Marriott Boulevard: The project's incremental impact would leave room for additional development in the vicinity while resulting in adequate LOS. There has been much development in the area, including the Colorado Mills mall. Roads and intersections have been widened and upgraded to accommodate traffic from that project. NREL's proposed action will have an insignificant incremental effect on current traffic levels of service.

Regional and local air pollutant emissions: Air quality in the Denver Metropolitan Area has been poor in the past, but has improved in recent years to the point where the Denver Metropolitan Area has recently been re-designated as an attainment area. The project's incremental impact would not be expected to have any meaningful impact on Denver Metropolitan Area air quality or attainment. However, air pollutant concentrations in the Denver Metro area are relatively close to the standard for ozone and other pollutants, so every source is scrutinized. Given the potential air quality benefits of renewable energy and energy efficiency research to be performed at the site, the overall net impact on cumulative air quality would not be considered significant.

Noise impacts on Pleasant View neighborhoods: Noise generated during construction, from vehicle use on the site, from site operations, and reasonably foreseeable sources is not expected to cause noise levels to exceed any cumulative noise impact standard.

Development intensification: The project includes new development and improvements on the mesa, but does not create unplanned development or present the potential to open up new off-site areas for development. It does not create improved access to real estate, reduce development restrictions, or substantially induce new development in unanticipated areas.

Increases in Lena Gulch stormwater flows: Existing flooding in Lena Gulch is created by an offsite channel constriction on land to become Camp George West Park. This can be resolved with planned modifications under consideration by the Pleasant View Metropolitan District. The Proposed Action would result in a minor increase in stormwater upstream of this constraint, but this stormwater will be detained on site if this improvement is not made in a timely manner.

Habitat losses from development of natural areas: The Proposed Action would not have direct impacts on protected species (PMJM, Ute ladies tresses orchid) or habitats (wetlands) that are the subject of regulations approved to address cumulative impacts on biological resources. However, the project could impact migratory bird species. Mitigation measures would be implemented to address the incremental and cumulative impacts. The indirect impacts of the Proposed Action would be minor with respect to cumulative impacts on biological resources because existing biological values associated with the site are predominantly oriented around the mesa top area, which is preserved in a conservation easement.

Demand for energy and beneficial impacts from improved alternative energy sources: All projects requiring energy have incremental impacts related to energy, but very few offer the possibility of making a positive contribution toward renewable energy and energy efficiency like

a laboratory dedicated to this purpose. The adverse energy impacts of the Proposed Action are at least balanced by the potential beneficial impacts of technology improvements.

Cumulative impacts are important to identify, but characterizing their significance is difficult because these projects are speculative. One example of an external action considered in this cumulative impact analysis is mitigation to be addressed by others for congestion issues on local roads.

4.14 IRREVERSIBLE/IRRETRIEVABLE COMMITMENT OF RESOURCES

An irreversible commitment of resources is defined as the loss of future options. The term applies primarily to the effects of use of nonrenewable resources such as minerals or cultural resources, or to those factors such as soil productivity that are renewable only over long periods. It could also apply to the loss of an experience as an indirect effect of a "permanent" change in the nature or character of the land. An irretrievable commitment of resources is defined as the loss of production, harvest, or use of natural resources. The amount of production foregone is irretrievable, but the action is not irreversible. If the use changes, it is possible to resume production.

The Proposed Action would not have irreversible impacts because future options for using this site would remain possible. A future decommissioning process could restore the site for alternative uses, ranging from natural open space to urban development. No loss of future options would occur.

The primary irretrievable impacts of the Proposed Action would involve the use of energy, labor, materials and funds, and the conversion of some lands from a natural condition through the construction of buildings and facilities. Irretrievable impacts would occur as a result of construction, facility operation and maintenance activities. Direct losses of biological productivity and the use of natural resources from these impacts would be inconsequential.

4.15 THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF THE HUMAN ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

This section addresses the commitment of resources associated with the Proposed Action relative to the loss of long-term productivity associated with these commitments.

The Proposed Action would commit resources in the form of energy, labor, materials, and funds over 20 years or more. The justification for these commitments at this time is described in Section 1.1 Purpose and Need. Long-term productivity associated with the site relates to biological value as habitat and open space values associated with aesthetic quality and recreation. The Proposed Action would involve the use of lands where these values have already been compromised by facility development and operations and would preserve much of the site for these purposes. For these reasons, the incremental loss of biological and open space values would be insignificant. Improved efficiency and increased reliance on renewable energy resources could substantially reduce reliance on coal, oil, and nuclear fuels and reduce resource productivity losses in resource extraction areas.

The Proposed Action would create no long-term risks to public health and safety.

4.16 UNAVOIDABLE ADVERSE IMPACTS

There would be no significant unavoidable adverse impacts of the components of the Proposed Action. However, some adverse impacts would be expected. These impacts and corresponding mitigation measures are described throughout other sections of Chapter 4 and are listed in the Summary of this EA.

4.17 SITE-WIDE ENVIRONMENTAL MANAGEMENT MATRIX

Table 4.4 presents a Site-Wide Environmental Management Matrix. The matrix provides an overview of impact issues associated with individual components of the Proposed Action. The matrix will also serve NREL staff, managers and other decision-makers by providing a quick reference guide for the key issues raised by anticipated improvements at the STM and DWOP sites.
The matrix covers a wide range of issues. These issues and others are managed by NREL under a series of ES&H policies and programs developed and implemented by NREL with oversight provided by DOE. The ES&H policies and programs are well developed and are already integrated into NWTC operations and processes for new projects.

The matrix lists each of the key components of the Proposed Action at the STM and DWOP sites and then compares them to key environmental management issues. The improvements and environmental issues are presented in the same order as they are presented in Chapters 2, 3, and 4 of the EA. If limits on the number, location, or other characteristics of a particular improvement are defined in the EA, those limits or ceilings are noted. If issue clarifications are needed and/or important NEPA “significance” thresholds can be characterized for a particular issue, details are provided in subsequent footnotes.

At this time, no other improvements/changes are anticipated. However, in an effort to improve the utility of this matrix, additional improvements/changes are included in the matrix to guide site managers in the event that unforeseen circumstances warrant changes to the program of improvements.

No mark in the matrix indicates that a particular issue does not relate to a particular improvement. An “X” in the matrix indicates that a particular issue applies or may apply to the corresponding improvement. In many cases, NREL has made commitments related to this issue or has ES&H policies and procedures in place that relate to this issue and may need to be considered as part of project implementation. A red “X” indicates high sensitivity for a particular improvement to the corresponding issue. If an X is present, existing ES&H practices and procedures and corresponding commitments presented in Chapter 1 of the EA should be evaluated to determine whether and how they may apply.

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INSERT TABLE 4.3. SITE-WIDE ENVIRONMENTAL MANAGEMENT MATRIX.

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Footnotes:

1. *Off-Site Land Use Compatibility* – Project requires activities on lands at or beyond the boundaries of the STM site or DWOP buildings. Coordination and/or negotiations with associated property owners and local governments may be a lead item and issues may result that have not been fully addressed by ES&H policies and procedures or commitments in the EA. NEPA could be triggered by substantial controversy or potentially significant off-site impacts that have not been addressed in the EA.

2. *Site-Wide Land Use Compatibility* - Project design elements should be checked with respect to development limitations: building locations, structure heights, setbacks, circulation, access, parking, implications on other projects, etc. Variations in excess of limits or outside of assumed parameters could necessitate NEPA review.

3. *Compatibility with Local Planning Policy* - Site facilities may require local government review despite formal legal authority.

4. *Traffic Congestion and Accidents* - Off-site road improvements and on-site changes that might substantially increase truck traffic, special event traffic volumes, or long-term peak period traffic volumes will necessitate coordination with the Colorado Department of Transportation and local governments.

5. *Air Quality* - Projects that increase air pollutant emissions beyond acceptable thresholds or add one or more new air pollutants to site emissions should be reviewed with respect to emission inventory figures in the associated Air Pollution Emission Notices, Colorado Department of Public Health, Air Pollution Control Division permit thresholds and associated policies, procedures, and committed measures. A significant air pollution impact requiring NEPA review and/or revisiting permits and notifications would be needed if total site-wide emissions exceed permitted limits one or more new harmful pollutants is added to the emission inventory

6. *Visual Quality* - Buildings visible from key public off-site vantage points that exceed the limits defined in Chapter 2 of the EA should be reviewed with respect to visual impacts. A significant visual impact requiring NEPA review would not have specific thresholds, but would require a technical judgment based on the variation from defined limits and potential public reaction to the difference.

7. *Biological Resources* - The following occurrences would be expected to trigger additional NEPA review and/or other specified processes:

- Trapping of a Preble's Meadow Jumping Mouse (PMJM in a new area where surface disturbance is unavoidable and mitigation measures are deemed inadequate by the USFWS. NEPA review and processes associated with the Endangered Species Act would apply.
- Documented presence of Ute ladie's tresses orchid or other protected species in an area where surface disturbance is unavoidable and mitigation measures are deemed inadequate by the USFWS. NEPA review and processes associated with the Endangered Species Act would apply.
- Impacts on wetlands as set forth under Section 404 of the Clean Water Act and associated requirements and guidance. A permit from the USACE may be required.

NEPA review would not be necessary, unless off-site or unusual circumstances and impacts were anticipated.

- Documented mortality of species protected under the Endangered Species Act.

8. *Cultural Resources* - Projects involving earthwork may uncover previously unknown and undocumented cultural resources. If human remains or other substantial resources are encountered, all work must stop and protocol set forth under the Section 106 of the National Historic Preservation Act (NHPA) would apply. The SHPO should be contacted. NEPA review would be unlikely unless impacts were deemed significant and unavoidable.

9. *Hazardous Materials* - Projects that would involve hazardous materials trigger numerous ES&H policies and procedures and require careful review with respect to agency permits notifications. NEPA would not be triggered unless substantial new risks were associated with increasing quantities or new materials. Contact the NREL NEPA Coordinator in the ES&H office.

INSERT FIGURE 4-4 PHOTOS HERE

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