

A photograph of the Department of Commerce Boulder Laboratories building. The building is a modern, single-story structure with a concrete upper level and a lower level featuring stone walls and large glass windows. A sign on the upper level reads "DEPARTMENT OF COMMERCE BOULDER LABORATORIES 325 BROADWAY". The building is surrounded by a landscaped area with large, reddish-brown boulders, a gravel path, and a green lawn. In the background, there are snow-capped mountains under a blue sky with scattered white clouds. Bare tree branches are visible in the upper right corner.

Department of Commerce Boulder Laboratories
Campus Master Plan

April 2026

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National Institute of Standards and Technology
Boulder, Colorado

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Campus Analysis



Executive Summary

1

The Department of Commerce research campus at Boulder has a beautiful setting, with Kohler Mesa and the Flatirons as a backdrop to the buildings and landscape. The 206-acre campus is home to research programs of the National Institute of Standards and Technology (NIST), the National Oceanic and Atmospheric Administration (NOAA) and the National Telecommunications and Information Administration (NTIA), with a 2024 total of 1,767 research scientists, engineers, administrators and support personnel. There are 30 occupied buildings on campus, plus several structures enclosing mechanical equipment or other infrastructure.

The **National Institute of Standards and Technology** at Boulder has four laboratory components located here: Communications Technology Laboratory (CTL), Information Technology Laboratory (ITL), Material Measurement Laboratory (MML) and Physical Measurement Laboratory (PML). These laboratories, together with administrators and support groups, have 846 employees and affiliates on campus. Research is conducted in the areas of materials reliability, opto-electronics, quantum electronics and physics, time and frequency, and electromagnetics.

The **National Oceanic and Atmospheric Administration** at Boulder conducts research in atmospheric and space sciences, with 849 employees and affiliates, including GSA operations and management personnel. Three research, forecasting and information programs share the NOAA campus facilities: the Office of Oceanic and Atmospheric Research (OAR), the National Weather Service (NWS) and National Environmental Satellite Data and Information Services (NESDIS). OAR's Earth System Research Laboratory has approximately 640 of NOAA's personnel.

The **National Telecommunications and Information Administration** has one laboratory headquartered at the Boulder campus, the Institute for Telecommunication Sciences. This group, with 72 people, researches cutting-edge areas of telecommunication technology, principles and applications. They work closely with PML's time and frequency research components and with CTL.

1.1 Master Plan Goals

The Department of Commerce (DoC) requires its agencies to have a physical Master Plan for their sites, reflecting both the anticipated special needs of the user groups and the impact of its activities on the surrounding community. The master plans are used to identify needed physical facilities, advance the agency's mission-related goals and develop a more efficient, flexible campus. Although this Master Plan for the Boulder Laboratories was commissioned in response to institutional policy, another factor also drove the request—the evolving mission of the laboratories and the greater demand for highly controllable research environments.

Campus and research programs have evolved since the founding of the Boulder campus. Today modernized lab space and flexible, integrative and collaborative space are needed to promote advancing research. The Master Plan is a supporting tool to meet the articulated campus goals of administrators, scientists and staff, including:

- A plan that creates a comprehensive and coordinated framework for physical development of the Boulder campus;
- A plan that develops appropriate facilities and infrastructure for the evolving and advancing scientific research;
- A plan that respects its location, historic context and agreements with the local community and Native American tribes;
- A plan that encourages collaboration and interaction among the laboratories and researchers, with welcoming facilities and staff amenities;
- A plan that accommodates interchange with the public and outside colleagues, using both conference facilities and technology;
- A plan that creates an attractive campus, respecting both the research and the researchers;
- A plan that promotes good stewardship of the natural environment, and supports and advances the sustainable design goals of the Department of Commerce, GSA, NIST and NOAA;
- A plan that prioritizes safety, especially addressing the growing risk for wildfires.
- A plan for gradual change, that is complete at each step.

Legend:

1 Radio Building	9 Gas Meter Building	33 David Skaggs Research Center
1C Building I Annex C	11 Ionospheric Observatory	34 NOAA Observatory
1D Building I Annex D	12 Hydrogen Test Facility	41 High Speed Switch
1E Building I Annex E	21 Maintenance Garage	42 Central Utility Plant
1F Building I Annex F	22 Warehouse	43 Hazardous Materials Facility - New
2 Cryogenic	23 Hazardous - To Demo	51 Security Center
2A Cryogenic Annex "A"	23A Hazardous - To Demo	81 Katharine Blodgett Gebbie Lab
3 Communications Tech.Lab.	24 Plasma Physics	91 Construction Research
3A Liquifier Annex "A"	25 Maintenance Shop	92 Boulder Computer Facility
4 Camco	25M1 Building 25 Annex	111 Building 4 Annex
5 Camco Annex	26 Day Care Facility	112 Butler Building
8 Cryogenic Mesa Test	27 High Frequency Field	

Map Labels:

- Bluebell Avenue
- King Avenue
- Medical Center
- Broadway St.
- 27th St.
- 28th St.
- 29th St.
- 30th St.
- 31st St.
- Ash Avenue
- State Highway No 93
- Campus Entrance
- Rayleigh Rd.
- Anderson Drive
- Curie Circle
- Compton Road
- Dartmouth Avenue
- Kohler Reservoir
- Skunk Canyon Path
- Skunk Creek
- Kusch Road
- Four Pipes Trail
- Kohler Mesa
- Research Zone 1 (11.74 Acres)
- Research Zone 2 (7.11 Acres)
- Tribal M.O.A protected area (25.37 Acres)
- Protected Area: 103.50 Acres (Includes Tribal M.O.A. Protected Area)
- Tribal M.O.A protected area (24.95 Acres)
- Research Zone 3 (83.31 Acres)

Scale: 0 100' 300' 600'

North Arrow: N



1.2 Master Plan Summary: Highlights

The Master Plan provides for the replacement of aging, inefficient buildings and accommodates modest growth in research programs over the next twenty years. Approximately 311,000 gross square feet of new facilities would be added, and approximately 169,500 gross square feet of aging and temporary buildings removed. The Plan offers a framework for accomplishing DoC's goals of creating an attractive and organized campus with appropriate research facilities. It emphasizes state-of-the-art facilities, collaboration, employee amenities, and sustainable practices.

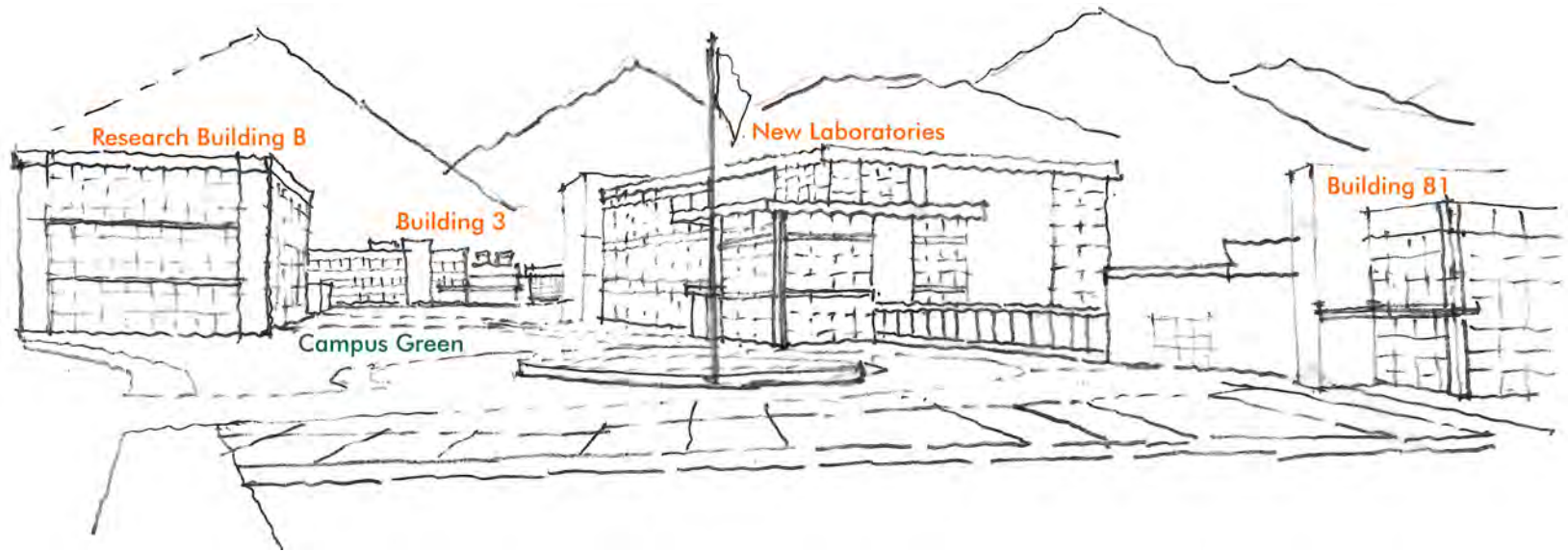
Developed by exploring and evaluating alternatives, the Master Plan creates a new campus green as a focal point, anchored by a pedestrian pathway that links the existing and new buildings. Research buildings would be easily linked, and employees would have greater opportunities for collaboration and informal interaction. The improved campus setting would enhance the working environment, encourage employee interaction, and provide an enhanced sense of place and pride in the institution. Highlights are as follows:

- **Welcoming entry.** New circulation, signage and visitor parking configuration welcomes visitors and streamlines the vehicle screening process.
- **Cohesive Campus Identity.** Buildings and landscaping are coordinated to create a unified and attractive campus, complementing the stunning natural setting and replacing scattered small buildings. Linear green space is a central organizing element, with the road removed from the heart of the campus to create people-friendly connections.
- **Modest Growth.** Overall space needs remain relatively stable throughout the planning period, although programs and projects will adapt to DoC missions.
- **Advanced Research Facilities.** Renovation and replacement of aging and obsolete research buildings provide the controlled environments necessary for advanced measurement science and research. Additional lab facilities for NOAA.
- **Conference Center Enhancement.** Improved conference facilities, with a new meeting place for visitors and tour participants.
- **Consolidated Support Facilities.** Multiple buildings are replaced with a single facility that houses administrative offices, facility offices, shops, garages and storage.
- **Connected Laboratories.** New laboratory buildings are arranged in a linear array that links to existing labs and supports new connections, for better efficiency, collaboration and sharing of equipment.
- **Historic Preservation.** Building 1 has been determined to be eligible for the National Register of Historic Places listing. Future modifications and changes will be governed by the National Historic Preservation Act, and in accord with the Secretary of the Interior's Standards for the Treatment of Historic Properties.
- **Natural and Sustainable Campus.** The Plan emphasizes natural and sustainable landscapes, introducing native and adapted vegetation for easy maintenance, a coordinated stormwater management strategy and the creation of landscaped seating and recreation areas.

Exhibit 3: Master Plan Program Summary by Organization

	Personnel			Space				
	Existing	Projected	Difference	Existing USF	Projected USF	Difference USF	Existing GSF	Proposed GSF
NIST	846	897	51	387,082	433,880	46,798	850,631	959,380
NTIA	72	105	33	21,234	32,100	10,866	Incl. above	Incl. above
NOAA + GSA	849	884	35	240,590	261,590	21,000	415,973	448,570
Total	1,767	1,886	119	648,906	727,570	78,664	1,266,604	1,407,950

Exhibit 4: Master Plan Concept - View Looking West



- **Energy Conservation Emphasis.** The renovations and new facilities replace multiple aging mechanical systems and package units with modern energy efficient systems, supplemented by on-site solar panels. The consolidated support facility and childcare center have net-zero energy use as a goal.
- **Structured parking.** A structured parking facility is introduced to replace parking lost and to reduce the impervious surfaces on campus.
- **Open Space Preservation.** The Plan maintains the campus open space in a natural state, and preserves the community use trails and bicycle paths. New buildings do not interrupt views to the Flatirons.
- **Wildfire Risk.** The plan includes shelter-in-place requirements for new buildings, and provisions for adaptation of existing buildings.
- **Flexible, incremental growth.** The Plan allows facilities to be added incrementally, as needed and financed when federal funding permits, each being linked to an established circulation and utility network.

1.3 The Master Plan

The core concept for the Master Plan is a linear arrangement of connected laboratory buildings, facing onto a campus green, creating opportunities for collaboration, sharing resources and easy pedestrian connections. Research buildings are renovated or replaced to provide the state-of-the-art infrastructure necessary for advanced research. Collaboration and efficiency are encouraged by creating a campus center that consolidates employee services and amenities into one building. Scattered, small support buildings also are consolidated into one management office and support building, replacing ageing and temporary buildings for better operations and more efficient energy use.

The Master Plan evolved from studies of existing conditions, site and regional analyses, building evaluations and program needs. Aging buildings and infrastructure were key drivers. They can no longer economically meet research program and federally mandated directives. Many of the buildings are in poor physical condition, and temporary buildings and trailers continue to be used for critical research and support functions.

Key Master Plan Components

Research Buildings: Renovated

The Radio Building (Building 1), is the core research building from the initial 1954 campus construction, and remains an iconic campus building. Although its systems are outdated and obsolete, the Building 1 laboratories are valued by the research community for their spatial and structural characteristics. The labs are typically high-bay spaces and single-story on-grade, which reduces vibration transmission to research instruments. It has been undergoing a gradual renovation and upgrade program, to replace mechanical systems and meet performance levels required by NIST's evolving research, as well as federal mandates for energy reduction, seismic strengthening and physical security. Three of the building's six wings have been renovated, and there are plans to renovate the other wings and the central spine. To-date, projects have involved complete interior renovation, system replacement, recladding, addition of utility galley space, and structural upgrades to meet seismic requirements of today's building code. Future phases of the Building 1 renovation will be implemented in accordance with the National Historic Preservation Act. The Liquefier Building (Building 3) was the second laboratory building to be renovated, completed in 2017.

Master Plan Concept - View from Broadway



Research Buildings: Replaced

Three NIST laboratory buildings, Buildings 2, 2A and 24, will be replaced. Both Buildings 2 and 24 are aging facilities (1951 and 1967), each with several additions, functional problems and systems well past their useful lives. Building 2A is a 35-year old "temporary" modular building. New research buildings are the heart of the Master Plan concept, linking new facilities to the old and shaping the central green space. The new laboratories will provide the flexibility, infrastructure and controlled environments needed to support advanced research. Laboratories for NOAA's National Weather Service will replace the Observatory Building 34 function with an expanded building.

Research Buildings: Retained

The David Skaggs Research Center (1999), housing NOAA, and the Katharine Blodgett Gebbie Laboratory (2012), housing NIST advanced laboratories, represent more than 50% of the campus space. These two buildings are in excellent condition and continue to support the functions within them. Other smaller specialty research buildings, such as the Hydrogen Test Facility, will remain in operation to support specific programs.

Management Resources Center: Replaced

NIST administrative functions—facility and construction management, maintenance, contracting, IT support and safety operations—are all located in separate small buildings, seven in all. An additional three buildings house the maintenance shops and support facilities supervised by this group. The existing buildings themselves are not in good physical condition; eight of the ten are temporary buildings or trailers, the oldest two from 1951. Each of these buildings has its own utilities and package mechanical equipment. Consolidation in one building will result in better energy efficiency, more efficient service for the campus, and easy opportunities for coordination and sharing of resources and equipment. The building is proposed to be a net-zero energy facility.

Conference Facilities

Conference facilities are available in three campus buildings, Buildings 1, 81 and 33, and improvements are planned for security and amenities. Modifications to visitor screening and parking will create a public zone where visitors can park their cars and walk to the conference facilities in Building 1 or Building 81 or meet at a new Coffee Bar for campus tours. Redirected circulation at the entrance will create this separate parking area and improve the screening process for other vehicles.

Childcare Center: Replaced

A new building will replace the existing Childcare Center and is proposed to be a net-zero energy facility. It is planned for the current enrollment and sized to meet the GSA Childcare Center guidelines. The current facility is very cramped and consists of two conjoined modular buildings, now in poor condition.

Exhibit 5: Master Plan Program Summary

Facility Needs		Master Plan Proposed Facilities	New GSF	Removed GSF	Renovated GSF
Research Facilities					
NIST/NTIA	Obsolete labs, infrastructure in buildings B1, B2, B2A, B24 and temporary buildings 1C, 1D	- Renovation in B1 (Wings 4, Spine, 1, 2) - New Lab Buildings - Lab addition B3 - Guest Offices/Hoteling (various buildings) - Demolition of B2, 2A, 1C, 1D, 24	8,000 132,700 27,600 1,600	(114,586)	116,000
NOAA	Additional Laboratory needs	Renovation/expansion B34	32,600		
Administration & Support Facilities					
NIST	- Scattered MR administration & support in 12 buildings - Aging, inefficient and temporary buildings - Storage needs - Decarbonization strategy	- New Management Resource Center - Storage Building - Central Utility Plant Expansion - Demolition of 10 small buildings	60,000 4,800 15,000	(47,095)	
Campus-wide	- Aging Childcare Center, below standards - Limited staff gathering places - Visitor screening congestion	- New Childcare Center - Café - Expansion of B51 Security Center - Shelter-in-Place Allowance	13,000 3,000 1,500 11,000	(7,776)	1,470
Subtotals			310,800	(169,457)	117,470
New Buildings/Additions Gross SF			310,800		
Existing Buildings Retained Gross SF			1,097,150		
Projected Campus Total Gross SF			1,407,950		

Buildings Removed

When new buildings are added, buildings must be removed to keep under the square footage cap in the MOA with the City of Boulder. The replacement of the laboratory buildings and the consolidation of the management/support functions permit the removal of sixteen obsolete and/or temporary buildings. The largest of these is Building 2 with its three additions at approximately 70,000 gross square feet, and the smallest is 525 square feet.

Wildfire Planning

The Master Plan recognizes that wildfire risk for the Boulder campus is increasing, noting seven notable wildfires in Boulder County since 2000, including three near the campus since 2022. Safety for staff and visitors will rely on multiple strategies, including policy/notifications, improved evacuation pathways, and facilities suitable for sheltering-in-place. Knowing that evacuation capacity is limited, several existing spaces/zones will receive architectural and engineering system upgrades to serve as shelters. Criteria and requirements for new building construction are included in the Plan. The Master Plan recommends that NIST initiate a detailed analysis and implementation plan for both policy and facility improvements.

Landscape and Open Space

One of the great assets of the DoC campus is the stunning backdrop of the Flatirons and the Rocky Mountain foothills. The Master Plan embraces the best aspects of this place, visually integrating the campus setting, and reducing resource intensive maintenance.

The signature landscape element is the linear campus green and pedestrian promenade, a unifying gesture that both connects the buildings and creates a range of social spaces and green infrastructure integrated into the physical design. The campus green provides a coherent link across campus: the continuity of paved surface, the expressive quality of trees and ground-layer plantings, and consistent palette of paving and furniture provide thematic links across the site. A tree-covered plaza is a focal point at the center of the green, visually and physically connecting the new research buildings.

Stormwater management is integrated into the design with a vegetated bioretention swale in the landscape of the central pedestrian green. This is as an attractive, character-defining feature that slows and filters stormwater that currently sheet flows across lawn and parking lots.

The proposed planting approach is modeled after the surrounding Ponderosa Pine savannah, an attractive, resilient plant community of scattered pines and cedars under planted with golden grasses. The Master Plan envisions replacing much of the water-intensive lawns that currently surround campus buildings with low grasses and clustered evergreens characteristic of savannah vegetation. Treatment will vary in different areas of the campus, as a gradient between natural and cultivated zones. Areas closer to the buildings and gathering places will incorporate more ornamental native selections. The public and conference center entrance will be the most formal landscape with structured and ornamental plantings.

In addition to aesthetics and ecological function, wildfire mitigation is a critical component of the landscape strategy. The plan incorporates defensible zones around structures with reduced fuel loads and strategic spacing of vegetation. Fire-resilient species are prioritized, with planting layouts that follow best practices for fire breaks, fuel breaks, and shaded fuel breaks to slow fire spread and protect structures. Evergreen trees are used selectively as windbreaks, while low-growing, fire-resistant groundcovers and widely spaced shrubs are arranged and maintained to help reduce ladder fuels near buildings.

Utility Framework

The Central Utility Plant (CUP) provides chilled water, steam and compressed air to most of NIST's laboratory buildings, distributed through a tunnel system running from the CUP to mid-Building 1, with services branching off the individual buildings. These systems are in good condition and will be extended to the new and renovated NIST laboratory buildings in the Master Plan. The existing central plant is anticipated to have sufficient capacity to support the proposed buildings if the new buildings incorporate sustainable design features, such as exhaust energy recovery and decoupled ventilation/cooling, and the chilled water temperature differential issues at the CUP are addressed. While sufficient capacity exists at the CUP, heating and cooling plant redundancy will be reduced relative to current levels given the projected increases in peak heating and cooling loads. Using conservative estimates and reasonable conclusions, the Master Plan will need additional primary electrical services. The existing redundant medium-voltage feeders are likely insufficient to meet the peak demand of a growing campus. Furthermore, the existing medium voltage high-speed transfer switch is antiquated, and the manufacturer's hardware maintenance and support will soon be discontinued. The NOAA expansion will be supported by independent systems.

Both the domestic water and sewer systems are approximately 50% loaded today, and adequate for the proposed changes.

Circulation and Parking

The Master Plan makes two major circulation-related proposals. The central campus roadway will be removed for the creation of a pedestrian-oriented and unifying campus green. A wide walkway will highlight and enliven the central campus, which will be designed to accommodate emergency and occasional maintenance vehicles when necessary. The second initiative is the modification of the campus entry, vehicle screening and visitor parking. This will support the public parking and will also correct operational problems of the screening procedure for cars and trucks. In addition, bike paths and pedestrian trails in the Open Space are maintained.

Parking demand on the campus is not expected to increase significantly, but the desired locations may shift with the building construction. Currently, there are 1,389 parking places on the campus, and that will increase modestly over the planning period, remaining below the maximum under the agreement with the city. On-campus parking will be provided in existing surface parking lots, lots near new buildings and a proposed parking structure associated with new research building construction. The new parking structure is anticipated to be the primary parking for the new research buildings, located less than a five-minute walk away from each.

Sustainable Design Initiatives

Sustainable design and energy efficacy are core principles, both as responsible practice and meeting the requirements of the Department of Commerce and NIST. A broad range of strategies are incorporated—water conservation, energy efficacy, adaptive reuse, stormwater management, landscape stewardship and renewable energy. Highlights include significant improved energy efficiency with the Plan's implementation, consolidating and replacing aging obsolete mechanical systems with modern ones. More buildings will be connected to the CUP for services. Stormwater management will be enhanced by the reduction in impermeable surfaces and the installation of a vegetated arroyo in the campus green. Solar collection is recommended on the Management Resources Center roof, and Childcare Center roof, as well as other technologies to assist in achieving net-zero energy use for these buildings. PV solar arrays are also proposed for the parking structure and on a surface field west of the Warehouse. However, because solar inverters emit electromagnetic signals that can interfere with sensitive laboratory equipment, careful mitigation is essential to protect mission-critical research activities. To address this, electromagnetic shielding—such as Faraday cages around inverters or equipment—can block radiated emissions.



NIST Boulder

Exhibit 6: Phasing Packages

Phasing Packages	Major Components	Comments
NIST Research Buildings	▪ Building 1 renovations ▪ Building 3 addition ▪ New research buildings -Buildings A and B, replacing Building 2, 2A & 24 labs ▪ Coffee Bar integrated into Building A ▪ Demolition of Buildings 2, 2A, 23, 24 ▪ Creation of Campus Green, center section ▪ Road/parking modifications; partial removal of center road ▪ New parking garage	▪ Multi-step process to ensure research continuity ▪ Priorities – Preliminary ▪ Building 1, Wing 4 ▪ Building 3 Addition ▪ Building A
Security Center, Parking and Vehicle Screening	▪ Parking lot modification ▪ Roadway and vehicle screening modifications ▪ Addition to Building 51	▪ Independent package; could proceed at any time.
Management Resources Center	▪ New Management Resources Center ▪ Swing space for Building 4, 5 occupants ▪ Demolition/removal of 10 support buildings ▪ Roadway, parking, utility yard modifications ▪ Installation of solar collection field	▪ Independent package; could proceed at any time. ▪ Completion would free up some space in B1
NOAA Research Building	▪ New research building or expansion of Building 34, utility extensions ▪ Roadway, parking modifications ▪ Road/truck maneuvering expansion at Building 22	▪ Independent package; could proceed at any time.
Childcare Center	▪ New Childcare Center, replacing existing Building 26 ▪ Landscaped play areas ▪ Removal of remainder of the center road & relocation of Curie Circle ▪ Completion of Campus Green	▪ Independent package; could proceed at any time. ▪ Surface parking lot lost
Wildfire Planning	▪ Shelter-in-place modifications to Building 1 Conference Center ▪ Shelter-in-place modifications to Building 81 Conference Center ▪ Shelter-in-place facilities added to new buildings	▪ Building 1 and Building 81 modifications are independent packages ; could proceed at any time ▪ New buildings would integrate into construction projects; gradual implementation
Other	▪ Storage Building, CUP expansion, misc. site and stormwater improvements	▪ Independent ; proceed as needed

Master Plan Implementation

The Master Plan is a look into the future—a structured approach to building and renovation that meets anticipated needs. The Plan for the Boulder campus is driven by current physical and functional needs, with research program growth integrated as a modest contributor. So, although twenty years is the timeframe for this Plan’s implementation, the proposed changes could have an immediate operational impact. There are five phasing packages, largely independent of each other. The Master Plan is designed to accept these packages in any desired order, and to appear “complete” at the end of each.

Master Plan implementation is dependent on many factors, such as funding, direction of scientific research, agency missions and priorities. The Master Plan needs to be thought of as a living document, setting a framework that remains flexible and sensitive to the timing and composition of specific projects.

Exhibit 7: Fast Facts

	2024	Planning Target
Personnel	1,767	1,886
Buildings/Structures	29	20
Building Total SF	1,266,604 GSF	1,407,950 GSF
Parking	1,389 spaces	1,463 spaces
Impervious Area	51 acres	49 acres
Alternative Energy	—	Building solar, Solar field





Background

2.1 History of Campus Development

The existing campus of the Department of Commerce (DoC) at Boulder was purchased by the Boulder Chamber of Commerce and its citizens in 1950 and donated to the Department of Commerce to house the National Bureau of Standards (NBS), which was renamed the National Institute of Standards and Technology (NIST) in 1988. The site was considered ideal for the measurement science and research that NIST conducted, and its close proximity to the University of Colorado promised outstanding scientific resources.

In its first 10 years on this site, NBS constructed over 300,000 gross square feet of space including the Radio Building 1 which included the library, auditorium, center spine and five wings (the sixth wing was built in 1962), the Cryogenics Building 2, the Liquefier Building 3, the Camco and Heavy Equipment Buildings 4 and 5, and several small structures.

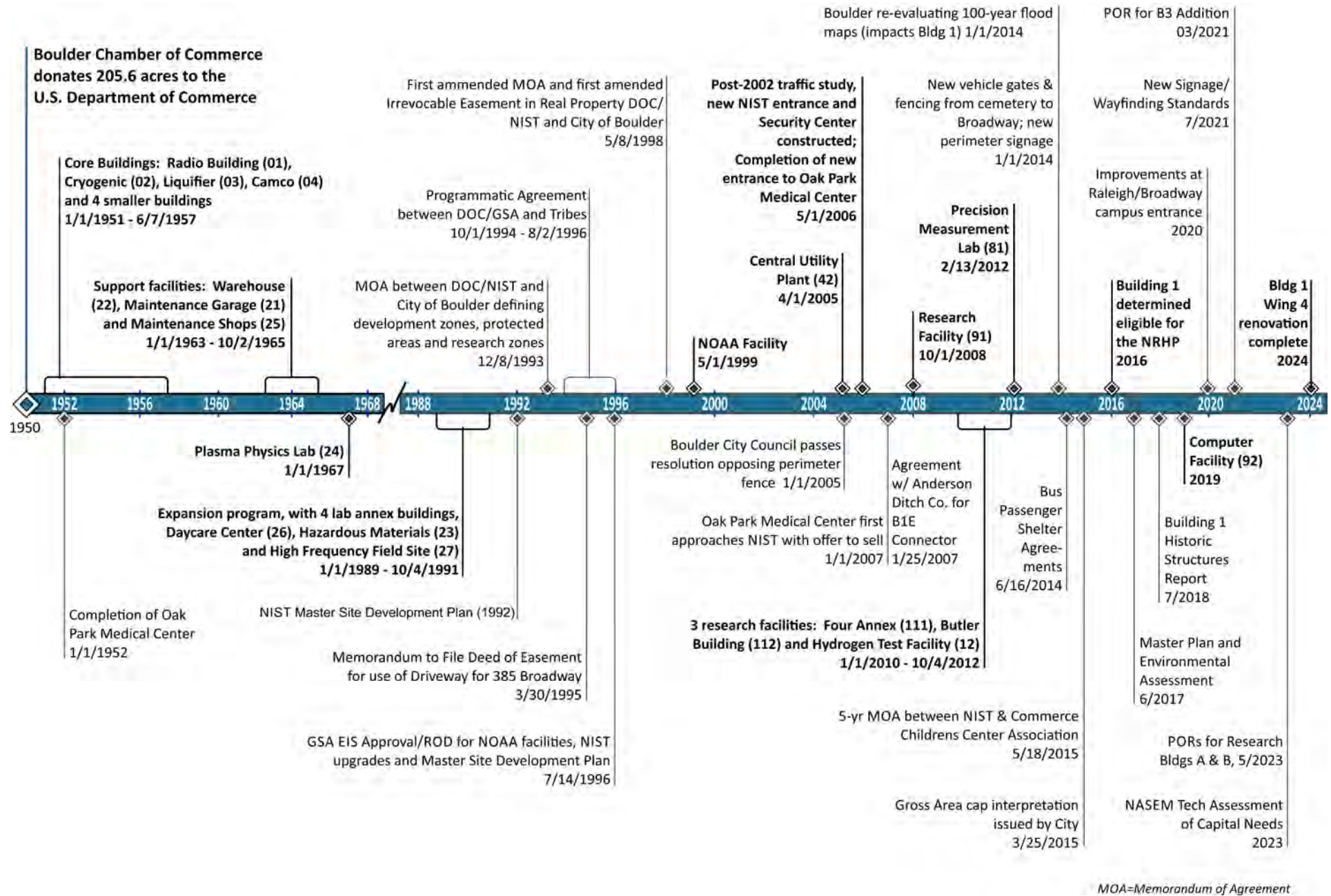
Between 1960 and 1970, another 140,000 gross square feet was constructed, mostly as additions to existing buildings 1 and 2, plus the construction of the Plasma Physics Building 24 and the Warehouse Building 22. The next 30 years in the history of the Boulder campus can be termed as the era of temporary structures. Numerous small buildings including the Childcare Center, Building 26, the Hazardous Materials Building 23, and annexes to Buildings 1, 2, 4, 24, and 25 were added. The additional square footage added to the NIST building inventory over this time was about 53,000 gross square feet.

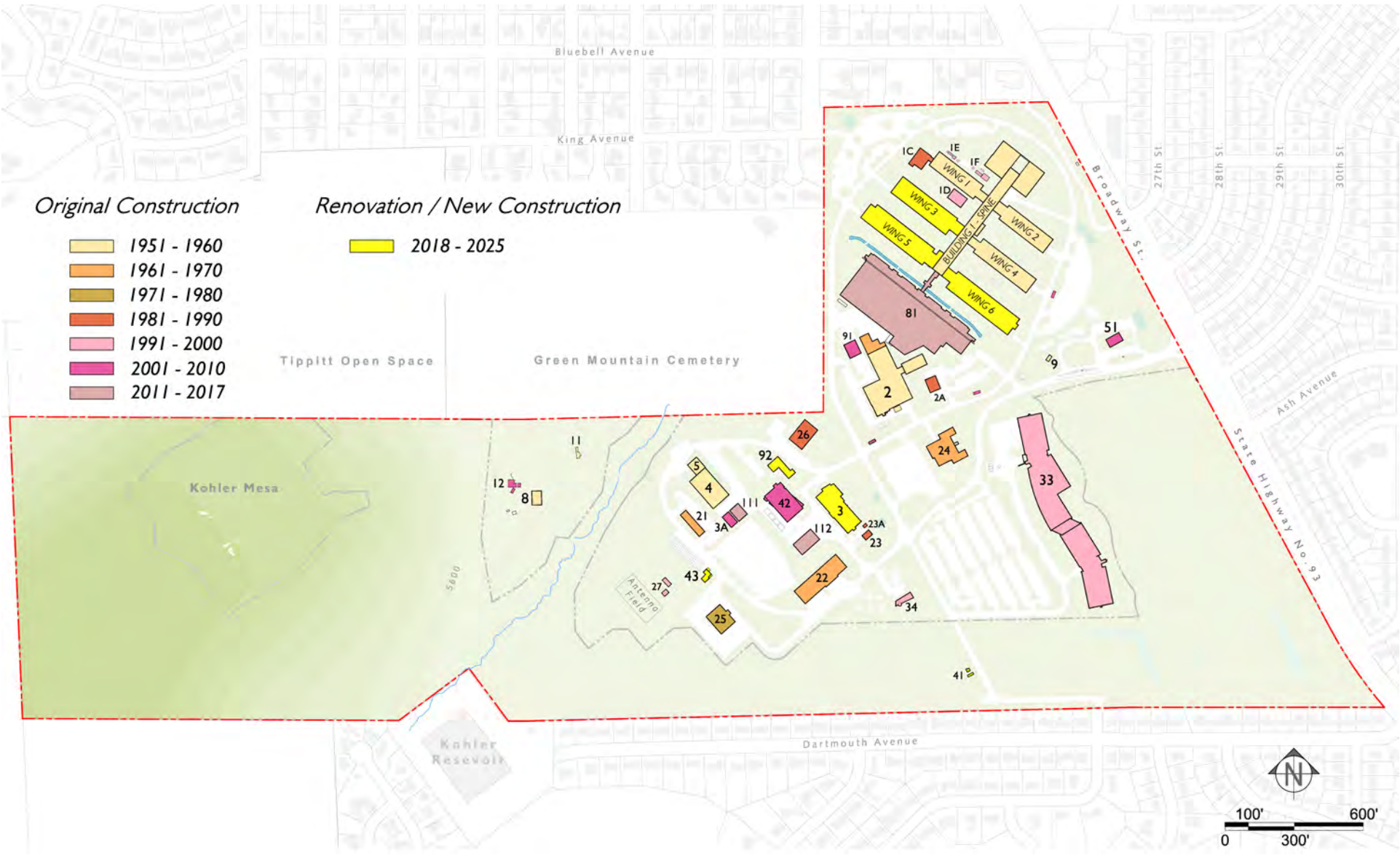
By 1990, NIST had recognized that its laboratory buildings, which were over 35 years old, were becoming obsolete and deficient for contemporary research and science. In 1991 NIST published its Capital Improvement Facilities Plan (CIFP), which documented the severe technical obsolescence and deteriorating facility conditions. A needs assessment found that about 60% of Boulder Laboratories failed to meet performance standards required by then current scientific and engineering programs. The study recommended construction of a Central Utility Plant (CUP), a clean room building, construction of new laboratories and a workshop—projecting a need for 372,000 gsf of new construction. It also recommended renovation of 4 wings (3, 4, 5 and 6) of Building 1 and minor renovation of Building 4.

Concurrently, DoC began considering consolidation of the National Oceanic and Atmospheric Administration (NOAA) facilities on campus as well as a facility for the U.S. Forest Service. Requirements for the two agencies were developed by General Services Administration (GSA), which was charged with accommodating them on campus. The planned development on the site faced significant opposition from the public and the Boulder City Council. As a result, NIST undertook to prepare a Master Site Development Plan that would set a framework for future development established through cooperative efforts of the City of Boulder and the Department of Commerce. The Forest Service facility was removed from the development plan.

After the approval of the 1992 Master Site Development Plan, the Central Utility Plant (CUP), the Katharine Blodgett Gebbie Laboratory, the David Skaggs Research Center for NOAA, and the Security Center were built. The NOAA building was completed in 1999; the CUP and Security Center were built in 2005; and the Gebbie Laboratory was completed in 2012. The Computer Facility is the latest building, constructed in 2019. The existing DoC Campus now has 30 buildings, many of them small, totaling approximately 1.3 million gross square feet.

Exhibit 8: History of Campus Planning and Development





2.2 Previous Master Plans & Studies

In its 65 years of existence the campus has expanded by a factor greater than four, from its initial 286,000 gross square feet in 1954 to about 1.3 million gross square feet today. Approximately two-thirds of the overall facility inventory, or about 849,500 gross square feet, is occupied primarily by NIST. There have been various studies conducted over the years, and a comprehensive Master Plan was for the DoC Boulder Campus site in 2017. This document is an update of that 2017 Master Plan, modifying its recommendations to incorporate recent changes and recognize mission-related priorities. The following provides a chronological list of the key studies and plans prepared for the campus.

- *1963 Campus Development Plan*: James M. Hunter and Associates developed a long-range plan for the National Bureau of Standards for developing new and expanded facilities. The plan forecasted a four-fold increase over the next 20-30 years before levelling off. The campus population would increase to 6,000–7,000 staff. It recommended a central core with administration and central support functions; an inner ring of intensive labs and offices; and, an outer ring of less intensive uses. The mesa was recommended for preservation, for an appropriate semi-independent use.
- February 1992 *NIST Master Site Development Plan*: Smith, Hinchman & Grylls Associates, Inc. developed this plan to address DoC's short- and long-range development needs and possibilities at the Boulder site. It identified a need to increase the 490,000 GSF of NIST facilities that existed by 697,000 GSF to include expanded facilities for NIST and new facilities for NOAA. A substantial increase in site parking spaces was also recommended, with the potential for 1,330 spaces. The final plan proposed maximizing infill zones within the existing NIST development and adding 9.22 acres for NIST and 12.9 acres for NOAA. Overall, development would comprise a total of about 80 acres, or 38.7% of the Site.
- March 1993 *Cultural Resource Inspection of the Proposed Building Site for NOAA*: Prepared by the National Park Service's Interagency Archeological Services in conjunction with the planning for the new NOAA facilities, the survey was conducted over the 55-acre project area. The historic Anderson Ditch was identified as the only asset eligible for the National Register of Historic Places, as it represented early irrigation efforts in Boulder County. It recommended that the Anderson Ditch be documented in some detail and avoided by construction.
- June 1996 *EIS for Actions by GSA for the NOAA and NIST in Boulder, Colorado*: The EIS investigated three primary proposed actions: consolidation of NOAA Facilities; upgrades to NIST Facilities; and, implementation of the NIST Master Site Development Plan. Besides the No Action Alternative, the EIS considered development alternatives at the DoC Campus, the IBM Plant Site in Boulder, and the CU-Boulder Research Park. When measured against the criteria identified by NIST and GSA/NOAA, no site other than the DoC Campus met all criteria. There were three areas of controversy: the size and location of the proposed GSA/NOAA building; allegations that a traditional cultural property, possibly a Native American medicine wheel, was located on the DoC campus; and, regional traffic might overburden several intersections in the general area of the preferred site. Development on the DoC Campus was the preferred alternative. Potential environmental impacts and appropriate mitigation measures were identified.
- July 2002 *NIST Main Entrance Study*: This study was conducted by Entranco, Inc. to investigate potential modifications to secure the campus in the wake of the September 11th, 2001 terrorist attacks. The study notes that the federal regulations require a single entrance be maintained to all federal facilities such as the campus. The Boulder campus had two: the main entrance from the Broadway and 27th Way intersection; and, a secondary entrance from Broadway at Rayleigh Road. After reviewing multiple alternatives, NIST decided to relocate its main campus access to Rayleigh Road and modify the Broadway access at 27th Way to provide exclusive access to the medical center property to the north. The issue of traffic conflict between vehicles and bicycles/pedestrians at the NIST entrance was discussed. It was determined that ideally a grade-separation at the main entrance to NIST would provide NIST traffic and bicycle/ pedestrian traffic with an improved safety condition.
- January 2006 *Report on NIST-Boulder Laboratory Facilities*: The NIST director convened a Boulder Facilities Team to review the amount and performance of laboratory space in the campus

in consultation with technical staff and Division leadership. This report summarized the team's findings and recommendations. It found that NIST-Boulder metrology and research programs would not expand but evolve to meet changing needs and address new technologies. A significant majority of the labs were found to be inadequate in performance. The report identified a need for 130,000 net assignable square feet (nasf) of good quality lab space and 48,000 nasf of metrology quality lab space with additional clean room space. Renovation of existing lab space and construction of a new advanced technology lab was recommended (now the Katharine Blodgett Gebbie Laboratory). A need for additional studies by a subject matter expert was also recommended to accurately determine laboratory facility needs and estimated costs, for renovation and new construction, revising the report's estimates as necessary.

- October 2014 *Safety Study for Broadway Street & Rayleigh Road*: NIST contracted Alfred Benesch & Company to study the intersection of Broadway and Rayleigh Road, the main entrance to the campus. The study was conducted as a result of bicycle/vehicle crashes at that location and several near misses. The study offered solutions based on signaling; the eastbound right-turn movement; bicycle traffic calming; intersection reconfiguration; and crossing relocation.
- August 2015 *Program and Performance Requirements for the Reuse and Repurposing of Building 3*: The study established the space requirements for the CTL lab components in the expanded Building 3, to be provided to the design-build contractor. Technical room requirements and building system performance requirements were included.
- July 2016 *Historic Assessment, Department of Commerce Boulder Laboratories*: This was a comprehensive study of the history and development of the DoC campus, and an evaluation of resource significance and integrity. See the Cultural Resources section for a study summary.
- June 2017 *Department of Commerce Boulder Laboratories Campus Master Plan*: The 2017 Campus Master Plan is the base for this current update. Recommendations included new and renovated research facilities, a new campus center consolidating staff amenities, and a new management resource center housing management staff and operational facilities. The plan had a new childcare center and facility/security improvements

for accommodating visitors and conferences. These strategies would allow the demolition of several small, aging and inefficient structures. Since the completion of this master plan, NIST has implemented renovation to Building 1 laboratories.

- July 2018 *Historic Structures Report for NIST Radio Building 1*. The report documents the history and construction of Building 1, its historic significance and current condition, with descriptions, plans, photographs, and building information. Included are recommendations and selected treatments.
- July 2021 *Signage and Wayfinding Design Standards and Guidelines for the Boulder Campus*. The document establishes design standards for exterior identification and wayfinding signage for the entire campus and interior identification signage for all NIST controlled buildings. It includes interior wayfinding signage is planned for the central spine of Building 1.
- 2021—2023 Programs of Requirements. Three buildings recommended in the 2017 Master Plan were further advanced by the preparation of Programs of Requirements (PORs). Each POR identified the building's rooms, square footage, and technical requirements, and developed a test layout on the site. The three PORs are the following: Research Building A with a Parking Garage; Research Building B; and Building 3 Addition.



Building 3 Lobby

2.3 Agreements

During the early planning stages for the NOAA facility in the 1990s, the Department of Commerce and GSA worked closely with the City of Boulder to address community concerns regarding further development on the site. The following agreements were signed, which considerably shaped future site development.

- *April 1995 Programmatic Agreement with the Tribes:* This agreement was extended to the Medicine Wheel Coalition and federally recognized Native American Tribes as a result of a consultation process. An irrevocable easement was established that overlapped with an existing irrevocable easement on the site held by the City of Boulder, a signatory to the agreement. The agreement includes provisions for use, management, maintenance, and other minor conditions. The City of Boulder Open Space retained the responsibility of maintaining the space.
- *May 1998 First Amended Irrevocable Easement in Real Property.* This agreement between the City of Boulder, Department of Commerce and NIST grants the city an easement to establish the open space protected area on DoC property, and defines boundaries, conditions for its use and maintenance. This updates a previous agreement signed in 1993.
- *May 1998 First Amended MOA between NIST, US DoC, and the City of Boulder:* This agreement updated a previous MOA signed on December 8, 1993. This updated MOA addresses DoC's and NIST's present and future federal research needs and the city's interests in preserving part of the undeveloped space and providing public access and enjoyment. Development zones, research zones and protected areas and their extents are defined in the agreement and restrictions noted. Other provisions of the agreement address traffic management, utilities, environmental considerations, and future construction considerations.
- *January 2021 Memorandum of Agreement Establishing a Joint Project between the National Institute of Standards and Technology, US Department of Commerce, and City of Boulder.* This agreement established a project to construct improvements to the Broadway/Raleigh campus entrance, improving safety for staff and the public. The work was completed and includes a new right turn lane along Broadway, the rerouting of the bike path and installation of traffic signals
- Several other agreements are in effect, including:
 - *385 Broadway Easement:* A deed of easement granting a vehicle right-of-way from Broadway through DoC property to the Medical Center 385 Broadway; dated April 4, 1995.
 - *Regional Transit District:* A license granting permission for bus stops on DoC property along Broadway at 27th Way and Ash Street; dated June 16, 2014.
 - *Anderson Ditch:* DoC owns some shares in the Ditch and has an agreement with the Anderson Ditch Company for easement through the DoC property, rights for irrigation use and NIST responsibility for repair and maintenance of the Ditch section on DoC property; latest agreement update 2007.
 - *Childcare Center:* A Memorandum of Understanding for the Establishment of an On-Site Child Care Facility, between the Boulder Laboratories and the Commerce Children's Center Association. Under the agreement, Boulder Laboratories is to provide space and facility services.
 - *Utilities:* An agreement with the City of Boulder for installation, operation and maintenance of utility and communications lines, dated February 2000.



Eastern Research Group

2.4 Agencies on Campus and Their Relationships

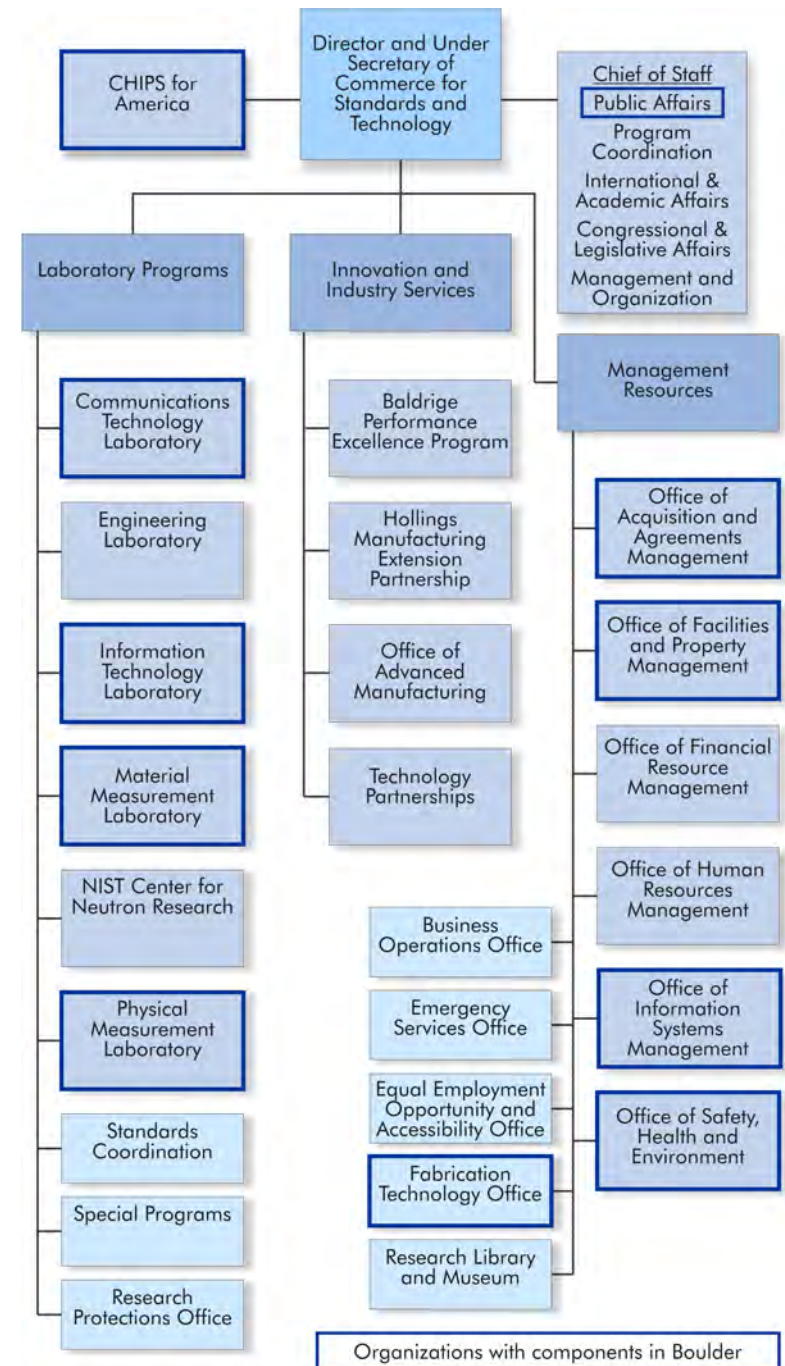
National Institute of Standards and Technology (NIST)

NIST was founded in 1901, as a non-regulatory federal agency within the U.S. Department of Commerce. It promotes U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve the quality of life.

The NIST Laboratories conduct world-class research, often in close collaboration with industry, to advance the nation's technology infrastructure and help U.S. companies continually improve products and services. Approximately 20% of NIST's Laboratory Programs are located in the DoC Boulder Campus. NIST's research in Boulder includes Microfabrication and Characterization; Laser and Optoelectronics; Time and Frequency Metrology; Quantum Information and Communications; Electromagnetics; Materials Properties; and, Chemical Properties.

NIST's laboratories on the Boulder campus are concentrated in five major buildings: Building 1, Building 2, Building 3, Building 24 and Building 81. NIST also manages all remaining buildings except for Buildings 33 and 34, which are occupied by NOAA and managed by GSA.

Exhibit 10: NIST Organization Chart



National Telecommunications and Information Administration (NTIA)

The National Telecommunications and Information Administration (NTIA) is a bureau within the Department of Commerce's Executive Branch and is principally responsible for advising the President on telecommunications and information policy issues. Its primary focus is expanding broadband internet access and adoption, expanding the use of spectrum by all users, and ensuring that the internet remains an engine for continued innovation and economic growth.

NTIA's research and engineering arm, the Institute for Telecommunication Sciences (ITS), is located on the DoC Boulder Laboratories Campus. ITS provides telecommunications research and engineering services to promote enhanced domestic competition and new technology deployment; advanced telecommunications and information services; improved foreign trade opportunities for U.S. telecommunication firms; and, more efficient use of the radio frequency spectrum.

ITS is located within NIST buildings, and many of its organizational units work closely with NIST's Communications Technology Laboratory (CTL). Its work at Boulder focuses on promoting and managing the radio spectrum and improving emergency responder communications.

National Oceanic and Atmospheric Administration (NOAA)

NOAA's roots date back to 1807, when the nation's first scientific agency, the Survey of the Coast, was established. Today, it maintains a presence in every state and has emerged as an international leader on scientific and environmental matters, playing a role in protecting life and property and conserving and protecting natural resources.

At Boulder, NOAA's work is rooted in the Central Radio Propagation Laboratory (CRPL) which was founded in the 1950s to conduct research on atmospheric processes and solar impacts. Currently, there are three major NOAA components at the Boulder facility: the Office of Oceanic and Atmospheric Research; the National Weather Service; and the National Environmental Satellite Data and Information Service.

The Office of Oceanic and Atmospheric Research is a key research component of NOAA, studying the complex planetary systems for a better understanding of the earth, better forecasts and earlier warnings for natural disasters. The Earth System Research Laboratory is NOAA's largest laboratory where researchers study the dynamics of the earth's physical, chemical and biological systems work together to produce weather and influence ecosystems.

The National Weather Service provides climate and weather information, including historical data, forecasts and warnings. The Denver-Boulder Forecast Office is one of the many local stations across the country, providing forecasts for Eastern Colorado. NOAA's Space Weather Prediction Center monitors solar activity, issuing information and warnings of space weather that can affect power grids, navigation, communication and other critical systems. It is a unique facility that provides real time space weather data to users across the planet.

The National Environmental Satellite Data and Information Service monitors and researches global environmental information from satellites, with its National Centers for Environmental Information located on the Boulder campus. The resulting data supports the management of environmental resources and the operations of aircraft and ships. The Paleoclimatology Program archives and studies past climate data to assist in the prediction of natural variations and future climate change.

NOAA's Boulder components are located in the David Skaggs Research Center (Building 33) and the Solar Observatory (Building 34). The two buildings, the associated parking areas and the grounds immediately adjacent (totaling approximately 15 acres), are managed by the General Services Administration (GSA).

Campus Management and Campus Cross Services Agreement

NIST, NTIA and NOAA have standing cross services agreement to cover several campus related functions.

NIST, with the DoC Office of Security (OSY), is responsible for the overall campus security and visitor screening. OSY is responsible for the campus policing services as well as visitor screening. NIST is responsible for access controls. The security of Buildings 33 and 34 that house NOAA components and the grounds that are immediately adjacent to those buildings and their parking lots are the responsibility of Federal Protective Service (FPS). However, FPS does not have

Exhibit 11: NTIA Organization Chart

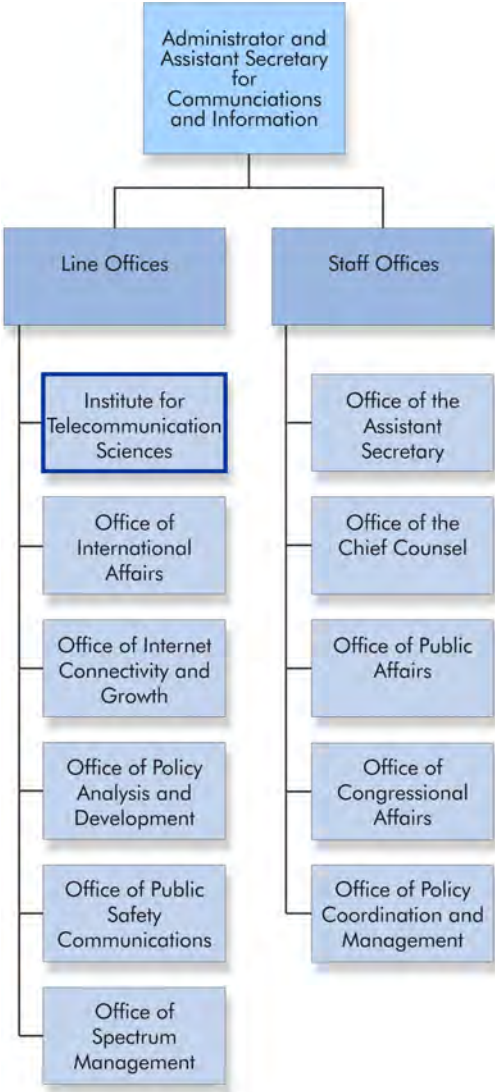
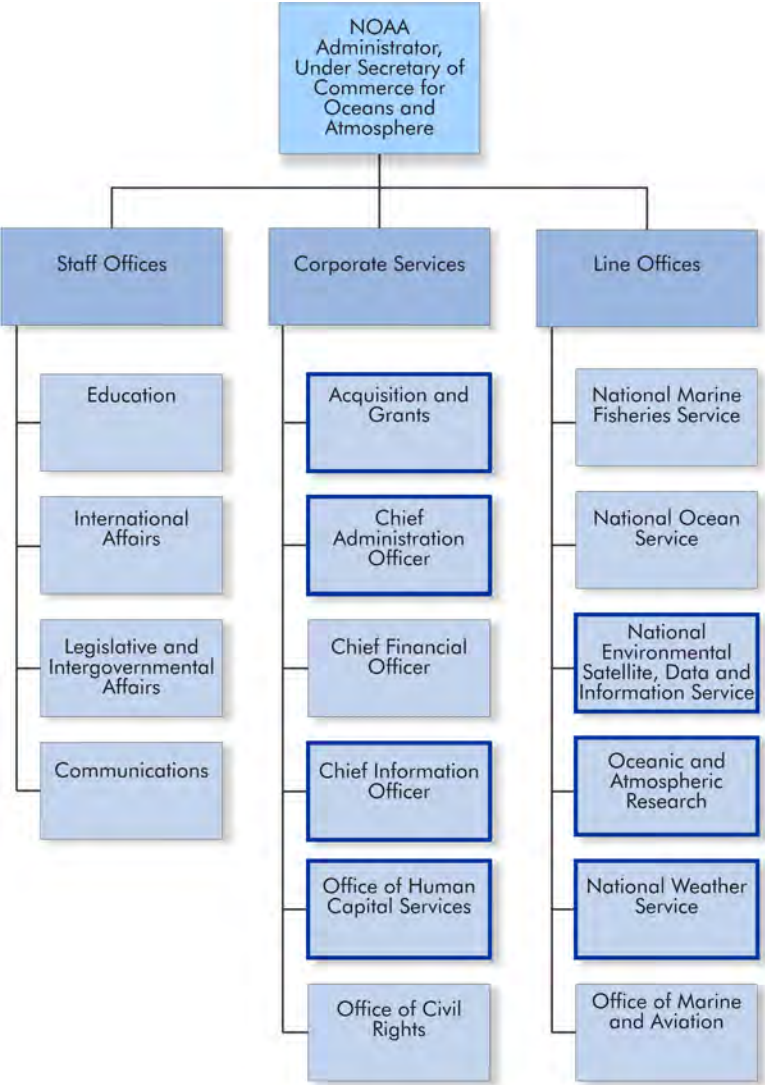


Exhibit 12: NOAA Organization Chart



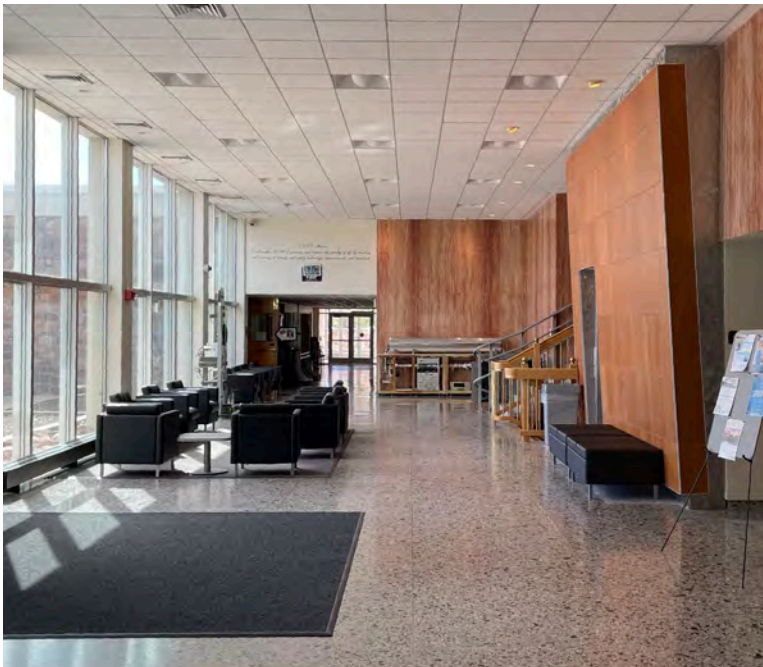
Organizations with components in Boulder

a station on site and responds to calls as needed. OSY provides first-response for GSA managed facilities as a courtesy. Boulder City Police provides back-up to the DoC campus police, although there is no formal mutual support agreement.

NIST is generally responsible for the site maintenance for the entire campus except for the GSA managed area (approximately 15 acres around Buildings 33 and 34). Other NIST responsibilities in the cross services agreement include audiovisual and conference services; maintenance of the Childcare Center; site/facility health and safety; environmental compliance and management services; hazardous and regulated waste management; site emergency management; custodial; and transit subsidy. Personal property is managed by both NIST and NOAA.

NOAA currently is responsible for maintaining the Network Operations Center which manages internet connectivity for all DoC components on the campus. It is also responsible for managing mail delivery/ pickup; freight shipping receiving and delivery pickup; storeroom services; warehousing; publications and printing; and library services.

NTIA/ITS manages Radio Frequency related issues on the campus.



Building 1, Auditorium Entrance Lobby

NIST Components at the Boulder Campus

Organizational Units (OUs) are the functional groupings on campus and the building blocks for the Master Plan. Offices, laboratories and support spaces are assigned to OUs, and this Master Plan continues to use that designation. The OUs are not necessarily consolidated. Specialized facilities and laboratory types may be grouped together for shared infrastructure, and intermittent growth has separated OUs based on available space. One goal of future development is to conveniently locate those specialized spaces that may be shared by several groups.

Communications Technology Laboratory (CTL)—Organizational Unit 67

CTL performs cutting edge research and development in advanced communication and wireless technologies, targeting understanding, testing and validation. CTL conducts research and development on the metrology and understanding of physical phenomena, and materials and systems relevant to advanced communications, including the development of precise instrumentation, testing protocols, and modeling tools support and advance emerging wireless technologies. CTL works with NTIA in a joint NIST/NTIA program to provide opportunities for collaborative research and access to test-bed resources.

Information Technology Laboratory (ITL) —Organizational Unit 77

ITL supports the NIST mission through research and development in information technology, mathematics, and statistics, to promote trust in IT and metrology. Collaborative research with NIST measurement labs, one core pillar of ITL work, ensures that novel and highly effective mathematical, statistical, and computational methods are used to design, analyze, and interpret data from laboratory experiments. In recent years much of this research in Boulder has focused on developing new analytical techniques for quantum information, artificial intelligence, and machine learning. Boulder ITL is comprised primarily of staff from the Applied and Computational Mathematics Division and the Statistical Engineering Division.

Material Measurement Laboratory (MML)—Organizational Unit 63

MML serves as the national reference laboratory for measurements in the chemical, biological and material sciences through activities ranging from fundamental and applied research to the development and dissemination of certified reference materials and tools to assure the quality of measurement results. MML is also responsible for coordinating the NIST-wide Standard Reference Material and Standard Reference Data programs. The Applied Chemicals and Materials Division is located in its entirety at the Boulder campus. The main research activities concentrate on the thermophysical properties of fluids and the reliability of materials. The main facilities include mechanical testing, optical, scan-probe and electron microscopy, experimental properties of fluids (e.g. density, speed of sound, vapor-liquid equilibrium, others), synthesis and characterization of nanoparticles, microbial studies, and computational chemical and materials science.

Physical Measurement Laboratory (PML)—Organizational Unit 68

PML develops and disseminates the national standards of length, mass, force and shock, acceleration, time and frequency, electricity, temperature, humidity, pressure and vacuum, liquid and gas flow, and electromagnetic, optical, microwave, acoustic, ultrasonic, and ionizing radiation. Its activities range from fundamental measurement research through provision of measurement services, standards, and data. Three PML Divisions are located on this campus—the Applied Physics Division, the Quantum Electromagnetics Division, and the Time and Frequency Division. The Applied Physics Division's key competencies include radiometry, advanced communications, sensing, imaging, quantum measurements, signal metrology, biophotonics, spectroscopy, forensics, and laser safety. The Division operates a state-of-the-art precision imaging facility to create and characterize unique devices that improve measurement science, standards, and services. The Quantum Electromagnetics Division leads scientific breakthroughs in the measurement needs for micro-fabrication, and operates a state-of-the-art micro/nano-fabrication facility. The Time and Frequency Division maintains the standard for frequency and time interval for the United States, provides official time to the United States, and carries out a broad program of research and service activities in time and frequency metrology.

Director's Office—Organizational Unit 0

Within the Director's Office, the Public Affairs Office (Division 107) is responsible for media relations and conference support on the campus. The group provides organizational, technical and logistical support for teleconferences, meetings and conferences. The AV Services personnel keep track of equipment and inventory, oversee the room reservation system and maintain AV equipment and related gear. The Conference Services personnel organize the conferences and work with the Gaithersburg Conference Services group to register attendees, collect names and necessary information for Foreign National attendees and provide support as necessary (name badges, room sets, wireless network connectivity, etc.) Public Affairs also organizes tours and demonstrations and collects images and artifacts for display.

CHIPS Research & Development Program – Organizational Unit 3

CHIPS develops programs to strengthen and revitalize the U.S. position in semiconductor research, development, and manufacturing, while also investing in American workers. The CHIPS Metrology Program at Boulder uses skills in measurement science, computing research, standards development and outreach experience to advance semiconductor manufacturing, responding to increasing demand on both performance and materials. Their research and development portfolios emphasize accurate and precise measurements necessary for producing quality microelectronic materials, devices, circuits and systems.

Office of Acquisition and Agreements Management—Organizational Unit 14

Acquisition Management (Division 141) supports the campus through the purchasing and management of contracts for goods and services on the Boulder campus.

Office of Facilities and Property Management—Organizational Unit 19

OFPM is responsible for overall management and operations of the campus facilities, including maintenance of buildings and grounds, provision of infrastructure, renovations, and design and construction of new facilities. OFPM also coordinates with other on-site federal agencies and local regulatory agencies and organizations including the City of Boulder and Native American Tribes.

Office of Information Systems Management—Organizational Unit 18

OISM acquires and manages information technology resources across the campus, for scientific and business computing services. It has the responsibility for centralized IT functions including telecommunication, networking, web services, integrated information systems, knowledge systems, and other IT infrastructure support services. OISM provides customer services for software and hardware, and for integrating emerging technology to assist the research mission. OISM also provides security for the IT network, including oversight and training.

Office of Safety, Health & Environment—Organizational Unit 15

The mission of Boulder Safety, Health and Environment Division (Division 153) is to help reduce safety, health, and environmental risks at NIST by planning, developing and maintaining, safety compliance and continually improving NIST's safety, health and environmental programs. Disciplines include fire protection, environmental compliance, radiation safety and industrial hygiene. Research laboratories are the customers for this group.

Associate Director for Management Resources—Organizational Unit 13

Fabrication Technology (Division 136) operates and manages production orders for a sophisticated machine shop. There are currently 2 staff members in Fabrication Technology.

2.5 Master Planning Process

The Master Plan for the DoC Boulder Laboratories Campus has been developed in collaboration with DoC representatives, and interaction with the local regulatory authorities such as the City of Boulder and Colorado State Historic Preservation Office (History Colorado.)

- Site, building and contextual information from the 2017 plan was reviewed and updated to incorporate current conditions.
- The program of space needs is based on discussions with the various Organizational Units about their staffing and research, review of recent trends, and evaluation of existing space use. Space programs developed in the recent PORs for three new

research buildings were incorporated. The program reflects DoC policies for space utilization and hybrid work.

- A Working Group of representatives from NIST, NTIA, and NOAA organizational units and management were instrumental in reviewing the findings, projections and master plan concepts. The group reviewed several masterplan options with recommendations that led to a preferred concept.
- The NIST Space Board reviewed the preferred concept with recommendations for refinement and phasing. This step also included an assessment of historic and cultural campus assets and a NEPA scoping process with a public presentation.
- The selected alternative was refined for the Master Plan document, with related site infrastructure, circulation, landscape frameworks. An Environmental Assessment accompanies the Master Plan document. The Final Master Plan and Environmental Assessment were prepared after a comment period and final review by the Space Board.

Campus User Feedback

An employee survey was conducted for the Campus Master Plan Update. The web-based survey was live for several weeks in June-July, 2024, and was open to all DoC federal employees and Associates on the Boulder Campus. A total of 278 responses were received of which 151 were from NIST, 99 from NOAA, 26 from NTIA, and two from contract employees working for NIST. The following are some of the key findings from the survey:

- Many respondents indicated an appreciation for the natural setting and the location of the campus. Other key “likes” were the fitness facilities, adequate parking, and campus architectural design.
- Respondents felt their work was supported by good facilities, collaboration with colleagues, telecommunication infrastructure, and the attractive setting of the campus grounds.
- Many respondents pointed out inadequacies in building services and infrastructure that did not support their work including unreliable power, HVAC and air quality issues, poor interior quality/layouts, and aging buildings. Many noted issues with campus access and roadways, and the lack of quality food and beverage services.

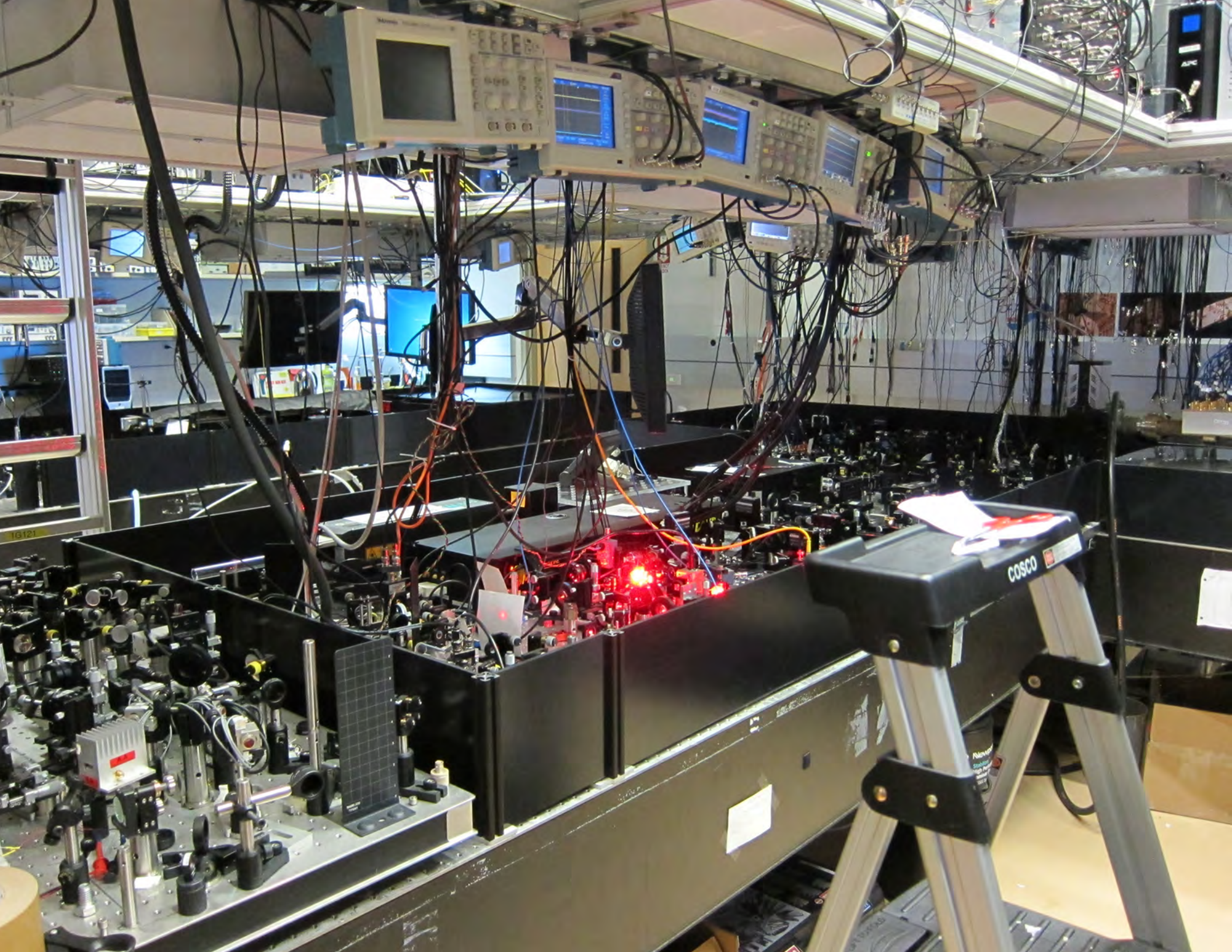
- Those responders hosting colleagues/guests on campus noted some facility issues. The top items cited were stringent site security and visitor processing requirements (especially for foreign personnel), and availability of appropriate conference facilities and support.
- Approximately 75% of the responding employees drive alone to work. Over 11% are bicycle commuters, and 5% take public transportation.
- Electric and/or plug-in hybrid vehicles are driven by 21% of the respondents.
- Hybrid work schedules are common, with 73% of staff working from home/elsewhere one or more days during a typical pay period. At the time of this Master Plan, the Department of Commerce policy on hybrid work changed and a minimum of three days per week in the office is required.
- There were many suggestions for amenities to be considered for the Master Plan. Among the most noted were:
 - Outdoor amenities for sheltered seating/lunch, walking trails, bicycle shelters and recreation areas
 - Fitness center enhancement, including shower and locker space
 - Coffee bar and on-campus food options
 - Centralized collaboration spaces

2.6 Applicable Standards and References

The Master Plan will be prepared in accordance with applicable Department of Commerce and other federal statutes. The plan will be guided by the Boulder City and county's Boulder Valley Comprehensive Plan, and related policies. Among the relevant standards and references are the following:

- First Amended Memorandum of Agreement between the National Institute of Standards and Technology, US Department of Commerce and City of Boulder; May 1998
- US Clean Water Act; US Environmental Protection Agency; 1992; and NIST Stormwater Permit #COR042002
- US Department of Commerce Real Property Management Manual; August 2014, revised March 2017
- DoC Departmental Administrative Order 217-21; Space Allowance and Management Program
- DoC Departmental Administrative Order 217-16; Energy and Environmental Management.
- National Environmental Policy Act (NEPA); US Environmental Protection Agency; January 1970
- Endangered Species Act of 1973
- NIST Sustainable Design Manual; July 2014
- Department of Commerce, High Performance and Sustainable Buildings Handbook; February 2011
- Department of Commerce Implementation Handbook for the Strategic Sustainability Performance Plan; August 2013
- National Historic Preservation Act of 1966, as amended; Department of the Interior, National Park Service
- Colorado Cultural Resource Survey Manual, Guidelines for Identification: History and Archaeology; Colorado Office of Archaeology and Historic Preservation; 2007
- US Executive Order 13693: Planning for Federal Sustainability in the Next Decade; 2015
- CEQ's Guiding Principles for Sustainable Federal Buildings and Associated Instructions; December 2020
- US Executive Order 14057: Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability; December 2021
- US Energy Independence and Security Act of 2007 (EISA 2997) US Energy Policy Act of 2005 (EPA); 2005
- GSA P-100 Facility Standards for Public Buildings, for GSA-owned facilities

Master Plan



Master Plan Program

3

Two components of the Department of Commerce — the National Institute of Standards and Technology (NIST) and the National Oceanographic and Atmospheric Administration (NOAA — are the primary tenants of the campus. The National Telecommunications and Information Administration (NTIA) occupies a portion of NIST's space, and the General Services Administration (GSA), as the manager of NOAA facilities, has a facilities management office in their space. The DoC Office of Security (OSY) occupies space in NIST facilities.

The overall existing space on campus is approximately 1,266,604 gross square feet. NIST manages the majority of these buildings, including campus support and security buildings that serve all agencies, although GSA manages the NOAA buildings and surrounding area. Three buildings that house laboratories and offices account for over 75% of the overall campus space: the Radio Building (NIST), the Katharine Blodgett Gebbie Laboratory (NIST) and the David Skaggs Research Center (NOAA). As of July 2024, the population on campus was 1,767 people, including federal employees, affiliates and contractors.

Exhibit 13: Existing Personnel and Occupied Space—July 2024

	Personnel	Assignable SF
NIST	846	387,082
NTIA	72	21,234
NOAA/GSA	849	240,590
Shared	—	included above
Total	1,767	648,906
Gross Square Feet		1,266,604

The space needs of current and future DoC employees are constantly shifting, modulating with the rise and fall of research projects, changes in staff assignments, and shifts in agency priorities and budget realities. For 2025 Master Plan, space requirements were projected based on the Department's historic patterns, current usage and goals developed for the Plan, realizing that the program components and square footages are a framework for the Master Plan and will be

reviewed with each construction project. Space needs were projected for a 10-20 year planning period, recognizing that future adjustments will be made in response to evolving mission priorities..

The program structure and components from the 2017 Master Plan were the starting point for the development of the space program. The program elements were reviewed with DoC participation, and analysis of the current space use, database information, and anticipated changes to mission and functions. The process included the four different agencies on the site, NIST, NTIA, NOAA, and GSA. The process to understand their requirements and estimate the space necessary to accomplish their functional goals was based on the following:

- Review of DoC and NIST guidelines and policies for labs and office space
- NOAA-provided space information and projected needs
- Interviews with steering committee and user groups about program needs, future direction and goals
- Employee survey of amenities and campus-wide needs
- Analysis of campus buildings, their functional issues and locations.
- Consideration of the overall campus goals and integration of the various user agencies.

Based on the 2017 Master Plan, NIST commissioned Programs of Requirements (PORs) for several of the new buildings recommended in the 2017 Master Plan. These PORs were developed with the participation of the users and stakeholders of the planned buildings and represent more recent and detailed requirements. The space components and square footages from these PORs are incorporated into the space program of this Master Plan.

Personnel growth on Campus is expected to be modest over the planning period, projected to increase by approximately 6% overall during the planning period. Space growth and change is based more on the replacement of aging and inadequate facilities than on space needed for additional personnel. Many of the existing laboratory buildings do not have the infrastructure support (interstitial or galley space) needed for the advanced research taking place, and support space will be added as the buildings are replaced. In addition, administration and campus support facilities are scattered in multiple buildings, and consolidation will save space as well as improve efficiency and save energy.

3.1 Space Needs for Growth and Change

The square footage on the accompanying table are shown in terms of both assignable and gross square feet. Assignable square footage is the area that is usable and assigned to specific personnel groups, such as offices and labs. For administrative space, assignable includes the office areas and the secondary circulation within the suites. Gross square footage covers the entire building, including the bathrooms, corridors, mechanical spaces, etc. The ratio of assignable-to-gross varies for different kinds of space; for example, lab spaces have a very high assignable-to-gross ratio because the mechanical and equipment galley space is part of the “gross”. For the Master Plan, gross square footage is the building block, because it represents the entire building or addition that must be included in the plan.

The space program projections are based on assumptions and existing priorities of the Department of Commerce agencies. These projections are not definite requirements or funded projects but provide the planners a basis to develop a framework for the Master Plan.

The following chart projects the additional space that is required to accommodate projected staff increases and anticipated growth or change in laboratory/support needs. It is limited to the incremental increase to specific spaces and does not include space needed to modernize the existing buildings or consolidate inefficient operations.

3.2 Space Needs

Space needs are projected to grow approximately 15% over the coming years, with most of that growth in laboratories and support space. The Master Plan space program is based on the anticipated staff growth and planned research initiatives. New square footage is included in the following:

Personnel Space. Office and office support space is allocated based on the Department of Commerce policy of assigning 150 assignable square feet per person. This allocation covers offices, workstations, suite internal circulation, and related offices areas such as conference rooms, copy centers, break rooms, filing etc. As new and renovated space comes into use, this standard will be utilized. Specific personnel assumptions include:

- The NIST Organizational Units (OUs) anticipate an average staff growth of 6% over the planning period based on interviews with the OUs and management review. However, the need for additional office space will be less than existing as NIST adopts the new Department of Commerce space standards. Several groups, notably CTL, anticipate more growth in the longer term, based on research trends.

Laboratories and Lab Support. Lab space allocations are based on the PORs developed as well as existing lab utilization, discussions and current projections from laboratory directors. The PORs add approximately 14,000 assignable square feet of laboratories, with a related increase in support spaces. The overall gross square footage will be higher as facilities are replaced or renovated in order to provide the utility infrastructure necessary to support the advanced research programs. Specific Master Plan assumptions include:

- The PORs increase total NIST lab space although this is not all new space. Much of it will replace obsolete laboratory space in existing lab buildings that are planned to be demolished or vacated.
- NOAA has not yet finalized their needs, but the planning assumption is the addition of 35 people during the short-term planning period and a modest need for future laboratory space. The program includes the long-term estimates made for the 2017 Master Plan.

- Laboratory renovations and replacements are planned. This space program indicates the assignable square footage only, and the Master Plan includes additional gross square feet for appropriate support and infrastructure needed in lab renovation/replacement.

Support Space. Existing facility support space is maintained, with a modest increase to parallel lab and office growth. Some economies are expected by space efficiencies captured when the administration offices, support workshops and service areas are consolidated. Specific Master Plan assumptions include:

- Campus support space for facilities, maintenance and storage functions are scattered among several buildings, and inefficient in layout and use. Existing space is retained, although a modest reduction is expected when the Master Plan approach is finalized, and these functions are consolidated into a more efficient building.
- For the Master Plan goal of creating opportunities for collaboration and additional employee amenities, space for a coffee bar and a small allowance for collaboration space has been included in the space program.
- Expansion of the Central Utility Plant (CUP) may be necessary to allow for equipment and service changes, upgraded utilities, or to meet a campus decarbonization program.
- The PORs include facility support space such as loading docks, computer spaces, etc., which are included in the space allocated to the OU that manages that type of space.
- NIST plans shelter-in-place facilities for wildfire safety, both in existing buildings and in new construction. The program estimates additional space to support this, pending recommendations from a planned NIST detailed study.

Exhibit 14: Program of Space Needs

Space Type by Organization	EXISTING		PROJECTIONS 10 YEAR		DIFFERENCE	
	People #	Space usf	People #	Space usf	People #	Space usf
NIST						
Office/Support - Administrative	180	36,186	191	31,820	11	(4,288)
Office/Support - Research	666	96,884	706	105,900	40	9,016
Laboratories/Support	incl. above	162,560	incl. above	172,846	incl. above	10,286
Facility Support/Storage	incl. above	65,988	incl. above	85,944	incl. above	19,957
subtotal	846	361,618	897	396,511	51	34,893
NTIA						
Offices/ Support	72	14,857	105	15,750	33	893
Laboratories/Support	incl. above	5,661	incl. above	15,040	incl. above	9,379
Facility Support/Storage	incl. above	716	incl. above	1,306	incl. above	590
subtotal	72	21,234	105	32,096	33	10,862
COMMON NIST & NTIA						
Collaboration/Support	—	6,070	—	16,370	—	10,300
subtotal	0	6,070	0	16,370	0	10,300
NOAA in NIST Buildings						
Offices/ Support	15	644	15	2,250	0	1,606
Laboratories/Support	incl. above	389	incl. above	389	incl. above	0
Facility Support/Storage	incl. above	18,362	incl. above	18,362	incl. above	0
subtotal	15	19,394	15	21,000	0	1,606
NOAA in NOAA Buildings						
Office/Support (includes 9 GSA)	834	—	869	—	35	—
Laboratories/Support	incl. above	—	incl. above	—	incl. above	—
Facility Support/Storage	incl. above	—	incl. above	—	incl. above	—
subtotal	834	240,590	869	261,590	35	21,000
Campus Total USF	1,767	648,906	1,886	727,567	119	78,661

- Several replacement and expansion projects are planned by NIST and have requirements and documents in place. These are included in the program. The projects are a new storage building and expansion of the security screening/security center building.

Shared Facilities. Certain services and employee amenities are shared campus-wide, including shipping/receiving, security center, library, health center, childcare, and conference center space. The program allocates space based on specific functional needs. . Specific Master Plan assumptions include:

- The Childcare Center is maintained at the current enrollment, but space is added to bring the undersized facility to meet GSA guidelines.
- A new coffee bar is proposed, which will be available campus wide and may serve as the gathering place for campus tours.
- The two existing fitness centers will remain in Building 1 and Building 34. Likewise, the existing library, health center, and NOAA snack bar are maintained in the program.

3.3 Facility Needs

Facility needs, more than space needs, shaped the Master Plan approach. Many of the campus buildings are obsolete, whether for physical and functional condition, for lack of adequate research infrastructure or for inefficiency of size and location. As a result, the Master Plan replaces these obsolete facilities and removes them from the campus inventory. Consequently, more new square footage is proposed than indicated by the Program Space Needs shown in Exhibit 14. The facility replacements require additional square footage for the infrastructure to meet modern research needs and building codes. See the table in the Executive Summary for a summary of the difference.

Buildings/Space Added	+310,800 GSF
Buildings Removed	(169,457) GSF
Difference	+141,343 GSF

Recommended renovations to Building 1 have taken place since the 2017 Master Plan, but the other consolidations and facility replacements of that plan remain to be implemented. The facility program for this Master Plan covers the unmet earlier recommendations, as modified by recent NIST mission evolution and priorities. Specifically, the facility program includes:

- Space for laboratories and office space campus-wide, based on personnel and research growth over the planning period.
- Research Buildings—replacement of Buildings 2 and 2A, replacement of the labs in Building 24, and renovation within Building 1. PORs are in place for these replacement buildings.
- Administration and Support—consolidation of management resource administration and support functions in a new Management Resources Center, and the demolition/removal of the ten scattered buildings they currently occupy.
- Childcare Center—replacement of the aging facility to current GSA standards.
- Support Buildings—additional storage space for OFPM and expansion of the Security Center building.

3.4 Maximum Campus Space

The 1998 Amended Memorandum of Agreement with the City of Boulder set a maximum square footage for site build-out. This maximum square footage was modified in 2015 to be 1,418,923 gross square feet by agreement between NIST and the City of Boulder¹ based on changed measurement methodology. The program’s allowable gross square footage corresponds to the MOA modification.

Exhibit 15: Maximum Campus Space

	GSF	
Current Campus Space	1,266,604	
Maximum Allowed	1,418,923	Allowed by MOA
Used in Master Plan	1,407,947	10,976 remaining

1. Jane S. Brautigam, Boulder City Manager to Virginia Holtzman-Bell, Boulder Laboratories Site Manager; March 25, 2015; Boulder Colorado

Exhibit 16: Distribution of Space Needs by Organization

Organization Needs		EXISTING		PROJECTED 10-YEAR				
		People #	Total USF	People #	Space Office/sup.	Space Lab/sup.	Space Stor/support	Total USF
NIST CAMPUS	ADMINISTRATION							
	CHIPS Research & Development Program Office	19	1,891	19	2,850	--	--	2,850
	Director's Office-Public Affairs	8	15,208	8	1,200	--	11,342	12,542
	Management Resources / BOO	9	496	10	1,500	--	--	1,500
	Emergency Services Office	10	7,278	12	4,970	128	3,858	8,956
	Office of Acquisition & Agreements Management	18	2,081	22	3,300	--	--	3,300
	Office of Facilities and Property Management	68	45,333	68	10,200	--	41,104	51,304
	Office of Information Systems Management	38	14,081	42	6,300	179	11,904	18,383
	Office of Safety, Health and Environment	10	3,668	10	1,500	--	1,350	2,850
	subtotal	180	90,036	191	31,820	307	69,558	101,686
	LABORATORIES							
	Laboratory Programs-Assoc. Director	1	671	1	150	341	--	491
	Communications Technology Laboratory	189	74,786	200	30,000	40,416	5,897	76,313
	Information Technology Laboratory	25	3,616	31	4,650	234	--	4,884
	Material Measurement Laboratory	110	46,025	116	17,400	33,266	4,727	55,393
	Physical Measurement Laboratory	341	146,484	358	53,700	97,406	5,719	156,825
	Lab Growth	--	--	--	--	876	44	920
	subtotal	666	271,582	706	105,900	172,539	16,386	294,825
	NTIA	72	21,234	105	15,750	15,040	1,306	32,096
	NOAA -- in NIST	15	19,394	15	2,250	389	18,362	21,000
	OU Totals	933	402,246	1,017	155,720	188,275	105,612	449,607
	COMMON NIST/NTIA (other existing shared in OU totals)							
	Common Collaboration	--	6,070	--	5,858	--	212	6,070
	Building A Atrium/Collaboration	--	--	--	6,400	--	--	--
	Hoteling / Guest office areas	--	--	--	1,200	--	--	1,200
	Coffee Bar	--	--	--	--	--	--	1,500
	CUP Expansion	--	--	--	--	--	--	300
	Shelter-in-Place Allowance	--	--	--	--	--	--	7,300
	NIST Campus Totals	933	408,316	1,017	169,178	188,275	105,824	465,977
NOAA CAMPUS	NOAA (staff on campus)	825	240,590	860	--	--	--	NA
	GSA	9	INCL. ABOVE	9	--	--	--	--
	NOAA Campus Totals	834	240,590	869	NA	NA	NA	261,590
DEPARTMENT OF COMMERCE TOTALS		1,767	648,906	1,886	USF 727,567			



Master Plan Concept

4

The 2025 Master Plan development began with the 2017 Master Plan and the goals for the campus, and was shaped by current projected space needs and evaluation of the existing conditions of the site, infrastructure and buildings. Site concepts and layout alternatives were explored and evaluated by the design team in concert with a steering committee with representation from NIST, NTIA and NOAA. The chosen approach is presented in this document.

4.1 Considerations for the Master Plan

The Master Plan looks to the future, anticipating growth and change to the Department of Commerce's mission and activities. But it also looks at today, and the campus issues that need improvement to achieve an efficient and pleasant workplace.

- **Environmental Control.** Much of the advanced research and measurement science taking place on the Boulder campus is based on precise performance and measurements, which demand very controlled environments—rigorous temperature and humidity control, vibration stability, air cleanliness and quality electric power. Other than in Buildings 81, 3, 33, and renovated wings in Building 1, these conditions are difficult to achieve. Researchers make do in the older lab buildings, but time is often wasted and experiments sidelined.
- **Lack of a Campus Organizing Principle.** The campus layout reflects its incremental growth stemming from space need and does not have a unifying vision or organization. There is no recognizable core that gives the campus identity as a place, like the rhythm of GPLs does at Gaithersburg, or a quad does for a university. Circulation from building-to-building is not straightforward; front doors are not used; wayfinding is difficult. The vehicle entrance has shifted from its original location, which had a direct view of the front of Building 1, to a location that shows guests a side view of the buildings.
- **Inefficiency of Small, Modular and Aging Buildings.** Incremental growth on campus has been addressed by adding modular buildings, small buildings and additions resulting in functional and physical inefficiencies and an unorganized campus. In all, there are 9 modular buildings on campus, with another 10 small buildings, each less than 5,000 square feet. Each has its own services and mechanical system.
- **Scattered Management Resource Functions.** Administrative functions—construction, facility management, maintenance, IT services and support—are all located in six separate small buildings. Lost are easy opportunities for coordination and sharing of resources, equipment and support.
- **Circulation and Screening Conflicts.** Congestion is apparent at the campus entrance and Security Center, where all visitors must get badges and non-employee vehicles must be screened. Maneuvering room is limited, and it is not possible to inspect a large delivery truck and passenger vehicles at the same time. The vehicle screening process is not apparent to visitors, and they often need to circle back around and re-enter the screening area. Visitors arriving by public transportation or on foot do not have signage directing them to the Security Center.
- **Wildfire Risk.** Wildfires have increased in frequency, severity, and size in the Boulder area, and the campus is a greater risk because of its open space and location by the foothills. Additionally, campus exits and adjacent roadways limit evacuation capacity.
- **Limited Collaboration Opportunities.** The campus, particularly the NIST precinct, has few areas that draw people together informally, either in a central location or within buildings. The NIST cafeteria is no longer open, and many break rooms and small meeting areas have become offices and lab support areas as space pressure increases.
- **Complexity of Public Forums.** Holding a tour, conference or public forum on campus requires visitor badging, vehicle screening, parking arrangements and coffee or food catering from an outside vendor. NIST would like to expand interaction with outside groups by easing this complexity and creating a separate parking and visitor gathering place with fewer security requirements.

- **Development Restrictions of the MOA and Community Requirements with the City of Boulder.** Any future development must consider the Memorandum of Agreement (MOA), which sets limits on campus total square footage, parking, building heights and view to Kohler Mesa. In addition to the MOA, other regulatory considerations include State Historic Preservation Officer review, EPA Stormwater Permit modifications, and federal energy and sustainable design considerations.
- **Community Concerns.** Public use on the campus is a community consideration, and the Master Plan makes no changes to the trails in the protected area. The DoC strives to be a good neighbor, working with the neighbors to identify and mitigate any complaints about noise or the shielding of site lighting.
- **Historic Preservation.** The Radio Building (Building 1) is eligible for listing on the National Register of Historic Places, according to the Colorado Office of Archaeology and Historic Preservation, which functions as the State Historic Preservation Officer (SHPO) in Colorado. Future modifications to this building require review under Section 106 of the National Historic Preservation Act. SHPO has suggested that renovations be approached as rehabilitation, which is one of four treatment methods. It is defined as the act or process of making possible a compatible use for a property through repair, alterations, and additions while preserving those portions or features which convey its historical, cultural, or architectural values. Building 24 was built in 1967 and is now 57 years old. NIST worked with SHPO to review its historic integrity and determined that B24 is not eligible for listing on the National Register of Historic Places because of the significant changes that have been made to the layout, materials and usage.
- **Projects in Motion.** Following the 2017 Master Plan, several NIST projects were built or planned. These projects have been incorporated in the 2025 Master Plan and the design approach.
 - Communications Technology Laboratory was established in a renovated and expanded Building 3.
 - Building 1, Wing 5 was renovated and expanded for modern laboratory space with service galleys and related office and collaboration space

- A new computing center, Building 92, was constructed to the north of the Central Utility Plant.
- Three Programs of Requirements were developed for research buildings planned in the 2017 Master Plan, outlining their sizes, technical requirements, and test layouts. Master Plan designates them Building A, Building B, and Building 3 Addition.
- Building 43 is a new hazardous materials storage building, replacing the existing Building 23. Building 23 will be demolished as part of the Plan.

4.2 Master Plan Concept

The Master Plan concept creates appropriate facilities to support the work of the DoC agencies, but it also strives to create a vibrant campus with an organized layout, employee amenities and an appreciation of the natural surroundings. The campus environment is intended to enhance the working environment, encourage employee interaction, and provide a sense of place and pride in the institution.

Research facilities are the building blocks of the Master Plan, directly serving over three-quarters of the staff from NIST, NTIA and NOAA. The Radio Building (B1), one of the original research buildings, is physically linked to the Katharine Blodgett Gebbie Laboratory Building 81. This interactive approach allows easy movement between buildings for both staff and equipment. The Master Plan continues this strategy for NIST, linking new research buildings in a linear concept. These connections are central to the concept and one of the reasons for the selection of this approach. Ease of movement is important, especially in inclement weather, as is the flexibility for sharing resources and accommodating shifts in lab assignments.

With the Master Plan, the research core of the campus will center around Building 81, extending westward. A plaza is created at the Building 81 entrance way, creating the campus public face visible from the campus entry drive and orienting pedestrians and visitors. A landscaped campus green and pedestrian way enhances the relationship between the research buildings, and ties together the research facilities that cannot be directly connected. The green provides organization and visual cohesion as well as an outdoor amenity. A new coffee bar is an element within the campus core, positioned to welcome staff from both NIST and NOAA buildings with light food and informal collaboration spaces. This space will become



the gathering place for campus visitors arriving for tours and seminars. The Master Plan reestablishes a zone in which visitors can park without vehicle screening and walk on to the campus, easing security screening time and complexity.

Support and service facilities are concentrated up the hill to the west of the research buildings. The Central Utility Plant, the planned Management Resource building and the Warehouse surround an open yard with parking for service vehicles. Vehicle access is from Curie Circle, the campus ring road. Pedestrians also can gain access to the Central Utility Plant and the Management Resources building from the campus green's walkway.

Open space encompasses approximately one-half of the campus land, and incorporates the areas protected under agreement with the Tribes and the City of Boulder. The 103.5 acre protected area begins in front of NOAA at Broadway Street, extends across the southern portion of the property and the western third. Within this open space is an existing secondary research area at the top of Kohler Mesa, established for specific programs. The Master Plan does not propose any buildings or roadways in the open space.

4.3 Master Plan Elements

Research is the heart and the business of the Boulder campus. Mission, research methods, and technology have evolved since the construction of the buildings slated to be renovated and replaced, and this advanced research requires more sophisticated buildings. New facilities will strive for flexible, adaptable lab facilities, precise environmental control and efficient, and comfortable working conditions for the researchers.

The Master Plan puts these objectives at its center, with the following research components.

Building 1 Renovation

The Radio Building 1 has been the core research building from the initial 1954 campus construction. It remains an iconic, recognizable building on the campus. A one-story conference center and library make up the front of the building, facing Broadway. From that headhouse, a three-story spine links six wings of laboratory and office space. The building has been undergoing a phased renovation and upgrade program, to replace outdated systems and meet the performance level required by NIST's research.

Renovation of Wings 3, 6 and most recently 5, have been completed. These wings have undergone complete replacement of infrastructure, systems and architectural elements. An accessible service corridor was added to each wing to house mechanical equipment for individual labs as well as the wing as a whole. The accessible service corridor also was added to provide seismic reinforcement required by current building codes. The façades were replaced with new insulation and glazing. Planned renovation of Wing 4 and the spine is anticipated to follow a similar approach, while respecting the building's historic features. The renovation of Wings 1 and 2 will follow, although the timeframe has not been established. Building 1 was determined to be eligible for listing on the National Register of Historic Places and all renovations in Building 1 will be governed by the National Historic Preservation Act and the Secretary of the Interior's Standards for Rehabilitation. Plans will be submitted to Colorado SHPO for review and comment.

Building 3 Repurposed



Following the 2017 Master Plan, the Liquefier Building 3 was repurposed and expanded to serve as the headquarters of the Communications Technology Laboratory (CTL), completed in 2018. The original building was a single story, high bay concrete structure constructed in 1952, and its repurposing has significantly changed both the use and appearance, creating three-stories of offices and computer laboratories. Limited elements from the original building were retained.

An addition will be constructed to consolidate and house laboratory space for CTL – see Replacement Research Buildings.

Exhibit 18: Concept - NIST Ground Floor Plans



Exhibit 19: New NIST Replacement Research Buildings



New NIST Replacement Research Buildings

New research buildings are the heart of the Master Plan concept, linking new facilities to old, and defining the central green space. The new laboratories will provide the flexibility, infrastructure and controlled environments needed to support advanced research. Two NIST laboratory buildings, Buildings 2 and 2A, will be replaced, as well as the labs in Building 24. Both Buildings 2 and 24 are aging facilities (1951 and 1967) with several additions, functional problems and systems well past their useful lives. Building 2A is a 35-year-old “temporary” modular building.

Laboratory needs and equipment used by NIST’s scientists vary with research priorities and technology advancements, evolving over time. New laboratories for NIST will emphasize flexibility—meeting research requirements today and able to adapt for tomorrow. To that end, NIST is developing a standard laboratory module for flexibility, consistency, and longevity. This research building approach combines three components, lab modules of

consistent size, researchers’ office space, and a galley along the labs for service and equipment.

The Master Plan includes three planned research buildings, each recommended in the 2017 Master Plan and later developed into Programs of Requirements (PORs). These research buildings are outlined in detail in separate PORs, documents that were developed with NIST stakeholders’ input. These three documents include the planned program spaces, test fit diagrams, and the technical building and infrastructure requirements. When construction is planned, each POR will be reviewed and modified as necessary for changing research priorities, standard lab modules or new programs.

The Master Plan indicates a future building location but this will only be possible if NIST renegotiates its MOA with the city.

Building A will be a research building with approximately 70 laboratories, both standard and high-bay, together with office areas and related support. The planned occupants are the Material Measurement Laboratory (MML) and Physical Measurement Laboratory (PML). Building A replaces outdated labs in Buildings 2, 2A, and 24 with expanded research space, capabilities, and modern infrastructure. The Master Plan places the building facing the campus green and linked to Building 81 by covered pedestrian paths. The new building will be on the site of Buildings 2 and 2A, so construction must be phased ensuring that ongoing research is not interrupted. A parking structure will be adjacent to Building A, conveniently located to campus buildings and sheltered pedestrian connections.

Building B will be a research building for the National Telecommunications and Information Administration (NTIA), replacing labs that are currently located in Building 1. This will allow renovation within Building 1 and provide space for staff currently housed in temporary buildings. Building B will house flexible dry laboratories

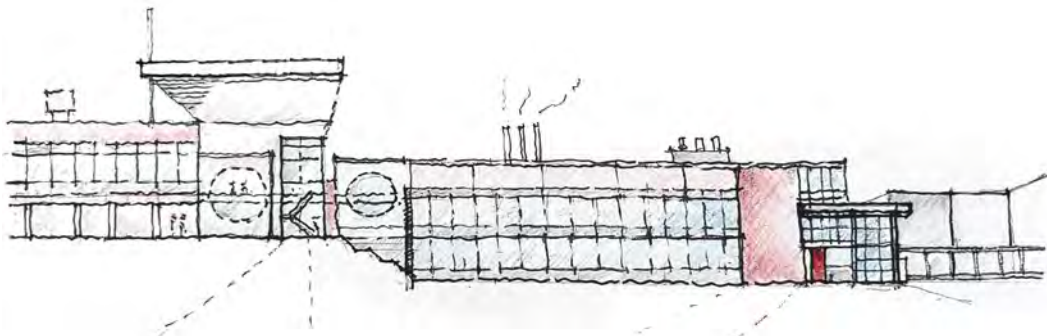
Exhibit 20: Concept - Example Laboratory Section



and support space. Like Building A, the new building will become part of the new central core of research buildings and help frame the campus green and pedestrian way.

Building 3 Addition will consolidate the research facilities of the Communications Technology Laboratory (CTL), providing new anechoic chambers, improved infrastructure and a more efficient research environment. The addition will replace outdated spaces now in Building 24 and Building 1. The building addition has stringent technical requirements, including load and vibration requirements. The POR links the addition directly to Building 3, sharing circulation and certain staff amenities. The Master Plan adds an allowance of 3,000 gross square feet to the POR program to supplement support because of shifted location. Enclosed parking is needed for two specialized vehicles, either adjacent to Building 3 or a protected area within the planned parking structure.

Exhibit 21: Existing Building 2 and Concept for Replacement Laboratory



The Katherine Blodgett Laboratory

The Katherine Blodgett Gebbie Laboratory, Building 81, is not changing in the Master Plan, but is the anchoring point for the replacement labs as well as the campus green. Movement and connection for both people and equipment are functional requirements. Building 81 is the knuckle, linking the new laboratories with those in the Radio Building.



Exhibit 22: Building 34 Expansion



Building 34 Renovation and Expansion

NOAA's Observatory Building 34 is isolated from the main building and is underutilized at this time. As the National Weather Service needs additional research space, the Master Plan proposes that Building 34 be preserved, repurposed and expanded to serve this group. The Plan indicates the general approach and preliminary size.

Existing Building 34



Exhibit 23: Management Resources Center



Management Resources Center

Consolidation of NIST's management and facility support groups is designed to increase efficiency, both functional and physical. Located in 10 small buildings plus the Radio Building, these groups cannot take advantage of adjacency to coordinate and collaborate. Both efforts and resources are duplicated, e.g. copy rooms, conference rooms, break rooms, rest rooms, filing, and reception. Many of the existing small buildings are not in good physical condition; eight of the ten are temporary buildings and/or trailers. For example, Buildings 4 and 5 were constructed as temporary buildings in 1951 at the initial campus development and have remained in use for these last 70+ years. In addition to human efficiency, energy efficiency can be gained in consolidation, as the multiple individually packaged HVAC units are replaced with an efficient central system.

The Master Plan approach creates a new Management Resources Center located along Curie Circle at the western end of the campus green, near the Central Utility Plant and the utility yard. Approximately 50% of the Center would be office areas, with office support space shared among the groups. The remainder would be maintenance shops, personnel support, supplies and storage, replacing the functions of the demolished buildings.

Although located together for functional reasons, the design requirements for each component are very different—different mechanical systems, different daylighting, different finishes—for the most energy efficient and appropriate concept. The preliminary concept suggests that maintenance shops and storage could be primarily day-lit, utilizing north-facing monitors that could have solar panels on their south sides. The shops might use natural ventilation, augmented when necessary, and the storage areas could use underfloor heating to efficiently keep the lower area comfortable for people. The office portion would have more typical comfort requirements and systems. Daylighting could provide much of the illumination for the office section too, by careful consideration of the building depth, orientation, internal layout and façade design. Although the Management Resources Center could be a single building, the Master Plan shows it as two connected facilities to allow vehicular access to the CUP without interrupting the campus green. Net-zero energy use is the goal for this facility.

Preliminary occupants for the Center would be primarily from the Office of Facilities and Property Management, including both office and shop functions, plus other management groups.

Some of the NIST administrative staff would not move to the new Management Resources Center but remain adjacent to their service areas. Specifically, the Safety, Health and Environment staff would remain located near the research laboratories, and the OFPM building management teams would remain within their assigned buildings. Administrative staff members that directly serve the Laboratories would remain in the research buildings.

The consolidation will reduce the overall assignable square footage needed by these groups, and increase physical and functional efficiency. About 100 staff are planned to have office space and shared support in the Center, consolidating them from the buildings to be demolished as well as freeing up space in Building 1. Maintenance shop areas can share support, and consolidated storage space can incorporate efficient warehouse shelving systems. Storage functions currently using shipping containers should be included.

Exhibit 24: Concept - Management Resources Center



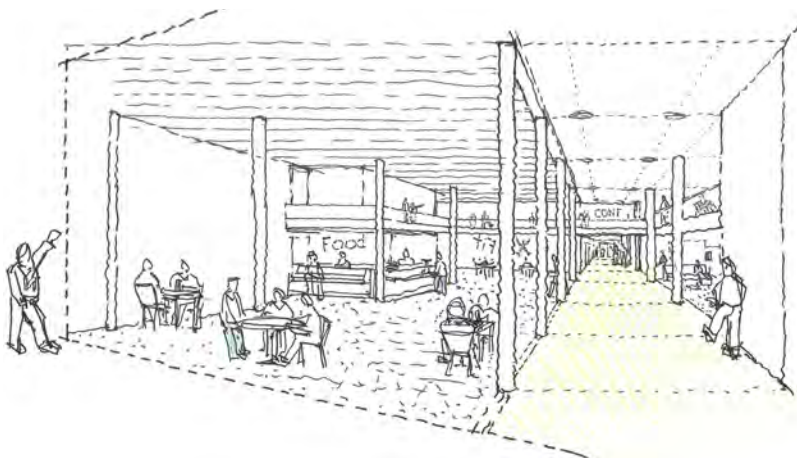
Exhibit 26: Coffee Bar



Coffee Bar

One of the amenities most requested by NIST staff is an on-campus food venue. The Master Plan proposes a coffee bar—a casual setting serving coffees and limited food/snacks. A location near the campus core and opening onto the campus green would attract NIST, NTIA and NOAA employees, strengthening the pedestrian realm of the campus and fostering a greater sense of community among all DoC staff. The space is envisioned as a lively gathering place with seating indoors and out, including several informal collaboration spaces. The coffee bar would be a public zone where staff and visitors could enter without badging in. It would be included with the development and construction of the new Building A, with a security separation from the laboratory section of the building. With its central location, the coffee bar could be the gathering place for on-campus tour groups. Its design, entrance, landscaping, and signage should create an image and signal that this is a welcoming place.

Exhibit 25: Concept - Coffee Bar



Conference Facilities

Conference facilities are available in three campus buildings, Buildings 1, 81 and 33. The largest (and the original) conference center is in the “front” of the Radio Building 1, facing Broadway. Its 500-seat auditorium opens to the original 1954 lobby space, as do several meeting rooms and the DoC Library. In addition, Building 81 has several flexible meeting rooms and related amenities at the entrance by the campus green, and NOAA has a conference center in Building 33. There have been fewer conferences on campus since the pandemic and subsequent expanded capability of video conferencing and on-line meetings. At this time, NIST anticipates that most conferences held on campus will be under 150 attendees, with video capability. Larger conferences will be held off campus in rental facilities. NIST’s small conferences could be held at either Building 81 or Building 1, with the following recommended facility improvements:

- Building 81. Create a security separation between the conference area and the laboratory section of the building. The conference center is self-contained with restrooms and kitchenette, but visitors can wander into other parts of the building at this time.
- Building 1. This conference center requires additional support facilities, including accessible restrooms and a breakroom or other space for coffee service or simple catering.

In addition to conferences, both NIST and NOAA host tours of their lab facilities, NOAA on a weekly schedule and NIST by prior arrangement. Security policy requires that a visitor entering a campus building be sponsored by a DoC employee, obtain a visitor badge and have their car screened before entering campus. The expanded Security Center and its proposed visitor parking lot (below) will ease screening for tours and conferences.

See section 4.4 for recommendations to modify these two conference areas to provide shelter-in-place facilities in case of wildfire.

Exhibit 27: Security Center



Security Center Modification

Located at the campus entrance, the Center provides front-line security, screening visitors and vehicles before they enter the campus. The number of visitors and the screening process have changed since the facility was built. The current building is not adequate for the processing functions, the flow of visitors through the metal detectors and the added facilities for a supervisor and fingerprinting. Expansion or complete replacement is proposed to ease the congestion and improve efficiency.

Screening of vehicles would also be modified to improve security and ease congestion. The screening area for trucks and private cars would be separated, and the turning, or reject, drive would be reconfigured. The Security Center modification has the following elements:

- Expanded building. Renovation and expansion will alleviate crowding with a larger waiting and screening area, and new staff work areas and support.
- Dedicated screening area. Visitors and delivery vehicles will be directed to a new drive and screening area for mandatory screening before entering campus or leaving via a separate reject drive.
- New guard booth with truck turnaround. A guard booth is the final checkpoint for vehicles entering campus, both staff and screened visitors/deliveries. The existing booth will be moved farther west, beyond the rejection lane for vehicle screening. A

paved area at the booth will allow a truck or car to turn around if they have accidentally missed the screening area.

- Visitor parking. A parking lot near the entrance would be accessible to both staff and visitors without vehicle screening. The lot would be separate from the campus circulation system, with entrance and exit from Broadway. Visitors parking here could walk onto the campus. (The Boulder campus is not fenced, and pedestrians are permitted free access to the campus grounds but must be badged to enter buildings.) NIST will initiate control procedures to make parking convenient but preserve the lot for DoC staff and their visitors.

The Master Plan shows one campus entrance at Broadway/Rayleigh Road for vehicles entering and leaving campus. An alternative approach could create a right-turn exit at the existing curb cut for the medical center, avoiding potential congestion at the exit. This requires coordination with the City of Boulder and a solution that does not interrupt bicycle movement along Broadway. This could be accomplished either with a grade separation (tunnel for bicyclists) or controls that give the bicyclists the right-of-way. Although not proposed in this Master Plan, this could be considered as an emergency exit component of wildfire planning.



R. Christopher Goodwin Associates



Childcare Center Replacement

The existing Childcare Center, Building 26, occupies two modular buildings, the first completed in 1989 and the second added and integrated in 1995. Space is very tight, and the building is in fair-to-poor physical condition, with many of the original mechanical systems. The building is owned and maintained by NIST but operated by the Commerce Children's Center, an independent contractor. Children range in age from infants to pre-K. Enrollment is approximately 100, with 90 children attending on a typical day.

The Master Plan replaces this aging and functionally inadequate building and moves childcare from the current location. It locates the building closer to the campus entrance, prioritizing easier access for parents and safer evacuation in case of emergency or wildfire risk. The planned capacity for the Childcare Center remains the same, although the square footage is approximately 50% larger, meeting the guidelines of the Child Care Design Guide, GSA Public Building Service, July 2003.

As a new building, net-zero energy use is the goal, with the potential incorporation of ample daylighting, an energy efficient envelope, possible use of solar photovoltaics, and other sustainable design strategies.

4.4 Wildfire Planning

Boulder County and the surrounding area are increasingly susceptible to wildfire events, with the DoC Boulder Laboratories campus at significant risk because of its open space and location at the foothills. Boulder area wildfires have increased in both size and severity. The county has had seven notable wildfires since 2000, burning over 27,000 acres, and there were two fires in 2022 near the DoC campus, the Sunshine Canyon fire and the NCAR fire. In addition to the risk, the evacuation capacity from the campus is very limited. There are three roads off the campus, two of which exit into neighboring residential streets. The main campus entrance/exit is to Broadway (State Highway 93), a two-way, multi-lane roadway. In a fire emergency, much of the dense residential area around the campus would also evacuate using Broadway, a roadway that was very backed up during the recent NCAR fire.

Wildfire planning, preparedness, and mitigation must be incorporated into implementation of the current Master Plan. The multi-jurisdictional nature of the campus adds planning complexity—the occupied campus is broadly divided into a NIST controlled area and a GSA controlled area. Within the NIST controlled area, there are employees from NIST, NTIA, and NOAA, whereas in the GSA controlled area, most employees are from NOAA with limited GSA staff and NIST employees. On the greater campus land, there are easements on the property defined by agreements with the City of Boulder; Anderson Ditch Company; and a compact with Native American Tribes.

The Master Plan is a development framework. To that end, this document identifies interventions required for the site, buildings, and infrastructure to mitigate the threat of wildfire, although not for mitigating operational and/or policy actions. But it is a broad planning document and recommends that NIST proceed with a planned, detailed study that evaluates the campus and buildings for preparedness, safety, and shelter-in-place solutions.

Mitigation Planning

Preparing for most hazards and threats, including wildfire risk, addresses the following considerations:

- **Planning:** Identify the hazards and develop a plan for each of the subsequent steps clearly identifying the action items, responsible parties, and anticipated timelines.
- **Prevention and mitigation:** Identify the preventative and mitigative measures that can stop or reduce incidences, and the immediate and later impacts from the hazards.
- **Preparedness:** Develop specific actions identified in the prevention and mitigation measures including physical readiness for anticipated hazards. Examples include warning systems, building/system modifications, equipment, training, preparation “grab list” or equipment to be secured, etc.
- **Response:** Plan and train for staff actions immediately before, during, and after a wildfire or other dangerous event.
- **Rescue:** Develop an evacuation and rescue plan for removing persons affected by the hazard immediately before, during, and after a wildfire or other dangerous event.
- **Recovery:** Anticipate that there will be disruption, evaluation, and work to bring affected areas of the campus back to normal functioning.

Master Plan Recommendations

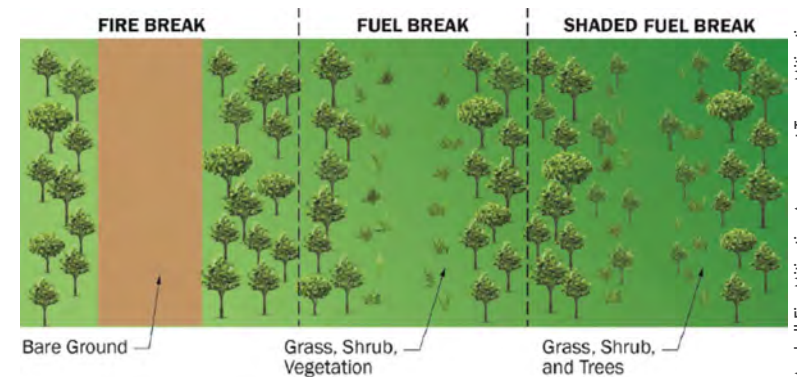
As part of the overall approach, DoC should develop operational policies, including prioritization of actions and allocation of responsibilities. These could include annunciation methods and equipment, training drills, rescue and recovery strategies etc. As an example, when there is a wildfire advisory, staff can be encouraged to telework and the childcare center could be closed. These policies should be included in the organizations’ Standard Operating Procedure (SOP) documents. Policy development will involve senior DoC management and require coordination with Boulder’s Incident Management Team, a city/county hazard team certified by the Colorado Department of Public Safety.

Site Interventions

Several key site interventions are proposed to mitigate wildfire risk and improve campus resilience. These interventions focus on creating defensible space, managing vegetation, and implementing fire-resistant landscape design strategies. The following measures are recommended:

- **Fuel Reduction and Clearance:** Regularly remove dead trees, shrubs, and debris to reduce surface fuels. Thin the overgrown areas to create defensible space and limit fuel continuity.
- **Strategic Fire and Fuel Breaks:** Establish fire or fuel breaks along high-risk zones such as building perimeters and near natural fire corridors like Anderson Ditch and Skunk Creek. Use non-combustible materials (gravel, irrigated low ground covers or turf) in these breaks to prevent fire spread. Implement other wildfire mitigation landscape strategies such as:
 - **Wind Rows** – plantings to reduce wind that spread fire toward buildings
 - **Shaded Fuel Breaks** – separation of trees or other tall vegetation with lower plantings to help reduce spread of fire
 - **Lifting Tree Canopy** – removal of lower tree limbs and reduction of understory plantings that may create a “ladder effect” enabling fire to spread upward into the tree canopy.
 - **Vegetative Zone Management:** Implement a gradient of vegetative zones, with a native, low-flammability planting

Exhibit 29: Fire and Fuel Breaks



Marshall Fire Mitigation Assessment Team: Mitigation Strategies to Address Multi-Hazard Events, June 2023

zone along the campus perimeter. Introduce and maintain plant arrangements between buildings to reduce ladder fuels while enhancing ecological aesthetics.

- **Invasive Species Control:** Regularly remove invasive species, such as cheatgrass and thistle, that increase flammability and fuel loads. Replant these areas with fire-resistant, native species that support wildfire resilience.
- **Irrigation and Green Spaces:** Integrate and maintain green spaces near buildings to prevent build up of combustible vegetation. Consider the strategic placement of water sources to support fire response capabilities on-site.

These site interventions will be critical in reducing wildfire hazards, enhancing campus safety, and promoting the health and longevity of the surrounding natural landscape.

In addition to landscape and plant interventions, other site elements should be modified and/or protected. Outdoor structures such as tanks or connexes should be secured to ensure they don't move in high winds and interrupt escape or rescue routes. Tanks with flammable content should be protected and not be located near vulnerable areas. Clear routes to safety and shelter-in-place facilities should be marked and supported by informational, wayfinding and identification signage.

Shelter-in-Place Planning

The priority in case of wildfire is the evacuation of the campus and moving the staff and visitors to safety. As noted, there are constraints on the capacity for quick and easy evacuation—campus numbers of up to 2,000 people, limited campus exits, and one adjacent county road also fed by several surrounding residential areas. Prudent planning suggests that shelter-in-place locations be created, places on campus to which people can find refuge and accommodation until safe evacuation or rescue is possible.

Shelter-in-Place considerations and preliminary strategies are part of the Master Plan, to be augmented by NIST's detailed planning study. The detailed study must analyze and recommend solutions to these factors at a minimum:

- Immediate and longer-range solutions. The threat of wildfire is immediate, but implementation of shelters and physical improvements will take time. This Master Plan suggests two

locations in existing buildings that could potentially be modified into shelters—and outlines basic criteria to be included in the construction of the new buildings proposed in the Plan.

- **Duration for sheltering-in-place.** Designing and equipping a shelter will depend on the anticipated length of occupancy. Factors include mechanical and electrical (emergency power) services, per person space, supplies stored for eating and drinking, emergency equipment/supplies, and potentially sleeping. NIST discusses a minimum of one day and up to three.
- **Study of potential influence of the campus fire environment** including the topography, wind patterns, weather, and vegetation patterns.
- **Review and modifications to the Master Plan elements/suggestions.** The Master Plan suggestions for existing building accommodation and criteria for new construction are preliminary and not based on detailed analysis of engineering systems, architectural detailing, historical considerations (B1), or budget reality.
- **Development of policy and procedures,** as noted above.

System Recommendations

Building Hardening and Equipment Placement

To enhance fire resilience, exterior-mounted equipment should be protected using enclosures made of fire-resistant or noncombustible materials. For larger equipment, it is recommended to construct dedicated fire-resistant buildings following ignition-resistant construction standard. Smaller equipment and hazardous materials should be fully enclosed in prefabricated or custom-built fire-resistant enclosures. Creating defensible space around buildings and equipment is critical. Installing a concrete pad at the base or surrounding the equipment with a noncombustible wall can help minimize fire exposure. Exposed electrical components and conduits on riser poles should be shielded with metallic conduits or other fire-resistant materials, such as flashing, to reduce fire damage risks. HVAC systems should also be hardened against ember intrusion. Outside air inlet vents can allow embers and debris to enter, increasing ignition risks. To mitigate this, it is recommended to install ¼-inch metal screens on inlet vents and, where feasible, use noncombustible horizontal louvers to maintain airflow while allowing vents to be closed during wildfire events. Finally, emergency and mission-critical backup power

systems should be protected and maintained to ensure continuous operation throughout a wildfire event. Proper planning and fire-resistant design measures will help safeguard both equipment functionality and overall building resilience.

Filtration

Filtration plays a critical role in protecting the indoor air quality from smoke, ash, and other particulates during a shelter-in-place event. A minimum of MERV 13 filtration is recommended on all outdoor air intakes, and HEPA filtration is recommended when at risk populations may be present. Filters are expected to load rapidly with smoke particulate, so spare filters should be stored within the building to allow for potential replacement during a shelter-in-place event. Finally, when upgrading filtration within an existing air handling system, supply fan capacity will need to be evaluated to ensure the fans can still meet design airflows at an increased filter pressure drop.

Building Envelope

Materials and assemblies of buildings are critical to reducing wildfire risk. Roof assemblies are recommended to be Class A by ASTM for wildfire mitigation purposes, meaning they are achieving the highest rating of fire-resistance. These roofs can be constructed using noncombustible materials (such as metal, slate, or concrete tiles), fire retardant treated wood with appropriate underlayment, or composite asphalt shingles designed for high fire resistance. To achieve a Class A rating, the entire roof assembly—including covering, underlayment, and deck—must meet fire performance standards. Exterior walls are another consideration for building envelope and wildfire mitigation. Exterior wall envelopes should be tight to reduce air infiltration, and should favor fire-resistant and noncombustible materials including stucco, metal siding, fiber-cement siding, masonry, and concrete. Fire-resistant materials should be approved for a minimum fire-resistance rating of 1 hour.

Control Strategy

During a wildfire, HVAC system controls should be adjusted to minimize smoke infiltration and maintain indoor air quality. Outdoor air intake should be limited by reducing ventilation and disabling economizers and demand-controlled ventilation (DCV) systems. Where feasible, exhaust reductions should be implemented to maintain positive building pressure and prevent unfiltered smoke intrusion; however, complete ventilation shutdowns should be avoided to reduce the risk

of air infiltration due to wind and stack pressures. Adjustments to laboratory exhaust systems must be carefully coordinated with the Office of Safety, Health, and Environment (OSHE) to ensure safety compliance. Additionally, portable air cleaners (PACs) should be deployed in unobstructed locations with access to emergency-backed power receptacles to enhance filtration and protect indoor air quality. In non-shelter-in-place areas or where HVAC systems are not mission-critical, a phased shutdown approach should be used to limit HVAC system damage and reduce the need for on-site personnel prior to evacuation. Implementing remote shutdown capabilities for HVAC systems can further mitigate damage and enhance operational resilience during wildfire events.

Additional Considerations

Additional design and operational adjustments can be made to ensure preparedness for wildfire events. Shelter locations should have a system in place to monitor fine particulate matter (PM_{2.5}), ideally tied into a building automation system. The sensors should be placed in occupied areas, entryways, and outside the building. Additionally, installation of differential pressure monitors is recommended to ensure the building is positively pressurized relative to outdoors. Finally, a schedule for monitoring and replacement of air filters should be developed and implemented.

Dinosaur Fire, July 2024



<https://boulderreportinglab.org/2024/07/12/slow-moving-dinosaur-fire-burning-near-boulder-no-calls-for-residential-evacuations/>

Planned Shelters-in-Place

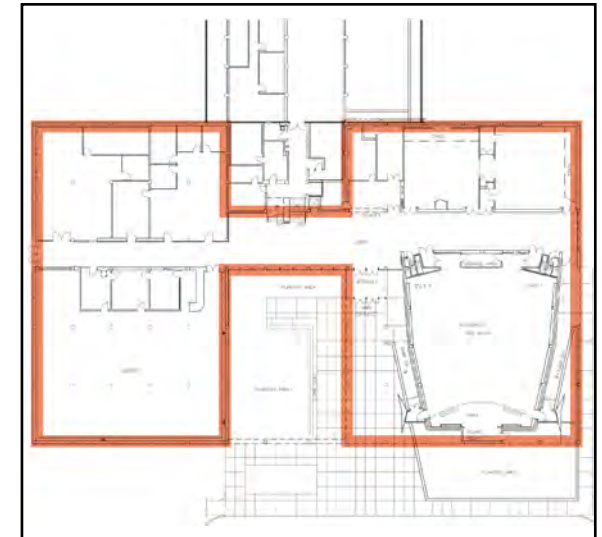
Shelter in Building 1

The conference center in the east end of Building 1 has the potential to be separated from the rest of the building to create a shelter, although with both system and architectural renovations. Building 1 has been determined eligible for listing in the National Register of Historic Places. Any modifications to create this shelter area will be governed by the National Historic Preservation Act, and in accord with the Secretary of the Interior's Standards for the Treatment of Historic Properties.

- **Access.** In addition to access through exterior doors, the space is connected internally to Building 1 circulation and further linked to Building 81.
- **Capacity.** The conference center has a 500-seat auditorium and two conference rooms totaling approximately 2,300 usf. Within the same designated area are a spacious lobby, the DoC library (4,500 usf) and an office space block (3,600 usf).
- **Facilities.** Toilet facilities are within the designated area but without the capacity for large crowds. Food and beverage facilities need to be added.
- The auditorium and lecture hall spaces of the conference center are currently served by their own dedicated air handling units (AHU1 & AHU2) that provide heating, cooling, and ventilation air. The current mechanical system zoning is advantageous because it allows for isolation of these spaces from other parts of the building during a wildfire event.
- The following design modifications are recommended to support the shelter-in-place areas within Building 1:
 - Harden the perimeter/roof and the separation between the conference center and other Building 1 areas. Determine whether the separation can occur at the open stair connection or must be within the B1 spine. If in the spine, hardening may be required through all floors to the roof.
 - Create restrooms, kitchenette and storage within the shelter perimeter; renovation of the existing office block is recommended. (The existing toilets may not be within the selected perimeter.)

- Remove planting within 5 feet of the building perimeter and replace with paving or other noncombustible material.
- Upgrade existing air handling unit filtration to MERV 13 or HEPA (preferred) and ensure air handler can account for increased pressure drop. The existing design drawings indicate a current filtration level of MERV 11, which is less efficient at capturing PM2.5, a significant component of wildfire smoke. Bipolar ionization should be installed in air handling unit to reduce particulates and mitigate odors.
- Install manual override switches to adjust HVAC controls within the shelter-in-place location.
- Install air quality monitors (PM2.5, CO2, CO) inside the shelter zone to optimize shelter-in-place operations, early detection of problems and protection of vulnerable populations.
- Prevent smoke from entering through exhaust paths by installing motorized dampers in return/exhaust air paths.
- Program controls to partially close outdoor air dampers, fully close return/exhaust dampers, disable demand control ventilation, and re-circulate prefiltered air during a shelter-in-place event while maintaining the occupied area positively pressurized to the outdoors.
- Connect dedicated air handlers to emergency power.
- Ensure generator and emergency electrical distribution are enclosed in fire-resistant enclosure.
- Assess electrical needs for lighting and power during a shelter-in-place event and revise circuiting as needed.

Exhibit 30: Building 1 Shelter-in-Place



Shelter in Building 81

Like Building 1, the conference center in the Gebbie Laboratory building is a discrete area that could be segregated from the laboratory areas of the building.

- Access. Access to the space is through the main doors on the south side. Although the conference center is a separate one-story space, it connects to the main building corridor and an appropriate separation would be required.
- Capacity. The conference center has five conference rooms, some connected, totaling approximately 2,600 usf. These rooms and related support spaces surround a spacious lobby.
- Facilities. Within the conference center are toilets, storage and a kitchenette.
- The following design modifications are recommended to support the shelter-in-place areas within Building 81:

Exhibit 31: Building 81 Shelter-in-Place



- Harden the perimeter/roof and the separation between the conference center and the B81 corridor and adjacent offices. If the shelter encompasses the adjacent corridor and offices, hardening may be required through all floors to the roof in this segment.
- Remove planting within 5 feet of the building perimeter and replace with non-combustible material,
- Install enhanced filtration for the dedicated air handler—preferably HEPA filters—and upgrade the air handler as needed to accommodate the increased pressure drop from higher-efficiency filtration. Bipolar ionization should be installed in the air handling unit to reduce particulates and mitigate odors.

- Add manual override switches to allow on-demand adjustment of HVAC controls within the designated shelter-in-place area.
- Install air quality monitors (PM2.5, CO2, CO) within the shelter zone to track indoor air conditions.
- Ensure the shelter-in-place zone is served by a dedicated air handler to provide independent control, filtration, and ventilation for the space.
- Prevent smoke intrusion through exhaust pathways by installing motorized dampers.
- Program controls to partially close outdoor air dampers, fully close return/exhaust dampers, disable demand control ventilation, and re-circulate prefiltered air during a shelter-in-place event while maintaining the occupied area positively pressurized to the outdoors.
- Connect the dedicated air handler to emergency power to maintain operation during power outages.
- If a central air handler must continue serving the shelter zone, ensure the zone can be isolated from other areas.
- Install smoke dampers to prevent airflow between interconnected zones.
- Add or upgrade motorized outdoor air dampers at the central air handling unit to enable full modulation of outdoor air intake during wildfire events.
- Consider installing a local recirculation fan with a high-efficiency filter inside the shelter zone to maintain slight positive pressure relative to adjacent space.
- Connect critical controls, such as dampers, to emergency power to ensure functionality during an outage.
- Ensure generator and emergency electrical distribution are enclosed in fire-resistant enclosure.
- Assess electrical needs for lighting and power during a shelter-in-place event and revise circuiting as needed.

Shelter in Planned New NIST Buildings

Creation of shelters in Buildings 1 and 81 will not provide quick access to all NIST staff in the center and west sides of the campus. Many of these buildings are planned for replacement in the Master Plan, and the following new buildings should be designed with shelter-in-place facilities.

- Childcare Center
- Management Resource Center
- Building 3 Addition
- Building B
- Modification within the existing CUP

Space allowance for these facilities is included in the program and NIST will require detailed drawings and specifications during the design process. These buildings and shelters should be constructed following the System Recommendations noted above. Preliminary design criteria for the new shelter areas include the following:

- New buildings should be designed so the shelter-in-place zone has its own dedicated air handling system. Air handler outdoor air intake should be located away from prevailing wind paths, exhausts paths, and loading docks in a protected location.
- Air handlers should be designed to incorporate MERV 13 filtration along with HEPA filter holding racks to allow for placement of HEPA filters during wildfire or other poor air quality events. Air handlers should also incorporate bipolar ionization to help reduce particulates and odors.
- Air handler and associated controls should be designed to positively pressurize the space to prevent smoke infiltration.
- Install combination fire/smoke dampers on ductwork penetrations serving the shelter in place areas.
- Ensure the mechanical systems and associated controllers are on emergency-backed power. Consider serving shelter-in-place areas with backup DX cooling and electric heating units in order to maintain comfortable space conditions when the central utility plant (CUP) is offline.
- Install manual override switches to adjust HVAC controls within shelter-in-place location.

- Include manual air-purge system for post-wildfire events to purge contaminated air and ensure continued safe operation of HVAC system.
 - Include fire-resistant generator enclosure and underground electrical distribution to designated shelter-in-place areas.
- Panel and distribution boards serving shelter-in-place area and associated equipment shall be isolated within the space.
- Provide dedicated technology room with emergency power to servers.
- Technology room shall serve dedicated data ports and wireless access points within the space.

Exhibit 32: Campus Shelter-in-Place Proposed Locations



Shelter in NOAA Building 33

NOAA personnel are expected to shelter in the main Building 33, which is owned and managed by GSA. NOAA and GSA must identify and modify space(s) within, following the general recommendations above and the *GSA Occupant Emergency Program Guide*.

Coordination with Boulder County and the City of Boulder

Much of Boulder County, including the DoC campus, is within a Wildfire Urban Interface, prone to wildfires because buildings meet or mix with wildland fuels such as the prairie grasses and pines. Both Boulder County and the City of Boulder provide resources and information on best practices to reduce the risk. The county's *Community Wildfire Protection Plan*¹ brings together state and local organizations to assess wildfire risk, prioritize protection measures, and provide information and recommendations. The 2024 plan presents strategies for fire-adapted communities, resilient landscape, risk-based programs and post-fire recovery by identifying specific projects with methodology, lead agencies and funding sources. The City of Boulder has a parallel document² that tailors the assessments and project recommendations to local areas within the city and immediate vicinity. Both documents include extensive links to resources, including local policy, codes/guidelines, grassland management mitigation strategies, evacuation and community preparedness.

1. Source: <https://assets.bouldercounty.gov/wp-content/uploads/2024/10/boulder-county-community-wildfire-protection-plan-2024.pdf>; accessed April 2025
2. Source: <https://bouldercolorado.gov/media/16866/download?inline=> Accessed April 2025



Exhibit 33: Concept - View from Rear of Property



4.5 Building Summary

Buildings Removed

Replacement of outdated and inadequate facilities will allow the removal of 16 buildings on the campus. The majority of these are small; 9 buildings are less than 4,000 GSF and another 4 are less than 10,000 GSF. Most of these small buildings would be removed when the Management Resources Center is constructed and occupied, including 7 buildings that were introduced as temporary buildings. The largest building to be demolished is the laboratory Building 2, which would be removed in phases as Research Building A is constructed. See the Buildings Removed exhibit for a list.

Replacement and removal of these buildings is central to the Master Plan, fulfilling these objectives:

- **Functional Efficiency.** Consolidation of administrative and support staff in one location rather than multiple buildings will improve coordination, supervision and collaboration, for more efficient operations. In parallel, duplication of support spaces will be minimized. For the laboratories, new buildings will provide more consistent and appropriate lab modules and eliminate layout irregularities that are the result of multiple additions to Buildings 2 and 24.
- **Environmental Control.** Existing laboratories are not capable of providing the controlled environments necessary for advanced research—temperature and humidity, vibration stability, air cleanliness and quality electrical power.
- **Energy and System Efficiency.** New and consolidated facilities will have modern mechanical, electrical and plumbing systems, replacing the multiple obsolete systems.
- **Campus Organization.** Removal of these scattered buildings supports the Master Plan's organizing principle of a central open green created by linked research buildings, and it removes the visual clutter of the existing campus.
- **Meeting agreements with the City of Boulder.** NIST has an agreement with the city that limits the square footage on the campus. To add the new Master Plan facilities, buildings must be removed to remain below the maximum allowable gross square footage.
- **Conex Removal.** Creation of efficient storage space with a structured shelving system would allow the consolidation of storage in various locations, including that stored in multiple shipping containers (Conexes) scattered across the campus.

Exhibit 34: Campus Buildings Removed

Buildings Removed		Built	GSF	Notes
Building 2	Laboratory	1951	70,829	Replace in new Research Building A
Building 2A	Laboratory	1989	2,880	Replace in new Research Building A
Building 1C	Lab Offices	1989	4,648	Consolidate w/ B1 renovation
Building 1D	Lab Offices	1992	3,456	Consolidate w/ B1 renovation
Building 3A	Offices	1989	2,160	Consolidate—new Management Resource Center
Buildings 4	Offices	1951	15,795	Consolidate—new Management Resource Center
Building 5	Offices, Lab	1951	3,149	Consolidate—new Management Resource Center
Building 21	Garage	1963	3,999	Consolidate—new Management Resource Center
Building 24	Plasma Physics	1967	32,773	Replace labs in Research Buildings & B3 Addition
Building 23	Hazardous Materials	1989	984	Replaced by Building 43
Building 25	Maintenance Shops	1966	8,306	Consolidate—new Management Resource Center
Building 25MI	Offices	—	525	Consolidate—new Management Resource Center
Building 26	Childcare	1989	7,776	Replace
Building 91	Offices	2008	3,561	Consolidate—new Management Resource Center
Building 111	Offices	2011	2,821	Consolidate—new Management Resource Center
Building 112	Maintenance/Storage	2011	5,795	Consolidate—new Management Resource Center
Removed Total (GSF)			169,457	

Exhibit 35: Campus Buildings and Space Added

Components Added	GSF	Notes
B1, Wing 4, Spine Renovation/addition	8,000	Space added with renovation -
Management Resources Center	60,000	Consolidates 10 Buildings
Research Building A	97,700	Replaces B2, B2A, part B24
Research Building B	35,000	Replaces NTIA labs from B1
Building 3 Lab Addition	27,600	Replaces labs in B24
Childcare Center Replacement	13,000	Replaces outdated, crowded facility
Security Center Addition-B51	1,500	Space added to existing
OFPM Storage Building	4,800	Modular
Coffee Bar and Guest Offices	4,600	Incorporated into above buildings
CUP Expansion	15,000	Tentative - depends on strategy
Shelter-in-Place Allowance	11,000	National Weather Service labs
NOAA Laboratory-B34 addition	32,600	National Weather Service labs
Added Total (GSF)	310,800	New Buildings & Additions

Exhibit 36: Campus Buildings Retained

Buildings Retained	Built	GSF	Notes
Building 1 Laboratory/office	1954	343,453	Radio Building; Renovation ongoing (see space added)
Building 3 Laboratory	2018	51,822	CTL Laboratory
Building 8 Laboratory	1953	2,400	Cryogenic Mesa Site
Building 11 Laboratory	1958	466	Ionospheric Observatory
Building 12 Laboratory	2010	1,446	Hydrogen Test Facility
Building 22 Warehouse	1964	17,530	Shipping/receiving; Storage
Building 27 Laboratory	1992	1,045	High Frequency Field Site
Building 33 Laboratory/office	1999	415,973	NOAA's main facility
Building 34 Laboratory	—	incl. above	NOAA lab w/ addition
Building 42 Utility	2005	45,844	Central Utility Plant
Building 43 HazMat	2025	1,200	Replaced Building 23
Building 51 Security	2006	1,470	Visitor screening (see Addition)
Building 81 Laboratory	2012	209,209	Katharine Blodgett Gebbie Laboratory
Building 92 Support	2018	4055	Computing Center
Concourse Support	2012	1,234	Connects Buildings 1 and 81
Retained Buildings Total (GSF)		1,097,147	Occupied Buildings and Concourse

Structures Retained	Installed	Notes
Building 1E Annex	—	Mechanical Equipment
Building 1F Annex	—	Mechanical Equipment
Building 9 Gas Meter (former)	1958	Water Pump Equipment
Building 41 Hi-Speed Switch	—	Electrical Equipment

Exhibit 37: Proposed Land Use

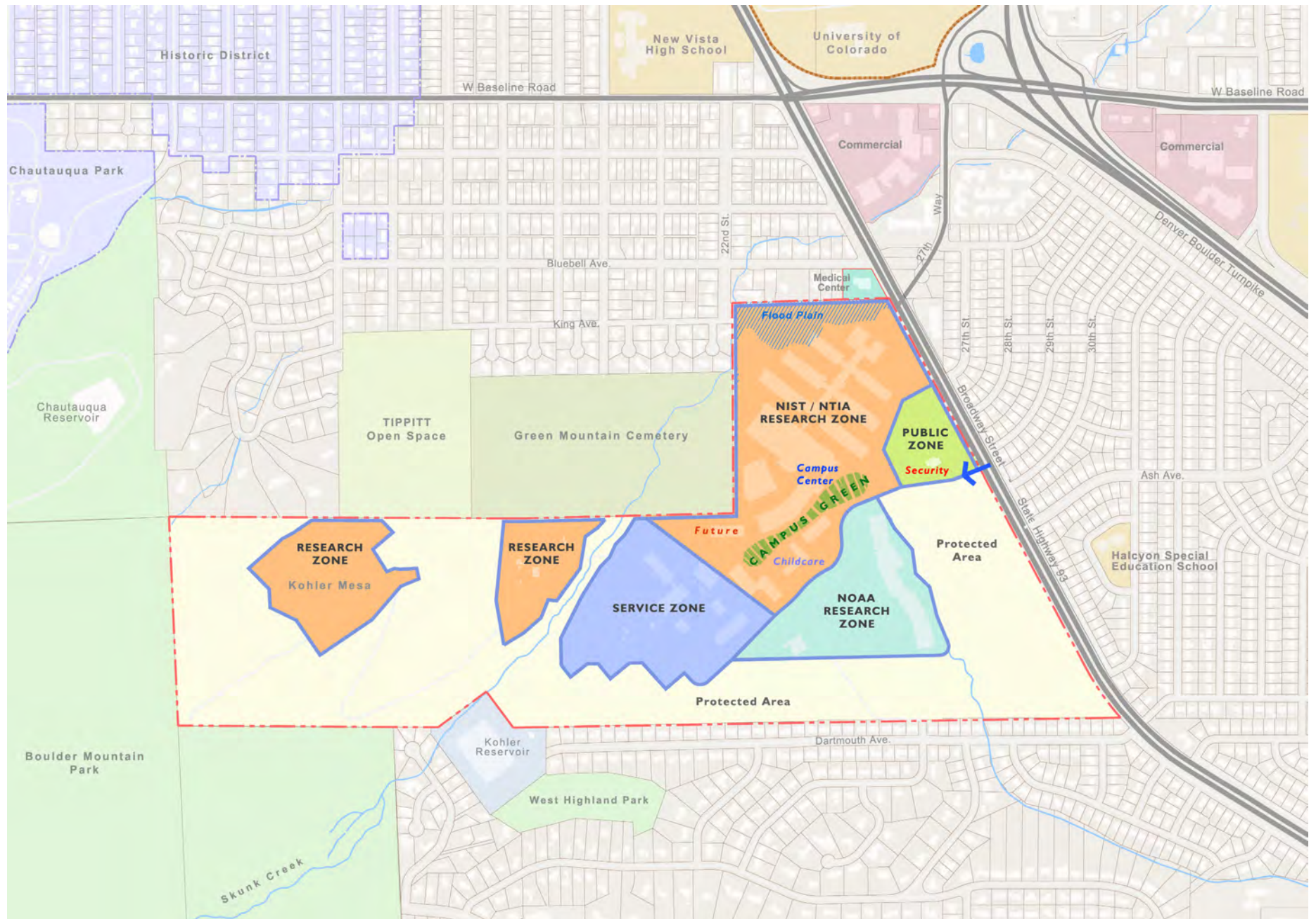


Exhibit 38: Building Change Summary

Building Number and Name		Existing GSF	Add	Subtract	Proposed GSF	Notes
	Radio Building	343,453	8,000		351,453	Renovation of Wing 5
	Annex	4,648		(4,648)	0	
	Annex	3,456		(3,456)	0	
	Cryogenic	70,829		(70,829)	0	
2A	Cryogenic Annex	2,880		(2,880)	0	
	Liquifier Building	51,822			51,822	
3A	EMSS Annex	2,160		(2,160)	0	
	Camco	15,795		(15,795)	0	
	Camco Annex	3,149		(3,149)	0	
	Cryogenic Mesa Test	2,400			2,400	
11	Ionospheric Observatory	466			466	
12	Hydrogen Test Facility	1,446			1,446	
21	Maintenance Garage	3,999		(3,999)	0	
22	Warehouse	17,530			17,530	
23	Hazardous Materials	984		(984)	0	
24	Plasma Physics	32,773		(32,723)	0	
25	Maintenance Shop	8,306		(8,306)	0	
25MI	Building 25 Annex	525		(525)	0	
26	Childcare Center	7,776		(7,776)	0	Replaced at GSA program
	New Childcare Center	0	13,000		13,000	
27	High Frequency Field Site	1,045			1,045	
42	Central Utility Plant	45,844	15,000		61	
43	New Hazardous Materials	1,200			1,200	

Building Number and Name		Existing GSF	Add	Subtract	Proposed GSF	Notes
51	Security Center	1,470	1,500		2,970	Expand for function
81	Gebbie Laboratory	209,209			209,209	286,674 w/interstitial
91	Construction Research	3,561		(3,561)	0	
92	Computing Facility	4,055			4,055	
111	Building 4 Annex	2,821		(2,821)	0	
112	Butler Building	5,795		(5,795)	0	
-	Concourse	1,234			1,234	
	New Management Resources Ctr.	0	60,000		60,000	Admin. & sppt. consolidation
	Building 3-Addition	0	27,600		27,600	POR + 3,000 GSF
	New Research Building A	0	97,700		97,700	POR
	New Research Building B	0	35,000		35,000	POR
	OFPM Storage Building	0	4,800		4,800	
	Hoteling / Guest Offices	0	1,600		1,600	Added to various bldgs.
	Coffee Bar/Collaboration	0	3,000		3,000	
	Shelter-in-Place Allowance	0	11,000		11,000	
NIST Total		850,631	278,200	(169,457)	959,374	
33	NOAA Skaggs Research Center	415,973			415,973	
34	NOAA Solar Observatory	included above	32,600		32,600	Expansion of existing
Site Total (GSF)		1,266,604	310,800	(169,457)	1,407,947	

Notes:

Table shows Buildings only.

Other named buildings are structures containing mechanical, electrical or plumbing equipment only:

1E Annex (mechanical equipment)

1F Annex (mechanical equipment)

9 Gas Meter Building (water pump equipment)

41 Hi-Speed Switch (electrical equipment)

Proposed parking structure



4.6 Master Plan Development

The 2025 Master Plan adopts the visual and function concepts of the 2017 Plan and modifies the layout to respond to current priorities, the interim construction of Building 92 and a planned new storage building and relocated hazmat building.

Four campus plan concepts were developed, exploring different variations on the existing Master Plan that meet the current goals and accommodate the future program. Each concept solved the same problems and accommodated the same functional elements, but in differing ways and different locations. The concepts were reviewed with a Department of Commerce working group composed of representatives of NOAA, NIST and NTIA. The approaches were evaluated against facility, functional and implementation factors, including the following: accommodation of research, support and staff activities; flexibility; energy and maintenance efficiency; campus character and image; and potential implementation costs. The concepts each included the same existing infrastructure and buildings.

Several elements were fixed elements in the concept development and incorporated into each concept.

- Research Buildings A and B, the Building 3 Addition, and their POR's .
- Hazmat replacement building, and the new OFPM storage building in its planned location.
- Consolidation of management resources and demolition of scattered temporary buildings.
- Replacement of the roadway in the campus center with a landscaped, pedestrian way.

What was in play was the location of Research Building B, Management Resource Center, and the Childcare Center. The connection of Research Building A to Building 81 was a master planning goal, and established in the POR. The extent and nature of the campus green and pedestrian links were explored with the building locations.

Exhibit 39: Linear Connection Concept



A. Linear Connection Concept

The linear concept closely follows the concept from the 2017 Master Plan, extending a landscaped pedestrian path from a visitor's pavilion in Building 1 through the campus to the support buildings up the hill. Outdoor amenities are localized to building clusters. Visitor parking is available in a new lot without vehicle screening, and visitors meet in a new pavilion at the Conference Center in Building 1. Plasma Physics Building 24 will be empty after construction of Research Building A and Building 3 Addition. It is repurposed into a childcare center, replacing the existing Center near Building 3. Research Building B is located on an existing parking lot, facing the linear campus green opposite Research Building A. Administrative offices and support shops are consolidated in a Management Resource Center building adjacent to existing support buildings.

Exhibit 40: Campus Core Concept



B. Campus Core Concept

The Campus Core concept highlights the center of the campus, responding to its greater density and increased activity with a central landscaped green with linked amenities. A meeting place is established at the junction of Building 81 and new Research Building A with the introduction of a coffee bar and plaza. This links to the conference facilities in Building 81, a place where visiting scientists already meet for campus tours and seminars. Plasma Physics Building 24 is demolished in the concept, and Research Building B is constructed close to this central spot. The administrative office component of Management Resources is separated from the shop component and located close to the new research buildings, on the site of the existing childcare center. A new Childcare Center is constructed on the parking lot west of existing B24. Similar to the Linear concept, there is a new visitor parking lot but there is no new visitor pavilion in B1.

Exhibit 41: Campus Green Concept



C. Campus Green Concept

This concept presents a more informal organization of the central campus open space, where landscaping welcomes arriving staff and visitors instead of buildings. The site of demolished Plasma Physics Building 24 is key to the development of the open green. The new research buildings are grouped together, linked for collaboration and efficiency, and conveniently located adjacent to the planned parking garage. The Childcare Center is accessed from Spine Road, but its play areas can become visually part of the informal open space. Outdoor amenities, walkways, and coffee bar seating can be organically integrated in the terrain. The western third of the occupied campus concentrates the administrative and support functions.

Exhibit 42: Campus Green Variation



D Campus Green Variation

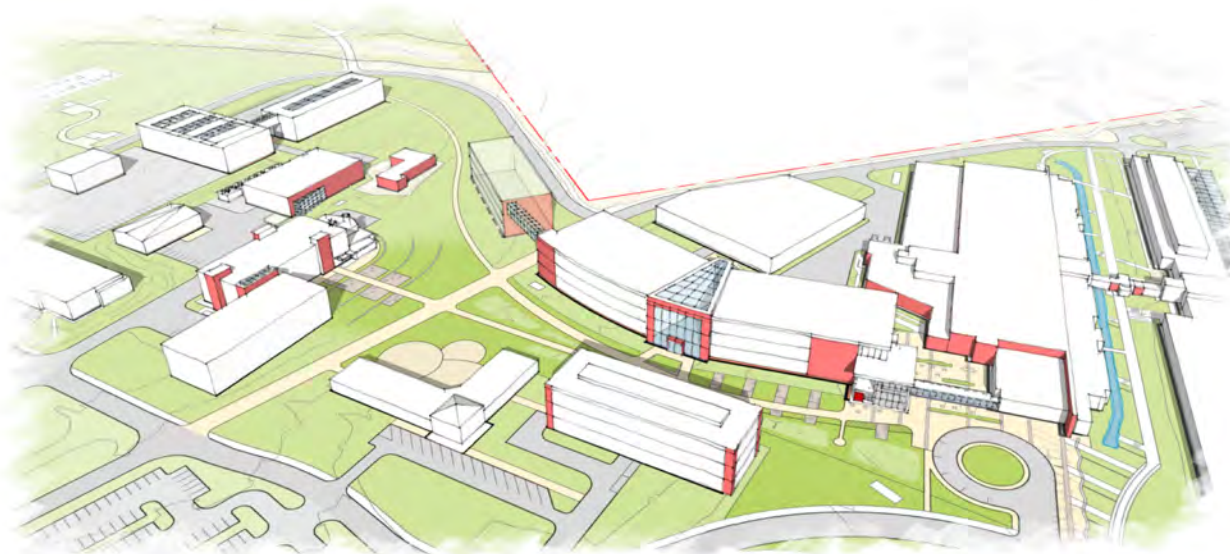
This variation assumes that NIST decides to retain Plasma Physics Building 24, or at least the original portion of the building. The other research and support facilities are the same as those in Concept C. The building could be completely renovated and adapted for the planned coffee bar, collaboration spaces and offices. Keeping B24 diminishes the idea of a large open landscapes area, but outdoor seating and landscape could still welcome arrivals.

Selected Alternative

The Master Plan approach was selected by the Space Review Board after review and recommendations from the Working Group. The final approach is based on Concept B Campus Core with minor variations. The Master Plan concept was developed further to coordinate architecture, infrastructure, landscaping, circulation and implementation strategy. In selecting the option, the Steering Committee agreed on these several considerations/advantages:

- Research Building A proximity to Building 81 and that building's extension through Building 1 – for encouraging collaboration and efficiency.
- Research Building B clustered near the other research buildings – for easy access and flexibility in the timing of construction.
- Demolition of Building 24 – recognizing that it would be very difficult and expensive to renovate and adapt to other uses.
- Creating a gathering place by Buildings 81 and A – enhancing the current use of Building 81 for tours and meetings, and the opportunity of incorporating a coffee bar into Research Building A, visually prominent and central to both NIST, NTIA, and NOAA buildings.
- A more central landscaped green – responding to goals of bringing people together and the considerations of maintenance and wildfire planning.
- Childcare Center relocated more centrally on campus – for easy parent access and greater convenience/safety in case of emergency or wildfire evacuation need.
- Consolidated Management Resource Center, with administrative offices, maintenance shops, garage, storage and their related staff – prioritizing collaboration, efficiency and sustainability approach. This includes the removal of multiple small and temporary buildings. The combined building was not proposed in the original Concept B but adopted from the other plan concepts as a preferred approach.
- Removal of central road – maintaining a vehicle loop that serves each building yet strengthens pedestrian links throughout.
- Campus entrance and screening improvements – correcting a congested and inefficient situation with new driveways, screening areas, parking, turnarounds, and signage.
- NOAA expansion of Building 34 – planning for the reuse and expansion of the under-used building.

Exhibit 43: Selected Alternative



Concept Grid

The Master Plan concept was developed to be the organizing element of the disorderly assemblage of facilities on the DoC Boulder Campus. While groups of buildings within the campus have geometric relationships, there is no overall organization or relationship between the eastern and western groups of buildings. The concept's campus green provides a unifying pedestrian zone within the core of the campus.

The Radio Building 1, fronting Broadway, is a highly structured research facility organized along a central spine with wings that create a rigid geometric grid of which Building 81 is the latest addition. As needs arose, other facilities were added to the campus and constructed as individual buildings arrayed on the slope to the west. While there appears to be no relationship between those structures, study reveals that they actually share a common underlying geometry—but not related to that of the Radio Building.

The challenge of the Master Plan was to bring unity to the entire campus by judicious location of new and replacement facilities so that the disparate geometries merge, connectivity is established, interaction is fostered, and new opportunities arise for members of the community.

Implementation of the concept is initiated as research buildings are replaced. The new major Research Building A assumes the geometry of the Radio Building 1 as it extends from The Katharine Blodgett Gebbie Laboratory, Building 81. The building assumes a gentle curve as it sweeps westward up the hill, bringing it into a dialog with the underlying grid of the independent buildings and resolving the clashing grids. As the buildings extend westward, their mass defines the northern edge of a new campus core and green for pedestrian activities. Building B and the Childcare Center follow and define the southern edge of the green.

Exhibit 44: Existing Site



Exhibit 45: Existing Site Geometry

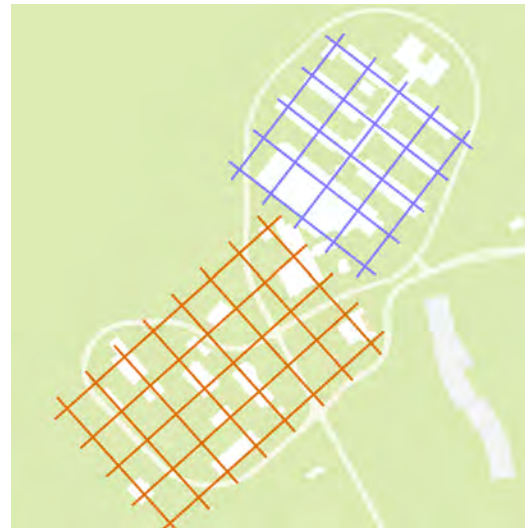


Exhibit 46: Master Plan Geometry





Landscape Master Plan

This Master Plan envisions a connected and integrated campus park that links existing buildings and new with a central pedestrian promenade and campus green. This linear arrangement links a series of outdoor spaces, both grand and intimate, that provide accessible connectivity, encourage social interaction and support highly functional green infrastructure. A unified palette of materials expressive of the local ecology and place establishes a visual identity that weaves through the entire campus.

5.1 Overall Approach: Reflecting a Sense of Place

One of the great assets of the NIST campus is the stunning backdrop of the Flatirons and the Rocky Mountain foothills. Instead of turning its back to this setting, this Master Plan embraces the best aspects of the place: the warm colors and rugged durability of the stone and trails; the room-like enclosures of clustered pines that open into wide expanses of grasslands, and the resiliency and beauty of the native vegetation. Embracing the materials and patterns of this landscape will not only result in a campus more visually integrated into its setting but also reduce some of the most time and resource intensive maintenance for the campus.

5



5.2 Major Design Features and Themes

The Campus Green and Central Promenade

One of the primary organizing elements of this Master Plan is the establishment of a pedestrian “greenway” within the central core of the campus. Serving as both a multi-modal corridor and a social spine, this feature integrates green infrastructure and a variety of outdoor gathering spaces along a linear pedestrian promenade; a singular, unifying gesture, that extends west from the main campus arrival plaza to the main entrance of Building 3. This promenade is flanked by complementary landscape typologies: on the north, structured plantings with orderly rows of trees and defined edges with comfortable places for social engagement offering shade and seating, while on the south, the landscape transitions to a naturalized meadow that supports surface stormwater conveyance and selectively placed native trees and shrubs to provide shade and visual screening. Together, they frame the view toward the distant mountains to the west, creating a layered and immersive visual experience evocative of the natural and urban landscapes of Boulder.

Along its length, the promenade accommodates a range of outdoor experiences—seating decks, overlook platforms, shade tree, ornamental plantings and terraced seating—designed to foster social interaction, inspiration, and reflection. While the promenade is dedicated to pedestrian use, it is intersected by a shared used path that provides access for emergency and service vehicles, preserving the promenade’s character as a pedestrian-first environment. Carefully selected surface materials and treatments clearly differentiate this space from conventional vehicular routes, emphasizing its role as a central civic and recreational spine. Cohesion across the promenade is reinforced through a unified palette of paving, furnishings, and expressive planting types, establishing the corridor as a signature feature of the campus landscape.

Example of a Central Promenade



Stockcake.com

Exhibit 47: Overall Landscape Master Plan



The Activated Campus

A key strategy of the Master Plan to activate the central promenade is to introduce a variety of outdoor spaces that encourage social engagement and recreational use for staff and visitors. At the eastern end of the promenade, a large paved plaza near Building 81 accommodates visitor drop-off and a welcoming point of arrival. With a new ground-floor coffee bar, moveable tables and chairs, raised metal planters with integrated wood seating and shade trees, the plaza also provides a comfortable, visually rich setting for outdoor dining and casual interaction. A covered walk between the coffee bar and Building 81 frames an inner plaza designed to serve the daily needs of campus staff—offering a relaxed environment for outdoor meetings, informal collaboration, lunch breaks, or quiet reflection. Together, these spaces form a vibrant and functional public realm that enriches the daily life of both visitors and employees.

Moving west along the promenade, an alley of shade trees lines the path, with wood deck seating areas for rest, conversation, and informal gatherings. The decks extend south of the promenade creating elevated overlooks with views toward the central meadow and offering opportunities to pause, take in views, and connect with the surrounding environment. At the main entrances to Research Buildings A and B and Building 3, generous terraces further activate the promenade by extending indoor functions outdoors—supporting social, recreational and alternative outdoor work space, while reinforcing the promenade’s role as a social and ecological spine through the campus.

Exhibit 48: Cross Section through Promenade at the New Coffee Bar and Central Meadow



Exhibit 49: Cross Section through Building 3 Terraced Plaza





At the west end of the promenade, a terraced plaza stepping down from Building 3, incorporates the site's natural topography with a series of terraces retained by boulders that create a more casual and inviting outdoor gathering space. Rows of trees provide shelter and shade with a variety of moveable chairs, tables, rockers and other furnishings to make the space feel welcoming and adaptable for different uses and different times of year. The varied spaces along the promenade offer a rich hierarchy of outdoor rooms, from open, public gathering areas to more intimate, secluded spots—encouraging daily use, interaction, and moments of rest and connections to nature.

Integrated Stormwater Management

The central meadow serves multiple purposes: it is an ecologically rich, visually striking landscape feature incorporating native plant species that provide habitat benefits to native animals and it also functions as a high-performance green infrastructure system. Stormwater runoff from surrounding buildings and paved areas will be directed toward the meadow, where it is slowed, filtered, and partially absorbed by the soil and plant roots with the remainder being conveyed to the underground storm system. The linear meadow will be graded with shallow basins and check dams to detain runoff where it is temporarily held and slowly released, enhancing water quality and reducing peak flows. The result is a multifunctional landscape that mimics the ecological performance of a natural wet meadow while also enhancing the visual identity of the promenade and overall user experience.

Example of a Wet Meadow



Pacific Forest Trust

Visitor Entry Landscape

The design of the NIST visitor entry plaza emphasizes a welcoming, functional, and visually cohesive arrival experience. Naturalized plantings frame the entry drive, guiding visitors toward a circular drop-off area that serves as the gateway to the campus. Traffic bollards discreetly define the vehicular route around the circle, ensuring pedestrian safety without disrupting flow. At the heart of the plaza, an open courtyard unfolds, featuring linear raised planters that organize the space with trees that provide deep shade and filtered sunlight depending on the time of year. Movable tables and chairs invite both visitors and staff to gather, relax, or work outdoors. Flanking the plaza are the new Research Building A and a small coffee bar, positioned to activate the space and provide everyday amenities for the campus community. A grove of shade trees offers comfort and scale, while distinctive paving materials differentiate the plaza from surrounding areas, reinforcing its identity as a civic threshold and social node. The design language for the corridor is a blend of two distinct but compatible themes. The first is the emphasis on contemporary design aesthetic that expresses the technological mission that is at the heart of the agency. The second is a naturalistic aesthetic for all the “soft” features of the campus that emphasizes the natural setting with ecologically functional plantings.

Contemporary Rustic Design Aesthetic

The first theme is based on an intentionally modern design aesthetic that incorporates materials with warm, weathered or rustic qualities. This aesthetic is visually compatible with the mountain setting that surrounds the campus. A contemporary design language reflects an aesthetic using bold structural forms; minimal detailing that emphasizes only the most essential connections, fittings, and unrefined materials. Detailing is minimal, forms are simple and lines are regulated but imprecise. Materials are close to their natural state with little or no refinement. Where possible, surfaces are unpainted and allowed to weather with only limited maintenance. Materials that are recycled or that can be recycled are incorporated where possible. Some examples of materials that meet these qualifications include: unit pavers in earthy and warm colors, cast-in-place concrete, asphalt, crushed stone, wood and weathering steel. This rugged palette of materials can be animated by the placement of some of the technological innovations of the campus featured and interpreted in the landscape, celebrating the achievements and mission of the agency.

Design Language - Contemporary Design Surrounded by a Naturalistic Context



Thomas Rainer



Ten Eyck Landscape Architects



PWP Landscape Architecture, Frank Farm, Flickr Creative Commons

Framed Naturalism

This concept is influenced by the need for the corridor to provide a serene, planted environment for the users and to reduce the use of resource-intensive lawn on the campus. Framed naturalism emphasizes use of low native grass plantings that are framed by paths, buildings, and lawn. Framing naturalistic vegetation helps it to appear neat and related to the campus context. For example, placing a mown lawn verge or a sidewalk against the edge of low grass makes it look more ordered and intentional. Informally arranged clusters of pines and cedars, low native grasses, and vegetated stormwater plantings are all important form-giving elements of the campus, providing a lush counterpart to the hard-edged built features.

Hardscape

The design language for the hardscape is inspired by the warm colors and rugged durability of the natural stone and trails that surround the site. A combination of natural materials such as stone, gravel and crushed stone combined with durable constructed materials like weathering steel, poured-in-place concrete, and unsealed asphalt all help to create a unified campus in harmony with its context. The use of materials and finishes that do not require frequent maintenance or repair is a priority. The rustic character will permit

a high degree of weathering and wear before elements appear neglected. Cast-in-place concrete structures can have a rough-hewn appearance depending on the type of form work and finishing applied. The irregularities that appear in the surface of the concrete are desirable in the rustic vernacular. This design language is further expressed in these principles:

1. Use maintainable, durable materials: Use cost-effective materials such as concrete with saw-cut joints, unit pavers, stone, crushed stone, and asphalt.
2. Use consistent colors and patterns: A consistent color palette of warm grays (in varying hues), browns, and rusticated steel provides a range of colors that are easily available across a range of materials.
3. Vary materials to express site hierarchy: Different hardscape materials can express the hierarchy of spaces and pedestrian circulation, integrating wayfinding into the design itself. For example, the central promenade may use unit pavers in with a strong graphic pattern such as stripes while sidewalks and other secondary circulation can use scored concrete.
4. Mix hard and soft materials to reduce scale of large, paved spaces: Break up large expanses of hard paved areas with crushed stone joints, edging, or seating areas.

Examples of Hardscape Materials



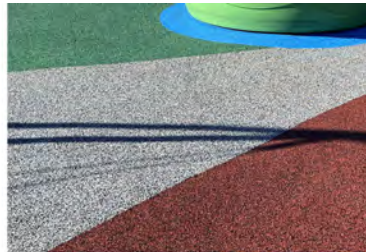
Two-Toned Integral Color/Patterned Concrete



Integral Color Scored/Stamped Concrete



Scored Concrete



Resilient Surfacing



Wood/Composite Deck



Stabilized Crushed Stone

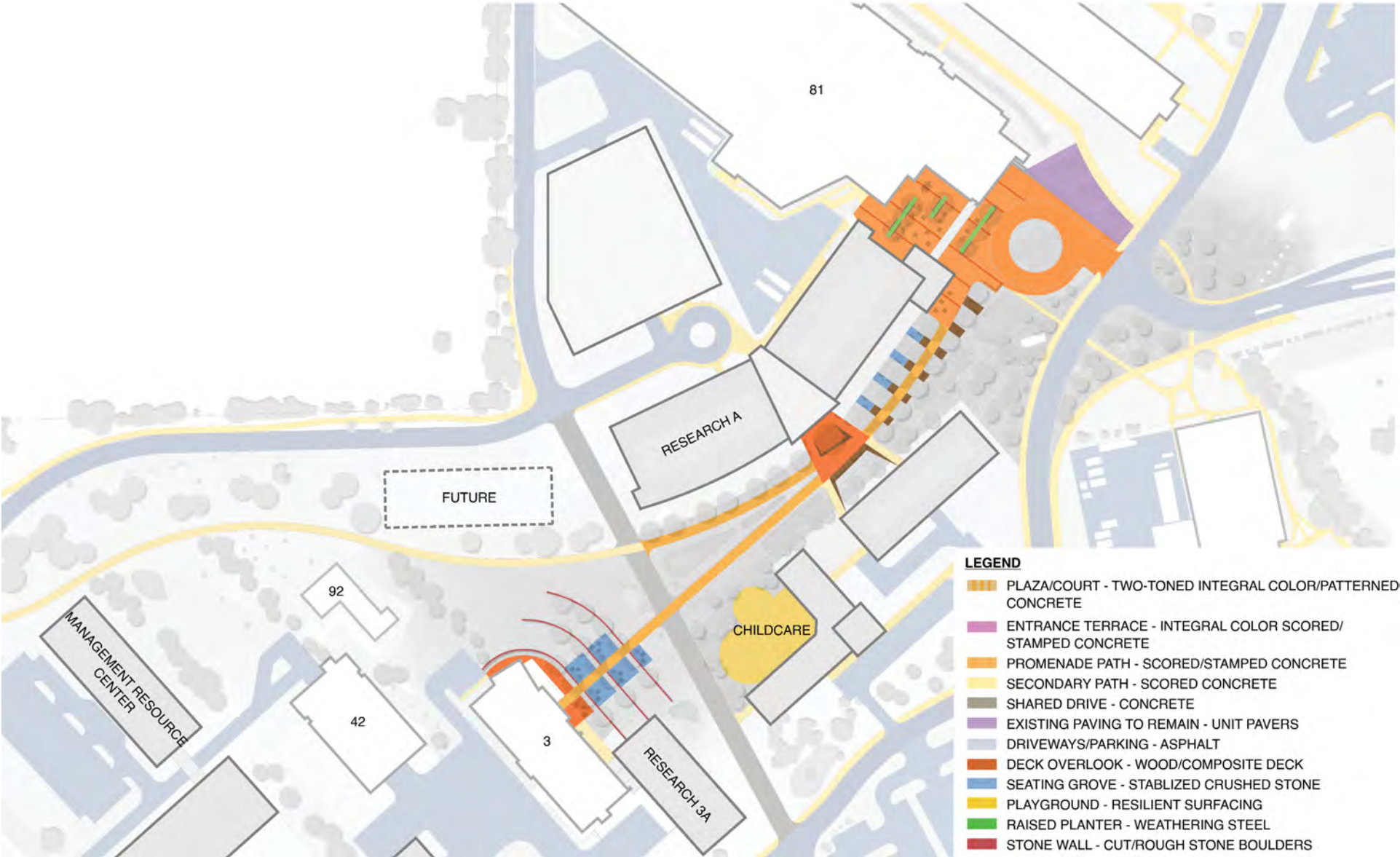


Weathering Steel Planters



Cut/Rough Stone Boulders

Exhibit 51: Hardscape - A Unified Palette of Simple, Durable Materials in Harmony with the Natural Setting



Site Architectural Elements

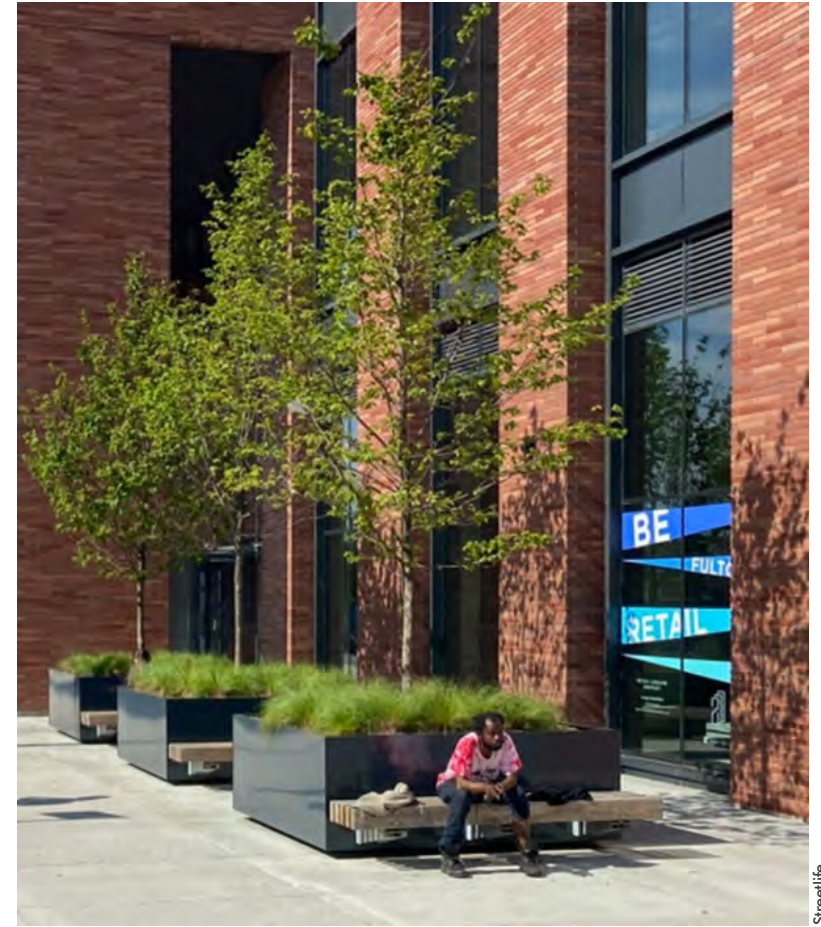
The repetition of distinctive small-scale landscape architectural elements throughout the campus helps establish a cohesive and memorable sense of place. Key features include wood deck seating areas that overlook the central meadow, creating informal thresholds between different site zones, and a continuous canopy of shade trees along the promenade that provides comfort and emphasizes primary circulation routes. Strategically placed trees and thoughtfully designed terraces offer natural shade and define gathering spaces without the need for temporary structures, which may be unsuitable in Colorado's high-wind conditions.

However, given the intensity of the sun in Colorado and the time it takes for newly planted trees to reach sufficient size, incorporating permanent shade structures is critical to facilitating the comfortable and consistent use of outdoor gathering spaces. In addition to trees, long-term shading can be provided through durable, low-maintenance structures such as metal shade canopies, pergolas, or louvered trellis systems. These permanent features offer year-round usability with significantly less ongoing upkeep compared to fabric-based options.

To ensure visual consistency across the site, all structural and vertical elements should share a common material language. Durable, regionally appropriate materials such as weathering steel, wood, and stone are recommended for their resilience and ability to blend seamlessly with the campus landscape.

Shaded Areas

Providing shade is an important consideration for activating public spaces



Streelife

Examples of Furnishings



Loft Designs



Rhodeside Harwell



Landscape Forms



Landscape Forms



Furnishings

Furnishings should follow the contemporary-rustic design aesthetic, with a focus on contemporary forms and bold sculptural elements. A mostly neutral color palette is recommended, (warm grays, earth tones), with selective use of a bright color accent. Durable materials including concrete, cast stone, and stainless steel should be used.

The recommended palette of site furnishings supports a range of functional and recreation uses. They should be used to create a dynamic and inviting outdoor environment that reinforce the hierarchy of social spaces. Flexible furniture shall be prioritized, including low walls that double as benches or moveable tables and chairs.

Lighting

The design of site lighting must address several key factors. First, lighting levels must be adequate to meet safety and security requirements, while meeting the highest and best sustainability requirements for light pollution reduction (LEED and federal requirements for Dark Skies and City of Boulder Outdoor Lighting Ordinance). Second, lighting fixtures must be energy-efficient and should require minimal maintenance. Finally, light fixtures should be compatible with the design language and should be integral to the family of site furnishings or be designed through the public art process.

Lighting Examples



Pedestrian Bollard



Traffic Bollard



Feature Light



Under Bench Light



Outdoor Power

Use the following types of lights and fixtures:

1. Utility lights: Existing campus pole lights for vehicular zones such as roads and loading docks.
2. Feature lights: Clustered arched poles with multiple fixtures can help to mark main plazas and entry court.
3. Bollard lights: Low-level pedestrian lighting that creates wayfinding along the pedestrian promenade.
4. Place-making lights: A range of different ambient lighting such as string lights in trees or bench lighting that activate outdoor gathering space.

Signage & Wayfinding

Many of the Master Plan's recommendations focus on clarifying the circulation on campus by providing centralized spaces, more direct connections, and a clear hierarchy of spaces and paths. All of these design elements will help pedestrians, drivers, and cyclists navigate the campus. In addition to the physical design itself, this plan recommends developing a cohesive wayfinding plan. Fully integrate signs with other disciplines, including architecture, interior design, lighting, landscape architecture, roadways and parking. Merge signage into the existing vocabulary of site materials and into the architecture and site itself, making signs present and readable, yet unobtrusive. Create designs that convey a positive visual image to all viewers and sense of identity for the campus. See NIST document "Signage and Wayfinding Design Standards and Guidelines," July 2021.

Examples of Signage and Wayfinding



Calori & Vanden Eynden, Flickr Creative Commons



Vincent Q, Flickr Creative Commons

Planting

The foothills surrounding the campus are predominantly characterized by Ponderosa Pine woodland and grassland ecosystems—landscapes that are not only resilient and adaptive, but also visually compelling and legible. The room-like quality created by loosely spaced tree clusters underplanted with sweeping golden grasses offers a model for human-scaled outdoor spaces and serves as an ideal inspiration for the campus landscape. This Master Plan proposes replacing much of the existing water-intensive lawn with drought-tolerant meadow grasses and clustered evergreens that reflect the character of Colorado's native woodland vegetation, while also supporting long-term sustainability and wildfire mitigation strategies.

Vegetation across the campus will be applied as a gradient from natural to cultivated, responding to the context of each zone. The Mesa and far site edges will be the most naturalistic, featuring native-only plantings and ecological management practices that preserve and restore local plant communities. Closer to buildings and major pedestrian routes, including the central promenade, the same native-based plant palette will be applied in a more stylish and structured manner. Along the promenade, this takes the form of a rich meadow planting integrated with stormwater management facilities, offering both ecological function and visual interest. Tree clusters are carefully spaced to maintain canopy separation and reduce fuel continuity—key principles in wildfire mitigation—while still providing shade, definition, and a sense of enclosure. Through these strategies, the landscape not only becomes more sustainable and adaptive, but also safer, more engaging, and more reflective of its regional identity.

Grasslands Planting at NCAR Campus



Thomas Reiner

Gradient of Vegetative Zones

A key principle of this Master Plan is the creation of a vegetative gradient that transitions seamlessly from the surrounding wild landscape to the more structured interior spaces of the campus. This approach enhances ecological cohesion, improves microclimate comfort, and incorporates wildfire and wind mitigation strategies into the overall site design. Three primary vegetative zones are proposed to reinforce this gradient while supporting defensible space planning and microclimate control.

At the perimeter of the campus, a Zone 3 wildfire-defensible area is proposed using predominantly native, drought-tolerant species. This outer zone functions as both a fuel break and a windbreak, utilizing widely spaced clusters of Ponderosa Pine and Rocky Mountain Juniper to slow wind speeds and reduce fire spread while providing screening for adjacent neighborhoods and parking lots. The structure of this vegetation helps break strong prevailing winds, common in the region, creating a more comfortable and protected campus interior.

Progressing inward, the landscape transitions into more structured zones between buildings. These areas serve as shaded fuel breaks, where tree canopy is retained for spatial definition and microclimate benefits, but the understory is managed to prevent ladder fuels. Plantings remain native and regionally appropriate, but are organized in a more formal layout to suit the campus context.

To successfully implement this gradient, the following planting guidelines are essential:

1. **Use a high percentage of visual essence species:** Dominant species from the regional woodland ecosystem—such as Ponderosa Pine and Rocky Mountain Juniper—should anchor the canopy layer. Understory planting should emphasize key native grasses including mountain brome (*Ceratochloa carinata*), needle and thread (*Hesperostipa comata*), green needlegrass (*Nassella viridula*), and mountain muhly (*Muhlenbergia montana*).
2. **Make natural patterns legible and structured:** To evoke the feel of surrounding woodlands in a designed context, plant native species in denser, more visible groupings. For example, where wild asters may appear sporadically in nature, clustering them into small masses strengthens their visual impact and clarity.

Exhibit 53: Planting Zones

Zone 1: Native



Where:

This plant community is typically found along the edges and large-scale open spaces on campus, where Ponderosa pines thrive in sunlit, well-drained areas.

What:

The Ponderosa Pine Woodland is characterized by widely spaced Ponderosa pines (*Pinus ponderosa*) with an understory of drought-tolerant native grasses, shrubs, and forbs.

Common native species include:

- Gambel oak (*Quercus gambelii*)
- Serviceberry (*Amelanchier alnifolia*)
- Blue grama (*Bouteloua gracilis*)
- Mountain mahogany (*Cercocarpus montanus*)
- Yucca (*Yucca glauca*)

How (Landscape Management & Fire Mitigation):

To preserve the stability of this plant community, the following techniques are used:

- Selective thinning of dense understory to prevent excessive competition and reduce fire risk
- Removal of invasive species that disrupt native plant dynamics
- Retention of native groundcover to prevent erosion and maintain soil health
- Use of evergreen windbreaks (e.g., native junipers or pines) on the windward side of open areas to reduce wind desiccation and slow fire spread
- Avoidance of "ladder fuels" by pruning lower branches and spacing shrubs away from tree canopies to prevent fire from climbing from ground to crown

Zone 2A: Naturalistic Meadow



Where:

Located within the central green the meadow defines the campus core and enhances the main pedestrian corridor, offering a welcoming, nature-rich views through the central open space.

What:

- Native grasses, sedges, perennials and wildflowers suited to local conditions with minimal maintenance
- The meadow mimics local plant communities, providing wildlife habitat and enhancing the visual landscape
- The plant selection attracts bees, butterflies, and other pollinators, improving campus biodiversity
- The meadow helps absorb and filter rainwater, reducing stormwater runoff.
- Pedestrians can enjoy a dynamic, sensory-rich environment as they walk through or beside the meadow.

How (Landscape Management & Fire Mitigation):

- Functions as a shaded fuel break using low-growing, widely spaced vegetation and deciduous trees to slow fire spread
- Open layout avoids dense plantings and ladder fuels, reducing vertical and horizontal fire risk
- Seasonal mowing and drought-tolerant groundcover maintain safe vegetation heights during fire season
- Bioretention design supports stormwater capture and filtration while reinforcing ecological performance and fire resilience

Zone 2B: Naturalistic Trees and Shrubs



Where:

Located at the edge of the central green and along the entry driveway, these landscapes create a welcoming, ecologically mindful entry experience serving critical environmental functions and providing shade, wind protection and visual screening

What:

A mix of

- Native and adapted tree and shrubs suited to local conditions with minimal care
- Naturalized design that reflects regional plant communities for habitat and visual appeal
- Evergreen and deciduous trees for shade and seasonal interest
- Woody and herbaceous shrubs that provide seasonal interest, screening and wildlife habitat.
- Grasses, sedges, and wildflowers that support pollinators

How (Landscape Management & Fire Mitigation):

- These areas act as shaded fuel breaks, using low-growing, well-spaced vegetation and deciduous trees to slow fire spread and protect key infrastructure
- Natural design avoids dense growth and ladder fuels, improving fire resilience while keeping the landscape open and attractive
- Fuel break zones are maintained with wide plant spacing to limit fire movement
- Low-maintenance groundcover and seasonal mowing keep vegetation at safe heights during fire season
- Deciduous trees provide shade and reduce heat near buildings without increasing fire risk

Zone 3: Structured and Ornamental



Where:

Located in central gathering areas, terraces, and courtyards between buildings, these landscapes create defined, welcoming outdoor spaces for socializing, studying, and relaxing.

What:

A composition of native and adapted plants arranged in formal, structured patterns to reflect the architectural rhythm of adjacent buildings.

Key elements include:

- Deciduous shade trees placed intentionally for comfort and energy efficiency
- Low-growing perennials and grasses that offer color and texture within a clean, ordered framework
- Hardscape elements (paving, walls, seating) integrated with planting design to reinforce spatial organization

How (Landscape Management & Fire Mitigation):

- Medium maintenance approach focused on preserving clear design gestures, including pruning, seasonal cleanup, and replanting to maintain structure
- Deciduous shade trees reduce ambient heat and are strategically spaced to avoid ladder fuels and crown continuity
- Structured planting beds with mulched groundcover and low-flammability species create buffer zones within dense campus areas
- Hardscape edges and plazas act as built-in fuel breaks, limiting the spread of fire and enhancing safety near buildings
- Regular debris management (e.g., removal of dry leaves and pruning waste) supports fire-resilient upkeep



3. Control height and spacing for safety and visibility:

Maintaining grasses at 18"–36" ensures plantings remain legible, accessible, and safe. Trees should be pruned to eliminate ladder fuels and maintain vertical separation from ground-level vegetation. Spacing of tree canopies and the use of lower, wind-resistant understory species supports both fire safety and effective wind buffering.

Through this layered approach, the campus landscape becomes multifunctional, supporting biodiversity, enhancing the user experience, and increasing resistance to wildfire and harsh environmental conditions such as high wind.

Structured and Ornamental Planting Zones

In plazas, terraces, and other high-use areas near buildings, planting design becomes more structured and ornamental while still drawing from native ecosystems for inspiration. These zones balance aesthetics, ecological function, and wildfire resilience. A carefully spaced grid of deciduous trees—such as hackberry (*Celtis occidentalis*), honey locust (*Gleditsia triacanthos*), select maples (*Acer* spp.), bur oak (*Quercus macrocarpa*), or western river birch (*Betula occidentalis* var. *fontinalis*, where irrigation is feasible)—can provide shade, seasonal interest, and a strong architectural relationship to adjacent courtyards and building forms.

In keeping with wildfire mitigation principles, tree canopies are spaced to avoid crown-to-crown continuity, and lower branches are pruned to reduce ladder fuels. Understory plantings use low-growing grasses (18–36 inches) and a carefully curated mix of ornamental native wildflowers to create a refined yet ecologically grounded ground plane. Species from genera such as *Aster*, *Penstemon*, *Liatris*, *Echinacea*, *Monarda*, and *Helianthus* are appropriate here, offering vibrant seasonal color, pollinator habitat, and resilience in Colorado's climate.

Although more stylized than the naturalistic outer zones, these structured planting areas remain part of the broader vegetative gradient—visually linking the built environment to the surrounding landscape while maintaining defensible space through thoughtful species selection, spacing, and maintenance strategies.

Care and Maintenance of Ash Trees

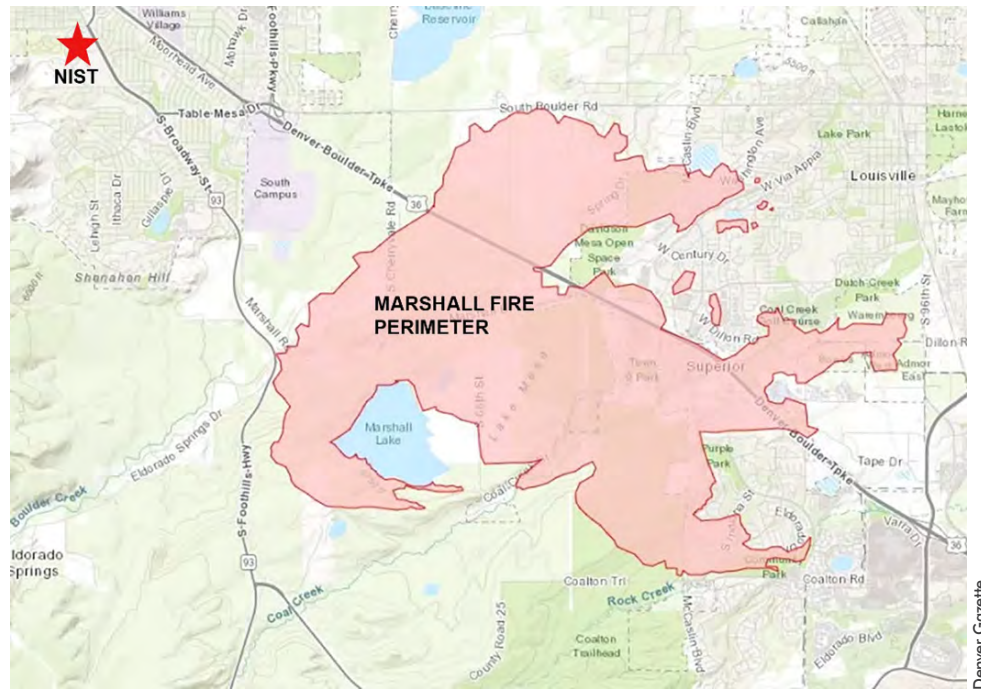
The normally prescribed method of protecting the ash tree from Emerald Ash Borers (EAB) is the application of a chemical insecticide. There are four methods of application: soil injection, trunk injection, lower trunk spray, and spray that encompasses trunk, branches, and foliage. While these methods provide prevention of EAB invasion, it is only on a temporary basis and dependent on vigorous tree health before application. Insecticide will have to be repeatedly applied to prolong protection from the invasion of EAB. The repeated and continuous application of chemical insecticide into the surrounding soil, and sprayed into the air around the tree can have detrimental effects to the neighboring environment. For these reasons, the best method of preserving the deciduous tree population on NIST Boulder's campus is diversifying the canopy. Over time, ash trees should be removed and replaced. Other native deciduous species like Narrowleaf and Plains Cottonwood, Balsam Poplar, and Peachleaf Willow should be introduced to the site to maintain deciduous foliage should the ash trees become invaded by EAB.

Ash Trees Around the NIST Campus



Thomas Rainer

Marshall Fire, December 30, 2021



Denver Gazette



<https://www.youtube.com/watch?v=Na1nJ25e7fA>

Landscape Wildfire Mitigation

Because of the increasing frequency and intensity of wildfires in the Boulder area, the Department of Commerce (DoC) has conducted a Wildfire Mitigation Assessment to evaluate strategies for reducing the risk of wildfire impacts on its facilities. The primary objectives of this assessment are to protect lives, safeguard mission-critical operations, and prevent the loss of equipment and valuable research in the event of a wildfire.

While many of the highest-priority recommendations focus on communication systems, emergency response protocols, and improvements to building safety and sheltering, the assessment also outlines important campus-wide and landscape-specific strategies. These include enhancing internal capacity by developing in-house expertise to lead and maintain a Campus Wildfire Protection Plan, reducing vegetation and structural fuel loads, and improving egress infrastructure to support safe and efficient evacuation during emergencies.

Key landscape-related wildfire mitigation strategies to be incorporated into the Master Plan include:

- Ongoing monitoring and proactive maintenance to reduce combustible materials, such as deadwood and overgrown vegetation, particularly near buildings;
- Establishment of defensible space zones around structures and high-use areas, with specific planting and maintenance guidelines to limit the accumulation of flammable vegetation;
- Design and management practices that introduce natural breaks between plant layers to slow or interrupt fire spread;
- Strategic planting that serves as a buffer against wind-driven fire, especially along the edges of campus and prevailing wind corridors;
- A curated plant list that prioritizes fire-resilient species and avoids highly flammable vegetation; and
- Enhanced and clearly defined pedestrian egress routes that improve safety and access during emergency evacuations.

Together, these recommendations will guide the integration of wildfire resilience into the landscape design and long-term management of the campus environment.



Utility Framework

6

The Central Utility Plant (CUP) provides chilled water, steam and compressed air to most of NIST's laboratory buildings, distributed through a tunnel system running from the CUP to mid-Building 1, with services branching off the individual buildings. These systems are in good condition and will be extended to the new and renovated NIST laboratory buildings in the Master Plan. The Childcare Center may be provided with dedicated heating and cooling systems independent of the campus systems or alternately connected to the campus steam and chilled water. Certain other planned buildings—NOAA Laboratory and the Security Center—are not near the CUP or utility tunnel and should be provided with dedicated independent heating and cooling systems. Normal electrical power and data communications services should be extended from the campus distribution systems. Note that NOAA buildings do not use the services of the CUP.

6.1 Renovations

Building 1

Building 1, the largest building on campus, will remain in its current form and function under the Master Plan. Complete renovation is planned for Wings 1, 2, and 4 and the spine. At present some wings are undergoing some level of construction activities, but a review of the available documents indicates that there is not an overall utility infrastructure plan guiding the various renovation efforts. A plan should be developed that clearly outlines the approach to provide primary utilities, including steam and chilled water, from the central plant and their distribution within Building 1 complex. Similarly, common systems such as heating hot water system and process cooling water system, should have a consistent plan for generation and distribution within the building. The main mechanical room in the basement, coupled with the spine for distribution to the individual wings, would be a logical approach to generation and distribution of key common utilities. Air handling systems should be dedicated to each wing as currently done in Wings 3 and 6.

The existing electrical distribution systems in areas not under renovation are antiquated and at the end of their service lives. Continued reliable operation of both the liquid-filled medium voltage distribution transformers and the low voltage switchgears will be challenging due to the unavailability of spare parts. Also,

emergency back-up power is not readily available in these wings to support the state-of-the-art research facility expectations defined by NIST laboratory classifications. As part of the overall plan for the Building 1 renovation, replacement and upgrade of normal and standby power system should be prioritized.

Renovation of the building should also include the complete installation of fire sprinklers throughout all areas. The renovations of Wings 3, 6, and 5 include a separate fire and domestic water service to each wing. This is a reasonable approach and should be carried forward in future renovations. Replacement of existing sewage ejectors that handle the lower levels of the wings is also suggested, as the older systems are near the end of their useful life. All domestic water and lab water supply piping has been modified many times and any new renovation should include complete replacement of the piping in the renovation area. The same is true for sanitary and lab waste piping. A new sanitary lateral should exit the building at each wing and tie into the site sanitary sewer system. Separate metering of all utilities to the building at each wing will provide an opportunity to monitor and fine tune efficiencies and consumption.

Building 3

Building 3 was renovated in 2017 and a new Program of Requirements has been completed for a Building 3 addition. The building is served with steam and chilled water from the CUP, with electrical power provided from the campus distribution system. Steam, chilled water and electrical power (normal and standby power) should be extended from the existing campus distribution system to serve the new addition. The addition should be provided with dedicated air handling systems, and power and data distribution to support the program. The POR for the addition proposed that some utilities from Building 3 be extended to support the addition.

6.2 New Buildings

New Research Buildings (Research Buildings A and B)

The new research buildings should be provided with steam and chilled water service from the utility tunnel. Normal electrical power and data communication services should be extended from the campus distribution system. Standby power should be provided via local dedicated diesel generators. NIST has developed design criteria and environmental controls for laboratories by designated type, which must be followed when planning and designing the new labs. These criteria should be used for planning of laboratory spaces and utility distribution. Primary mechanical, electrical and plumbing equipment should be sized and arranged with redundancy such that if any major equipment fails or is out of service, the remaining equipment can support the laboratory demands without compromising function.

Modular layout and distribution should account for long-term flexibility allowing easy accommodation of changes in use within the same laboratory types. Laboratories should be zoned for energy and operational efficiency such that lighter duty labs that may use recirculating air systems are grouped together. Similarly, chemical and fume hood intensive laboratories requiring 100% outside air systems should be zoned together. Hybrid air/water cooling systems (such as chilled beams) should be considered for equipment and instrument intensive laboratories. Special attention should be provided in the electrical distribution system with regard to power quality. Piped utilities such as compressed air, vacuum, high purity water distribution should generally follow the modular arrangement to maximize flexibility. Special laboratory gases may be provided by local sources such as generators or cylinders with local distribution.

Prior to construction of new laboratory buildings to the west of Building 81, a portion of Building 2 will need to be demolished leaving the northernmost section of the building (1964 construction) to remain for continued occupancy. The existing mechanical (steam and chilled water) utility entrance from the main tunnel will be impacted by the portion of the building that needs to be demolished. Further, the primary air handling system along with electrical service serving the 1964 construction is located in the penthouse mechanical room, in the portion of the building to be demolished. Therefore, temporary dedicated mechanical, plumbing and electrical systems need to be provided for the 1964 area of Building 2 prior to demolition. This will allow continued operation of existing functions in the 1964 area.

In addition, prior to construction of the new laboratories, site electrical duct banks and manholes and communication duct banks in this area should be re-routed to clear the proposed footprint of the new laboratory buildings. After completion of the laboratory buildings, it is planned that the remaining section (1964 area) of Building 2 will be vacated and demolished. A detailed phasing plan is proposed in the Building A POR.

Building 24

Existing Building 24 is served by the central plant steam and chilled water systems. The primary pumping systems and heat exchangers are in poor condition. Two of the three air handling units serving the building, located in the basement mechanical room, have also exceeded their useful life. A third air handling unit located in the penthouse mechanical room appears to be a more recent installation and may be evaluated for re-use if functionally feasible. The main electrical room is located in the basement of Building 24. There are two separate electrical services, one active and one abandoned. The medium voltage transformer and low voltage switchgear are beyond their useful service life. The plumbing systems are largely comprised of the original equipment and piping and have little residual value. The existing building is not fully sprinklered.

Building 24 is planned for demolition in the 2025 Master Plan. If this plan is changed and the building is kept for reuse, it should be provided with properly sized upgraded services from the campus utility distribution system for steam, chilled water, power, data, water and sewer. New air handling systems should be provided and zoned to match the various functional requirements. New service transformers, switchgear and power distribution system should be provided along with a new generator for life safety loads. All engineering systems must be evaluated and integrated with the architectural systems to achieve a goal of LEED Gold Certification.

Management Resources Center

The Management Resources Center, with its office and support functions, has the potential to be a very energy efficient building—net zero energy consumption, certified LEED Gold or higher and meeting a maximum Energy Use Index of 25 kBtu/sf-yr. Considering that this building replaces several aged and inefficient buildings with equipment efficiencies that are well below modern standards, a high performing modern building will result in significant net energy and cost savings to NIST. The inclusion of computer backup facilities in the building, which is under consideration, may make the net-zero goal difficult or impractical.

The building may be provided with dedicated heating and cooling systems independent of the campus systems or alternately connected to the campus steam and chilled water system because of its planned proximity to the CUP. Standby power should be provided via a local dedicated diesel generator. Prior to construction of this building, the existing electrical duct bank and manholes should be relocated/re-routed to clear the proposed footprint of the new building.

Childcare Center

As a part of the Master Plan, the current Childcare Center will be relocated into a new building that is more centrally located on campus. The new location is adjacent to the CUP utility tunnel pathway, enabling it to be interconnected to the CUP. Alternatively, the building could be provided with standalone heating and cooling systems. This building will be designed with the intent of being net-zero energy by employing high performance design practices to optimize energy efficiency coupled with solar photovoltaics. Photovoltaic inverters will need to incorporate electromagnetic shielding as to not affect sensitive equipment in adjacent labs. Emergency loads shall be served from an inverter system dedicated to the Childcare Center; the inverter shall be capable of a minimum of 90-minutes of run-time.

6.3 Central Utility Plant (CUP)

Under the Master Plan, the following buildings are proposed to be connected to the central plant steam and chilled water system:

Exhibit 54: Connections to the CUP

Building	Steam	Chilled Water
Building 1	X	X
Building 3	X	X
Building 42	X	X
Building 81	X	X
Building 92	X	X
Management Resources Center	X	X
Replacement Laboratories (Research Buildings A and B)	X	X
Childcare Center	X	X
Building 3 Addition	X	X

Based on conceptually estimated heating and cooling loads (approximately 5,800 tons of chilled water and 81,500 PPH of steam), the central plant has the capacity to support the existing and new buildings proposed under the Master Plan at a reduced level of equipment redundancy. This is based on the assumption that the chilled water system is capable of producing the design output of 1,500 tons per chiller (6,000 tons total for the plant) through implementing measures to address the low delta-T system described further below. The existing CUP is also anticipated to meet the campus's future steam demand with a current steam capacity of 93,000 PPH utilizing three 900 BHP boilers. This is based on the assumption that HVAC systems for new and renovated buildings will be provided with sustainable features such as exhaust air energy recovery and decoupled ventilation/cooling, as outlined in NIST's building design guidelines.

In addition, as part of the construction of new buildings and parking structures, roof-mounted photovoltaic systems integrated with the building power system should be considered.

During the City of Boulder's maintenance on one of the campus feeds, it was recently observed that the water supply to the CUP was inadequate. The inadequate water supply to the CUP is potentially related to tuberculation of the main water distribution loop. In addition to lining all existing pipes, it is recommended that a second

water supply to the CUP be constructed/connected in the Building 3 vicinity from the opposite side of the existing connection to the distribution loop. Lining the existing pipes should start with the main water distribution loop as discussed in the “Campus Domestic Water Systems” section of this report.

6.4 Mechanical System Issues

The condition of mechanical system infrastructure varies greatly across the campus, depending on the buildings’ ages and the renovations that have taken place. NIST’s 2023.09.23 NIST 5 YR Mechanical Plan Boulder CO v1 FY23 provides a detailed summary of equipment replacement and maintenance projects that are planned for the CUP and buildings.

A key priority identified by NIST’s Office of Facilities and Property Management (OFPM) is decoupling each building from the campus chilled water loop, utilizing heat exchangers and separate CHW loops within each building. The campus experiences an average chilled water system temperature differential of 8° F, which is lower than designed and referred to as low delta-T syndrome. This results in a significant energy penalty and the need to run all four chilled water pumps during peak cooling conditions with no redundancy. Decoupling the buildings from the campus loop will allow buildings to maintain flow of chilled water when the CUP pumps are down. Although the building water loop will warm over time without chilled water supply from the CUP, this strategy will maintain partial cooling for critical spaces and equipment during short CUP outages. Additionally, decoupling the buildings from the CUP will address the high chilled water pressure issues observed in B81.

Addressing the low delta-T system will require a close review of each building connected to the CUP. Recommendations to address the low delta-T syndrome include:

- Clean fouled cooling coils: Fouling or debris buildup on the airside of the cooling coil can act as insulation, reducing heat transfer efficiency and lowering delta-T.
- Ensure proper coil and valve sizing: Undersized coils or control valves may be unable to transfer the required heat load, limiting cooling capacity and contributing to low delta-T.
- Avoid oversizing control valves: Oversized control valves may struggle to modulate flow accurately, leading to inconsistent

cooling and temperature swings, which can lower system efficiency.

- Eliminate unnecessary three-way valves: A three-way valve located at the coil or in the building chilled water loop can divert chilled water from supply directly to return, bypassing coils and reducing chilled water return temperatures.
- Install control valves on process equipment: Process equipment connected to the chilled water system without a control valve can allow uncontrolled chilled water flow during low-load or shut-down periods, reducing delta-T by short-circuiting chilled water.
- Close unnecessary chilled water bypass lines: A chilled water bypass line that allows continuous chilled water flow from supply to return without passing through loads can dilute return temperatures and lower delta-T.
- Maintain control valves in good working order: A failed or malfunctioning control valve stuck open, closed, or unable to modulate properly can prevent the system from meeting cooling demand, reducing delta-T.
- Verify accurate sensor operation: Faulty temperature sensors can send incorrect signals to control valves, leading to overcooling or undercooling and contributing to low delta-T.

The CUP boilers are also nearing their end of life and are recommended for replacement in Fiscal Year 2028. The existing boilers have experienced issues with tubes cracking. A smaller capacity boiler should be installed to handle the summer load, to avoid potential damage to the larger boilers when operating them at the significantly reduced summer load. The smaller boiler could also be utilized for backup during other seasons if a larger boiler is down.

Steam and chilled water submeters should be installed for each building served by the CUP for monitoring and trending purposes.

6.5 NIST/NTIA Electrical Power

The total built area under the Master Plan is approximately 1,404,947 GSF (including NOAA buildings, which are on a separate system). For the NIST/NTIA system, approximately 680,000 gross square feet of existing buildings are retained and 309,000 gross square feet of new building/additions are planned. Current peak

Exhibit 55: Proposed Electrical and Data Distribution



demand of 5462 kW (6,828 kVA) registered in July 2016 translates to about 7.7 VA/sf. This number appears to be low compared to industry benchmarks for comparable campuses. For planning purposes, we have assumed load densities based on building occupancy type and whether or not the facility is CUP interconnected for mechanical loads.

This results in a projected campus connected load of 16,006 kVA (16.0 MVA). The campus is provided with two primary medium voltage feeders, each rated for 11 MVA. Estimated loads are often significantly higher than actual metered loads, do not account for diversity and the load shall be monitored as buildings are brought online. Over the course of adding new facilities, it will be critical to coordinate (2) additional redundant utility feeds to support the final electrical load. Utility planning can take several years for large interconnections such as this and should be initiated well in advance. Assuming a diversity factor of 60%, the projected peak campus electrical demand would be 9.6 MW.

Exhibit 56: Building Electric Load Estimates by Building Type

Building Type	CUP Interconnected Electric Load (W/SF)	Non-CUP Interconnected Electric Load (W/SF)
Lab	12	24
Office	3	12
Mixed Lab	8	18
Storage	2	6
Garage/Workshop	3	6
Conference	4	12
Computing Facility	30	N/A

The existing medium voltage high-speed transfer switch is an issue to be addressed in the near term. The NIST Boulder campus electrical engineers report that the existing high-speed transfer switch is antiquated and the switch manufacturer will no longer provide hardware, maintenance, and support beyond the next two to three years. The high-speed transfer switch accepts two utility medium voltage feeders and distributes branch circuit feeders to campus buildings through a network of underground ductbanks and manholes. One utility feeder is active at a time and, if out of service, the high-speed transfer switch will transfer the entire NIST Boulder campus electrical loads to the back-up utility feeder. The current high-speed switch is designed to complete transfer in less than one cycle.

To replace the existing medium voltage high-speed transfer switch, three options were discussed with NIST Boulder electrical engineers. For all three options, the new electrical distribution equipment should be installed and commissioned before the existing equipment is dismantled to maintain continuity of electrical service on the campus. A focused study should further explore the following options, to determine the most appropriate solution considering reliability, performance and cost.

Option 1

Provide a new medium voltage distribution switchgear to accept one utility feeder and distribute branch circuit feeders to buildings on the

Utility Tunnel



Affiliated Engineers, Inc.

campus. The advantage of this approach is that it is cost effective and simple to maintain. However, it will not provide redundancy at the service entrance level.

Option 2

Provide a new medium voltage distribution switchgear to accept two utility feeders with a tie breaker. The switchgear can be arranged to have the tie-breaker closed to allow one utility feeder to serve the entire campus. The tie breaker and utility feeder main breakers can be controlled by either relays or a programmable logic controller (PLC). If the active utility feeder fails, the relay or PLC will open the failed utility feeder main breaker and close the main breaker of the back-up utility service feeder.

The advantage of this configuration is that redundancy of electrical service will be provided at the service entrance level. The disadvantage is that it will cost more than Option 1 and require a larger footprint for the equipment. Also, the tie-breaker transfer typically takes four to five cycles, which is longer than the current less-than one cycle transfer time.

Option 3

Provide a new medium voltage distribution switchgear to accept one or two utility feeders and a generator-backed uninterruptable power supply (UPS) as a back-up feeder for campus medium voltage power distribution. This medium voltage switchgear configuration would be similar to Option 2, with the utility feeder serving the switchgear for campus wide distribution while the tie breaker is in the closed position. The main breaker of the generator-UPS power supply would be open. Upon detecting the utility feeder(s) has failed, the main breaker of the utility feeder would be opened by relay or PLC and the generator-UPS feeder main breaker would be closed to serve the switchgear. Once utility integrity is reestablished the generator-UPS will automatically transfer back to utility service.

6.6 Electrical System Issues

The electrical system has experienced ongoing power quality and power instability issues that have impacted key functions on campus. There also are concerns noted about back-up power generation and the minimal stand-by power available to support lab functions in the event of power loss.

There is rotary UPS switchgear installed on site and this switchgear is backed up by two 1760KW diesel generators on campus that do not operate. There is an ongoing project to replace this system with bio-fuel powered RUPS units – this system ideally will alleviate some of the power instability issues that have been hindering campus and provide additional redundancy to the normal utility circuits.

The advantage of this approach is that ultimate reliable electrical service is provided for the NIST Boulder campus because the electrical power supply is completely independent of utility services. The disadvantage of this configuration includes the large footprint required, increased capital cost and long-term maintenance cost of generator-UPS system.

6.7 Campus Domestic Water Systems

The campus domestic water system is connected to the City of Boulder water supply at four active locations. A fifth connection is currently not recording flow. Wells are not permitted on this facility. The existing piping system is approximately 50% loaded and is in a loop configuration which provides an adequate level of system redundancy. A significant reduction in water use is the goal of the agency for more efficient and cost saving operation. The primary challenge with the domestic water system is the fiscal year 2025 usage goal which is approximately 25% reduction current water consumption from 2007 levels. Early on in 2025 it was discovered that two major valve failures were causing water to flood underground, which could have significantly contributed to water consumption. Action has been taken to address these leaks. Because of the system's age, the recommendation is to line all existing pipes that can remain in service and not be impacted by future growth. This will ensure, going forward, that any water main leaks will be eliminated, thereby conserving water. Lining of all existing pipes will also address tuberculation of existing water pipes which has likely occurred over time, resulting in reduced water flow in the main water distribution loop. It was recently observed during the City of Boulder's maintenance on one of the campus feeds that the water supply to the CUP was inadequate. The inadequate water supply to the CUP is potentially related to tuberculation of the main water distribution loop. In addition to lining all existing pipes, starting with the main water distribution loop, it is recommended that a second water supply to the CUP be constructed/connected in the Building 3 vicinity from the opposite side of the existing connection to the distribution

loop as illustrated in the exhibit “Proposed Water Distribution System Modifications.”

With goals to efficiently use water and achieve water utility savings, actions that should be taken include:

1. Ensure no domestic water use for irrigation. (Current irrigation strategy utilizes Anderson Ditch water.)
2. Provide low-flow fixtures in all new buildings.
3. Eliminate all one pass cooling for any equipment.
4. Repair and line all underground pipe.
5. Comply with “Best Practices for Municipal Water Conservation in Colorado.”
6. Monitor the metering of the buildings versus the total campus flow to ensure there are no underground leaks.

Modifications to the existing water distribution system to accommodate master planned buildings and associated demolitions scheduled with the 2025 Master Plan are illustrated in the exhibit “Proposed Water Distribution System Modifications” and discussed in the following paragraphs.

Management Resource Center

Building 4 and 5 are scheduled for demolition with the 2025 Master Plan to accommodate the proposed Management Resource Center. It is anticipated that the water line serving Building 4 would continue to serve the Management Resource Center. A portion of the existing water distribution system is located in the proposed Management Resource Center footprint and would need to be relocated. The re-located alignment could be located beneath the proposed driveway separating the west and east portions of the proposed building.

A waterline also extends from the northwest corner of existing Building 4 west to Building 8 (Cryogenic Mesa Test) which appears to provide a secondary water service to Building 8. It is anticipated that this connection will need to be re-established via either a reconnection to the Management Resource Center water distribution system or at a different location in the existing water distribution line.

Also in this general vicinity (southwest portion of the site), existing Building 21 and 25 are scheduled for demolition with the 2025 Master Plan. Therefore water service to these facilities would be removed with the building demolition.

Building 3 Addition

It is anticipated that water service to the Research 3-A building would be provided by a connection to the existing water distribution line serving Building 3. However, an existing water distribution line currently serving Building 22 is located within the proposed building footprint and will require relocation outside of that footprint. Reconfiguration of the waterline in this area will be required to maintain the water distribution system in this area and to provide a second water connection to the CUP (Building 42).

Research A and Parking Garage

Water service for the proposed Research A building could be provided from a connection to the existing 12-inch water distribution system to the south (in existing Wilson Road) or to the existing 12-inch water distribution to the west (in existing Compton Road). A portion of the existing water service distribution line to existing Building 81 is located in the proposed Research A building footprint and will require relocation outside the building footprint. Also, a portion of the existing fire service line to existing Building 81 is located in the proposed Parking Garage footprint and will require relocation outside the building footprint.

Building 2 and 2A are scheduled for demolition with the 2025 Master Plan to accommodate the proposed Research A building. Water distribution service for Building 2A is located within the proposed footprint of the Parking Garage. Although the Building 2 water distribution line is also very close to Building 81, it does not appear that it serves Building 81. Assuming this water service line serves only Building 2 and not also Building 81, it could be removed with Building 2 demolition. If water service is required to the proposed Parking Garage, a connection could be made from the existing 12-inch water distribution line in the existing roadway to the west (Compton Road).

Exhibit 57: Proposed Water System



Childcare and Research B

Building 24 is scheduled for demolition with the 2025 Master Plan to accommodate the proposed Research B and Childcare buildings. Two water service distribution lines serve Building 24. The first extends from the north face of the building and connects to the 12-inch Campus distribution system in existing Wilson Road. The second extends from the south face of the building and continues west to the 8-inch water distribution system in Compton Road. A water service line also extends from the south face of Building 24 and continues south to a stub-out in Spine Road.

A new waterline is proposed in this area to maintain the connection to the existing stub-out in existing Spine Road and to allow a second connection to the proposed Research B building (if desired), such as currently exists to existing Building 24.

Research 34 Expansion

Water service for NOAA's Buildings 33 and 34 is owned and maintained by GSA. Water service to the Research 34 Expansion could be provided by an internal connection to the piping within building 34 or from a separate connection to the existing water service line serving the existing building.

6.8 Campus Sanitary Sewer System

The existing sanitary sewer collection system runs from west to east across campus and discharges at two outfalls to the Municipal system. Based upon the domestic water loads and topographical features, the existing system is less than 50% loaded. Due to the age of the system, the recommendation is to line all existing pipes that can remain in service and not be impacted by future growth. This will ensure going forward that any future maintenance will be eliminated, conserving water. Clean rooms in buildings throughout the campus generate a significant amount of waste (lead, acids, basis, solvents, etc.); however, hazardous materials are disposed of separately and are not discharged to the sanitary sewer system.

Modifications to the existing sanitary sewer system to accommodate Master Planned buildings and associated building demolition scheduled with the 2025 Master Plan are illustrated in the exhibit "Proposed Sanitary System Sewer Modifications" and discussed in the following paragraphs.

Management Resource Center

Building 4 and 5 are scheduled for demolition with the 2025 Master Plan to accommodate the proposed Management Resource Center. It is anticipated that the sanitary sewer serving Building 4 would continue to serve the Management Resource Center. However three different sanitary sewer lines currently pass through the proposed footprint of the Management Resource Center.

The westernmost sanitary sewer line passing through the proposed footprint serves existing Building 21 which is scheduled for demolition with the 2025 Master Plan. Thus this line could be removed assuming existing Building 21 demolition occurs in advance of the construction of the Management Resource Center.

The other two sanitary sewer lines within the proposed footprint extend upstream (southeast) to an existing manhole intercepting the Building 25 sanitary sewer lateral. Building 25 is scheduled for demolition with the 2025 Master Plan; therefore sanitary sewer to Building 25 would no longer be required. However, this existing manhole not only intercepts the Building 25 sanitary sewer service lateral but also intercepts an upstream run of sanitary sewer. It is unclear what this upper segment of the existing sanitary sewer serves and if it is still in use. However, a portion of it would need to remain to provide sanitary sewer service for existing Building B43 (Hazardous Materials). A relocated connection to maintain service to this existing upstream manhole could be provided in the proposed roadway between east and west building additions.

Building 3 Addition

It is anticipated that sanitary sewer service to this proposed building would be provided by a connection to the existing sanitary line serving existing Building 3. However, an existing sanitary line currently serving existing Building 22 is located within the proposed building footprint and will require removal and a new sanitary line will need to be constructed to provide sanitary service to Building 22. This new sanitary sewer line could be routed from the existing manhole immediately adjacent Building 22 to the northwest (northwest corner of existing Building 3) and continue to a new connection to the existing sanitary mainline passing through the center of the Campus.

Research A and Parking Garage

The campus sanitary sewer main currently passes through the south side of the southwestern portion of the proposed Research A footprint and would be required to be shifted slightly south outside the proposed footprint. Although there would be space constraints, the existing sanitary sewer could be relocated between the proposed Research A building and the existing utility tunnel. Sanitary sewer service to the proposed Parking Garage would be connected to this relocated sanitary line. Building 2 and 2A are scheduled for demolition with the 2025 Master Plan to accommodate the proposed Research A building. Where Building 2 and 2A sanitary sewer service is inside the proposed footprint of the Research A building, it would be removed with the demolition of Building 2 and 2A. A new connection to the existing adjacent sanitary main could be established to serve the Research A building either in the same location/alignment as the existing lateral serving existing Buildings 2 and 2A and/or to the aforementioned relocated sanitary main.

Childcare and Research B

Building 24 is scheduled for demolition with the 2025 Master Plan to accommodate the proposed Research B and Childcare buildings. A sanitary sewer connection for the proposed Childcare building could be provided by extending a connection from the proposed building to the existing sanitary sewer main to the north. Where Building 24 sanitary sewer service is inside the proposed Research B footprint, it

Central Utility Plant

would be removed with Building 24 demolition and a new connection to the existing adjacent sanitary main established to serve the Research B building.

Research 34 Expansion

No sanitary sewer currently exist to Building 34 or in this vicinity. A new sanitary sewer connection could be provided to the existing sanitary sewer serving existing Building 33.

6.9 Campus Storm Sewer System and Stormwater Management

Several storm sewer systems exist at the site, collecting storm water from the campus and discharging to various locations. In the north portion of the campus, a storm sewer system exists collecting runoff from Building 1, the eastern portion of Building 81, and Building 2 and discharges to the municipal system in Broadway. A separate storm sewer system collects stormwater from the western portion of Building 81 and discharges to Skunk Creek. A third storm sewer system is present on the western portion of the campus collecting runoff from buildings and surrounding areas and conveying it to an open channel system discharging to an existing stormwater management (SWM) facility at the southeast corner of the site inside the Tribal Protected Area. Storm sewer from the existing parking lot west of Building 33 is also conveyed to this existing SWM facility. Storm sewer from the southeast portion of the campus (Building 33 and adjacent



Exhibit 58: Proposed Sanitary Sewer System





area) is conveyed to second existing SWM facility, further east of the aforementioned SWM facility at the southeast corner of the site inside the Tribal Protected Area.

Anderson ditch is the source of water for the campus irrigation system and runs through the site along the east side of Building 81, continuing southeast along the east side of Building 33 and continuing off-site. Only Building 33 has storm drain draining directly to Anderson Ditch; the majority of the campus stormwater discharge is isolated from the Ditch. NIST is responsible for the maintenance of the Ditch on its property, under a 2007 agreement with the Ditch Company. Existing trees near the ditch need to be removed to improve drainage in the channel. Natural stone is embedded in the ditch bottom which makes cleaning difficult.

The storm sewer system and drainage patterns and discharge points described above can also be observed in the exhibit “Hydrology” located in the Chapter 12 “Campus Site Analysis” section of this report.

As described, the campus storm sewer system collects storm water from the facility to discharge to municipal system, Skunk Creek, existing SWM facilities located on the Tribal Protected Area at the southeast corner of the site, and to a limited extent, Anderson Ditch. Under the Master Plan, the overall impervious surface is reduced, which should reduce the total stormwater flow. However, whether local and State of Colorado or Energy Independence and Security Act of 2007 Section 438 stormwater requirements are utilized, stormwater quality control is required including best management practice (BMP) measures. On the Boulder campus, providing point-source treatment using bioretention facilities for new structures and associated impervious (hardscape) site improvements is recommended under this Master Plan. Bioretention facilities are designed to capture the first flush of a rainfall event, and to treat this “dirty water” via plantings, soil filter media and the associated microbial action, and the controlled release of the treated stormwater. The first flush of stormwater inflow is directed through the filter media and collected by perforated underdrains. The peak stormwater flows are directed through an overflow structure and to an outlet drain connected to the storm sewer system. These facilities are generally considered to be very efficient stormwater treatment measures. See the exhibit “Proposed Storm Sewer Modifications and Bioretention Facilities” for conceptual location of bioretention facilities recommended for the Master Plan.

Currently there is a Stormwater Management Plan (SWMP) that NIST follows and maintains to comply with the requirements of National Pollutant Discharge Elimination System (NPDES) Permit No. COR042002 (MS4 Permit). For the Master Plan, new building structures will need to comply with the MS4 Permit in effect at the time of construction. All upgrades shall be in accordance with the City of Boulder Comprehensive Stormwater Utility Master Plan, which includes the local and State of Colorado laws.

Modifications to the existing storm sewer system to accommodate master planned buildings and associated building demolition are illustrated in the exhibit “Proposed Storm Sewer Modifications and Bioretention Facilities” and discussed in the following paragraphs.

Management Resource Center

Existing storm sewer is located in the immediate vicinity but outside the Management Resource Center footprint. New bioretention facilities are the recommended approach under this Master Plan to capture and treat runoff from the proposed building roof drains and impervious areas. Proposed underdrains from bioretention facilities would connect to existing storm sewer in the vicinity. Buildings 4, 5, 3A, 111, and 21 are scheduled for demolition with the 2025 Master Plan to accommodate the proposed Management Resource Center. Roof drain and storm sewer laterals associated with these buildings would be removed with building demolition.

Building 3 Addition

The existing storm sewer that served the former Building 23A is located within the proposed building footprint and would require removal. New bioretention facilities are the recommended approach under this Master Plan to capture and treat runoff from the proposed building roof drains and impervious areas. Proposed underdrains in bioretention facilities would connect to existing storm sewer in the vicinity.

Research A, Parking Garage, Research B, and Childcare

Building 2A is scheduled for demolition with the 2025 Master Plan to accommodate the proposed Research A building and Building 24 is scheduled for demolition with the 2025 Master Plan to accommodate the proposed Research B building. Storm sewer serving these existing buildings is located inside the proposed footprints and

would be removed. New bioretention facilities are the recommended approach under this Master Plan to capture and treat runoff from the proposed building roof drains and impervious areas. Proposed underdrains in bioretention facilities would connect to new storm sewer in this area and discharge to the existing storm sewer in Wilson Road. The exception is for the Parking Garage. In order to honor existing drainage divides, the northern portion of the Parking Garage storm sewer/runoff is anticipated to be required to discharge/connect to existing storm sewer on the southeast corner of Building 81 which outfalls to Skunk Creek.

Research 34 Expansion

Existing storm sewer and associated open channel storm drain are located in the immediate vicinity but outside the Building 34 expansion footprint. New bioretention facilities are the recommended approach under this Master Plan to capture and treat runoff from the proposed building roof drains and impervious areas. Proposed underdrains in bioretention facilities would connect/discharge to the existing storm sewer/open channel in the vicinity.

6.10 Campus Natural Gas Distribution System

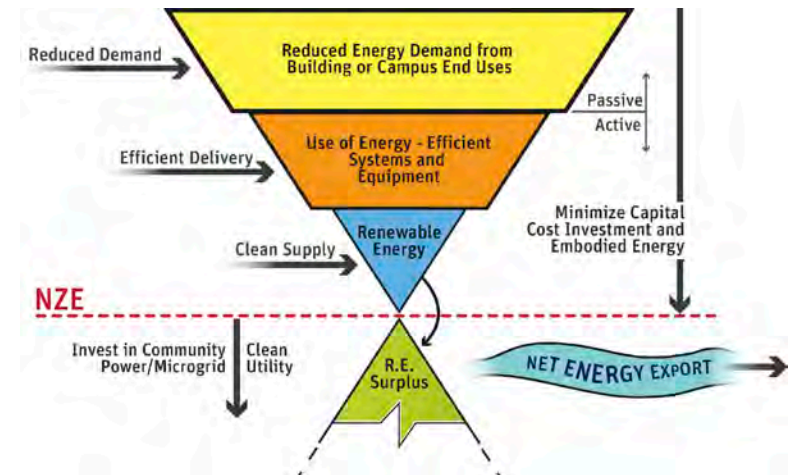
A high-pressure distribution gas service provides service from the off-site connection to the CUP. At the CUP, normal pressure gas piping connects to the high-pressure main and is distributed as normal pressure natural gas piping throughout the Campus. It is government owned and operated after the meter.

6.11 Building Energy Design Strategies

High-performance buildings are defined by their efficient systems, which are intentionally designed to work together as a cohesive unit. Each system is optimized to enhance the performance of the others, creating a building that operates more effectively than the sum of its parts. This integrated approach ensures that the building achieves superior energy efficiency and functionality.

The Management Resources Building and the Childcare Center are proposed to be net-zero energy buildings. All new and renovated buildings shall be designed with energy efficiency to the greatest extent possible.

Exhibit 60: Net Zero Strategy

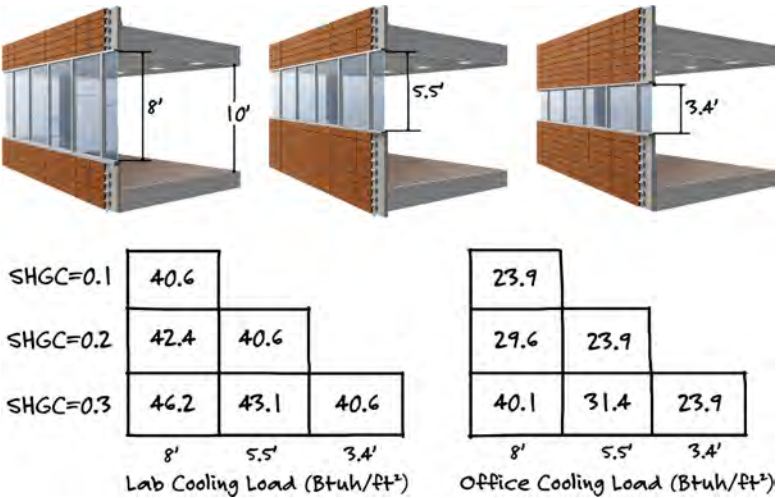


Design strategies and related technologies for all the new buildings and renovations should begin with optimization of the project program and design, then continue to evolve with the refinement of the program, architecture, and budget. Design strategies described here are not exhaustive, and supplemental approaches may be necessary to meet the stated goals. Strategies should be chosen to meet the performance criteria of the building, supported by detailed analysis, documentation and ultimately proven out through field commissioning at the end of construction. The building design should employ both passive and active systems. The approach is multi-tiered:

1. Reduce energy demand;
2. Choose energy efficient equipment and systems;
3. Provide a clean renewable energy supply.

Natural Ventilation. The location of the Management Resources Center with its temperate climate is well suited for natural and passive ventilation. The design should consider integrating both passive and natural ventilation into the building. In addition, ceiling fans should be provided along with nighttime flushing and additional thermal mass as required to maintain occupant comfort. The use of outside air filters for the passive ventilation strategy should be reviewed with NIST during the development of the design. Active mechanical cooling should be supplemental. Shop and storage areas can utilize natural ventilation, supplemented when using shop equipment. Natural ventilation could be considered for other new or

Exhibit 61: Window Wall Ratios and Solar Heat Gain



renovated campus buildings, except for laboratory programs which require more carefully controlled environments.

High Performance Envelope. The design of the building envelope is not only a matter of aesthetics and basic enclosure, but also an opportunity to address various climatic and operational impacts on building energy and comfort performance. It is the intersection for aesthetics, solar radiation (heat gain and daylight), heat transfer, moisture transfer, visual connection, and natural air movement. As such, it is important to address the factors in an integrated manner.

A simple adjustment of either window to wall ratio or the solar heat gain coefficient can lead to significant cooling load increases in various space types. This in turn requires an increase in cooling equipment capacity (and often size). The increase can also be a limiting factor in the types of cooling systems that can address the loads effectively.

Design can alter space cooling loads through varying the window-to-wall ratio and solar heat gain coefficient (SHGC). The amount of glazing area also plays a key role in allowing daylight into the space. Useful daylight is that which provides illumination to the tasks occurring in the space without providing excess quantities that create glare discomfort. Thus, between window area and the visible light transmittance, a balance must be determined. This balance must also consider the impact on solar gains to the space which result in cooling loads. Often this balance between glare, useful daylight, and

Exhibit 62: Dynamic Electrochromic Glazing



heat gain is only partially resolved, resulting in the use of internal shade devices. Another possible solution to explore is the use of electrochromic glazing. This technology uses a small electrical charge to change the glass from a “transparent” state to a “tinted” state along a continuum with operational steps between the two points. The advantage is that both the visible light transmittance and solar heat gain coefficient area dramatically lowered when in the tinted state, reducing glare potential and cooling load, yet there is still a visual connection to the outdoor environment, unlike with internal shade devices. The system can be controlled using solar time or solar radiation, and connection to the space thermostat can inform modulation of the dimming to offset any comfort heating demand.

The application of electrochromic or similar thermochromic glazing is most likely not cost effective or necessary in all areas of the building, but various target areas should be considered such as the east and west façades. In addition to these types of dynamic glazing, active external shading devices can provide similar benefit with a different aesthetic expression.

Building wall and roof insulation play a critical role in energy conservation by minimizing heat transfer between the interior and exterior, helping to maintain consistent indoor temperatures and reducing the need for heating and cooling. To maximize energy savings, these components must comply with the latest ASHRAE Standard 90.1 or IECC requirements, which set minimum R-values (a measure of insulation effectiveness) and other performance criteria. Properly installed insulation reduces heat loss in winter and heat gain in summer, significantly lowering energy consumption.

Infiltration, or the unintended flow of air through gaps and cracks in the building envelope, can undermine insulation's effectiveness and lead to increased energy use. To address this, new construction should incorporate air-sealing techniques, such as caulking and weatherstripping, to limit infiltration. Additionally, continuous insulation, which covers the entire building envelope without thermal bridging, should be considered to further enhance energy efficiency and ensure compliance with the latest standards.

In evaluating such envelope strategies, it should be recognized that the building skin is an integral part of the building HVAC system and it is possible to reduce mechanical HVAC capital costs with such strategies.

Lighting Load Reduction. The Management Resources Center and office areas within research buildings present opportunities to create outstanding and memorable buildings with reduced energy consumption. Lighting load reduction begins with the effective utilization of natural light. Design studies should maximize the use of natural light for most daytime general illumination, augmented by task lighting tailored to activities. Natural lighting strategies must control glare, which is dangerous in shop areas and which can prompt office workers to close the shades/blinds, negating the environmental and energy benefits. Considerations include orientation, window height, shading devices, and daylighting controls on ambient lighting.

To successfully meet the energy goals, the electric lighting systems must be designed to incorporate highly efficient technologies, maximizing illumination while reducing glare or veiling reflections, e.g. dimmable LED light sources. The intensity of light should be accurately tailored to the task requirements of the users, with little or no excess capacity. Key components should be developed to form a comprehensive strategy which unites various spaces within the building to create a consistent light character and quality of light. The solutions developed should integrate light within the form and structure of the space to clearly communicate function and the relationship of the lighting to the larger architecture of the building. Comprehensive control systems will maximize the benefits of day light, turn off lights when spaces are unoccupied, and reduce lighting after hours. These should be selected to maximize simplicity within spaces while still providing the highest level of controllability.

Exhibit 63: Office Lighting Strategy



Plug Load Reduction. Purchasing more efficient equipment is the most direct way to reduce plug loads. Equipment with energy-saving features may or not have a higher associated first cost. When moving older, less efficient equipment into a new building from other facilities, effort should be taken to replace or upgrade those inefficient devices. Energy use can be reduced by intelligently controlling equipment via occupant-sensing technologies. Examples include fume hoods, computer monitors with occupant sensors, banks of equipment linked to room occupancy sensors, etc. Where possible, shared occupancy sensors linked to multiple pieces of equipment can help to reduce first costs. Controlled receptacles are mandated by energy codes such as the 2022 ASHRAE Standard 90.1 and the 2024 *International Energy Conservation Code (IECC)*. These codes require that at least 50% of all receptacles in certain spaces (private offices, conference rooms, classrooms, and copy rooms) be controlled by automatic shut-off mechanisms such as timers, occupancy sensors, or building automation systems. This requirement aims to reduce energy consumption by ensuring that plug loads are minimized when spaces are not in use.

Air-side Energy Savings. The use of air distribution can be an efficient means to provide cooling if the system is designed well and takes advantage of the climate opportunities of Boulder. The requisite amounts of outside air supplied to the office and support spaces is based on the number of people in each space. In order to diminish the conditioning and fan energy associated with outside air supply, occupancy sensors and carbon dioxide monitoring should be used to determine the quantities required (CO₂ serves as a proxy for occupancy). Decoupled cooling and ventilation systems such as chilled beams should be considered for spaces with high sensible loads.

Natural ventilation should also be investigated for the non-lab buildings. By using unconditioned outside air when conditions are favorable, associated energy use can be minimized. As part of the natural ventilation design, operable windows with contact sensors may be used in perimeter office and conference spaces. When the windows are opened, a signal to the building automation system will close down the air terminals to those spaces.

Additionally, air side energy recovery should be employed where it is feasible to precondition the incoming outside air. Heat pipes or glycol runaround loops are recommended for laboratory systems to avoid cross contamination of the air streams. Enthalpy wheels are recommended for systems serving non-laboratory areas due to their higher effectiveness.

Exhibit 64: Plug Load Reduction

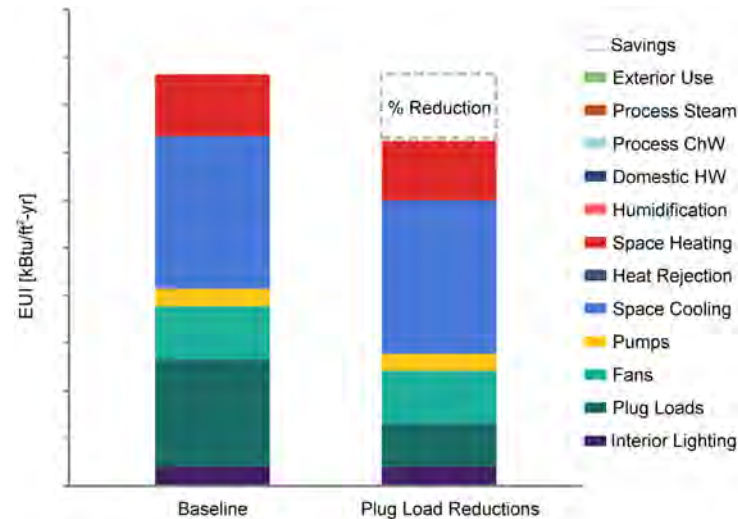
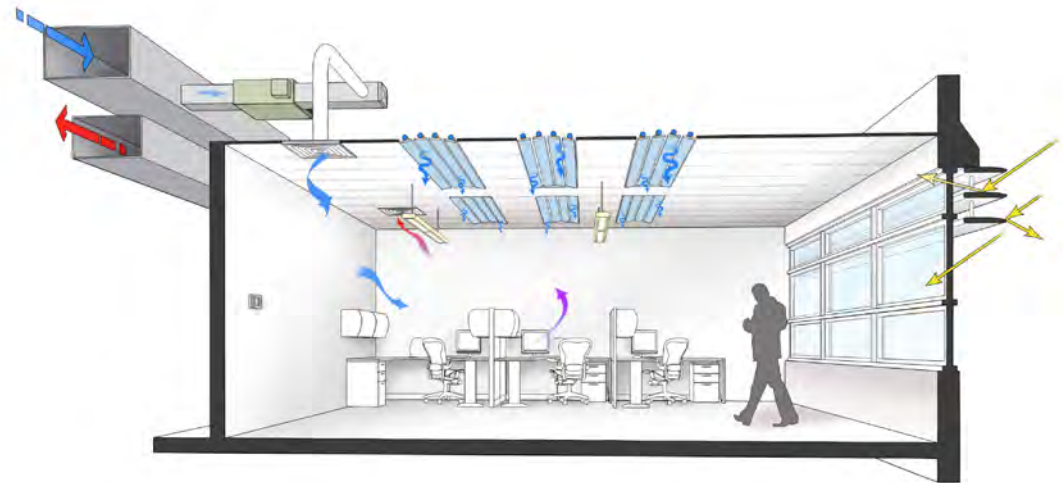


Exhibit 65: Office Space Energy Strategy



Water-side Energy Savings. As noted above, the distribution of cooling energy via water rather than air is typically much more efficient. Zone level cooling also creates energy efficiency opportunities due to elevated chilled water temperatures. This warmer chilled water can be provided via the return leg of the campus chilled water system, via water-side economizing with a fluid cooler device, or via chillers operating at higher efficiency due to decreased lift. Pumps should

include variable frequency drives to reduce pumping energy when heating and cooling demands are lower than peak. Additionally, low-flow domestic fixtures, including faucets, showerheads, and toilets, are designed to reduce water usage by limiting flow rates without sacrificing performance. By using less water, especially in hot water applications like hand washing and showers, they not only conserve water but also decrease the amount of energy required to heat the water. This results in lower utility bills and reduces the overall energy consumption associated with water heating, making them an efficient choice for both water and energy conservation.

Solar Energy Systems. NIST has a strong history of supporting solar technologies, especially photovoltaic energy systems. Previously, building designs considered inclusion of the renewable energy PV systems both on top of the building structure and over the canopy shielding the parking areas. Onsite PV arrays require inverters which can interfere with sensitive lab equipment due to production of electromagnetic signals. Shielding measures that can be taken include installing electromagnetic shielding (e.g., a Faraday cage) around the sensitive equipment or inverter, using shielded and properly grounded cables, and adding EMI filters at power connections to suppress conducted noise. Increasing physical separation between the inverter and sensitive equipment, as well as powering sensitive devices from isolated transformers or clean circuits, further reduces interference. Proper grounding and bonding of the entire system are critical to ensure the effectiveness of these shielding strategies.

Geothermal Systems. Buildings with relatively balanced annual cooling and heating loads, such as the childcare center and administration building, should consider geothermal HVAC systems. Economic feasibility of such system should be evaluated during design with consideration to soil conditions and local environmental regulations.

6.12 Campus IT Fiber Optic Cabling Infrastructure

The CUP tunnel is the main conduit for fiber optic cabling on campus. Some cabling is run in existing conduits or limited duct bank; most cabling is direct buried.

OISM's planned BCCF (Boulder Contingency Computer Facility) located in the Spine of Building 1 would provide redundant connections to each research building (with the primary connection to each

research building from the BCF). While the CUP tunnel serves as cable pathway for the BCF connection to most buildings, alternate pathways from the BCCF in Building 1 to each research building should be considered. These pathways include internal pathways such as cable tray, and external pathways such as buried conduit duct bank with handholes.

6.13 Low Voltage Systems

NIST IT / VOIP / Security Standards

Renovated and newly constructed buildings for NIST will incorporate OISM's "Bolder Campus IT Network Infrastructure Standards" and ESO electronic security equipment standards. The OISM and ESO standards include requirements for equipment rooms, structured cabling support systems, primary and emergency power, and climate control. Electronic security systems will be provided in accordance with ISC Appendix B: Countermeasures.

All renovations and new buildings must comply with the applicable FSL-III (Facility Security Level) requirement. FSL levels are assessed periodically for the whole campus as well as for individual facilities within the campus. Each project shall confirm the FSL for the project at the time of design development and ensure that all applicable requirements and measures are incorporated.

Infrastructure, cabling, and security devices shall be provided to support the anticipated Physical Access Control System (PACS), Intrusion Detection System (IDS), Video Management System (VMS).

NIST AV Systems

Audiovisual (AV) systems for each renovated and new NIST building will meet OISM's AV standards. These standards incorporate "hybrid" meeting features for collaboration with remote attendees. AV systems include new video displays as well as updated camera(s) and microphone arrays.

OISM AV standards include platform agnostic room video collaboration systems with USB connections for "BYOD" (Bring Your Own Device) meetings with a user-provided laptop computer.

Except for the Building 1 and Building 81 Conference Centers, most NIST AV systems will be self-service, i.e. not requiring dedicated AV technicians.

Mass Notifications System

A campus-wide mass notification system with voice annunciation is a priority recommendation of the Wildfire Mitigation Plan. Coverage is required through the entire DoC campus, including the Table Mountain site. Building interiors can be addressed via standard ECS (Emergency Communication System) voice evacuation system equipment. Exterior spaces in the central campus can be covered by distributed loudspeakers located on building facades and fixtures such as light posts. Remote exterior spaces will require longer range horn loudspeakers located on buildings or posts. Equipment closets will be located throughout campus for control, monitoring, and amplification equipment. These locations will require fiber optic cable interconnections as well as emergency power.

Building 1 Renovation

The new BCCF as described above will be constructed in the spine of Building 1. In addition to the existing CUP tunnel connection, both an internal pathway to Building 81 and existing communications conduits to Building 81 should be evaluated to determine both condition and capacity as an alternate cable pathway from the BCCF to other campus buildings.

Audiovisual systems in the existing conference center are obsolete and will be updated to reflect NIST's status as a global leader in technology development. New video displays, speaker systems, video camera systems, microphones, and AV control systems will be furnished with the renovations. A new AV control room will facilitate system control, monitoring, video recording, streaming, and remote collaboration.

Building 3 Addition

The Addition will connect to campus services from the BCF via the existing Building 3. An alternate pathway to the BCCF should be developed.

NOAA Research Building 34 Renovation and Addition

The Addition will connect to campus services via the existing Building 34. The existing fiber feed to Building 34 may require relocation due to planned construction in the vicinity.

Building 51 Renovation and Addition

As the campus security screening center, building 51 should be updated with redundant fiber optic cable connections. The fiber optic cables should be secured in buried conduit, ideally connecting at two points to the CUP tunnel. A new security closet should be included in the addition to house the new monitoring, screening, and access control equipment.

Research Building A

Building A should be equipped with independent fiber optic cabling pathways to connect to both the BCF and BCCF. Existing fiber optic cabling may require relocation due to site excavation.

Research Building B

Building B should also be equipped with independent fiber optic cabling pathways to connect to both the BCF and BCCF.

Childcare Facility

A new fiber optic conduit connected to the BCF via the CUP tunnel will serve the new Childcare Facility.

Management Resources Center

A new fiber optic conduit connected to the BCF via the CUP tunnel will serve the new Management Resources Center.

Parking Garage

Security access control and video monitoring are anticipated in the parking garage. A security closet and redundant fiber optic cabling connections to campus systems are required.

Exhibit 66: Existing and Proposed Data Cable Pathways





Circulation Framework

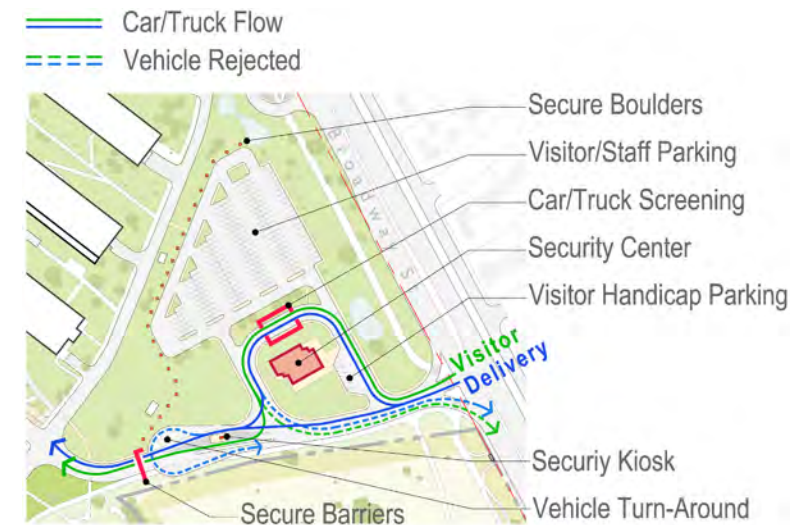
7.1 Circulation

The Master Plan proposes incremental changes to the campus, in conjunction with the proposed new construction and renovation of the facilities. Most of the proposed changes are independent of one another. The following is a summary of the key changes to the circulation system corresponding to the construction and renovation proposals in the Master Plan:

- The central roadway between Buildings 3 and 81 would be eliminated with the construction of the new research buildings.
- Its extension, Curie Circle, would be reconfigured with the relocation and construction of the Childcare Center.
- The reconfiguration of the roadways and screening areas surrounding the Security Center should be timed with the expanded Security Center, although the parking lot changes could precede this.
- Compton Road, the north-south roadway dividing the central campus green, should be limited to bicycle, pedestrian, and emergency traffic. It would preserve the central part of the campus as a more pedestrian and bicycle-oriented space. However, this would cause some additional circulation for vehicles accessing the new parking garage behind Building 81.
- The reconfiguration of the intersection of Rayleigh Road, Wilson Road and Lawrence Road as a typical 4-legged stop-controlled intersection would provide better clarity for visitors and employees as they enter and exit the campus.

As the Master Plan is implemented, the DoC may wish to develop a Transportation Management Plan that seeks to further reduce the number of single occupancy vehicles arriving on campus. DoC has already managed demand by encouraging and supporting bicycle commuting and providing transit subsidies.

Exhibit 67: Circulation Improvements for the Campus



Truck Circulation/Screening





Exhibit 69: Road Network and Service Delivery Improvements



Visitor and Delivery Screening

Visitor screening is planned to continue at the reconfigured Security Center, Building 51. Visitors are expected to park, proceed into the Security Center building, and complete the verification and screening inside. The vehicle screening process will be accomplished curb side before proceeding to the entry gate into campus.

Fewer parking spaces are planned adjacent to the Security Center than exist in the current configuration, but the reconfigured parking lot to the north is planned to be outside of the secure perimeter. This condition will allow visitor vehicles to be parked without entering the secure campus. There will be no direct connection between this parking facility and the public roadway system, allowing visitors to park their vehicles outside of the security perimeter and to walk into the campus. This will remove vehicular pressure from the security gate, allowing it to primarily serve employees, delivery truck drivers, and others that have need to use a vehicle on campus. Visitors for conferences and other large meetings will be able to park in the lot north of the Security Center, reducing additional queuing at the security booth during conferences.

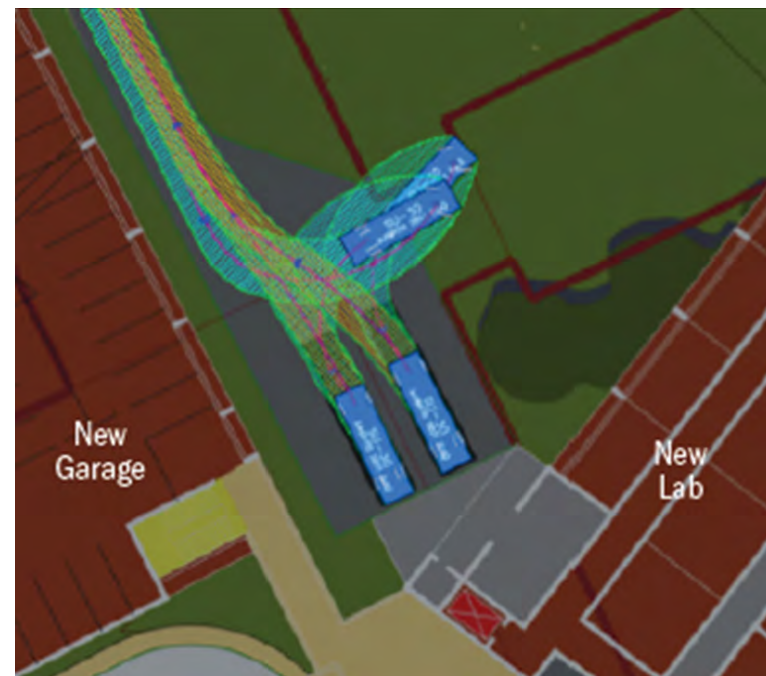
Truck and delivery screening will continue to take place at the reconfigured Security Center. It is expected that, as with visitors in personal vehicles, truck drivers will proceed into the Security Center building for personal screening and verification and will then have their truck screened at curbside before proceeding to the entry gate into campus. The driveway around the Security Center will be expanded and reconfigured for truck maneuvering and parking. The truck lane through the security booth and gate should be 14-16 feet in width to allow for maneuverability. Additionally, there are truck-turning maneuver provisions west of the security gate for a truck to be able to turn around and exit the campus in the event that truck is not allowed to enter onto campus. It is recommended that the turning area east of the security booth and gate should be striped rather than curbed for truck maneuverability. To that end, turning maneuvers should be examined with AutoTurn (or a comparable program) as design plans are developed to determine the adequate curb alignment for trucks to continue to the gate area.

To achieve this maneuverability, the guard booth will be relocated west of its current location. Rejected cars and trucks exit the campus by turning left from the truck/vehicle screening area onto Rayleigh Road and exit at Broadway (right turn only). Gate controls are planned, which will be developed and finalized at design.

Exhibit 70: Relocated Building 1 Maneuvers



Exhibit 71: New Research Building Loading Dock Truck Maneuvers



7.2 Parking

When evaluating parking needs for a large campus, parking occupancy is often evaluated on a per-lot or a per-quadrant basis. It is unlikely that the parking lot layouts proposed in the Master Plan will be followed exactly during implementation. Accordingly, it is reasonable to determine the parking needs for each portion of campus based on demand associated with the uses within the proximate buildings.

Parking usage data was collected and documented for each lot. The campus currently has 1389 spaces for 1,767 employees. On an average day, 71% of the parking spaces were occupied indicating 0.58 occupied parking spaces per employee for the campus, overall.

For the Master Plan, the parking needs were evaluated based on the redistributed uses. A total of 1,463 spaces have been proposed in the Master Plan for the anticipated 1,886 employees. In general, the proposed parking provisions reflect a higher space per employee ratio than the existing occupied spaces per employee. Applying current demand ratios to the Master Plan development, the average day peak parking demand for the campus is expected to be approximately 990 vehicles. Some sharing of parking between Quadrants 1 and 2 is likely.

Parking facilities are generally considered to be “full” when they reach 90% occupancy. Accordingly, a parking supply of 1,099 parking spaces would be needed to accommodate the average day demands of the campus and any minor fluctuations. A maximum occupancy of 75% is sometimes targeted for additional flexibility, which would require 1,318 spaces in the campus when the Master Plan is fully implemented.

Large conferences can skew the average day demand significantly. The Institute of Transportation Engineers (ITE) manual suggests that conference centers may expect parking ratios of approximately 0.31 vehicles per conference attendee. Based on an optimum conference attendance of 500 people (the highest recorded conference attendance is 537), an additional parking demand of 155 vehicles could be expected. However, such conferences would also include a number of DOC employees amongst its attendees. NIST anticipates that most conferences will not exceed 150 people, but the parking spaces provided in the Master Plan should be sufficient to accommodate the campus peak demand even when large conferences are hosted.



A visitor parking lot has been provided near the campus entrance to allow visitors who can park without undergoing a vehicle screening process. It will provide added flexibility in accommodating visitor parking during special events such as conferences and ease vehicle screening loads at the security center. DoC staff will share this parking space with visitors at other times. In order to accommodate conference attendees, DOC may want to require employees to avoid parking in the visitor parking lot when conferences are hosted in the campus.

Parking on the GSA-managed lot near the David Skaggs Research Center B33 has a capacity of approximately 600 cars. The projected program does not require any capacity change to this lot, however the Master Plan recommends modifications to increase permeability and reduce the visual impact of this “sea of parking.” Suggestions include decking a portion to allow the removal of some surface paving, taking advantage of the site’s upward slope. Introduction of trees and other plantings would assist in the mitigation.

7.3 Loading Docks and Service Areas

New loading docks are proposed at the research buildings. Relocation of the primary loading dock for Building 1 has also been proposed to the north side of the building. Loading and service for the Management Resources Center will be an important consideration during the building design. The loading areas should be designed to ensure adequate maneuvering area for trucks to back into loading docks and evaluated on the specific needs of the loading facility (i.e. size of trucks expected) and surrounding constraints. It is recommended that AutoTurn (or a similar program) be used during design of loading facilities to test turning maneuverability.

External delivery trucks are expected to continue to use Building 22 for deliveries, as is current practice. Deliveries are taken at Building 22 and then distributed throughout the campus to the various end destinations. Today, large trucks sometimes intrude into the adjacent roadway for backing maneuvers into the Building 22 loading docks. The Master Plan recommends a widening of the road at Building 22, to improve maneuvering and ensuring that the truck is out of the travel lanes of the adjacent roadway once it is parked.

Exhibit 72: Future Parking Provisions

Scenario	Quadrant 1	Quadrant 2	Quadrant 3	Quadrant 4	Security/Visitor	Total
Existing 2024						
Employees	393 employees	318 employees	221 employees	834 employees	1 employees	1,767 employees
Provided Spaces	367 spaces	237 spaces	120 spaces	640 spaces	25 spaces	1,389 spaces
Occupied Spaces	260 vehicles	178 vehicles	68 vehicles	339 vehicles	9 vehicles	854 vehicles
Occupied Spaces/Employee	0.66 spaces/emp	0.56 spaces/emp	0.56 spaces/emp	0.41 spaces/emp	9.00 spaces/emp	0.48 spaces/emp
Campus Master Plan						
Employees	483 employees	407 employees	125 employees	869 employees	2 employees	1,886 employees
Proposed Supply	382 spaces	330 spaces	99 spaces	647 spaces	5 spaces	1,463 spaces
Proposed Ratio	0.79 spaces/emp	0.81 spaces/emp	0.79 spaces/emp	0.74 spaces/emp	2.50 spaces/emp	0.78 spaces/emp
Avg. Day Demand	320 spaces	228 spaces	70 spaces	353 spaces	18 spaces	989 spaces
Demand Ratio	0.66 spaces/emp	0.56 spaces/emp	0.56 spaces/emp	0.41 spaces/emp	9.00 spaces/emp	0.48 spaces/emp
10% Space Rec. Supply	356 spaces	253 spaces	78 spaces	392 spaces	20 spaces	1,099 spaces
10% Supply Ratio	0.74 spaces/emp	0.62 spaces/emp	0.62 spaces/emp	0.45 spaces/emp	10.00 spaces/emp	0.58 spaces/emp
25% Space Rec. Supply	427 spaces	304 spaces	93 spaces	470 spaces	24 spaces	1,318 spaces
25% Supply Ratio	0.88 spaces/emp	0.75 spaces/emp	0.75 spaces/emp	0.54 spaces/emp	12.00 spaces/emp	0.70 spaces/emp

Exhibit 73: Master Plan Parking





Sustainable Design Approach

8

Master Plan incorporates sustainable design and energy efficacy as core principles and one of its goals. The campus development approach includes environmentally responsible strategies in the plan and the building design guidelines. Certain principles are inherent in the Master Plan as it is implemented, and certain principles are enabled with the design of specific buildings following the Design Guidelines. The following are key sustainable design approaches:

- **NIST Requirements:** Meet the requirements of the *NIST Sustainable Design Manual (July 31, 2014)*, and the *DoC Real Property Management Manual (August 2014, rev. March 2017)*, and any subsequent revisions. The manuals reflect both NIST and DoC policies on sustainable design.
- **Energy Efficiency:** Implementation of the Master Plan will increase energy efficiency through the elimination of aging and inefficient mechanical systems that serve the buildings being replaced. In addition, the consolidation of scattered administration and support functions into one shared building will provide better service, reduce duplication, and incorporate modern energy-efficient systems.

The major proposed buildings would be connected to services from the Central Utility Plant (CUP). Energy-efficient design strategies are recommended for the planned buildings, supported by NIST's Design Guidelines. Recommended strategies for all new and renovated buildings include clustering building functions to optimize HVAC system design and distribution; incorporating daylighting; using high-performance building envelopes; leveraging natural ventilation where feasible; and selecting energy-efficient equipment and systems.

Energy conservation measures should include demand control strategies, process energy recovery, fume hood controls, decoupled cooling and ventilation, and the use of air-side economizers for recirculating air handling units. Site-wide projects should incorporate energy conserving technologies that will continue to evolve over the life of the Master Plan.

Both the Management Resources building and the Childcare Center are proposed as net-zero energy buildings, targeting reduced energy

demand and efficient systems augmented by solar energy. The general approach first reduces the demand for energy through building design and organization, followed by the selection and commissioning of energy efficient systems, and then the provision of clean renewable energy.

- **Water efficiency:** Keep water use within the levels allowed by state permit, even with the projected new buildings and lab modernization. The NIST goal is a 25% reduction in water use over the baseline year 2007 for each building. The high water use on campus must be reduced, by investigation of possible leakages, control of use in labs for cooling, and installation of water efficient systems. Water conservation in Colorado is especially important because water reuse and rainwater collection are not permitted.
- **Stormwater Management:** Utilize strategies to ensure stormwater quantity and quality control, including landscape "best management strategies" such as swales and plantings that increase ground water recharge rather than runoff. The parking demand has only a minimal increase with the Master Plan, and a recommended parking garage will reduce the impermeable surface on campus, as will the removal of the central drive.
- **Daylighting:** Organize the buildings to maximize the use of natural light for illumination and occupant comfort, specifically to the staff offices, support and corridors. Daylighting within the laboratories is not typical because of research requirements, but this should be discussed with each building project. The NIST Sustainable Design Manual sets a minimum goal of a 2% daylighting factor for 75% of regularly occupied areas.
- **Adaptive Reuse:** Utilize existing buildings that are in good condition and renovate them for compatible uses. Building 1 is undergoing an extensive phased renovation to provide advanced research facilities in the 1952 shell. Building 24 is no longer appropriate for advanced research. The Master Plan recommends demolition of Building 24 because of its condition and layout. A number of other buildings are recommended for removal by the

Master Plan because they are not in good condition, not adaptable to current needs or were installed as modular/temporary buildings.

- **Heat Gain and Wind Moderation:** Moderate the solar heat gain on the buildings through glazing selection and orientation, envelope and roof design and screening with vegetation. The prevailing wind primarily comes from the west. The new campus green and pedestrian path would be sheltered by the new buildings and added trees.
- **Landscape Stewardship:** Minimize the disturbance of landscape features when new buildings and infrastructure are constructed. The Master Plan concentrates new development on sites that have already held buildings and paved areas. Buildings would be located on relatively flat land, following the contours to minimize cut and fill. The protected area would not be altered by Master Plan recommendations but remain as native vegetation with pedestrian trails.
- **Appropriate Planting:** Augment the tree cover to moderate temperatures, shade the buildings, enhance stormwater management and absorb pollutants. The new campus green balances the use of lawn for activity areas with native or adapted species for easy maintenance and to reduce fertilizer and pesticide use. Minimize water-dependent landscapes and water intensive plantings that require irrigation.
- **Renewable Energy:** Solar photovoltaic (PV) installations are proposed for parking lots and unoccupied areas across the campus, offering a valuable opportunity to reduce energy costs, lower carbon emissions, and increase energy resilience. However, because solar inverters emit electromagnetic signals that can interfere with sensitive laboratory equipment, careful mitigation is essential to protect mission-critical research activities. To address this, electromagnetic shielding—such as Faraday cages around inverters or equipment—can block radiated emissions.

Current Sustainable Design Policies

The Master Plan promotes an integrated view of sustainability, incorporating federal policies, guidelines and directives and going beyond minimum standards toward creative environmental strategies.

The Master Plan integrates sustainability policies outlined by the Department of Commerce and NIST, referencing other federal sustainability regulations. Included are the *NIST Sustainable Design Manual* (July 31, 2014); the *DoC High Performance and Sustainable Building Handbook* (February 15, 2011), the *DoC Environmental Management System Operations and Implementation Manual* (October 2013), and the *DoC Implementation Handbook for the Strategic Sustainable Building Plan* (June 2013).

Federal regulations currently governing energy consumption, water use, environmental performance, and sustainability in federal buildings include the Energy Policy Act of 2005 (EPAct 2005), the Energy Independence and Security Act of 2007 (EISA 2007), the Energy Conservation and Production Act (ECPA), and applicable provisions of the Code of Federal Regulations, including 10 CFR Parts 433 and 435. These requirements are subject to change and each project will be designed to comply with the federal sustainability standards and regulations in effect at the time of design and construction.

The *DoC High Performance and Sustainable Building Handbook* and the *NIST Sustainable Design Manual* provide the framework for the Department's overall sustainability program, summarizing the Department's program for incorporating sustainable measures into its building assets.

Exhibit 74: Sustainable Design Features



Building Rating Systems

NIST's Sustainable Design Manual, in congruence with Energy Efficiency Standards for the Design and Construction of New Federal Commercial and Multi-Family High-Rise Residential Buildings (10 CFR Part 433), requires certification by a third-party for all major construction or renovation projects, as well as meeting the Design Manual requirements and those of the Guiding Principles checklist. Certification by either the most recent version of Leadership in Energy and Environmental Design (LEED) (Silver level) or Green Globes (two globes) is acceptable. LEED, developed by the United States Green Building Council, and Green Globes, developed by the Green Building Initiative, are both programs to assess building performance and meet broad sustainability goals. They differ in their assessment procedures and emphasis on specific areas of sustainability. Both programs are updated regularly, and current standards should be reviewed with each construction or renovation project.

Labs2Zero (formerly Labs21) is a separate standards program that addresses laboratory buildings. Labs2Zero was created as a partnership between the US Environmental Protection Agency, the US Department of Energy, and the International Institute for Sustainable Laboratories, and seeks to improve energy efficiency and environmental performance of the nation's labs on a voluntary basis (Labs2Zero, 2024). This program bridges the gap in current implementation strategies (i.e., Green Globes, LEED) for sustainable design associated with laboratories. The Master Plan recommends that Labs2Zero be used to design and evaluate the performance of sustainable laboratory facilities.



NIST Boulder

Exhibit 75: Impervious and Pervious Areas, Existing

	Research Zone 1 SF	Research Zone 2 SF	Research Zone 3 SF	Protected Area SF	Total SF	Total Acres
Impervious Areas	34,600	31,800	2,002,900	174,700	2,244,000	52
Buildings	1,100	5,400	609,700		616,200	14
Antenna Field			20,100		20,100	0
Other Structures/Areas		2,500	84,000	1,700	88,200	2
Utility Yard			70,500		70,500	2
Parking/Loading Areas	1,800	5,000	725,900		732,700	17
Road/Sidewalk	31,700	18,900	492,700	173,000	716,300	16
Pervious Areas	476,800	277,900	1,626,100	4,333,800	6,714,600	154
Total Site Area	511,400	309,700	3,629,000	4,508,500	8,958,600	206

Exhibit 76: Impervious and Pervious Areas, Master Plan

	Research Zone 1 SF	Research Zone 2 SF	Research Zone 3 SF	Protected Area SF	Total SF	Total Acres
Impervious Areas	34,600	31,800	1,885,492	174,700	2,126,592	49
Buildings	1,100	5,400	690,946		697,446	16
Antenna Field			20,100		20,100	0.5
Other Structures/Areas		2,500	12,600	1,700	16,800	0.4
Utility Yard			49,682		49,682	1
Parking/Loading Areas	1,800	5,000	582,420		589,220	14
Road/Sidewalk	31,700	18,900	529,744	173,000	753,344	17
Pervious Areas	476,800	277,900	1,743,298	4,333,800	6,832,008	157
Total Site Area (rounded)	511,400	309,700	3,629,000	4,508,500	8,958,600	206



Implementation Planning

9

The Master Plan is a look into the future and a plan to build and renovate facilities to meet current and anticipated needs. Ten+ years is the timeframe for base information and approach for this Master Plan Update, with the recognition that modifications may occur as projects are implemented. The changes have been prioritized and shown as a continuum of construction, rather than structured phases 1, 2, 3. This approach reflects the needs on the Department of Commerce campus, which are not based on gradual growth, but on current needs—research requirements, aging facilities and inefficient operations.

As with any institution, DoC's program of renovation and construction are dependent on many factors, e.g. funding, research and agency-wide priorities. The Master Plan, therefore, becomes a living document, setting a framework that remains flexible and sensitive to the timing and composition of specific projects. The phasing of the plan is organized to meet the following implementation goals:

- The Master Plan is driven by physical and functional needs, with growth integrated as a modest contributor.
- The Plan phases research facility renovations and replacement as a steady process, designed to gradually improve infrastructure and research environments, while minimizing disruptions to research programs.
- The Plan allows great flexibility in the phasing of non-research facilities, because their implementation is independent of the research facility changes. These replacements should proceed when priorities and funding dictate.
- The Plan is able to accept variations in timing and project groupings
- The Master Plan appears "complete" at the end of each phase or significant addition.

The purpose of the Master Plan is to guide future development; it does not represent the pre-approval of any individual facilities project or the specific needs of programs to be accommodated on the campus. The financing of such projects and programs must be addressed within the annual DoC budget process and review mechanisms. Furthermore, the Master Plan is not a commitment for the agency

to build these facilities within a specific timeframe. Sometimes a ten-year master plan becomes a thirty-year plan or a fifteen-year plan, yet the framework for this development remains valid.

9.1 Phasing Priorities

Phasing of the campus projects is flexible, because most of these packages could be implemented independently of the others, and in the order that responds to DoC mission, policy and funding. The Master Plan components are all needed today, to satisfy functional and physical facility need. They are not changes based on incremental growth.

Research facility improvements have been the primary goal of the NIST management and its Space Board, an outlook supported by the currently prioritized renovation/expansion projects in Buildings 1. The Master Plan anticipates that continuing those renovations and new replacement buildings will be the implementation priority. Creating the campus green along with new research buildings will improve the cohesion and visual image of the campus.

Building 1, Wing 3 and Wing 5



Management Resources Center’s replacement of 10 small inefficient buildings with a modern, well-designed building is another significant project. Its implementation will save NIST money for many years through energy savings, maintenance needs and operational efficiency.

Although a smaller project, the Security Center, Parking and Vehicle Screening improvements will address security issues and support the operations of the DoC Boulder Laboratories organization and the NOAA programs. The Coffee Bar is another shared function that will enhance the operations and collaborations of the research community. It is planned with the implementation of Research Building A. Temporary parking may be necessary during certain phases, prior to the construction of the garage.

Exhibit 77: Phasing Packages

Phasing Packages	Major Components	Comments
NIST Research Buildings	▪ Building 1 renovations ▪ Building 3 addition ▪ New research buildings -Buildings A and B, replacing Building 2, 2A & 24 labs ▪ Coffee Bar integrated into Building A ▪ Demolition of Buildings 2, 2A, 23, 24 ▪ Creation of Campus Green, center section ▪ Road/parking modifications; partial removal of center road ▪ New parking garage	▪ Multi-step process to ensure research continuity ▪ Priorities – Preliminary ▪ Building 1, Wing 4 ▪ Building 3 Addition ▪ Building A
Security Center, Parking and Vehicle Screening	▪ Parking lot modification ▪ Roadway and vehicle screening modifications ▪ Addition to Building 51	▪ Independent package; could proceed at any time.
Management Resources Center	▪ New Management Resources Center ▪ Swing space for Building 4, 5 occupants ▪ Demolition/removal of 10 support buildings ▪ Roadway, parking, utility yard modifications ▪ Installation of solar collection field	▪ Independent package; could proceed at any time. ▪ Completion would free up some space in B1
NOAA Research Building	▪ New research building or expansion of Building 34, utility extensions ▪ Roadway, parking modifications ▪ Road/truck maneuvering expansion at Building 22	▪ Independent package; could proceed at any time.
Childcare Center	▪ New Childcare Center, replacing existing Building 26 ▪ Landscaped play areas ▪ Removal of remainder of the center road & relocation of Curie Circle ▪ Completion of Campus Green	▪ Independent package; could proceed at any time. ▪ Surface parking lot lost
Wildfire Planning	▪ Shelter-in-place modifications to Building 1 Conference Center ▪ Shelter-in-place modifications to Building 81 Conference Center ▪ Shelter-in-place facilities added to new buildings	▪ Building 1 and Building 81 modifications are independent packages ; could proceed at any time ▪ New buildings would integrate into construction projects; gradual implementation
Other	▪ Storage Building, CUP expansion , misc. site and stormwater improvements	▪ Independent ; proceed as needed

The site plan illustrates the layout of the University of Utah Health Center. Key features include:

- Legend:**
 - Existing Building (White outline)
 - Proposed Renovation (Orange outline)
 - Proposed New Construction (Red outline)
- Buildings and Areas:**
 - Existing Buildings:** 8, 12, 27, 33, 41, 42, 81, 92.
 - Proposed Renovation:** 3, 22, 34, 45.
 - Proposed New Construction:** 9, 51.
 - Other Features:** Antenna Field, Solar Field, BUILDING 1, 27th St., 28th St., 29th St., Ash Avenue.
- Scale and Orientation:**
 - North Arrow pointing up.
 - Scale bar: 0, 60', 120', 240'.



9.2 NIST Research Building Phasing Package

Components:

- Building 1 laboratory renovations, Wing 4 and the Spine. Renovation of Wings 1 and 2 will follow.
- Building 3 Addition
- New research buildings A and B
- Demolition of Building 24
- Creation of the Campus Green
- Road, parking modifications; partial removal of the center road
- New parking garage
- Coffee Bar

Implementation Steps

1. **Planned Renovations.** Implement planned renovations to Wing 4 and the Spine in Building 1. The modernization and renovation of Wing 5 is a priority project and currently is funded through the design phase. NIST is planning to reserve swing space in Building 1 as space is reassigned after renovation. Renovation of Wings 1 and 2 and the Spine will follow.
2. **Construction of New Laboratory Buildings.** The replacement laboratories are shown as two buildings and an addition to the CTL labs in the now-renovated Building 3.

At this time, the first research building planned for construction is the Addition to Building 3, followed by phased construction of Building A.

3. **Phasing of Construction for Building A:** Relocate personnel and research project from Buildings 2A and 2 to planned swing space in Building 1, and demolish in stages (sections 1951, 1986, 1995, and 1964) as needed to construct Building A while keeping the research functions in B2 and B2A operational. This demolition will require modified and/or temporary building systems, and re-routing of the services coming from the utility tunnel. The POR for Building A contains a proposed and detailed phasing plan.
4. **Coffee Bar.** The Building A project should include the coffee bar in the first phase of construction, conveniently located for NIST, NTIA, NOAA and campus visitors.
5. **Demolition of Building 24.** CTL occupies approximately two-thirds of the space in Building 24 and these labs and functions will be accommodated in the B3 Addition. Building 24 should be demolished after B3 Addition is occupied if temporary locations can be found for the remaining labs and offices (MML and PML). OR, the building systems should be modified to run efficiently until the remaining occupants move into the new Building A.
6. **Creation of Campus Green.** After construction of the laboratories, the center road from the Building 81 to Compton Road will be removed, and the intersection modified at Building 81. Compton Road will remain. The pedestrian walkway, the plaza by Building 81 and terraces/sidewalks by the new buildings will

be implemented. The plantings and the stormwater swale will be constructed in this area.

7. **Parking.** The parking structure will be constructed to the north of the new research building, as part of the Research Building A project.

Disruption

- Continuity of research programs is required.
- The B3 Addition can be isolated from most pedestrian circulation. Staging area around B3 Addition will need to be created, and the access to B3, B112, and B42 will need to be kept clear for services and deliveries. Connection of the addition to the existing B3 will require careful coordination to limit disruption to the B3 occupants and the building services to be shared. Building 23 will be demolished
- Wing renovations within B1 will have only minor disruption within the building, but contractor parking will impact employee parking near the building. Spine renovation must be done in stages to control disruption to building circulation and services.
- The center road will be kept open during building construction.
- Temporary access and protections will be required for the staff working in the remaining B2 sections during the construction of the new research buildings. Temporary parking will be needed if construction on the B24 lot precedes the construction of the garage.

Links to Other Projects

The Childcare Center replacement will be adjacent to Building B. A shared drive should be planned with the design of Building B to have combined vehicle access for Building B service and Childcare Center drop-off. This will minimize paved areas and maximize flexibility for children's play areas. (This assumes that Building B precedes the Childcare Center construction.)

Exhibit 80: Security Center, Parking and Screening Implementation



9.3 Security Center, Parking, Vehicle Screening

Components:

- Addition to the Security Center, Building 51
- Roadway and vehicle screening modifications
- Parking lot modification, unscreened parking
- New sidewalk connections for visitors and bus riders

Implementation Steps

1. Parking and Screening. Modifications to the circulation, visitor parking and Security Center addition should be completed as one project and are not dependent on any other campus actions.

Disruption

- Reconfiguration of the screening entry, guard booth relocation, and roadway widening will slow peak time circulation. Phasing and temporary driveways are anticipated.
- Parking will be disrupted when the parking lot and access road is reconfigured, which can be minimized with phased repaving and striping.



9.4 Management Resources Center Phase

Components:

- New Management Resources Center
- Swing space for Building 4 and 5 occupants
- Demolition/removal of Buildings 3A, 4, 5, 21, 25, 25MI, 91, 111, 112
- Roadway, parking, utility yard modifications

Implementation Steps

1. The location for the Management Resources Center is shown on the footprint of the existing Buildings 4 and 5 because it is the best final location for both pedestrian and vehicular circulation, and completion of the campus green. This means that swing space is needed for the occupants of Buildings 4 and 5. The NIST database reports 22 people assigned to these buildings at the time of this report. Building 5 contains occupied office space. Building 4 contains office area and storage that needs to be relocated (warehouse is suggested).
2. Construction of the Management Resources Center could proceed in two steps, with the administration section constructed first to allow Buildings 3A and 111 to remain occupied, followed by the support section after the office staff from 3A and 111 are moved into the Center. It would be more efficient to construct both sections simultaneously if swing space could be found for the office staff.
3. The 10 support and office buildings will be demolished or removed after the Center is occupied, and the drive, parking and maintenance yard modified. The buildings must be demolished to remain under the SF cap agreement with the City of Boulder.
4. A solar field is proposed on the site that will become available after demolition of Building 25.

Disruption

- Staff in Buildings 3A and 111 will need to be protected if they are not relocated. (Note that both buildings could potentially be moved.)
- A new storage building will be constructed on the adjacent utility yard prior to construction of the Management Resource Center. This must be protected during construction of the Management Resource Center and possible staging use of the utility yard.

Links to other Projects

Curie Circle, the road that loops around existing Building 5, remains in place until the Childcare Center is replaced and relocated. The new access to the CUP Building 42 can be modified with this project, or deferred until Curie Circle is rerouted.

Exhibit 82: NOAA Research Building Implementation



9.5 NOAA Research Building Phase

Components:

- New research building or expansion of Building 34
- Utility extensions
- Roadway, parking modifications
- Road/truck maneuvering expansion at Building 22

Implementation Steps

1. Building 34 currently is underutilized, and the relocation of some equipment and adjacent Conex containers would allow for the Building 34 expansion or reconstruction into a new facility and the related parking and site modifications.
2. Curie Circle, as it passes by this site and the Warehouse Building 22, should be modified during this Research Building Phase, to provide more maneuvering distance for trucks at the Warehouse.

Disruption

The location shown in the Master Plan would allow the existing satellite dishes to remain in place, if they are protected. The final size and design of the NOAA facility may require that these dishes be moved.

Exhibit 83: Childcare Center Implementation



9.6 Childcare Center Building Phase

Components:

- New Childcare Center, replacing existing Building 26
- Landscaped play areas
- Removal of remainder of center road & relocation
- Completion of Campus Green

Implementation Steps

1. Construction of the Childcare Center, play area with drop-off and temporary parking. To minimize the paved area around the Center and near the campus green, parking should be limited to temporary parent parking, with staff parking in the garage or in the adjacent NOAA parking lot (crosswalk to be added.)
2. With the removal of the existing Childcare Center building, the western segment of Curie Circle can be relocated, which can link to the campus green. This could become a future building site if the square footage cap increases.

Disruption

The Childcare Center will be constructed on an existing parking lot. The site should be adequate for construction staging.

Links to other Projects

The vehicle entrance and drop-off should be coordinated with the service access to the planned Building B, which will be adjacent.

9.7 Wildfire Planning

Components:

- Shelter-in-place modifications to Building 1 Conference Center
- Shelter-in-place modifications to Building 81 Conference Center
- New building shelter-in-place facilities – gradual implementation
- Site and landscape interventions

Implementation Steps

1. NIST to initiate a detailed study to develop a strategy for implementing shelters-in-place, including notification and operational policies, physical facilities needed, and necessary building and system modifications.
2. Renovate the Building 1 conference area to allow separation of physical space and engineering systems, and the necessary hardening. Add a kitchenette and food storage area. Expand or replace the toilets to increase capacity. To accomplish this, consider the renovation of the office block within the conference center wing.
3. Renovate the Building 81 conference area to allow separation of the physical space and engineering systems and the necessary hardening. Building egress will need to be modified.
4. For new buildings, ensure that shelter-in-place requirements are included in the program, budget and design documents.

Disruption

Renovations within Buildings 1 and 81 will need to be phased, particularly for the changes to the engineering systems.

Links to Other Projects

- Building 1 renovations may be integrated with planned renovation of the Spine, if the timing is appropriate.
- Shelters in new buildings will be integrated into the overall projects.

Exhibit 84: Proposed Campus Shelters-in-Place



Design Guidelines

10

The Master Plan, as a physical framework for development, was formed around core design and organization principles that address the goals for a future DoC Boulder Laboratories Campus. The NIST Space Board and administration selected a physical Master Plan concept in 2017 that created a sense of place, met their functional goals and added flexibility for growth and change. This 2025 Update maintains those foci and features and reflects current needs. The design guidelines highlight the key characteristics that would maintain those opportunities.

Creating a sense of place and a coherent, functional campus at the Boulder Laboratories requires a consistent design focus and a set of flexible rules. The illustrative plan indicates the preferred Master Plan growth but recognizes that there needs to be flexibility in its implementation. The design guidelines are the tools that anchor the design principles for a cohesive whole.

These guidelines are intended to provide specificity to ensure the creation of a family of related buildings and open spaces yet provide flexibility to allow designers creative latitude in responding to aesthetic and programmatic issues. Although many architects and landscape architects resist the constraints of guidelines, these guidelines are intended to highlight the key elements that met Department of Commerce objectives, shaped the Master Plan and led to the selection of the final concept. The guidelines are intended to support creativity, and allow the designers to shape each building and site improvement to meet the program and focus at the time of implementation.

These design guidelines cover several different design elements:

- Open Space
- Architecture
- Landscape
- Circulation and Parking
- Security

These guidelines are specific to the Boulder campus and are intended to supplement any Department of Commerce standards and policies, as well as requirements and agreements with outside agencies. Specifically, the

campus is bound by two agreements with the City of Boulder: a) The First Amended Irrevocable Easement in Real Property; and b) First Amended Memorandum of Agreement, both finalized on May 8, 1998. The campus has important research and building history. This should be honored with creative design reflecting the historic context and the Secretary of the Interior Standards, especially for the views, buildings and landscape proximate to Building 1.

10.1 Open Space Guidelines

The campus plan identifies several distinct open space zones, each with different functions and characteristics. Their organization, components and landscape character further distinguish and define the areas.

Campus Green and Walk

The campus green serves to visually unify the campus with a center focus and provide physical organization for new buildings. It will create the “campus feel” within the heart of the DoC complex. The green is intended to form the foreground for the existing and new research buildings and reinforce linkage and collaboration. Landscaping will create areas for outdoor dining, recreation and gatherings. A pedestrian pathway will connect the central buildings, paralleling the internal circulation within them. This pedestrian path should have distinctive paving, be easy to maintain and designed to support occasional maintenance and emergency vehicles.

Public Zone

Creation of a Public Zone preserves the vehicular security perimeter on campus, while welcoming professional colleagues and interested public to conferences and educational programs. NIST, NOAA and NTIA want to support these events held on campus by easing the restrictions and time required for visitors to get passes and screen their vehicles. The Security Center building will be expanded to better process visitors for conferences and tour, screening each person and his or her belongings, as is done in other federal buildings. Separate

visitor parking will be located nearby. Key features of the Public Zone include:

- A parking area for visitors will be separated from the internal circulation on campus and available without vehicle screening. Physical barriers, such as large boulders, must prevent cars from driving onto campus roadways from the parking area. Staff may use this parking lot when there are no conferences planned.
- A driveway and signage at the main entrance will indicate the visitor parking area and clearly distinguish this activity from the vehicle screening area for those bringing their vehicles on campus.
- Connections to the bus stops and bicycle trails at Broadway should be enhanced, including safety improvements at Rayleigh Road and bicycle parking for visitors.
- Walkways, landscaping and signage must guide visitors and visually define the public zone.
- Another public zone will be the Coffee Bar in the campus core. Its service, with indoor and outdoor seating, will be available to both staff and visitors without badging in.

View of the Mesa from Entrance at Broadway

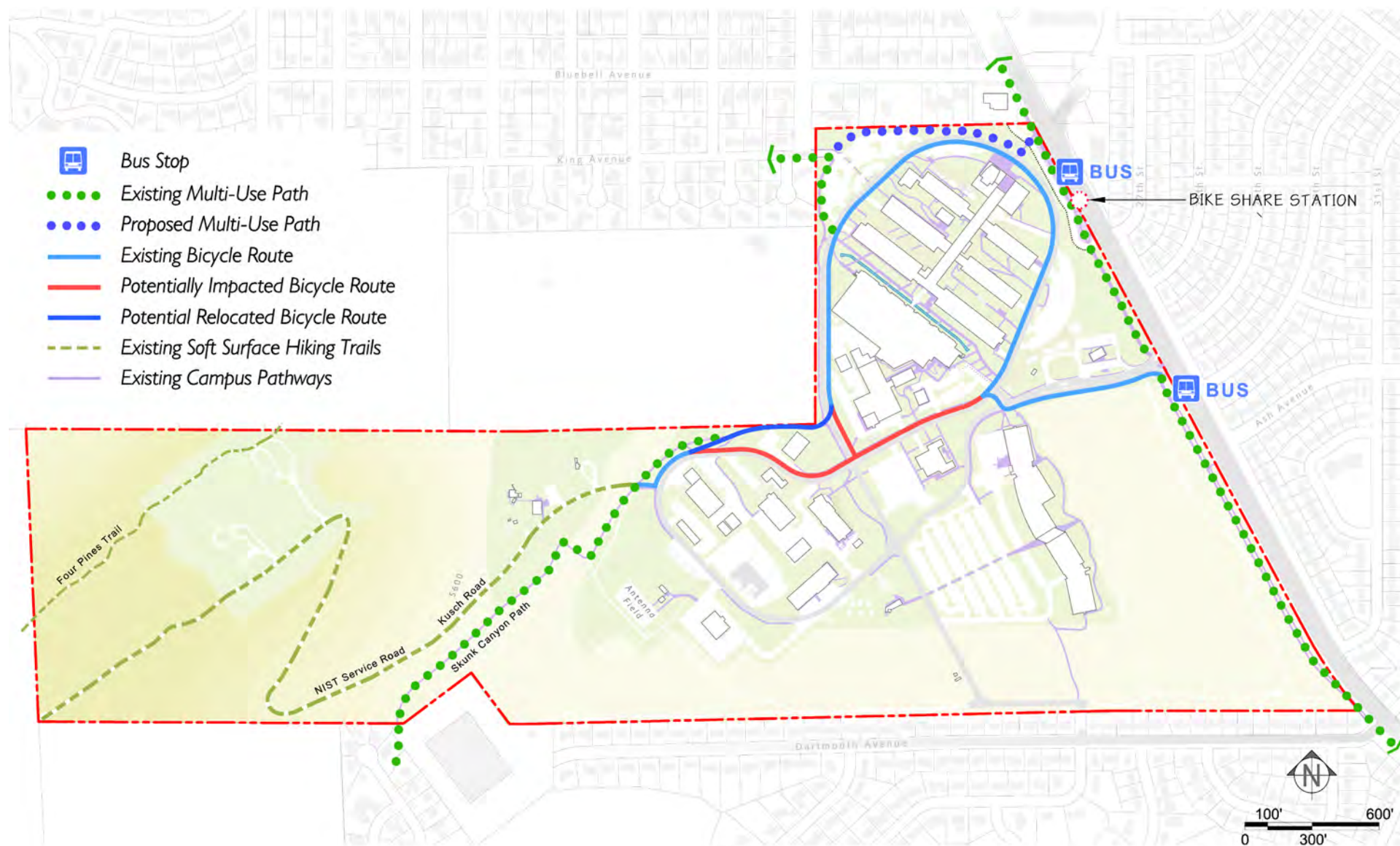


Community Context and Campus Zones

NIST and the Department of Commerce have several agreements with the City of Boulder and a consortium of Native American tribes, described in the Background section. The Master Plan follows the guidelines and restrictions of these agreements, and these must be maintained in the design development of any of the proposed facilities unless a new agreement is in place. Key elements:

- Protected Area, a 103.5-acre undeveloped buffer with the surrounding neighborhood
- Public views of Kohler Mesa maintained from Broadway
- Access to bicycle and pedestrian trails in the Protected Area
- Limits on the site buildout square footage, number of parking spaces and building height
- No perimeter fencing around the Protected Area
- Buildings must follow building codes, and the city has a review and comment period on any development of 10,000 square feet or more.
- See the agreements for more details and other requirements.

In addition to meeting requirements, the DoC wants to be a good neighbor and maintain the natural character of the DoC campus. Considerations include screening loading docks and equipment areas, full cut-off luminaires for exterior lighting, mitigation of any noisy equipment, trip reduction planning, screening of parking areas, etc..



10.2 Architectural Guidelines

The architectural guidelines of the Master Plan define the form, bulk, and locations of the principal buildings, the organization of the circulation within the buildings, and the principal design considerations for the building façades. The diagrams indicate principles, not designs.

Building Organization/Geometry

The organizing principle of the plan is a connected, linear arrangement that gently curves up the hill, unifying the independent buildings and surrounding a central campus green. The linear arrangement recognizes the two underlying grid patterns of existing buildings—anchoring the major new research buildings in the geometry of Buildings 1 and 81 and engaging the grid of the independent buildings as they sweep up the hill. To accomplish this and achieve a demonstrative impact, the Master Plan sets guidelines for the placement of buildings and the alignment of façades.

- The new and existing buildings should be seen to frame the campus core, with the green as a foreground. Each building becomes an important part of the campus, and its organization and wayfinding are apparent.
- Minimizing the gaps between buildings will better define the green and unify the buildings and strengthen pedestrian connections.
- Façades along the north side of the campus green are anchored by a connection to Building 81, and then gently curve to the north. Connectivity is maintained.
- The Management Resources Center is aligned with the underlying grid pattern of the independent buildings.

Exhibit 86: Building Connectivity - Section Looking North



Exhibit 87: Existing Site Geometry



Exhibit 88: Central Campus Geometry



Building Organization/ Massing

Massing guidelines help to define important spatial relationships between buildings and open spaces. They define building form and the corresponding outdoor spaces of the campus—relating the bulk and placement of new buildings to existing buildings, topography, and the sun.

Simple and flexible building envelopes are preferred, creating buildings that can accommodate different research configurations over time. For most of the buildings, simple and straightforward clues to the important components of the building—its entrances, ground floor use, and internal circulation—are encouraged. The laboratory massing diagrams generally indicate simple building forms, which is in keeping with the modular nature of laboratory construction. Flat roofs are generally shown, as these will be used for mechanical equipment.

Massing Guideline—Orientation

The Master Plan evolved to establish an order to the various buildings on the Boulder Campus. Its gentle curve achieves the objective of bringing order, but it presents some challenges in controlling the sun as the orientation of the façade changes. A sun control system that provides deep vertical baffles on the east then transitioned to shallow vertical but deep horizontal baffles on the south and then back to deep verticals on the west should be considered to address the challenge.

Massing Guideline—Building Heights

Maximum building heights must be in conformance with guidelines established with the City of Boulder and the MOA. Buildings may not exceed 55 feet in height when measured in accordance with Section 84 of the Boulder City Charter and may not impair the view of the top one-third of Kohler Mesa, as seen by a person standing on Broadway.

Along the northern edge of the campus green, building heights are proposed to be two stories plus an architecturally designed mechanical penthouse. Penthouses on the northern edge of the greenway are encouraged to be integrated with the primary façade of the buildings so that the additional height can help define the perimeter of the greenway.

Massing Guideline—Floor to Floor Heights

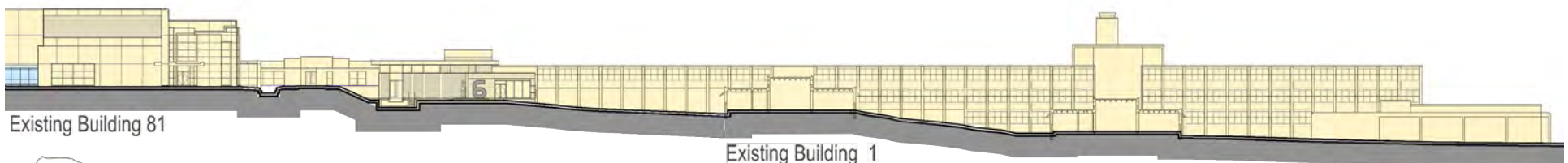
Occupied floors of buildings should be established at the same elevations as in the adjacent buildings to allow continuous internal circulation and enhance connectivity between building elements and research programs.

Building Connectivity

The purpose of the building circulation guidelines is to organize movement through the campus buildings in a way that supports efficiency and a sense of orientation, as well as encourage interaction and sharing of resources.

Connection between research buildings is one of the core principles of the Master Plan. The Katharine Blodgett Gebbie Laboratory Building 81 is the gateway to the new laboratory Building A, and the existing connection to the Radio Building 1. New research buildings will be linked by a continuous pedestrian walkway from the west side of Building 81. Across the campus green, both Building B and

Exhibit 89: Building Connectivity



Building 3 Addition will be linked into the pedestrian walkway. Key design considerations include the following:

- Covered connections should be provided when enclosed physical links are not practical or desired. Any covered grade level connections across the wide pedestrian path in the green (or a road) must have a minimum vertical clearance of 13'6" to allow for the passage of emergency vehicles.
- The campus terrain rises to the west. Connections between research buildings must be maintained even if a level change is necessary.
- Inviting access to the Coffee Bar should extend to both NOAA and NIST/NTIA facilities. A covered or enclosed connection to NOAA's Building 33 is not envisioned, but a crosswalk and path-way must be provided.
- Connection does not imply sameness. Distinguishing characteristics should assist in orientation and wayfinding as one passes from one building to another.

Exhibit 90: Master Plan Geometry



Daylight and Views

The nature and organization of the research buildings and the important emphasis on connection means that orientation for daylight and views is not ideal in the Master Plan, but welcoming daylight into the buildings is a DoC goal, both for employee well-being and energy savings, with the following recommendations:

- Generous windows are assumed for personnel-oriented spaces such as offices and workrooms in research, administration, and support buildings. High vertical window dimensions, paired with high ceilings are preferred, to maximize daylight penetration.
- Windows should be appropriately shaded for their orientation to prevent glare. In general, enclosed offices and spaces should not be located along the windows; instead, open work areas should face the windows.
- NIST has not introduced daylight into its research laboratories, but it should be discussed in depth when specific facilities are designed. Many research protocols are light and temperature-sensitive so some researchers do not want windows in their labs.
- Some research laboratories, like those for the Communications Technology Laboratory, are computer oriented. Much like office space, these labs could benefit from natural light, but it is critical that glare, intensity and reflections be controlled.
- Windows, roof monitors and/or skylights should be used to illuminate circulation areas when practical.
- Daylight should be the primary illumination for the Management Resources Center and the Childcare Center, supporting the goal to be net-zero facilities.
- High performance glazing with high visual transmittance should be used.

Views to the Flatirons are magnificent and should be celebrated in building and site design. During the design of these buildings, internal organization and component locations will need to balance Flatiron views with the more immediate view of the landscaped campus green. Designers should seek opportunities to capture Flatiron views, especially in shared use facilities such as conference rooms. The Management Resources Center has the location and orientation to achieve this.

Façades

Façade guidelines are based on proportion and scale, areas that require focus, and the use of materials. The building façades facing the campus core and entry will be important walls defining the outdoor spaces of the campus and are thus just as important as the ground plane in establishing the quality of these spaces.

Principles for façade design include several key considerations:

- Human scale: Because pedestrian circulation through the campus is encouraged, the building façades facing the important campus open spaces should maintain a design scale, rhythm, proportion, and detail related to the pedestrian.
- Response to context: An important design issue is the integration of the new buildings into the existing campus context. The massing guidelines begin this integration by requiring compatible building heights and footprints to maintain views and light to all buildings. Building façade materials can further assist this integration. The campus material vocabulary is a mixed palette of natural stone, precast, glass, and metal. Incorporation of Lyons Sandstone is recommended—a local indigenous material used extensively in the Boulder area and on several campus buildings.
- Response to environment: The orientation of the varying façades to the sun, and the effects of shading on the façade are important design determinants. Consideration of orientation represents a systematic and environmentally sound approach to building design. The building design responds directly to the environmental conditions with a corresponding reduction in energy use and operating costs.
- Visual interest. Variety and pattern enliven the larger and research buildings on campus, and the smaller and support buildings deserve the same design consideration. New buildings and structures, however small, must receive review and approval by the NIST Design Review Board for design as well as technical features. One existing building, 92, should be studied for façade improvement. With its prominent place on campus, the building presents a solid, unadorned, brick façade, flat roof, and surrounding black fence.
- Wildfire considerations. Buffer zones of non-combustible materials are to be created around buildings for a minimum of 5 feet.

Typical Campus Lyons Sandstone Façade Materials



Building 3 Façade, Contemporary Building Materials



10.3 Landscape Guidelines

The goal of the landscape approach and treatments is to unify the campus, minimize the irrigation and maintenance, enhance wildfire resiliency, and create a place richly evocative of the natural setting. Landscape guidelines, in the campus context, go beyond plantings, to include the campus walkways, site furnishings, and signage. The Landscape Chapter provides further description, definition and design intent for the items below.

Design Language

The design language for the landscape and campus green should blend a contemporary design aesthetic that expresses the technological research mission with a naturalistic aesthetic that emphasizes the “soft” features of the campus’s natural setting with ecologically functional plantings.



Hardscape

The design language for the hardscape is inspired by the warm colors and rugged durability of the natural stone and trails that surround the site. A combination of natural materials such as stone, gravel and crushed stones combined with durable constructed materials like corten steel, poured-in-place concrete, and unsealed asphalt all help to create a unified campus in harmony with its context. The use of materials and finishes that do not require frequent maintenance or repair is a priority. The rustic character will permit a high degree of weathering and wear before elements appear neglected. Cast-in-place concrete structures can have a rough-hewn appearance depending on the type of form work and finishing applied. The irregularities that appear in the surface of the concrete are desirable in the rustic vernacular. This design language is further expressed in these principles:

- **Use Maintainable, Durable Materials:** Use cost-effective materials such as concrete with saw-cut joints, unit pavers, stone, crushed stone, and asphalt.
- **Protect Equipment:** When design or utility elements are introduced in landscaped or paved areas, they must have a base that resists damage from snow removal and mowing equipment.
- **Use Consistent Colors & Patterns:** A consistent color palette of warm grays (in varying hues), browns, and rusticated steel provides a range of colors that are easily available across a range of materials.
- **Vary Materials to Express Site Hierarchy:** Different hardscape materials can express the hierarchy of spaces and pedestrian circulation, integrating wayfinding into the design itself. For example, the central pedestrian plaza may use unit pavers with a strong graphic pattern such as stripes, while sidewalks and other secondary circulation can use scored concrete.
- **Mix Hard and Soft Materials to Reduce Scale of Large Paved Spaces:** Break up large expanses of hard paved areas with crushed stone joints, edging, or seating areas.

Wildfire Considerations

To reduce wildfire risk and enhance campus resilience, landscape design at the NIST Boulder campus must incorporate wildfire mitigation strategies focused on fuel reduction and defensible space. Plant selection should prioritize low-flammability, drought-tolerant native species that are appropriately spaced to prevent fire spread. Maintenance practices must include regular removal of dead vegetation, thinning of overgrown brush, and pruning of lower tree limbs to eliminate ladder fuels. Incorporating non-combustible materials such as gravel, stone mulch, and irrigated lawn areas around buildings and along key perimeters can serve as effective firebreaks. These measures should be integrated into a long-term maintenance plan and coordinated with local fire management guidelines to ensure continued effectiveness and safety.

Gradient of Vegetative Zones

Creating a subtle gradient between the wild landscape surrounding the campus and the structured spaces of the campus itself is a key principle of this master plan. Three distinct vegetative zones are proposed. Along the perimeter of the campus, a predominantly native zone is recommended. This area would remain unirrigated and rely on drought-tolerant clusters of pines and junipers, which can screen views of parking lots and adjacent neighborhoods while minimizing maintenance. In addition to supporting ecological continuity, this zone should be managed to reduce fuel loads and maintain defensible space, including strategic thinning of trees and removal of ladder fuels to protect the campus from potential wildfire encroachment.

Two more structured vegetative zones are envisioned for interior campus spaces between buildings. These areas will still feature native species, but plantings will be more formal in layout. Exhibit 53 in the Landscape chapter outlines the placement and principles of each zone. Several key guidelines inform the establishment of this native-type vegetation:

- Use a high percentage of visual essence species: To reflect natural woodlands, use large quantities of dominant native plants. Key canopy species include Ponderosa Pine and Rocky Mountain Juniper. Groundcover should include grasses such as mountain brome (*Ceratochloa carinata*), needle and thread (*Hesperostipa comata*), green needlegrass (*Nassella viridula*), and mountain muhly (*Muhlenbergia montana*).
- Make the patterns visible: Natural woodland patterns should be emphasized through denser and more deliberate planting arrangements. For example, while wild asters may occur loosely in nature, planting them in tighter clusters of five to seven can create a stronger, more legible visual impact.
- Restrain the height of plantings: Keeping grasses within a height range of 18–36 inches enhances legibility, supports visibility, and maintains compatibility with defensible space strategies by reducing the accumulation of fine fuels near structures.



10.4 Circulation and Parking Guidelines

The Master Plan proposes a change to the campus circulation system, retaining the loop roadway “behind” the major buildings and preserving the center of campus for pedestrian circulation and outdoor use. In general, parking areas are accessed from this loop road.

Roadways

Roadway design should be standardized for the entire DoC campus in terms of geometrics, curb profiles and pavements. The following are some of the specific recommendations:

- **Intersection Geometrics:** When possible, configure intersections with approaches perpendicular to one another at right angles in order to improve visibility for motorists, bicyclists, and pedestrians at the intersection.
- **Roadway Cross-sections:** The current roadway widths of 26 feet are adequate for campus use. This could be reduced to 24 feet in width for newer roads. The corresponding lane widths will be 13 feet and 12 feet respectively. Standard six-inch curbs with 18-inch gutters are recommended for use in most areas of campus. Standard curbs provide the requisite protection and guidance for vehicles that may veer from the roadway potentially into pedestrian areas while providing needed channelization for runoff.
- **Mountable curbs** are only recommended in those locations where vehicles would be expected to cross the curb line on a regular basis (for instance near areas where trucks may need to mount curbs for maneuvering purposes or locations in which campus personnel or security may need to regularly access off-road areas). Curbs of 3-3/8 inches in height with 14-inch gutters are recommended, similar to those recommended in City of Boulder standards.
- **Special Pavement Design:** The central spine roadway between Buildings 3 and 26 (dividing the central campus) should be limited to bicycle, pedestrian, and emergency traffic. It should be noted that this would cause some additional circulation for vehicles accessing the new parking garage behind Building 81. However, it would preserve the central part of the campus as a more pedestrian and bicycle oriented space. Textured pavement

could also be used with speed tables incorporated to slow traffic should this roadway remain open to through traffic.

- Select pedestrian pathways (based on fire codes) should also adopt textured pavements and utilize construction that allows access by emergency vehicles as and when needed.

Parking

On-campus parking will be provided in existing surface parking lots, proposed lots near new buildings and a proposed two or three-level parking structure associated with new research building construction. The new parking structure is anticipated to be the primary parking for the new research buildings, located less than a five-minute walk away from each. Accessible parking for people with disabilities should be located as close to the campus buildings as possible. On-street parking should be prohibited along all roadways.

The First Amended Memorandum of Agreement between the National Institute of Standards and Technology, US Department of Commerce and the City of Boulder, Colorado (May 1998) sets a limit on the number of parking spaces on the campus at 1802 spaces, which is not exceeded in the Master Plan.

Parking is a part of the daily experience on campus and should be well organized with pedestrian walkways, shading and visual screening. Specifically, these features:

- A high percentage of deciduous tree cover should be utilized to shade vehicles and reduce the heat island effect of large, paved areas. Light colored paving and permeable paving should be used whenever practical.
- Parking structure design should seek to reduce energy consumption and enhance the user experience by introducing natural light through light wells and openings, and by utilizing natural ventilation.
- Electric vehicle charging stations should be included in the garage, in accordance with government regulations.
- Locating secure and/or heated parking space in the garage should be planned, to accommodate specialized maintenance vehicles that would otherwise require separate enclosed parking elsewhere on campus.

- Solar panels should be considered over the upper level of the parking structure and over existing/new surface parking.
- Parking lot design should optimize the layout for snow removal, considering plowing patterns and locations to pile the removed snow. Walkways must drain properly, to minimize icing.
- Best management practices for localized stormwater management should be incorporated.
- Pedestrian circulation should have dedicated walkways through the parking lots and the parking structure.
- Temporary parking lots should be identified early in the planning for each construction project.

Bicycle Storage

The DoC Boulder Laboratories Campus has a fairly large number of bicycle commuters. Over 11% of the respondents in a 2024 employee survey indicated that their primary mode of transportation is

Bicycle Shelter - Replace to Blend with Campus Aesthetic



bicycle, and 50% of respondents responded that bicycle parking/shelters should be enhanced. Campus facilities personnel indicated that many of the bicyclists bring their bicycles to their offices against campus policy primarily because:

- Absence of bicycle lockers proximate to their offices
- Perception that the outdoor bike racks are insecure

The following guidelines are recommended:

- New buildings and major renovations should integrate indoor bicycle storage spaces with direct access from outside or nearby sheltered areas. For larger buildings, multiple storage areas could be considered to improve convenience of access.
- Outdoor bicycle shelters should be designed to blend into the campus setting and architectural aesthetic. A standard should be developed and existing shelters replaced to conform.
- Integrated bicycle storage areas should be secure and where possible, include individual lockable units.
- Shower and locker facilities proximate to integrated bicycle storage rooms should be considered.
- Bicycle racks shall also be provided close to building entrances for temporary parking.

The total capacity of the indoor bicycle storage and outdoor bicycle racks should be equivalent to 15-20% of the projected building population.

Bicycle and Vehicular Roadway Intersections

The campus frontage has two curb cuts on Broadway: the main campus entrance (Rayleigh Road) and the Medical Center Drive. A bicycle path runs along this frontage that intersects the curb cuts at both entrances at 90 degrees. In 2020, the City of Boulder, working with NIST, modified the campus entrance from South Broadway with a new turning lane and traffic signal. The bicycle path was rerouted for better lines of sight for both drivers and bicyclists. The new configuration encourages bicyclists to slow down, and the traffic signal controls movement for cars and bikes.

10.5 Security Guidelines

The Department of Commerce Office of Security (OSY) is responsible for the physical security on the Boulder Laboratories campus and must be included in the planning of the new and renovated facilities. Following is an excerpt from the OSY Security Standards for Construction Projects, in effect at the time of this Master Plan.

“Including the Security organization in the requirement development, planning, design and build out phase of all construction projects is essential to ensure physical security standards are considered to provide risk-managed protection to facilities, information and most importantly personnel. The inclusion of the Security organization within the early stages of design through construction ensures regulatory and risk-based security measures and considerations are incorporated in the initial project requirement process and supplant the need for costly change orders that often have impact to budget, schedule or performance. The Security organization should review all related construction documents/drawings/specs and be included as a member of the construction project team from the early onset of the project. In addition, consultation with the Security organization facilitates early discussion and planning for contract employee background investigation and access requirements.

“For new construction and major renovations, the security organization must conduct a project-specific risk assessment during the requirements definition phase and recommend countermeasures and design features to be included in the design specifications. This risk assessment should include the proposed Facility Security Level of the facility, which will be used to identify minimum security countermeasures as recommended by the Interagency Security Committee.”

Campus Analysis



Regional Analysis

11

11.1 Regional Context Overview

The Department of Commerce campus in Boulder, Colorado is located in the southwestern part of the City of Boulder, at the base of the Flatiron Mountains. The region in general and the City of Boulder in particular, are widely recognized for an educated workforce, the University of Colorado Boulder (which is one of the nation's top ranked public research universities), and a robust economy featuring diverse industries that include aerospace, bioscience, cleantech, IT/software, natural products and outdoor recreation. The regional setting of the campus, in many ways, has implications for its future development in many ways.

This chapter describes the campus' regional contexts as it relates to:

- Geopolitical divisions
- Demographics and socioeconomics
- Institutional environment
- Business environment
- Regulatory authorities
- Transportation infrastructure
- Built environment
- Natural environment

11.2 Geopolitical Divisions

Denver-Aurora-Greeley Combined Statistical Area (CSA):¹

The Denver-Aurora-Greeley CSA comprises the Denver-Aurora-Centennial, CO Metropolitan Statistical Area (MSA), the Boulder, CO MSA, and the Greeley, CO MSA. It consists of the counties of Denver (includes City of Denver), Arapahoe, Jefferson, Adams, Douglas, Broomfield (includes the City of Broomfield), Elbert, Park, Clear Creek, Gilpin, Boulder, and Weld. According to the Census Bureau's 2024 estimates, the Denver-Aurora-Greeley CSA is the seventeenth most populous CSA in the nation.

Boulder County: Boulder County is home to nearly 327,000 residents and includes some of the most diverse natural landscapes and sustainable development along the Front Range. From visionary open space, land use and sustainability policies to forward-thinking public services programs, the county government helps foster a vibrant, healthy, and active community. The county seat is the City of Boulder. Other incorporated towns and cities include Erie, Jamestown, Lafayette, Longmont, Louisville, Lyons, Nederland, Superior, and Ward. The county also comprises the Boulder MSA.

City of Boulder: The City of Boulder is the largest municipality in Boulder County. It is located about 30 minutes from downtown Denver and 45 minutes from one of the nation's largest international airports. Boulder has a vibrant economy representing a diverse array of industries, including aerospace, bioscience, cleantech, IT/software, natural products, outdoor recreation, and tourism. Besides those housed in the Department of Commerce Campus, the city also has about a dozen other federal research laboratories including the University Corporation for Atmospheric Research (UCAR).

1. Combined Statistical Areas (or CSAs) are based on social and economic ties measured by commuting patterns between adjacent MSAs. Typically, each CSA is a collection of adjacent metropolitan/micropolitan statistical areas (MSAs). The primary distinguishing factor between a CSA and an MSA is that the social and economic ties between the individual MSAs within a CSA are at lower levels than between the counties within an MSA.

Denver Regional Council of Governments (DRCOG): The Denver Regional Council of Governments (DRCOG) was created to foster collaboration and cooperation among the communities of Adams, Arapahoe, Boulder and Jefferson counties. It was created circa 1955 to talk about joint issues and concerns as the region was in the midst of a post-World War II growth spurt. It is one of the nation's three oldest councils of governments. The Council has instituted the Metro Vision regional growth and development plan, which defines goals and actions needed to ensure the vitality of the region. It is essentially a planning organization where local governments collaborate to establish guidelines, set policy and allocate funding in the areas of transportation and personal mobility; growth and development; and, aging and disability resources.

Exhibit 92: Regional Context

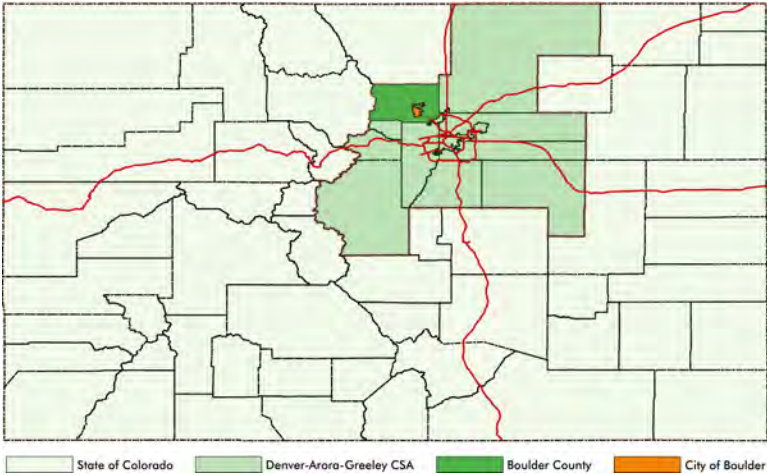
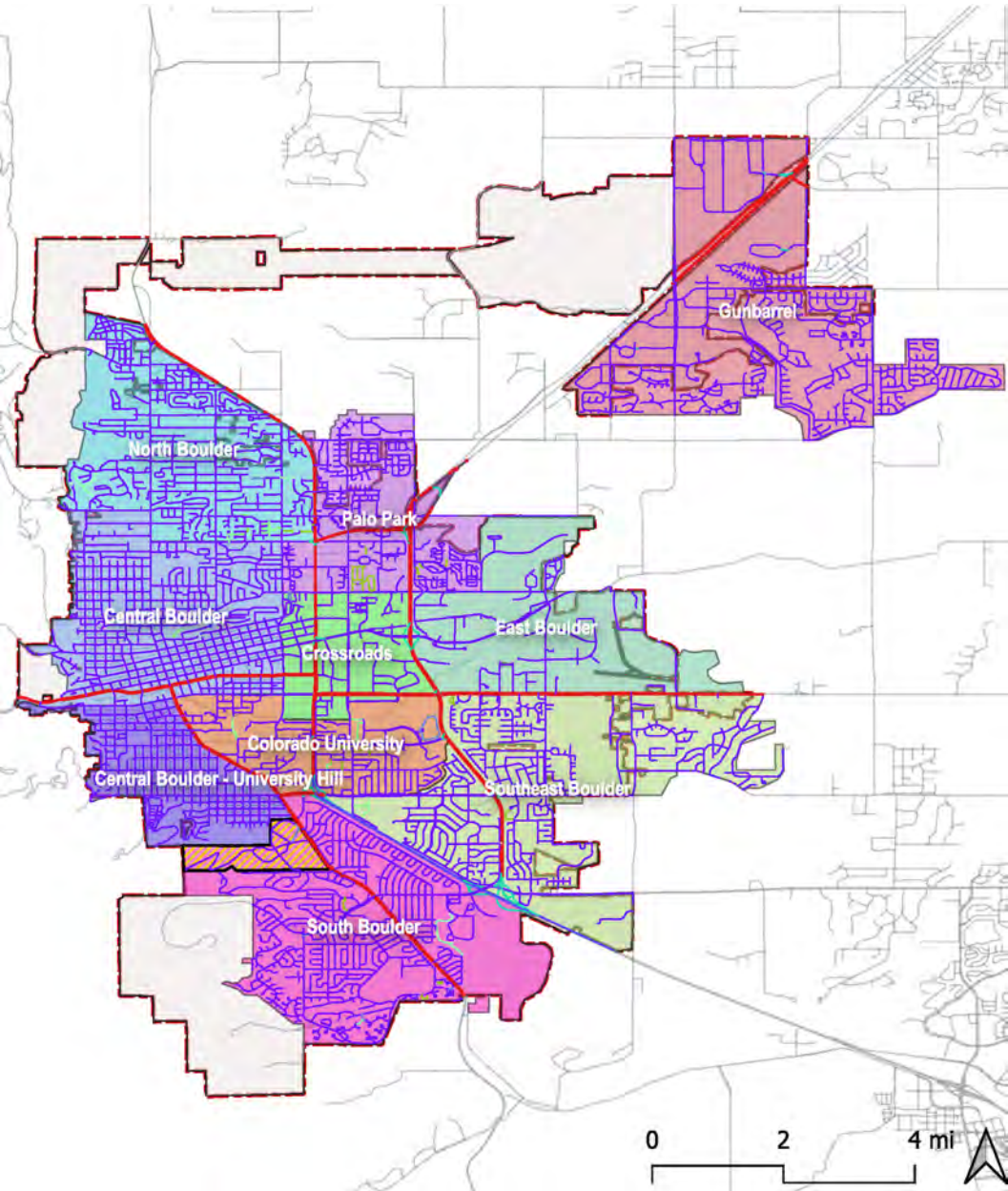


Exhibit 93: Boulder Sub-Communities



11.3 Demographics and Socioeconomics

Population

The City of Boulder has a population of over 106,000. It has a gender ratio of 110.4 (i.e. 1,104 males to every 1,000 females). This is atypical, given that the nation, as a whole, has a ratio of 98.0 (i.e. 980 males for every 1,000 females). Also, the City of Boulder, and to a lesser extent Boulder County, has a relatively younger population when compared to the entire country. The median age of the city residents is 28.6 years compared to the 38.2 years for the county, 37.9 years for the state and 39.2 years nationwide. The city also has a relatively higher percentage of their population in the 18 through 64 years age bracket compared to the state and the nation. Less than 13% of the city's population is above 65 years of age compared to 16.1% for the state and 17.7% for the country.

The Denver-Aurora- Greeley CSA, which includes Boulder, is home to over 63% of the state's resident population although it comprises less than 33% of its land area. It is the 17th most populous of the 181 CSAs in the United States.¹

Exhibit 94: Population and Demographics Comparison¹

	United States	Colorado	Denver-Aurora-Greeley CSA	Boulder County	City of Boulder
Total population	334,914,896	5,877,610	3,691,404	326,831	105,893
Male	165,729,373	2,980,108	1,863,448	164,956	55,570
	49.5%	50.7%	50.5%	50.5%	52.5%
Female	169,185,523	2,897,502	1,827,956	161,875	50,323
	50.5%	49.3%	49.5%	49.5%	47.5%
Under 18 years	72,648,436	1,210,680	766,554	55,557	12,157
	21.7%	20.6%	20.8%	17.0%	11.5%
18 to 24 years	30,475,343	531,807	326,051	50,745	33,192
	9.1%	9.0%	8.8%	15.5%	31.3%
25 to 64 years	172,484,061	3,190,581	2,056,998	164,814	46,848
	51.5%	54.3%	55.7%	50.4%	44.2%
65 years and over	59,307,056	944,542	541,801	55,715	13,696
	17.7%	16.1%	14.7%	17.0%	12.9%
Median age (years)	39.2	37.9	37.3	38.2	28.6
Sex ratio (males per 100 females)	98.0	102.9	101.9	101.9	110.4

Education

The Boulder Economic Council states that it has the "...the nation's most highly educated population."² Over 75% of the population above the age of 25 have at least a Bachelor's degree, and over 37% have graduate or professional degrees—significantly higher than the state figures and more than double the national percentages.

The Boulder Valley School District has 56 schools spread across 11 communities and has over 28,000 students and about 1,650 full-time equivalent classroom teachers.³ The University of Colorado, Boulder (CU-Boulder), which is proximate to the DoC Boulder Laboratories, is classified as "Research 1: Very High research Spending and Doctorate Production" based on the Carnegie Classification of Institutions of Higher Education.⁴ It has over 75 research centers,⁵ institutes and laboratories and offers over 5,100 courses in more than 270 fields of study.⁶ Among the University's faculty are five Nobel Laureates, five National Medal of Science winners, and 12 MacArthur fellows.

The average 12-month earnings in 2023 inflation adjusted dollars for Boulder County was 22% higher than the national average. The earnings in Boulder County were lower than the national average for those without any college experience, yet those with a bachelor's degree or a graduate or professional degree earned significantly higher than the national average.⁷

1. Source: United States Census Bureau, 2023 ACS 1-Year Estimates
2. Source: Boulder Chamber Economic Council <https://bouldereconomiccouncil.org/boulder-economy/>
3. Source: National Center for Education Statistics [https://nces.ed.gov/ccd/districtsearch/district_detail.asp?Search=2&details=1&ID2=0802490&DistrictID=0802490]
4. Source: <https://carnegieclassifications.acenet.edu/institution/university-of-colorado-boulder/>
5. Source: <https://www.colorado.edu/research/centers>
6. Source: <https://www.colorado.edu/academics>
7. Source: United States Census Bureau, 2023 ACS 1-Year Estimates

Exhibit 95: Educational Attainment Comparison

	United States		Colorado		Denver-Aurora-Greeley CSA		Boulder County		City of Boulder	
	Population 25 years and over	12-month Median Earnings (2023\$)	Population 25 years and over	12-month Median Earnings (2023\$)	Population 25 years and over	12-month Median Earnings (2023\$)	Population 25 years and over	12-month Median Earnings (2023\$)	Population 25 years and over	12-month Median Earnings (2023\$)
Population 25 years and over	231,791,117	51,288	4,135,123	59,076	2,598,799	61,934	220,529	62,649	60,544	61,465
Less than high school graduate	23,698,453	31,660	277,844	39,959	191,190	40,745	11,242	36,598	2248	22,344
High school graduate (includes equivalency)	60,105,924	39,428	798,897	42,541	458,582	43,666	23,452	37,738	4,562	32,269
Some college or associate's degree	64,170,652	45,924	1,138,325	49,707	655,490	51,427	41,687	40,511	7,806	19,018
Bachelor's degree	50,567,878	67,256	1,170,106	73,072	787,033	79,242	76,931	75,837	23,440	70,734

Jobs, Employment and Income

The City of Boulder Department of Community Planning and Sustainability estimates that there are 106,200 jobs in the city as of 2025 and projected to reach 120,000 by 2040 . About 40% of the jobs are held by city residents whereas 60% are held by commuters.¹

Although the sizes of the City of Boulder's labor force for the population over 16 years of age are comparable to the national average, unemployment rates are higher than the county, CSA, the state, and the nation . Educational services, and health care and social assistance services (27.2%) and professional, scientific, and management, and administrative services (21.3%) are the two leading employment sectors City.²

Although the mean household income for the city is 16% higher than the nation, the median household income is marginally lower.¹ Boulder County, the CSA, and the state mean and median incomes are all significantly higher than the national average.¹

Exhibit 96: Income Distribution

	United States	Colorado	Denver-Aurora-Greeley CSA	Boulder County	City of Boulder
No. of Households	131,332,360	2,428,261	1,511,377	137,425	44,722
Less than \$10,000	5.30%	4.20%	3.90%	5.30%	10.30%
\$10,000 to \$14,999	3.50%	2.50%	2.30%	2.00%	2.70%
\$15,000 to \$24,999	6.40%	4.90%	4.30%	7.10%	9.10%
\$25,000 to \$34,999	6.80%	5.10%	4.50%	4.80%	6.90%
\$35,000 to \$49,999	10.30%	8.50%	7.60%	8.30%	8.40%
\$50,000 to \$74,999	16.10%	15.10%	14.20%	13.80%	12.00%
\$75,000 to \$99,999	12.70%	13.00%	12.20%	10.00%	8.10%
\$100,000 to \$149,999	17.40%	19.10%	19.30%	15.90%	12.80%
\$150,000 to \$199,999	9.10%	11.80%	12.90%	11.10%	7.50%
\$200,000 or more	12.40%	15.90%	18.80%	21.60%	22.20%
Median income (dollars)	\$77,719	\$92,911	\$101,700	\$95,363	\$75,923
Mean income (dollars)	\$109,160	\$124,578	\$134,695	\$135,560	\$127,027

1. Source: City of Boulder Website, Boulder Community Profile (<https://boulder-colorado.gov/boulder-measures/about-us-boulder-community-profile>)

2. Source: United States Census Bureau, 2023 ACS 1-year estimates

Exhibit 97: Comparison of Employment Characteristics

	United States		Colorado		Denver-Aurora-Greeley CSA		Boulder County		City of Boulder	
Population 16 years and over	271,122,729	100.0%	4,818,044	100.0%	3,017,854	100.0%	279,688	100.0%	95,260	100.0%
Not in labor force	98,083,934	36.2%	1,495,145	31.0%	858,921	28.5%	92,352	33.0%	34,997	36.7%
In labor force	173,038,795	63.8%	3,322,899	69.0%	2,158,933	71.5%	187,336	67.0%	60,263	63.3%
Armed Forces	1,295,873	0.5%	46,869	1.0%	6,642	0.2%	69	0.0%	69	0.1%
Civilian labor force	171,742,922	63.3%	3,276,030	68.0%	2,152,291	71.3%	187,267	67.0%	60,194	63.2%
Employed	164,346,993	60.6%	3,151,694	65.4%	2,072,607	68.7%	178,463	63.8%	55,952	58.7%
Unemployed	7,395,929	2.7%	124,336	2.6%	79,684	2.6%	8,804	3.1%	4,242	4.5%
Agriculture, forestry, fishing and hunting, and mining	2,568,128	1.6%	59,222	1.9%	30,196	1.5%	1,509	0.8%	823	1.5%
Construction	11,365,506	6.9%	248,490	7.9%	155,297	7.5%	8,156	4.6%	1,229	2.2%
Manufacturing	16,271,926	9.9%	211,426	6.7%	147,696	7.1%	18,961	10.6%	4,482	8.0%
Wholesale trade	3,340,218	2.0%	58,779	1.9%	44,109	2.1%	1,808	1.0%	361	0.6%
Retail trade	17,465,488	10.6%	313,321	9.9%	200,439	9.7%	19,259	10.8%	6,325	11.3%
Transportation and warehousing, and utilities	9,884,522	6.0%	160,011	5.1%	107,401	5.2%	4,246	2.4%	970	1.7%
Information	3,054,393	1.9%	82,446	2.6%	63,533	3.1%	5,997	3.4%	1,845	3.3%
Finance and insurance, and real estate and rental and leasing	10,878,803	6.6%	218,616	6.9%	152,189	7.3%	6,219	3.5%	2,325	4.2%
Professional, scientific, and management, and administrative and waste management services	20,998,610	12.8%	504,863	16.0%	367,225	17.7%	38,507	21.6%	11,899	21.3%
Educational services, and health care and social assistance	38,561,546	23.5%	685,627	21.8%	429,068	20.7%	42,915	24.0%	15,245	27.2%
Arts, entertainment, and recreation, and accommodation and food services	14,492,950	8.8%	302,116	9.6%	189,802	9.2%	17,849	10.0%	6,052	10.8%
Other services, except public administration	7,832,146	4.8%	154,960	4.9%	99,807	4.8%	8,317	4.7%	2,466	4.4%
Public administration	7,632,757	4.6%	151,817	4.8%	85,845	4.1%	4,720	2.6%	1,930	3.4%

Housing

The vacancy rate of occupied housing units in the City of Boulder is 3.1 percentage points lower than the nation. The vacancy rate for Boulder County is lower than the City of Boulder, and the vacancy rate for the CSA is lower than both the City and the County. As far as occupied housing units are concerned, the national average for percentage of owner-occupied units is 65%; the same percentage varies between 61% and 66% for the County, the CSA and the State. The percentage of the owner-occupied housing is significantly lower in the City of Boulder, where it is 45%. The higher percentage of rental units can at least partially be attributed to the University of Colorado Boulder's students who opt for off-campus rental housing.

The average household sizes in both owner- and renter-occupied housing units for the City of Boulder are lower than the County, CSA, State and the national averages.

The median value of owner-occupied housing units in the City of Boulder is almost three times that of the nation, 30% higher than the County, and 62% higher than the CSA.

Over 70% of the City of Boulder housing stock is older than 35 years and almost a quarter of its stock was built in the 1970s, and that is true for the County, CSA and the State as well. The median year of construction of the City's housing units is 1979. In comparison, the County, CSA, State and the nation housing stocks have respective median years of construction as 1987, 1989, 1988, and 1981.

In spite of the aging housing stock, the City of Boulder commands a significantly higher median housing value. For all owner-occupied housing units, the median value is \$989,100 and for the units that have a mortgage, the median value is even higher at \$1,030,400. While almost 51.7% of the City's and 27.4% of the County's owner-occupied housing units are valued at over a million dollars, the respective percentages for the CSA, State and nation are 12.6%, 10.8% and 7.5%. The City's median housing value for owner-occupied housing units with a mortgage is 13.6 times the median household income. This is very high compared to the national average of 4.8 as well as the State, the CSA, and County (6.1, 6.0, and 7.9 respectively).

Exhibit 98: Comparative Analysis of Housing Values¹

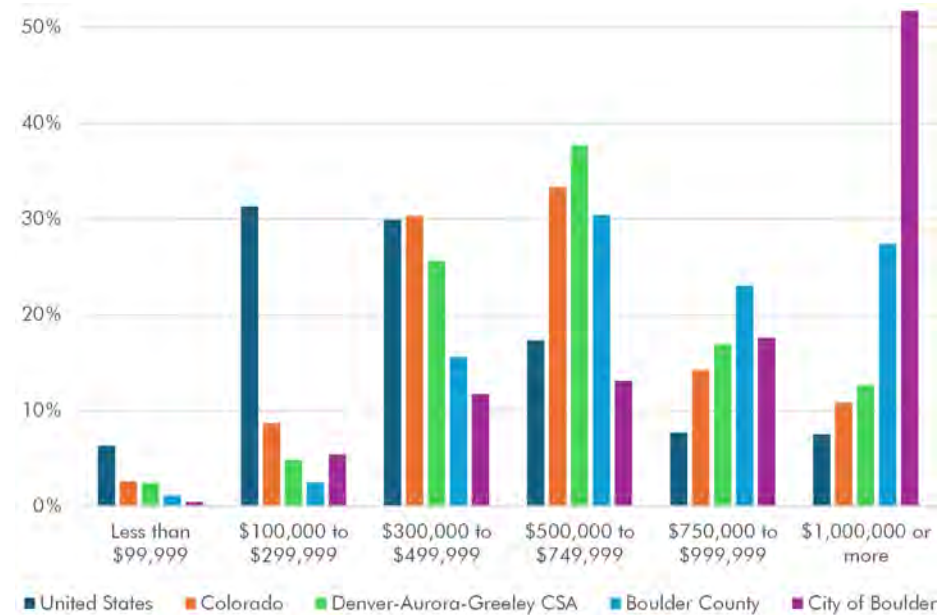
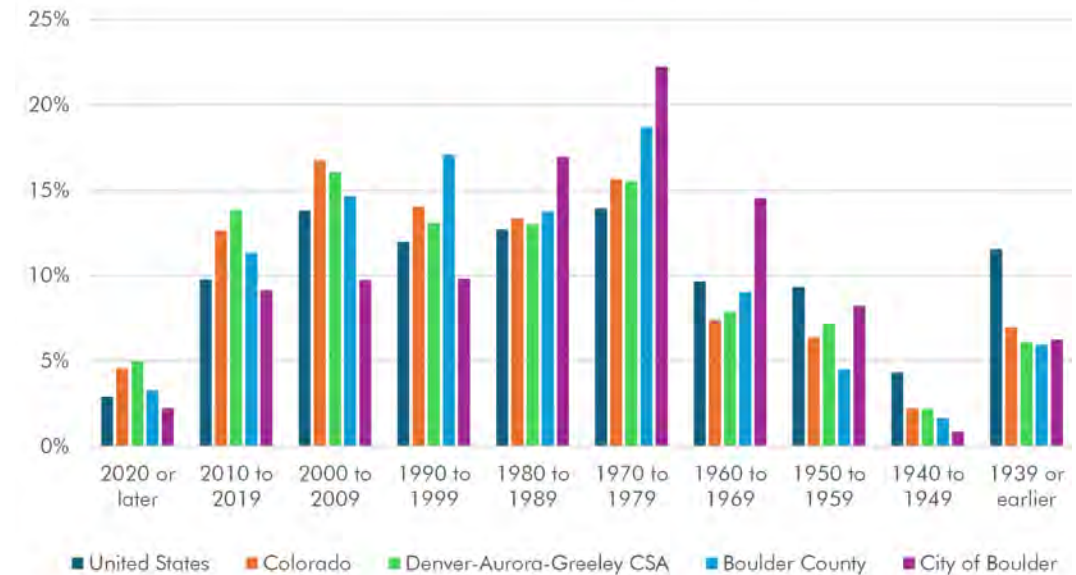


Exhibit 99: Comparative Analysis of Housing Stock Vintage¹



1. Source: United States Census Bureau, 2023 ACS 1-year Estimates

Exhibit 100: Comparison of Housing Tenure and Household Size¹

	United States	Colorado	Denver-Aurora-Greeley CSA	Boulder County	City of Boulder
Total housing units	145,333,462	2,638,093	1,593,153	146,373	47,842
Vacant housing units	14,001,102	209,832	81,776	8,948	3,120
	9.60%	8.00%	5.10%	6.10%	6.50%
Occupied housing units	131,332,360	2,428,261	1,511,377	137,425	44,722
	90.40%	92.00%	94.90%	93.90%	93.50%
Owner-occupied	85,685,869	1,594,191	966,206	84,169	20,183
	65.20%	65.70%	63.90%	61.20%	45.10%
Renter-occupied	45,646,491	834,070	545,171	53,256	24,539
	34.80%	34.30%	36.10%	38.80%	54.90%
Average household size of owner-occupied unit	2.61	2.51	2.59	2.40	2.16
Average household size of renter-occupied unit	2.25	2.10	2.09	2.09	2.05
Median Value (Occupied Housing Units)	340,200	550,300	608,800	763,600	989,100

1. Source: United States Census Bureau, 2023 ACS 1-year Estimates

2. Source: University of Colorado Boulder Website, Rankings and Achievements (<https://www.colorado.edu/about/rankings-achievements>)

3. Source: JILA Website (<https://jila.colorado.edu/about/about-jila>)

11.4 Institutional Environment

University of Colorado, Boulder²

The University of Colorado Boulder (commonly referred to as CU Bolder) is a public institution founded in 1876, with a 600-acre campus located within the City of Boulder. It is the flagship of the University of Colorado system and the only school in the Rocky Mountain Region to make it into the Association of American Universities, an elite group of 71 research universities. The university has a proud academic tradition, with five Nobel laureates, twelve MacArthur “genius grant” recipients, and more than 90 Fulbright fellows since 2013. CU-Boulder also has a long history of environmental awareness and has been ranked among the top “green” universities in the country and the first to achieve a STARS Gold rating for sustainability.

CU-Boulder and NIST have a long history of collaboration, primarily through JILA, an institute that was founded in 1962 and is located on the CU-Boulder campus. Soon after its inception, JILA’s research quickly expanded from its original astrophysics mission to include fields like quantum information science & technology, atomic & molecular physics, laser physics, biophysics, chemical physics, nanoscience, and precision measurement. Over the years, it has evolved into one of the nation’s leading research institutes in the physical sciences. JILA’s current faculty includes two Nobel laureates, Eric Cornell and John Hall, as well as two John D. and Catherine T. MacArthur Fellows, Margaret Murnane and Ana Maria Rey.³

Other Academic Institutions

The following are some of the prominent academic institutions in the region:

- Colorado State University, Fort Collins
- University of Colorado, Denver and Aurora
- Metropolitan State University of Denver, Denver
- Colorado School of Mines, Golden
- United States Air Force Academy, Colorado Springs
- University of Denver, Denver
- Regis University, Denver

Federal Agencies and Federally Funded Research Centers in and Around Boulder

The National Center for Atmospheric Research (NCAR) is the only other federal entity outside the Department of Commerce campus that has a significant presence in Boulder. NCAR is a federally funded research and development center devoted to atmospheric and related sciences. Its mission is to understand the behavior of the atmosphere and related physical, biological and social systems; to support, enhance and extend the capabilities of the university community and the broader scientific community nationally and internationally; and to foster transfer of knowledge and technology for the betterment of life on Earth. The National Science Foundation is NCAR's primary sponsor, with significant additional support provided by other U.S. government agencies, other national governments and the private sector. Besides NCAR, the University Corporation for Atmospheric Research (UCAR) also has locations in Boulder Colorado.

Colorado has one of the highest per capita concentrations of federally-funded science, research, and engineering facilities in the nation. Besides NCAR and UCAR, some of the other facilities include:¹

- National Renewable Energy Laboratory, Golden
- National Solar Observatory, Boulder
- Centers for Disease Control and Prevention (CDC), Division of Vector Borne Diseases, Fort Collins
- U.S. Department of Agriculture, Agricultural Research Service, Fort Collins
- U.S. Forest Service, Rocky Mountain Research Station, Fort Collins
- Infectious Disease Research Center, Colorado State University, Fort Collins
- Cooperative Institute for Research in Environmental Sciences (CIRES), University of Colorado Boulder, Boulder

Other federal agencies that have a significant presence in the region (i.e. the Denver-Aurora-Greeley Combined Statistical Area) are:

- US Securities and Exchange Commission (SEC), US Department of Labor, and National Labor Relations Board in the Byron Rogers Federal Building
- US Department of Transportation, and Federal Highway Administration, Lakewood
- Environmental Protection Agency, Denver and Lakewood
- Two components of the U.S. Department of the Interior: Bureau of Reclamation, which is in the Denver Federal Center, Denver; and the Bureau of Land Management (BLM) Lakewood
- U.S. Geological Survey's Colorado Water Science Center, Lakewood
- The Department of Veterans Affairs, Rocky Mountain Regional VA Health Center, Aurora; and Veterans Benefits Administration, Lakewood and Aurora

1. Source: Colorado Labs (<https://www.co-labs.org/labs-institutes>)

11.5 Business Environment¹

Boulder features a diverse mix of industries of local, national and global importance. Certain industry clusters command a high employment concentration that includes aerospace, bioscience, cleantech, IT/Software, natural products, and outdoor recreation. In addition, key industries that provide economic impact to Boulder include tourism and research. The following provides briefs on some of these sectors in Boulder and the key organizations that spearhead them:

- **Aerospace:** The aerospace industry has a long history in Boulder, dating back to the formation of Ball Aerospace and Technologies Corporation here in 1956. Ball Aerospace served as an important anchor, serving civil, commercial, and military markets. In 2023 Ball Aerospace was acquired by BAE Systems. Over the years, other aerospace companies established their presence in Boulder, including Lockheed Martin, Northrup Grumman, Special Aerospace Services, and Blue Canyon Technologies, Brungard Aviation, SpaceNav and Think Orbital. Today, the Boulder MSA has 55 firms in this sector employing almost 3,500 people and an employment concentration (Location Quotient) that is 14.9 times the national average.
- **Bioscience:** The bioscience industry emerged, in part, from research conducted at the University of Colorado Boulder. Over the past forty years, the area has developed a high concentration of companies (7.3 times the national average) in pharmaceuticals, biotechnology, medical devices and instruments and others employing more than 13,400 people in the Boulder area.
- **Cleantech:** The city has a host of companies that are environmentally friendly, and businesses in the renewable energy and energy efficiency industries. There are 115 Cleantech companies employing over 1,000 people, and an employment concentration that is 5.7 times the national average.
- **Information Technology and Software:** IBM established a 500-acre facility in North Boulder in the 1960s, which initiated a strong technology and information economy in the city. The Boulder area has one of the nation's largest concentrations (5 times the national average) of IT employment and is home to two of the world's ten fastest supercomputers.
- **Natural Products:** The city has the nation's largest concentration of natural and organic products companies, and has the highest per capita consumption of organic foods in North America, according to the International Federation of Organic Agriculture Movements.
- **Outdoor Recreation & Tourism:** The city is a destination for active lifestyle and outdoor recreation enthusiasts. It is home to businesses involved in the outdoor recreation industry including manufacturers, distributors, retailers, and service providers. The estimated number of jobs in Boulder County attributable to tourism is about 3,200.

Based on the Market Profile published by the Boulder Economic Council, the City of Boulder has approximately 2,500 employers with 5 or more employees. Its ten largest employers (listed in alphabetical order) are:

- Ball Aerospace & Technologies
- Boulder Community Health
- Boulder County
- Boulder Valley School District
- City of Boulder
- Google
- IBM
- Medtronic
- UCAR/NCAR
- University of Colorado Boulder

1. Source: Boulder Economic Council (<https://bouldereconomiccouncil.org/boulder-economy/key-industries-companies/aerospace/>)

11.6 Local Regulatory Authorities

The DoC Boulder Laboratories is a federal campus and is generally exempt from local regulations. However, DoC, like many other federal agencies, practices a “good neighbor” policy and generally complies with the applicable local regulations. The following are some of the key regulatory bodies that have jurisdiction in the area.

City of Boulder:¹ The City of Boulder has the primary land use jurisdiction within its borders including building permits, code enforcement, planning and zoning. It also has other responsibilities as summarized below:

- The Planning and Development Services Department is responsible for defining and implementing an inclusive vision for the city’s future, while consistently administering codes and policies to ensure the health, safety, and well-being of the community. The department’s divisions administer building codes and regulations, permits and inspections, property information, zoning, and comprehensive planning, among other responsibilities.
- Historic Preservation is tasked with preserving the community’s unique heritage, culture, and character by protecting buildings and sites that are significant to Boulder’s past. There are over 1,300 designated historic properties in Boulder, including 200+ individual landmarks and 10 historic districts. The city has developed a Historic Preservation Plan that outlines program areas and identifies near-term and long-term goals for the program.
- The Transportation & Mobility Department oversees multimodal transportation planning and operations, transportation capital projects, traffic engineering, transportation maintenance and the Boulder Municipal Airport. The Transportation Advisory Board (TAB) advises City Council, Planning Board and city staff on community transportation issues. The board also reviews transportation, community, and environmental assessment processes (CEAPs); reviews plans for capital improvements; reviews and recommends updates to the Transportation Master Plan; and works with neighborhood groups, residents and staff on traffic mitigation issues.
- Open Space & Mountain Parks Department oversees the natural environment and land resources that characterize Boulder including the city’s 155 miles of trails and 46,640 acres of

preserved and protected land, wildlife habitat, unique geologic features and greenways. The five-member Open Space Board of Trustees makes recommendations to the City Council and staff on the acquisition and management of Open Space.

Boulder County: Although the county is not responsible for land use related regulations within the City of Boulder, it has jurisdiction in terms of flood plain management and assessments. It is part of the National Flood Insurance Program and is responsible for reducing flood hazards, regulating floodplain activities, adopting floodplain policies, mapping floodplains, and educating the public about floods and floodplains. It also provides criteria and design standards for the many different conditions within the Urban Drainage and Flood Control District. Besides floodplain management responsibilities, the county also is responsible for property assessments, managing appeals regarding property values, and for property tax abatements.

Regional Transportation District (RTD): Organized in 1969, the RTD is the regional authority responsible for operating public transit services in 40 municipalities across eight of the twelve counties in Denver-Aurora-Greeley CSA. RTD currently operates bus, rail, shuttles, ADA paratransit services, demand responsive services like FlexRide, special event services, vanpools, and many more.

Colorado Department of Transportation (CDOT): CDOT builds and maintains interstates, US highways and state highways. CDOT conducts snow and ice operations, roadway maintenance and preservation, and construction management as their primary activities. In addition, it provides traffic monitoring, avalanche control, rockfall mitigation, transit development and grants, and traffic safety education for impaired driving, teen driving, distracted driving, work zone safety, seat belts and more.

History Colorado: Colorado’s State Historic Preservation Office (SHPO) is housed within the State Historical Society, History Colorado. It administers the national historic preservation program by reviewing National Register of Historic Places nominations, maintaining data on historic properties, and consulting with Federal agencies during Section 106 reviews for the entire state. Other programs managed by the SHPO include the State Historical Fund and federal and state rehabilitation tax credits and survey and inventory of cultural resources across the state.

1. Source: *The City of Boulder Website*

11.7 Natural Environment¹

The Boulder Valley sits between the Flatirons section of the Rocky Mountains and the western edge of the Great Plains at an average elevation of 5,430 feet above sea level. The 31-mile-long Boulder Creek that runs through the valley drains the nearby mountains as well as the surrounding plains. Thus, the Boulder Creek Watershed is a natural “container” encompassing some 440 square miles and extending from the Continental Divide to the high plains. In the mountains, Boulder Creek passes over granitic and metamorphic rocks that aren’t very reactive; when it moves into the plains, the geology is dominated by sedimentary rocks, including sandstones and shales.

The City of Boulder as well as Boulder County consider the natural environment a critical asset for the region and make efforts to preserve and protect the same through its plans and policies.

11.8 Built Environment

The City of Boulder has a compact urban form comprised of predominantly low-rise and some mid-rise development. It has a mix of residential developments ranging from pre-World War II era to more recent Neo-Traditional and New Urbanist housing. Non-residential uses range from commercial retail, industrial, research and institutional uses, all connected through a robust multimodal transportation infrastructure. The city form is strongly influenced by the foothills of the Flatirons on the west and the greenbelt to the north, east and south. The city has a centrally located historic core (about 3 miles northwest of the Department of Commerce Campus) with a string of pre-World War II neighborhoods. The city has a retail corridor north of Arapahoe Avenue along 28th Street. The university and the federal campuses of DoC and NCAR are on the southern part of the city. The industrial areas are to the east and the newer residential areas are to the north.

11.9 Transportation Infrastructure

Airports: Boulder Municipal Airport is a general aviation airport, less than five miles from the DoC campus. It provides business, private, recreational and emergency aviation services to the surrounding communities but does not offer commercial airline services. The

nearest commercial airport is the Denver International Airport (referred to as DIA), about forty miles from the DoC Campus. It was the sixth busiest airport in the world in 2024, serving approximately 82.4 million passengers that year.² The DIA is connected to the region through the SkyRide bus system which operates year-round. The AB1 and AB2 SkyRide Routes connect Boulder to DIA. AB1 SkyRide has a stop on Broadway at the front of the DoC campus.

Road Network: The City of Boulder has three major highways, generally running in the north-south and north-south-southeast directions. The State Highway 93 (which has other local designations for different segments) passes along the western side of the city and eastern boundary of the DoC campus. The segment along the DoC campus is designated as S Broadway. The Denver-Boulder Turnpike runs north south (designated as 28th Street for an extended length) almost centrally within the city and then towards southwest towards Denver. The Turnpike is also designated as Federal Highway 36 beyond Boulder County. State Highway 157 also runs north south, east of 28th Street, and merges into the Boulder-Denver Turnpike near the southern limits of the city. To the north, it meets Diagonal Highway, which is also designated as State Highway 119. The primary thoroughfare in the east west direction is State Highway 7, also designated as Arapahoe Road. West of 28th Street, the major east west connection is Canyon Drive also designated as the continuation of State Highway 119.

Public Transit Network:

- **Bus Network:** Within the Regional Transportation District (RTD), there are four separate route systems. The SkyRide system connects the DIA to the regional population cores. The Local/Limited routes are generally confined within each of these population centers; and the Regional Routes connect the population centers. Flatiron Flyer is a bus rapid transit system (BRT) that connects Boulder to other population centers in the region.
- **FasTrack:** This is a multi-billion-dollar public transportation expansion program administered by the RTD consisting of new commuter rail, light rail, and express bus services. The longest of the FasTrack projects, the Northwest Rail Line is planned to be a 41-mile fixed-guideway transit line to Longmont from Denver passing through Boulder.

1. Source: Boulder Area Sustainability Network

2. Source: CNN Travel: World’s top 10 busiest airports for passenger traffic in 2024 <https://www.cnn.com/2025/04/14/travel/worlds-busiest-airports-passengers-2024/index.html>

11.10 Regional Planning Environment

The Boulder Valley Comprehensive Plan (BVCP) is a collaborative effort between the City of Boulder and Boulder County that informs and guides the planning and development in the Boulder Valley. The current plan was originally adopted in 1977 and is currently undergoing its eighth major update which will be completed in 2025-2026. As stated in the city's website, "the BVCP policies guide decisions about growth, development, preservation, environmental protection, economic development, affordable housing, culture and the arts, urban design, neighborhood character and transportation. The policies also inform decisions about the manner in which services are provided such as police, fire, emergency medical services, water, utilities, food control and human services". It also establishes the desired land use patterns including type and intensity of development.

Campus Land Use Designations: The Department of Commerce campus has multiple land use designations, as noted in the 2022 Boulder Valley Comprehensive Plan Land Use Designation Map:

- Majority of the developed areas and their immediate surrounds (Research Zone 2 and Research Zone 3, shown on the Existing Site Plan) are designated as Public Use, referring to a wide range of public and private nonprofit uses that provide a community service and include government laboratories;
- The Tribal MOA Protected Area is designated as Open Space, Development Rights, referring to Privately owned land with conservation easements or other development restrictions; and,
- The Research Zone 1 or the mesa, is designated as Open Space, Other, referring to public and private land designated prior to 1981 that the city and county would like to preserve through various preservation methods including but not limited to intergovernmental agreements, dedications or acquisitions.

Surrounding Land Use Designations: The campus is mostly surrounded by Low Density Residential (two to six units per acre) designations to the north, east and south. To the west, the land use is Open Space, Acquired.

A medical office use sits on a single parcel to the north of the campus on Broadway which shares a boundary and has an access easement through the campus. This parcel is zoned RL-1 or Low Density

Residential. Its land use designation has been recently changed from Transitional Business to Low Density Residential, as well.

Boulder Transportation Master Plan:¹ The City of Boulder's Transportation Master Plan (TMP), represents the transportation policy and strategy directions to support the broader community goals identified in the Boulder Valley Comprehensive Plan. The most recent version of this plan is from 2019. The Transportation Master Plan initiatives target safe and comfortable travel, plan for mobility options including new and novel options while prioritizing pedestrians and improve regional connectivity. The plan also outlines investment programs for funding the Plan. The TMP specifically plans to reduce the vehicle miles traveled (VMT) as its population grows, increase walking biking and transit use, reduce transportation sector GHG emissions, eliminate fatal and serious injury crashes, and expand fiscally viable transportation options to vulnerable populations.

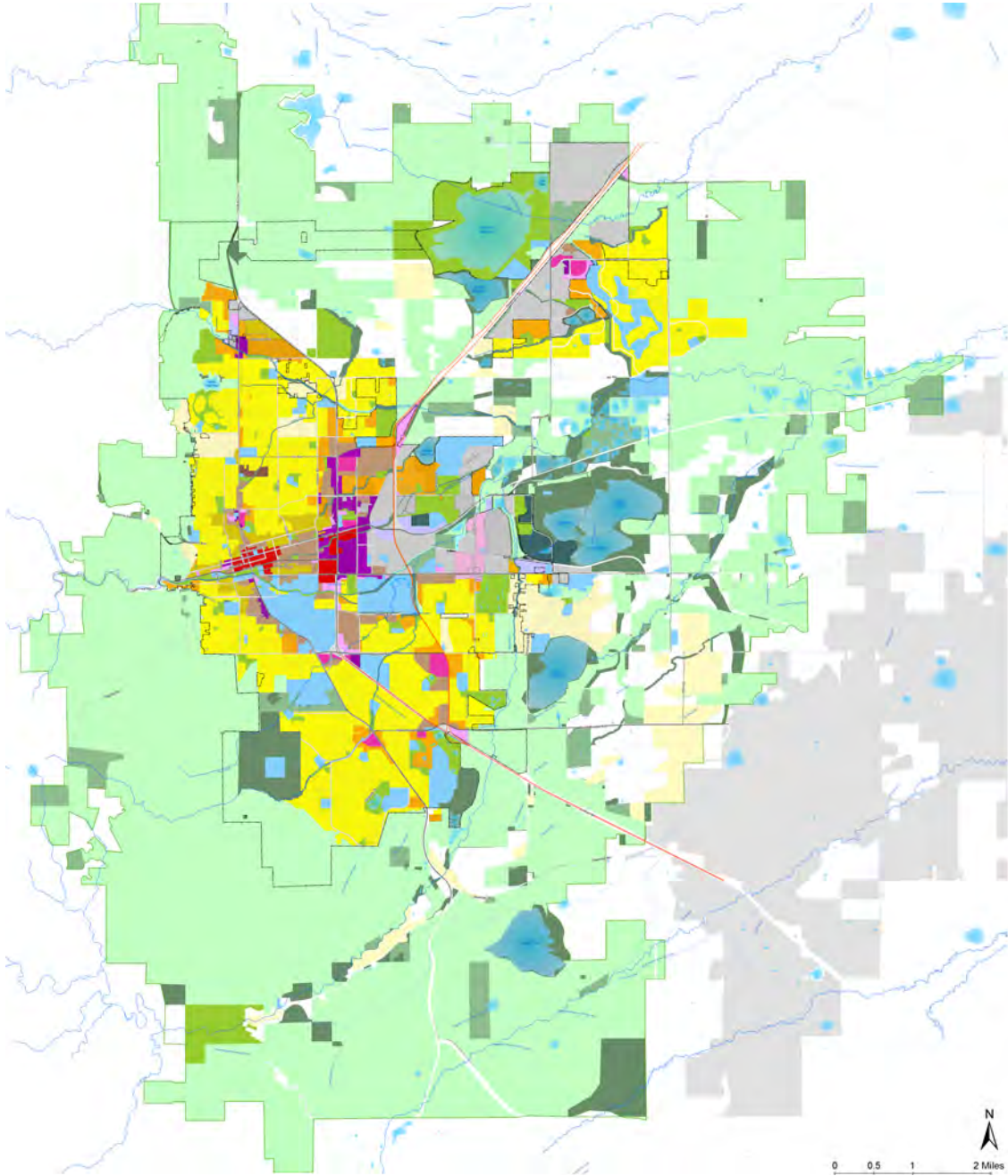
11.11 Significance for the Master Plan

Although seemingly self-contained, the Department of Commerce campus is an integral part of a larger economic, environmental and scientific community. Specific considerations for the Master Plan include:

- **The City and County of Boulder.** The city and county work together to create forward-looking policies on land use, transportation, sustainability, stormwater, construction and recreation. Their goals and regulations are coordinated across multiple departments and clearly stated in the Boulder Valley Comprehensive Plan. The city has shown interest and willingness to work with the DoC in crafting their future plans and advancing specific projects.
- **Transportation.** Boulder has a strong public transportation infrastructure, and an even stronger bicycle path network, both of which serve the DoC campus. Many employees and associates use public transportation or the network of designated and protected bicycle routes. Incorporating and strengthening these systems will benefit both the campus and the employees.

1. Source: 2019 Boulder Transportation Master Plan: <https://boulder.colorado.gov/media/1045/download?inline=>

Exhibit 101: Boulder Valley Comprehensive Plan Land Use Designation Map



- Residential**

 - Very Low Density Residential
 - Low Density Residential
 - Manufactured Housing
 - Medium Density Residential
 - Mixed Density Residential
 - High Density Residential
- Business**

 - Community Business
 - General Business
 - Service Commercial
 - Transitional Business
 - Regional Business
- Industrial**

 - Community Industrial
 - General Industrial
 - Light Industrial
 - Performance Industrial
- Mixed Use**

 - Mixed Use Business
 - Mixed Use Industrial
 - Mixed Use Residential
 - Mixed Use Transit Oriented Development
- Open Space and Mountain Parks**

 - Open Space, Acquired
 - Open Space, Development Rights
 - Open Space, Other
- Other**

 - Agricultural
 - Park, Urban and Other
 - Public
 - Environmental Preservation
- Roads**

 - Expressway
 - Freeway
 - Principal Arterial
 - Minor Arterial
- Parcels**

 - Reservoirs and Ponds
 - Ditches
- Other City Limits**

 - BVCP Planning Area Boundary
 - City Limits
 - Other City Limits

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The City of Boulder has provided the data as a public service and offers no guarantees or warranties, expressed or implied, as to the accuracy and/or completeness of the information contained herein. The City of Boulder makes no warranties about the datasets and disclaims liability for all uses of the datasets, to the fullest extent permitted by applicable law.

Map produced by the City of Boulder Planning and Development Services Information Resources Group. For information visit us on the web at <https://boulder.colorado.gov/planning>.

- **Environmental awareness.** Sustainable design, energy and water conservation are on the minds of Boulder residents, and form the basis of many of the policies and regulations of the city. The DoC Boulder Laboratories has demonstrated awareness, such as xeriscaping and solar site lighting. The Katharine Blodgett Gebbie Laboratory received LEED Gold certification for its design and construction. The community and city would welcome additional consideration and strategies in the Master Plan.
- **Open space and parks.** The DoC property is integrated into the trail and recreation system maintained by the City of Boulder Open Space & Mountain Parks Department. Boulder Mountain Park abuts the property to the west, and Tibbet Open Space to the north. Trails from both these recreation areas cross the property, and trail modifications/upgrades are planned by the city.
- **Institutional and hi-tech environment.** Advanced and related research is conducted at the University of Colorado, which is located down the street, and at the National Center for Atmospheric Research, also located in Boulder. These institutions, as well as five other academic institutions and several hi-tech businesses in the region, enrich the scientific dialog and interaction that NIST wants to encourage.
- **Residential neighbors.** The residential neighbors in Boulder are affluent, well-educated and concerned about their environment and housing values. They are interested in planned actions at the DoC campus. The DoC held a public meeting during the 2017 Master Plan development process at which the community commented on the development 2025 concept. This update was shared with the City and other stakeholders for comments and suggestions.



Campus Site Analysis

12

The campus for the Department of Commerce Boulder Laboratories is approximately 206 acres in size, configured roughly in an L-shape. The entrance and buildings are oriented toward the east, bordering on Broadway, which is Colorado State Highway 93. The remainder of the property is surrounded by residential development and recreational land, with a cemetery bordering the campus at the north. The land gently rises toward the west, culminating in a steep rise to Kohler Mesa at the western end of the property. Two ephemeral water bodies transect the site, Skunk Creek and the Anderson Ditch, an irrigation channel. Much of the property is designated Open Space, protected from development under a Memorandum of Agreement with the City of Boulder together with an association of Native American tribes.

The site presents opportunities and constraints that have influenced its development and will shape any future growth or change. These influences fall into two categories: Natural Characteristics; and Development Characteristics. The natural characteristics are those inherent in the land itself in its current state, such as topography and water features. The development characteristics are either regulatory or operational in nature, such as zoning regulations and security requirements.

12.1 Natural Characteristics

Topography

The City of Boulder and the Department of Commerce campus lie in the eastern foothills of the Rocky Mountains. To the west of the campus, the dramatic Flatirons rock formation rises above to frame the view. The eastern edge of the DoC campus lies at an elevation of 5,405 feet and rises gently across the developed areas of the site. The slope increases more rapidly to the west of Skunk Creek, rising up to Kohler Mesa, at an elevation of 5,910, which is 505 feet higher than the campus entrance at the eastern edge.

Hydrology and Water Resources

Watershed

The DoC campus is within the Boulder Creek Watershed, a 440 square mile area extending from the Continental Divide to the plains east of the City of Boulder. It is in the designated Skunk Creek Basin. Skunk Creek is one of fifteen tributaries that

drain into Boulder Creek, and an important drainage channel in this area of the city. Stormwater and flood management are critical in Boulder, and the city has prepared a Comprehensive Flood and Stormwater Utility Master Plan with specific mitigation recommendations and requirements. Management of stormwater in the watershed is complicated by its urbanized nature and susceptibility to flash floods. (Source: Comprehensive Flood and Stormwater Utility Master Plan, City of Boulder, October 2022)

Surface Water

Skunk Creek and Anderson Ditch are the two waterways that transect the campus. Skunk Creek is an intermittent stream, located to the west of the DoC buildings, at the foot of Kohler Mesa. The creek normally does not have flowing water except during storms. The stream flows across the campus from the southwest to the northwest. The stream experienced some erosion from the storm and ensuing flood of 2013.

The Anderson Ditch is an irrigation channel, established in 1860 by Jonas Anderson and Marinus Smith. Drawing water from Boulder Creek, it once irrigated 425 acres. It is owned and operated by the Anderson Ditch Company and holds an easement through the DoC campus. Today, NIST is one of the shareholders in the Ditch Company, although the city of Boulder is the majority shareholder.¹ Release of water through the Ditch is controlled upstream, and it flows from the northeast corner of the site through the campus to the south. Anderson Ditch is located in the midst of the campus developed area, and is enclosed and partially covered in the area of the Precision Measurement Lab (Building 81), and open throughout the remainder of the property. NIST is responsible for the maintenance of the Ditch on its property, under a 2007 agreement with the Ditch Company. In consultation with the Ditch Company, NIST restored the ditch in 2014 after a major flood by removing sediment and widening the Ditch slightly in selected locations. Anderson Ditch is the source of water for the campus irrigation system. NIST currently does not use all of its Anderson Ditch water share.

1. *The Ditch Project*; Accessed May 16, 2024. http://bcn.boulder.co.us/basin/ditchproject/?Our_Ditches:Anderson_Ditch

Flood Plain

The Federal Emergency Management Agency (FEMA) is the official source for Flood Insurance Rate Maps, which identify areas subject to flooding for flood management planning and insurance underwriting. These maps are developed by studying data for river and stream flow, storm tides, hydrology, topography and rainfall. The current 2020 FEMA map for the campus shows Skunk Creek and the road to the north of Building 5 in high-hazard flood Zone A within the 100-year floodplain, which is a designation in which there is a potential for people to be swept off their feet. Areas to the north of Building 1, Building 81, and the north parking lot are in the 500-year floodplain. The City of Boulder's Code has restrictions on development, building additions/modifications and new parking in the floodplain—more restricted for High Hazard Zones. (Boulder Revised Code, Chapter 9-3-2: Floodplains)

The campus and the City of Boulder experienced a serious flood in September 2013 resulting from a rainstorm that dropped 18" of rainfall in 8 days—called the 1000-year flood by many. There was significant damage in Boulder, despite the city's preparations. On the Department of Commerce campus, flood waters inundated several basements.

After the flood, the Water Resources Board of the City of Boulder commissioned a floodplain mapping study that included Skunk Creek. The mapping study was based on 2013 flood information, theoretical flash flood modeling, and updated topography mapping developed by using Light Detection and Ranging (LiDAR) technology. Significant topography changes incorporated into the study results. A new floodplain map was proposed and adopted in 2018.¹ The new mapping was submitted to FEMA for inclusion in their Flood Insurance Rate Maps. The City of Boulder has created flood mitigation alternatives for Skunk Creek, which are being evaluated at the time of this Master Plan.

Stormwater

Stormwater flows from west to east across the campus with the terrain, from both the DoC property and upland areas beyond. The northern portion of the campus stormwater is collected in underground piping, which connects to a City of Boulder municipal system. A small portion flows into Skunk Creek. However, the majority flows

into two campus water bodies, flanking Anderson Ditch near the southern boundary line. Only Building 33 has storm water draining directly into the Ditch; the majority of the campus stormwater discharge is isolated from the Ditch. Stormwater from both Skunk Creek and Anderson Ditch flows to Bear Canyon Creek, although at different locations—Skunk Creek to the north of campus and Anderson Ditch to the south. Bear Canyon Creek drains into Boulder Creek approximately two miles south of the campus.

As part of the system, the campus has several non-structural, or natural, stormwater control measures to detain the stormwater and slow or lessen the amount of water flowing off-site. There are two detention basins in the southeast Protected Area and several smaller areas, including two along Broadway, one by the northern pedestrian gate and another by Building 3.

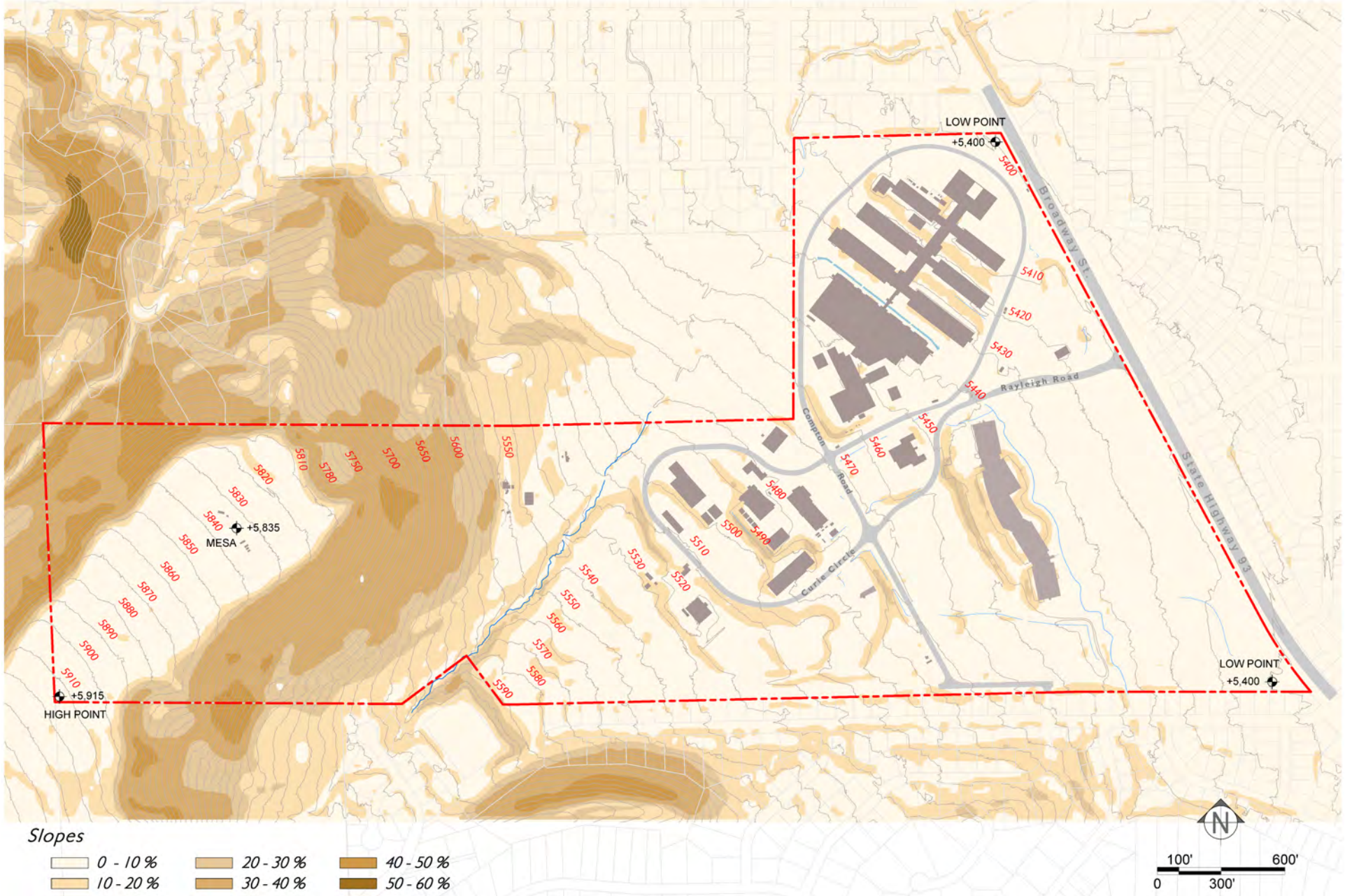
Boulder Laboratories, with its Municipal Separate Storm Water System, holds a permit from the US Environmental Protection Agency, meant to protect runoff quality and prevent harmful pollutants from being discharged untreated into local waterbodies. This permit, called an MS4, meets the requirements of the National Pollutant Discharge Elimination System (NPDES). To support the permit, the DoC has prepared a Stormwater Management Plan (SWMP), which outlines information, actions and training to meet the permit terms and protect water quality.

The purpose of the permit and the SWMP is to eliminate or reduce pollutants that are carried by stormwater into the receiving streams. The SWMP identifies actions and responsibilities for campus personnel, and includes six minimum control measures (MCM) and the Best Management Practices (BMP) that support them. The six MCMs' are:

- Public Education and Outreach on Storm Water Impacts;
- Public Involvement/Participation;
- Illicit Discharge Detection and Elimination;
- Construction Site Storm Water Runoff Control;
- Post-construction Storm Water Management for New Development and Redevelopment; and
- Pollution Prevention and Good Housekeeping for Municipal Operations.

1. <https://boulder.colorado.gov/projects/skunk-creek-bluebell-canyon-creek-and-kings-gulch-flood-mitigation-projects>

Exhibit 102: Slopes



The MS4 permit and SWMP are an important consideration for the Master Plan. The SWMP includes best management practices to control runoff, spills and leaks, waste disposal, construction practices, and raw material storage. The US Clean Water Act; US EPA requires an NPDES permit for proposed land disturbing projects of one acre or more. The Energy Independence and Security Act of 2007 Section 438 establishes strict stormwater runoff requirements for federal development and redevelopment projects. The provision requires any development or redevelopment project involving a Federal facility with a footprint that exceeds 5,000 square feet to use site planning, design, construction, and maintenance strategies for the property to maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to the temperature, rate, volume, and duration of flow. A key issue for the campus is controlling and offsetting the addition of impervious surfaces, recognizing the significant amount of paving that exists, most without trees or vegetation to control runoff.

Natural Ecosystems, Vegetation and Wildlife

The Department of Commerce Campus is part of the Montane Woodlands and Great Plains Mixed Grass Prairie natural ecosystem, according to the Boulder Valley Comprehensive Plan. Natural ecosystems zones, as defined by City of Boulder, support native plants and animals or possess important ecological, biological, or geological values. They may also contain features that are rare, unique, or sensitive to human disturbance.¹

The western part of the site falls within the “Group Two Natural Ecosystem Zone” which is generally considered important in providing ecosystem connections and buffers. Although there may be human-altered landscapes in these zones, the area may still retain significant populations of species of concern or function to meet biological requirements for species of concern (e.g., reservoirs).

The National Environmental Policy Act (NEPA) requires an Environmental Assessment (EA) or/and an Environmental Impact Statement (EIS) during construction to assess the environmental effects that a proposed project will have on the environment prior to making any changes. The 1996 Environmental Impact Statement for the campus notes that of approximately 1,500 species of vascular plants occurring in the Boulder region, nearly 430 species, representing 77 families, have been identified on the DoC campus. It also

notes that the campus vegetation was severely disturbed in the mid-1950s and non-native species replaced much of the native vegetation. In the 1990s, the dominant species were nonnative grasses and forbs that escaped from cultivation and landscaping, which included Kentucky bluegrass, cheat grass, orchard grass, and crested wheatgrass. Non-native weedy annuals, biennials and perennials were also prevalent. Native plants, mostly grasses such as switchgrass, Canada wild rye, and western wheatgrass were sparsely distributed on the campus and constituted less than one percent of the total vegetation cover. Box elder, cottonwood and green ash were the main shrubs found along Anderson Ditch and Skunk Creek.

The Boulder Laboratories campus has a large number of ash trees, notably lining the Anderson Ditch in front of the David Skaggs Research Center. Ash trees in Colorado are suffering from an infestation of the Emerald Ash Borer, a federally quarantined invasive tree pest that feeds on and destroys ash trees. DoC has taken some preventative action but expects to lose most or all of their ash trees over time.

The Mesa serves as a transition area for prairie and mountain plant species containing stands of Ponderosa pine and other plants like big bluestem, pasture sage, Canada bluegrass, prairie dropseed, needle-and-thread, cinquefoil, prickly pear and rose. There are some introduced herbaceous species present, including sunflowers. Some pine regeneration occurred in the 1990s.

The Endangered Species Act of 1973 provides a framework to conserve and protect endangered and threatened species and their habitats both domestically and abroad. It requires that the habitats of federally listed endangered species not be affected by any activities with federal involvement. If there are any activities that could affect the habitats, a mitigation strategy may be required to reduce any impacts. The United States Fish and Wildlife Service (USFWS) conducted faunal surveys in 1992 on the campus which included the Skunk Creek drainage and adjacent uplands, Anderson Ditch and adjacent areas, and the Mesa. It was concluded that mammal species, such as mountain lion, black bear, and beaver, were likely individual rare transients whereas coyote, bobcat, and red fox, were uncommon. Common animals spotted were yellow-bellied marmot, prairie dog, cottontail, mice, and shrews. While the site is within the historic range of such species as peregrine falcon, bald and golden eagles, on-site nesting could not be confirmed. Amphibians such as leopard frogs, chorus frogs, woodhouse toads, and tiger salamanders were also common.² Local residents have reported seeing additional species.

1. Source: City of Boulder and Boulder Valley Comprehensive Plan

2. 1996 Environmental Impact Statement for NOAA and NIST



Geology and Soils

The campus, not unlike the extended region east of the Rocky Mountains, is underlain by Pierre shale geologic formation or series, formed in the Late Cretaceous period.

The predominant soil type on the campus is Nederland (NdD) which covers over 80% of the site including all of the campus area east of Skunk Creek outside the Tribal Protected Area. The NdD soils are deep, well drained, moderately permeable soils formed in very cobbly and gravelly alluvium derived principally from granite. These soils, which allow slow to medium runoff, are generally conducive to development although the presence of stones and cobbles can impede some excavations.

West of the Mesa, there is a wide section of Colluvial Land (Cu) soils covering about 17% of the site. Colluvial soils are highly variable in depth, texture, color and stoniness and consistently exhibit high erosion potential. The erosion potential impedes even low-intensive improvements, such as paths and trails.

Two other types of soils cover the remaining three percent of the campus, namely Goldvale-Rock (GrF) along the west boundary and Terrace Escarpments (Te) along the south boundary east of Skunk Creek.

GrF soils are characteristically well drained, allow medium to rapid runoff, and feature slow permeability. Terrace Escarpments are unconsolidated in nature and typically feature steep slopes. The presence of silts and clays in terrace escarpments can easily make them unstable when development activities occur on or near this landform.

Exhibit 104: Soils

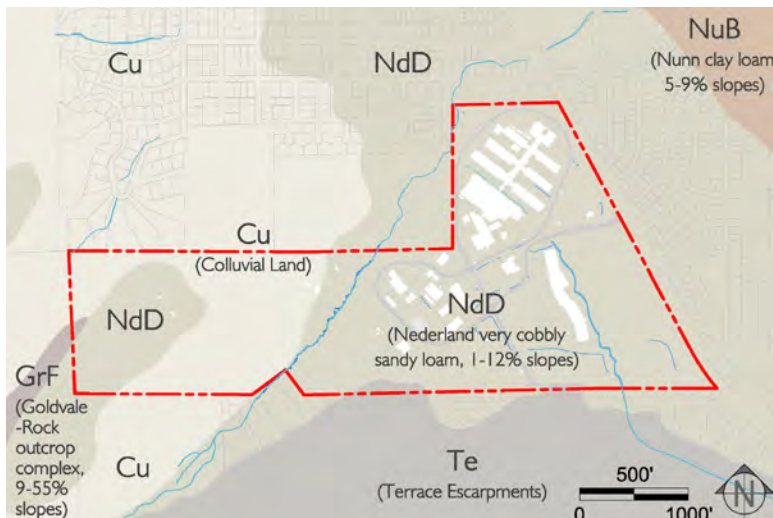


Exhibit 105: City of Boulder Climate Graph¹

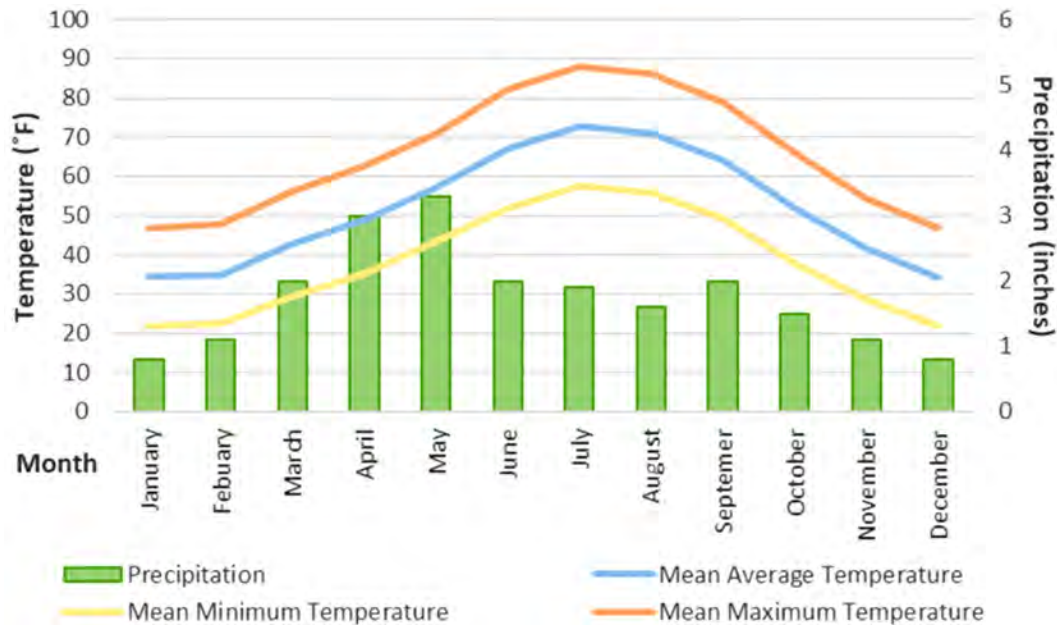
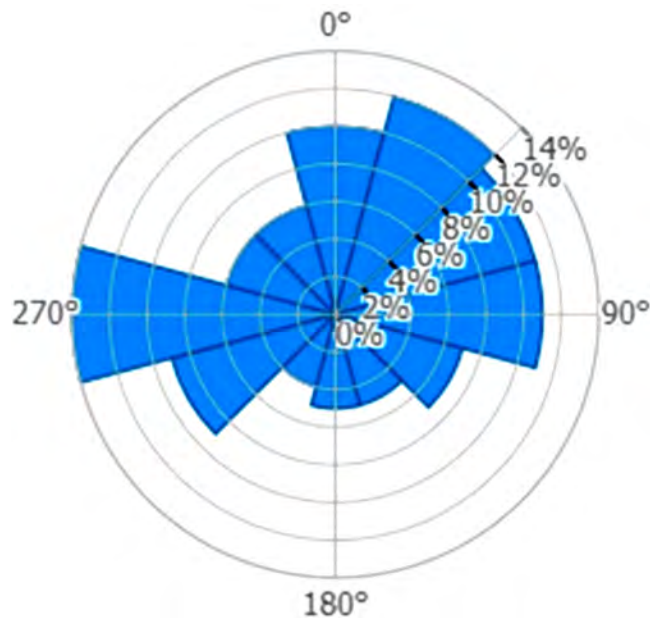


Exhibit 106: City of Boulder Wind Frequency¹



1. Source: 2024 City of Boulder Wildfire Protection Plan
2. <https://bouldercounty.gov/disasters/wildfires/maps-and-videos/>

Climate

Boulder Colorado, which has an average altitude of 5,400 feet above sea level, has a predominantly semi-arid climate. July is usually the warmest month of the year averaging daytime temperatures of 87°F. January is the coldest, with an average daytime high of 45°F. On an average, there are four to five nights per year when the temperature reaches 0 °F. Snowfall averages 88 inches per season, but snow depth is usually shallow; a strong warming sun due to the high elevation can quickly melt snow cover during the day and Chinook winds bring rapid warm-ups throughout the winter months. Prevailing wind directions are from the south, north, and south-southwest.

Wildfire Hazard

Environmental considerations and climate change require focused attention and new strategies to safeguard people and protect the natural and man-made environments—increasingly from wildfire hazard. Wildfires have increased in severity and size in the Boulder area. Boulder County has had seven notable wildfires since 2000, burning over 27,000 acres. Two fires in 2022 were near the DoC campus, the Sunshine Canyon Fire and the NCAR Fire. The NCAR Fire burned approximately 190 acres in the Boulder Open Space Mountain Park area south of the NCAR campus. Over 19,000 people were evacuated. The Sunshine Canyon Fire was in the foothills west of Boulder and burned approximately 20 acres. Less than three months earlier than NCAR, in December 2021, was the Marchall Fire, the most destructive in Colorado history in terms of homes destroyed (1,084).² This fire was southeast of the City of Boulder, centered around Louisville and Superior. Approximately 6,026 acres were destroyed and 30,000 people evacuated. The DoC campus location by the foothills and the open land to the west of the campus buildings make it vulnerable. The Boulder County Wildfire Zone Map includes the lands west of US 26, including the DoC campus, in zone 1 (of 2) for wildfires.

Evacuation capacity from the campus is very limited. There are three roads off the campus, two of which exit into neighboring residential streets. The main campus entrance/exit is to Broadway (State Highway 93), a two-way, multi-lane roadway. In a fire emergency, much of the dense residential area around the campus would also evacuate using Broadway, a roadway very backed up during the recent NCAR fire.

Sustainable Design Opportunities

Successful integration of sustainable design strategies will require a comprehensive framework in the Master Plan, and a targeted approach for each project that results from it. The Department of Commerce, like other federal agencies, strives to save energy, conserve resources and limit pollution. Following are standards and executive orders to be considered:

- Department of Commerce 2022 Sustainability Plan, or latest version
- Department of Commerce 2021 Climate Action Plan for Adaptation and Resilience, or latest version
- Department of Commerce High Performance and Sustainable Buildings Handbook, latest version
- Department of Commerce Implementation Handbook for the Strategic Sustainability Performance Plan, June 2013
- NIST Sustainable Design Manual, latest edition
- US Executive Order 13693: Planning for Federal Sustainability in the Next Decade; March 2015
- CEQ's Guiding Principles for Sustainable Federal Buildings and Associated Instructions; latest version
- US Energy Independence and Security Act of 2007 (EISA 2997)
- US Energy Policy Act of 2005 (EPA 2005)
- The Energy Independence and Security Act (Public Law 110-140) of 2007

The Boulder Laboratories already embrace many of the principles of sustainable design in the campus elements and operations. Much of the campus is preserved and protected in its natural state, open to community use and protecting Skunk Creek. Landscape irrigation water is drawn from the Anderson Ditch. Transportation alternatives are supported, including extensive use of public transportation and bicycle commuting. Solar collectors are used for site lighting.

The Master Plan recommends other opportunities for incorporating sustainable design strategies into campus development and future buildings.

- Enhance strategies for stormwater quantity and quality control, including reducing impervious surfaces and utilizing plantings where possible to increase ground water recharge rather than runoff
- Enhance campus-wide energy performance by consolidating small inefficient buildings
- Facilitate and augment the already established bicycle and public transit use
- Incorporate daylighting into building design for offices, support spaces and selected laboratories. Utilize strategies to reduce glare and solar heat gain on the building envelope through building orientation, design and screening with vegetation.
- Maintain and increase tree cover to moderate temperatures, shade buildings and outdoor activity areas and absorb pollutants
- Explore the potential for incorporating on-site energy generation.

Exhibit 107: Campus Existing Impervious Surfaces

	Research Zone 1 SF	Research Zone 2 SF	Research Zone 3 SF	Protected Area SF	Total SF	Total Acres
Impervious Areas	34,600	31,800	2,002,900	174,700	2,244,000	52
Buildings	1,100	5,400	609,700		616,200	14
Antenna Field			20,100		20,100	0
Other Structures/Areas		2,500	84,000	1,700	88,200	2
Utility Yard			70,500		70,500	2
Parking/Loading Areas	1,800	5,000	725,900		732,700	17
Road/Sidewalk	31,700	18,900	492,700	173,000	716,300	16
Pervious Areas	476,800	277,900	1,626,100	4,333,800	6,714,600	154
Total Site Area	511,400	309,700	3,629,000	4,508,500	8,958,600	206

12.2 Development Characteristics

The visual character of the campus is dominated by the terrain—the natural landscape, Kohler Mesa, and the Flatirons beyond. Both by design and regulation, the buildings are low in scale, appearing as foreground elements before the views. The buildings step back from Broadway, following the gradually rising slope. The majority of the site is preserved as designated Open Space and characterized by low mixed grasses and intermittent trees. Riparian vegetation marks the paths of the Anderson Ditch and Skunk Creek across the property.

Surrounded by residential and low-scale commercial development, the campus is easily recognized, with no visual buffer from Broadway, which is a main thoroughfare. Two buildings are prominent when approaching the campus: Building 1—Radio Building, and Building 33—NOAA's David Skaggs Research Center. These two largest campus buildings represent two eras of laboratory construction. The Radio Building, built in the 1950's, is a concrete and stone panel building with six wings linked by a multi-story spine. Renovation of the wings and the spine is ongoing. The 1999 David Skaggs Research Center is a long linear building of four stories, clad in local stone and brick.

Campus Organization

While there are three designated "research zones" in accordance with the MOA with the City of Boulder, two of these are restricted in their use. The largest, Research Zone 3, is also designated as the Development Zone. Within the Development Zone, the campus can be loosely organized into three districts, based on physical characteristics and typical uses. The road structure is a very strong campus organizing element, reinforced by changes in grade. The three campus zones do look different from each other, and there is very little feeling of linkage or functional relationship.

The laboratory district is the cluster of buildings by Broadway, anchored by the Radio Building and encompassing the original campus buildings and most of the labs, including the state-of-the-art Building 81. This area is defined by an enclosing loop road, called Compton Road and Marconi Road. Laboratory buildings are close together, connected and characterized by multiple additions and annex buildings. One lab building, Building 24, is an outlier from the loop road.

The support district is to the west, also enclosed by a loop road, the Curie Circle. Located here are the Central Utility Plant and various

Exhibit 108: Development Zone Functional Districts



administration and support buildings, and one lab building, Building 3. Except for Building 3, this area houses distinct individual buildings, typically one-story in height. Many of these buildings are modular buildings or temporary buildings that have taken on permanent status. Each building has its own adjacent parking area.

NOAA's buildings and parking form the third district. This roughly triangular parcel is to the south of the site along Anderson Ditch. Although not physically separate from the rest of the campus, maintenance of NOAA's area is managed by the U.S. General Service Administration. The primary structure is the David Skaggs Research Center; in addition, a large parking lot and an observatory building are terraced up the slope.

With limited land available in the laboratory zone, the support zone is a likely location for future NIST development. Buildable parcels are available, and the low and temporary buildings offer the opportunity for future consolidation of administrative and support functions. A second development location exists between the three zones if phased construction replaces existing buildings.

One of the challenges of the Master Plan is the integration of more distant research buildings into the hub of scientific activity, for a cohesive and comprehensible campus. NIST has developed a conceptual “center of scientific influence” to help define the levels of lab technology and organize lab assignments. This center is designated to be at Building 81, the Katharine Blodgett Gebbie Laboratory, and defined as the core of intense lab infrastructure, with specialized infrastructure that links and supports other laboratories.

Campus Circulation

The Boulder campus has a single vehicular entrance from Broadway, which is Colorado State Highway 93. All employees, visitors and deliveries use the same entrance. The Security Center, Building 51, is located as one enters the campus, where visitors, delivery personnel and their vehicles are screened. Employees use an adjacent lane and enter with their ID badges. The single campus entrance is well marked with prominent signage. However, some confusion is caused by an entrance drive just south of Building 1 that leads to a privately-owned building located adjacent to the campus.

Vehicular Circulation

Branching off from the entrance, two loop roads characterize the main campus circulation. Compton Road and Marconi Road circle the area occupied by the majority of the research buildings. A second loop, Curie Circle, services the building to the west of the campus, as well as access to the NOAA building parking area. The roads are well maintained and offer easy access to the various parking lots. Evaluation of circulation patterns identified several areas of conflict to be addressed in the Master Plan, including the following:

- Congestion at the campus entry. Visitors and their vehicles must be screened upon entry into the campus. Space and maneuvering room are limited, and congestion is a problem. See the security description in this chapter.
- Conflict at entrance. A city designated bike route passes along Broadway and the campus entrance. It is heavily used, and often by speeding bicyclists. Recent access modifications and the addition of a traffic light have eased the conflict but have not eliminated it.
- Conflict near Building 81. The two loop roads are connected by a short drive, located between Building 81 and Building 33. This 50-foot long segment supports drivers turning from four

directions, including visitors from the entry drive who must make a decision at this point. This intersection is very confusing, and there is no signage to assist. The road radius is not adequate for large trucks, and curb damage has occurred.

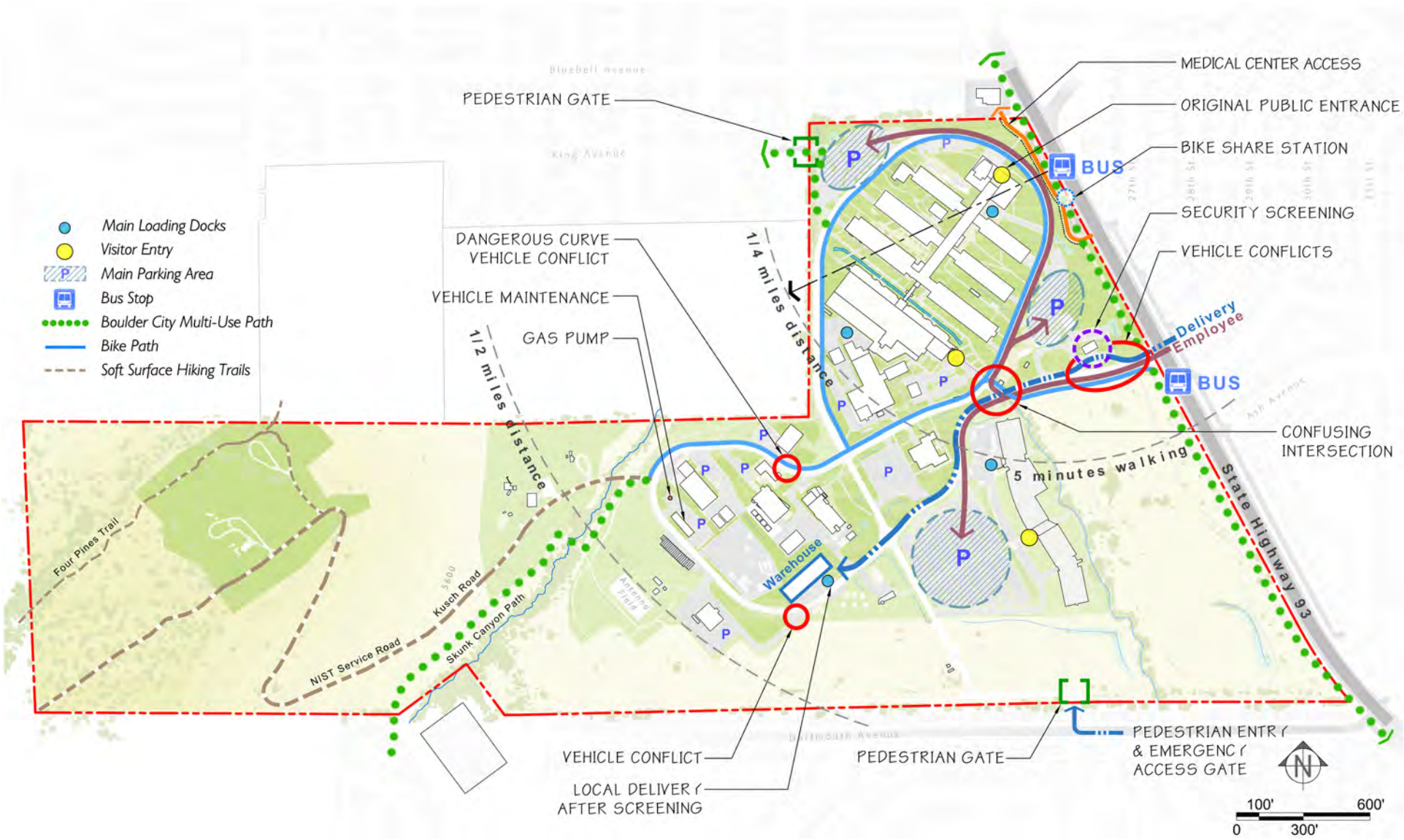
- Dangerous conflict at the Childcare Center. A pull-off lane and parking area are provided for parents who are dropping off their children for daycare. Cars then exit the parking onto a blind spot on Curie Circle, just beyond a right-hand curve for cars coming from the entry road.
- Conflict at Warehouse–Building 22. The parking area at the warehouse is shallow, at approximately 56 feet. There is little maneuvering room, and the staff temporarily closes this section of Curie Circle when tractor-trailers are backing in or extending into the roadway.
- Signage. Directional signage is lacking at decision points along the campus roadways.

Pedestrian and Bicycle Circulation

Employees arrive at the campus by car, bicycle and public bus. Parking is available in open lots near the buildings.

Many employees commute to campus on bicycles year-round. The number of bikes observed inside lab and office areas (not permitted) suggests that the current amount of protected bicycle storage is not adequate. Bicycle racks, bike lockers and bike rooms are located in and around campus buildings. There is a covered bicycle parking facility at the intersection by Building 81, by Building 2, and Building 3. In addition, there are bicycle lockers and racks available on campus.

The Regional Transportation District operates bus lines along Broadway and along 27th Way, stopping at the two bus stops at the Boulder Laboratories campus. There is no convenient walkway from the bus stops to the campus buildings.



Campus Paths and Trails

Pedestrians, both employees and the public, have free access to the site for recreation. There are two pedestrian gates from adjacent residential areas, and trail access from parkland at the western edges of the property. The City of Boulder has established an extensive integrated network of walking and bicycle paths throughout the city and hiking trails in the nearby mountain parks. Several of these pass through the Boulder Laboratories campus.

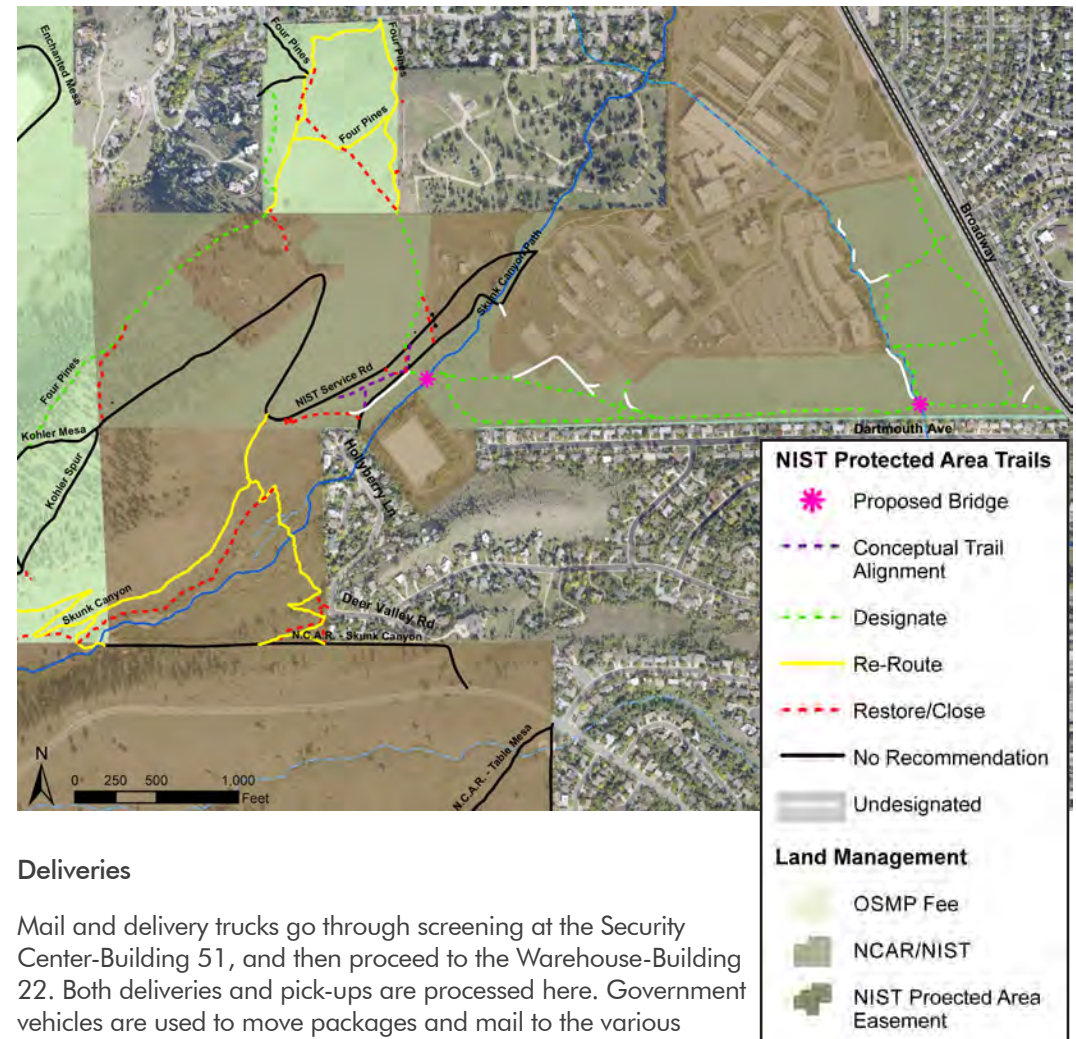
Designated Bike Route. Part of the city-wide system, a public bicycle route has been established through campus, maintained in an arrangement with the City of Boulder. The route covers most of the roads on the campus, beginning at the Broadway entrance, following Rayleigh Road, looping around Buildings 2, 81 and 1, and extending to Curie Circle, where it connects with a city multi-use path west of Buildings 4 and 5.

Multi-Use Paths. The city designates multi-use paths for shared use by pedestrians, bicyclists, skaters, and other non-motorized uses. They are pathways physically separated from streets and traffic. Two main multi-use paths are on campus, connecting to the designated bike route noted above. One of these paths runs parallel to Broadway, marked for pedestrians and bicyclists and separated from the street. The second runs along Skunk Creek, connecting Curie Circle with a bike path at the south property line that links to Table Mesa Drive.

Campus Trails. The city's Open Space and Mountain Parks group maintains hiking trails throughout city parkland and designated Open Space. The trail systems through the campus Protected Area make use of DoC's Kusch Road. It links the campus roadways to Kohler Mesa and Boulder Mountain Park to the west. Four Pines trail at the western edge of the property connects Boulder Mountain Park to the Tippitt Open Space along the north property line.¹

NIST is engaged in a collaborative project with Boulder's Open Space and Mountain Parks (OSMP) to create a designated environmentally sustainable trail system. The city is responsible for maintaining the Protected Area and is concerned with issues of erosion, landscape protection and safety. The NIST campus is part of the Chautauqua & Flatirons Subarea.

Exhibit 110: City of Boulder Existing and Proposed Trails



Deliveries

Mail and delivery trucks go through screening at the Security Center-Building 51, and then proceed to the Warehouse-Building 22. Both deliveries and pick-ups are processed here. Government vehicles are used to move packages and mail to the various campus buildings. Scheduled deliveries of large equipment or bulk items, such as construction materials, are often driven to the receiving building by the outside delivery truck. Under an interagency agreement, NOAA staff manage the mail and delivery services for all organizations on the campus.

1. Source: City of Boulder website; Map of Bike & Pedestrian Routes, and Map of Open Space Trails.

Campus Landscape

The developed campus landscape consists primarily of lawn and suburban-style planting beds, creating a visual hodgepodge of disconnected landscapes unrelated to the campus Open Space. There is the opportunity to use plantings to unify the campus and create a richer sense of place in harmony with its larger context. The Ponderosa Pine Savanna that surrounds the campus is beautiful, and ecologically resilient, and it is a signature feature of the larger Front Range landscape. Plants of this community can help to unify the campus, minimize irrigation and maintenance, and create a place richly evocative of the natural setting. This basic palette of plants can be patterned in a variety of ways—highly naturalistic arrangements to more formal compositions—depending upon the specific context.

Existing Plant Character. The campus is open in character with trees scattered throughout but no continuous canopy. The ground plane is composed of a random combination of lawn, ornamental plant beds, and low meadow-like grasses. The presence or absence of irrigation greatly influences the quality and character of the planting.

Tree issues. Existing pine trees seem to thrive on the site. Some of the most significant stands of deciduous trees include the ash trees planted along the Anderson Ditch. Many of the ash trees suffer from Emerald Ash Borer, an infestation that will likely result in the decline of those trees. This prompts the need to create a campus-wide arboricultural management plan as well as to diversify the canopy and select more resilient species.

Potential Wildfire Hazards. The existing Juniper trees near buildings, along with the accumulated plant debris on site, present significant wildfire hazards by providing ample combustible materials that can fuel fires, influencing key factors such as intensity, spread, and duration. Overgrown grasslands, particularly those infested with flammable invasive species, and the build up of dead wood along Anderson Ditch and Skunk Creek, further exacerbate the wildfire risk. These continuous surface fuels, combined with abundant ladder fuels, can ignite rapidly, facilitating the swift spread of fire. To mitigate these risks, strategic placement of fuel treatments and the establishment of fuel breaks are essential to limiting fire spread, while simultaneously enhancing the overall health and resilience of the forested landscape.

The landscape surrounding the campus should create a needed sense of continuity and place on campus. A well-designed landscape

that harmonizes with the larger natural setting can serve as living connective tissue that ties together the disparate pieces of architecture and surface parking.

Campus Security

The perimeter of the campus is open to adjacent streets and residential areas, without a surrounding fence. Several trails cross the campus, and the neighbors use the site for recreation, jogging and biking to downtown or the university. NIST controls vehicular access to the property at the entrance from Broadway, where visitors' cars and delivery trucks are screened. Other than the screening of vehicles, campus security is at the building level, with access control and hardening of the exteriors.

Visitors who plan to enter any campus building must stop at the Security Center to be screened and receive a badge and escort. Today, a visitor parks next to the Security Center building and enters to be issued a visitor badge and have the magnetometer screen any possessions brought into the building. If the visitor does not bring in any possessions (briefcase, bag etc.), but leaves them in the car, the items are not scanned. Also, the visitor is screened only on the initial day of a multi-day pass. Because of the building's small size, visitor flow is not efficient. On a typical day, approximately 100–125 visitors are screened.

All non-employee vehicles are screened before they are permitted to enter the campus. Vehicles pull into the Security Center parking area, where officers/guards visually inspect vehicle contents, using handheld mirrors and cameras when appropriate. Campus security also checks with the NIST employees that are sponsors for any deliveries. The building and vehicle inspection areas are close to the Broadway entry, limiting queuing space and constricting flow. Security issues at the entrance include:

- Visitor parking, car and truck inspections are conducted in the same area, and maneuvering room is very limited. It is not possible to parallel process a tractor trailer and passenger vehicle, so traffic can back up into the campus entry at busy times.
- Space is needed for large trucks to pull off the main circulation and park for further inspection where they will not interrupt the flow.

- There is no turn-around space for cars or trucks that accidentally miss the screening area and arrive at the final inspection booth.

Visitor parking is not currently allowed in the lot behind the Security Center because the exit from this lot bypasses vehicle inspection. Cars must then circle around via the main drive.

- The distance from the entrance booth to the security bollards is not long enough space to allow the person at the inspection booth be able to react and raise the bollards in time to stop a breaching vehicle.
- Operational issues, including limited scanning of visitor possessions, and no secondary validation of driver identity at the entrance booth.
- Signage is not sized or positioned such that it can be read by first-time visitors.
- As a federal property, federal laws apply. Some are in conflict with Colorado regulations that allow concealed firearms and marijuana. Visitors may inadvertently have these items in their vehicles, which then can't be allowed onto the property and can't be parked at the entrance.

Employees use a separate traffic lane when entering the campus, using their IDs to open a gate.

Regulations Governing Site Development

Memorandum of Agreement

Much of the Boulder Laboratories Campus is protected from development through agreements with the City of Boulder and a collective of Native American tribes. In 1993, the US Department of Commerce and the US General Services Administration entered into an agreement to protect campus land with fourteen Native American tribes and the Medicine Wheel Coalition for Sacred Sites of North America. Recognizing overlapping easements, this earlier agreement was folded into the First Amended MOA between the National Institute of Standards and Technology, U.S. Department of Commerce and the City of Boulder, signed May 8, 1998.

This Memo of Agreement (MOA) protects specific areas of the campus from development and sets limits on site usage and future buildings. Key provisions that affect the Master Plan are the following:

Campus Development Zones

The *Development Zone* is an 83.31-acre area where any construction is to take place, and where the existing major research buildings are located. (This is also referred to as Research Zone 3.) Within this area, the Government may maintain existing buildings and build new ones, subject to certain restrictions.

- Buildings may not exceed 55 feet in height, when measured in accordance with Section 84 of the Boulder City Charter, and the height must not impair the view of the top one-third of Kohler Mesa, as seen by a person standing on Broadway. Any proposed variations of this must be presented to diverse community groups for review.
- Total square footage of all buildings is limited. Originally, the maximum square footage was set at 1,187,270 gross square feet. This was adjusted by NIST and the City of Boulder in a March 2015 letter to account for new measurement methodologies. It is now set at 1,418,923 gross square feet as measured by GSA and the Building Owners and Managers Association (BOMA).¹
- Parking spots are capped at a total of 1,802 spaces. Parking areas are to incorporate landscape treatments that help them to better blend into the natural environment.
- Buildings must comply with national and local building codes.

Research Zones 1 and 2 are designated areas that currently support outdoor research and several small buildings. Kohler Mesa is Research Zone 1, at 11.74 acres. Research Zone 2 is in the north-central part of the campus, by Skunk Creek, and is 7.11 acres in size. No new habitable buildings are permitted in Research Zones 1 and 2, but the existing buildings may be redeveloped if similar in use, size, and height.

Exhibit 111: Existing Built Environment vs. Permitted

	Existing	Permitted
Buildings	1,266,604 GSF	1,418,923 GSF
Parking	1,364 spaces	1,802 spaces

1. Jane S. Brautigam, City Manager to Virginia Holtzman-Bell, Boulder Laboratories Site Manager; March 15, 2015; Boulder Colorado



The Protected Zone encompasses approximately one-half of the campus land, and incorporates the areas protected under agreement with the Tribes. The 103.5 acres begins in front of NOAA at Broadway, extends across the southern portion of the property and the western third, excepting the top of Kohler Mesa. In the Protected Zone, no research will be conducted.

- The public has access, and the Native American Tribes are permitted to hold gatherings in their protected areas.
- No new perimeter fencing is permitted in this zone without written permission between the parties and the Tribes, if adjacent to their easement.
- Utility and communication lines may be placed beneath the protected area.
- Pedestrian and bicycle paths exist, which are to be maintained by the city. No new paths are to be created.
- A portion of Anderson Ditch is in the Protected Zone, and the government is allowed to use this for irrigation.
- Two detention ponds for stormwater are permitted and have been built in the southeast area of the campus.

Other Development Considerations

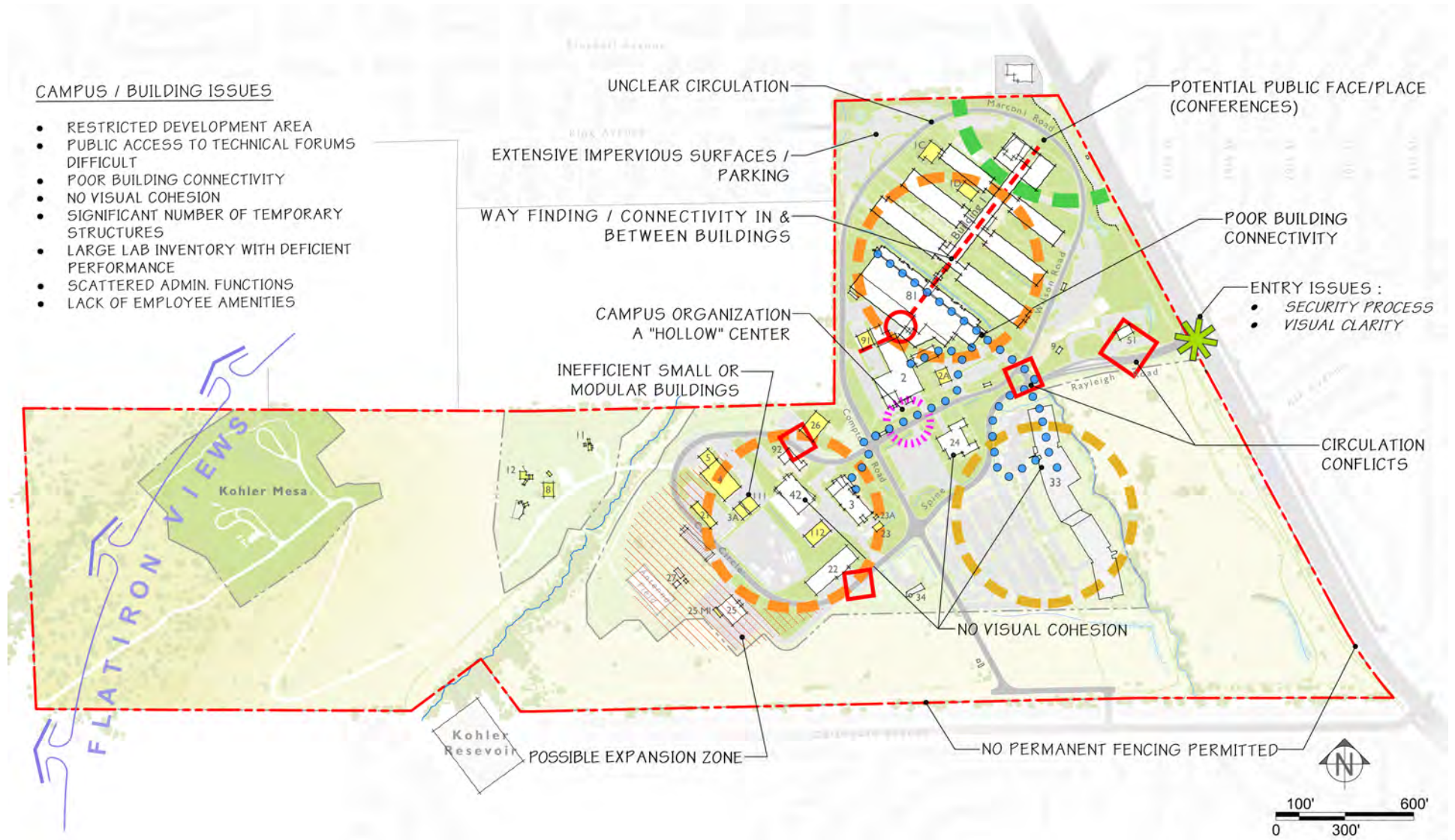
- The Department of Commerce must keep the community informed when any construction is undertaken.
- The City of Boulder will review any proposed building over 10,000 gross square feet in size, reserving a 30-day review and comment period to consider a full range of issues.
- In accordance with the National Environmental Policy Act (NEPA), DoC must complete requisite environmental review and documentation.

Easements

The Boulder Laboratories campus is encumbered by several easements in addition to the restrictions of the MOA: 1) The City of Boulder has an easement with NIST for the creation of the Protected Areas; 2) The Department of Commerce is responsible for the repair and maintenance of the Anderson Ditch, which has an easement through the campus running between Building 81 and Building 1, and then south into the protected area; 3) The owner of 385 Broadway holds an easement for the property's entrance drive, which is a turn-off from Broadway; 4) The City of Boulder has a pedestrian and bikeway easement along Broadway Street. The city also has easements for utility and communication lines, one along the north property line, as well as several in the protected area; and 5) The Regional Transportation District (RTD) has a license for bus shelters on NIST property along Broadway.

City of Boulder

The Boulder Campus is located within the City of Boulder. Owing to its federal ownership, the campus is generally exempt from local regulations and plans. The Federal Government, through the General Services Administration (GSA), has instituted the "Good Neighbor Program" to ensure quality work environments for the employees of federal agencies by helping to revitalize the nation's communities. Executive Order 12072 also requires that "federal facilities and federal use of space in urban areas shall serve to strengthen the nation's cities and to make them attractive places to live and work. Such federal space shall conserve existing urban resources and encourage the development and redevelopment of cities."





Campus Built Environment

13

The Department of Commerce Boulder Campus is approximately 206 acres and contains 35 permanent and temporary structures that support the research mission, 30 of which are occupied buildings. These buildings represent a spectrum of uses, from laboratory buildings to offices to garages. Eight buildings remain from the initial campus development in the 1950's including the Radio Building, representing approximately 35% of the total campus space. There was little additional construction until 1999, when a major building for NOAA was completed. NOAA's David Skaggs Research Center and subsequent construction over the last 15 years now represent approximately 58% of the total space. Many campus buildings, both old and new, are modular construction or small, simple buildings. Three buildings—the Radio Building, the Katharine Blodgett Gebbie Laboratory and the David Skaggs Research Center—represent over three-quarters of the campus space.

13.1 Functional Observations

Campus buildings are well maintained, and repairs are made when necessary. A 2023 facility condition assessment of the NIST buildings and grounds by Nelson Engineering, identified physical deficiencies, and recommended repairs to each building. Many of these were implemented or are planned for upcoming projects. While the total repair backlog is significant and many of the buildings received a Facility Condition Index (FCI) score in the poor range, the renovated wings of Building 1 and newest building are in good to excellent condition. An enterprise risk management assessment determined poor facilities pose a high risk to NIST, with over 52% of the laboratories in Boulder in poor or critical condition. The assessment also pointed out the aging nature of many buildings, especially the smaller ones, and the inefficiency of multiple, older engineering systems.

The National Academies of Sciences, Engineering and Medicine (NASEM) evaluated the NIST facilities, summarized in a 2023 report: *Technical Assessment of the Capital Facility Needs of the National Institute of Standards and Technology*.¹ The assessment described both the extraordinary contributions of NIST in measurement science and the risk that current laboratory and infrastructure deficiencies poses to NIST's mission and its greater role in the U.S. economy and security. NASEM, in an excerpt from the report: Specific physical

1. National Academies of Sciences, Engineering, and Medicine. 2023. *Technical Assessment of the Capital Facility Needs of the National Institute of Standards and Technology*. Washington, DC: The National Academies Press. <https://doi.org/10.17226/26684>

deficiencies on the Boulder campus are cited, highlighting limitations and delays in research priorities and national security deliverables, and aging facilities and infrastructure that can't support precision measurement science and risks serious damage to highly specialized equipment. Two of the NASEM key recommendations:

- NIST should modernize laboratory facilities to provide the performance needed to meet the measurement science and mission-focused research and development challenges for today and the future, and to attract and retain the scientists and engineers required to solve these challenges. Current conditions and functionality are adversely impacting NIST's current mission, and modernization is well overdue and desperately needed.
- NIST should address the underlying deficiencies with campus infrastructure including the CUPs, distribution systems, and electrical power quality and continuity to ensure that the modernization plan investment is effective. If not developed in conjunction with laboratory modernization, the requirements of the new labs will not be met. Inefficiencies are not only in the physical building systems, but also in their layout and organization. The nature and activities of today's scientific research and support have outgrown many of the facilities in which they now occur. For the Master Plan, the team reviewed each campus building for its condition and functional suitability. Additionally, they interviewed the building managers and users to identify current and anticipated issues.

Following is a summary of key observations and issues:

- **Environmental Control.** Much of the advanced research taking place on the Boulder campus is based on precise performance and measurements, which demand very controlled environments—rigorous temperature and humidity control, vibration stability, air cleanliness and quality electric power. Other than in Buildings 81, 33, and renovated B1 wings, these conditions are difficult to achieve. Researchers make do in the older lab buildings, but time is wasted and experiments sidelined. Renovations to several wings of Building 1 have upgraded facilities to the requirements of the laboratories.

- **Separation of Working Groups.** Functional units and research working groups are not located together, with related laboratories and/or offices located in several buildings. This situation was magnified when the Gebbie Laboratory opened, and the most environmentally demanding labs were relocated. Collaboration on projects, sharing of resources and working efficiency are compromised.
- **Scattered Administration.** Like the scientific groups, the administrative functions are scattered across the campus and are housed in a variety of small and modular buildings. Construction, facility management, maintenance, administration, and contracting/acquisition personnel are all located in separate buildings (7 in all). Not only are opportunities for human synergy lost, but multiple buildings use more energy and necessitate the duplication of resources and equipment.
- **Front Door.** There is no recognizable front door or downtown for visitors and staff. The head-house of Building 1 was once the main campus entry, but with the relocation of the entry road, each building seems autonomous, and the entrance nearest its parking lot becomes the main one. What is lost in this scenario is a sense of place and a central location where staff casually meet or come together across various organizations.
- **Lack of Amenities.** Spaces that draw people together or provide general support are limited, constrained by space pressure or circumstance. No food service or coffee bar facilities are available in the NIST Buildings; there is a small self-service snack bar in the NOAA building, open to all on campus but limited in offerings and not convenient for the NIST community. Although there are some break rooms, coffee pots and small refrigerators appear in many office areas, which is against DoC policy. Former collaboration space and small meeting rooms have become offices and lab support areas, as space is needed. Building 1 wing renovations have included more collaboration and breakroom spaces.
- **Conference Conundrum.** Both NIST and NOAA host conferences on campus. The NIST auditorium serves as a campus-wide resource, equipped with video and telecom technology. Large conferences are no longer held on campus because of space, security and service concerns. Conference space is available in three buildings—Buildings 1, 81 and 33—but they are not located near enough to support each other for larger conferences.

Security also constrains certain conferences. Each attendee must go through security badging and vehicle screening, with extra hurdles if the attendee is not a US citizen. Food services are not readily available at the DoC campus, and each conference must be catered for coffee or meals. If not catered, attendees leave the campus for meals. Sometimes the conference hosts arrange for attendees to park at an off-site location and come in by bus to expedite the security screening.

- **Wayfinding.** Wayfinding can be a challenge, because of both limited signage and confusing layouts. The Radio Building (Building 1) steps up the slope, so that the floors of the central spine are discontinuous, and vertical transitions must be made to reach all the wings; there is only one elevator and 2 stairs that reach all levels. Within some older buildings, renovations and additions have created multiple corridors and confusing circulation. Visitors are typically escorted, following security policy but also ensuring they can find their desired location. Campus signage and wayfinding standards were developed and are gradually being implemented.
- **Changing Role of Library and Media.** Library facilities exist in both NIST and NOAA facilities, with the NIST Building 1 library considered the main library and NOAA the branch. Journals and other resources are more and more available on-line, from the researcher's desktop; librarians are changing their role to direct information research and encourage shared resources/collaboration. In parallel, the NOAA Information Technology group wants to offer education and collaborative software research into new technologies that will aid in science. Together, there is the potential for synergy, and a reconsideration of the "library."



NIST Auditorium, Building 1

- **Duplication of Resources.** Multiple buildings with multiple working groups suggest a review of support facilities, to improve their quality and utilization. One example is the number of staff workshops on campus. The main machine shop creates tools and parts on a per-order basis, but other workshops are available to staff for immediate and minor work. There are at least eight of them within the NIST lab buildings, created by different groups and unsupervised.
- **Storage.** Active equipment and temporarily side-lined equipment are hard to distinguish, but the planning team was told that there is limited designated storage space. Items are stored within lab areas, limiting the flexibility of the labs. The campus has approached the storage issue by adding shipping containers placed on the site, many of them in and around Building 21 and its adjacent yard. On campus, there are over 40 containers, or approximately 11,000 SF of storage space. Note, the containers are referred to as Conexes, after Container Express, a logistical container loading method.
- **Temporary Buildings.** Incremental growth on campus has been addressed by adding modular buildings, small buildings and additions, resulting in the separation of working groups mentioned above, in physical and energy-related inefficiencies and an unorganized campus. In all, there are 9 modular buildings on campus, together with another 10 small buildings.

13.2 Visual Character

The initial campus development in the 1950s presented a strong community image and campus organization, with the NIST (then NBS) public face and entrance directly at the intersection of 27th Way and Broadway. Vehicles entered the campus at 27th Way—with the visual impact of the Radio Building’s front façade and main entrance. Subsequent development and the shift of the campus entrance have diluted that image. Now, the drive into campus is dominated by the NOAA building on the left, and multiple buildings/wings on the right. The current entry drive and parking no longer allow appreciation of the Radio Building’s front appearance. The campus has no apparent organizing principle or unifying elements, either building vocabulary, circulation or landscape treatment. The Flatirons provide a dramatic backdrop and do enhance the visual impression of the campus.

Pressing needs, coupled with procurement realities, have been addressed in recent years with small additions and modular buildings. Each is undistinguished in design, and together they give the campus a haphazard and temporary appearance. This is made worse by the random parking of construction trailers and use of multiple shipping containers for storage at the western side of the property.

The major buildings—Katharine Blodgett Gebbie Laboratory and David Skaggs Research Center and the renovated wings of the Radio Building 1—are well-designed, attractive buildings that project an image appropriate to the advanced research taking place.



Exhibit 114: Existing Building Examples



Building 18: Katharine Blodgett Gebbie Laboratory



Building 3: Liquifier Building



Building 1: Annex D



Building 33: David Skaggs Research Center



Building 2A: Cryogenic Annex



Building 22: Warehouse



Building 42: Central Utility Plant



Building 24: Plasma Physics



Building 1: Wing 6



Buildings 4 and 5: Camco

Exhibit 115: Summary of Campus Buildings and Structures

Building Number and Name	Size (GSF)	Year Completed	Occupants	Spaces
1 Radio Building (Wings 1–6 + Spine)	343,454 1–5 story	1954	Various Labs and Admin.	Labs, Offices; Public; Support
1C Annex C	4,648 1 story	1989	PML,CTL	Offices (research)
1D Annex D	3,456 1 story	1992	PML	Offices (research)
1E Annex E	Equipment Structure	Not available	—	Mechanical Equipment
1F Annex F	Equipment Structure	Not available	—	Mechanical Equipment
2 Cryogenic	70,829 3 story	1951	PML; MML	Labs; Offices (research)
2A Cryogenic Annex	2,880 1 story	1989	PML	Labs; Offices (research)
3 Liquifier Building	51,822 3 story	1952/ 2018	CTL	Labs; Support
3A OFPM Annex	2,160 1 story	1989	OFPM	Offices (admin)
4 Camco	15,795 1 story	1951	OFPM	Offices (admin)
5 Camco Annex	3,149 1 story	1951	OFPM; OISM	Offices (admin); Lab
8 Cryogenic Mesa Test	2,400 1 story	1953	MML	Labs
9 Gas Meter Building	Equipment Structure	1958	—	Water Pump Equipment
11 Ionospheric Observatory	466 1 story	1958	NOAA	Labs
12 Hydrogen Test Facility	1,446 1 story	2010	MML	Lab, Support
21 Maintenance Garage	3,999 1 story	1963	OFPM	Support; Offices (admin/support)
22 Warehouse	17,530 1 story	1964	NOAA	Support (Ship/Receive, Warehouse)
23 Hazardous Materials	984 1 story	1989	OSHE	Support
24 Plasma Physics	32,773 3 story	1967	CTL; PML, MML	Labs; Offices (research)

Building Number and Name	Size (GSF)	Year Completed	Occupants	Spaces
25 Maintenance Shop	8,306 1 story	1966	OFPM	Support (workshops); Offices (support)
25M1 Building 25 Annex	525 1 story	Not available	OFPM	Offices Support
26 Childcare Center	7,776 1 story	1989	OFPM manages	Support/Public (Classrooms)
27 High Frequency Field	1,045 1 story	1992	CTL	Lab (Antenna testing w/ RF Shielding)
41 High Speed Switch	Equipment Structure	Not available	—	Electrical Equipment
42 Central Utility Plant	45,844 3 story	2005	OFPM	Support (Utility); Offices (support)
43 HazMat	1,200 1 story	2025	OISM	Hazardous Material Temporary Storage
51 Security Center	1,470 1 story	2006	Mgmt. Resources	Support (Visitor Screening)
81 Katharine Blodgett Gebbie Laboratory	209,209 1 story	2012	PML; CTL; MML OFPM	Labs; Offices (research); Conference (additional 77,465 sf interstitial)
91 Construction Research	3,561 1 story	2008	OISM	Offices (admin)
92 Computing Facility	4,055 1 story	2018	OFPM	Equipment
111 Building 4 Annex	2,821 1 story	2011	OAAM	Offices (admin)
112 Butler Building	5,795 1 story	2011	OFPM	Support (storage)
— Concourse	1,234 1 story	2012	—	Connector between Buildings 1 and 81
NIST Total	850,631*			
33 David Skaggs Research Center	415,973 4 story	1999	NOAA	Labs; Offices; Public (Cafeteria, Multi-purpose, Display, Fitness)
34 NOAA Solar Observatory	w/above 1 story	1999	NOAA	Lab
Site Total	1,266,604			

* NIST lists Building 81 at a total of 286,674 GSF, but 77,465 is interstitial space (walk-on ceiling) and not counted as occupiable gross square feet. (see Program section).

Cultural Resources

14

The National Institute of Standards and Technology, Boulder, Colorado identifies, evaluates, and manages historic properties under its stewardship in accordance with Section 106 and Section 110 of the National Historic Preservation Act of 1966, as amended (NHPA). Historic properties are cultural resources, i.e. buildings, structures, objects, sites, or districts that are listed in, or eligible for listing in the National Register of Historic Places (NRHP). Major studies completed to support cultural resources compliance efforts include the Historic Assessment, National Institute of Standards and Technology, Boulder, Colorado (R. Christopher Goodwin & Associates, Inc. 2016) and the Results of an Intensive Cultural Resources Inventory of the Boulder NIST Site, Boulder, Colorado (Larson-Tibesar Associates, Inc. and Gulf Engineers and Consultants, 1994). In addition, agreements have been executed related to the management of historic properties and sacred sites.

14.1 National Register of Historic Places Criteria

Properties are evaluated for significance and integrity by applying the NRHP Criteria for Evaluation found in 36 CFR 60.4 (a-d). To be listed, or considered eligible for listing, in the NRHP, a property must meet at least one of the four following criteria:

- **Criterion A:** The resource is associated with events that have made a significant contribution to the broad pattern of history.
- **Criterion B:** The resource is associated with the lives of people significant in the past.
- **Criterion C:** The resource embodies distinctive characteristics of a type, period, or method of construction; represents the work of a master; possesses high artistic value; or represents a significant and distinguishable entity whose components may lack individual distinction.
- **Criterion D:** The resource has yielded, or may be likely to yield, information important in prehistory or history.

In addition, the National Register has established Criteria Considerations applicable to cemeteries, properties owned by religious institutions, reconstructed or moved structures and other specialized situations. These may be eligible if they are integral to districts that meet the criteria, or if they fall within specifically defined categories.

The National Register also defines seven aspects of integrity to determine if a resource retains the ability to convey significance: location, design, setting, materials, workmanship, feeling, and association (U.S. Department of Interior 1997:44). Not all seven aspects are required for eligibility, but the property must retain the integrity necessary to convey its significance. Resources must possess overall historical integrity as well as significance to qualify for NRHP eligibility.

14.2 Summary of 2016 Study Assessment

The majority of buildings at the Boulder campus are less than 50 years old and were constructed between 1989 and 2013. Buildings at the DoC Boulder Campus that are 50 years old or older include:

- **Building 1 (Radio Building):** In a 2016 letter, the Colorado State Historic Preservation Officer (SHPO) recommended Building 1 as eligible for listing in the NRHP under Criteria A and possibly C. Follow-up discussions have confirmed that recommendation. NIST and the SHPO are in consultation to negotiate protocols that will govern future renovation in accordance with 36 CFR Part 800 – Protection of Historic Properties and the Secretary of the Interior’s Standards for the Treatment of Historic Properties.
- **Building 2 (Cryogenic Building); Building 3 (Liquifier Building); Building 4/5 (Camco):** Buildings 2, 3, and 4/5 previously were recommended as potentially eligible for listing in the NRHP. On September 9, 2015 correspondence with the Colorado State Historic Preservation Officer (SHPO) clarified that, because of a lack of integrity, Building 3 no longer is NRHP eligible. Because Building 3 is not eligible, the two other buildings (Building 2 and 4) associated with Building 3 also are not NRHP eligible. In 2017, Building 3 was expanded with significant renovations.
- **Anderson Ditch:** Anderson Ditch has been determined eligible for listing in the National Register, with a potential for significance under Criteria A, B, and C. Note that Anderson Ditch is privately owned, with an easement through government property.

- **Building 24 (Plasma Physics Building).** Building 24 was built in 1967 and is now 57 years old. NIST worked with SHPO to review its historic integrity and determined that B24 is not eligible for listing on the National Register of Historic Places because of the significant changes that have been made to the layout, materials and usage.
- **Building 8 (Cryogenic Mesa Test); Building 9 (Gas Meter Building); Building 11 (Ionospheric Observatory); Building 21 (Maintenance Garage); Building 22 (Warehouse); and Building 24 (Plasma Physics):** These six buildings do not appear to be NRHP eligible.

14.3 Archeological Resources

The 1994 cultural resources investigation completed by Larson-Tiberar Associates, Inc. did not identify any prehistoric archeological resources.

14.4 Agreement Documents

A Programmatic Agreement (PA) *Regarding Protected Areas at the Department of Commerce Site, 325 Broadway, Boulder, Colorado*¹ was executed in 1995 among NIST, the City of Boulder, eleven Native American tribes, and the Medicine Wheel Coalition for Sacred

Sites in North America. The stipulations of the PA address maintenance, utility work, and tribal use within a 24.95 acre Tribal easement area.

The Department of Commerce updated an easement agreement in 2007 with the Anderson Ditch Company for access through the campus, rights for irrigation use and NIST repair and maintenance of the section of the Ditch on DOC property.

14.5 Significance for the Master Plan

Under 36 CFR 800, when a federal agency plans an undertaking, the agency is required to take into consideration the effects it will have on historic properties and afford the Advisory Council on Historic Preservation the opportunity to comment. An undertaking is any project, including projects requiring a federal license, permit, or approval, funded directly or indirectly by a federal agency.

The SHPO is a consulting party under 36 CFR 800, and the Office of Archaeology and Historic Preservation functions as the SHPO in Colorado. Their determination that Building 1 is NRHP eligible means that changes to the building will require submission to the SHPO, under Section 106 of the NHPA. The Colorado SHPO recommended that Building 1 renovation projects be approached as “Rehabilitation,” one of the four treatment methods prescribed by the Secretary of the Interior Standards.

1. Edward C. Nichols, SHPO, to Virginia Holtzman-Bell, Boulder Laboratories Site Manager; September 9, 2015, Boulder Colorado



Carnegie Library for Local History, Boulder

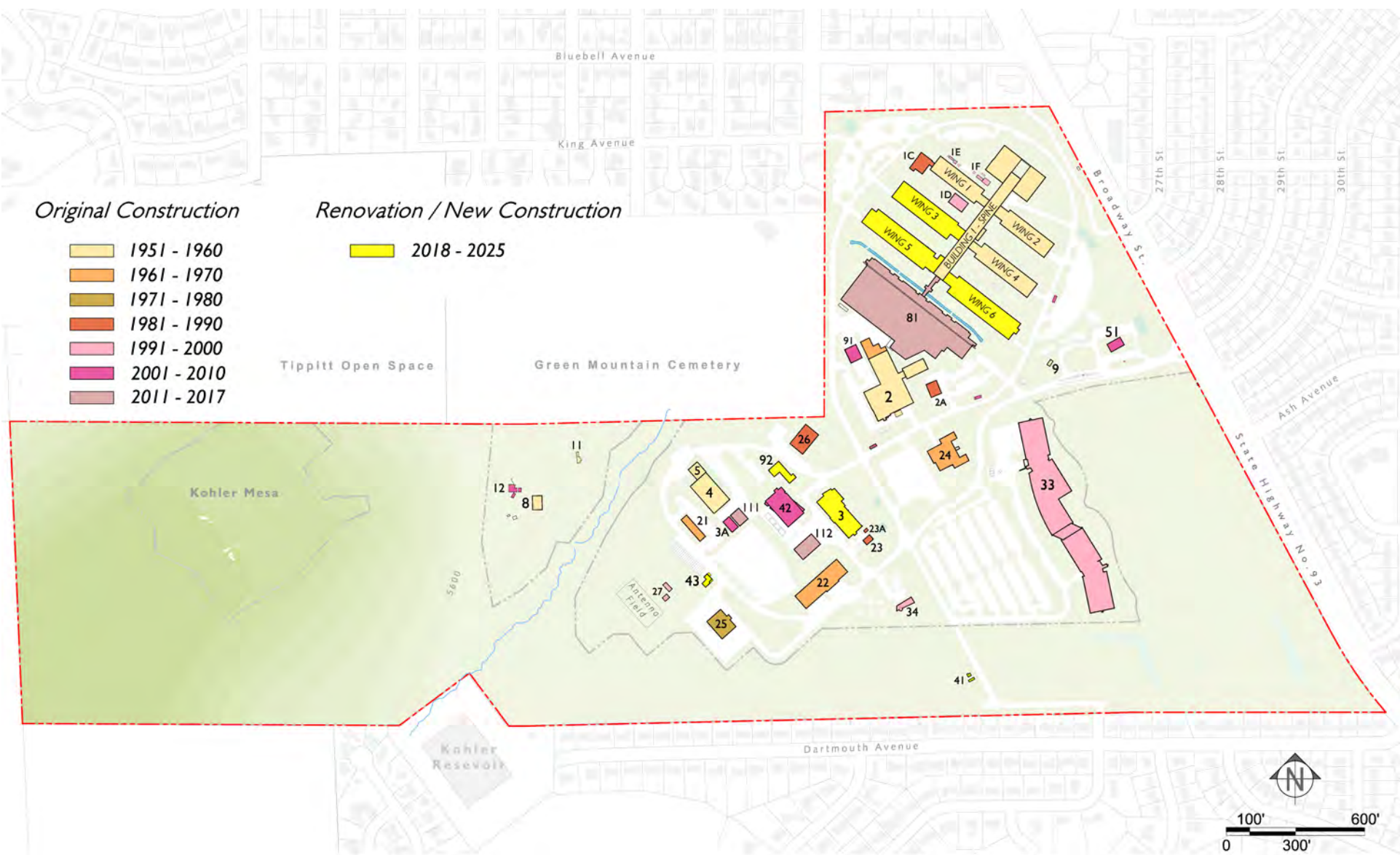


Exhibit 117: Historic Building Photos

1954 Photograph of Building 1



1967 Photograph of Building 3, looking west



1964 Photograph of Building 2, Wing B



1967 Photograph of Building 4, looking southwest



Images Courtesy of NIST Boulder

Circulation and Transportation

15.1 Overview

The Department of Commerce Campus in Boulder is located on Broadway (State Highway 93), a major arterial road in the City of Boulder, between Baseline Road and Table Mesa Drive. Broadway, a six-lane urban roadway, has a raised median and left turn lanes at side street intersections. The posted speed limit is 40 mph. The intersection with Rayleigh Road is a signalized intersection with a northbound left turn protected/ permitted signal phase.

There is a second curb cut into the site from Broadway across from 27th Way. This access does not serve any of the DoC facilities; it provides the only means of access to a parcel to the north, which currently has a medical office building. The intersection of 27th Way and Broadway is not signalized.

The Campus also has two additional gated access points, one to the north from King Avenue, and the other from Dartmouth Avenue, both residential streets. These gated access points are closed to general motorized traffic but are open to bicyclists and pedestrians. These two gates are used if staff must evacuate the campus in an emergency. Additionally, a bicycle/pedestrian entrance is available at the southeast corner of the campus, connected via an unimproved trail.

15.2 Internal Vehicular Circulation

The primary access to the site from Broadway is through Rayleigh Road. Visitors and deliveries to the campus are required to go through a screening process at the Security Center and Vehicle Inspection Facility located off of Rayleigh Road. There is a checkpoint on Rayleigh Road to check employee and visitor credentials.

The majority of the NIST buildings on the campus are within two loops, both accessible from Rayleigh Road. The major laboratory buildings—Buildings 1, 2, and 81—are located north of the campus bounded by a loop formed by Compton Road. The major facility buildings and Building 3 are bounded by the second loop formed by Curie Circle and Compton Road. NOAA's primary facility, Building 33, is to the south of Rayleigh Road. NOAA's solar observatory is located just south of Curie Circle (southwest of the Compton Road & Rayleigh Road/Curie Circle intersection).

The facilities west of Skunk Creek are served by Kusch Road and the NIST Service Road (a continuation of Kusch Road).

General Circulation Issues

Observations regarding street signage, pavement markings, operational considerations at intersections, and queueing at the Rayleigh Road entrance are detailed in the following section. These observations, traffic and parking counts were conducted on typical workdays April 23-25, 2024. A generous remote work policy was in effect in April, but that is changing to require more on-campus attendance.

Yield Signs

Yield signs were observed to be the primary method of control at all unsignalized internal intersections within the campus, although many intersections with yield signs also had painted stop bars. An example can be seen below. This use of yield signs is confusing, given it allows vehicular traffic to move freely (often without stopping) around campus, potentially endangering cyclists, pedestrians, and motorists in conflicting directions.

Example of a Yield Sign



Internal roadways should comply with MUTCD 11th Edition guidelines. Section 2B.10 (“Yield Control”) outlines the only scenarios where a yield sign is applicable:

- Median breaks for divided highways;
- Channelized turn lanes;
- Intersections with “special problems”;
- Difficult merging operations;
- Low-volume rural roads; and
- Intersections with right-turn only movements.

None of these scenarios apply to these intersections. Yield signs should be removed and replaced with stop signs, especially because stop bars are already painted on the roadways. The presence of stop bars (despite having yield signs) is a violation of MUTCD guidelines, as in Section 3B.19: “stop lines shall not be used at locations where drivers are required to yield...”

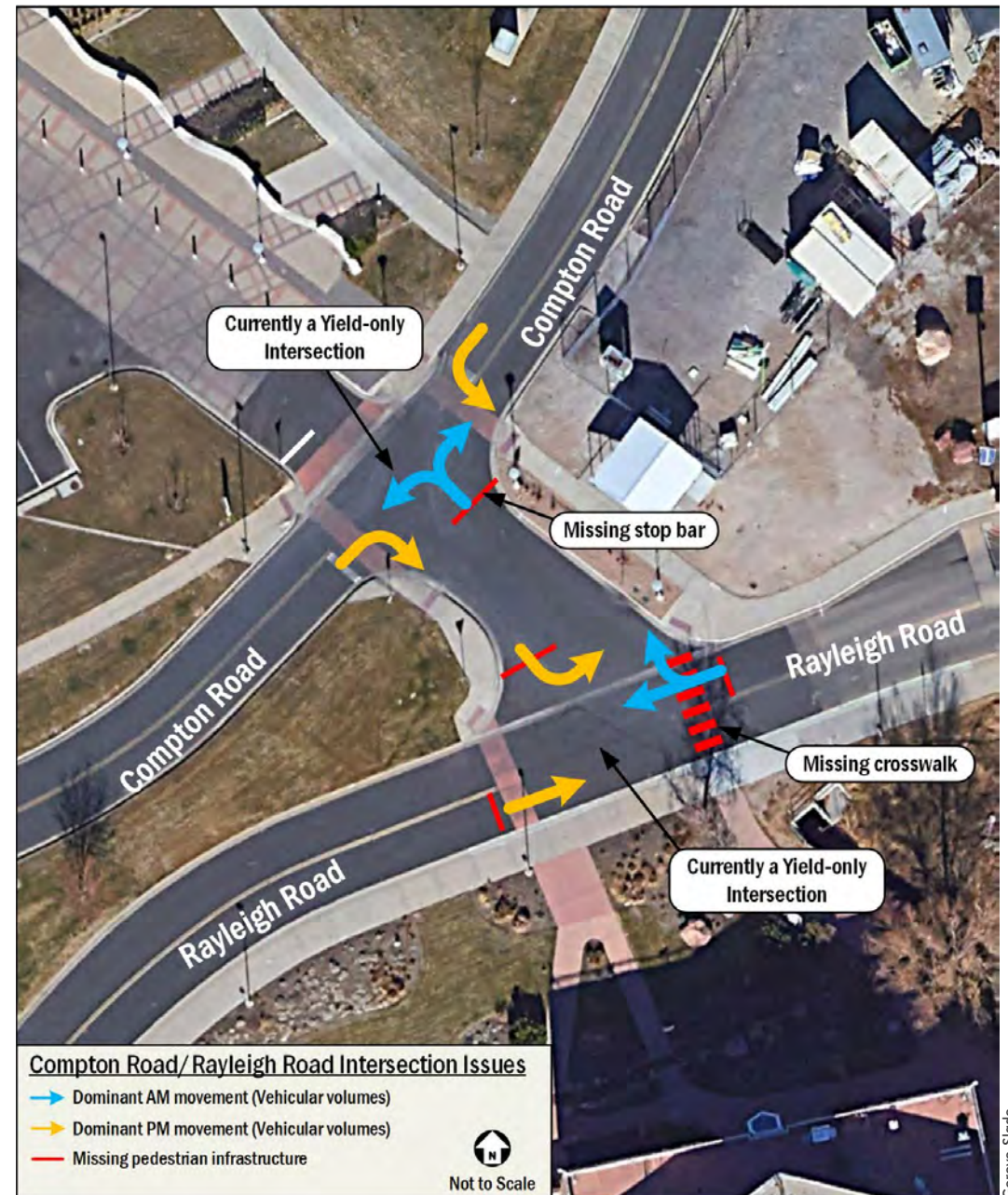
Compton Road and Rayleigh Road Intersection

The Compton Road & Rayleigh Road intersection, located just west of the Guard Station, is actually two clustered intersections: one four-way and one T-intersection, connected by a 60’-long road neck and controlled by yield signs.

Both intersections use only yield signs as traffic control measures. This creates a confusing and difficult interchange where drivers must look for oncoming traffic at both intersections. Vehicles were observed driving and making multiple turns through the intersection without stopping.

This is a concern as both pedestrians and bicyclists use this intersection. The intersection is at the confluence of the two signed bicycle routes on campus. A designated bicycle parking area is located adjacent to the intersection as well. The collected count data also showed a high volume of pedestrians using this intersection—20 pedestrians in the AM and 15 in the PM for the southern part & 34 pedestrians in the AM and 21 in the PM for the northern part. These pedestrian volumes conflict with the dominant vehicular movements in the AM and PM peak hours, highlighting the need for these improvements. These issues are displayed in Exhibit 118.

Exhibit 118: Compton Road/Rayleigh Road Intersection Issues



Queuing at the Guard Station/Security Center

Inbound queueing was observed along Rayleigh Road at the Guard Station and its two lanes: one for vehicles with sensor fobs that can be swiped, and one for vehicles without fobs (primarily visitors). Visitors must present an inspection token to the security guard to prove that their car has undergone a vehicle inspection. These two lanes are only separate for 100', and most of the queueing area is along a single lane.

Queueing was an issue during the AM peak period (observed from 8:00 to 9:30 AM). The maximum observed queue was between 8:50 and 9:00 AM, exhibiting a queue of 22 cars, spilling back to the Broadway and Rayleigh Road intersection. This created additional queueing on Broadway on its southbound right lane and northbound left lane. Ten cars were queued on the southbound right lane, while five (5) cars were queued on the northbound left lane—all because of the back-up on Rayleigh Road.

Additional peaks in queueing occurred at 8:45 AM and at 8:47 AM, with a 15- and 21-car queue, respectively. The 21-car queue extended out to the Broadway and Rayleigh Road intersection, with vehicles observed queueing in the southbound right-turn and northbound left-turn lanes. A snapshot of these long queues is presented below.

Exhibit 119: Queuing at 8:46am, Rayleigh Road



In instances where queues extended out to the Broadway and Rayleigh Road intersection, the cause of the queue was because a vehicle in the fob lane had issues with their fob or lack thereof. In these cases, the security guard spoke with the vehicle's driver to determine the issue, then opened the gate and directed them to the turnaround loop (so that the vehicle can either be inspected or be directed to the correct lane). This takes the security guard from their position in the other lane, which halts those vehicles from proceeding. Furthermore, this whole operation takes several minutes before the problematic vehicle can clear the gate (and the queue can proceed). The typical fob entry was observed to only take 5-10 seconds.

In speaking with Captain Weber of the Guard Station, there are approximately 15 to 20 such turnaround incidents a day, with the vast majority being campus visitors who have gone in the wrong lane. Captain Weber assisted the security guard with these incidents for approximately 45 minutes during the AM peak period.

Signage along Rayleigh Road explaining the difference between the two entry lanes is limited and difficult to read, indicating an opportunity to potentially alleviate visitor confusion and reduce the number of queue-causing incidents during the morning peak period. Queueing was also observed at the Guard Station during the midday and PM peak periods; however, no queueing issues were observed during these periods.

Evacuation Routes

The DoC Boulder Campus is susceptible to wildfires coming from the west, with seven (7) wildfires having occurred since October 2020 (per a July 2023 NIST Wildfire Mitigation Assessment presentation).

Currently, there is only one point of vehicular egress for the DoC campus, at the intersection of Rayleigh Road & Broadway. The King Avenue and Dartmouth Avenue exits access the neighborhoods and are designated for pedestrians and bicycles only. However, they have been opened to allow for emergency egress.

Having a second, fully open means of egress was highlighted in the 2017 Master Plan as a need for the campus, although it is not included in this 2025 Plan. The aforementioned July 2023 presentation echoed that "Improved egress capabilities...multiple egress route options" were critical for campus improvements across the Colorado DoC campuses.

Exhibit 120: Current Campus Circulation



Google Earth

Having a second means of egress onto Broadway would create an additional conflict with the existing multi-use path on Broadway. Coordination with the City and the bicycle community on adding a second egress point would be essential moving forward.

15.3 Pedestrian and Bicycle Infrastructure

The City of Boulder's multi-use path runs along the Broadway frontage of the campus which carries significant bicycle traffic. There are two signed bicycle routes on-campus. One route loops around Buildings 1, 2, and 81 on Compton Road, while the other runs along Rayleigh Road between Broadway and the Skunk Creek Multi Use Path. A segment of the City's multi-use path, called Skunk Canyon Path, runs along Skunk Creek and through the campus, connecting to the King Avenue/22nd Street Entrance, although a portion of this path is on-street. An additional path connects to the Kenwood Drive/Dartmouth Avenue entrance, connecting to neighborhoods to the south, with a unimproved trail connecting to Broadway at the campus' southeast corner.

Segments of soft surface hiking trails also pass through the non-research zones of the campus. In addition, there is a robust network of pedestrian pathways connecting the campus buildings.

There is one apparent gap in bicycle infrastructure along Compton Road in the northwest corner of the site. Here, the Skunk Creek Multi Use Path connects to the King Avenue/22nd Street entrance via a "designated bike route" per the City of Boulder's Bike Map. Along Compton Road, however, signs read "Bike Path Ends", and bicycles are directed to use the street as the path narrows to the south. This gap is likely due to the pedestrian path getting narrower to the south. Given that this is an important connector for bicycle infrastructure within the site, it may be useful to explore ways to connect the entrance to the Skunk Creek Multi Use Path via a formalized path.

Boulder's Transportation Master Plan (2019) proposes several bicycle facilities on and near the site. These include:

On-Site:

- Multi-Use Path along the south side of Rayleigh Road (to the Rayleigh Road & Compton Road intersection)
- Multi-Use Path along Compton Road around the north side of campus, linking to the King Avenue/22nd Street entrance

Site-adjacent:

- Proposed Neighborhood "GreenStreet" along Dartmouth Avenue east of Kohler Drive
- Proposed Neighborhood "GreenStreet" along S Lashley Lane (Broadway frontage road)
- Proposed Neighborhood "GreenStreet" along 22nd Street north of King Avenue

Neighborhood GreenStreets are defined as roadways that have "low motor vehicle traffic" and are "configured to prioritize biking and walking", according to Boulder Transportation Master Plan. Existing and Boulder Transportation Master Plan-proposed bicycle facilities are shown in Exhibit 121.

Pedestrian facilities exist along most roadways on campus. However, there are large gaps in the network when crossing parking lots and wide driveways. There are several locations (particularly on the western half of the campus) where there are large curb cuts, some up to 190' wide, with sidewalks at both ends but no marked crosswalks or curb ramps to facilitate pedestrian crossings. Additionally, portions of roadways are missing sidewalks on one side of the street, and some segments are missing sidewalks on both sides of the street (e.g. Rayleigh Road east of Curie Circle). These pedestrian facility gaps are shown in Exhibit 120.

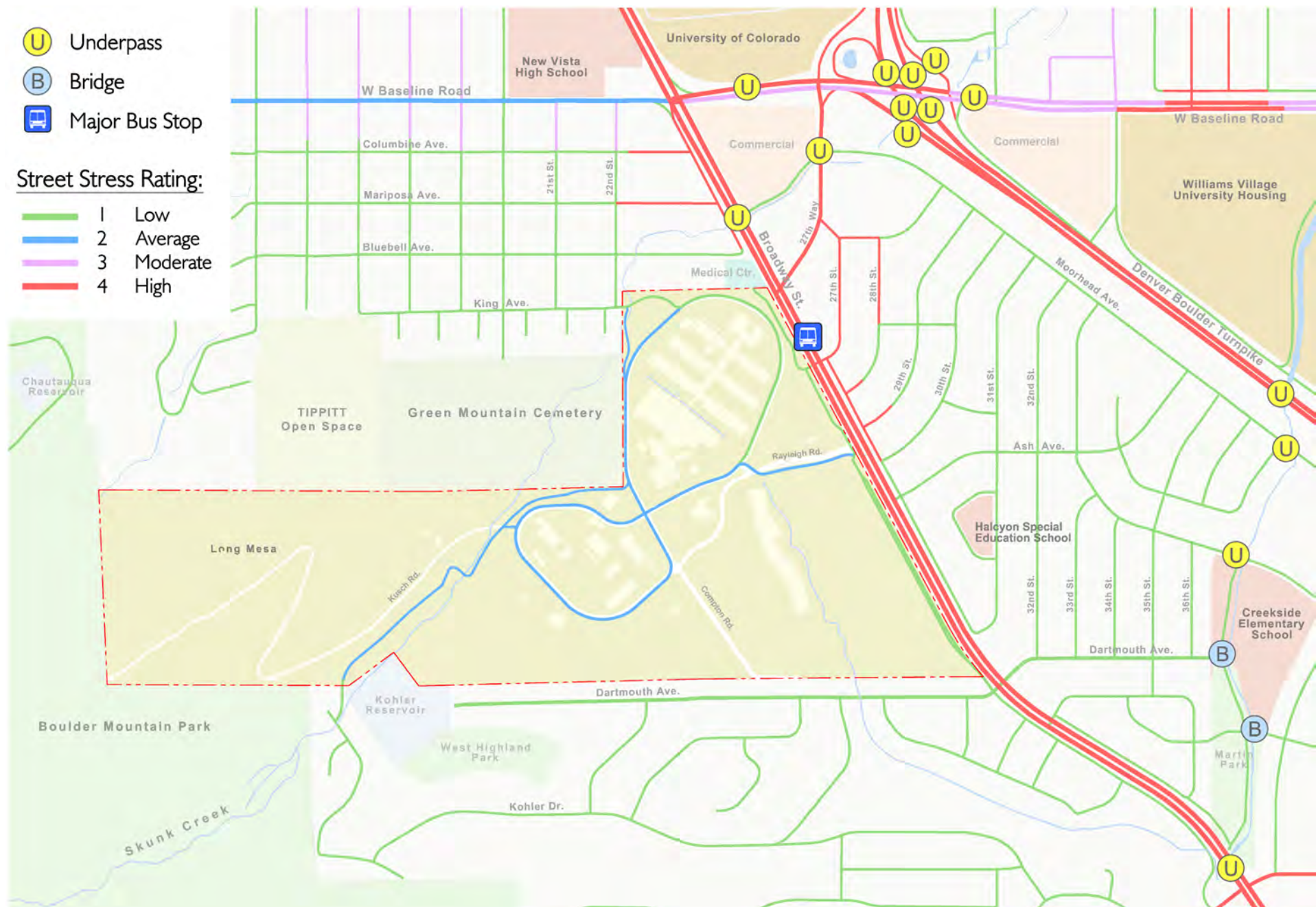
"Bike Path Ends" Sign, Compton Road



Exhibit 121: Pedestrian, Bicycle, and Transit Facilities Near Campus



Exhibit 122: Pedestrian and Bicycle Facilities Near the Campus



15.4 Public Transit and Bike Share

Four bus stops serve the DoC Boulder Campus: two at the intersection of Broadway & Rayleigh Road (Stop IDs: 12471 & 12473) and two at the intersection of Broadway & 27th Way (Stop IDs: 12438 & 12439). Both bus stops serve southbound traffic—corresponding northbound bus stops are located across Broadway. The bus routes serving these two stops are detailed in Exhibit 123. Both bus stops on the site frontage have shelters but are lacking certain amenities such as lighting or trash receptacles. A breakdown of the on-site bus stop amenities is detailed in Exhibit 124. The locations of these bus stops are shown in Exhibit 121.

There are two Park-n-Ride locations proximate to the campus at 27th Way and Broadway and at 32nd Street and Broadway.

The Boulder B-cycle bikeshare station previously located south of the 27th Way & Broadway intersection and identified in the 2017 Campus Master Plan has been relocated. The nearest bikeshare station to the campus is now located at the northeast corner of the Broadway & Baseline Road intersection.

Exhibit 123: Bus Stop Routes Serving the Site

		Service Hours at Stop Closest to Site			Headway (minutes)	Bus Stop Served
Route Number	Route Name	Weekdays	Saturdays	Sundays		
RTD						
AB1	Boulder-Denver Airport	3:16am-9:41pm	3:16am-9:41pm	3:16am-9:41pm	52-90	12439
DASH	Boulder-Lafayette via Louisville	6:16am-1:22am	6:14am-12:22am	7:15am-12:23am	28-68	12439; 12473
GS	Golden-Boulder	7:04am-5:28pm	N.A.	N.A.	85-90*	12439
SKIP	Broadway	5:27am-11:56pm	7:18am-12:17am	7:16am-11:17pm	14-30	12439; 12473
BOUND	Route Bound	5:25am-11:40pm	7:30am-11:30pm	9:00am-9:30pm	15-30	12438
Boulder County (Seasonal)						
ELDO	Eldorado Park Shuttle (5/25 – 9/2 only)	8:00am-7:00pm	8:00am-7:00pm	8:00am-7:00pm	20	12439; 12473

Exhibit 124: DOC Campus Bus Stop Amenities

Location	Bus Stop ID	Routes Served	Bus stop flag	Route map & schedule	Landing pad	Sidewalk	Bench	Shelter	Dynamic info sign	Lighting	Trash Recp.
Broadway & Rayleigh Road SB	12373	AB1, DASH, ELDO, GS, SKIP	•		•	•	•	•			
Broadway & Rayleigh Road NB	12471	DASH, ELDO, SKIP	•	•	•	•	•	•			
Broadway & 27 th Way SB	12439	DASH, ELDO, SKIP	•	•	•	•	•	•			•
Broadway & 27 th Way NB	12438	AB1, BOUND, DASH, ELDO, GS, SKIP	•	•	•	•	•	•		•	•

15.5 Parking

The Campus has 1,389 parking spaces across 15 surface parking lots. Approximately 50 of these parking spaces are accessible to persons with disabilities. The largest of these lots serves the two NOAA buildings, Building 33 and Building 34 and has 635 parking spaces. The largest parking lots serving the NIST buildings are located northwest and southeast of Building 1, with 192 and 160 parking spaces respectively.

A parking usage survey was conducted for the campus on Tuesday, April 23, 2024, between 8:00 AM and 6:00 PM at two-hour intervals. Data collected included:

- Parking occupancy;
- Total number of parking spaces;
- Number of parking spaces blocked (e.g. by containers, equipment, etc.);
- Number of ADA parking spaces; and
- Number of motorcycle spaces.

This data was collected for the parking lots identified in Exhibit 127. The characteristics of these parking lots are reported in Exhibit 125. Parking occupancy results are reported in Exhibit 126, with any parking occupancy above 90% highlighted in red. Please note that blocked parking spaces (by shipping containers, construction equipment, etc.), were not counted towards the total number of parking spaces, to provide for a more accurate and conservative parking occupancy rate. The Security Center/Guard Station was not included in the parking usage survey because it functions differently. The existing 25 parking spaces there are enough to serve the Security Center, although the current layout is inefficient.

Parking occupancy peaks for the majority of NIST parking lots at 2 PM, including the overall parking occupancy, which peaks at 63%. The only parking lot to exceed a 90% parking occupancy rate is Lot 1, which is located between Buildings 81 and 2, and is one of the closest parking lots to the campus entrance via Rayleigh Road. A parking occupancy of 85-90% is considered to be the ideal peak utilization for any given parking facility. At this ideal peak utilization rate, a parking lot is being well-utilized, while also ensuring that

spaces are always available for entering vehicles to find without a need to excessively circulate to find parking.

In the 2017 Master Plan (with data from 2016), parking occupancy rates were collected once during the day and showed an overall occupancy rate of 72%. With the most recent parking counts, the peak overall parking occupancy rate is approximately 63%. Parking lot occupancy was more unevenly distributed in 2016, with certain lots having neared or reached capacity, while in 2024 only one lot exceeded 90% (reaching a high of 98%). The results are summarized below:

- Parking lot demand is less than in 2016 and more evenly distributed across NIST & NOAA lots
- Current parking needs can be accommodated by the existing parking facilities. (Note that the generous remote work policy in effect in April is changing to require more on-campus attendance.)
- Parking lots #2, #7, #13, and #14 saw higher parking occupancy rates when compared to 2016
- Parking lots #4 and #10 saw approximately the same parking occupancy rate when compared to 2016
- Parking lots #1, #3, #5, #6, #8, #9, #11, and #12 saw a lower parking occupancy rate when compared to 2016

Exhibit 125: Parking Lot Characteristics

Parking Location	Total Parking Spaces	Parking Spaces Blocked	Total Parking Spaces (minus blocked spaces)	Handicapped Spaces	Motorcycle Spaces
1	52	0	52	2	0
2	159	17	142	6	0
3	25	0	25	4	0
4	183	9	174	7	0
5	70	0	70	1	0
6	92	6	86	1	0
7	20	0	20	1	0
8	40	0	40	2	3
9	18	0	18	1	0
10	11	5	6	0	0
11	42	0	42	3	0
12	12	0	12	1	0
13*	635	0	635	20	0
14	5	0	5	1	0

Exhibit 126: Parking Lot Occupancy

Parking Location	8:00:00 AM	10:00:00 AM	12:00:00 PM	2:00:00 PM	4:00:00 AM	6:00:00 PM
1	50%	96%	94%	98%	60%	21%
2	30%	78%	80%	80%	58%	25%
3	63%	84%	76%	79%	34%	18%
4	13%	60%	61%	62%	51%	28%
5	27%	53%	60%	64%	44%	21%
6	24%	72%	79%	76%	50%	15%
7	80%	85%	70%	70%	35%	30%
8	50%	48%	55%	45%	30%	23%
9	56%	56%	56%	56%	28%	11%
10	50%	50%	50%	50%	50%	33%
11	57%	60%	57%	62%	17%	17%
12	8%	50%	58%	58%	50%	0%
13*	45%	56%	53%	53%	40%	11%
14	20%	20%	20%	40%	20%	20%
Total	39%	63%	63%	63%	44%	17%

*Lower-level parking area (closest to NOAA Building) not included in occupancy analysis

Exhibit 127: Current Campus Parking Distribution

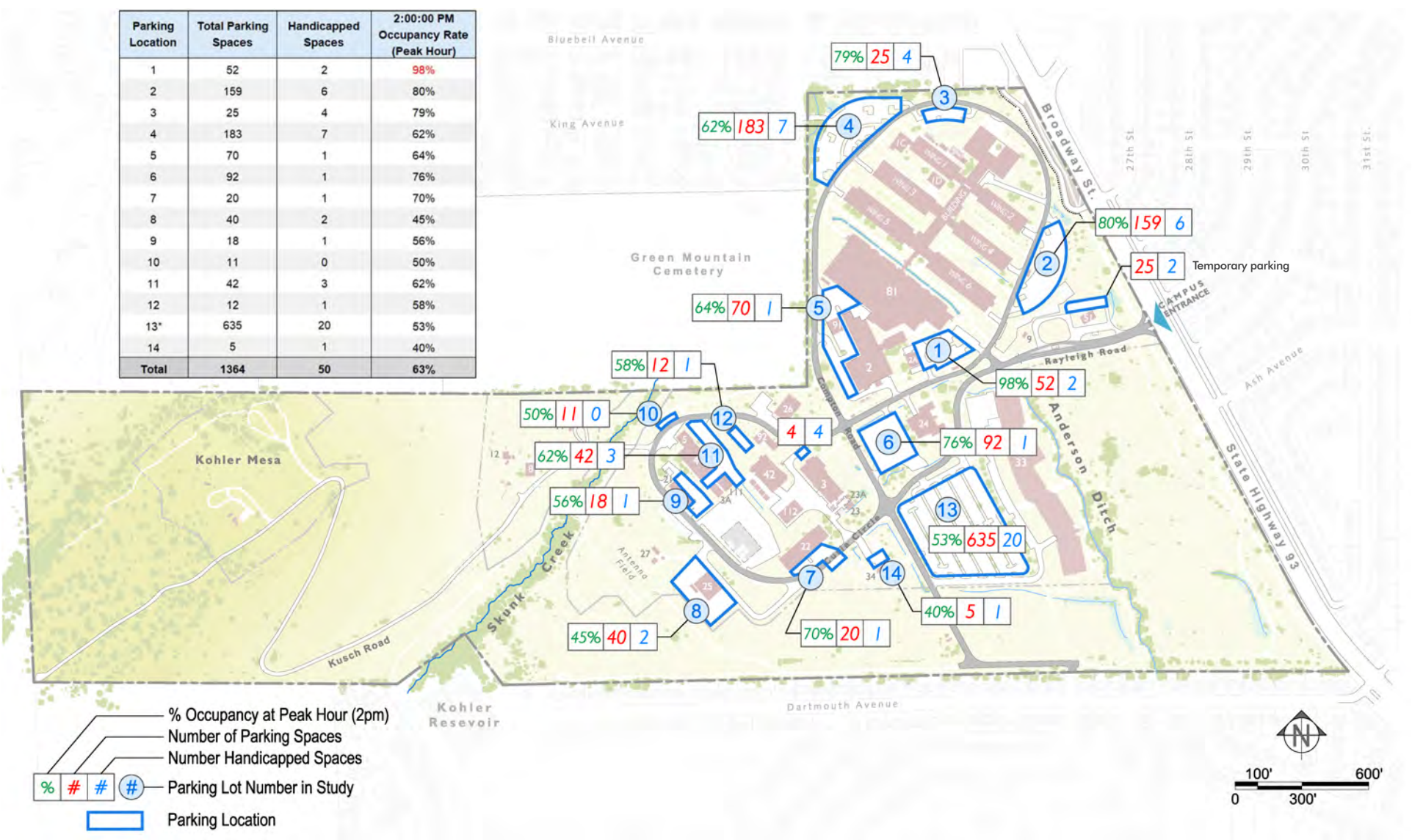


Exhibit 128: Summary of Parking Survey

	Existing				
	Employees	Spaces	Occupancy	Occupied Spaces	Occupied Spaces/ Employee
Security/Visitor (Next to Building 51)	1	25	0.36	9	9.00
Quadrant 1	393	367		260	0.66
North of Building 1		25	0.79	20	
Northwest of Building 1		183	0.62	113	
Southeast of Building 1		159	0.8	127	
Quadrant 2	318	237	0.75	178	0.56
2A and Southeast of Building 81		52	0.98	51	
Southwest of Buildings 2 and 91		70	0.64	45	
Southwest of Building 24		92	0.76	70	
West of Building 26		11	0.5	5	
Northwest of Building 3		12	0.58	7	
Quadrant 3	221	120	0.57	68	0.56
West of Building 42		42	0.64	26	
Northeast of Buildings 4, 5, and 111		18	0.56	10	
Southwest of Building 25		40	0.45	18	
South of Building 22		20	0.7	14	
Quadrant 4	834	640	0.53	339	0.41
North of Building 34		5	0.4	2	
West of Building 33		635	0.53	337	
Total	1,767	1,389		854	0.48

15.6 Vehicular Turning Maneuver Data Collection and Results Summary

Vehicle circulation data collection and observation were undertaken on a typical spring day at the DoC campus in Boulder, Colorado. This data collection effort is the first step in a more extensive master planning exercise and will be used as a basis for further analysis as the master planning is further developed.

Vehicular and bicycle turning maneuver as well as pedestrian crossing data was collected on Tuesday, April 23, 2024 from 6:30 AM to 9:30 AM and from 3:30 PM to 6:30 PM to determine the peak hour utilization of several intersections on and surrounding the DoC campus. Data was collected when local schools, as well as the nearby University of Colorado, were in session. In addition, observations were made regarding queuing and other general traffic flow conditions at the study intersections.

Vehicular access to the campus is provided via a single entrance from Broadway at Rayleigh Road on the eastern side of the campus. Pedestrian and bicycle access is provided via entrances from Broadway to the east near 27th Way, at Rayleigh Road, and at the southeast corner of the site (via an unimproved trail). Additional pedestrian and bicycle entrances are available from Dartmouth Avenue and from King Avenue to the north. An extensive bicycle and pedestrian network surrounds the campus, connecting it to various local destinations such as the University of Colorado, Downtown Boulder, and many of the surrounding parks and neighborhoods.

The following lists the eight off-campus intersections and four on-campus intersections where data was collected:

Off-Campus Intersections	On-Campus Intersections
1. Broadway/Baseline Road	1. Rayleigh Road/Lawrence Road - Wilson Road Connector
2. Broadway/27th Way	2. Lawrence Road/Wilson Road/Rayleigh Road Connector
3. Broadway/Rayleigh Road	3. Rayleigh Road/Curie Circle/Compton Road
4. Broadway/Dartmouth Avenue	4. Lawrence Road/Curie Circle/Compton Road
5. Broadway/Table Mesa Drive	
6. Kenwood Drive/Compton Road/Dartmouth Avenue	
7. 22nd Street/King Avenue	

The peak hours were determined to be from 7:45 AM to 8:45 AM and from 5:00 PM to 6:00 PM for the off-campus intersections and from 8:00 AM to 9:00 AM and from 5:00 to 6:00 PM for the on-campus intersections. The off-campus vehicular turning maneuver data is summarized in Exhibit 129 and the on-campus vehicular turning maneuver data is summarized in Exhibit 130.

Exhibit 129: Existing 2024 Peak Hour Vehicle Volumes – Off-Campus

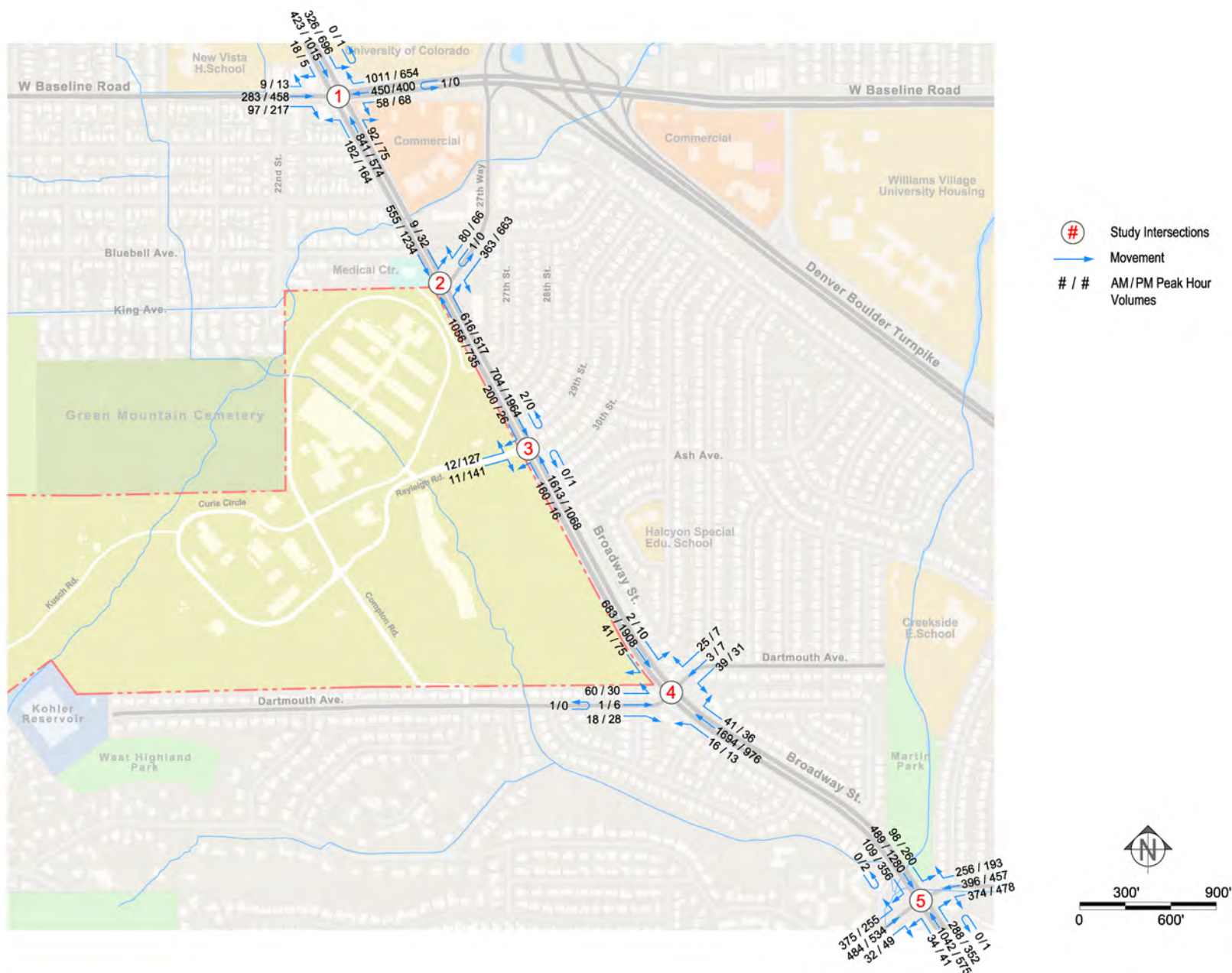


Exhibit 130: Existing 2024 Peak Hour Vehicle Volumes – On-Campus



General Traffic Volume Comparisons

The traffic volume data collected in April 2024 shows broader trends when comparing pre-COVID and post-COVID traffic patterns, when compared to the AM and PM peak hour traffic volume data reported in the 2017 Master Plan (with data from 2016).

Along Broadway, the main thoroughfare by the DoC Campus, 2024 thru movement traffic volumes were lower than in 2016 during the AM and PM hours for the northbound movement. Southbound traffic were also lower during the AM peak hour but higher during the PM peak hour. These volume changes between 2016 and 2024 are shown in Exhibit 131.

These corridor-wide traffic volumes show that overall, traffic volumes have decreased when compared to pre-COVID years, which reflect increased teleworking options among commuters.

Regarding traffic volumes entering or exiting the site, volumes are relatively unchanged between 2016 and 2024. During the AM peak

hour, the dominant northbound left and southbound right movements see a 15% increase and a 7% decrease respectively. During the PM peak hour, the dominant eastbound left and eastbound right movements see a 21% decrease and a 15% increase. These changes can be seen in Exhibit 132.

Regarding on-campus traffic volumes, there was a 5% decrease in AM peak hour traffic volumes and a 29% increase in PM peak hour traffic volumes in 2024. The greatest increases in volumes for the PM peak hours come from vehicles making their way to the exit point along Rayleigh Road.

It should also be noted that while the AM peak hour for on-campus intersections was the same between 2016 and 2024, the PM peak hour in 2016 was from 5:00 to 6:00 PM. Thus, it appears that while the AM peak hour is relatively the same for volumes and timing, the 2024 on-campus PM peak hour is earlier in the day and has a greater volume of vehicles navigating the campus.

Exhibit 131: Broadway Traffic Volume Comparison

Broadway Thru Traffic Volume Change: 2016 to 2024				
Intersection	Northbound - AM	Northbound - PM	Southbound - AM	Southbound - PM
Broadway & Baseline Road	-203	-158	- 31	183
Broadway & 27th Way	-247	-167	- 80	9
Broadway & Rayleigh Road	-229	-184	-200	30
Broadway & Dartmouth Avenue	-147	-167	-189	43
Broadway & Table Mesa Drive	- 61	- 22	- 99	63

Exhibit 132: Site Access Volume Comparison

Intersection	Inbound Vehicles (AM Peak Hour)		Outbound Vehicles (PM Peak Hour)	
	Northbound Left AM	Southbound Right AM	Eastbound Left PM	Eastbound Right PM
Rayleigh Road & Broadway	15%	-7%	-21%	15%

Vehicle Turning Movement Counts and Vehicular Capacity Analysis Summary

The vehicular capacity and queueing analysis was performed to determine if any intersections are currently operating with poor Level of Service (LOS) or Delay. The City of Boulder considers traffic operations to be acceptable at a LOS-D or better for all movements, based on the City of Boulder Design and Construction Standards. Thus, any intersections (and approaches) operating at a LOS-E or worse are noted in this summary.

The vehicular capacity and queueing analysis was performed using Synchro 11 and the HCM 2000 methodology for both the on- and off-campus intersections (using their respective system peak hours). Signal timings and the baseline Synchro network were provided by the City of Boulder. The baseline Synchro network was updated to reflect the latest signal timing and roadway geometries. Signal timings are included in the Technical Attachments.

Vehicular Capacity Analysis Results

On-and off-campus intersections were observed to operate with acceptable LOS and delay during the AM peak hour, but some intersections had movements that with an LOS-E in the PM peak hour:

- Broadway & Baseline Road
 - Westbound Left (PM peak hour only)
 - Southbound Left (PM peak hour only)
- Broadway & Rayleigh Road
 - Eastbound Left (PM peak hour only)
- Broadway & Dartmouth Avenue
 - Northbound Left (PM peak hour only)
- Broadway & Table Mesa Drive
 - Eastbound Left (PM peak hour only)
 - Westbound Left (PM peak hour only)
 - Northbound Left (PM peak hour only)

Of note is the eastbound left at the Broadway & Rayleigh Road intersection. This is an important movement as this is entirely made up of traffic leaving the DoC campus. For master planning purposes, this will need to be considered. Exhibit 133 and Exhibit 134 show the LOS results graphically across the on- and off-campus study intersections. The full LOS and delay results are presented in Exhibit 135.

Queueing Analysis Results

Queueing issues were identified as any 95th percentile queue exceeding the storage capacity (the length of the storage or thru lane). Similar to what was observed and reported in the 2017 Master Plan, queueing issues are relatively minor for the surrounding roadway network: the Broadway & Rayleigh Road intersection, most important to the DoC Campus, was shown to have no queueing issues. Rayleigh Road's queueing capacity for eastbound outbound movements was sufficient.

Other intersections and movements among the off-campus intersections exhibited queueing that exceeded the storage capacity, which includes the following:

- Broadway & Baseline Road
 - Southbound Left (PM peak hour only)
- Broadway & 27th Way
 - Northbound Right (AM peak hour only)
- Broadway & Dartmouth Avenue
 - Eastbound Right (PM peak hour only)
 - Broadway & Table Mesa Drive
 - Westbound Left (AM and PM peak hours)

The full queueing analysis results are presented in Exhibit 136. Queueing results are not reported for on-campus intersections as these intersections only use yield signs for traffic control. Nonetheless, no significant queueing issues at internal intersections were observed during the site visit. However, queueing issues were observed at the Guard Station, which is explained in further detail in the "General Circulation Observations" section.

Exhibit 133: LOS/Delay Results (AM Period)

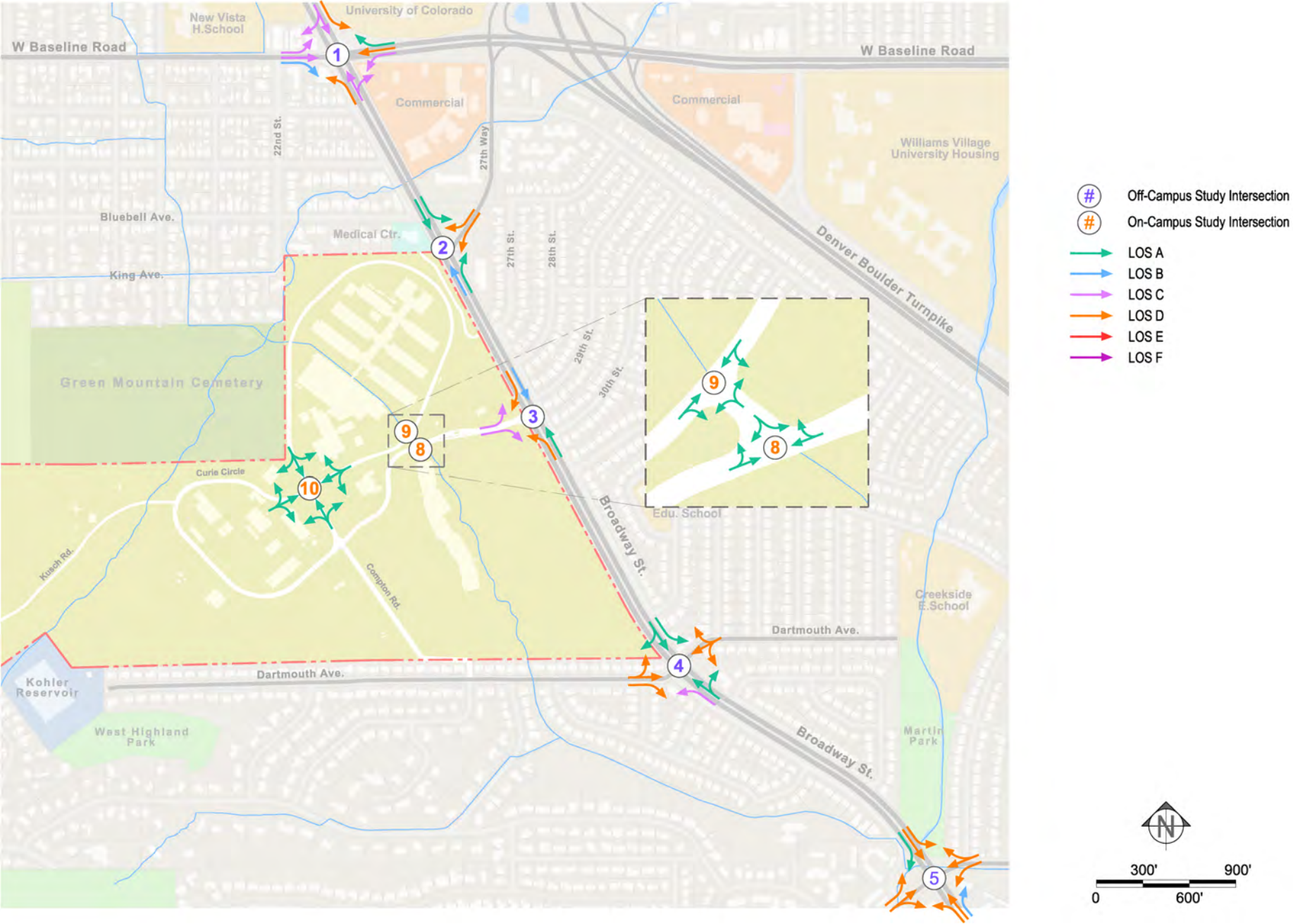
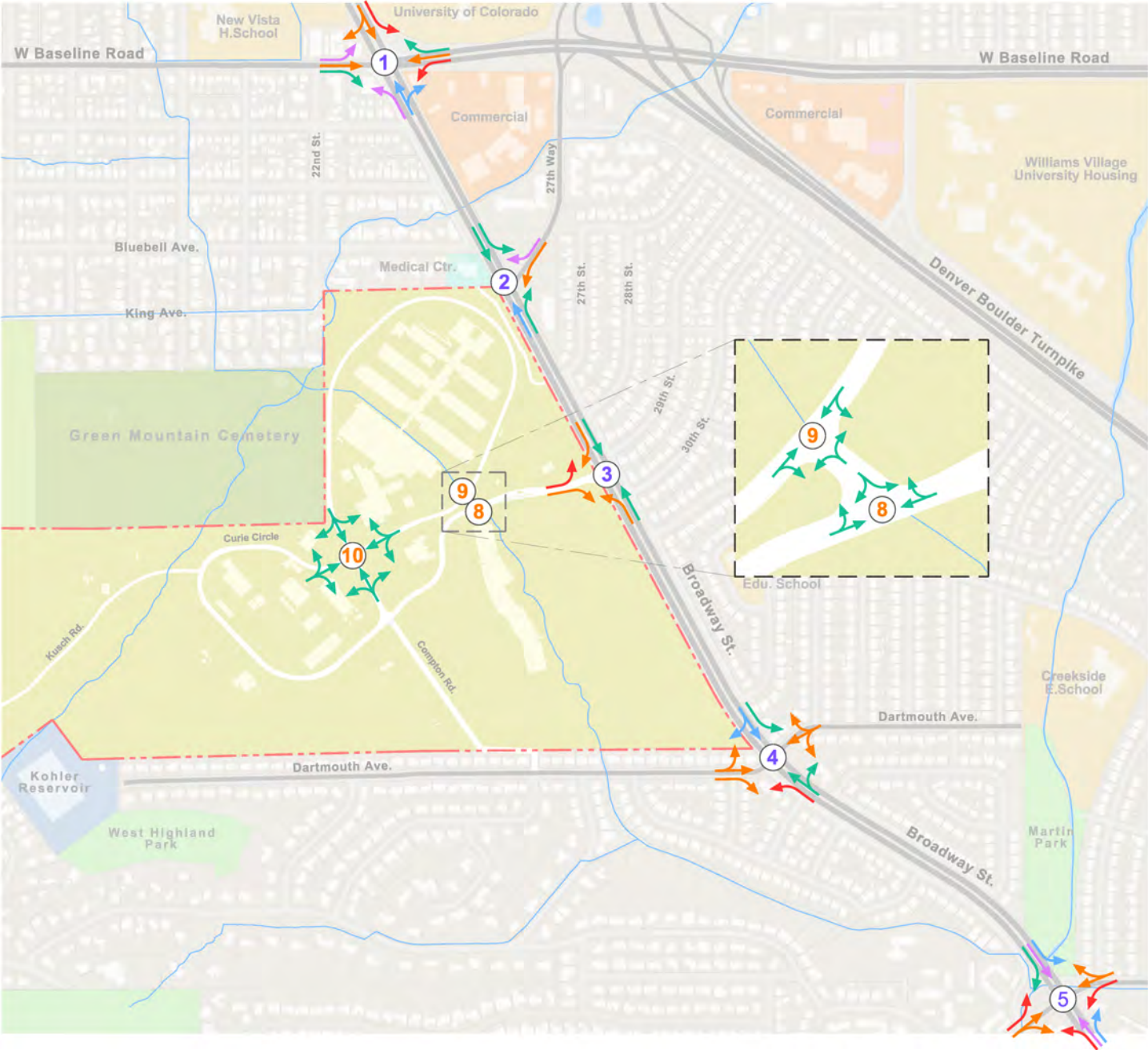


Exhibit 134: LOS/Delay Results (PM Period)



- Off-Campus Study Intersection
- On-Campus Study Intersection
- LOS A
- LOS B
- LOS C
- LOS D
- LOS E
- LOS F

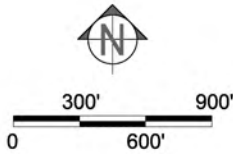


Exhibit 135: Level of Service (LOS)/Delay Results*

Intersection and Approach	Existing (2024)			
	AM Peak		PM Peak	
	Delay	LOS	Delay	LOS
1 Broadway & Baseline Road	22.9	C	35.1	D
Eastbound Left	23.8	C	28.0	C
Eastbound Thru	28.1	C	44.0	D
Eastbound Right	14.6	B	9.9	A
Westbound Left	25.4	C	65.3	E
Westbound Thru	39.6	D	37.6	D
Westbound Right	3.1	A	0.9	A
Northbound Left	46.8	D	21.9	C
Northbound Thru/Thru Right	25.7	C	19.6	B
Southbound Left	41.4	D	64.9	E
Southbound Thru/Thru Right	20.4	C	46.6	D
2 Broadway & 27th Way	12.2	B	13.1	B
Westbound Left	51.9	D	49.3	D
Westbound Right	37.5	D	34.8	C
Northbound Thru	10.1	B	5.7	A
Northbound Right	0.8	A	0.7	A
Southbound Left	0.9	A	2.9	A
Southbound Thru	0.9	A	2.7	A
3 Broadway & Rayleigh Road	13.8	B	9.4	A
Eastbound Left	32.8	C	48.2	E
Eastbound Right	32.5	C	47.9	D
Northbound Left	44.3	D	47.0	D
Northbound Thru	5.1	A	4.0	A
Southbound Thru	13.9	B	5.2	A
Southbound Right	53.4	D	48.3	D
4 Broadway & Dartmouth Avenue	6.6	A	10.5	B
Eastbound Thru Left	48.4	D	37.3	D
Eastbound Right	41.9	D	37.7	D
Westbound LTR	48.8	D	37.4	D
Northbound Left	31.9	C	76.0	E

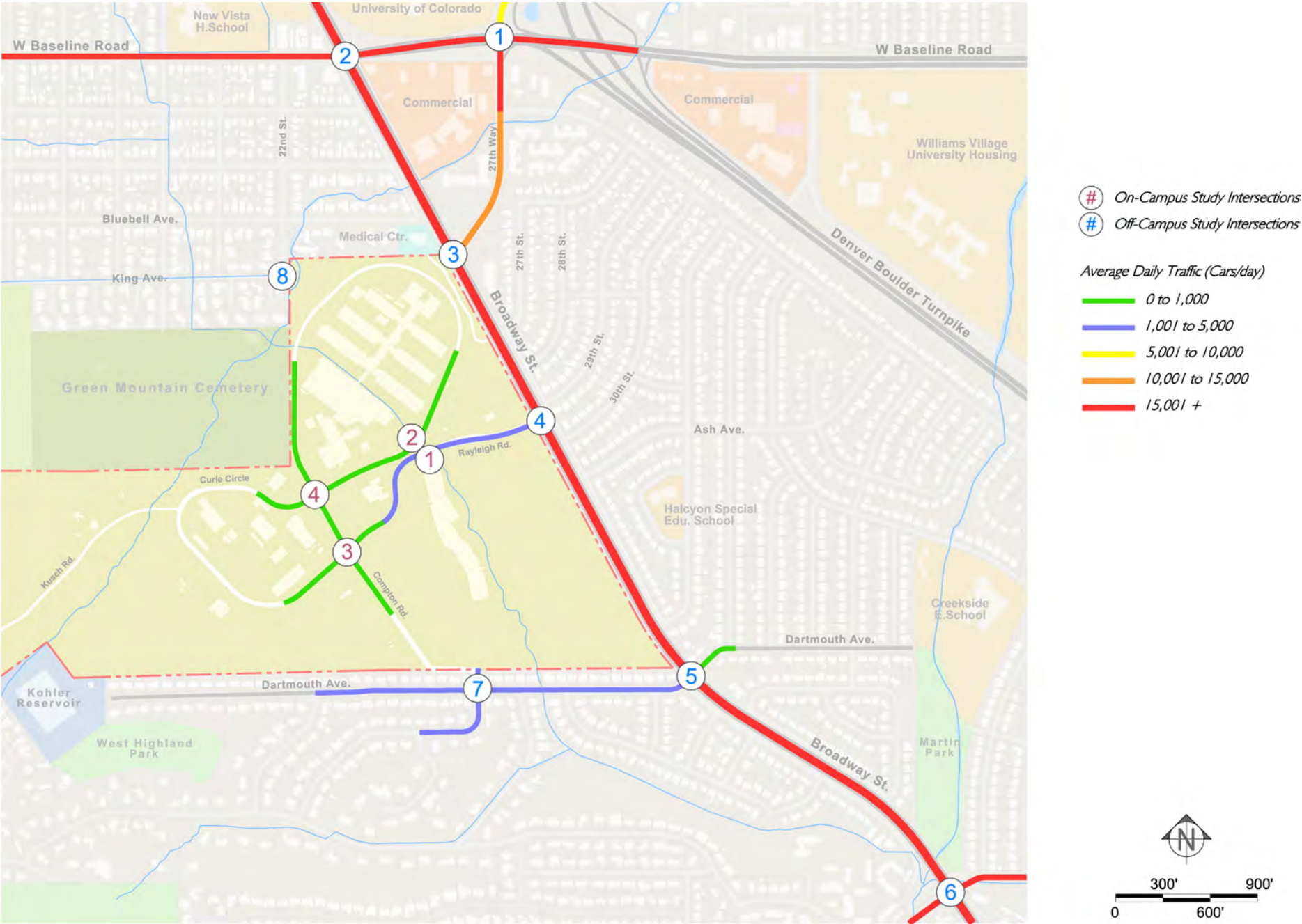
Intersection and Approach	Existing (2024)			
	AM Peak		PM Peak	
	Delay	LOS	Delay	LOS
4 Broadway & Dartmouth Avenue	6.6	A	10.5	B
Northbound Thru/Thru Right	1.8	A	3.1	A
Southbound Left	2.3	A	5.8	A
Southbound Thru/Thru Right	8.1	A	12.3	B
5 Broadway & Table Mesa Drive	38.2	D	34.5	C
Eastbound Left	44.8	D	55.9	E
Eastbound Thru/Thru Right	38.8	D	49.6	D
Westbound Left	41.8	D	59.0	E
Westbound Thru/Thru Right	41.1	D	40.5	D
Northbound Left	47.8	D	57.1	E
Northbound Thru	40.6	D	34.3	C
Northbound Right	13.4	B	18.8	B
Southbound Left	47.6	D	15.4	B
Southbound Thru	41.7	D	28.6	C
Southbound Right	0.1	A	0.3	A
8 Rayleigh Road & Compton Road (South)				
Eastbound Left Thru	7.6	A	8.5	A
Westbound Thru Right	9.0	A	7.1	A
Southbound Left Right	8.0	A	9.1	A
9 Rayleigh Road & Compton Road (North)				
Eastbound LTR	7.1	A	6.9	A
Westbound LTR	7.4	A	7.7	A
Northbound LTR	7.9	A	7.5	A
Southbound LTR	7.4	A	7.4	A
10 Compton Road & Curie Circle				
Eastbound LTR	7.1	A	7.3	A
Westbound LTR	7.1	A	7.2	A
Northbound LTR	7.5	A	7.2	A
Southbound LTR	6.9	A	7.1	A

Exhibit 136: Queuing Results

Intersection and Lane Group	Storage Length (ft)	Existing (2024)			
		AM Peak		PM Peak	
		50th	95th	50th	95th
1 Broadway & Baseline Road					
Eastbound Left	65	5	16	8	24
Eastbound Thru	1,030	170	213	352	#488
Eastbound Right	310	34	50	68	121
Westbound Left	870	30	61	50	#138
Westbound Thru	870	285	373	282	395
Westbound Right	240	0	0	0	0
Northbound Left	235	111	#203	98	201
Northbound Thru Right	1,330	168	250	134	191
Southbound Left	430	105	153	305	#434
Southbound Thru Right	1,590	71	108	300	333
2 Broadway & 27th Way					
Westbound Left	900	124	#194	261	332
Westbound Right	305	0	43	0	37
Northbound Thru	1,070	97	230	104	111
Northbound Right	90	0	388	24	1
Southbound Left	155	0	1	3	m6
Southbound Thru	1,385	8	10	0	53
3 Broadway & Rayleigh Road					
Eastbound Left	660	7	21	112	165
Eastbound Right	210	0	14	18	71
Northbound Left	190	114	178	14	35
Northbound Thru	1,825	77	351	50	54
Southbound Thru	1,030	116	202	215	105
Southbound Right	270	112	m215	17	m45

Intersection and Lane Group	Storage Length (ft)	Existing (2024)			
		AM Peak		PM Peak	
		50th	95th	50th	95th
4 Broadway & Dartmouth Avenue					
Eastbound Left Thru	150	45	80	26	57
Eastbound Right	40	12	32	19	47
Westbound LTR	230	48	86	29	64
Northbound Left	145	10	m13	8	m18
Northbound Thru/Thru-Right	2,070	46	91	3	4
Southbound Left	210	2	m0	3	m4
Southbound Thru/Thru-Right	1,840	183	2	258	156
5 Broadway & Table Mesa Drive					
Eastbound Left	245	134	177	103	146
Eastbound Thru/Thru-Right	640	183	221	234	292
Westbound Left	140	123	175	194	#294
Westbound Thru	2,820	177	239	227	303
Westbound Thru Right	105	0	0	0	0
Northbound Left	440	24	58	35	75
Northbound Thru	1,355	378	#571	216	306
Northbound Right	550	36	82	54	105
Southbound Left	215	73	#123	102	127
Southbound Thru	2,055	193	235	543	#703
Southbound Right	2,045	0	0	0	0

Exhibit 137: Estimated Average Daily Traffic (ADT) Volumes



15.7 Bicycle Turning Maneuver Collection Summary

As with the vehicular turning maneuver data, bicycle turning maneuver data was collected at all study intersections on Tuesday, April 23, 2024, from 6:30 AM to 9:30 AM and from 3:30 PM to 6:30 PM as well. These volumes are summarized below in Exhibit 138 and Exhibit 139.

These results show that there was minimal bicycle activity on campus, with only a maximum total of 17 bicycles being counted at a single intersection in either the AM or PM peak hour (during the AM peak hour at the north Compton Road & Rayleigh Road intersection). Minimal bicycle activity was also noted at the Kenwood Drive/Dartmouth Avenue and King Drive/22nd Street intersections.

The heaviest bicycle volumes were seen at the off-campus intersections, particularly those intersections improved with significant bicycle infrastructure such as the Broadway & Baseline Road intersection.

For the limited number of bicyclist cut-through trips traversing the campus, bicyclists were observed to travel at high speeds. Prior to the April site visit, the NIST team had noted anecdotally that bicyclists travel between the two ped/bike entrances on Kenwood Drive/Dartmouth Avenue and King Drive/22nd Street, cutting through the campus enroute to their destination. The King Drive/22nd Street entrance is downhill from the Kenwood Drive/Dartmouth Avenue entrance and, as a result, bicyclists tend to traverse through the campus at high speeds along campus roads and sidewalks. This activity was also noted in the 2017 Master Plan.

15.8 Pedestrian Crossing Data Collection Summary

As with the vehicular and bicycle turning maneuver data, pedestrian crossing data was collected at all of the study intersections on Tuesday, April 23, 2024, from 6:30 AM to 9:30 AM and from 3:30 PM to 6:30 PM as well. These volumes are summarized below in Exhibit 140 and Exhibit 141.

Internally, pedestrian activity was observed to be highest during the AM peak hour, particularly at the Compton Road & Rayleigh Road intersection. Off-campus, pedestrian volumes were highest south and north of the DoC Campus, at the Broadway & Baseline Road intersection and the Broadway & Table Mesa Road intersection, similar to what was observed in the 2017 Master Plan. However, a similarly high number of pedestrian volumes were seen to be crossing Rayleigh Road along Broadway during the AM peak hour as well.



Exhibit 138: Existing 2024 Peak Hour Bicycle Volumes – Off-Campus

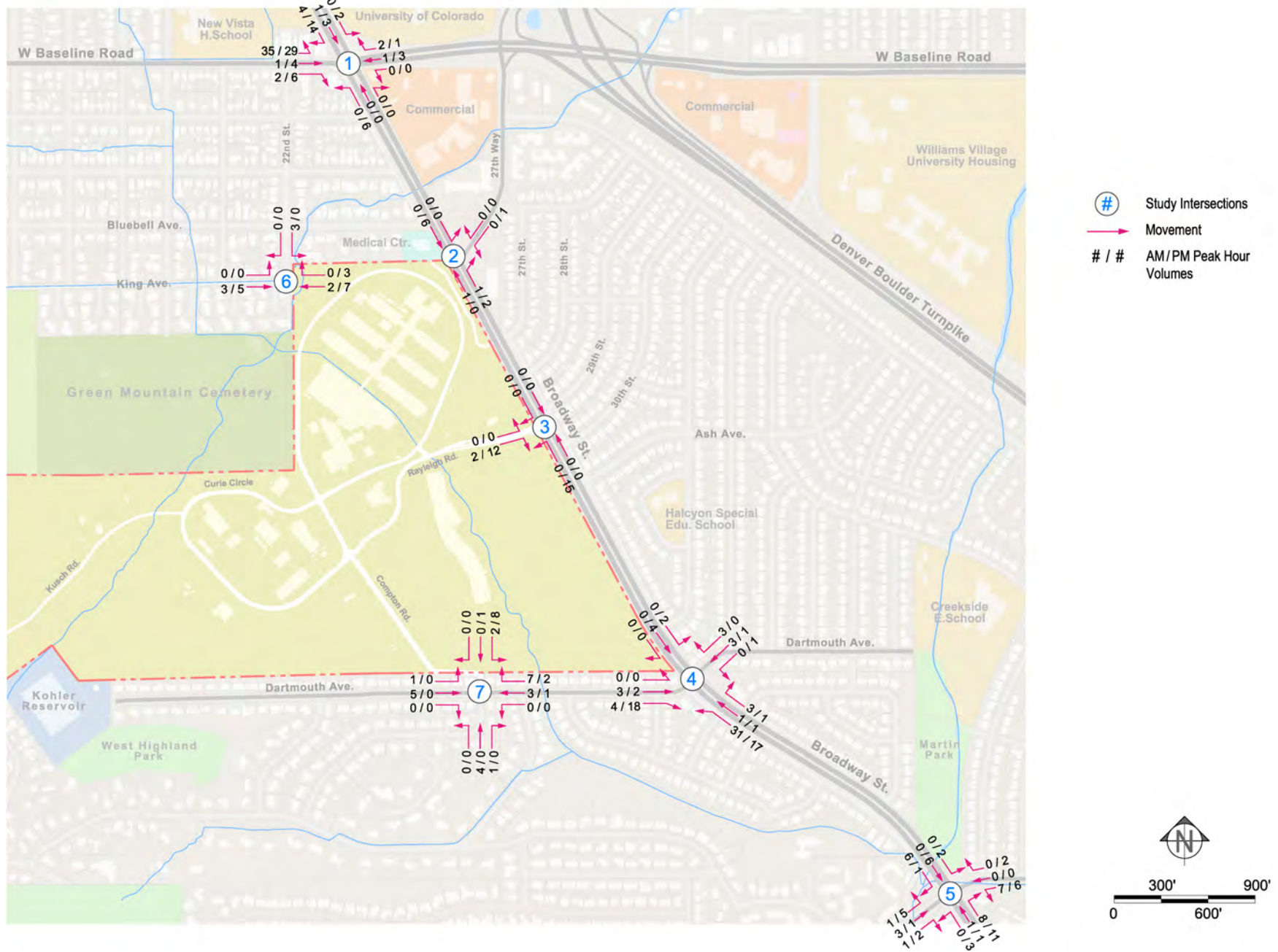


Exhibit 139: Existing 2024 Peak Hour Bicycle Volumes – On-Campus



Exhibit 140: Existing 2024 Peak Hour Pedestrian Volumes – Off-Campus

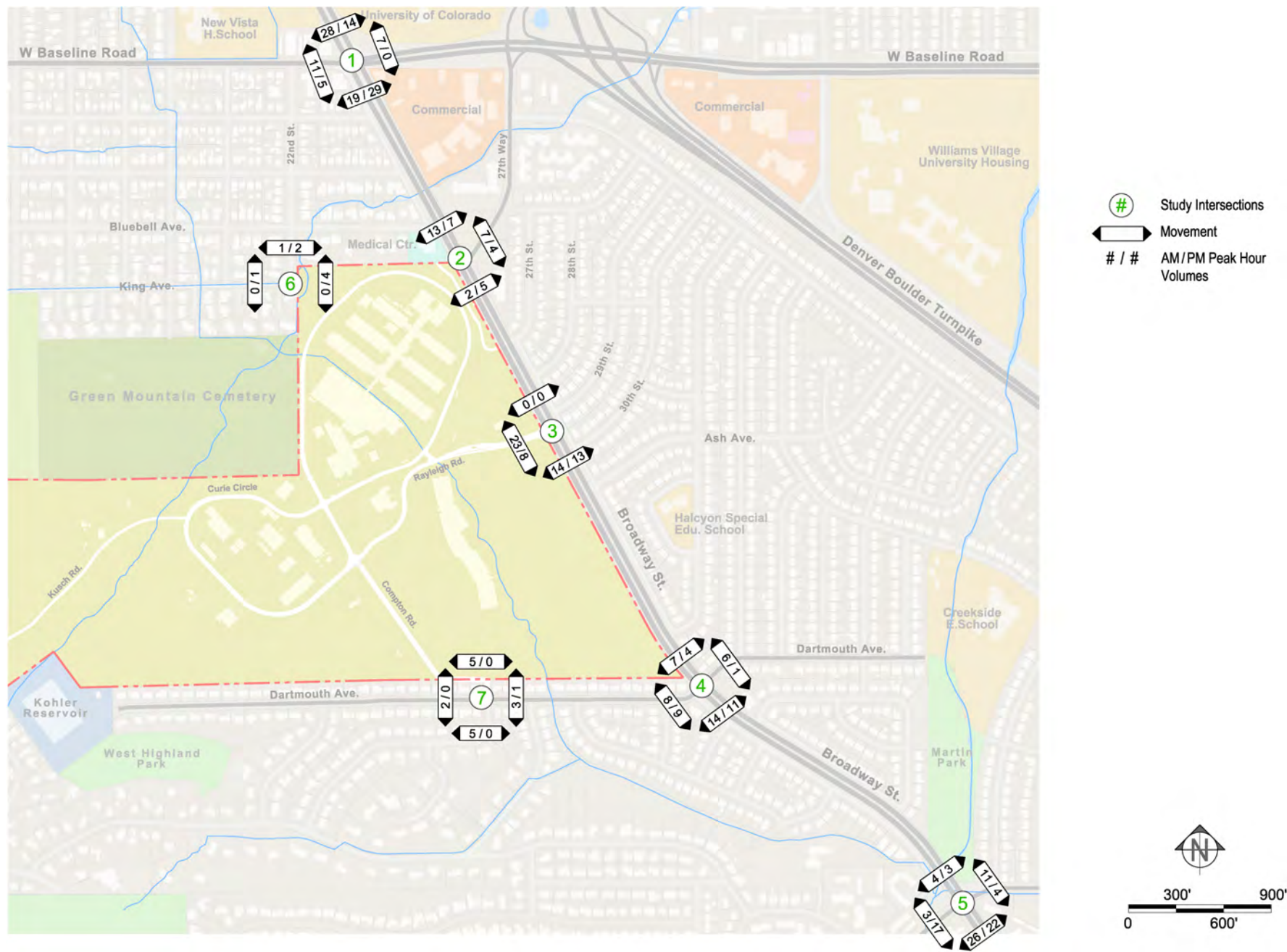


Exhibit 141: Existing 2024 Peak Hour Pedestrian Volumes – On-Campus



