2 VISION

This section forms the programmatic basis for the LRDP in three parts:

Scientific Vision

Space and Population Projections

Site and Facilities Vision

The Scientific Vision for Berkeley Lab

BERKELEY LAB WILL BE THE LOCATION OF CHOICE FOR LEADING SCIENTISTS TO SOLVE MAJOR CHALLENGES OF OUR TIME ON BEHALF OF HUMANKIND AND THE ENVIRONMENT.

Berkeley Lab has been the location of choice for leading scientists for decades, resulting in the rich history of scientific achievement outlined in the prior section. The Laboratory is committed to continuously delivering innovations in science and technology that address significant problems facing humankind and the environment. Figure 2.1 provides a sample of the Laboratory's scientific goals that address energy supply and use, models of living systems, and the nature of the universe.

Discoveries across this broad range of scientific disciplines promise to advance human knowledge and improve health, environmental protection, and our economy. However, continuation as the location of choice for scientists to successfully engage in these endeavors is challenged by eroding infrastructure and a stock of single-purpose facilities whereas research buildings built for multi-discipline collaborations will be the key to future success. These shortcomings threaten Berkeley Lab's ability to sustain its core competencies, obtain sponsorship for leading-edge programs, and attract new scientific talent.

This LRDP focuses on the site, facilities, and infrastructure aspects of achieving Berkeley Lab's scientific vision. Scientific discovery and the development of useful applications are accelerated when facilities consolidate advanced instrumentation with researchers from complementary disciplines. This requires the optimization and rehabilitation of facilities that can cost-effectively be made suitable for the evolution of scientific endeavors.

In addition, the replacement of existing facilities, and construction of additional facilities, will be required to meet the demands of the next generations of scientific endeavors and

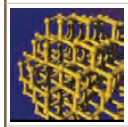
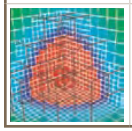
Federal Scientific Research Initiative	Berkeley Lab 20-Year Science and Technology Goals
 **Develop New Energy Technologies and Environmental Solutions**	Safe, sustainable, and CO2-neutral sources of energy • Understand global climate change • Demonstrate a safe and effective carbon sequestration system • Improved commercial and residential building efficiency
 **Discover the Composition of Matter and Energy in the Universe**	Greater understanding of the cosmos through the precision measurement of dark energy • Support the Joint Dark Energy Mission Launch • Fabricate advanced detectors to understand the origin of mass and the structure of nucleonic matter • Lead national and international efforts for underground neutrino detectors to determine neutrino mass
 **Understand and Engineer Living Systems through Quantitative Biology**	Understand and engineer living systems • Overcome the challenges of difficult biomolecular structures to deliver engineered environmental mitigation • Develop new detectors and molecular contrast agents to detect and quantify disease processes • Efficient and targeted synthesis of materials, fuels, and drugs from microbial systems
 **Create Designer Materials through Nanoscience**	Radically new generations of materials with tailored properties, with an emphasis on integrating inorganic and biological nanomaterials • Assembly of complex nanodevices such as nanomotors, nanophotovoltaics, and nanophotosynthetic systems • Transfer of nano-photovoltaic systems to industry for selected commercial applications
 **Advance X-ray and Ultrafast Science**	Overcome the challenges of moving x-ray science into the femtosecond and attosecond time domain • Develop an x-ray slicing source and further improving time-average brightness at the Advanced Light Source • Conduct x-ray probe experiments in reaction dynamics at sub-femtosecond resolution
 **Enable Scientific Discovery through Advanced Computing**	Develop the next generation of scientific computing architecture and facilities • Overcome interconnect latency, scaling difficulties, and software limitations to provide the best computing tools for the largest scale problems

FIGURE 2.1 Berkeley Lab's scientific goals address significant problems facing humankind and the environment

accommodate growth in space needs and population. Technical challenges presented by the problems to be addressed and the scale of systems that must be understood—from sustainable sources of carbon-neutral fuels to understanding dark energy—exceed Berkeley Lab's current capabilities. New facilities, specifically designed to address major challenges of our time, will be required for Berkeley Lab to continue as *the location of choice for leading scientists*.

A comprehensive renewal of the main site, facilities, and infrastructure that is sufficient for the achievement of Berkeley Lab's scientific vision and goals will require, and result in, a modest increase in building space and population. The Laboratory's approach to achieve this renewal is the basis of the LRDP growth projections and underpins the basic planning principles of the Plan:

- *Strengthen and expand existing research programs to sustain and grow Berkeley Lab's role as a national research institution.* The Laboratory's leadership in areas of emerging federal priority, such as solar energy, energy efficiency, and nanoscience, will result in increased funding with requirements that Berkeley Lab increase staff levels and scientific capabilities.
- *Expand partnerships and collaborations to enhance Berkeley Lab's scientific and technical base.* The Laboratory's partnerships with other national laboratories, academia, and private industry such as the Supernova Acceleration Probe will increase staff levels in supporting programs, related disciplines, and off-shoot research groups.

- *Provide flexibility to return staff from its off-site facilities leased in Berkeley and Oakland to the main site in order to enhance collaboration, productivity, and efficiency.* Projects such as constructing a high-performance computing facility at the Laboratory and returning staff and equipment from leased space would increase the building space and population at the main site without an increase in overall staff levels.
- *Expand the capacity of existing high-demand advanced facilities and provide broader functionality.* Core staff and visitors to Berkeley Lab's advanced scientific facilities are expected to increase as a result of keeping pace with technological advances such as adding new beamlines at the Advanced Light Source.

FIGURE 2.2 (below) The proposed User Support Building would provide staging area and laboratory space for users of the Advanced Light Source, as well as replace a seismically "very poor" building

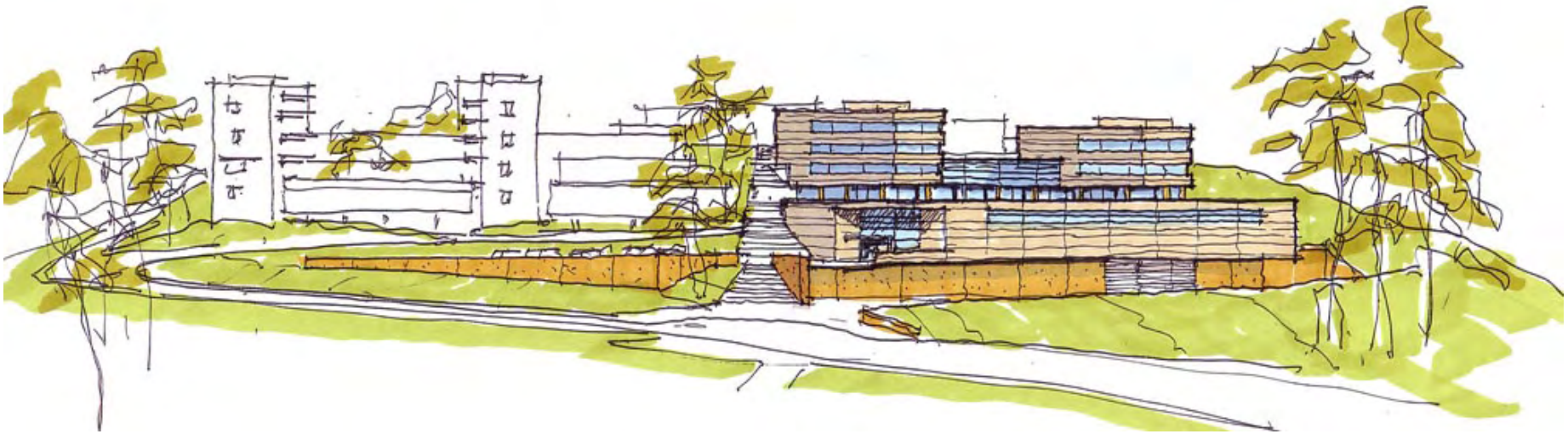
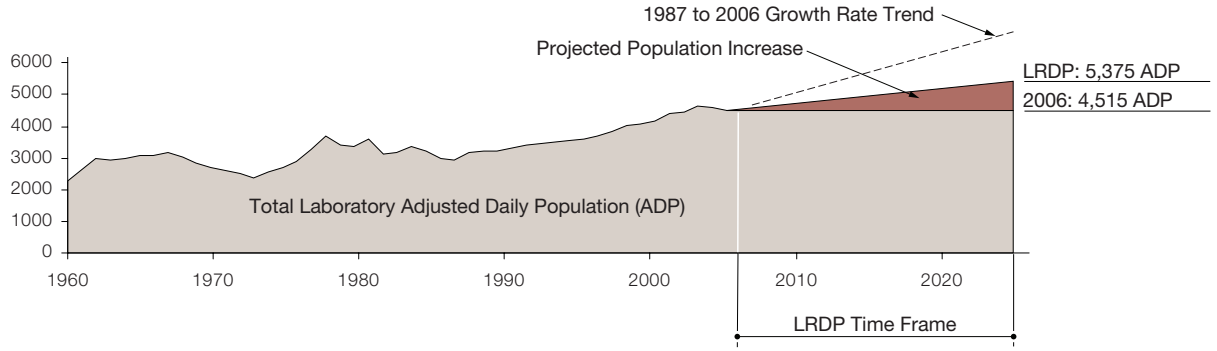


FIGURE 2.3 (above) Prospective high-performance computing facility to accelerate discovery in all scientific and engineering disciplines

- *Rehabilitate facilities that have outlived their intended purpose and can be cost-effectively adapted for use in new regions of scientific discovery.* For example, converting animal care space to life sciences laboratories and solving structural deficiencies in the process would enable an increase in the Laboratory's population while improving safety.
- *Replace single-purpose facilities with new facilities programmed to accommodate multiple disciplines with advanced infrastructure suitable for future scientific endeavors.* An increase in Berkeley Lab building space will result from projects such as the Bevatron demolition, which will provide a three-acre site for development of other new research programs.
- *Construct new scientific facilities to support future research initiatives and continued growth in existing programs.* For instance, developing methods to efficiently convert sunlight to fuels will demand high performance infrastructure and other advanced facility features that renovated space cannot provide. In addition, tackling problems of this scale will attract whole new research groups to the Laboratory and increase employee population.

Space and Population Projections



Note: Data relates to ADP in all facilities occupied by Berkeley Lab

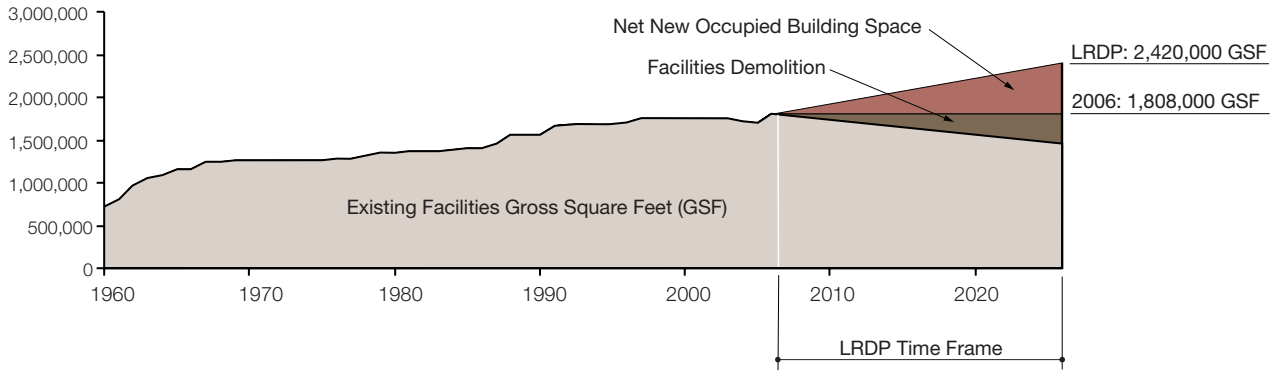
FIGURE 2.4 Berkeley Lab's Projected Population Increase

The achievement of Berkeley Lab's scientific vision and goals will result in growth of research programs, population, and occupied space. Berkeley Lab's population in all of the facilities it occupies is projected to grow from 4,515 in 2006 to 5,375 by 2025. This population increase of 860 represents an average annual growth rate of 0.9 percent over that time period. This rate is less than 40% of the Laboratory's overall 2.3 percent growth rate from 1987 to 2006.

Berkeley Lab uses the Adjusted Daily Population (ADP) to describe the actual population associated with the laboratory on workdays. It is calculated as the full-time equivalent (FTE) employees plus 40% of the registered guests which takes into account travel, vacation, part-time employees, and the periodic nature of guests actually entering the Laboratory. For example, 160 new FTE staff, plus 40% of 100 new registered guests, equals 200 new ADP.

The historical population levels at the Laboratory demonstrate the ebb and flow nature of research sponsorship at a national laboratory. As Figure 2.4 shows, Berkeley Lab's population has fluctuated considerably throughout its history in response to national research imperatives and budget opportunities or constraints. The Laboratory has experienced modest population growth since the late 1980s and reached a peak ADP of 4,643 in 2004. This growth is projected to continue, although at a slower pace through the time frame of this LRDP. Out of Berkeley Lab's total poulation, the main site 2006 ADP of 4,000 is projected to grow to a maximum of 5,000 by the year 2025.

The projected net increase in occupied building area on the main site is 612,000 gross square feet (gsf), from 1,808,000 gsf in 2006 to 2,420,000 gsf. This net growth factors in the demolition of 272,000 gsf of building space that is unsafe or



Note: Data relates to Berkeley Lab's Main Site only

FIGURE 2.5 Berkeley Lab's Projected Occupied Building Space Increase at the main site

beyond its useful life. The projected annual space growth rate of 1.5% is 25% greater than the Laboratory's facilities growth rate of 1.2% from 1987 to 2006 and relatively higher than the projected population growth rate. This increase reflects greater investment in large scale equipment, and the construction of facilities for the return of existing employees from leased facilities to the main site.

The following discussion characterizes the types of facilities that would be required to accommodate the future population and space growth at Berkeley Lab in the scientific and operations areas. Future scientific discoveries and new national challenges will guide a more detailed definition of facilities requirements over the coming decades.

Life & Environmental Sciences

Berkeley Lab's environmental research programs will continue to address the major challenges of environmental restoration and global climate change. A new generation of bioscience laboratories will be required to reveal the molecular mechanisms of living systems' adaptation and response to their environment, utilize microbes and plants to provide a new basis for fuels production, develop biological processes for legacy waste clean-up, and sequester carbon to reduce the advancement of global warming.

Physical Sciences

Berkeley Lab is focusing its strengths to address the national and global need for sustainable, carbon-neutral fuels production. Improvements in the efficiency of solar to chemical energy conversion and photovoltaic cells require new multi-disciplined research laboratories in close proximity to national user facilities existing at Berkeley Lab. The Advanced Light Source is being upgraded to enable science currently not possible and high demand

is expected once the capability is delivered. Further improvements will address user demands for the coming decades.

Computing Sciences

Computation at the largest scales possible will be increasingly important to advance the frontiers in every scientific discipline. Expanded high-performance computing facilities are necessary for improvements in computational power, network bandwidth & reliability, and mathematical & software tools to enhance the scientific productivity of computational scientists.

General Sciences

Berkeley Lab expects to be a leader in accelerator and space-based experimental programs. The recent discovery that the expansion of the universe is accelerating marked a major scientific revolution. The next generation of accelerator-based research facilities will open an era where laboratory experiments shed light on some of the most profound mysteries of the universe. Berkeley Lab is leading the effort to measure dark energy by observing distant Type Ia supernovae spectra with a highly instrumented orbiting telescope - this effort will require sustained engineering laboratories and office space.

Operations

Full-service operational support is provided to enable the Laboratory's scientific programs to focus on research. Growth in the scientific programs will require a corresponding growth in support population and occupied building space. Moving administrative staff from leased facilities to the main site will also increase building space occupied by Operations. A proposed facility for providing short-term accommodations to guests of Berkeley Lab would add occupied space and a small number of new staff to the main site.

Reserve

The occupied space and population reserve would allow Berkeley Lab to quickly deliver the facilities and personnel required to meet national challenges as they emerge. While the facilities would be laboratory, advanced instrumentation, shop, office, and conference space, the types of science to be conducted in these facilities would be determined by new knowledge that will be developed within the time frame of this LRDP.

A conceptual projection for the occupied space and population growth in each functional area over the next 20 years is provided in Tables 2.1 and 2.2.

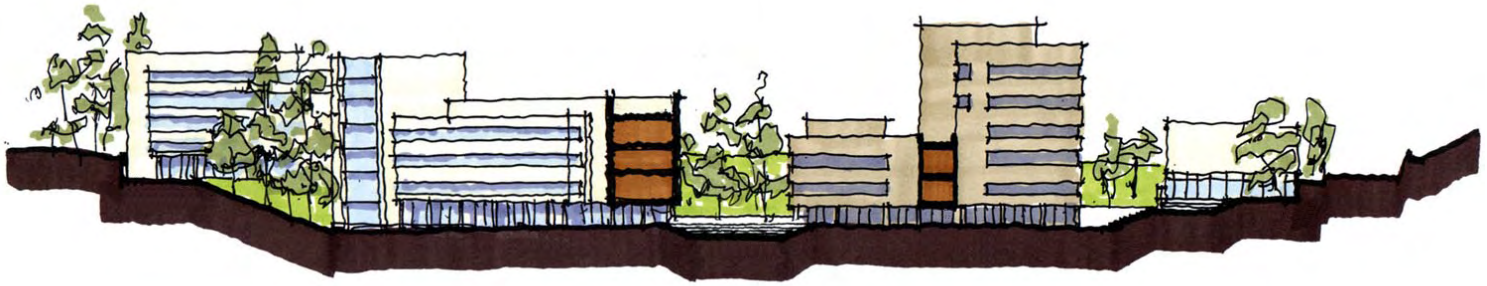


FIGURE 2.6 Genomics and Biosciences facilities with advanced infrastructure are required to address major challenges in energy, health, and the environment

TABLE 2.1 Summary of Projections for Population Growth

Area	New Employees	New FTE	New Registered Guests	Net New ADP (Note 1)
2006 Population Baseline ADP (all sites)				4,515
Life & Environmental Sciences	200	180	50	200
Physical Sciences	300	260	180	330
Computing Sciences	40	30	50	50
General Sciences	100	90	30	100
Operations	80	70	20	80
Reserve	100	90	20	100
Totals, 2006-2025	820	720	350	860
Total Projected Population (all sites)				**5,375**

TABLE 2.2 Summary of Projections for Space Growth

	New GSF	Demolition GSF	Net New GSF
2006 Space Baseline GSF (Main Site only)			1,808,000
Life & Environmental Sciences	115,000	11,000	104,000
Physical Sciences	276,000	34,000	242,000
Computing Sciences	170,000	3,000	167,000
General Sciences	142,000	126,000	16,000
Operations	25,000	5,000	20,000
Reserve	156,000	93,000	63,000
Totals, 2006-2025	884,000	272,000	612,000
Total Main Site Occupied Space			**2,420,000**

Note 1: Adjusted Daily Population (ADP) =
Full-Time Equivalent (FTE) Personnel + (Registered Guests * 40%)

The Site and Facilities Vision

The new development identified in this Plan offers an opportunity to preserve and enhance Berkeley Lab's valued environmental assets while making improvements to functional and experiential qualities of the Laboratory's main site. The 2006 LRDP will realize this opportunity by applying four principles inspired by the special qualities of the Laboratory setting to the future physical development identified in this Plan. These principles are the foundation of the site and facilities vision to make Berkeley Lab "An outstanding place to do world-class science."

Preserve and enhance the environmental qualities of the site as a model of resource conservation and environmental stewardship.

As a leader in energy and environmental research and the stewards of this extraordinary site, the Laboratory has an opportunity and responsibility with each new project to be a model for environmentally responsible development. Construction of new facilities will take place on land within already developed areas of the site to allow undisturbed open space to remain at the site's perimeter. Sensitive habitats and riparian areas are protected and stands of screening trees will be expanded to screen views of Laboratory buildings from all directions.

New buildings will meet or exceed the *UC Presidential Policy for Green Building Design*. Whenever possible, new building elements and/or design strategies developed by University of California researchers will be showcased in new projects as a way to reinforce a "culture of sustainability" at Berkeley Lab. All of this will be done in a way that enriches the unique place that is Berkeley Lab.

FIGURE 2.7 Laboratory facilities like the historic ALS building complement the Berkeley Hills setting

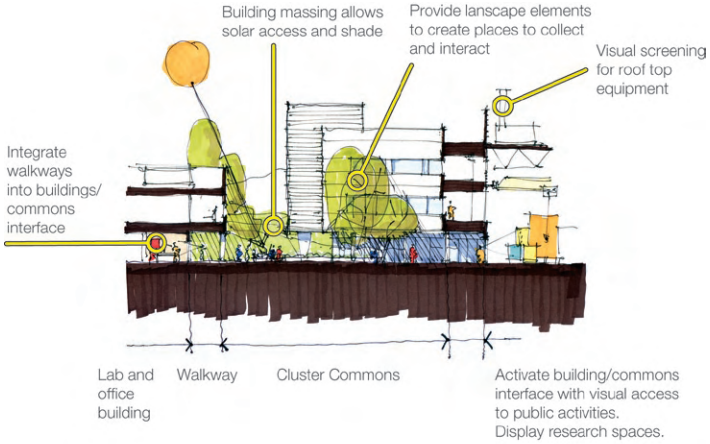


FIGURE 2.8 (far left) New facilities built at higher densities, like the Advanced Materials Laboratory, enhance operational effectiveness and flexibility

FIGURE 2.9 (left) Select architectural elements of a campus-like setting

Build a safe, efficient, cost-effective scientific infrastructure capable of long-term support to evolving scientific missions.

Life safety is a top priority at Berkeley Lab. New facilities will provide state of the art protection against potential occupational hazards and will address the two natural hazards common to the East Bay region—wildland fires and seismic activity. Future development and landscape improvements will continue and strengthen the Laboratory's existing fire protection and vegetation management strategies that have served as a model to the region. The replacement of older facilities with new ones built to modern life safety standards will significantly reduce the threat to life safety in the event of fire and earthquakes as well as the potential occupational hazards of scientific research.

The efficient, long-term operation of a research institution where scientific needs are constantly changing is a challenge that demands a high degree of flexibility in the way new projects are planned and designed. Accordingly, the Plan provides the flexibility needed to meet both known and unforeseen programmatic needs in a cost effective way without compromising the environmental assets of the site.

Operational efficiency is also strengthened by bringing researchers and their programs closer together. Whenever possible, new projects will be located in close proximity to facilities with common activities and/or related research interests to capitalize on the benefits of collaboration and shared use of specialized equipment and facilities.

Build a more campus-like research environment.

Berkeley Lab's scientific endeavors rely on the healthy exchange of ideas sustained through formal and informal social interaction among scientists, engineers, students, and support staff. To build an environment that fosters this valuable social interaction, the design of new Laboratory projects will draw inspiration from university campus type settings. Future development at the Laboratory will place an emphasis on the pedestrian experience both indoors and outdoors to create a setting conducive to interaction and collaboration.

New projects will be planned to segregate pedestrian and vehicular circulation. Buildings, built at greater densities than they are now, will better define outdoor spaces between them. Future development will build upon the informal character of the Laboratory and lead it in a direction where buildings are

FIGURE 2.10 Access to advanced scientific equipment like the Advanced Light Source supports international collaborations

not thought of as individual objects, but work in concert to weave the Laboratory site into a coherent whole.

Improve access and connections to enhance scientific and academic collaboration and interaction.

As the Laboratory takes on new challenges it will increasingly rely on the rapid innovation that emerges from interdisciplinary collaboration. Whether at the scale of individual researchers, or a consortium of public and private institutions working together, clear and convenient access to and around the Laboratory is vital to the work and culture of team science at Berkeley Lab.

The Laboratory is committed to providing access in the safest, most environmentally responsible way possible. In 2006 nearly half of the Laboratory's adjusted daily population commuted to the main site on its shuttle system which has connections to UC Berkeley and regional mass transit systems. New and improved pedestrian routes will provide safe and direct linkages between onsite shuttle stops, facilities, and parking. The improved walkways will offer an outdoor amenity that not only provides a sense of connection to the natural setting and views, but also promotes chance meetings along the way.