VISION MADE REAL

I am pleased to present this final report detailing Western Carolina University’s new master plan, which will guide the development and improvements of the campus over the next several decades. Approved in December 2013 by the WCU Board of Trustees, this document closely links physical facilities of the university, including future construction and renovation, to the goals of our strategic plan, “2020 Vision: Focusing Our Future.” Envisioned as a flexible framework for growth, the master plan is based on enrollment projections that anticipate more than 11,000 students studying in Cullowhee by the year 2023, and the need for approximately 486,000 gross square feet of additional interior space to accommodate the needs of those students.

Approval of the plan, which was drafted with the guidance of a 16-member task force, came after a 17-month process that included numerous public forums designed to collect input and feedback from university students, faculty and staff, and from residents of surrounding communities. The plan addresses issues related to new building needs, utilization of existing space, parking and transportation, technology infrastructure, sustainability, safety and security, preservation of campus heritage and integration of the campus with the surrounding community.

I must recognize Sam Miller, vice chancellor for student affairs, and Melissa Canady Wargo, chief of staff, for their excellent leadership as co-chairs of the master planning task force. I am grateful to the 14 additional members of that group, which included broad representation from campus and community, as well as those who served on the many subcommittees and those who attended public forums or used our online survey instrument to offer valuable input and feedback throughout an open and transparent process.

If, as I believe, our strategic plan is a road map for the university for the coming years, then this master plan is our GPS. It is a living document, one that is not set in stone but rather will be a guide to us going forward – a tool adaptable to changing conditions as we continue to work together to define our future in pursuit of distinction.

David O. Belcher
Chancellor
The Campus Master Plan seeks to support the 20/20 Vision Plan by enabling Western Carolina University’s physical resources to accommodate the goal to be a national model for learning and engagement, while embracing its responsibilities as a regionally engaged university. The plan will maximize existing campus infrastructure to accommodate growth, plan for sustainable systems to anticipate growth, steward the rich heritage of Western Carolina, and celebrate the campus’ unique sense of place.
The Master Plan is grounded in the physical and social context of WCU. The planning team examined the University’s physical and architectural character, environmental context, landscape, social and academic organization, pedagogy, and history.

The Western Carolina University 2013 Campus Master Plan supports the University’s 20/20 Vision Plan and its vision statement, “To be a national model for student learning and engagement that embraces its responsibilities as a regionally engaged university.” The 20/20 Vision Plan outlines Six Strategic Directions:

1. **Fulfill the Educational Needs of Our State and Region**
   WCU’s faculty, staff, and students together make the University’s academic mission paramount.

2. **Enrich the Total Student Experience**
   Every WCU student’s experience reinforces high standards and expectations, incorporates meaningful external engagement, and instills pride in the university.

3. **Enhance Our External Partnerships**
   WCU is recognized as an active partner within the western North Carolina region, its communities, organizations, and businesses.

4. **Invest in Our People**
   WCU is recognized as one of the most highly competitive and desirable employers in the region.

5. **Invest in Our Core Resources**
   WCU’s core infrastructure is sustainable and positioned to support its strategic priorities.

6. **Garner Support for the Vision**
   WCU develops the resources and markets the vision to ensure achievement of its strategic priorities.
In order to establish planning priorities to support the strategic plan and foster communication between the Master Planning Team, the University Community, and the Cullowhee Community, WCU established task force committees focused on key areas. These task force committees represented these focus topics:

- Integrating Community and Preserving Campus Heritage
- Space Utilization: Making the Most of What We Have
- Enhancing Parking and Transportation
- Creating a Sustainable Campus
- Improving Technology
- Safety and Security
- Millennial Initiative

Discussions with these task force committees, and input from the broader University and Cullowhee communities, resulted in a list of goals to guide the evaluative and design process of the Master Plan.

In addition to these goals, each task force committee submitted a summary report outlining specific goals for its respective focus area. These specific focus areas are addressed later in this document.

**master plan goals**

**SUPPORT** the 20/20 Vision Plan by enabling WCU’s physical resources to accommodate the goal to be a national model for student learning and engagement that embraces its responsibilities as a regionally engaged university.

**PLAN** for the long range highest and best use of the University’s land assets.

**MAXIMIZE** the value and usefulness of the existing campus infrastructure while accommodating growth.

**PLAN** sustainable transportation and infrastructure systems to anticipate growth rather than react to demand.

**PRESERVE** the unique heritage of Western Carolina and celebrate the campus as a place.

**CREATE** a walkable, highly connected, and vibrant campus.

**PRODUCE** a “living” document to allow for future revisions and alternatives, while proposing solutions based on current strategies and data.
PROCESS OVERVIEW

Data collection and research for the Master Plan commenced in the spring of 2013. Multiple cycles of analysis and options by the planning team and with input from the Steering Committee, Task Force Committees, and broader university community yielded progress updates presented to the Board of Trustees in June and October, with final approval in December of 2013.

The design team facilitated multiple on-campus workshops encompassing more than 70 meetings to gather input and feedback on WCU’s current status and future needs. These workshops included sessions with task force committees, focus groups, leadership, faculty, staff and also community open house forums. This input was combined with site analysis, observation of existing conditions and facilities, a space utilization analysis, the Academic Program Prioritization Study, and input from the Facilities Staff regarding existing utilities and infrastructure. The result was a set of findings to guide the development of the Master Plan.
The Master Plan is grounded in the physical and social context of WCU. The planning team examined the University’s physical and architectural character, environmental context, landscape, social and academic organization, pedagogy, and history. Particular attention was focused on the Millennial Initiative potential of the western campus, as well as on maximizing the potential of existing academic space.

Specific planning issues were also noted by the planning team:

- Lab space, particularly for sciences is a critical need.
- Many primary pedestrian paths currently pass through parking and vehicular areas.
- The academic core seems disconnected from the upper campus, and the connection to the library is circuitous.
- Multiple small parking lots in the campus core generate additional vehicular traffic.
- The connection between the eastern and western campus needs improvement.
- The existing steam plant is at maximum capacity and the boiler equipment is antiquated.
In order to establish the University’s space needs for the planning horizon, WCU’s 10-year enrollment projections were outlined and vetted with University leadership. These projections were refined for each College and Program based on recommendations from the Program Prioritization Study and input from the University. The 10-year enrollment projections are shown in Figure 1.1. Based on these projections, space needs were defined by space type and also by College. A summary of the planning horizon space needs are shown in Figure 1.2 and define the Program for the master plan to accommodate on the Cullowhee campus. In summary, WCU will require approximately 486,000 gross square feet of additional space to support the projected 2023 enrollment.

Once the Master Plan Program was established, the planning team outlined the existing land uses as shown in Figure 1.3 and developed long-range land uses and circulation strategies as a framework to accommodate growth. Three Land Use options were presented and vetted with the University and Community. Based on feedback, a preferred land use scenario was established and is shown in Figure 1.4.

The preferred 10-year land use scheme focuses new academic development in the existing academic core to maximize the use of existing infrastructure, enhance programmatic adjacencies, and promote a pedestrian oriented core. The land use scheme also proposes focused and opportunistic development of the western campus adjacent to the Human and Health Sciences facility, while reserving the majority of the high-sloped, forested western property as an environmental preserve. Another key feature of the land use scheme is a new campus entrance from NC 107 at Little Savannah Road to enhance access and connectivity between the eastern and western campuses.
The preferred land use scheme focuses new academic development in the existing academic core to maximize the use of existing infrastructure, enhance programmatic adjacencies, and promote a pedestrian oriented core.
CIRCULATION

A framework for pedestrian and vehicular circulation (Figure 1.5) stitches together the land use diagram and guides opportunities for creating outdoor places and activity nodes. Existing inefficient parking in the pedestrian core that conflicts with primary pedestrian movements is relocated and consolidated toward the perimeter of the walkable academic core and is linked to pedestrian paths. Perimeter parking allows daily users and visitors to easily find a parking space and walk to their building rather than weaving through campus to search for a space.

Figure 1.5 – Circulation and Framework Diagram
Proposed academic and mixed use development along Centennial Drive with enhanced pedestrian amenities and view to Moore Hall.
Figure 1.6 – Illustrative Plan

Executive Summary

Centennial Dr.
Little Savannah Rd.
PROGRAM ACCOMMODATION

Building on the framework established by the Land Use Diagram and Circulation Diagram, the Illustrative Plan (Figure 1.6) offers a vision of the future campus, addressing the space needs for enrollment while enhancing the organizational and qualitative characteristics of the campus. While the plan proposes specific footprints and square footages to accommodate projected space needs, individual building program, footprint, and location will be examined and refined as each project moves forward into design and construction. The conceptual recommendations create a framework for future growth and are driven by overarching planning principles. Overarching planning principles for Program Accommodation include:

» Maximize the use of existing building, road, and utility infrastructure where practical.

» Reorganize academic spaces to enhance efficiency, synergy, collaboration and engagement.

» Create pedestrian oriented outdoor spaces that encourage interaction, reinforce land use patterns and program adjacencies, and celebrate the beautiful, natural context of western North Carolina.

» Transition central heat generation toward a more efficient distributed model. Systematically reduce the central plant heating load.

Specific recommendations include:

A Position and unite the College of Arts and Sciences in the academic core. Create a new sciences quad with the new sciences building and Stillwell Hall.

B Consolidate Fine and Performing Arts spaces near the Fine and Performing Arts Center.

C Enhance pedestrian connectivity between the historic upper campus and the academic core. Open up the view from Centennial Drive to Moore Hall. Enhance the campus street edge along Centennial Drive and improve the east-west pedestrian flow.

D Make use of open land in the Cullowhee Creek flood plain for recreation programs and athletics field space as well as parking.

E Provide academic and partnership space opportunities adjacent to the Health and Human Sciences building on the western campus.

F Position new athletics spaces and fields proximate to existing facilities.

G Create a new campus entrance at Little Savannah Road to better connect East and West Campuses. Locate a new 1,200 car parking structure and Welcome Center near the entry.

H Enhance and strengthen the residential communities in the Upper Campus by adding a new dining facility and accommodations for 300 additional resident students.

I Remove inefficient parking and vehicular circulation from central pedestrian areas. Create new pedestrian-friendly outdoor campus spaces. Strengthen pedestrian path and connection to the library.

J Re-route Joiner Drive to connect with Central Drive to enhance transit route circulation.

K Locate new Center for Student Engagement to facilitate connection between Upper Campus and the main academic core and activate the street edge.
Proposed new campus open space with potential outdoor classroom or amphitheater and enhanced pedestrian link through Stillwell to Hunter Library. New sciences building is to the left, the new Center for Student Engagement is back right.
FUTURE FOCUS

Conceptual recommendations for the future campus create a framework for growth that are driven by overarching planning principles. Three focus areas emerged.

1. REVITALIZE THE CORE
   Focus new academic development in the existing core to maximize use of existing infrastructure, enhance programmatic adjacencies, encourage collaboration, and promote a pedestrian friendly environment.

2. ENHANCE CULLOWHEE CREEK CORRIDOR
   Utilize open land in the flood plain for recreation facilities, athletic fields and perimeter parking. Promote watershed health and ecological function through the development of a Riparian Buffer Plan.

3. CONNECT EAST AND WEST CAMPUS
   Focus near-term development around the Health and Human Sciences Building while preserving most of the steep sloping land as an environmental preserve. Create a new campus entrance to enhance the connectivity between the East and West Campus.
CHAPTER 2

FOCUS AREAS

The Master Plan proposes new construction to meet 2023 enrollment projections and renovation actions to address space quality and programmatic organization comprehensively. Each proposed building element is sited to extend and enhance the campus network of open spaces and complement existing and future program functions.
focus areas overview

Figure 2.1 – Illustrative Plan with Focus Areas
The Illustrative Plan (Figure 2.1) provides a comprehensive vision of the future campus. The Plan is guided by the proposed land use diagram and is informed by the space needs analysis. The conceptual recommendations illustrated create a framework for future growth and are driven by overarching planning principles. The overarching principles include:

- Maximize the use of existing building, road, and utility infrastructure where practical.
- Reorganize academic spaces to enhance efficiency, synergy, collaboration and engagement.
- Create pedestrian-oriented outdoor spaces that encourage interaction, reinforce land use patterns and program adjacencies, and celebrate the beautiful, natural context of western North Carolina.
- Holistically plan for infrastructure based on sustainable development strategies. Transition central heat generation toward a more efficient distributed model. Systematically reduce the central plant heating load.

The Illustrative Plan diagram proposes new construction to meet 2023 enrollment projections and renovation actions to address space quality and programmatic organization comprehensively. Each proposed building element is sited to extend and enhance the campus network of open spaces and complement existing and future program functions. However, a campus master plan is about more than siting buildings. A university’s physical character, or sense of place, results from the blending of numerous characteristics – topography, architecture, landscape, and broader geographic context, as well as its geographic relationship to its host community. These characteristics comprise the “physical DNA” that give each campus a unique personality. Combining appropriate building function with insightful placemaking is a fundamental aspect of a successful campus plan.

In order to communicate proposed actions clearly, the Illustrative Plan is divided into three focus areas: the Revitalized Core, the Cullowhee Creek Corridor, and the West Campus.
The plan reinforces the core campus area as the undergraduate academic nucleus and seeks to better link this zone to the upper campus. The proposed actions will address facility needs, enliven outdoor spaces for informal gathering, activate the campus edge along Centennial Drive, and create a pedestrian-focused, vibrant core (Figure 2.2).

RECOMMENDATIONS

A. Position and unite the College of Arts and Sciences in the academic core. Create a new sciences quad with a new sciences building and Stillwell Hall. The new sciences building (140,000 GSF) is proposed as a two-phase construction effort to allow for the vacation and demolition of the Natural Sciences building and part of Stillwell Hall. The new sciences building should include a regional boiler plant to serve this area, shedding load from the central steam plant. Create an enhanced pedestrian portal to the sciences quad from the Killian Annex area.

B. Provide a new addition (20,000 GSF) to the west side of Hunter Library to provide new collaborative study spaces, create a new façade and entry facing the courtyard, and improve circulation within the library.

C. Remove Hoey Hall and create a new open green space for a potential informal amphitheater and/or outdoor classroom space.

D. Enhance pedestrian connectivity between the historic upper campus and the academic core. Open the view from Centennial Drive to Moore Hall. Enhance the campus street edge along Centennial Drive and improve the east-west pedestrian flow. Consider didactic landscape opportunities along this corridor to address storm-water quality and quantity.

E. Remove inefficient parking and vehicular circulation from central pedestrian areas. Create new pedestrian-friendly outdoor campus spaces. Strengthen the pedestrian path and connection to the library.

F. Renovate Killian and Killian Annex for the College of Arts and Sciences.

G. Renovate Coulter Hall to provide a new “one-stop shop” for student services, IT headquarters, student health, and student activities. Consider a physical connection to the University Center.
H. Renovate Forsythe for the College of Arts and Sciences. Provide additions to the east and west sides (20,000 GSF each) to provide classroom and collaborative study space and enhance the pedestrian edge of campus along Centennial Drive. Create a new outdoor plaza space south of Forsythe to address the street. See Chapter 4’s section on Deck Shuffling for specific information regarding space relocation.

I. Locate a new Center for Student Engagement building (75,000 GSF) at the base of the hill to upper campus to embody and showcase the University’s vision to be a national leader for student learning and engagement. The building location could help facilitate pedestrian movement between upper campus and the main academic core, as well as activate the street edge facing McKee Hall and the new outdoor space. Relocate health sciences from Bird Hall to Coulter Hall and demolish Bird Hall. See Chapter 4’s section on Deck Shuffling for specific information regarding space relocation.

J. Renovate Breese Gymnasium to provide space for Graduate School & Research and Alumni Affairs and to acknowledge and celebrate the historic roots of the campus.

K. Develop a new mixed use facility in two phases with first floor retail and upper floor residential space for approximately 250 students. Single and double units will be in the Blue Ridge style.

L. Locate a new College of Business building (60,000 GSF) to frame the edge of the fountain area open space and to strengthen the architectural edge of campus along Centennial Drive.

M. Enhance and strengthen the residential communities in the upper campus by renovating Brown Hall to create a 450-seat dining facility. Reorient the loading dock of Brown Hall for easier truck access, and use the lower level to accommodate a new regional boiler facility.

N. Add an addition to Buchanan Hall for 90 students with new common spaces and elevator. Renovate Buchanan Hall.

O. Provide a new residence hall for 300 students adjacent to Brown Hall and Buchanan Hall. The new residence hall will help frame the open space east of Brown Hall and complement the Buchanan residential community.

P. Renovate Moore Hall to provide academic space for areas relocated from Belk and innovative classroom space, and to acknowledge and celebrate the historic roots of the campus. See Chapter 4’s section on Deck Shuffling for specific information regarding space relocation.

Q. Create an accessible pedestrian path linking the upper level of the Center for Student Engagement through the upper campus residential area to the Central Hall area.

R. Re-route Joiner Drive to connect with Central Drive to enhance transit route circulation.

S. Locate a new pre-engineered storage building for residence life adjacent to the facilities storage area.

T. Widen the pedestrian walkway north of the University Center to enhance this east-west pedestrian corridor. Selectively remove parking from this area to improve circulation and pedestrian safety.

U. Provide a new bike and pedestrian path connecting the campus to Cullowhee.
ARCHITECTURAL GUIDELINES

Detailed architectural, site, and landscape guidelines were established in the 1999 Campus Master Plan to improve consistency of the campus built environment. These guidelines continue to be relevant and should be referenced for new construction and renovations on campus.

As the recommendations of this master plan are implemented, new construction should positively contribute to the architectural context of the campus and reinforce the WCU identity and sense of place. This is true for buildings as well as site and landscape elements. All new development on campus should:

- Follow the building siting and open space objectives outlined in the master plan.
- Contribute to the development of pedestrian oriented exterior spaces whenever possible.
- Follow sustainable design best practices and achieve LEED requirements outlined by the University.
- Consider the existing district Floor Area Ratio range so that new development reinforces consistent district density.
- Complement existing district building heights but limit new construction to five stories above grade, unless approved by the University.
- Follow the campus materials palette guidelines with brick as the predominant building material, unless otherwise approved by the University.
Proposed new campus open space with potential outdoor classroom or amphitheater and enhanced pedestrian link through Stillwell to Hunter Library. New sciences building is to the left, the new Center for Student Engagement is back right.
Proposed academic and mixed use development along Centennial Drive with enhanced pedestrian amenities and view to Moore Hall

The images on the opposite page illustrate examples of concepts to enhance the pedestrian experience, provide collaborative outdoor spaces, and integrate sustainable landscape features.
Section through Centennial Drive looking north.

Example of vibrant mixed-use corridor at the edge of a university campus.

Example of pedestrian circulation connecting an upper and lower campus.

Example of cafe street on a university campus.

Example of integrated storm water bio-swale that helps teach students about sustainability.
the cullowhee creek corridor

Figure 2.3 – The Cullowhee Creek Corridor
The Cullowhee Creek Corridor district (Figure 2.3) comprises the western half of the current academic core, along with athletics, recreation, residential, and support spaces. This district includes the most level topography on the campus, much of which lies in the 100-year flood plain of the Cullowhee Creek. The plan seeks to maximize the use of this relatively level open land for recreation and athletics field space, as well as perimeter parking. The plan also seeks to acknowledge and celebrate the presence of this trout stream as a natural living laboratory for teaching and research, a recreational and community amenity, as well as a reminder of the natural western North Carolina context. Additionally, the plan sets up a framework for future growth and connectivity by means of a new campus entry at Little Savannah Road.

**RECOMMENDATIONS**

A. Consolidate and unite Fine and Performing Arts spaces adjacent to the Fine and Performing Arts Center. See Chapter 4’s section on Deck Shuffling for specific information regarding space relocation.

B. Provide new addition to FPAC 20,000 GSF for recital and performance spaces.

C. Provide new addition to Belk 29,000 GSF for Fine and Performing Arts spaces. Renovate Belk Hall for use by The Kimmel School and Fine and Performing Arts. Consider physical connection to the Center for Applied Technology to create contiguous space for The Kimmel School. See Chapter 4’s section on Deck Shuffling for specific information regarding space relocation.

D. Provide a new addition to Reid Hall for new collaborative classroom and study space, along with space for the College of Education. Renovate Reid Hall and consider demolition and reconstruction of gymnasium and pool spaces.

E. Make use of open land in the Cullowhee Creek flood plain for recreation programs, athletics practice field space as well as parking. Create a new recreation field space west of Norton Hall and accommodate the .47-acre designated wetland area as a natural wetland.

F. Work with authorities having jurisdiction to create a management plan for the Cullowhee Creek area on campus property. Enhance riparian buffer areas where appropriate and remove scrub invasive species, in accordance with authority approval, to open views to the creek in key viewshed locations. Prioritize the water quality and health of the creek as part of a comprehensive campus storm-water management plan.

G. Locate a new field house and indoor practice facility adjacent to the football stadium. Add a new press box and priority seating to the west stands. Enhance the north-south pedestrian path connecting the stadium area with the campus core.

H. Create a new entrance to campus from NC 107 at Little Savannah Drive. The new entry should be designed to enhance transit bus, bike, and pedestrian circulation across NC 107. The existing pedestrian bridge can remain or be modified to suit the campus entry design.

I. Locate a new 1,200-car parking structure, with associated Welcome Center and campus support space, adjacent to the new campus entry. Relocate program spaces from the Camp Complex and demolish the Camp Complex. Consider locating a regional chilled water and/or boiler facility with this parking structure. See Chapter 4’s section on Deck Shuffling for specific information regarding space relocation.
the west campus

Figure 2.4 – The West Campus
The 344 acre western campus property (Figure 2.4) comprises some of the steepest terrain and natural forest ecosystem on campus. The property currently is designated as a Millennial Property. But that status may be changed to allow development flexibility. The master plan proposes to develop areas of this property selectively, and in a sustainable manner, focusing development in limited, less steep, areas and preserving most of the forested, steep terrain as a natural environmental preserve and living laboratory. The plan proposes to take advantage of the existing infrastructure at the Health and Human Sciences building to allow expansion for appropriate academic and private partnership programs, while enhancing pedestrian, bike, and transit connections to the main campus.

**RECOMMENDATIONS**

A. Provide academic and private partnership space opportunities (120,000 GSF) adjacent to the Health and Human Sciences building to take advantage of existing utility and parking infrastructure, and allow for complementary program adjacency with HHS.

B. Enhance and maintain riparian buffer areas along creek area and tributaries.

C. Preserve steep, natural forested areas as an environmental preserve and living laboratory for teaching, research, and approved recreation (WCU Trail System).

D. Improve pedestrian and bike connectivity along Little Savannah Road.

E. Create potential location for surge space parking.

F. Create potential location for surge space parking in the near term. In the long term, consider demolition of existing faculty housing and develop mixed use or appropriate private partnership program space.

G. Identify future expansion zone for west campus academic and private partnership space.

H. The Forensic Anthropology Research Facility is an important resource on the west campus and will need to be accommodated as the West Campus is developed.
CHAPTER 3

COMMUNITY & CAMPUS HERITAGE

Western Carolina University strives to become a national model in student engagement, while honoring its regional roots to serve educational and community needs in Western North Carolina. This section outlines goals to improve accessibility to the community and increase awareness and preservation of campus heritage elements to support WCU’s regional presence.
integrating community and preserving campus heritage

Western Carolina University strives to become a national model in student engagement, while honoring its regional roots to serve educational and community needs in Western North Carolina. The University's vision statement calls for WCU to “embrace its responsibilities as a regionally engaged University.” The University established a task force for Integrating Community and Preserving Campus Heritage, which subsequently outlined goals for a Campus Master Plan to improve accessibility to the community and increase awareness and preservation of campus heritage elements to support WCU’s regional presence.

WCU has several ongoing projects that serve the community, celebrate the unique region, and preserve Western North Carolina’s Appalachian and Cherokee cultures (Figure 3.1). The Mountain Heritage Center is a museum and archive of mountain heritage artifacts. Its activities range from exhibitions and publications to educational programs and demonstrations. The Center also hosts a yearly event called “Mountain Heritage Day” that draws thousands of community members and artisans for a celebration of regional food, games, crafts, and music.

The Cullowhee campus is also the heart of the homeland of the Eastern Band of Cherokee Indians. In addition to housing interdisciplinary Cherokee Studies and language programs, WCU also runs the Cherokee Center, which was established in 1975 and serves the tribal and non-tribal residents of Cherokee, N.C. The Craft Revival Project is a Web-based digital history project through WCU’s Hunter Library Digital Programs. The project, a collaboration of seven partner institutions, details the regional Craft Revival movement, 1895–1945, through a virtual collection of documents, photographs, craft objects, and artifacts.

The Master Plan seeks to continue to support and enhance these existing programs, as well as look at other opportunities to improve connections to the community and to preserve campus heritage.
The Master Plan seeks to continue to support and enhance existing programs, as well as look at other opportunities to improve connections to the community and the preserve campus heritage.
Community members frequent the WCU campus for arts performances, athletics games, use of the Reid pool, school tours and outreach, hikes along the Creek trails, and enjoyment of the fountain plaza, in addition to programs like the Cherokee Center. Some community members move through the campus on a daily basis to get from home to work or to take their children to school. WCU strives to support local community members in their daily activities and to be a conscientious neighbor in all decision-making and campus planning. During the master planning process, several community forums were held to ensure appropriate communication with the community and to give multiple chances for input. The Master Plan recommendations support community interactions and include opportunities to improve public access to the great resources that WCU can provide (Figure 3.2).

**TASK FORCE GOALS**

- More collaboration between University and outside entities
- Improved communication with the community, particularly raising awareness of events, and campus resources
- A user-friendly campus that is more accessible to the public, providing social events and attractive facilities
- A campus that is an obvious and visible presence in Jackson County and supports county planning efforts, when possible

**STRATEGIC INITIATIVES**

- Initiative 2.2.4: Provide every student with an opportunity to participate in student-led outreach projects that focus on civic engagement. (See Initiative 2.1.5)
- Initiative 2.3.5: Ensure that University events are consistently well-advertised to external audiences.
- Initiative 5.5.4: Sustain and enhance partnerships (e.g., mutual aid agreements, EMS service provision, etc.) with local governments, regional public safety agencies, and health organizations in support of campus and community safety priorities.

"Honoring the history of community investment in this University is a critical part of the story of our campus."
—Community Task Force Report
MASTER PLAN RECOMMENDATIONS

- New parking garage and entrance to create convenient access for visitors and commuters
- Metered parking in the core – reliable and convenient parking for core campus community needs
- Wayfinding and signage to better communicate and locations that visitors and community access frequently, including visitor parking
- Improved pedestrian connectivity on campus and with Cullowhee. This would include improved walking conditions to draw the community to recreational creek or river trails, convenient and pleasant walking to campus food and retail outlets and convenient access to the Cullowhee Riverfront (new pedestrian connection to Old Cullowhee)
- New visitor’s center/ welcome center at the parking deck, creating a one-stop check in for visitor information
- New athletics facilities
- A consolidated area for the arts, convenient to the new entrance and parking garage
- Improved roads, intersections and parking to help with school and bus access for visiting students and conferences
- Alumni space in Breese – use of a historic building for alumni lounge space to create an alumni “home” on campus
- Mixed-use development to enhance facilities for on-campus retail partners and create more dining options for the Cullowhee community
In 1888 the residents of the village of Cullowhee organized a board of trustees and established a community school that came to be known as Cullowhee Academy. This marked the beginning of a journey of transition and development of the school to become what is now Western Carolina University. Founded in 1889 as a semi-public secondary school and chartered in 1891 as Cullowhee High School, it served the Cullowhee community and boarding students from neighboring counties and states in Appalachia. The vision of the founder, Robert Lee Madison, was to provide education in the region and to train teachers to spread education throughout the western part of the state.

Led by local Jackson county representative Walter E. Moore in 1893, the North Carolina Legislature authorized appropriation for the establishment of a normal department at the school for the purpose of training teachers, a designation that became the first publicly funded normal school in North Carolina.

Early Years
In 1903, the school began its campus and built its first substantial edifice, the original Madison Building located on the hillside site of an ancient Cherokee Indian village. This multipurpose structure housed classrooms, administrative offices, and an auditorium. It was also the first building to be constructed with funding from the state of North Carolina. This marked the physical beginnings of the institutions community focus, commitment to and preservation of the rich traditions and heritage of the Southern Appalachian people. The school’s name was changed to Cullowhee Normal & Industrial School after the state assumed title to the school’s buildings and property and made it a state institution in 1905. In 1910, the first all-Women’s Dormitory, known as the Davies Home was built on the present day site of Reynolds Hall and also provided dining facilities for all students.

In 1913, Cullowhee transformed itself from a high school to a junior college program and the first college-level (one-year) degree was awarded. The hillside campus continued to grow and the Joyner Building replaced Madison as the center of the growing school with the inclusion of the Woodland Theater between the two buildings. Joyner contained almost all the classrooms as well as administrative offices and an auditorium until the next significant phase of campus expansion in the 1930’s. The Joyner Building was unfortunately destroyed by fire in 1981 and is held in remembrance today by Joyner Plaza which was built on the site of the former building.

The Walter E. Moore dormitory for women, Moore Hall, was designed and constructed in 1924 adjacent to the Joyner Building complementing the Colonial Revival architectural style of Joyner. Architect G. Murray Nelson employed Beaux-Arts form, Italianate details, arches and a pitched hip shingle roof form in the neo-colonial design of Moore, further expanding and defining the architectural character of the campus. The steam plant building, still in service today, followed and now shares the distinction with Moore as the oldest buildings remaining on campus. Large brick arches and well-proportioned arched windows are significant elements in the steam plant building design that began a cohesive architectural expression of the original campus buildings. The brick and stone materials and arch form detailing of these buildings set a precedent that was followed in later building designs and established an architectural fabric and character of brick structures evident on the campus today.
In 1925, the school created a four-year Bachelor of Science degree program and became a coeducational institution. The name was changed to Cullowhee State Normal School and the stated purpose of the school was to train teachers for the North Carolina public schools.

Over the course of the school’s first forty years of history, the school expanded its curriculum and in 1929 it was chartered by the Legislature as a four-year institution under the name Western Carolina Teachers College. In 1931 the first Baccalaureate degree was awarded and the 1930’s saw the advent of the first period of rapid building in Western’s history. At the beginning of the decade, the school consisted of four scholastic buildings and one physical plant that provided heat and power.

**Becoming a Modern Campus**

By 1939, the campus was beginning to evolve into its present state. Hoey Auditorium, the McKee Building, Breese Gym, the current Madison Hall, Graham Infirmary as well as a football field and a separate baseball field were all added during this time. The campus expansion moved downward toward the valley.

Demand for both liberal arts and other programs at the College led to a further needed expansion of educational offerings and buildings. Post graduate studies were added to the curriculum in 1951 and the first Master’s degree awarded in 1952. In 1953, the name “Western Carolina College” was adopted.

The next significant phase of campus development occurred during the 1950’s. By 1952 both the Stillwell Building and Hunter Library had been constructed. Both have been expanded and physically connected in later years. Western’s original football stadium was located behind Stillwell and the library and received continuous improvements during this time. The last major addition to Western’s campus during this time was Reid Gym, which opened in 1957. Located across the baseball field from McKee and Hoey, Reid marked the geographical direction the University’s planners were continuing to take in moving the educational institution down the hill, to develop the valley. In 1967, the institution was designated a regional university and given its current title, “Western Carolina University” – WCU. The University became a member of the University of North Carolina system in 1972.

Most of what is the current Western Carolina University campus was built between 1955 and the present. As the campus center moved, academic, administrative, recreational and social buildings were constructed. Many of these were added in the 1960’s and 1970’s. The HFR Administration Building was built in 1979 at the main entrance to the campus and houses the Mountain Heritage Center, a museum for the rich traditions and artifacts of both the Appalachian and Cherokee cultures. The 1980’s saw the expansion of WCU athletics and sports facilities with the construction of the Ramsey Regional Activity Center in 1986. The main campus has evolved and grown to offer both the culture and amenities of a small town. The campus center is now the campus commons adjacent to the University Center building and is marked by the campus icon, the Alumni Tower, built in 1989, on the 100th birthday of the University.

Today, Western Carolina University is a major educational, scientific and cultural force, serving the community of Cullowhee and more than 10,000 students. Campus student residences are comprised of thirteen residential buildings, including one for graduate students and one for married students. Academic programs span more than 220 undergraduate areas of study and over 40 graduate study programs.
Western Carolina University has a rich campus heritage that includes not only historic campus features such as Moore Hall, or the original steam plant building, but also less obvious heritage features such as Cullowhee Creek, the Woodland Stage, and Native American archeological sites. While the University has not always prioritized the preservation and expression of these resources, the Master Plan provides an opportunity to preserve, acknowledge and share this heritage more fully. Master Plan recommendations identify opportunities to give new life to old features and enhance their value and visibility to the University and the region.

**EXISTING HERITAGE FEATURES**

- West Campus archeological sites near HHS
- Native American Homestead site near Ramsey Regional Activities Center
- Native American archeological mount near Killian and McKee
- Madison Memorial – marking the site of the two first buildings on campus
- Joyner Memorial – commemorating a historic building that was destroyed in a fire
- Memorial Tree Plantings – trees planted in honor of students and faculty at WCU
- Historic Woodland Theater – beautiful and unique feature of the historic upper campus
- Old Student Union – valuable historical architectural character
- Moore – oldest building on campus, architectural significance, crown of the hill
- McKee – former teaching school
- Breese – historically and architecturally significant stone building
- Mountain Heritage Center and site of Mountain Heritage Day
- Settlers Cabin – 17th century log cabin moved to a site on campus from another location
- Cullowhee Creek
- Tuckaseigee River
Master Plan recommendations identify opportunities to give new life to old features and enhance their value and visibility to the University and the region.
TASK FORCE GOALS

- Emphasize education and interpretation of the past to improve preservation of resources
- Use outdoor signage, art, installations, exhibits and virtual means to inform
- Capitalize on the 125th anniversary in 2014 to develop programs and recognize the rich educational resources
- Increase awareness of campus resources, protect them for the future, interpret them, and find creative ways to disseminate that information.

STRATEGIC INITIATIVES

- Initiative 1.1.2: Position and market WCU as the cultural heart of Western North Carolina in the creative arts
- Initiative 2.3.2: Create and sustain campus traditions that strengthen students' connection to their University and its surrounding communities.
- Initiative 2.3.3: Build and sustain consistent celebrations of Cherokee history, culture, and traditions.
MASTER PLAN RECOMMENDATIONS

- Enhance connections to and visibility of the historic upper campus; open up a view corridor to Moore Hall
- Use native plants and responsible landscaping to preserve natural campus character and its unique and beautiful regional setting
- Pursue arboretum status of the upper campus to preserve character and enhance educational opportunities for students and the community
- Save and repurpose Moore, Breese, Student Union, and the Woodland Stage. Provide an accessible path to the Historic Woodland theater to allow more use
- Create signage and acknowledgement of historic and culturally significant campus sites
- Support the development of the Jackson County Greenway and make a connection to this community resource when possible
- Pursue opportunities to enhance and preserve Cullowhee Creek as a unique campus resource for teaching and recreation
CHAPTER 4
SPACE UTILIZATION
Making the Most of What We Have

The efficient and effective use of instructional space is critical for any institution, particularly in a climate of declining funds for capital expenditures. When the need for new types of spaces develops, universities must prioritize efficient use of current resources. A utilization study of instructional space was conducted as a part of the Master Plan process. In addition, the team conducted a space needs analysis.
Western Carolina University is planning for growth of 37 percent in face-to-face students by 2023. In fall 2012 the University had 8,841 face-to-face full time equivalent students (FTE). In 2023, WCU expects 12,086 FTE.

The University created a Program Prioritization Task Force to address the challenge of 2020 Vision Strategic Direction 1: To serve the educational needs of its students, state, and region. In June 2013, the Task Force issued the Program Prioritization Task Force Final Report.

The Report and enrollment history from 2007-2012 were applied to the 37 percent growth appropriately across all departments (Figure 4.2). The following adjusted percentages were applied to the slow-, average-, and fast-growth programs between 2012 and 2023:

- Slow Growth Programs: 25 percent
- Average Growth Programs: 37 percent
- Fast Growth Programs: 41 percent

The result shows that the College of Arts and Sciences will contribute 42 percent of the entire campus FTE growth 2012-2023 (Figure 4.1).

### Table: College FTE Growth

<table>
<thead>
<tr>
<th>College</th>
<th>Projected FTE Growth 2012-2023</th>
<th>Percent of total FTE growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>College of Arts and Sciences</td>
<td>1,490</td>
<td>42%</td>
</tr>
<tr>
<td>College of Health and Human Sciences</td>
<td>418</td>
<td>13%</td>
</tr>
<tr>
<td>College of Education and Allied Professions</td>
<td>491</td>
<td>15%</td>
</tr>
<tr>
<td>College of Business</td>
<td>449</td>
<td>14%</td>
</tr>
<tr>
<td>College of Fine and Performing Art</td>
<td>308</td>
<td>9%</td>
</tr>
<tr>
<td>The Kimmel School</td>
<td>89</td>
<td>3%</td>
</tr>
</tbody>
</table>

Figure 4.1 – Projected FTE Growth by College

Program growth projections based on Program Prioritization Task Force Final Report (June, 2013) and meeting with WCU Interim Provost.
SUMMARY OF CURRENT SPACE USE

The data received from the University, specifically the course schedule and the Physical Space Inventory (PSI), are the basis of the space analysis process. The portion of Western Carolina University’s Cullowhee Campus considered to be “net assignable square footage” (NASF) for this study equals 1,928,344 NASF (Figure 4.3). This space excludes the Highland Biological Station, athletic outbuildings, inactive space, miscellaneous storage buildings, and guest housing.

Figure 4.4 illustrates the credit hours generated by each college at WCU and the NASF of non-instructional space dedicated to each College. Instructional space is not included, since general classrooms are not dedicated to departments. Conversely, class labs must be dedicated to departments – regardless of efficiency – in order to offer specialized programs. The College of Arts and Sciences is both the largest generator of credit hours and has the largest amount of dedicated space.

The State of North Carolina Higher Education Comprehensive Planning Program issues an annual Facilities Inventory and Utilization Study. The following comparisons of WCU to its peers are derived from data in the 2012 report (issued in September 2013). The State of North Carolina Facilities Inventory and Utilization Study accounted for the entire Cullowhee campus (without excluding any buildings), so the NASF used for comparison to peers was 2,025,181. These graphs only represent on-campus space and face-to-face enrollment.

Figure 4.5 illustrates WCU’s capacity compared to its enrollment. Capacity is the quantity of NASF of instructional and library space, and enrollment is weekly student clock hours. The lower the ratio, the more efficient the institution is with its space. WCU’s ratio is near the average of its peer North Carolina comprehensive universities; the ratio for WCU has gone down since 2008 when it was close to five.

1 NSF excludes offline buildings, athletic outbuildings associated with fields, and guest housing.
2 Weekly student clock hours = (Number of class meetings per week) x (duration of class meeting) x (class enrollment)
The Health Sciences Building opened in academic year 2012-2013, and the Capacity/Enrollment ratio at WCU went up to 4.5 from 4.43 in 2011-2012. With any new building, there is an expected gap in time until the space is fully utilized.

Figure 4.6 displays the percentage of total instruction space on the WCU campus compared to its peers. At WCU, instructional space made up 23.6 percent of the campus in 2012. WCU has about the same percentage of instructional space as UNC Wilmington, but Wilmington’s capacity to enrollment ratio is much lower. In fact, Wilmington had about 13,500 NASF less instruction space in 2012 than WCU did, but they offered 56,679 more student clock hours. Wilmington offered more instruction in less space – or used its space more efficiently – than WCU.

As displayed in Figure 4.7, WCU dedicated 1.5 percent of its total space, about 30,400 NASF, to research in 2012. That is below the average of 2.1 percent. Recognizing that WCU has a strategic goal to increase its funded research by 50 percent by 2023, this could suggest that more space be dedicated to research in the future.

Figure 4.8 shows space assigned to public service for the specific purpose of responding to a community need or solving a community problem. UNC Wilmington assigned over 29,500 SF to public service where WCU was just over 4,000. This could be attributed in part to space categorizing, but in terms of percentage of overall space, WCU assigned only 0.2 percent of its space to public service in 2012. Increasing community outreach is a goal set out in 2020 Vision and ranked very high in the faculty workshop prioritization exercise; this suggests that more space should be dedicated to this purpose.

Academic Support is any activity in direct support of instruction, research or public service. Figure 4.9 shows that WCU has a higher percentage of space dedicated to academic support than the average of its peers in the North Carolina system. This might suggest that, if existing academic
support space is used effectively, it is possible to achieve the 2020 Vision goals related to student success and retention without dedicating more academic support space to these functions.

Student Services refers to space dedicated to programs that contribute to students’ emotional and physical well-being and their intellectual, cultural, and social development outside of formal instruction. Figure 4.10 shows WCU to be on par with its North Carolina peers in terms of the percentage of space dedicated to student services. Since student housing falls into this category, student services makes up about half of the total NASF on many campuses.

In the Institutional Administration category, WCU was slightly above average among its peers. In general, administration space becomes more efficient as an institution grows because there is an economy of scale; a university can add more academic space without adding an equal percentage of administration space. However, as shown in Figure 4.11, Fayetteville (which is the smallest institution in the group by NASF) had the smallest percentage of administration space, which is counter intuitive. If Fayetteville was excluded from the set, the average would be 6.82 percent, which is very comparable to WCU’s 7.1 percent.
space utilization and space needs analysis

INTRODUCTION
The process for the WCU space needs analysis for the Cullowhee Campus included two main tasks: data collection and analysis, and future space recommendations.

Interviews and Workshops
In March and April of 2013, meetings and workshops were held with the Master Plan Steering Committee, Space Utilization Task Force, student groups, and faculty. In addition, the planning team interviewed department heads, University staff, and administration to gather information. The interviews and workshops were valuable parts of the process.

Data Collection and Analysis
During the same time period, the team gathered data from the University relating to students, buildings, and employees. The data were compared to WCU’s peers, North Carolina standards and national higher education planning rules of thumb.

Drivers and Goals
WCU provided the master planning team with a road map: its Strategic Plan, called 2020 Vision. While every strategic direction does not relate specifically to space planning, the six strategic directions outlined in 2020 Vision provide criteria for the success of planning concepts:

1. Fulfill the educational needs of our state and region.
2. Enrich the total student experience.
3. Enhance our external partnerships.
4. Invest in our people.
5. Invest in our core resources.
6. Garner support for the vision.

DATA SOURCES
Information collected from WCU:
- WCU 2020 Vision
- Space Utilization Task Force Report
- Space Management and Assignment Policy (2010 draft)
- Previous Reports/Studies
- Physical Space Inventory 2013
- Faculty and Staff lists – Spring 2013
- Existing Floor Plans
- Fall 2012 Course Schedule
- Enrollment Data – Fall 2007 - Fall 2012
- Program Prioritization Task Force Final Report (June 2013)

Insights were also gained through:
- Space Needs Interviews
- Student Workshops
- Faculty Workshops
- Building Walk-throughs
- Peer Data

Space calculations were based on:
- University of North Carolina Facilities Inventory and Utilization Study, 2011 (used as basis for determining space factors for WCU)
- University of North Carolina Facilities Inventory and Utilization Study, 2012 (released in September 2013 and used for comparison of WCU to peer universities)
- CEFPI space planning guidelines for Higher Education
- Consultants’ professional experience

REPORTED SPACE NEEDS

Interviews and Workshops

The team conducted meetings with administrators, deans and department heads to learn about university-wide, college, and department space needs. Below is a list of preliminary questions to trigger discussion and facilitate conversation. The interviews were not limited to these topics.

1. How are enrollments in existing programs and courses anticipated to change over the next five to 10 years?

2. Describe any innovative institutional or departmental changes that will affect space usage or needs in your area. Include course revisions that change mode of instruction, such as the addition of labs or specialized instructional/study space, or the migration to on-line or hybrid course delivery.

3. How could current program and/or department adjacencies be improved to support interdisciplinary collaboration? What departments or divisions do you currently collaborate with or wish to collaborate with in the future?

4. What is the ideal class size for your area and why?

5. Are there current technological challenges that limit your ability to teach the way you would prefer (e.g., collaborative or experiential modes of teaching)? If so, where? How will technology impact your future instructional space needs?

6. What percent of your undergraduate and graduate students participate in research? Will that change in the future?

7. What is your division’s policy for providing office space for full-time, part-time and adjunct faculty? Are there facilities issues associated with your office and support space? Identify any full- and part-time individuals in your area who do not have adequate or appropriate office space. Identify any surplus space that could be put to better use.

8. Identify, in your estimation, college-wide space needs and issues. From your perspective, what are the most pressing facilities issues?

From the team’s initial RFP response: “The process will start to build constituent ownership in the plan by giving the campus community an opportunity for input. Through these meetings, themes will start to develop as planning drivers which will then inform the analysis.”

Across all interviews, surveys, and workshops, the following key points were repeated by nearly every group:

- Many Schools and Colleges felt their space lacks identity and that students and faculty do not have appropriate space to interact and collaborate.

- Research space (quality and quantity) must be improved if WCU intends to increase funded research.

- Full-time faculty office space is generally adequate but disparate locations do not contribute positively to collaboration and collegiality. There is not a sufficient amount of office space for adjunct faculty in many programs.

- Interdisciplinary project-based learning would be more common if space was available.

- The University needs a centralized testing center for proctored exams, especially for Blackboard tests. It could be used for GMAT and other tests, and could be a source of revenue.

- The physical conditions within many older buildings detract from the quality of a WCU education. These conditions include poorly functioning building systems, outdated or worn finishes, and inappropriate furnishings.

- There is wide recognition (by non-science disciplines) that additional/upgraded science labs are needed.
• There is great affection for Moore Hall, Breese Gymnasium, and the historic Upper Campus. People want to retain this important part of WCU’s heritage.

• Some programs and colleges already feel “maxed out;” there is concern for how WCU will accommodate additional enrollment growth without more physical and financial resources.

• The Faculty Commons would get better utilization if it were more centrally located.

• The Admissions office does not deliver a positive first impression of WCU due to its location, look, and lack of amenities.

• Classrooms (and some labs) are generally too small for section sizes and flexible teaching/learning, especially with need to accommodate larger course section sizes as enrollment increases. Eleven department heads responded that they would offer larger course sections if larger classrooms were available.

• Faculty members asked specifically for modern instruction and communication technology, updated lighting, and acoustical upgrades. A pedagogy and technology survey conducted by the Sextant Group revealed that 80 percent of WCU faculty respondents said that the design of learning spaces informs their pedagogical choices.

• One of the most valued qualities in teaching space is its proximity to departmental offices and shared resources.

• Instructors appreciate windows in the classrooms, but daylight control is necessary.

• The Millennial Campus is an opportunity for public/private investment, but there are challenges such as funding, regulations, and limitations on how revenue from Millennial Campus can be spent. In addition, it will be a challenge to integrate it with the rest of the campus.

In addition to the general points above, each group expressed its own unique needs. The complete interview report is included in Appendix A.

Concurrent with the WCU master planning process, staff from the Hunter Library worked with McMillan Pazdan Smith Architecture to evaluate Hunter Library and develop an understanding of goals and needs. The resulting Hunter Library Master Plan is another input in to the WCUMaster Plan.
instruction space utilization

**SPACE UTILIZATION TARGET CRITERIA**

There are three variables in the space utilization equation: the square footage per student station in each room; the percentage of available hours a room is scheduled; and the percentage of seats filled when a room is in use. A change in any one of these variables has an effect on the utilization of the space.

**Square Footage per Student Station** – The amount of space provided for each student workstation in an instruction space. The square footage per student station should be adequate for the student, the student’s possessions (books, bags, and coats), the instructor, and circulation.

**Room Utilization** – The number of hours an instruction space should be in use during an instructional week.

**Seat Occupancy** – The percentage of seats that should be filled in an instruction space when a course meeting is in session.

The target criteria in Figure 4.12 were used for this study to determine whether a room was being used efficiently.

The same three factors that influence efficient instruction space also affect the teaching and learning experience.

**Square Footage per Student Station** – Although a smaller area per station may be sufficient for lecture-style instruction, it is not appropriate for peer-to-peer learning or collaborative instruction. An area between 20 and 25 square feet per student station is more supportive of modern pedagogies.

**Room Utilization** – The number of hours a space is scheduled indicates whether there is a capacity to add or a need to reduce course meetings. However, the number of hours a space is scheduled is also affected by campus logistics. For example, the distance students and faculty must travel and campus topography are factors that affect how many course meetings can be scheduled in a day. In addition, factors such as instructional technology, acoustics, lighting, and thermal comfort influence the popularity of a space. Popular classrooms are often very well utilized.

**Seat Occupancy** – The seating occupancy of a space, combined with the square footage per student station, can have a big impact on students’ experience in a space. For example, if a classroom has 30 stations at 18 square feet each, and 25 stations are occupied, then the room will feel crowded with students’ book bags and coats.

<table>
<thead>
<tr>
<th>Planning Factor</th>
<th>North Carolina System</th>
<th>Council of Educational Facility Planners International (CEFPI)</th>
<th>Used for WCU 2023</th>
</tr>
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<tbody>
<tr>
<td>Classroom Station Occupancy Rate Target</td>
<td>65%</td>
<td>60%</td>
<td>65%</td>
</tr>
<tr>
<td>Teaching Lab Station Occupancy Rate Target</td>
<td>70%</td>
<td>80%</td>
<td>70%</td>
</tr>
<tr>
<td>Classroom hours of instruction per week</td>
<td>88% 35 hours/week</td>
<td>67.5% 27 hours/week</td>
<td>75% 30 hours/week</td>
</tr>
<tr>
<td>Teaching Lab hours of instruction per week</td>
<td>50% 20 hours/week</td>
<td>50% 20 hours/week</td>
<td>50% 20 hours/week</td>
</tr>
<tr>
<td>Classroom SF/Station</td>
<td>18 sf/station</td>
<td>18-24 sf/station</td>
<td>22 sf/station</td>
</tr>
<tr>
<td>Teaching Lab SF/Station</td>
<td>Varies by lab type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Classroom Space Factor (lower means more efficient)</td>
<td>0.79</td>
<td>0.96-1.11</td>
<td>1.04</td>
</tr>
<tr>
<td>Teaching Lab Space Factor</td>
<td>Varies by lab type</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Figure 4.12 – Target Space Planning Standards*
HOURLY UTILIZATION OF INSTRUCTION SPACE

In general, instruction space at WCU could be used more efficiently. There is sufficient capacity for WCU to accommodate enrollment growth in its existing space while modernization and new construction take place. In response to interview comments indicating a need for larger classrooms, the most-favored teaching spaces were analyzed in detail. The findings revealed that larger classrooms with flexible furnishings and good instructional technology were filled at- or over-capacity for more hours than other general instruction classrooms.

Appendix A includes hourly utilization charts for WCU’s instructional buildings. Figures 4.13 and 4.14 at right are examples of how hourly utilization results show opportunities to optimize efficiency.

The red line for classrooms shows the North Carolina room use target of 88 percent, or 35 hours out of a 40 hour week, which is the most stringent of the targets. The nationally accepted guideline is less at 67.5 percent, or 27 hours per week. For WCU a target of 75.5 percent, or 30 hours per week, was used. This held WCU at the same hourly use the University achieved in 2011.

For teaching labs the North Carolina room use target is 50 percent, or 20 hours out of a 40 hour week. The national target is 60 percent. Hourly utilization targets are lower for teaching labs than for classrooms because students need access to labs after hours for experiments and practice. In addition, faculty need time between classes for setting up and taking down experiments.

The Belk Building is shown as an example. Belk classrooms are in use roughly half as many hours as the North Carolina target. Belk class labs could increase hourly use by about 15% to 25%, depending on which target standard is used. Because Belk is far from the academic core, its efficiency could be increased if complementary departments were located nearer to one another. This would reduce travel time to reach classes, meaning that more hours could be scheduled in each academic building.

Buildings that showed classroom hourly utilization near targets were Reid, Forsyth, Killian, and McKee. Stillwell was well above the targets, indicating that it is used for more hours per week than any other building on campus. Belk and Natural Science showed the poorest utilization of classrooms. Analysis of the Health and Human Sciences Building (HHSB) indicates that there is plenty of additional hourly capacity, as would be expected in a new building.

Class lab utilization for most buildings was well under the targets. The exceptions were Natural Science, Coulter, and Stillwell; all three showed hourly utilization near or above targets. The departments using those spaces were primarily Biology, Chemistry & Physics, and School of Music, indicating a possible need for additional lab space.
Figure 4.13 – Example (Classrooms, Teaching Labs)

Percent of Hours used by Department (Classrooms)

Figure 4.14 – Belk (Classrooms, Teaching Labs)

Percent of Hours used by Department (Teaching Labs)
SEAT FILL OF INSTRUCTION SPACE

The following two tables (Figure 4.15 and Figure 4.16) illustrate the degree to which class size correlated to room size. Green highlighting indicates the number of course meetings where the class enrollment was appropriate for the room size, meaning there was a good match between the number of students enrolled and the seating capacity of the room in which the course was scheduled. Light green highlighting indicates the number of course meetings that were scheduled in rooms that were marginally larger than the class enrollment but within an appropriate range. Red cells show the number of course meetings that occurred in rooms that were significantly larger or smaller than the enrollment.

Of the 2,285 scheduled course meetings (courses that ran the full semester) in classrooms in which seat data was available, 69 percent of the courses were scheduled in classrooms appropriate for the enrollment or within an appropriate size. A total of 31 percent of classes were scheduled in rooms that were significantly larger or smaller than class enrollment. Of the 740 course meetings held in class labs in which seat data was available, 71 percent of the course meetings were scheduled in rooms that were appropriate for the enrollment or within an appropriate range. Only 29 percent were held in rooms that were significantly larger or smaller than the class size.

Figures 15 illustrates how the weekly course meetings fit into the instruction spaces during the study week. In fall 2012, 161 classrooms were used. By examining the 31 to 40 seat category for classrooms, the following conclusions can be drawn:

- 628 course meetings, or 27 percent of the total course meetings, enrolled 31 to 40 students.
- 325 of them were in appropriately sized rooms and 244 of them were in rooms that were within an appropriate range; 91 percent of the rooms were appropriately matched to the enrollment.
- Eight course meetings were held in rooms that were too small. 51 were held in rooms that were much too big, totaling nine percent.
- Figure 15 displays that there were far more courses held in rooms that were too big than were held in rooms that were too small. The analysis of course meetings in class labs (Figure 16) showed that 86 (or 25 percent) of the 344 course meetings with 11 to 20 students were held in labs that were too big.

This suggests that there is adequate capacity with WCU’s current classroom and class lab inventory to accommodate increased enrollment through larger section sizes and/or resizing of instruction spaces. A variety of classroom sizes and configurations will help meet the needs of different enrollments, instructional technologies, teaching methods, and learning methods.
### Scheduled Class Size (Enrollment)

#### Classroom Seating Capacity

<table>
<thead>
<tr>
<th>Room Count</th>
<th>1 to 10</th>
<th>11 to 20</th>
<th>21 to 30</th>
<th>31 to 40</th>
<th>41 to 50</th>
<th>51 to 60</th>
<th>61 to 70</th>
<th>71 to 80</th>
<th>91 to 100</th>
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<tr>
<td>1 to 10</td>
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<td></td>
</tr>
<tr>
<td>11 to 20</td>
<td>2</td>
<td>6</td>
<td>8</td>
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<tr>
<td>21 to 30</td>
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<td>31 to 40</td>
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<td>51 to 60</td>
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<td>81 to 90</td>
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<td></td>
<td></td>
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Total Course Meetings: 1,285

#### Scheduled Class Size (Enrollment)

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<th>41 to 50</th>
<th>51 to 60</th>
<th>61 to 70</th>
<th>71 to 80</th>
<th>91 to 100</th>
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</table>

Total Course Meetings: 2,285

---

**Figure 4.15 – Classroom Seating Capacity**

**Figure 4.16 – Teaching Lab Seating Capacity**
Figures 4.17 and 4.18 illustrate how seat fill and hourly utilization apply to an individual space using the fall 2012 course schedule.

- Forsyth 329 has a capacity of 63 students and a seat fill average of 43 students in fall 2012. This represents 68 percent seat fill. The North Carolina target is 65 percent; a seat fill rate of 37 to 47 students would fall within an acceptable range of this target.

- Forsyth 329 was scheduled for 23.3 hours during the study week. However, the national target is 27 hours and the North Carolina target is 35 hours. Used at its target efficiency, 47 seats would be occupied and the room would be in use 35 hours per week.

Forsyth 329 is adequately filled or above its target for seven of 10 courses. There is time available for more course meetings to relieve crowding in its most highly filled sections. If the three largest sections were split in two, the new sections would add 5.83 hours to the weekly hourly utilization for a total of 29.1 hours, which is between the national standard and the North Carolina target. The six class sections would all be low in seat fill, but there would be capacity to increase enrollment by about 20 students in each section, or 120 students total. Used at North Carolina target rates for all course sections, Forsyth 329 could accommodate 200 additional students per week. This type of schedule fine-tuning will help WCU continue to grow in FTE while campus improvements are taking place.
SPACE PROJECTIONS
The analysis of current and projected space needs for Western Carolina University (2012 through 2023) is based on North Carolina space guidelines unless otherwise noted. Spaces are categorized according to Higher Education General Information Survey (HEGIS) categories.

Space Projection Data Assumptions
• Projections were organized by space use code from the Physical Space Inventory (PSI).
• Projections were broken down by College and Department for teaching labs, research space, and offices.
• Existing area (NASF) and space use code (HEGIS) for 2012/2013 came from the PSI.

Classrooms (HEGIS category 100)
Classroom space (110) is defined as a room or space used primarily for instruction that is not tied to a specific subject or discipline by equipment in the room or the configuration of the space. This includes rooms or spaces generally used for scheduled instruction that require no special, restrictive equipment or configuration. These spaces may be called lecture rooms, lecture-demonstration rooms, seminar rooms, and general purpose classrooms. Included are service rooms (115), space that directly serves one or more classrooms as an extension of the activities in that space. Spaces may include rooms such as projection rooms, cloakrooms, preparation rooms, closets and storage.
• WCU will need just over 21,000 NASF of additional classroom space for 2023, including service space.

Laboratories (HEGIS category 200)
Laboratory facilities can be subdivided into three categories: class, open, and research/nonclass laboratory. A class lab is used for scheduled instruction. An open lab supports instruction but is not formally scheduled. A research/nonclass lab is used for research, experimentation, observation, research training, or structured creative activity that supports an extension of a field of knowledge.

Each category includes service rooms, space that directly serves one or more class laboratories as an extension of the activities in that space. Spaces may include rooms such as projection rooms, coat rooms, preparation rooms, material storage, dark rooms, closets, etc. Not included are animal facilities, greenhouses, or central services.
• The overall projection for the laboratories category (200) at WCU shows a deficit of over 80,000 NASF, or a need for 56 percent more laboratory space. The need for open labs (220) is a 75 percent increase over the existing space.

Class Laboratories (Teaching Labs - HEGIS category 210)
Class/Teaching Lab space is defined as a space used primarily for formally or regularly scheduled instruction that require special purpose equipment or a specific space configuration for student participation, experimentation, observation, or practices in an academic discipline.
• The projected need in this category is 44,854 additional NASF in 2023.
Open Labs (HEGIS category 220)

Open Lab space is defined as a laboratory used primarily for individual or group instruction that is informally scheduled, unscheduled, or open. An open lab is designed for or furnished with equipment that serves the needs of particular discipline or discipline group for individual or group instruction where use of the space is not formally or regularly scheduled, or access is limited to specific groups of students. Included in this category are spaces generally called music practice rooms, language laboratories used for individualized instruction, studios for individualized instruction, special or learning laboratories if discipline restrictive, and computer laboratories involving specialized restrictive software or where access is limited to specific categories of students.

- WCU will need 31,203 additional NASF in category 220 in 2023.

Research Laboratories (HEGIS category 250)

Research/nonclass lab space is defined as a space used for laboratory experimentation, research, or training in research methods; professional research and observation; or structured creative activity within a specific program or for sponsored research. A research/nonclass lab is designed or equipped for faculty, staff, and students for the conduct of research and controlled or structured creative activities. These activities are generally confined to faculty, staff, and assigned graduate students and are applicable to any academic discipline.

- The Strategic Plan calls for a 50 percent increase in research at WCU. In 2011, the University engaged in roughly $6 million in research. A 50 percent increase would yield $9 million in research. The existing 36,000 NASF coded for research is adequate to accommodate the University’s current research according to CEFPI guidelines. However, considering the strategic goal, WCU will need 5,000 additional NASF in category 250 in 2023 is recommended.
**Offices (HEGIS category 300)**

Office space (310) is defined as a space housing faculty, staff, or students working at one or more desks, tables, or workstations. Included are faculty, administrative, clerical, graduate and teaching assistant, and student offices. Office service space (315) directly serves an office or group of offices as an extension of the activities in those spaces. This category includes all offices (administrations and academic/faculty).

- With a surplus of over 10,000 NASF in this category, there appears to be more than enough space to carry WCU forward to 2023. The North Carolina standards are very generous. The national trend is toward less space per person, so WCU’s actual need is likely even less. While the University as a whole has a surplus of office space, it is not true of every College. The College of Business, College of Education & Allied Professions, and College of Health & Human Sciences all show deficits in office space.

**Study Space (HEGIS category 400)**

Study Space is classified into five categories: study room (410), stack (420), open-stack study room (430), processing room (440), and study service (455). Offices used for library activities are coded as office facilities. A study space may contain equipment or materials that aid the study or learning process and that do not restrict the space to a particular academic discipline or discipline group. Study service space is defined as a space that directly serves study spaces, stacks, open-stack study spaces, or processing rooms as a direct extension of the activities in those spaces.

- Study space and related service is also showing a substantial deficit in 2023 of 22,864 NASF, which supports the notion of creating study/collaborative space outside the library closer to students’ areas of study.

- To advance the strategic goal of student engagement, a portion of that 22,864 NASF should be study space that is directly associated with academic departments. For every FTE student in a department, 0.5 NASF was allocated. For small departments, a 150 NASF minimum was used. It is expected that complementary departments will co-locate study space to enhance collaboration. Overall, the space reserved for distributed study space is just under 6,500 NASF (Figure 4.19).

<table>
<thead>
<tr>
<th>Department</th>
<th>Dedicated Study Space</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accounting, Finance, Information Systems &amp; Economics</td>
<td>299 NASF</td>
</tr>
<tr>
<td>Anthropology &amp; Sociology</td>
<td>169 NASF</td>
</tr>
<tr>
<td>Art and Design</td>
<td>174 NASF</td>
</tr>
<tr>
<td>Biology</td>
<td>303 NASF</td>
</tr>
<tr>
<td>Business Administration/Law &amp; Sport Management</td>
<td>208 NASF</td>
</tr>
<tr>
<td>Chemistry &amp; Physics</td>
<td>390 NASF</td>
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<tr>
<td>Communication</td>
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<td>Communication Sciences &amp; Disorders</td>
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</tr>
<tr>
<td>Construction Management</td>
<td>150 NASF</td>
</tr>
<tr>
<td>Criminology &amp; Criminal Justice</td>
<td>212 NASF</td>
</tr>
<tr>
<td>Engineering Technology</td>
<td>150 NASF</td>
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<tr>
<td>English</td>
<td>352 NASF</td>
</tr>
<tr>
<td>Entrepreneurship, Hospitality, Sales, Marketing</td>
<td>202 NASF</td>
</tr>
<tr>
<td>Geosciences &amp; Natural Resources</td>
<td>196 NASF</td>
</tr>
<tr>
<td>Global Management &amp; Strategy</td>
<td>150 NASF</td>
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<td>Health Sciences</td>
<td>337 NASF</td>
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<td>History</td>
<td>217 NASF</td>
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<td>Human Services</td>
<td>244 NASF</td>
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<td>Mathematics &amp; Computer Science</td>
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<td>Modern Foreign Languages</td>
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<tr>
<td>Music</td>
<td>222 NASF</td>
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<td>Nursing</td>
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<td>Philosophy &amp; Religion</td>
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<tr>
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<tr>
<td>Political Science &amp; Public Affairs</td>
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<td>Psychology</td>
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<td>School of Teaching &amp; Learning</td>
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<td>Social Work</td>
<td>151 NASF</td>
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<tr>
<td>Stage and Screen</td>
<td>156 NASF</td>
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*Figure 4.19 – Dedicated Study Space Outside Library*
**Special Use Facilities (HEGIS category 500)**

This category includes several space use categories that are sufficiently specialized in their primary activity or function to merit a unique space code. Although many of these special use facilities provide service to other areas, their special use or configuration dictates that these areas not be coded as service spaces. Included in this category are Athletic or Physical Education (520), Media Production (530), Clinic (540), Demonstration (550), Animal Facilities (570), Greenhouse (580), and Other/All Purpose (590), as well as associated service space. Athletics is showing a surplus of space, but this is a category that is typically driven by specific athletic programs and individual campus needs, not FTE calculations. Therefore, reducing existing area would not be suggested. In fact, based on the emerging Athletics Strategic Plan, more space may be necessary to respond to particular programmatic needs.

**General Use (HEGIS category 600)**

General Use Facilities are characterized by a broader availability to faculty, students, staff, or the public than are Special Use Facilities, which are typically limited to a small group or special population. General Use Facilities comprise a campus general service or functional support system for the institutional and participant community populations. Included in this category are Assembly (610), Exhibition (620), Food Facility (630), Day Care/Child Care (640), Lounge (650), Merchandising (660), Recreation (670), and Meeting Room (680), as well as service space, defined as a room or area that directly serves the space as an extension of the activities in that facility, for each.

- The results support the reported need for a dining facility, which is already evident on upper campus, where students require a place to eat and gather near their residence halls.

---

**Space Needs by code**

<table>
<thead>
<tr>
<th>Space Use Code</th>
<th>Space Name</th>
<th>2013 Existing ASF</th>
<th>2023 Space Need</th>
<th>Variance</th>
<th>True Variance</th>
<th>Percent Change of True Variance</th>
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<td>100</td>
<td>Classroom</td>
<td>96,261</td>
<td>117,367</td>
<td>(21,106)</td>
<td>(21,106)</td>
<td>21.9%</td>
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<td>200</td>
<td>Laboratories</td>
<td>144,804</td>
<td>226,435</td>
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<td>(81,631)</td>
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<td>250</td>
<td>Research Laboratories</td>
<td>29,492</td>
<td>36,279</td>
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<td>300</td>
<td>Office</td>
<td>316,606</td>
<td>306,003</td>
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<td>(22,864)</td>
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<td>Special Use Facilities</td>
<td>213,640</td>
<td>153,717</td>
<td>59,923</td>
<td>(7,990)</td>
<td>3.7%</td>
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<tr>
<td>600</td>
<td>General Use</td>
<td>281,918</td>
<td>221,002</td>
<td>60,916</td>
<td>(45,875)</td>
<td>16.3%</td>
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<td>700</td>
<td>Support Facilities</td>
<td>57,905</td>
<td>78,192</td>
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<td>800</td>
<td>Health Care Facilities</td>
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<td>900</td>
<td>Residential</td>
<td>658,184</td>
<td>920,000</td>
<td>(261,816)</td>
<td>(261,816)</td>
<td>39.8%</td>
</tr>
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</table>

**Figure 4.20 – Projected 2023 Space Need by Space Use Code**

**Figure 4.21 – Space Needs Pie Chart**
Support Facilities (HEGIS category 700)
Support facilities, which provide centralized space for various auxiliary support systems and services of a campus, help keep all institutional programs and activities operational. While not as directly accessible to institutional and community members as General Use Facilities, these areas provide a continuous, indirect support system to faculty, staff, students, and the public. Support facilities are centralized in that they typically serve an area ranging from an entire building or organizational unit to the entire campus. Included are centralized areas for Computer-based data processing and Telecommunications (710), Shop (720), Central Storage (730), Vehicle Storage (740), and Central Service (750), as well as associated service area.

- Central computer, shops and Service and Support could all use more space. The calculations suggest that a Public Safety facility (Police, EMT, etc.) and a centralized IT facility are justified. Central storage and vehicle storage is “ad hoc,” so projections are justified by individual campus needs, such as the reported need for appropriate space to store the items currently located in the basement of Brown (an inactive building).

Health Care Facilities (HEGIS category 800)
Health facilities provide space for patient care located in student infirmaries and teaching hospitals and clinics, and include patient rooms, treatment rooms, nurses’ stations, observation rooms, examination rooms and a variety of support facilities.

- WCU will need an additional 1,080 NASF of health care space in 2023.

Residential (HEGIS category 900)
Residential facilities include housing for students, faculty, staff, and visitors to the institution. There is a substantial need to accommodate higher enrollment.

- The current space allocation per bed at WCU is 162 ASF. Some campuses use as much as 225 ASF per bed, which reflects trends such as suite and apartment living. For future student housing at WCU, 200 ASF per bed is recommended, which includes student living quarters and associated support space.

Figure 4.22 – Current and Projected Data by College
SUMMARY OF SPACE PROJECTIONS

Considering all surpluses and deficits in all space categories, it appears that WCU will need a total of approximately 284,000 (or about 15%) more NASF in 2023 to accommodate enrollment growth of 37 percent. However, theaters, gymnasiums, kitchens and other highly specified spaces are not easily converted to other space uses, so surpluses in those areas will not offset deficits in other areas, like class labs, residence halls, etc. The “True Variance,” graphically shown on page 58, reflects non-fungible surpluses in Special Use Facilities (500s) and General Use Spaces (600s). When considering the non-fungible space, the true variance is a deficit of close to 460,000 NASF.

Looking at the space necessary for academic departments in 2023 (faculty offices, classrooms, class labs, research space, and service/support space totaling approximately 135,000 NASF), it is apparent that Arts and Sciences, the largest contributor of FTEs, also has the largest space needs. Figure 22 shows the historical space distribution and credit hours generated by College (repeated from Figure 4) and the projected FTE growth and 2023 space need by College.

It is important to note that these projections reflect the quantity of space only, not the quality. In addition, the projected square footage needed in 2023 reflects net increases over what is currently in use on campus. The numbers do not reflect replacement of space that might be repurposed or demolished to enable projects in the Campus Master Plan.

There are several departments that have a projected space deficit of more than 10,000 NASF for 2023:
- School of Health Sciences – 33,817 NASF
- Chemistry & Physics – 27,853 NASF
- Biology – 23,244 NASF
- School of Teaching and Learning – 12,948 NASF

Four departments are projected to have modest to moderate space surpluses:
- Physical Therapy – 4,942 NASF
- School of Music – 1,295 NASF
- Communication Sciences & Disorders – 428 NASF
- School of Art & Design – 248 NASF
The WCU Campus Master Plan is a strategic design framework based on a set of data-derived space challenges. Following the analysis phase, the team departed from the numbers and embraced the 2020 Vision Plan as the key tool for evaluating concept success.

The following broad-brush goals are the foundations of the academic and administrative projects in the master plan. They are organized according to Strategic Directions #1, #2, #3, and #5. Space plan recommendations are repeated when they support more than one strategic direction. Detailed space moves are described elsewhere in this report.

**STRATEGIC DIRECTION 1:**
**Fulfill the educational needs of our state and region**

**Space Plan Recommendations**
- Make a Science Quad composed of instructional spaces that offer real-world lab experiences for students.
- Create a formal Academic core that is home to most of the non-science and non-health science departments.
- Cluster Fine and Performing Arts schools near Bardo Fine and Performing Arts Center to form an Arts Destination or quad.
- Locate complementary departments near one another to make the best use of shared resources, large classrooms, and (where appropriate) specialized instruction spaces.
STRATEGIC DIRECTION 2:
Enrich the total student experience

Space Plan Recommendations

• Create a Center for Student Engagement (CSE). The CSE should be considered a “crossroads” space where students and faculty come together. The CSE will be home to a variety of study and collaboration spaces and Active Learning Labs, open labs, faculty commons, writing and learning commons, and International Programs.

• Combine student services (One-Stop), health services, and information services in a central, easily accessible location.

• Locate complementary departments near one another to make the best use of shared resources, large classrooms, and (where appropriate) specialized instruction spaces.

• Make collaboration and study spaces (formal and informal) throughout campus, close to students’ areas of study.
**STRATEGIC DIRECTION 3:**
Enhance our external partnerships

*Space Plan Recommendations*
- Create a Center for Student Engagement (CSE). The CSE should be considered a “crossroads” space where students and faculty come together. The CSE will be home to a variety of study and collaboration spaces and Active Learning Labs, open labs, faculty commons, writing and learning commons, and International Programs.

**STRATEGIC DIRECTION 5:**
Invest in our core resources

*Space Plan Recommendations*
- Locate complementary departments near one another to make the best use of shared resources, large classrooms, and (where appropriate) specialized instruction spaces.
- Streamline space use of H. F. Robinson Administration building to make room for a new Admissions office.
- Prioritize modernization of existing buildings and campus infrastructure.
### Facility Building Assessment

Fifteen campus buildings were selected for evaluation and assessment:

- Belk Building
- Natural Sciences Building
- Camp Annex
- Old Student Union
- Camp Building
- Reid Gymnasium
- Camp Gym
- Stillwell Building
- Coulter Building
- Breese Gymnasium
- Hoey Auditorium
- HFR Admin. Building
- Hunter Library
- Ramsey RAC
- Killian Building

### Process

Evaluation scorecards were developed to address each building regarding Accessibility and ADA Compliance, Egress and Exiting, Building Exterior Envelope, Building Interior Conditions, Hazardous Materials, Mechanical, Electrical and Structural Issues. Scorecards were provided to the WCU Facilities Maintenance Department, whose staff commented on the conditions of buildings with respect to their areas of expertise. Information was documented in the score cards and distributed to architects and mechanical and electrical engineers to assist with building assessments.

Room-by-room and external evaluations were conducted for each building using the score cards as guides. Conditions were documented further with an extensive catalog of photographs. Reports were prepared for each building based on the outline of issues shown above. Conditions and systems of each category were graded on a scale of 0 to 5, indicating a status of missing, need to replace, or renovate. There was also an evaluation of condition from poor to good. The reports include a summary of anticipated construction scope for needed remediation or renovation.

<table>
<thead>
<tr>
<th>FACILITY ASSESSMENT</th>
<th>FUTURE PROGRAM</th>
<th>CURRENT UTILIZATION</th>
<th>EXISTING CONTRIBUTION</th>
<th>OCCURRING VALUE SITE IMPACT</th>
<th>BUILDING CONSIDERED FOR DEMOLITION OR RENOVATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>BELK BUILDING</td>
<td>BIRD</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>BROWN</td>
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<tr>
<td>CAMP ANNEX</td>
<td>CAMP ANNEX</td>
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<td>CAMP GYM</td>
<td>CAMP GYM</td>
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<tr>
<td>COULTER</td>
<td>GRAHAM</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>HUNTER LIBRARY</td>
<td>KILLIAN</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NATURAL SCIENCES</td>
<td>NIGLI AUDITORIUM</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>OLD STUDENT UNION</td>
<td>REID</td>
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<tr>
<td>REID</td>
<td>STILLWELL</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>BREESE GYM</td>
<td>BREESE GYM</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HFR ADMIN. BUILDING</td>
<td>RAC RAMSEY</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>MOORE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Good Condition (May Have Some Outstanding Issues)
- Moderate Condition (Needs Substantial Work)
- Poor Condition or Predetermined By Owner For Demolition Or Renovation
A guiding tenant in the transportation planning for this Campus Master Plan has been to maximize the effective use of existing infrastructure capacity before committing to long-term investment in new transportation facilities or services. This approach is consistent with fiscal and social responsibility as well as environmental sustainability. For more information, see Appendix B: Parking and Transportation at the end of this document.
introduction

The long history of the Western Carolina University campus in Cullowhee has included changes to its transportation system that have been both gradual and dramatic. Over time, the automobile has become the dominant mode of travel for students, employees, and visitors.

A guiding tenant in the transportation planning for this Campus Master Plan has been to maximize the effective use of existing infrastructure capacity before committing to long-term investment in new transportation facilities or services. This approach is consistent with fiscal and social responsibility as well as environmental sustainability. Traditionally, much transportation planning has consisted of trying to identify travelers’ desires, and then satisfy them by increasing capacity. This approach is no longer sustainable from physical and fiscal perspectives. The more resources that are devoted to a single mode of travel, the fewer resources are available to support and promote alternate modes. While this may not be a problem when conditions are constant, such a system can be very unstable, and possibly more susceptible to sudden, unanticipated failure. A balanced system is more robust, more adaptable to changing and unexpected conditions, and more stable.

To address the challenges ahead, steps should be underway already to institute a comprehensive travel demand management (TDM) program. Such a program encompasses a set of coordinated incentives and disincentives – carrots and sticks – designed to provide attractive, affordable alternatives to driving a single-occupant vehicle to or on campus. The key to a successful TDM program is the creation of an environment in which the true cost of various transportation choices are made obvious, so that rational decisions by individuals result in desirable outcomes. These outcomes can include reduced travel expenses by individuals, lower infrastructure costs, preservation of limited campus land resources, benefits to the environment, and enhanced sustainability.

The transportation recommendations summarized in this chapter were developed as part of the Campus Master Plan with the intent of creating an efficient, resilient, and adaptable framework for dealing with a changing campus and an uncertain future. Emphasis is placed on staged implementation that maintains the functionality and livability of campus throughout all stages of implementation. A complete transportation report is included as an appendix to this document.

Most of the transportation challenges facing Western Carolina University, now and in the future, relate either directly or indirectly to parking.
SUMMARY OF TRANSPORTATION PLANNING ISSUES

Access to Campus: How do people get to and from campus?

• The campus is automobile-oriented, due to plentiful parking, convenient access by car, and residential distance to campus: 95% of people commute via car—85% single-occupant and 10% carpool.

• There are limited bicycle and pedestrian facilities leading to campus, and the roadways surrounding (and serving) campus are barriers to safe and convenient walk and bike access. Weather, terrain, and barriers such as creeks, rivers, and roadways are also limiting factors.

• Ridership for off-campus bus routes has been low, due to the availability of inexpensive parking, fairly low density and dispersed residences, and a somewhat low frequency/coverage of transit service.

Circulation on Campus: How do people get around on campus?

• Auto circulation has few capacity constraints, other than parking and pedestrian conflicts. However, congestion can disrupt campus travel during critical AM and PM peak periods.

• Pedestrian and bicycle circulation is constrained by topography and physical barriers, as well as a lack of continuous facilities.

• Transit service is complicated by a roadway network that imposes circuitous routing due to geometric constraints. Convenience, reliability, and pedestrian accessibility are also perceived as deficient.

Parking
The existing parking system has evolved as a rational result of user needs and available resources. However, changes resulting from campus growth will exert increasing pressure for alternative management strategies.

• Parking spaces will be lost to the construction of new facilities, and replacement parking will be more expensive, and/or less convenient.

• Although there has been understandable resistance to increases in parking fees, survey responses suggest that a significant share of both students and employees would be willing to pay more for parking that better fit their needs (as defined by convenience, reliability, and security). However, having a low-cost parking option was also a clear priority.

• Current parking policies and fees will not yield sufficient revenues to fund parking expansions needed to accommodate anticipated growth and maintain existing facilities.

• The monitoring of permit sales in conjunction with available parking supplies and occupancy rates will be increasingly important to maximize utilization of available parking supply. This will become especially critical as some lots are removed for construction.

• A zone-based parking system, with tiered fees and/or other improvements to parking allocation, could improve utilization of existing parking supply.

• Supportive parking policies, especially related to the management of price and supply, are critical to reducing reliance on single occupant vehicles, as well as associated expenses.

• Combined with satellite parking lots and shuttles, could a comprehensive, integrated travel demand and parking management (TDM) program postpone the need for a parking deck for several years?
Most of the transportation challenges facing Western Carolina University, now and in the future, relate either directly or indirectly to parking. Most campus traffic problems result from interactions between class schedules and the parking system (supply, location, and policy). Most cars on campus roads, especially during peak periods, are traveling to or from a parking space. (Whether the driver knows the location of that space, or is driving around searching for the perceived best available space is another issue.)

Planning elements critical to success include efforts to reduce traffic demand while providing attractive travel alternatives, as well as measures to spread traffic demand across different locations and times to take advantage of unused capacity. The goal is to provide a balanced transportation system. Several key strategies have been employed to achieve that goal:

- Provide and promote good pedestrian connectivity. This is essential to any efficient, robust, and sustainable transportation system, regardless of mode of travel.

- Encourage “parking once.” To reduce traffic congestion and conflicts with other travel modes, driving between campus locations should be discouraged. Achieving this objective requires removing impediments to other modes, as well as investing in infrastructure and services to make walking, bicycling, and transit more attractive. Also implied in this strategy is a parking system that eliminates driving around to find the best space, and one that works with the road network to promote driving directly to a particular parking facility by the shortest route.

- Recognize differences in the value of parking spaces. Not all people place the same value on a parking space. Location, time-of-day, and purpose of trip affect the perceived value of a space. People will pay a price commensurate with their need and the value received, if they are given a choice. Appropriate pricing can be used to help manage demand by increasing occupancy in remote or inconvenient lots, and suppressing demand (while generating additional revenue) in more desirable and convenient facilities.

- Use strategies to reduce traffic and parking demand. In addition to increasing capacity where necessary and appropriate, make alternatives available, and provide incentives (and disincentives) to encourage their use.

- Consider the total costs of transportation investments. In addition to the costs of constructing, financing, operating, and maintaining transportation infrastructure projects, careful consideration should also be given to the opportunity costs (what else could be done with those funds, or that land?), as well as the often overlooked risks built into the assumptions justifying such projects. If fuel costs increase, and fewer people choose to drive, will parking permit sales and revenues be adequate to cover expenses, including debt service for structured parking? Does focusing on satisfying expectations for automobile travel create a situation where there is little choice for an institution (and its constituents) to do other than invest even more resources in support of automobile travel? Are roadway capacity improvements necessitated by a new parking deck captured in a rigorous benefit-cost analysis?

Increasing fuel and automobile ownership costs, combined with growing concerns about sustainability (not only environmental, but also social and fiscal), are encouraging interest in driving alternatives. Being able to attend a school where an active educational, recreational, and social life is possible without a car can lower the effective cost of attending that school, by eliminating car payments and costs for insurance, fuel, parking, and repairs. The principles guiding development of the transportation recommendations include the following:

- Maintain balance. Avoid depending too much on a single facility or mode, and provide options or choices whenever practical.

- Promote safety among all modes of travel.

- Recognize and work with the strengths and limitations of the external transportation system.

- Anticipate and adapt to changing travel patterns, both on and off campus.

- Preserve and utilize existing capacity as efficiently as possible.

- Minimize the amount of driving on campus by providing the most direct routes possible to major trip generators, and by locating such facilities where they can be accessed effectively.

- Emphasize multimodal options. At the very least, do nothing to preclude or obstruct other modes of travel.
CAMPUS MASTER PLAN CHANGES TO ROADWAYS

The Campus Master Plan incorporates a series of changes to the existing campus road network. Some of these changes are needed to provide access to new facilities – West Campus, and the Millennial Initiative, in particular. Other projects result from conflicts with new buildings or other facilities that require roadway realignment or closure. Still others reflect changes in roadway function due to increased demand for pedestrian, bicycle, or bus traffic, or attempts to improve existing roadways to current standards. Finally, some roadway recommendations result from shifts in travel demand resulting from the expansion and relocation of parking facilities, as well as general growth and redistribution of traffic volumes, both on and off the campus.

The bottom line is that campus growth creates the need for most of the roadway improvements identified in the Master Plan. However, significant expansion of campus roadway capacity does not appear to be needed; this is fortunate since the mountainous terrain severely limits options, and makes them almost prohibitively expensive. The proposed Campus Master Plan includes a variety of modifications to the existing campus road system. These modifications fall into one or more of the following categories: modify road surfaces and/or cross-sections; realign existing roads; restrict access to roads or segments of roads, or prohibit certain turning movements; and construct new roads, or extend existing roads.

Figure 5.1 depicts the major roadway improvement recommendations described in Appendix B.

- **A** New Campus Entrance at Little Savannah Road
- **B** No thru traffic; pedestrian friendly
- **C** Remove parking; narrow pavement; widen sidewalk
- **D** Improve cross-section; pedestrian improvements
- **E** Remove high-speed right-turn lane; pedestrian improvements
- **F** Traffic calming; pedestrian zone
- **G** Realign and narrow; remove parking; pedestrian improvements
- **H** Improve alignment and cross-section; extend to Central Dr.; make two-way
pedestrian and bicycle facilities

Figure 5.2 and Figure 5.3 depict key elements of the pedestrian and bicycle networks recommended as part of the Master Plan. Figure 5.2 shows the complete bicycle network by facility type, and includes multi-use paths essential to the connectivity of the system. Figure 5.3 indicates critical crosswalk locations, as well as sidewalk projects needed to complete the pedestrian network.

ON-CAMPUS

Recommendations for pedestrian and bicycle improvements span a variety of facility types and treatments:

- **Multi-use path** – Paved or unpaved pathway for walking and biking.
- **Sidewalk** – Paved pedestrian-only facilities, both roadside and not.
- **Bike lane** – Portion of a road designated by striping, signage, and pavement markings as being for exclusive/preferential use by bikes.
- **Cycle track** – Exclusive bike facility physically separated from traffic and distinct from sidewalk.
- **Shared-use road** – Road designated by signs and shared-lane pavement markings (sharrows) as a bicycle route or bicycle boulevard.
- **Bicycle “ramp” or “stairs”** – Specially-designed stairs incorporating “gutters” to guide bicycle wheels; used to traverse steep grades.
- **Crosswalk** – Location for pedestrians and dismounted cyclists to cross a roadway, designated by pavement markings, signage, and sometimes signals; may incorporate a speed table and or curb extensions to narrow the street and crossing distance.
- **Traffic calming** – A wide range of design treatments used to modulate traffic speeds; includes speed humps and tables, chicanes, curb bump-outs, and related measures.

Also necessary for a campus to promote and sustain bicycle travel are such critical amenities as racks, lockers, repair/maintenance facilities, and education and safety programs. Types and locations of such amenities are not specifically identified in this plan; however, they should be a reviewed as recommended bicycle facilities are designed and programmed. They also should be considered in the design of future facilities that could generate significant bicycle trips, including residence halls, recreation areas, classrooms, dining halls, libraries, and parking facilities.

While earlier attempts at bike-sharing were abandoned, advancements in the delivery and administration of these services by private contractors show promise, and bike-sharing programs continue to spread. The feasibility of bike-sharing at WCU should be revisited, especially as bicycle improvements are implemented. Conditions at WCU and the nature of the CAT-TRAN system do not suggest a need for a bikes-on-buses program at this time.

Specific bicycle and pedestrian facility improvements recommended as part of the Campus Master Plan are described in Appendix B of this report.
Sidewalks
Figure 5.3 identifies sidewalk improvements recommended as part of the Master Plan. Some of these improvements are addressed in the description of the roadway projects with which they are associated. The remainder consists primarily of missing links in the existing sidewalk network.

Figure 5.3 also indicates the locations of critical crosswalks deemed because of heavy vehicle/pedestrian conflicts or safety concerns. Although no single design solution can be applied to every situation, standard guidelines should be followed in installing and maintaining all crosswalks. Due to the mountainous terrain, ADA accessibility remains a challenge. The situation is exacerbated on Main Campus by infrastructure that was constructed prior to the adoption of current standards. Figure 5.3 also indicates the locations of critical crosswalks deemed because of heavy vehicle/pedestrian conflicts or safety concerns. Although no single design solution can be applied to every situation, standard guidelines should be followed in installing and maintaining all crosswalks.

OFF-CAMPUS
The most critical off-campus facilities are those that link the WCU campus with the surrounding community. In some cases, a highway or river or other physical barrier must be overcome; in others, there is no external network to tie into. Active coordination and partnering with surrounding jurisdictions is needed to eliminate barriers to safe and convenient travel between logical destinations, and to provide a comprehensive bicycle and pedestrian network. Descriptions of key projects in that process follow.

Multi-Use Paths
One key recommended facility enhances connectivity with the Cullowhee Community to the north and east of Main Campus, doing so with minimal expense and disruption. This 0.16-mile-long connection would terminate at the new sidewalk installed as part of the NCDOT bridge replacement project B-4159, providing convenient access to the Cullowhee community, the Tuckaseigee River, and proposed Jackson County parks and greenways. Grades are reasonable, and construction and right-of-way costs should be minimal.

Other critical connections include the segment of the Jackson County Greenway system proposed along Cullowhee Creek to the north of campus. Although the alignment has not been finalized, it ultimately would reach the WCU campus immediately north of The Village, from which point it could easily be extended to tie in with existing walking/jogging trails north of Schrader Soccer Field.

To the south, it may be possible to extend a multi-use path or greenway along Cullowhee Creek that could connect with a future county greenway. This route could provide access for residents of Catamount Peaks, an option superior to walking or biking on Speedwell Road, a facility that would be difficult and expensive to upgrade for safe and comfortable non-motorized travel.
The shuttle routes and stops shown in Figure 5.4, Figure 5.5, and Figure 5.6 should not be taken as specific or final recommendations; they are intended to illustrate the options provided by the Master Plan’s roadway improvements. They also suggest shifts in travel patterns and transit demand that will occur as the Plan is implemented, and parking lots are relocated and new buildings constructed.

While the Campus Master Plan establishes a viable framework for transit service over the next 10 years, various policies, programs, and routes will need to be reevaluated frequently. These options depend on the type of service being provided, which can evolve over time. For example, as parking lots are shifted to the periphery of campus, it will be important to adjust routing and frequency of shuttle service. As parking costs and permit prices increase, transit becomes an important option for commuting to campus. It is also recommended to look for opportunities to partner with county services and the private sector, such as apartments and downtown merchants to coordinate funding and service between WCU and off-campus locations. Frequent off-campus bus service, in conjunction with other options, such as occasional-use parking permits and guaranteed rides home, would encourage bus use. Once high-frequency bus service is in place, the University could also consider restricting parking for those served by transit.
ADDITIONAL TRANSIT PROGRAMS

Promotional and educational outreaches, especially those targeting new student (or employee) orientation can be very effective and are especially important when service changes are implemented. Ideally, input from both users and non-users should be obtained to help identify potential markets, and improve service. Strategies for continuous monitoring of ridership and improvements to existing routes should be in place, too.

One market that appears to have potential is the large number of students (and some employees) living in residential concentrations within a short bus ride of campus. While there are administrative hurdles, many public universities have negotiated mutually beneficial arrangements with apartment complex management and/or local transit providers to run apartment shuttles or neighborhood circulator routes with shared costs. Off-campus students with the option to ride a bus to campus will reduce the demand for new parking spaces as enrollment increases.

Figure 5.6 – Proposed Upper Campus Shuttle Route
IMPECTS OF PARKING SUPPLY CHANGES & ENROLLMENT GROWTH

As the campus population grows, WCU’s parking challenges will shift. The approaches it has been using to manage parking, while reasonable and appropriate now, will become less effective. The effects of an increasing driver population will be compounded by the displacement of existing parking by new facilities being constructed near the campus core. Not only must lost spaces be replaced, but additional spaces provided for new students and employees. As available land on main campus disappears and costs increase, it will no longer be possible to meet increasing demand by constructing new surface lots in convenient locations. A combination of remote surface lots and close-in structured parking will be needed. Because of the longer distances involved, some of the more remote lots on West Campus near the Health and Human Sciences Building, and along Little Savannah Road, will require shuttle service. While this will increase expenses, users will not want to pay full price for a less convenient parking space. At the same time, higher parking fees will be needed to cover the costs of building, maintaining, and financing a parking deck or decks. These factors will strain the current permit system, introducing significant pressure for a range of permit fees and choices, depending on parking location and service.

Parking resources will need to be managed more actively, requiring regular and detailed monitoring and data collection. As parking costs increase, options that may not have seemed attractive or necessary previously will become more viable. Transit, walking, bicycling, and TDM measures can begin to reduce the automobile share of campus travel. To be effective, these programs must be in place before they are actually needed. This careful coordination and monitoring of parking, alternatives to driving, and TDM measures are best undertaken under the auspices of a Transportation Department, with a single Transportation Director, to develop synergy.

The final build-out scenario of the Master Plan will have various qualitative and quantitative impacts to the parking supply. Some lots will be completely removed to make room for new facilities or green space, while other lots are partially impacted or reconfigured. Several large-capacity surface parking lots, as well as one parking deck, are proposed as well. The overall strategy is to:

- Selectively remove lots from the campus core that are difficult to access, do not inter-connect, or affect the ease of movement for pedestrians/bicyclists.
- Build or expand some of the large surface parking lots along the campus periphery, easily accessible to nearby thoroughfares to help reduce on-campus traffic and road capacity needs.
- Locate much of the visitor parking in the proposed parking deck.
- Maintain sufficient, reasonably convenient parking in the campus core for special needs and ADA access. Some short-term metered parking is also desirable.

Parking impacts, i.e. gains and losses, were analyzed on a lot-by-lot basis, as shown in Figure 5.7 and Figure 5.8. The cumulative impact on the parking supply is a gain of approximately 1,200 new parking spaces. Main campus has a net gain of more than 500 spaces with construction of the parking deck; more distant areas gain roughly 700 spaces.
### Figure 5.7 – 10-Year Parking Losses

<table>
<thead>
<tr>
<th>PARKING LOT ID</th>
<th>PARKING LOT NAME</th>
<th>SPACES REMOVED</th>
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<tbody>
<tr>
<td>64A</td>
<td>Brown S Upper</td>
<td>28</td>
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<td>43</td>
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<td>34</td>
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<td>Coulter</td>
<td>119</td>
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<td>30</td>
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<td>17</td>
<td>Balsam</td>
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<td>Total</td>
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### Figure 5.8 – 10-Year Parking Gains

<table>
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<th>REFERENCE ID</th>
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<th>SPACES ADDED</th>
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<td>1</td>
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<tr>
<td>2</td>
<td>West Campus Remote Surface</td>
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<tr>
<td>3</td>
<td>Natural Sciences Ground Floor</td>
<td>50</td>
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<tr>
<td>4</td>
<td>Faculty Housing Remote Surface</td>
<td>250</td>
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<tr>
<td>5 (a, b, c options)</td>
<td>Parking Deck</td>
<td>1200</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>1950</td>
</tr>
</tbody>
</table>
Figure 5.9 summarizes the changing relationship between parking supply and demand over the next decade, and highlight the potential impacts of travel demand management (TDM), increased parking efficiency, and construction of a 1,200-space parking deck.

**LONG-TERM PARKING SUPPLY CHANGES**

The cumulative parking impact for The Master Plan development scenario is +1,200 spaces, which includes the construction of one parking deck (located at the current Cordelia Camp building and parking lot).

Combined with the new entrance proposed at Little Savannah Road, this location allows commuters and visitors to be “intercepted,” reducing the need to drive further into the campus. To accomplish this objective, the parking deck should incorporate visitor information and wayfinding; a transit hub; convenient pedestrian and bicycle connections and amenities; and other complementary services, such as a convenience store, coffee shop, commuter lounge, and public safety station.

This location also offers excellent proximity and ease of access/egress for a variety of cultural, athletic, and other special events. With good pedestrian and bicycle connections, the parking deck could provide convenient access to future development west of NC 107.

Small parking areas in the campus core are inefficient and negatively impact the pedestrian campus environment.

Football and special events pose parking challenges.
OTHER PARKING ISSUES

ADA Accessible Parking. Implementation of the Campus Master Plan will displace a number of existing surface parking spaces, especially in the campus core. Among these are a significant number of ADA accessible spaces. While accessible spaces will be provided in all new parking facilities, these spaces may not be as convenient to destinations in the campus core. The Campus Master Plan includes the flexibility to locate permanent or interim accessible parking spaces at various central locations. Careful monitoring of this situation will be needed throughout implementation of the Campus Master Plan, since available parking spaces and accessible routes will change due to ongoing construction. In addition, as a larger share of campus travel occurs on foot, bicycle, and bus, accessible transit options will need to be emphasized.

On-Street and Metered Parking. Although on-street parking and metered parking are not synonymous, most metered parking is on-street, and on-street parking in urban settings is frequently metered. Like many campuses, WCU has little on-street and metered parking. However, there are instances where on-street and metered parking (implemented either separately or together) can provide significant benefits. On-street parking can create a buffer for pedestrians; help suppress travel speeds; provide room for service/delivery vehicles and bus stops; and reduce off-street parking needs. Combined with individual or multi-space meters that can accept payment by coins, bills, credit cards, smart cards, and even mobile phones, these spaces can provide convenient short-term parking for visitors, students, or employees. Off-street metered spaces can serve the same function. When operated in appropriate, high-turnover locations, metered parking can provide a significant revenue stream. Long-term or unmetered on-street parking is not recommended, except for special uses, such as delivery or service, special events, handicap, or possibly vanpool or car-sharing.

Special Event and Football Parking. As the supply and location of parking shifts over time, providing access and parking for special events, especially football games, remains an on-going challenge. In general, the Campus Master Plan appears to provide enough parking to handle most special events, given adequate notice and preparation time. In fact, all of the Campus Master Plan recommendations appear to provide potential benefits for game-day travel, by improving the quality of traffic, and quality and quantity of transit, parking, and walking infrastructure. In some cases, it may be necessary to reserve parking spaces in some facilities to ensure an adequate supply. However, a single definitive answer is not possible, since each event is unique, and since conditions will change as various parking facilities go offline and others come online. Fortunately, most major events occur outside of peak parking and traffic periods.

CONCLUSIONS

Given the high costs associated with financing, building, and maintaining structured parking spaces, the University has a chance to begin changing attitudes and behaviors with regard to driving and parking at WCU. This is a low-risk opportunity to dispel the automatic assumption that parking is a “fixed” demand that must be met in direct proportion to campus population.

In any case, a solution that reduces, or even delays, the need for construction of new parking supply also avoids associated capital and maintenance costs, as well as potential environmental impacts, especially those related to water quality and habitat disruption. A non-construction alternative that makes more efficient use of existing parking infrastructure (rather than unnecessarily increasing parking supply) also seems to better support the direction of ongoing campus master planning efforts. In fact, temporary parking losses associated with the construction of new buildings provide an excellent opportunity to introduce some of the parking policy changes and TDM strategies proposed during the master planning process, and to test their effectiveness on a small scale.

A range of viable alternative solutions are described below. In most cases, they are not mutually exclusive, but could be implemented either individually or in appropriate combinations.
### Summary of Transportation Element Goals and Strategies

<table>
<thead>
<tr>
<th>Strategies</th>
<th>Goals: Increase percentage of trips on sustainable modes</th>
<th>Make getting around campus easier</th>
<th>Ensure Campus Master Plan can work</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roads</td>
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<tr>
<td>Promote a balanced transportation system</td>
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<td>●</td>
<td>●</td>
</tr>
<tr>
<td>Design roads for people, not just for cars</td>
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<td>Focus on function</td>
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<td>Parking</td>
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<td>Accept a lower parking ratio (fewer spaces per person)</td>
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<td>Reduce parking demand</td>
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<td>Treat parking as a strategic campus resource</td>
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<td>Maintain effective parking capacity and occupancy levels</td>
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<td>Offer parking permit options that meet the needs of both users and the University</td>
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<td>Adjust parking fees</td>
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<td>Walking and Bicycling</td>
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<td>Improve pedestrian access and safety</td>
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<td>Increase connectivity, facilities and amenities for bicyclists</td>
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<td>Create a comprehensive transportation management position that integrates all aspects of campus transportation planning and operations</td>
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<td>Recognize the role of transportation in campus life by proving relevant support and advice</td>
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<td>Implement comprehensive, performance-based transportation and parking monitoring program</td>
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Look for the shuttle stop signs on campus.
The broad goal of creating a sustainable campus affects all aspects of this master plan. From sustainable land-use strategies, use of existing infrastructure, and energy conservation, to sustainable transportation and storm-water strategies, the master plan emphasizes a holistic approach to sustainability.
creating a sustainable campus

INTRODUCTION
Though highlighted in this chapter, the broad goal of creating a sustainable campus affects all aspects of this master plan. From sustainable land-use strategies, use of existing infrastructure, and energy conservation, to sustainable transportation and storm-water strategies, the master plan emphasizes a holistic approach to sustainability. Additionally, master plan recommendations respond to the University task force report outlining specific drivers and goals for creating a sustainable campus.

Drivers And Goals
- Design and manage the campus landscape without compromising the natural environment
- Focus on stewardship of resources – landscape and water
- Emphasize campus as a living learning-laboratory – woodlands, waterways
- Optimize energy and conservation
- Restore and preserve open space
- Balance growth
- Champion sustainability
- Update campus design standards to address sustainability
- Enhance community partnerships and connections
- Employ less consumptive maintenance practices – emphasize life cycle
- Consider waste stream in the composting, reusing, and recycling of materials
- Achieve carbon neutrality
- Reduce energy consumption
- Consider downstream effects of campus landscape decisions
- Consider the interconnectedness of stewardship, pedagogy, and service learning

Charge
A sustainable campus is one that focuses on stewardship of resources, as well as one that recognizes and preserves the ideal that the entire campus, including undeveloped areas such as woods and waterways, serve as academic laboratories.

The Western Carolina master plan process follows the University of North Carolina Sustainability Policy (UNC Policy Manual, Section 600.6.1 amended 06/14/2013) that states, “Sustainability principles related to infrastructure, natural resources, site development, and community impact shall be incorporated into comprehensive master plans.”
ENVIRONMENTAL CONTEXT

Western Carolina University is situated in a very unique physical environment, which is at the core of its identity. The setting of the Southern Appalachian mountains helps define the University’s sense of place in a striking and unforgettable way.

The Southern Appalachian mountains are ecologically rich, being one of the most biologically diverse areas in the temperate region of the world. Close to 10,000 different species have been identified here, with more discovered each year. The University campus is located in a valley, roughly between the Great Smoky and Balsam Mountain ranges. Campus property ranges in altitude from approximately 2,100 to 2,600 feet. Annual precipitation is about 52 inches. The range of topography and abundant rainfall give rise to an array of vegetation and habitats that are not often found in a University setting. The campus property also is surrounded by the Nantahala National Forest, with thousands of acres of undeveloped forest. The network of undeveloped forested areas that border the Main Campus and encompass the West Campus are ecologically important, because they provide habitat and travel corridors for many species of organisms. Protection and conservation of those habitat and corridor areas is vital to regional ecological sustainability.
Cullowhee Creek is probably the most visible and unique ecological feature on campus. It is a hatchery-supported trout stream, which flows into the regionally important Tuckaseigee River just north of campus. Cullowhee Creek is an extremely valuable natural resource asset from ecological, educational and aesthetic standpoints. The Creek’s vegetated riparian areas provide wildlife habitat and a corridor for wildlife travel, while also providing aesthetic appeal. Its hydrology, riparian area, vegetation and aquatic habitats, along with its convenience, provide a myriad of educational opportunities both now and in the future.

A well-known tenet of ecology is that everything is connected. Likewise, the University campus is connected to and affects its surrounding areas—open space, forest, streams and rivers. University actions can have positive or negative effects on the surrounding environment. Applying sustainability principles to guide development will help ensure that the future well-being of the natural setting the University enjoys will be secure. The high quality natural resources on campus and surrounding campus provide a marvelous educational and aesthetic setting. They also are a delicate asset that needs to be managed and protected in a sustainable way for future generations.

**NATURAL RESOURCE PROTECTION CONSIDERATIONS**

- Promote watershed health and ecological function through the development of a Riparian Buffer Plan. The U.S. Army Corps of Engineers (USACE) requests a Riparian Buffer Plan, which details existing uses, promotes best management practices and future potential allowable uses within the riparian buffer, for discussion and approval.

- Honor the USACE requirement that a 35-foot buffer from the top of bank landward on both sides of the stream (Cullowhee Creek), be preserved in a conservation easement. However, the USACE acknowledges that there are existing uses that will constrain natural vegetation in the buffer, such as existing sewer right of way, existing power line right of way, existing monitoring wells, an historic pedestrian bridge that is slated for replacement, and the potential need to add to any one of these existing uses.

- Restore and enhance stream banks and buffers along Cullowhee Creek on main campus and the associated tributaries on west campus in conjunction with the Riparian Buffer Plan created per USACE requirements.

- Utilize a diverse and context-appropriate native plant palette in riparian buffer plantings along tributaries to Cullowhee Creek and the creek itself. Prioritize native plant species in specifications for all stream buffer plantings. Promote biodiversity through a mix of woody and herbaceous species.
sustainability in the campus landscape

LANDSCAPE CONTEXT

Sustainability is based on the concept that a system can sustain itself over time – whether that is a community, a business, or a landscape. Furthermore, sustainability is about a long-term commitment toward a full integration of functional natural systems within the built environment. Natural systems are at the foundation of any landscape, but in the case of the WCU campus, it is even more apparent because of the very dramatic forms and topography that define the campus location. The Blue Ridge Mountains provide the backdrop for the campus, situated both in the valley along Cullowhee Creek and on the hills that surround it, and just downstream the Cullowhee feeds into the Tuckaseigee River. Campus landscape planning efforts should promote development that supports ecological function and strengthens the community’s relationship with its natural environs. Western Carolina University has a long history of landscape stewardship efforts and partnerships that promote sustainability through stewardship. In the mid 1980’s the university hosted the 1st Native Plant Conference.

CULTIVATING A REGENERATIVE CAMPUS THROUGH SUSTAINABLE PRACTICES & DESIGN

It is important to design for the inherent connection between the campus landscape and the natural resources that connect to the landscape, including the woodlands and the tributary streams that join to form Cullowhee Creek, which flows through the campus. Landscape design and management, when done in a sustainable way, promotes stewardship of natural resources and provides the opportunity for experiencing the campus as a living and learning laboratory, as well as a social and communal space. There are numerous opportunities for service learning and other curricular connections that connect campus life more with the living system that underlies the campus landscape – connecting the principles and practices of sustainability in the landscape with campus stewardship and study academics.

The university can plan for a sustainable campus with the consideration of seven principles of landscape design that conserve water and protect the environment:

- Planning and design
- Plant selection
- Practical turf areas
- Efficient/limited landscape irrigation
- Soil improvement
- Mulch use
- Appropriate maintenance
If one considers the campus from the perspective of green infrastructure, there are considerable opportunities for sustainable landscapes woven into the built environment at Western Carolina. Developing a strong and resilient green infrastructure landscape network involves examining, interpreting and building upon the inherent patterns in the campus landscape, starting at the broader regional scale and then drilling down to the scale of the campus, in an effort to build a site’s capacity for regeneration. There is an opportunity to address interrelated issues associated with stormwater runoff, energy use and conservation, microclimates, tree canopy coverage, recreation, outdoor instruction, connectivity and circulation. Green infrastructure also provides improved wildlife habitat and corridor connections to broader open space areas in the vicinity for pollinator species and other wildlife.

The master plan proposes removing inefficient parking from core campus areas and creating new, pedestrian oriented outdoor spaces. With each new development project and each building renovation on campus, smaller
open/green spaces should be integrated into the site design, as appropriate with associated programming, while responding to the surrounding campus context. The design of these open spaces will be visually and physically connected across the campuses, will incorporate a native plant palette, and will integrate on-site vegetated storm-water management where feasible. Landscape design that is responsive to this unique locale can draw connections between the hilly topography of the surrounding region and the buildings on campus. For instance, green roofs can be integrated into building design as an architectural feature that explores the elevational landscape. There are also energy consumption savings positively associated with green roof technology. Landscape designs for new buildings/structures should adhere to a strong compositional unity within each landscape space, as well as visual continuity between contiguous landscape spaces and the broader connections to the regional native landscapes. This includes emphasizing the utilization of native plants on campus. Trails and paths that traverse the campus landscape, both in the more formal academic core, as well as the wooded areas on campus, should be designed in a manner that allows them to be an amenity and a learning experience, while also providing beneficial ecological habitat where possible.

Storm-water treatment practices should be integrated into the landscape design wherever feasible, in order to treat the storm water closest to “where the raindrop falls.” Campus site design that incorporates integrated storm-water management within the landscape helps make the transition from grey (conventional) infrastructure to a greener and more sustainable infrastructure system – promoting broader water quality improvement for Cullowhee Creek, its tributaries, and the Tuckasegee River. Integrated storm-water treatment practices include parking lot bioretention, and permeable paving for new walkways, hardscape areas, plazas, and streets. New or redeveloped surface parking should include canopy trees, as well as median and perimeter plantings that incorporate bioretention – for storm-water treatment, increased shade, and woodland character.
PLANT SELECTION

Use of a native plant palette in landscape design promotes biodiversity, helping to restore plant communities native to the ecoregion; these attract butterflies, bees, birds and other beneficial wildlife. Whenever possible the campus landscape should adhere to an approved regional native plant list. The design intent is to support biodiversity, reduce pesticide use, increase wildlife habitat (depending on space and programming use) and maximize water conservation (http://www.ncwildflower.org/natives/natives.htm). A comprehensive vegetation survey should be completed for the entire campus, followed by a vegetation management and maintenance plan for future stewardship and maintenance. This guidance should be consistent with the Cullowhee Creek riparian buffer management plan that will be completed per USACE requirements and any other campus sustainability initiatives. An updated detailed inventory of significant woody and herbaceous vegetation on campus should be created based on size, age, quality, diversity, uniqueness and location. An invasive species management plan should also be developed. The use of species that are currently listed on any of the following lists as invasive should be avoided (http://plants.usda.gov/java/noxious; http://plants.usda.gov/java/noxious?rptType=State&statefips=05; http://www.ncwildflower.org/invasives/list.htm).

The goal should be to preserve and restore native canopy and subcanopy trees, as well as shrubs and groundcover, to ensure a diverse, healthy, and functioning ecosystem in forest and riparian areas. An arboretum on campus could showcase the diverse flora of Western North Carolina and southern Appalachia, and serve as an educational and aesthetic resource for the University and the community. Program elements can include education, research, public service, outreach, conservation, preservation, and restoration. An affiliation with related associations like the National Arboretum and Botanical Gardens, the American Association of Botanical Gardens and Arboreta, and the North Carolina Arboretum in Asheville, N.C., could provide funding and other interdisciplinary research opportunities. Pedagogical linkages can be made with appropriate university disciplines, including Environmental Science as well as Engineering and Technology.
TURF – A NEW PARADIGM
One way to promote carbon neutrality is through a native-focused plant palette that requires less regular maintenance. This also means limiting turf areas to distinct locations for recreation fields or active/passive use programming areas. Where turf does exist, Integrated Pest Management should be the adopted maintenance regime (Federal: www.gsa.gov/ipm; NC Cooperative Extension: http://www.turffiles.ncsu.edu/PDFFiles/000806/wqwm156.pdf).

MAINTENANCE/ SOILS/ MULCH/ IRRIGATION
Sustainable management of landscapes limits fertilizers, pesticides, and herbicides through integrated pest management and other best management practices including use of mulch and compost. Integrated pest management is a combination of means including design choices, cultural practices, and chemical controls used to manage pests in the landscape. A sustainable campus landscape is one that respects what is found below the surface as well. Soils literally provide the foundation for the landscape, and should be cared for as such. Steep slopes, where soils are likely to be erodible, should be stabilized by re-establishing native vegetation (a diverse set of woody and herbaceous plants). The campus landscape design should minimize any need for mowing on steep slopes through the replacement of turf in any of these areas. Composting yard waste and food waste, as an onsite store of more natural fertilizer and soil conditioning materials, promotes materials reuse and recycling and a more holistic approach to the life cycle of materials used on campus. Mulch can be used both as a stabilization tool as well as a way to help retain moisture around plantings (minimizing the need for irrigation), and as a source of organic materials that help to build up soils over time, as the mulch decomposes. Irrigation should be limited to the establishment phase for all areas that concentrate on native plants, which are most adapted to local climate patterns.

When designing for sustainable landscapes, there are many opportunities for pedagogical connections and stewardship. Students can help create signage and interpretive elements along the trails/walkways in the natural/ ecological landscape zone. Students and faculty can help with the care and maintenance of student gardens, the campus arboretum, or other smaller memorial gardens. Research and learning can be centered around studies of native plants or integrated vegetated storm-water practices.
INTEGRATED STORM-WATER PRACTICES & CONSIDERATIONS

As previously noted, the campus is in the Cullowhee Creek subwatershed. Cullowhee Creek flows into the Tuckaseigee River, which eventually joins the Tennessee River system. The Tuckaseigee is an important hatchery-supported trout stream upstream of WCU for many miles, and downstream past Cullowhee Creek a short distance (< 1 mi.) to the NC 107 bridge, where it becomes a Delayed Harvest trout stream for several miles. This is an important recreational resource for fishing, in addition to the other water sports, canoeing, kayaking, tubing, etc that the river affords (http://watrnc.org/). Because of the importance of these waterways for recreation and fisheries, water quality and aquatic health are important considerations.

As a leading educational institution and landholder in the region, the University plays a leadership role in the stewardship of water resources – stewardship that includes minimizing pollutants in storm-water runoff from both new development and redevelopment. Conscientious storm-water management provides the University an opportunity to draw visible connections between storm water in the campus landscape and the downstream water quality of Cullowhee Creek, the Tuckaseigee River and the Tennessee River (https://roma.wcu.edu/groups/getlocal/wiki/28aea/; http://www.wcu.edu/WebFiles/PDFs/WheeFlyFishingGuide_printable.pdf; http://www.thefishingwire.com/story/283887).

Integrated storm-water practices also can include parking lot bioretention, and permeable paving for new walkways, hardscape areas, plazas, and streets. These practices could serve to augment the restoration and treatment practices being employed in the creek channel corridor, providing both water quantity and water quality improvements. Integrated storm-water treatment practices also help control soil erosion from development and increases in nonpoint pollution, including fertilizer and herbicide runoff, from maintained landscapes. Vegetated treatment practices help promote evapotranspiration of storm water by using tools such as engineered soils, vegetation on green roofs or biofiltration areas. They maximize the potential for evapotranspiration, which helps to minimize storm-water discharge.

Another important storm-water control strategy is the reduction of effective impervious surface within the campus by minimizing total impervious cover, disconnecting directly connected impervious areas (rooftops etc), and using alternative materials. New or redeveloped surface parking should include canopy trees, as well as median and perimeter plantings that incorporate bioretention – for storm-water treatment, increased shade, and woodland character.
Storm-water Treatment Opportunity

Figure 6.4 – Open Space Diagram

Figure 6.5 – Potential Integrated Bio-retention Features

Figure 6.6 – Campus Hydrology
sustainable campus landscapes by typology

PEDESTRIAN/ ACADEMIC CORE
In the pedestrian/academic core, the landscape is characterized by open quadrangles enclosed by academic buildings. The aesthetic has a manicured look. These are manipulated landscapes with highly designed planting beds and small gardens. They may be more geometric in shape and generally respond to the design dynamic of the surrounding architectural style. Planting design and maintenance supports seasonal visual interest and variety, while framing both the open spaces and the campus buildings. Planted areas are designed to optimize safety and visual access while providing aesthetic amenity. Turf is dominant in this typology, although there are canopy trees that provide shade and outdoor classroom spaces in some of the larger open space areas. In the central quad areas of the academic core reaching westward, there are diverse groupings of native species, as the campus approaches the Cullowhee Creek Stream/Floodplain Area. Tree canopy could be enhanced from current conditions to provide more shade in some of the broadest open space areas. The plant palette consists of ornamentals, cultivars, and natives, although non-native invasive species are avoided. In all future planting designs, native plants should be considered to help connect to the native landscapes in the surrounding areas. Streetscapes should be designed to complement the landscape character in terms of plant palette, but with the inclusion of vegetated storm-water management practices. Traffic should be slowed through various integrated streetscape design practices, including vegetation, to promote a safe and comfortable pedestrian environment.
A stream buffer of 15' from top of bank on each side of the stream is required along Cullowhee Creek throughout the campus.
FOREST CONSERVATION
The existing woodlands throughout the WCU campus provide a rich resource for ecological function and native habitat. The forest structure reflects the character of the Southern Blue Ridge Mountains, with a diverse, yet complementary set of plant species that provide important ecosystem services for a variety of wildlife. The focus of these landscapes should be on preservation and conservation. An emphasis should be placed on maintaining the diverse wooded character of all the streams on West Campus. Canopy cover and vegetative filtration in the riparian buffers along these streams improves ecological sustainability by protecting both habitat quality and water quality. The forest should only be planted, when enhancements may be needed, with native plants that are suited to the site hydrologic and aspect characteristics. Forest lands should be monitored for the effects of known pests and future pressures associated with climate change. Management of invasive species is particularly important to the overall regeneration and resilience of the forest ecosystem, especially along forest edges where nonnative invasive plants can become especially problematic. The forest landscape supports existing and future research and curricular opportunities, as well as recreation, as long as those activities do not lead to further degradation. Trail maintenance or creation should limit erosion and forest fragmentation through the use of best practices and low-impact design.

MANAGED NATURAL AREAS
These landscapes bridge the natural areas of the floodplain/stream buffer and forests, with the more urbanized pedestrian/academic core. They support ecological function through a diverse native palette, a robust vertical structure, and natural groupings of groundcover, herbaceous materials, woody shrubs, understory and overstory trees in relatively dense plantings. These landscapes have a less manicured appearance than the pedestrian/academic core, invoking the more naturalistic aesthetic of the woodland and stream buffers but with a clear design intention that capitalizes on native plants seasonal diversity. Turf is limited in this landscape, with the exception of the athletics fields. Vegetated storm-water treatment practices are especially important in this landscape to provide water quality treatment and to strengthen the ecological function of the floodplain and forest edge ecosystems. Athletic fields are maintained with the least amount of fertilizer and pesticides necessary, and runoff is captured and filtered directly adjacent to maintained fields wherever possible. Streetscapes are designed to complement the landscape character in terms of plant palette, but with the inclusion of vegetated storm-water management practices whenever feasible.
ARBORETUM LANDSCAPE

The wooded, park-like landscape of the upper campus possesses the fundamental qualities of an arboretum. Whether formally designated as an arboretum or not, this landscape typology could celebrate native Blue Ridge Mountain tree and plant collections, but also could provide space for other species, including ornamentals and cultivars. As an arboretum landscape there should be a focus on North Carolina heritage, creating a living and learning environment, promoting stewardship, and highlighting plant identification with signage and programmatic support. This landscape includes the woodland amphitheater, as well as spaces identified for future memorial groves (Catamount Memorial Garden). The University could consider the planting/propagation of the Cullowhee Lily species (Zephyranthes atamasco), if growing conditions are appropriate, as part of the arboretum landscape.

The cultivation of tree groves as well as spaces for rare native plants should be considered. There should be a focus on maintaining the wooded feel of the existing landscape, and enhancing vertical structure and outdoor spaces defined by the trees and shrubs. Concentrating views and experiences internally, along with framing limited views from the hill into the pedestrian/academic core, can help provide connections to the campus core. This landscape will require a robust management and maintenance plan for all species within the arboretum. Streetscapes should be designed to complement the landscape character in terms of plant palette, but with
Figure 6.9 – Riparian Buffers

SUGGESTED STREAM BUFFER CONSIDERATIONS
(35’ ON EACH SIDE OF CULLOWHEE CREEK IS REQUIRED)
the inclusion of vegetated storm-water management practices whenever feasible.

**STREAM BUFFER/ FLOODPLAIN**

Stream buffers and floodplains are both ecologically important and hydrologically significant. Additionally, activities in the stream buffer/floodplain are regulated by state and federal governments. Cullowhee Creek and its tributaries represent a unique and valuable natural resource for the University. The relatively high water quality of the Creek allows it to be managed for hatchery-supported trout fishing, as is the Tuckaseigee River downstream. These two natural resource assets are valuable, but delicate. Management of the stream buffer and floodplain areas is critical in the achievement of sustainable development and will have a significant effect on water quality, wildlife habitat and potential outdoor instruction opportunities in the future. The challenge is to fulfill the mandate for future development for higher education, while protecting and improving the natural resources associated with Cullowhee Creek and the Tuckaseigee River. These resources are such an important part of the University’s heritage, appeal, and educational potential going forward.

A conservation easement will protect the stream buffer on Cullowhee Creek, generally 35 feet from the top of bank landward, on both sides of the creek. There are some areas where the buffer will not be able to support native vegetation, due to existing utilities, roads, parking lots or stream monitoring instrumentation. However, the U. S. Army Corps of Engineers will require management that is as natural as possible in most buffer areas. The details of the riparian buffer management plan will be determined in the near future.

The areas between the conservation buffer’s landward edge to the 100-year floodplain boundary are subject to inundation during infrequent, but high-energy flooding events. Much of this floodplain area on both sides of the Cullowhee Creek has been developed for sports, recreation, and transportation. Many of these uses must be maintained for University operations. However, for sustainability and legal reasons, the future management of these areas needs to take into account both the regulatory and ecological importance of them. Future management should consider the following:

- The University should continue to follow all regulatory requirements for development in both the stream buffer and the floodplain. Additionally, the University should take advantage of opportunities to restore areas in the floodplain back to a natural forest condition for water quality and wildlife habitat improvement, where feasible.
- The riparian buffer protects and sustains water quality in the stream. Buffers can treat future sheetflow storm water, and reduce its pollution load. Storm water that passes through the buffer untreated (e.g. in pipes or ditches) will contribute to water quality degradation in Cullowhee Creek and the Tuckaseigee River.
- The riparian buffer is also an important wildlife habitat area and travel corridor. Its vegetative structural integrity should be considered an asset to future educational instruction opportunities.
- Tree species planted in these areas should be tolerant of occasional high moisture and flooding conditions. Examples include green ash, red maple, sycamore, river birch, and yellow poplar.
landscape: the revitalized core

THE REVITALIZED CORE FOCUS AREA

• Wherever possible treat storm water close to where it falls via rain gardens, foundation storm water planters, street tree pits, bioretention areas, etc before it enters the existing system. Vegetated and bio-engineered practices can promote ecological enhancement, with a diverse palette of native plants integrated into storm-water design. Biodiversity supports resilience and sustainability. Native plants should require less maintenance, in terms of watering and fertilizing, since they are adapted to native conditions.

• An overall storm-water management plan could be considered, with further examination of existing infrastructure.
Planting design in this and other courtyards can provide a diverse set of native plants organized in such a way to create small outdoor rooms for gathering, outdoor classroom space, etc.

Based on the size of this courtyard, size restrictions need to be considered for landscape material. A mix of native herbaceous, shrubs, and smaller trees (dogwoods, redbud, etc), shade-tolerant trees and lower stature trees should be considered.

Design this as more of an integrated bioretention treatment area and landscape amenity in central landscape open space.

Preserve vegetation and natural woodland resources in the existing Woodland Amphitheater and improve access. Careful attention to grading and effects on mature tree roots in this special location.

Consider the views from the hill-slope across the campus towards the lower campus, and on towards the mountains, views to the green roofs (providing new horizontal planes of vegetation).

To open up the views from Centennial Drive a few of the white pines will have to be removed. The alternative trees to be considered at the bottom of the hillslope in the new planting zones could be lower stature native shrubs and trees that tie into the transitional and arboretum palettes.

Arboretum Landscape Zone: The wooded areas on the hill surrounding Moore Hall as well as the residential buildings in this portion of campus provide an opportunity for a campus arboretum, connected by walkways through the woods, including the woodland stage. Tree identification and other educational opportunities could help enhance this experience and promote regional landscape understanding.

Transitional Landscape Zone: Provides an ecological, aesthetic, and experiential connection to wooded hills to the east and west, with a more native-centric plant palette and a more natural planting design integrated with suggested bioretention areas and foundation rain gardens around new buildings.

Suggested bioretention integrated into design of this open space, for collection and treatment of storm water.

Plant larger trees in more formal areas.

Native vegetation integrated into storm-water design

Vegetated edge along bioretention area here, open views from sidewalk on Centennial drive side, more veg on northern edge.

On the south side of Centennial, enhance pedestrian areas of the streetscape and implement integrated storm water bio-retention landscape strategies.

Formal Landscape Zone: A more manicured and formal planting design, associated with the traditional quad design envisioned for this more central part of campus. Native plants should still be considered, along with non-invasive plant cultivars that are existing in the campus landscape. Additional trees and shrubs are suggested to enhance ecological capacity and shade in this landscape zone, as well as foundation rain gardens on the new buildings suggested for this zone.

Consider planting larger native trees in this wide open central space to promote more shade, and urban ecological services (cooling, bird habitat, etc), Consider oak species including: southern red, northern red, white, scarlett, pin, and hickory species as well. Consider placement to create outdoor rooms.
landscape: the cullowhee creek corridor

THE CULLOWHEE CREEK CORRIDOR FOCUS AREA

• Wherever possible treat storm water close to where it falls: rain gardens, foundation storm-water planters, street tree pits, bioretention areas, etc before it enters the existing system. Vegetated and bio-engineered practices can promote ecological enhancement, with a diverse palette of native plants integrated into storm-water design. Biodiversity supports resilience and sustainability. Native plants should require less maintenance, in terms of watering and fertilizing, since they are adapted to native conditions.

• Management of nonnative invasive species is very important, especially along forest edges where these plants can be especially problematic

A Athletic fields are maintained with the least amount of fertilizer and pesticides necessary and storm-water runoff is captured and treated/filtered directly adjacent to fields

B Managed natural areas at interface with creek corridor habitat/buffer area: Include a diverse native palette, robust vertical structure, dense plantings. Less manicured appearance than academic core

C West side buffer (35’ min) of Creek should be natural - mix of native trees, shrubs and herbaceous cover. East side buffer (minimum 35’) of Cullowhee Creek has some utilities constraints, should still aim for a mix of native trees, shrubs and herbaceous cover, some limited open views to Creek. See Cullowhee Creek cross section with annotated notes from Biohabitats for more detail considerations and USACE requirements.

D Integrated SWM practices around all parking lots and large impervious surfaces, especially near tributaries to Creek. Limit turf use throughout this focus area

E Vegetated edge along this tributary conveyance to Cullowhee Creek, natural edge, swales could convey SW from neighboring buildings, if feasible

F Streetscapes are designed to complement landscape character in terms of plant palette, with the inclusion of vegetated storm-water management practices where-ever feasible
Technically, the USACE requires a 35-foot buffer from the top of bank landward on both sides of the stream, to be preserved in a conservation easement. However, the USACE also acknowledges that there are existing uses that will constrain natural vegetation in the buffer, such as existing sewer ROW, existing power line ROW’s, existing monitoring wells, historic pedestrian bridge that is slated for replacement, and potentially the need to add to any one of these existing uses.

- The main goal of the buffer is to shade the creek and provide natural habitat for wildlife.

- The character of the buffer will change over time, as trees planted in the buffer zone reach maturity and begin to shade out the understory.

- West Side: Downstream of the existing entrance, the USACE sees the buffer on the west side of the creek being practically all natural. There are areas downstream of the existing entrance, on the west side of the creek, that may possibly be allowed to remain relatively open for security around parking lots. There are also areas upstream of the existing entrance, on the west side of the creek, that may possibly be allowed to remain relatively open for security around parking lots. More to be determined as the University prepares their Riparian Buffer Plan to the Corps.

- The USACE requests the University to submit a “Riparian Buffer Plan”, which details existing uses, and future potential uses of the riparian buffer, for discussion and approval.

- East Side: The USACE acknowledges that the buffer on the east side of the creek, downstream from the entrance, will have many constraints such as the existing sewer line, the existing monitoring wells, etc.

- Mix of mature native trees, shrubs, and herbaceous cover.

- Open views to the Creek.
landscape: the west campus

Figure 6.12 – The West Campus
THE WEST CAMPUS FOCUS AREA

A  Plant only native plants that are suited to site hydrology and aspect of the forest. Focus on the preservation and conservation of forested areas. Forest lands should be monitored closely for effects of known pests and future pressures associated with climate change. Management of nonnative invasive species is very important in the west campus forest areas, especially along forest edges where such plants can be especially problematic.

B  Maintain the diverse native woody vegetation that characterizes all streams in this focus area.

C  Limit trail maintenance or creation so as to not fragment the forest. When trails are created, they should be designed to limit erosion and fragmentation through the use of best practices and low impact design.

D  Consider the vegetated edge along this tributary conveyance to Cullowhee Creek as a channel to convey storm water from neighboring building. Utilize integrated storm-water management practices around all parking lots and large impervious surfaces, especially near tributaries to creek.

E  Design streetscapes to complement landscape character in terms of plant palette, with the inclusion of vegetated storm-water management practices wherever feasible. Consider building design that integrates green roofs to better interface with surrounding landscape, and provide additional storm-water management/treatment before water leaves the building site.
EXISTING CONDITIONS
Western Carolina University (WCU) owns and operates its own water treatment and distribution system. This consists of a raw water intake facility; water treatment plant, rated at 1.0 million gallons per day (MGD); and three concrete reservoirs, for a combined storage capacity of 2.2 million gallons. Campus water lines range in size from 2- to 12-inches in diameter. Raw water is withdrawn and treated from the Tuckaseigee River which flows along the north-eastern edge of campus. WCU owns the dam and raw water intake structure located on the Tuckaseigee River. The water treatment, storage, and distribution system provides domestic and fire service requirements to most of the campus. WCU’s average daily consumption was approximately 0.4 MGD in 2005 and approximately 0.35 MGD in 2012. WCU’s water system, with minor repairs and infrastructure upgrades, should be able to provide sufficient water capacity for present and future campus growth for the main campus. Presently, water main infrastructure located on the older section of campus is approximately 70 years old, indicating a need for replacement; two of the raw water intake pumps are aging and in need of upgrade.

NEAR TERM
In the near term, WCU should implement an annual plan and budget to update aging water infrastructure, abandon or remove cross-connections, create logical loops within the system for added serviceability and extend new infrastructure on campus to areas of planned growth. Below is a list of specific recommendations for the near term:

- The older part of upper campus has outdated water infrastructure. All infrastructure containing lead joints should be replaced.
- A western connector loop on the main campus should be installed to link the 6-inch water main just north of the Ramsey Regional Activity Center to the 10-inch water main running northwest to east of the Fine and Performing Arts Center.
- A central connector linking two dead-end mains just north of the Center for Applied Technology and east of the Fine and Performing Arts Center can provide water flow reliability, serviceability and elimination of stagnant water zones and allow for planned growth along these campus corridors.
- An outdated cross-connection running through central campus, from the southwest corner of Reid Gym to the southwest corner of McKee Building could be removed, as it is not an effective part of the water service system. Reid Gym could be serviced from the 10-inch main running along its western side.
- Aging water mains could be removed from around Cordelia Camp Lab Complex.
- A Tuckaseigee Water and Sewer Authority (TWSA) water main should be installed to feed the proposed buildings south of the Health & Gerontology Buildings on the West campus.
LONG TERM

As noted in the near-term assessment, WCU should implement long-term planning and budgeting to address aging water infrastructure, system serviceability and reliability and planned campus growth. This would include infrastructure extensions to serve planned future growth and the continuation of the creation of water main connector loops to significantly increase reliability and serviceability throughout campus. Below is a list some specific long-term recommendations:

- A northern connector loop should be extended from the University Bookstore to the Natural Science Building.
- A northern connector loop should be made from the 6-inch main at the Track, Soccer and Tennis Facility Village to the 6-inch main feeding the Village Residence Halls.
- Due to age and limited remaining lifespan and healthy operation, the old 6-inch main feeding Hennon Stadium and Childress Baseball Field and the Nursery Complex should be replaced.
- A central connector loop should be extended from the Fine & Performing Arts Center to the University Bookstore.
- A northeast connector loop should be extended from the Water Treatment Plant to Hunter Library.
- TWSA water mains should be extended to the proposed long-term West campus buildings.

**Figure 6.14 – Near-Term Water**

**Figure 6.15 – Long-Term Water**
EXISTING CONDITIONS
WCU owns and operates a non-residential sanitary sewer collection system throughout the campus. The collection system is predominantly composed of brick manholes and vitrified clay pipe installed during the initial phases of the university’s construction dating back to the early 1900s. The entire collection system is a gravity system composed of manholes and service line ranging in sizes from 4-inch to 12-inch for the system’s mainline. There are numerous instances of sewer collection lines beneath existing campus buildings. The facilities management warehouse currently is served by an on-site septic system. The system currently is interconnected with Tuckaseigee Water and Sewer Authority’s (TWSA) sanitary sewer system at numerous locations, with the occurrence of shared lines and pass-through effluent from off-campus properties. The western portion of campus is primarily serviced by TWSA sewer lines. TWSA ultimately treats the effluent collected from WCU at the downstream wastewater treatment facility in Dillsboro, N.C.
NEAR TERM
In the near term, WCU should implement an annual plan and budget to update aging sewer infrastructure, abandon and reroute outdated mains running beneath buildings, and extend service line branches, and mains or connections to TWSA mains and to extend sewer main connections to near term proposed buildings and campus facilities. Below is a list of some specific recommendations for the near term:

- A sewer main running under McKee Building and Hoey Auditorium should be abandoned and rerouted.
- The older part of campus has outdated sewer infrastructure. All remaining vitrified clay piping and outdated sewer main and service lines on campus should be considered for replacement.
- The existing sewer main running beneath Cullowhee Baptist Church should be abandoned and re-routed to connect with the TWSA main north of the current location.
- Sewer service should be extended to serve the proposed long term West campus buildings.

LONG TERM
As covered in the near-term assessment, WCU should implement long-term planning and budgeting to address aging sewer infrastructure and extend sewer main connections to serve the proposed long-term campus buildings and facilities and extend TWSA sewer connections to proposed long-term West campus improvements. Below is a list of some specific long-term recommendations:

- In order to eliminate existing on-campus septic systems, it is recommended to tie the remaining existing septic system, near the facilities management warehouse, to the TWSA main on the northeastern portion of campus.
EXISTING CONDITIONS
WCU campus is not currently subject to the North Carolina Division of Water Quality (DWQ) Phase II Storm-water requirements for water quantity and quality of storm-water runoff. Conveyance pipes throughout campus should be evaluated for integrity and viability for future service. An existing 50-year-old, 72-inch diameter concrete conveyance pipe located on the central part of campus, serves as the primary trunk line, conveying much of the campus storm water to an outlet into Cullowhee Creek.

NEAR TERM
In the near term, WCU should implement an annual plan and budget to update and replace aging storm-water infrastructure as necessary, complete a comprehensive mapping of storm-water infrastructure for future maintenance and implement storm-water management plans to treat campus runoff. Below is a list of some specific recommendations for the near term:

- Culvert capacity issues downstream of Albright Benton residence hall should be evaluated.
- There is a backwater valve to gutter downspouts at Walker Residence Hall.
- A 48-inch culvert near Hunter Library is severely deteriorated should be evaluated for replacement.
- Frequent flooding in the basement of the Natural Sciences Building during moderate to heavy rainfall events should be addressed.
- NCDOT drains on campus are in poor shape and should be identified for upgrade or replacement.
- The Old Student Union and Camp Building appear to have poor site drainage issues, which should be evaluated.
- Part of the older upper campus has an open ditch with small crosspipes. These should be replaced with drainage piping to tie in with the existing storm-water conveyance system.
LONG TERM
As covered in the near-term assessment, WCU should implement long-term planning and budgeting to address aging storm-water infrastructure throughout campus and extending storm-water connections to proposed long-term campus buildings and facilities. Below is a list of some specific long-term recommendations:

• Considerations should be made to address the appropriate land use for flood plain areas on campus.
• WCU should consider treating an increase of storm-water runoff from future growth and planned buildings with appropriately sized treatment and control systems.
• Tie-in all long-term storm drain lines from future proposed building sites to existing conveyance drainage systems.

REFERENCES
Wiley & Wilson, 2006, “Western Carolina University Steam and Water Master Plan”
McMillan, Pazdan, Smith Architecture, “Western Carolina University Building Facility Assessments Summary Draft” MPS Project No. 013130.01
SUMMARY OF EXISTING SYSTEMS

Of the 123 buildings totaling 3,350,478 SF on the Western Carolina University campus, 35 buildings, comprising approximately 2.2M S.F., are connected to the campus central steam plant. The balance of campus facilities are heated by local means (boilers, heat pump, geothermal, etc.). The recently constructed Health & Human Science building is the first building on the Millennial Campus west of highway 107. It is currently served by a condensing boiler hot water heating plant.

The campus central steam plant (Figure H1) is housed in a building originally constructed in the 1920’s. While some historic value has been placed on the facility, its condition is failing, and overall, it is a poor example of the type of building used for a modern boiler plant. The four steam boilers in the plant can fire either natural gas or #6 fuel oil. The boilers range in age from 1951 to 1973 and, although maintained very well, they are past their service life. Boiler capacities total 141,000 pounds per hour (PPH) as originally designed, however, their reliable capacity is considered to be only 107,000 PPH due to de-rating caused by age and maintenance patches following past boiler failures. Based on a plant heating demand study in 2006, the connected steam load for campus facilities averages approximately 0.06 PPH per gross square feet of building space. Considering current conditions, it is believed that the peak heating plant demand is 105,000 PPH (assumes an 80 percent diversity factor). This obviously allows for no boiler redundancy in the system. A failure of any boiler would render the plant insufficient on a very cold day. A catastrophic boiler failure would create the need to rent a temporary boiler (expensive) until such time that the overall shortcomings of this 60+ year old plant are addressed.

The campus steam distribution infrastructure includes approximately six miles of underground steam and condensate return piping. Most steam is conveyed at 120 psi; however, a small portion of campus is served with 30 psi steam. This infrastructure varies in age and condition. WCU does an excellent job of maintaining this infrastructure. However, given declining repair and renovation funding contrasted with increasing distribution failure rates of an aging system, it is a losing battle. As is typical on many campuses, the condensate return piping fails the most often which reduces boiler plant efficiency and increases make-up water needs. The section of campus steam distribution noted as being in the poorest condition is a critical segment along Central Drive between the steam plant and the McKee Building (Figure H2). Overall, such a large network of existing distribution infrastructure affords the opportunity to remotely create steam; however, the cost of maintaining/replacing the infrastructure and loss of efficiency is an ever-present issue.
**PLANNING CONCEPTS**

1. **Shedding steam plant load**: Explore concepts for reducing boiler plant load in order to create inherent redundancy. This also works towards the possibility of disconnecting all buildings connected to the central plant.

2. **Re-feeding building disconnected from steam plant**: Consider alternative options for providing heat to facilities currently using campus steam.

3. **Re-using site steam infrastructure**: Determine feasibility of maintaining portions of existing campus steam infrastructure as might be needed for either: 1) continued use of campus steam plant; or 2) partial re-use within the context of smaller regional steam plants.

4. **Maintaining existing steam plant**: How much longer can the plant remain operational before a catastrophic boiler failure forces a system replacement option?

5. **Trends**: What are industry developments and tendencies for campus heating systems with regard to fuel sources, heating equipment types, etc?

6. **10-year campus build-out**: How best to implement heating systems for planned growth.

**IMMEDIATE NEEDS**

Addressing the failing and inadequately sized campus boiler plant is paramount. Reducing connected load in order to create redundancy with the existing boilers would allow more reliable operation of the plant until such time that the central steam plant could be replaced or relocated.

Boiler #1 is the oldest and least reliable (10,000 pph). In order to target a steam plant demand load that requires only two of the three most reliable boilers, then approximately 30 percent of the connected load should be shed. This equates to approximately 700,000 S.F.

Converting campus buildings from reliance on the existing steam plant can be achieved through various options:

1. **Utilize local boiler system (one plant per building)**
   - Steam, cast iron or steel, 80 percent efficiency
   - Hot water, condensing, 95 percent efficiency

2. **Create regional boiler systems (one plant per cluster of buildings)**
   - Steam
   - Re-use portions of campus steam distribution

3. **Geothermal (building HVAC system conversion)**
   - Heat pump
   - Residence halls are good candidates.
10-YEAR BUILD-OUT

East Campus Residential District

Disconnecting this eastern leg of the campus steam distribution system would reduce the steam plant load by 15 percent and negate reliance on approximately two miles of site steam/condensate piping. Options for re-feeding those building heating systems, as well as serving the new proposed residence hall include: geothermal heat pumps, as well as regional or local boiler systems (Figure H3).

Regional Steam Plant Options

Based on buildings that are reasonably clustered together, it is possible to develop new regional steam plants that serve multiple buildings from a single boiler plant that re-uses portions of existing site steam infrastructure (Figure H4). New boiler buildings likely would be necessary adjacent to existing construction, or the opportunity of future new buildings could be leveraged to create regional boiler plants as part of new construction.

Local Boiler Plant Options

Certain buildings with outlier-type locations are candidates for single boiler plant installations (Figure H5). This would not require use of existing site
steam infrastructure and would allow for inclusion of high efficiency hot water condensing boilers. As an example, de-centralizing the southwest district would reduce the current steam plant load by 37 percent and negate reliance on approximately 1.5 miles of site steam/condensate piping.

Miscellaneous

- Preliminary layouts for new construction suggest only two areas where existing steam distribution systems would be disturbed: Forsyth Addition and new dorm additions at Buchanan Residence Hall (Figure H6).
- Is a central heating plant really necessary? Steam distribution is expensive to install and maintain and has high energy losses. In contrast, a 25 percent or more reduction in heating costs often can be obtained by going to individual, high-efficiency condensing hot water boilers at each building (or small groups of building).
- Where regional or local boiler plants are utilized to replace reliance on the campus steam system, it should be noted that the campus steam connection could be maintained purely as a back-up source for the building.
- To be sustainable, fuel sources range from biomass to natural gas. Biomass requires a reliable fuel supply, which can often be difficult to source close to the user. The North Carolina Ports Authority is investing in storage and distribution of wood pellets (biomass fuel), which supports a growing trend. However, in today’s marketplace the economic viability of using biomass is closely tied to a close proximity between biomass fuel production and boilers. The distance from Cullowhee to the North Carolina coast appears too far, as transport efforts would work against the value of biomass from both cost and sustainability standpoints. To simply reduce greenhouse emissions, natural gas is the best fuel currently available. In relative terms it is inexpensive, plentiful, and clean. Also, with natural gas, highly efficient condensing boilers can be used.
- Cogeneration, or combined heat and power (CHP) systems, are of interest to WCU. To make CHP work, a natural gas turbine (or steam powered) can be used to produce electricity for the campus and the waste heat from the turbine can be used for campus heating. Since high electrical loads and high heating loads are rarely coincidental, this concept requires natural gas fired boilers to supplement when recovered turbine heat is insufficient. Successful CHP would also require a buy-sell agreement with Duke Energy to sell excess generated electricity and buy-electricity for peaking, since it rarely pays to install a CHP plant for 100 percent of peak electrical demand. CHP cannot be considered an ultimately sustainable solution for the long term. However, it can help slow the rate of carbon emissions with substantial energy savings in situations where more sustainable options are not available or affordable. Perhaps the greatest issue with CHP, aside from its complexity, is its cost, as these systems are generally capital intensive.

SUSTAINABILITY OPTIONS

- Reduce load connected to the inefficient campus central boiler plant
- Increase campus use of high-efficiency, hot-water condensing boilers
- Utilize geothermal heat pump systems where practical
- Consider co-generation boiler plant, likely for educational purposes

20-YEAR BUILD OUT

Because future building footprints on the main campus are within the same proximity of existing facilities, the long-term future for heating plants likely will be an extension of any initiatives developed over the next 10 years. A combination of regional steam plants with outlier facilities served by either condensing hot water boilers or geothermal heat pumps is the most likely scenario.

For the Western Campus, long-range build-out plans will be on virgin land; therefore greater flexibility in heating plant options is possible. For instance, co-generation may be more feasible if heating plant locations are coordinated with utility substation locations. New technologies in heat delivery systems, not to mention fuel sourcing, likely will be available in this timeframe.
SUMMARY OF EXISTING SYSTEMS
Most all campus facilities are cooled by local means (chillers, heat pump, geothermal, etc.). Select residence halls utilize heat pump and geothermal equipment. The balance of cooled campus facilities utilize local chillers to produce chilled water for the building hydronic system. Where cooling loads are approximately 150 tons or less, air-cooled chillers typically are utilized. Larger loads usually are served with water-cooled chillers. 150-200 tons is a common breakpoint, based on equipment availability and life cycle cost for these types of systems. Considering pumping, as well as chillers, energy usage is generally 1.1 KW per ton for air-cooled systems and 0.7 KW per ton for water-cooled systems. Because of the size of most WCU facilities, the campus is generally cooled by the more efficient water-cooled system.

Because campus chillers are generally located adjacent to the buildings they serve, there is very little underground chilled water infrastructure. This piping is typically ductile iron and in contrast to underground steam/condensate piping is relatively low-cost and long-lasting.

PLANNING CONCEPTS
1. Local chillers or regional plants: Consider options to maintain current one chiller per building approach or expand reach by integrating new regional chiller plants to serve clusters of buildings.
2. Chiller locations: Determine best fits based on proximity to buildings, aesthetics, available space, noise, etc.
3. Chilled water distribution: Best locations if regional plants are utilized.
4. Geothermal: Evaluate feasibilities to apply geothermal heat pump systems.
5. 10-year campus build-out: How best to implement cooling systems for planned growth.
10-YEAR BUILD OUT

The current use of local chillers (Figure C1) is certainly acceptable, particularly given that WCU utilizes water cooled chillers wherever possible. This methodology could be continued successfully as the campus expands. Also, as chillers age out, newer technology systems, such as magnetic bearing compressors, may be employed to further improve chilled water system efficiencies. Lack of redundancy is a drawback to single local chillers, as equipment failure will take the entire cooling system down.

Regional chiller plants increase the opportunity to use multiple sets of chillers, thereby offering redundancy in case of failure. An N+1 application is recommended. Multiple chillers also allow for staging to optimize operating efficiencies to match load conditions. These added benefits may not warrant un-doing the local chiller usage on campus, however as new facilities come on-line and/or existing facilities are renovated, WCU should consider regional chiller plants where building clusters exist (Figure C2).

Choosing locations for regional chiller plants would be driven by buildings in close proximity to one another. Other location drivers are available space for equipment, chiller noise and cooling tower appearance. A convenient location for central utility plants, particularly chiller plants, is parking decks. Although WCU currently has no parking decks, future growth likely will result in at least one parking deck within the next 10 years (Figure C3).

Chilled water distribution piping for regional chiller plants should be located to avoid existing utilities, minimize site disruption during installation and be in an area that allows for ease of future maintenance/replacement needs. As the campus master plan develops, planned pedestrian corridors will emerge. These corridors, where applicable, represent a path where site utilities could be congregated and more easily maintained.

WCU has expressed interest in utilizing geothermal heat pump systems. Drivers for this type of system include: site space available for geothermal well field; and buildings where constant-volume, single-zone heat pumps are feasible. Given these parameters, residence halls are typical applications for these types of systems.

SUSTAINABILITY OPTIONS

- Optimize chiller efficiency by utilizing water-cooled systems and/or magnetic bearing chillers.
- Utilize geothermal heat pump systems where practical.
- Consider regional chiller plants where improved optimization efficiencies offset added distribution piping cost.

20-YEAR BUILD OUT

Because future building footprints on the main campus are within the same proximity of existing facilities, the long-term future suggests a combination of existing local chiller applications along with new regional chiller plants (where feasible) and geothermal heat pumps (residence halls).

For the Western Campus, long-range build-out plans will be on virgin land. Therefore greater flexibility in chiller plant options is possible. Heating plant locations may be driven by proximity to electrical substations to incorporate cogeneration possibilities. Chiller plants may also occupy the same locations in order to be closer to electrical utilities (minimize power distribution cost) and to congregate services into a central energy plant scenario.
SUMMARY OF EXISTING PRIMARY ELECTRICAL DISTRIBUTION

The Western Carolina University campus is served from an existing 66 kV transmission line owned and operated by Duke Energy (Figure E1). The point of delivery for WCU exists at the campus substation located on Norton Road on the main campus. This point of delivery consists of two distribution transformers. The first is a 10 mVA unit that serves the main campus and the second is a 5 mVA unit that serves the southwest portion of the main campus, the Western Campus and additional retail customers.

At the south end of the Campus Substation, there are two sections of metal clad switchgear that serve the main campus (Figure E2). The first section is Westinghouse switchgear that is approximately 26 years old. The second section is ABB switchgear that is approximately 10 years old. This equipment is serviced by WCU on an annual basis as part of a preventative maintenance program.

The switchgears serving the main campus are arranged to supply five primary electrical distribution circuits. These circuits are primarily routed in underground in duct banks (Figure E3). The circuits serve pad mounted switches, which in turn, serve smaller distribution transformers outside the campus buildings. A limited amount of overhead distribution still exists in the vicinity of the Camp Buildings, the Physical Plant and the Print Shop.

In contrast, the distribution system served by the 5 mVA transformer at the substation is primarily routed overhead (Figure E3). This system serves a portion of the main campus in the vicinity of the Catamount Athletic Complex and retail customers on the west side of Highway 107. In addition, this system serves the first facility established as part of the Western Campus, the Health & Human Sciences Building.
The load profiles for the various primary circuits on the WCU campus are not readily available, as no metering exists in the system on the circuit level. Limited historical data was available from Duke Energy for the delivery point for the main campus switchgears. This data places the peak demand at the 10 mVA transformer over the past 12 months at 8.7 mW, or 10.2 mVA at a power factor of 0.85. No information was made available for the demand at the 5 mVA transformer.

**PLANNING CONCEPTS**

**Evaluate Existing Primary Circuit Routes:** Generally, the arrangement of the primary circuits on main campus is well situated to serve the Master Plan’s projected loads. Minor modifications may be required to permit installation of new pad-mounted switches and transformers for proposed buildings; however, the proposed building sites are found to be reasonably close to the present circuit routes.

The existing system is strategically connected to selected points to allow adjustments at sectionalizing switches for isolating elements of the system for maintenance operations or repairs at failure points. This arrangement also allows normal mode operation to be configured to balance the loads among the four circuits serving main campus, providing the most desirable conditions for longevity in the operational life of the primary circuits.

**Evaluate Existing Primary Circuit Capacities:** In absence of historical load data on the individual primary circuits serving main campus, an analytical model was developed to project the load seen on each circuit. To develop the analytical model, a total building area (SF) was calculated for the buildings served by the five primary circuits and the 10 mVA transformer. The total building area was divided into the total electrical energy (kW) used in those buildings served to yield a kW/SF value. Values for building area and energy use were obtained from building data provided by WCU.

The value of 0.037 kW/SF was determined as an energy use unit to be used in the model. Applying this unit to the respective buildings served by each primary circuit provided a total system load, which could be compared to the historical data available for peak demand from Duke Energy. Adjustments for system and circuit diversity allowed the alignment of the two values for system loading.

Although too simple to account for the dynamic changes in real-time electrical demand across the system, the analytical model provides a basic means to distribute the known peak demand for the system across the five primary circuits. The circuit loads determined in this model are used as a basis for discussing the circuits further in this section.

**Evaluate Life Expectancy of Existing Primary Switchgear and Circuits:** Operational life expectancy for the primary switchgear is affected by loading, ambient temperature, switching operations and maintenance procedures. The conditions seen by the two switchgears serving the main campus are favorable in these areas, as circuit loading is moderate, temperatures are reasonably mild in the higher elevation and the switching duty on the equipment is low. Even with these favorable conditions, consideration of equipment replacement for the Westinghouse switchgear is appropriate, based on its age. The ABB switchgear should have another 15 to 20 years of reliable operational life under present conditions.

Existing primary circuits on campus vary in age. Cable life expectancy is affected by a number of conditions, which include loading and the dissipation of heat generated in the cables. Recommendations in this section address strategies to balance the campus electrical loads among the primary circuits and relieve the locations where heat generated within the circuits is highest.

It is common to utilize underground primary cables to the point of failure, assuming the means to quickly isolate the failure and restore power around the localized failure point while cable replacement takes place. Recommendations in this section address the need to have spare raceways available in the underground system to improve recovery durations. This is particularly important in areas where circuit density is highest.
**Immediate Needs**

**Expand Duct Bank Infrastructure Leaving Substation:** Four of the primary circuits travel south from the substation in a common duct bank (Figure E4). It is understood that this duct bank section includes no spare conduits, while containing feeders that support 96 percent of the electrical load on main campus. The addition of spare conduits along this section of routing will permit a timely recovery from an underground circuit failure along the section.

It is recommended that a second duct bank section be installed in parallel with the existing duct bank, bearing a minimum of four raceways. This occurs between the substation and the Courtyard Dining Hall. Some lateral separation from the existing duct bank offers a reduction in the risk that both duct banks are compromised by a single event such as excavation.

It is further desirable to migrate two of the existing circuits into the new duct bank. The benefit of this modification is the reduction of mutual resistive heating among the circuit conductors. Under the requirements of the National Electrical Code, Table 310-77, the capacity of primary feeders grouped together along a common pathway is diminished as the quantity of circuits is increased.

Under the present arrangement, the maximum loading of the four primary circuits along the initial section of duct bank should be de-rated approximately 74 percent from the rated value of a single feeder. Under the proposed arrangement, the de-rating requirement is reduced, allowing the circuits to be loaded to the 88 percent of rated value of a single feeder. Similar benefit is achieved in the duct bank section containing three primary circuits, though the increase in circuit ampacities is less significant.
Increase Circuit 4 Capacity: The last recommendation associated with the feeders is the replacement of one of the circuits, permitting conductors with a higher ampacity to be utilized. Primary circuit 4 is currently composed of 250 kcmil conductors, while the other circuits are sized at 500 kcmil. As a result, Circuit 4 has about 70 percent of the current carrying capacity that the other circuits provide. Under the present normal mode loading arrangement, this is not a concern; however, this does limit the flexibility of this circuit to accept additional load. As the campus grows, this limitation will become more significant.

Replace Flammable Oil in Campus Owned Transformers: The State Construction Office Electrical Guidelines presently require that all transformers containing a flammable oil as a heat dissipating and insulating medium to be located at least 30 feet from occupied buildings or structures. Observations made during the site evaluation for this Master Plan reveal a number of transformers on the WCU main campus that do not meet this criteria.

The replacement of the flammable oil with a listed Less-Flammable Fluid or Nonflammable Fluid is recommended. This modification is relatively low in cost, assuming the removed oil does not contain PCB’s, in which case the cost for proper disposal will increase. This modification will require that the associated building electrical service be interrupted for a period less than a day.

Acquire Selected Equipment to Improve Campus Owned Inventory: The ability to minimize the disruption to a campus building after a failure can be improved by developing an inventory of the more common elements of the primary distribution system. The acquisition of specific transformer configurations and pad-mounted sectionalizing switches can reduce downtime and cost following a failure. Obtaining a stock of transformers that contain a listed Less-Flammable Fluid or Nonflammable Fluid also will reduce the likelihood that equipment purchased in response to a failure contains a non-desirable insulating material.

Install Meters at Substation for Primary Circuits: Currently, the electrical demand on the main campus can be accommodated by the 10 mVA transformer and the five primary distribution circuits. The five primary circuits generously sized to handle the present loads and the peak load on the system fall within the limits of operation for the transformer.

The distribution arrangement includes intentional switching locations across the campus to permit modifications to the present configuration of the primary circuits for maintenance and service related operations. Such switching operations can isolate equipment for service or in response to a failure. As a result, the loading for each circuit may increase or decrease significantly, based on the re-configuration.

The installation of permanent meter provisions on the individual primary electrical circuits serving campus will assist WCU in managing the existing and future load across the circuits in the normal mode of operation and in maintenance and/or service modes. These provisions can be added within the individual switches in the primary switchgear at the substation and specified as part of new switchgear in replacing equipment in the years to come.
10-YEAR BUILD OUT

The present configuration of the primary circuits on the main campus (Figure E5) includes five circuits leaving the switchgear at the main campus substation and routed through campus to serve specific geographical regions as indicated. Projected loads, based on the analytical model, have been applied to the associated building areas served by each circuit (Figure E6).

**Primary Circuit 1** serves the geographical region that holds the highest concentration of new electrical load in the 10-year build out (Figure E7). The addition of approximately 293,000 S.F. of new building program will place the circuit demand load at 3.15 mVA.

**Primary Circuit 2** serves a geographical region that receives a moderate concentration of new electrical load in the 10-year build out. The addition of approximately 79,000 S.F. of new building program will place the circuit demand load at 2.20 mVA.

**Primary Circuit 3** serves a geographical region that receives a moderate concentration of new electrical load in the 10-year build out. The addition of approximately 190,000 S.F. of new building program will place the circuit demand load at 3.92 mVA.

**Primary Circuits 4 and 5** serve geographical regions that receive nominal concentration of new electrical load in the 10-year build out. No changes are projected for these circuits in the analytical model.

<table>
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<tr>
<th>Circuit Designation</th>
<th>Building Area (SF)</th>
<th>Projected Load (mVA)</th>
<th>Projected Load vs. Capacity</th>
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Loads have been projected for the 10-year build out (Figure E8). The projected electrical load for main campus, based on the analytical model, is 11.84 mVA. This value exceeds the rated value of the 10 mVA utility transformer presently serving the main campus. Although Duke Energy has allowances for utilizing distribution equipment beyond rated values, it will be prudent to ensure that the plans for building development are shared with this utility provider during the 10-year build out.

As Circuit 3 retains the highest concentration of electrical load in the 10-year build out, the recommendation to increase the capacity of Circuit 4 to match that of the other circuits supports the opportunity to migrate some of the loads along the west side of the main campus from Circuit 3 to Circuit 4 for the normal configuration.

There is a recommended configuration for the normal mode of operation on the main campus for the 10-year build (Figure E9). This configuration serves to distribute the majority of the campus electrical load across four of the primary circuits, providing the most favorable conditions for equipment and conductor longevity.

**SUSTAINABILITY OPTIONS**

- Develop a campus standard for exterior site lighting. Consider emerging technologies related to LED lamp sources and solar powered assemblies. Utilize control schemes to permit reduction of light levels after late night hours in areas where security is not compromised.
- Consider interior lighting renovations to convert all magnetic ballasts used for fluorescent lighting to energy efficient, electronic ballasts. Convert all T12 fluorescent lamps to T8 lamps.
- Provide automatic lighting shutdown systems in buildings that have limited occupancy schedules.

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Figure E8 – 10-year Primary Electrical Distribution

Figure E9 – 10-year Recommended Configuration
SUMMARY OF EXISTING SYSTEMS
PSNC Energy is the natural gas provider (utility company) for Western Carolina University. The primary consumer of natural gas on campus is the central steam plant (see figure G1). This large single point meter offers a competitive rate structure as opposed to a scenario where several smaller meters are utilized throughout campus. The rate is also lower as an interruptible service, where the utility can turn off the gas supply with minimal notice to the user. WCU is a good candidate for this situation, as the boiler plant is a dual fuel facility (natural gas or #6 fuel oil); therefore losing natural gas service is not necessarily a problem.

As a rule, PSNC is responsible for the installation and maintenance of all equipment and piping on the supply site of the meter. WCU is responsible for natural gas piping between the meter and the load connection.

PLANNING CONCEPTS
Heating Plant Layout: Natural gas piping and metering locations will be based on where future boiler plants are located.

Owner Preference: WCU has indicated an initial preference for the utility company to have the ownership and maintenance responsibilities of below grade natural gas distribution piping.

Meter Locations: Consider options of individual gas meters at each building versus regional meters to serve multiple buildings.

Meter Charges: Explore impact of higher gas rates for small individual meters versus more competitive rates for larger regional meters.
10-YEAR BUILD OUT
Based on options for future heating plants (Figure G2) several smaller natural gas meters would be necessary in order to keep ownership and maintenance of underground natural gas the responsibility of the utility company. As the campus heating plant scenario is developed, it would be prudent to engage in a deeper study of comparing gas rate costs between meter layouts (local versus regional).

20-YEAR BUILD OUT
Future main campus build-outs likely will be in the same proximity of existing buildings, therefore the concepts developed for campus natural gas infrastructure in the next 10 years will likely be the same for 20+ years. Of course, fuel sourcing may change in the future. Trends in fuel availability and cost should always be evaluated.
CHAPTER 7

IMPROVING TECHNOLOGY

Today’s university campus must support a technology landscape that is constantly evolving and expanding in terms of the demand for higher data system bandwidth, voice, and video communications. Infrastructure must be planned to be as flexible, expandable, and resilient as possible.
improving technology

TODAY’S CAMPUS CORE INFRASTRUCTURE

Today’s university campus must support a technology landscape that is constantly evolving and expanding in terms of the demand for higher data system bandwidth, voice, and video communications. Infrastructure must be planned to be as flexible, expandable, and resilient as possible.

The interbuilding network architecture serving the Western Carolina University Main Campus comprises a backbone optical fiber system in support of many specialized applications including, but not limited to, information technology data and voice communications, video distribution, AV, and security systems.

Presently constructed as a combination of underground and aerial interbuilding outside plant (OSP), the campus is served by the following:

- One building housing the primary Data Center (Forsyth)
- Seven buildings configured as Core Distributors (CD) (Admin, Belk, Bookstore, Forsyth, Graham, Killian, and Reynolds) connecting all other local buildings to the network
- One building housing a video head end (Stillwell), receiving signal from multiple input sources and redistributing them to the campus via optical fiber
- One building that is home to the Campus Police security operation

The Main Campus optical backbone also extends to the Western Campus, which is home to the recently completed Health and Human Sciences (HHS) complex. HHS houses a secondary hot site Data Center that is connected back to the Main Campus via dual redundant backbone links.

One building, Scott Hall, presently houses a voice head end and legacy digital PBX system that will reach the end of its life soon. Scott Hall is also the source of a secondary optical system, serving five PBX system remotes (Balsam, Central Drive, Center for Applied Technology, Bookstore, and Fine & Performing Arts). However, it is expected that this optical system will be abandoned as the University moves toward full-scale VoIP (Voice over IP) deployment. Several Core Concept recommendations will pave the way for just such a deployment by means of an enhanced optical distribution system and options for deployment of new passive system technologies.

TODAY’S CAMPUS CORE CONNECTIVITY PATH

The general topology of the interbuilding network architecture is one in which a series of point-to-point links have been routed through CD buildings so that all of the remaining buildings, referred to as Building Distributors (BD) are served by one of the CDs. The point-to-point links
also form several physical sub-rings that contribute to the redundancy of the system primarily due to multiple links that can be established to the campus Data Center(s). The educational portion of the campus is largely served by underground infrastructure, the residential areas are largely served by aerial, and the HHS complex is served by a combination of both underground and aerial.

INFORMATION TECHNOLOGY STRATEGIC GOALS
A number of strategic goals have been developed by WCU Information Technology Division (IT) for implementation over the foreseeable future. Some of these goals address internal agendas for improvements such as further engagement and support of administrative technologies and business processes, including increasing automation. However, most of the goals discussed can be directly impacted by the implementation of the Master Plan.

The physical improvements to infrastructure and facilities in the plan will directly support the following goals:

• Enhance collaboration across IT
• Co-location of IT groups
• Maintain IT’s engagement and support of instructional delivery technology
• Maintain IT’s ability to support students in academic needs and residential living halls
• Ensure that current and future technology needs are addressed
• Support demand increases of personal technology devices
• Plan for ‘portability’ of technology

These goals directly relate to an overriding goal of the Strategic Vision:

GOAL 5.4: SUSTAIN AND INCREASE INFORMATION TECHNOLOGY CAPABILITIES AND CAPACITY REQUIRED TO MEET THE GOALS OF THE UNIVERSITY.

The improvements to process, design approach, and physical backbone scenarios will help strengthen IT’s ability to support physical growth, bandwidth and utilization increases, and new services and technologies being used around campus. By co-locating the IT groups, better collaboration among team members will enhance the way new initiatives are rolled out, as an increasing number of IT strategies require teamwork among multiple specialties within IT.
10-YEAR CORE TECHNOLOGY CONSIDERATIONS

As projected by the Master Plan, much of the future construction activity is expected to directly affect CD facilities, while other activity will certainly directly affect, or come close to, the pathway infrastructure throughout the campus. There will also be new building construction for which consideration must be given to the most effective way to integrate new infrastructure with the existing.

Some significant factors involve careful consideration of building communications entrance facilities, both existing and those yet to be planned. As presently designed today, campus serving zones have been established based upon a predefined number of buildings assigned to function as a CD. Since the CD not only serves its own internal systems but also those of other satellite buildings, it is considered of strategic value to the campus and must be connected back to the Data Center facilities by means of redundant links. When designated buildings are assigned such a responsibility, a well-organized and manageable data system is the result. However, there are other factors that may need to be considered including those that may arise as a result of issues pertaining to building tenancy. The Health and Human Sciences (HHS) complex on the west campus is to be included as part of the core distribution of that zone.

Figure 7.3 – Existing Campus Infrastructure

Phasing Option A
1. Demolition of Graham: decommission core functionality and redistribute via new optical cross connect
2. HFR Administration Building Renovation: project existing core location
3. Belk Renovation: project existing core location
4. New Science Building: project existing video headend or relocate to another facility
5. Camp Demolition: establish new location for campus police
6. New College of Business: candidate for additional core location
7. Forsyth Addition: project existing campus data center facilities
8. Health and Human Sciences (HHS) complex: project existing core location
Hierarchical star topologies are common in campus backbone networks today. Such a configuration would be simply defined as one in which each building is individually homed to one or more campus data centers. While full stars are more common these days than physical rings, there are advantages to both. Consider the impact when a building containing a CD is slated to undergo a significant renovation, demolition, or has been subjected to a disaster such as fire, water damage, or other conditions affecting its ability to have service restored quickly. This negatively affects internal operations as well as those of other BDs for which it has responsibility to deliver services.

Many times, existing conduit and duct bank systems are filled to capacity, making the addition of new cabling, installation, and management of new systems a complicated, costly, and time consuming proposition. It is the intent of this analysis to offer several significant recommendations that can be accomplished in manageable steps as funds become available to make them a reality.

**Figure 7.4 – Existing Campus Infrastructure**

Phasing Option B

1. Demolition of Graham: decommission core functionality and redistribute via new optical cross-connect
2. New College of Business: candidate for additional core location
3. Forsyth Addition: project existing campus data center facilities
4. HFR Administration Building Renovation: protect existing core location
5. Belk Renovation: protect existing core location
6. New Science Building: protect existing video headend or relocate to another facility
7. Camp Demolition: establish new location for campus police
improvement of the core system

**CORE CONCEPT: OCC – OPTICAL CROSS-CONNECT**

The OCC is a rugged carrier grade enclosure designed to live within both OSP and indoor industrial grade environments. A limited number of OCCs, strategically placed, offer WCU tremendous flexibility and system expansion capacity. The greatest impact of the OCC concept is in its promise to free the campus from its dependency on the tenancy implications of building-based CD installations as WCU moves forward with construction in the next 10 years and beyond. When the OCC system is completed, WCU will have invested in a network infrastructure that benefits from being directly homed to both Data Centers by means of a meshed star topology, ring topology, or both. Specific features of the OCC concept are as follows:

- Provides option to be pad mounted or located in industrial environments such as utility tunnels
- Reduces dependency on internal building locations
- Enhances system capacity and improves disaster recovery
- Offers flexibility to be used as a cross-connect, TDU (Tube Distribution Unit), or fusion splice housing
- Predefines campus serving zones in support of existing and new building construction
- Provides convenient launching platform for expanded campus services such as external Wi-Fi and emergency communications not dependent upon individual building tie-ins

![Figure 7.5 – OCC – Optical Cross Connect](image)

1. Pad mounted above ground or located in industrial environments
2. Reduces dependency upon internal building locations
3. Enhances system capacity & improves response time for disaster recovery
4. Flexible cross-connect, TDU, or fusion splice enclosure serving predefined campus zones in support of existing and future construction
5. Convenient access for campus services such as Wi-Fi, DAS & emergency communications
CORE CONCEPT: ABF – AIR BLOWN OPTICAL FIBER
ABF is an optical fiber cabling system that uses the viscous flow of air to carry small, lightweight multi-fiber bundles into a previously installed network of tubes or tube cables. The concept of ABF is significantly different than the traditional approach, which typically requires a predetermined installation of dark fiber, also implying a requirement for the use of lower-capacity inner ducts, higher cost maintenance holes and pull boxes, proper confined space techniques, pulling equipment, and tensile stress. Characteristics of the ABF concept are as follows:

- Multiple tubes sheathed to create a tube cable. Tube cables connected with push fit couplings and TDUs to create a flexible pathway system.
- Open tubes to provide future proofing and flexibility, allowing new cable requirements to be installed in hours instead of days, weeks, or months as well as the original complement of fiber to be removed and the tube to be re-used if the technology requirements change in the future.
- Maximized use of existing conduit; can also be installed as armored, direct bury for long-haul OSP segments, such as may be the case to the Western Campus site, satellite off-site locations.
- Perfect match for the OCC Concept with “Pay-as-You-Go” expansion and easy upgrade path to new technologies, minimizing risk of un-used investment in dark fiber.

**Air Blown Fiber**

- **Network Moves, Add, and Changes**
  - Immediate Scalability
  - Requires installation of additional cable, open taking weeks or months to plan and install
  - Keeps pace with emerging technology
  - Risk of dark fiber becoming obsolete
- **Installation Speeds of up to 150 feet per minute allow installation anytime and anywhere for quick incremental upgrades**
  - Upgrade reported to take up to 12 times longer at 10 times the cost
  - Dark fiber, once laid, may never be used

**Conventional Cabling**

- **Capacity Control & Allocation**
  - Maximizes conduit space and fiber pathways
  - Consumes conduit space, limiting network expansion and potential capacity; risk of over- or under-provisioning
  - Eliminates the need for additional new conduit construction
  - Leads to congested conduit, requiring installation of additional conduit and cost
- **Planning and Budgeting**
  - Eliminates forecasting future technology requirements
  - Requires predicting future network growth and other variables
  - Pay-as-you-go budgeting
  - Investment in dark fiber
- **Fast and easy installation reduces planning time. Increases responsiveness and controls recurring costs resulting in positive ROI**
  - Extensive project planning slows turnaround, especially for emergencies and network restoration. High installation costs increase recurring costs, inhibiting ROI

- **Quick project turnaround**
  - Time frame of hours rather than days, weeks, or months

**Figure 7.6 – ABF – Air Blown Optical Fiber**

**Figure 7.7 – ABF – Air Blown Optical Fiber Comparison**
**CORE CONCEPT: PON – PASSIVE OPTICAL NETWORKING**

PON is an optical fiber cabling network technology that makes use of point-to-multipoint links that are connected to unpowered splitters enabling a single optical strand to deliver multiple services such as data, video and voice to multiple locations. The recommended system is considered an enterprise version of the well-known FIOS system employing carrier class equipment having five nines of reliability with a MTBF of ~ 100 years.

PON consists of only two primary active components; the OLT (Optical Line Terminal) located in the Campus Data Center(s) and the ONT (Optical Network Terminal) co-located close to the end-user, such as within a residence hall living suite.

**Advantages of the PON concept are as follows:**

- Efficient use of existing optical cable facilities, especially when splitters are strategically placed on each floor of a residence hall facility in lieu of standard structured cabling installation.
- Enhanced management and delivery of services to multiple users with WCU as service provider.
- A single condensed platform, based upon IEEE standards.
- Simplification of tele/data room requirements.
- Estimated energy savings of ~ 50%.
- Estimated installation cost savings of ~ 50%.
- Does not require expenditures and maintenance of Cisco-class switching systems and associated costs such as Smart Net.

**Forsyth - Data Center Requirements**

- Dedicated power
- Rack space
- Connectivity to the Core

**Typical Residence Hall Requirements**

- Two Ethernet ports
- One cable TV jack
- One strand of fiber per room supports all connectivity
- Local patch cords

**Tellabs 1150 OLT (19" 11RU Chassis)**

- 48G of LAG Network Interfaces to the Core
- Up to 8,192 Gbe, PoE Ports
- Fully redundant backplane, switching, power
- 100% Non-blocking architecture
- High Availability ASLAN Certified

**Tellabs 705GR ONT**

- Gigabit Ethernet Ports (4)
- POTS Ports (2)
- 75-Ohm CATV
POL (Passive Optical LAN) technology offers an alternative to the two- or three-tier switched Ethernet design used today by most enterprises. It is an adaptation of GPON, which, as previously mentioned, is deployed to more than 3 million residential customers for the delivery of triple play services. POL represents a substantial bandwidth upgrade for enterprise networks currently operating with 1GbE backbones, while its asymmetrical data rates fit well within the emerging “Internet-centric” usage patterns of office workers. Furthermore, POL is less costly and is not as resource or labor intensive as tiered switched Ethernet networks. POL is standardized at Layer 2 of the OSI model. It would coexist with the University’s existing network architecture. In new buildings, or for upgrades, POL can replace the existing access switches and cabling; where the core hands off to traditional distribution switches, POL simply hands off to the ONT (Optical Network Terminal). Both access architectures (traditional distribution/access switches and POL) can be operated side-by-side with no complications. Some say this approach represents the next big enterprise technology, however, each organization must evaluate the pros and cons, as well as analyze their ROI balancing equipment costs, against energy saving and reduction in administrative overhead. (See Figures 7.8–7.10 on the following pages).

**Data Center Requirements**
- Patch Panels & Interconnects

**Pathway Requirements**
- Individual Strands of Fiber

**Residence Hall Requirements**
- Patch Panels & Interconnects
- Passive Optical Splitters (Fiber Splitter Boxes on Each Floor)
- Horizontal Fiber
- Faceplates
- Patch Cords

**Additional Considerations**
- Condense distribution and access onto one platform in the Data Center
- Moving splitters out to residence halls minimizes consumption of backbone strands
- Minimize or eliminate Telecom Room requirements
- Eliminate HVAC/UPS requirements
- Reduce structured cabling, weight, and space
- Reduce number of active devices to manage (1 OLT)
- Reduce power consumption
- Reduce maintenance costs (IT gear, HVAC, UPS)
Figure 7.10 – PON – Passive Optical Networking – Architecture in Expansion
INCREMENTAL STEPS APPLIED BASED UPON A TRIO OF SOLID CORE CONCEPTS

With the understanding that IT budgets for full implementation may not be available immediately or all at once, it is necessary to establish priorities that can be accomplished as budgets become available. For example, when a building having CD functionality has been scheduled for demolition, the connectivity that it represents can be replaced by an OCC that not only serves the immediate need, but that will also establish a strategic connecting point for that particular zone of the campus. Since each OCC will be provisioned with ABF on a pay-as-you-go basis, backbone capacity is most efficiently served without the concern of overbuilding along with a need to redo the physical pathway conveyances the very next time a new requirement surfaces within the OCC zone of coverage. The optical backbone system makes it possible to deploy multiple services, such as data, video, and voice (both POTS and VoIP) using a single cable media; optical in lieu of copper. In a time when traditional digital/analog voice distribution systems are reaching end-of-life, and legacy copper cabling systems are beginning to become more challenging to maintain, PON makes it possible to redeploy voice services, as well as higher bandwidth data and video distribution all across campus.

Figure 7.11 – Campus Optical Core Connectivity Path

Initial Development
1. Place new occ-1 (optical cross-connect) and redundant abf (air blown fiber) optical feed to Forsyth
2. Re-feed Bird from new occ-1
3. Re-direct original Forsyth/Bird feed to hunter
4. Place new occ-2 and abf optical feed from occ-1 to occ-2
5. Re-feed Reynolds core to occ-2
6. Place new (or rework aerial) feeds from occ-1 and occ-2 to other (non-core) buildings
The Core Concepts, previously presented, represent two passive physical technologies and one active electronic technology that, when combined, represent a powerful “Trio” of building blocks that can be used in combination with existing systems, enhancing the already excellent data strategies of Western Carolina University in terms of capacity, reliability, and disaster recovery. This represents significant savings in capital and operational expenditures.

Figure 7.12 – Campus Optical Core Connectivity Path

Ongoing Development
1. Place new occ-3 and abf optical feed from occ-2 to occ-3 to complete initial implementation of campus-wide redundant ring
2. Re-feed Belk core to occ-3
3. Place new occ-4 and abf optical feed from occ-3 to occ-4
4. Place new occ-5 and abf optical feed from occ-4 to occ-5
5. Re-feed bookstore to occ-5
6. Place new abf optical feed from occ-5 to Forsyth to complete final implementation of abf-based redundant ring
7. Occ-6 provides opportunity to bypass Forsyth if necessary
LEVERAGING CORE CONCEPTS TO ENHANCE CAMPUS COMMUNICATIONS

The establishment of a flexible, high-capacity, campus-wide optical network will pave the way for WCU to realize many benefits in addition to that of a resilient and reconfigurable network topology. Zoned physical access to the high bandwidth optical media will allow implementation of many technologies including, but not limited to, the following:

- DAS (Distributed Antenna Systems) both in buildings and outdoors across campus
- Widespread coverage for outdoor 802.11 Wi-Fi services covering outdoor walking areas, traffic patterns, and sports activities
- Introduction of video surveillance coverage anywhere on campus
- Widespread and reliable emergency communications

DAS technology was introduced to the WCU campus when the HHS Campus came online. It already is perceived as having added value to local communication capabilities. This type of host-neutral, passive antenna system is designed for the transmission of multiple radio frequency (RF) signals simultaneously over a common infrastructure. This platform accommodates a broad range of wireless services operating between 400 to 2500MHz, including two-way radio, first-responder radio, paging, cellular, PCS, and WiFi.

Next generation WiFi, based upon 802.11ac, is expected to be ubiquitous by 2017 and this technology will offer bandwidth that is three times higher than present implementations of WiFi. Not everyone would have expected wireless technology to place the highest demands upon the “wired” network. However, many recent network deployments, as well as structured cabling installations, may not yet be ready for this in-building demand, including 10 to 40Gbps uplinks, PoE+, and Augmented Category 6 horizontal cabling.
Preparing WCU Campus for Next Generation Wi-Fi

1. 802.11ac should be ubiquitous by 2017
2. Approximately 3 times higher bandwidth than 802.11n
   - Theoretical limit of 1.3Gbps (wave-1) and 6.9 Gbps (wave-2)
   - Practical limit is much less especially considering distance
3. 30-40% reduction in battery consumption
4. Things to Consider
   - Switching Infrastructure
   - Channel Planning
   - Wi-Fi Network Architectures
5. All current 802.11ac APs require (2) ‘af’ ports or (1) ‘at’ port
6. Use of a standards-based aggregation method
7. 10Gbps or even 40Gbps switch uplinks at the core 80Mhz channels
INSTRUCTIONAL TECHNOLOGIES
The Division of Information Technology is responsible for developing and maintaining common standards for instructional technology across campus and currently manages the technology in approximately 95 percent of classrooms. Where possible, standard components and replacement parts are used to facilitate maintenance, but due to the constantly evolving technology landscape, these standards are routinely adjusted and adapted to meet academic and technology support goals. Collaboration between IT and departments to support academic initiatives is growing in frequency and importance in the context of facility planning and renovation on campus.

WCU campus IT has stated a desire to streamline operations and maintenance, freeing up more staff time to focus on planning and implementing new projects that support academics, student life, and faculty development as they relate to technology. Instructional technology initiatives both currently underway and planned for the future are an excellent example of cross-departmental collaboration opportunities where the involvement of IT is vital to success. Because WCU IT supports all of the campus’ academic departments, they are a key component to achieving:

- Ensure that current and future technology needs are addressed
- Support demand increases of personal technology devices
- Leverage shared or collaborative technologies/services to address campus needs
- Support emerging trends in instructional delivery
- Plan for the impact pedagogical changes have on technology needs
- Plan for 'portability' of technology

Challenges to comprehensive, proactive technology planning on campus include funding limitations, year-end disbursement timelines, technology obsolescence, and availability of support resources. An immediate challenge in classrooms and other presentation spaces is the transition from analog to digital video. Instructors and guests increasingly are bringing devices with only digital video outputs to classrooms that have no digital input capabilities. Most classrooms fall into this category. One potential solution is to provide network-based screen sharing solutions that are combined with robust wireless coverage. This is one example of a relatively small technology solution that can be used to bridge the divide between a legacy technology classroom and one that is current and state-of-the-art.

The demand for certain classroom technologies and applications will help define space and systems planning, driving the need for close collaboration between the Division of IT, Facilities, and designers. At WCU, there have been increasing requests for capturing and recording student and faculty interactions for in-class discussions and teleconferencing or webconferencing with outside experts. In addition, more than one pilot program for classroom lecture or rich media capture is underway. The sight lines to screens, as well as from cameras to participants, are critical to the success of these systems. Finally, there is a methodical transition from technologies used for teaching and learning from campus-provided to campus-facilitated, driven by personal devices (BYOD) movement.
Finally, there is growing evidence of a methodical transition underway: technologies used for teaching and learning are migrating from campus-provided to campus-facilitated, driven by the bring your own device (BYOD) movement. This challenges the traditional WCU cost model for investment in learning technologies. While the initial investment may be offset by reliance on personally-owned devices and apps, the cost to provide support and management of these technologies is very difficult to quantify and predict ROI. For example, WCU is weighing the potential costs and benefits to increasing wireless network coverage at major spectator sporting venues on campus in an effort to attract students by providing free online access. The allowable and supportable technologies and software that define this institutional to personal transition are in a constant state of review by WCU instructional technology and faculty development IT staff. We predict that as the BYOD movement pushes personal device usage further into the interior of buildings, into spaces such as sports facilities where service is spotty, and into the learning process using apps and smartphones as information portals, the IT department must be reinforced with additional staff to support this growing trend.

CLASSROOM TYPOLOGIES AND SOCIAL LEARNING SPACE

The adoption of alternate teaching and learning pedagogies, beyond traditional place-based lecture, has led to new trends and experimentation in space design. The influences and challenges for designers of technology systems, and the spaces that support learning, are many. They include changing student behavior and expectations, ongoing faculty development, operational budgets and capital improvement funding, and support from IT staff and faculty. Many older buildings on the WCU campus, as in most higher education institutions, were designed for one-way lecture to support class sizes of a fixed number of students. In addition, the metrics used to design these spaces – still often cited by state administrators – focus on how many students can physically fit into the space, without taking into consideration the types of activities that may occur. A large lecture hall may accommodate hundreds of students at 18sf per student, but many active learning classroom activities can demand over 30sf per student.

Western Carolina has implemented a number of SCALE-UP-style classrooms based on the model originally developed at North Carolina State University. The plan identifies the potential to adopt new types of teaching spaces to suit the institution’s vision and its departments’ learning objectives.
STUDENT-LED LEARNING

Traditional lecture is often a one-way information delivery system. In large part, the faculty at WCU structure class time to include some form of group discussion or active involvement by students. Traditional lecture hall design does not facilitate group discussion or individual student engagement in the learning process beyond viewing slides and listening. Active learning models such as NC State’s SCALE-UP and MIT’s TEAL concepts combine the passive listening activities of a lecture with the active learning activities found in laboratory exercises, and the space planning reflects this. These classes typically begin with a brief lecture or introduction, followed by lab-type problem-based learning in small groups where all students are actively engaged. Instructors and teaching assistants act more as guides, helping groups when they reach an impasse but allowing them to work through solutions. Furniture and seating are important to support student discussion and interaction. For instructional technology, the systems must support live file sharing, interactivity with visual data, remote collaboration, BYOD, and access to the Internet and online resources.

At the edge of space planning for student-led learning activities are spaces that function as creation studios. An illustration is the Black Box Classroom, which combines the flexible infrastructure of the black box theater with the functionality and mission of an academic classroom. In these spaces, students are encouraged and required to create their own content and to demonstrate knowledge through presentation, making, and doing. WCU is in the planning stages of such a “Maker Space” to support the higher order thinking skills of analyzing, evaluating, and creating solutions that are desirable attributes of college graduates entering the workforce and graduate research.
ACTIVE LEARNING IN LARGE SPACES

While student-led learning is often associated with smaller, more manageable teaching spaces, it can occur in large classrooms. A popular hybrid model involves taking the tiered lecture hall design and modifying it to support two rows of tables and chairs on each tier. This balances the need for sight lines in large spaces with the ability to collaborate in groups. Students in odd-numbered rows can turn their chairs around to collaborate with peers on even-numbered rows. If groups are kept to four to six students each, a high degree of collaboration and discussion can occur.

Institutions such as University of Virginia and University of Minnesota have developed models of active or problem-based learning in large spaces of more than 150 students, where smaller groups operate relatively autonomously during classes with a limited number of faculty. There can be benefits to the economy of scale for implementing group-based classes, such as dry laboratories in large environments, when separate lecture and multiple labs or seminar spaces typically are employed.
FLEXIBLE LEARNING SPACES

Faculty surveys and interviews revealed that classrooms should support a high degree of flexibility to allow for multiple configurations. Moveable tables and chairs should always be considered when planning future teaching spaces, where specialized furniture or lab desks are not required. Sometimes, nesting tables and chairs can add value to the furniture’s lifespan. Something to consider when planning future classroom space is that a larger footprint often can better accommodate combined classes where 40 or more students are in attendance.

Many institutions are also analyzing spaces that are traditionally underutilized due to space sizes that do not fit current class student enrollment standards. Rooms that are too large can be repurposed to accommodate smaller groups or combined classes with adjustments to furniture, pedagogy, and presentation technology. Likewise, when classrooms seem too small to be flexible, walls separating back-to-back classrooms can be removed, opening much-needed circulation space for group learning activities.
Flexible Learning Spaces
Social Learning Spaces

Students thrive and support each other’s academic efforts when facilities include informal gathering and study areas. The modern academic library is slowly changing from the “third place of learning” in a quiet, individual learning setting to a dynamic, always-on hub for intellectual pursuit and social interaction. Elements of social learning are found across campus, and can be planned in future facilities to provide learning experiences and opportunities. Often, such as in the case for a proposed new Center for Student Engagement (CSE), these spaces are designed to facilitate student-faculty interaction in a less intimidating environment than the formal classroom or professor’s office.

Students will seek spaces for discussion between classes, places to check email and catch up on assignments, and technology-enabled study rooms to work with classmates. These elements should be carefully designed in new facilities as they may require special emphasis on acoustical and technology performance. Spaces often named Academic, Learning, or Technology “Commons” are inherently social learning spaces, where peer-to-peer collaboration should be encouraged and student-mentor consultation supported.

Space types that support learning in a social, semi-public environment are numerous and include computer labs with tables supporting multiple students, group study rooms, collaboration areas and nooks, cafes, and outdoor gathering areas. While these spaces often are intended for ad-hoc encounters, they can serve as assignable classroom space and a resource that students can reserve after class hours. A major goal for future campus IT development is to expand wireless network coverage and Internet access to all academic buildings and the majority of outdoor areas in the campus academic core. This helps students to continue learning on a schedule of their own choosing.
As mentioned earlier, many classrooms at WCU do not support modern digital video connections commonly found on laptops and tablet devices. Rather than creating a massive and expensive overhaul of all classrooms on campus, certain measures can be taken to incrementally improve instructional technology systems. Renovations of outmoded systems and outdated classrooms can take place over the summer break and may serve as influential pilot programs. These new efforts, taken one at a time as year-end allocations, grants, and other funding sources come available can lead to influential updates to IT standards and academic models. In nearly every case and despite the funding source, any implementation of computer, network, audiovisual, or other information technology becomes the domain of WCU (not the department or faculty member) and falls under the support of the IT department. Because of this, WCU IT must be engaged as a partner when new innovations or traditional applications of technology are planned that involve the teaching of students or the interaction of faculty and users.

One of the most notable learning objectives identified by the institution is improved student retention, as the state of North Carolina may associate capital funding approval with a member institution’s ability to retain and graduate its students. Other learning objectives often stated by universities include improvements in attendance, grades, comprehension, participation, and performance by key demographics. In conclusion, the spaces, technology systems, and pedagogical approach for new and renovated facilities should be planned together to support desired outcomes for improving measurable learning objectives.

INSTITUTIONAL SUPPORT AND INNOVATION
Creating a baseline for standard classroom instructional technology is a common goal in educational institutions. It allows for streamlined support and maintenance, provides familiarity to users, and can assist in planning and budgeting efforts. However, rigid compliance to campus standards for instructional technology can have unwanted negative effects. These technologies – and perhaps more importantly, their applications – change quite rapidly. Therefore, it is important to balance the practical elements of standardization with a visionary view of innovation in support of students’ education.
As WCU looks to address the first Strategic Direction regarding the educational needs of its current and future students, a number of factors will come in to play. These four questions help set the framework for your master plan.

1. What skills will students graduating from Western Carolina University need to be productive citizens in career and community?
2. What experiences will you provide them to learn those skills?
3. What spaces will accommodate those experiences?
4. What tools will be needed?

Following is a summary of research-based trends and practices to guide thinking.

Changes in pedagogy, student expectations, campus culture, and corporate competition are resulting in fundamental shifts at many institutions in the state and region. To meet the evolving needs of today’s students, campuses must examine teaching and learning through a new lens. Learning is moving more and more outside the walls of traditional classrooms. Content and context of material is being delivered in homes, cars, coffee shops, and on personal mobile devices. Learning needs to become situated, personal, collaborative, and lifelong. Delivery and facilitation of learning requires new approaches that have a core strategy of re-thinking and re-structuring. The forces that are converging to bring this transformation to life are: economic trends, learning spaces, course redesign and faculty adoption. These ultimately can affect the types of spaces and facilities that will be planned on campus in the near future.
Economic outlook is a real concern on college campuses today. As tuition cost continues to rise, and financial support shrinks, institutions both public and private recognize that they cannot continue to do business as usual. They must become creative in applying technology to deliver a higher quality learning experience for less money. As demand continues to increase and universities are pressures to improve value, they must look at how they can deliver more services without putting strains on current real estate. As addressed in:

**GOAL 1.1 “DELIVER HIGH-QUALITY ACADEMIC PROGRAMS DESIGNED TO PROMOTE REGIONAL ECONOMIC AND COMMUNITY DEVELOPMENT.”**

“A variety of assessment techniques used by TEAL have shown the effectiveness of interactive engagement across a range of student backgrounds. The teaching methods used in the TEAL classroom produced about twice the average normalized learning gains for low-, intermediate-, and high-scoring students when compared to traditional instruction. These findings replicate the results of studies performed at other universities.”

“Corporate and community will take leading roles in helping campuses prepare students for jobs that don’t yet exist, that will use technologies that have yet to be invented to solve problems we don’t even know are problems yet.” –Karl Fisch Shift Happens 2006

Aligned with economic assumptions, comes the need to look at learning spaces with a new view. Digitally motivated students may not settle for lecture halls where “stand and deliver” is the preferred pedagogical choice. As a result of this movement, different kinds of learning spaces are popping up at universities around the country. More than 100 universities have developed their own studio-based active classrooms. A few examples are TEAL at MIT, TILE Classrooms at the University of Iowa, Active Learning Classrooms at the University of Minnesota, and SCALE-UP at NCSU.
When you walk into these rooms you see and feel a difference. They have been specifically created to facilitate active, collaborative learning. They promote interactions between groups of students. There is no front of the room. Conversation and collaboration are happening everywhere. A decade of research indicates these new approaches to educating students are improving student outcomes and reducing delivery cost for institutions.

Research in the science of learning indicates that active learning is one of the most important and essential components in the learning process. In How People Learn, John Bransford and his colleagues explain that when students are actively engaged in their learning process, and when they can apply what they have learned, they retain knowledge. Active learning classrooms focus on social interactions between students and faculty. “What Matters in College” author Alexander Astin explains that the relationships students build with each other and with faculty is the most important outcome of their four-year experience. Active learning classrooms are filled with hands-on activities, simulations, or essential questions and problems where students work as a team to solve real-life issues. Most importantly the traditional notion of classroom is flipped: “what used to be homework happens in the classroom and what used to happen in the classroom becomes homework.” These learning spaces addressed above speak directly to:

**GOAL 1.3 “ENSURE THAT ALL PROGRAMS INCLUDE CROSS-CURRICULAR, EXPERIENTIAL, APPLIED, AND INTERNATIONAL/GLOBAL AWARENESS OPPORTUNITY FOR ALL STUDENTS.”**
Trends in availability of online technologies and research on how we learn all seem to support the growth of blended learning (BL) concepts and are driving the crusade of course redesign. The National Center for Academic Transformation (NCAT) is a forward-thinking not-for-profit organization that is assisting campuses with course redesign. NCAT’s approach brings together face-to-face activity with Web-based content in a planned, pedagogically valuable manner and is referred to as blended learning. It provides today’s students with anytime, anywhere convenient access to materials and blends synchronous and asynchronous instruction to offer new approaches to educational delivery and facilitation. BL is considered an effective and low-risk strategy that helps position universities for the onslaught of technological developments that will arrive in the future. It increases options for greater quality and quantity of human interaction in the learning environment. Students can learn the way that suits them best: on their own time, at their own pace, in their own place, using the tools with which they are most comfortable. As universities look to improving the learning environment in higher education, they must convert teaching from a solo endeavor to a community-based research activity. Because of the different modes of delivery, BL meets the educational needs of a much larger audience. Key baselines to consider with blended learning are: learning outcomes, student satisfaction, retention and achievement. The concepts listed above focus on:

GOAL 2.1 “FOSTER A STUDENT-CENTERED CAMPUS CULTURE THAT EMPHASIZES ACADEMIC EXCELLENCE, PERSONAL GROWTH, NETWORKING OPPORTUNITIES, AND GLOBAL AND SOCIAL AWARENESS.”
NCAT case studies illustrate the success of this model. A recurring theme is that by redesigning courses, universities can reduce costs and teach more effectively. SUNY Buffalo’s course Economics 101 saw significant increase in student learning outcomes and improved student success rates from 67 percent to 76 percent and reduced costs by 46 percent by doubling section size. A team of faculty, administrators and technology experts at Frostburg State University redesigned the General Psych course and significantly increased student performance while reducing instructional costs by 71 percent. Mississippi State showed a cost savings of 25 percent per student. These are remarkable outcomes that are forcing colleges to look seriously at real transformation. Further studies can provide a more comprehensive understanding of blended learning in course redesign and its potential in education, but many universities recognize the need for change and that this solution can be very effective. Susan Patrick, president and CEO of International Association for Online Learning agrees with this analysis. She said the advantage of blended learning over just face-to-face instruction “is the combination of rich student-teacher-peer communication and interactions that are both asynchronous and synchronous, better utilizing precious resources of time during, and outside, the school day to maximize learning and personalize it in a way never before possible.” She states that the factors needed to make blended models better than face-to-face models are the factors researchers define as good teaching: “increased interactions between students and teachers, increased depth of rigor and exploration into content, customized learning to meet the students exactly where they are in learning the material, better use of data to inform instruction, and providing additional student support to help personalize instruction by the instructor.”

Following the current trends discussed above WCU will need a wide variety of teaching and learning spaces on this campus from large and small classrooms, to collaboration spaces, to informal breakout areas which all will have their specific needs. As you consider these spaces it would be helpful to keep in mind these planning principles.

- Is the space flexible?
- Does it have the potential to evolve?
- Does technology support the learning activities?
- Does it support a diversity of learners, a diversity of content, and a diversity of pedagogical approaches?
- Does it enable student engagement?
- Does it foster professional development for faculty?

As we look at the opportunities for delivering the highest quality student educational experience at WCU, blended learning initiatives usher in a new paradigm of education and provides a model for enhanced student-faculty interaction. A close look at the learning and teaching relationships that facilitate a community of inquiry and build upon cognitive, social and teaching presence are at the heart of this pedagogical approach. A theme of engaging, enabling and empowering learning must replace traditional approaches to meet the needs of our wired students who desire to be able to work, learn, and study whenever and wherever they want. The abundance of resources and relationships made easily accessible over the internet is driving us to revisit our roles as educators. This creates a challenge to all and a shift in thinking that policy and leadership must endorse for transformation to take place.
6. Student-Centered Active Learning Environment for Undergraduate Programs, http://scaleup.ncsu.edu/
9. Salman Khan, Khan Academy, Presentation at TED 2011, http://www.youtube.com/watch?v=gM55HH4gLk
10. The National Center for Academic Transformation, www.thenCat.org
CHAPTER 8

SAFETY & SECURITY

WCU seeks to implement physical security solutions that proactively meet the long-term mission of the campus. This section outlines planning principles that can be used to guide future decisions for technology implementation, staffing, policies and procedures, and refreshment.
PLANNING PRINCIPLES

By understanding the needs and concerns of its constituents, WCU can implement physical security solutions that proactively meet the long-term mission of the campus, rather than implementing short-term solutions that are more reactive to deficiencies. Additionally, unexpected year-end funding or grants can be applied to security upgrade projects independently of capital projects. Campus safety and security personnel identified several goals that are affected by the master plan that include:

- Incorporate issues of safety and security in planning for new buildings or renovation of existing buildings
- Detail equipment and technology resources necessary to secure the campus and ensure business continuity and disaster recovery
- Assess the impact of steps taken to ensure safety and security on campus employees, students, and visitors
- Set physical security design standards in new building plans and in renovation and repair plans
- Partner with external agencies to ensure campus safety and security where prudent
- Understand and mitigate how the physical layout of the campus affects communication response systems and coordination
- Balance access to space and equipment in buildings and the need to mitigate risk

These questions are largely addressed in this section of the master plan. The topic of disaster recovery is addressed in more detail in the Information Technology Core Infrastructure section. Namely, the development of redundant network and communications strategies including the implementation of optical cross-connect facilities not tied to physical buildings requiring maintenance and replacement is a major consideration to improve business continuity. The needs for partnering with external agencies to support safety and security should be addressed internally as it relates to operations and governmental contracts beyond the reach of the master plan.

To provide a foundation for decision-making by designers and stakeholders now and in the future, and to reinforce the plan’s intent, the following planning principles can be used to guide future decisions for technology implementation, staffing, policies and procedures, and refreshment.

GOAL 5.5: “MAINTAIN AND IMPROVE CAMPUS SAFETY SYSTEMS, CAPABILITIES, AND INFRASTRUCTURE IN SUPPORT OF THE UNIVERSITY’S STRATEGIC PRIORITIES.”

In this section, recommendations are offered for facility and infrastructure considerations that relate to the overall Master Plan. Please also refer to the “Improving Technology” infrastructure section of the Plan.
Balance: Safety
Physical security systems shall be designed to improve student, staff, and visitor safety with the understanding that balancing how security is perceived in a collegial setting is an important influence on planning.

Balance: Privacy
Physical security systems shall be designed to improve safety while being sensitive to the privacy concerns of students and staff.

Adaptability
Systems and procedures should be able to adapt to heightened security levels or concerns by implementing additional measures when appropriate.

Industry Best Practices
Systems shall be designed to comply with industry best practices, based on operational needs of the facilities.

Interoperability
Interoperability of the security systems is key to the daily and long-term operations of campus facilities by safety personnel and administrators. Proprietary systems and components should be avoided.

Ease of Operation
Systems shall be designed to operate simply and efficiently. Whenever possible, the solutions should require a minimal amount of training to operate effectively by safety personnel and staff.

Supportable
Systems must be supportable by campus and departmental technical personnel with limited outside technical assistance. Multiple companies should be able to provide service and maintenance on installed products.

Integrated Solutions
Systems will strive to deliver seamless integration of technologies with facility architecture and enterprise systems.

Cost Effective
Solutions will use financial resources effectively, efficiently and strategically.

Goals and Objectives
Goals should be realistic. Interim objectives to reach overall goals should promote visible results that staff and students can take pride in achieving.

Strategic Vision Goal 5.5: “Maintain and improve campus safety systems, capabilities, and infrastructure in support of the University’s strategic priorities,” including its underlying initiatives from the WCU Strategic Vision, states in a general sense much of what needs to be addressed for future safety and security improvements. In this section, recommendations are offered for facility and infrastructure considerations that relate to the overall Master Plan.

A BALANCED APPROACH TO SECURITY
Modern-day facility crime prevention has evolved into a three-phased dynamic, which addresses all facets of a comprehensive security program. A balanced approach to facilities security involves three main aspects: the first is the use of CPTED (Crime Prevention Through Environmental Design), the second is Electronic Security (Intrusion Detection, Access Control, and Video Surveillance), and the third is the use of Staff (the “face” of security).
Crime Prevention Through Environmental Design (CPTED) is defined by the National Crime Prevention Institute as the proper design and effective use of the built environment, which may lead to a reduction in the fear and incidence of crime and an improvement of the quality of life. CPTED’s goal is to prevent crime through designing a physical environment that positively influences human behavior – people who use the area regularly perceive it as safe and would-be criminals see the area as a high risky place to commit crime. The principles of CPTED are being applied on new campus construction projects and renovations, including the removal of landscaping that goes against CPTED principles.

An effective security plan for campus facilities needs to be formed with a balance of Deterrents, Delay/Denial measures, Detection mechanisms, and appropriate Responses supported by a comprehensive set of Security Policies and Procedures. The program should be built around the “Rings of Protection,” using CPTED principles. Deterrents include physical items such as signage, lighting, security officers on patrol at irregular times, clear (hiding-free) zones, and psychological elements, including observant people, unobstructed views of critical areas, site illumination, and video surveillance systems.

Delay and Denial mechanisms include physical restriction items such as locks, doors, vehicle barriers, fences, bollards, walls, and access control systems. Detection systems may include alarm systems, video surveillance cameras, campus police, and observant facility personnel. Response may include lights, audible alarms (bells/sirens/horns), alarm transmission and notification systems, or safety personnel intervention. The ‘Rings of Protection’ concept places Deterrent, Delay/Denial, Detection, and Response elements immediately around the target to be protected, at the perimeter of the property and between the perimeter and the target ring as illustrated below.

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Outer Ring
- Site lighting
- Fences
- Gates
- Bollards
- Walls
- Safety officers on patrol

Buffer Ring
- Locked perimeter doors
- Receptionist
- Badge checks
- Access control system
- Window bars/graftes
- Mail screening

Inner Ring
- Attentive personnel
- Interior door locks
- Intrusion detection
- Visitor escort policies
- Access control devices
- Emergency communication system
- Secure areas
- Video surveillance and recording
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CPTED is defined as a multidisciplinary approach to deterring criminal behavior through the design of the environment. CPTED strategies rely on the ability to influence offender decisions that precede criminal acts by affecting the built, social, and administrative environment. CPTED strategies are based on the following four principles:

Natural Surveillance
Natural Surveillance calls for creating an environment where the occupant has an enhanced ability to observe the surrounding environment and the potential offender has a heightened perception of the increased risk of being observed. Design principles include creating good sight lines and minimizing visual obstacles so that the occupant has a high degree of visual control. People will always feel safer when they can see and be seen. This feeling is promoted by features that maximize visibility of people, parking areas, and building entrances: doors and windows that look out on to streets and parking areas, pedestrian-friendly sidewalks and hallways without areas for adversaries to hide, and parking layouts that maximize visibility.

Proper lighting also will create an effective deterrent to crime, because good lighting discourages criminal activity, improves visibility, and reduces fear.

Many WCU representatives indicated that site lighting is in need of improvement: better uniformity, better coverage of pedestrian paths and parking areas, and more reliable power systems.

Natural Access Control
Facility and site design can decrease criminal opportunities by denying access to targets and creating a perception of risk in would-be offenders. This is achieved by designing streets, sidewalks, building entrances, hallways, and lobbies to indicate public routes, and discouraging access to restricted areas with structural elements. Providing for a single visitors’ entrance, which is clearly indicated and is situated so that the “natural” traffic flow leads to a reception desk, is a good example of Natural Access Control.

Territorial Reinforcement
Physical design can create or extend a sphere of influence. Users develop a sense of territorial control, while potential offenders are discouraged. This is promoted by features that define property lines and distinguish private spaces from public spaces using landscape plantings, pavement designs, gateway treatments, doors, and walls. When a window is broken and not quickly repaired, or graffiti appears on the outside of a public facility, it is likely that more windows will be broken, or more graffiti will appear, because the criminals’ perception is that the facility is no one’s responsibility. Conversely, when the damages are quickly repaired or cleaned, the appearance is that the facility is being “watched over,” making it less likely to be damaged again.

Target Hardening
Target Hardening is an extension of CPTED, making a site or building more difficult to access or enter using force. It is accomplished by features that prohibit access: window locks, dead bolts for doors, interior door hinges, or vehicle bollards.
STAFF CONSIDERATIONS

Campus staff that manage planning, operations, and maintenance of security systems and policies are central to the security plan. The WCU Police Department and Emergency Management serve as the lead units responsible for public safety at WCU.

WCU has limited staff to manage the systems and services currently under its control. Future upgrades for campus systems, facilities, and services should focus on operational requirements before such enhancements are implemented. The majority of campus police staff are located in a 5,100 square foot area of the Camp building Annex. A consolidated Public Safety space is proposed as part of the new Parking Deck and Welcome Center in the 10-year plan to provide more efficient safety and security related services on campus.

Campus Police

The University Police Department is a service-oriented law enforcement agency responsible for providing a full range of law enforcement and security services to the campus of Western Carolina University. The Police Department is also responsible for administering the campus parking and transportation program CAT-TRAN.

Emergency Management

Emergency management is the managerial function charged with creating the framework within which the University reduces vulnerability to hazards and copes with disasters. Emergency management protects the University by coordinating and integrating all activities necessary to build, sustain, and improve the capability to mitigate against, prepare for, respond to, and recover from threatened or actual natural disasters, acts of terrorism, or other man-made disasters. The Emergency Management function of the University also oversees the dispatch function which handles all on campus emergency communication and manages all emergency alert systems.

IT Support

At Western Carolina, as is the case at many universities, daily security and safety management is not solely the responsibility of Campus Police. The IT department maintains electronic security components that reside on the campus network, notably IP-based video surveillance cameras and their digital/network video recording appliances and servers. When significant weather or safety events occur, Campus Police coordinate with IT to make announcements via a campus Web page, text message alerts, and through audible sirens, if necessary. The campus IT staff must be consulted frequently about expansions or changes to existing electronic security systems on staff that utilize IT resources.
ID Card Access Infrastructure

Card access to student residential buildings and other electronically secured facilities and services on campus is possible through WCU’s CatCard, a multi-function “one-card” that combines a picture ID with secure credentials. The CatCard identifies students, faculty, and staff members provides access to many other vital functions on campus. Until recently, CatCard use was fairly limited to student residential and Campus Recreation Center access, library book checkout, and point-of-sale functions on campus such as dining facilities and bookstore purchases.

The access control function of the CatCard had its beginnings in campus residence halls but has spread to new academic buildings on campus, including Health and Human Sciences (HHS) on the Millennial Campus. The CatCard database and card management continues to be managed by Residence Life.

Current WCU staff are stretched thin managing the current access control functions of the one-card system. The system was not originally envisioned or planned to support all facilities on campus, yet new buildings are requiring electronic access control capability.

It is our recommendation that a plan be implemented to transition the access control system to a University wide system and that management of this system be centralized. This would require prioritization and identification of an appropriate level of resources to manage the system: including providing adequate staffing, training, IT support, and integration with the campus residence hall, enrollment and staffing databases.

Faculty and Staff

Faculty and staff are a key part of the operational equation for a robust security plan. At a minimum, staff should be educated to avoid allowing the following common security risks: piggybacking and door propping.

These security risks are common in commercial and educational facilities, and are more passive in nature as opposed to more obvious and easily-understood active security breaches such as forcing open doors, crashing through vehicular gates, etc. Piggybacking is one of the most common methods for criminals to easily gain entry into a facility without alarming security staff. It comes in many forms, but it basically refers to an unauthorized person gaining entry by following an authorized individual into a secure area of a building. In vehicular entries, it is commonly known as “tailgating.” For example, a perimeter card reader door could be circumvented by an individual waiting outside while smoking or talking on a cell phone. If a staff member exits this door without confronting the person, he or she may simply slip in as the staffer exits. Often, unauthorized persons will gain access to facilities by following staff members past a check point. Students should also be oriented to understand that thieves may gain access to residential facilities using these methods.

Propping doors open is a major problem in many facilities. Such a practice is an invitation for a criminal to gain entry into secure areas. Doors are most often propped open when staff members go outside to smoke or need to make a quick trip outside for another reason and don’t want to be forced to walk further than necessary. Adding card readers to certain doors should alleviate this situation, but staff members will be required to keep credentials with them for building re-entry. At a minimum, all unmanned or unobserved perimeter doors should incorporate alarms. Door-prop alarms would sound a very loud local nuisance alarm when doors remain open for more than 15 seconds, or other predetermined period of time. Emergency exit doors should sound an alarm immediately if used. Personnel can also be alerted through the access control system software, and migration of responsibility for monitoring this software should eventually fall under the domain of Campus Police.
**ELECTRONIC SECURITY**

The four elements for an effective electronic security plan are: Access Control, Video Surveillance, Alarm Monitoring, and Emergency Call and Notification.

**Access Control**

Access Control utilizes devices such as proximity readers, in conjunction with electronically controlled door locks, to provide for entry control into selected portions of the building. The technology also provides a record of who has had access to certain areas and when. Card access is generally provided for all main and secondary entrances, staff-only entrances, and all doors to areas containing high value items, but each facility has its own standards of which doors will require card access.

The expansion of campus access control systems beyond its early implementation in residential buildings has burdened the WCU safety and Residence Life staff. The construction of the HHS building has doubled this burden from a card access credential enrollment and maintenance standpoint. A major obstacle that must be addressed is database management, specifically the ability to automatically update the access control database when students are no longer enrolled in classes or are no longer living in on-campus residential housing, faculty have relocated, and staff are no longer employed. Currently, the database is not updated consistently when faculty, staff, or students are no longer authorized to use campus facilities and services.

There is some agreement on campus among safety and Residential Life staff that a new platform for campus access control is desired, and that additional staffing is required to properly maintain the system. Future plans should seek solutions that are non-proprietary and integrate well with other campus safety and IT systems. Some access control platforms are now Web-based and do not require local servers or proprietary hardware to operate. Likewise, access control systems should be able to integrate directly with campus video surveillance systems. When an access control alarm event occurs, it is valuable to have a live video window displayed from a nearby camera. It is also recommended that any long-term access control cards issued to non-employees only be done after a thorough screening of the individual. Providing non-employees free access through secure doors should be done only when absolutely necessary and with the authorization of the Campus Police department.

**Video Surveillance**

Electronic surveillance is a widely used method of observing and recording the events within and around the campus facilities through the use of discrete cameras and electronic control and storage devices. Generally, a camera is most useful when it is visible to the public, but enclosed in a round, darkened enclosure. While every campus is different, students and staff have come to understand video surveillance as a useful tool helping to ensure safety on campus. This is especially true for remote areas, pedestrian walkways, and parking lots where a criminal may lie in wait for an isolated victim to approach.
Cameras should be located in appropriate quantities and locations as needed to provide visual records of high traffic areas including entrances and parking areas. Recording systems include “watermark” capability, which makes the recorded video admissible as evidence in a court of law when needed. The ability to record audio with the video stream is not a standard on campus, but might be a consideration for special situations. Campus standards for facilities address resolution, compression and bandwidth, storage duration, and network architecture that all require direct planning with IT department representation.

Video surveillance on campus is generally limited to recording video events at facility entrances and exits. Additional cameras can be added to monitor sensitive areas where cash, chemicals, drugs, or other sensitive or valuable items are stored. In addition, it is recommended to add video surveillance and associated signage at the water treatment facility, building generators/UPS, or any other high-risk areas, where tampering with critical campus systems is a risk.

Electronic Surveillance should not be used as a substitute for designing Natural Surveillance features into the building and the site, but it can be used to offset any inadvertent blind spots created by the facility. It must be understood that cameras are a secondary resource to the natural surveillance features of a facility. Camera systems on campus are not monitored in real-time. While advanced video surveillance systems can serve as a deterrent and identify suspicious persons and behavior, the primary benefit of this system on a college campus is to provide a video record of an incident for future response and prosecution. This is an important point when dealing with campus user groups who are unfamiliar with campus electronic security systems. Good facility design will minimize access to/from facilities and sensitive functions while meeting egress codes, also help to limit the investment in video surveillance.

Alarm Monitoring
Alarm monitoring on campus generally covers intrusion detection that can be an element of access control systems. Intrusion detection requires devices such as magnetic door contacts, motion sensors, and glass break detectors to create a secure, outer building detection envelope. The system can be turned on and off on a daily, weekly, or monthly calendar, and it includes control panels to allow access by authorized personnel. The system can sound an audible alarm, notify staff, notify campus police, or any combination of the above. Since many buildings will have multiple public access spaces on multiple floors, systems should be set up in zones that provide sufficient detail to indicate the type of problem and its appropriate response. A growing trend is to provide duress button alarms for faculty and staff. This is especially true in higher-level dean and administrator suites, where cash may change hands, and where people are at risk for assault or confrontations. Duress alarms should be uniquely identifiable to safety staff no matter what technology is employed.

Emergency Call and Notification
Campus emergency call boxes are located in some areas of the campus, but a more uniform and ubiquitous coverage of call boxes is a common desire of students. Many of the current call boxes were implemented through grant funding years ago and use solar panels with batteries and radio communications for operations. Newer units, such as those located at the HHS building, use hardwired power and telecom connections. The former approach is suitable where power and telecom infrastructure access is difficult; the latter is appropriate where access and site work are simpler, such as in new building construction.

There are three outdoor emergency sirens that can sound alarm signals and voice alerts across campus. As the campus expands, the siren system will need expansion or reevaluation for relevance in light of modern personal communication devices. Though uncommon, facilities may employ overhead paging systems for emergency notifications, and digital signage is often incorporating these features in university buildings. WCU is currently piloting integration of desktop computer-based notification that integrates with campus digital signage. Audible, visible, and personal IM/text alert capabilities should all be considered as part of the campus security plan moving forward.
EMERGENCY VEHICLE ACCESS
The proposed new main entrance improves emergency vehicle access, especially from the Cullowhee Fire Station on Little Savannah Road. It would also enhance vehicular evacuation, should that be necessary.

The topography and narrow streets that characterize upper campus are a challenge for emergency vehicles. WCU Police noted that they often move their EMT operations and Ambulance to lower campus in anticipation of inclement weather. The roadway improvement recommendations on the old/upper campus (Joyner/Chancellors/Young Drives) will significantly improve emergency vehicle access by providing wider, straighter alignments or roads and direct access via the new connection to Central Drive (south). Eliminating or consolidating small parking lots in the campus core reduces traffic congestion that could impede emergency access, especially since many of these lots currently serve as pedestrian and vehicular access/circulation routes. Careful design of plazas, pathways, and service roads will maintain or even improve emergency vehicle access. A recent restaurant fire on Centennial Drive demonstrated the problems that can be caused by cars parked immediately around buildings, especially when they are parked between the buildings and the only access road. In some instances, removable or mechanical bollards may be installed to mitigate this risk. However, campus safety and facilities personnel must be consulted as removable bollards can pose a challenge to operations, especially in the event of an emergency at during non-work hours.

Consolidation of parking allows more effective and efficient monitoring by police, especially if a police post/office is planned as part of the deck. Scattered, irregular lots tucked between buildings and vegetation encourage hiding places for perpetrators. Modern deck designs minimize such hiding places, and can provide vastly improved lighting and surveillance. Creating long, continuous visible sightlines through parking decks from the outside and vice-versa is an excellent way to support territorial reinforcement of safety for visitors using a parking lot or deck.

Most mass-evacuation events (chemical spill, explosion threat, etc.) would require evacuation on foot, rather than by car or bus. The pedestrian improvements in the Master Plan provide benefits in this regard. New building designs should allow for safe gathering areas within close walking distance outside of facilities.

SITE CONSIDERATIONS
- Create a soft site perimeter around campus facilities, implementing video surveillance of all potential pedestrian access including associated signage.
- Incorporate analytics such as motion sensing based recording and alarm/alert at pedestrian and vehicular access areas.
- Improve site lighting, especially in parking lots, at stairwell and elevation transitions, and around buildings.
- Add license plate recognition (LPR) analytics to new camera positions at the vehicular entrances to the campus. LPR systems can integrate site cameras with patrol vehicle cameras, tying in to a central server referencing law enforcement databases.
- Install door contacts with hold-open alarms at all exit doors; exit-only doors should not have exterior pull hardware.

BUILDING PERIMETERS
- Creating a defined perimeter around buildings is an essential component to any physical security plan. Since the majority of personnel and assets are inside buildings most of the time, defining and securing all potential points of access into the buildings is critical to the overall success of any facility project. This includes public access doors, staff-only doors, and emergency exits required by code. It also includes any vulnerable points that could serve as entries such as low-level windows, loading docks, and other less-obvious weak points.
• Incorporate video surveillance cameras at building perimeter doors to capture foot traffic entering or exiting facilities.

• Install door contacts with hold-open alarms at all exit doors. Exit-only doors should not have exterior pull hardware.

**INTERIOR SECURITY MEASURES**

Opportunities for creating an “interior perimeter” within the campus buildings should be pursued, as this directly relates to the Rings of Protection concept of CPTED. An interior perimeter could take many forms, but the primary goal is to delay or deter a crime or significant interruption of building activities. Such a measure would create a buffer zone between highly sensitive areas such as cash assets.

Another application creates zones within a building that operate on a different schedule. For example, there is high demand to use the Technology Commons in the Hunter Library beyond the library’s operating hours. If this area were reconfigured with additional entry/exit paths and able to be cordoned off separately from the library as a whole, the Technology Commons would see increased usage at all times of the day. The concept for student-accessible commons space will be pursued and applied in many buildings types in the future at WCU. The design of these facilities must take into account the desires of students and the understanding that learning may take place at any time. The facilities and spaces that support learning will need to balance access to internal spaces due to need and level of authority or responsibility. It is much easier to plan this into building designs rather than remediate facilities with electronic security measures.
APPENDIX B

PARKING & TRANSPORTATION

VHB