# Purpose

## This “best practices” guideline serves as a resource to all constituent institutions and affiliated entities to achieve the goals of the [UNC Sustainability policy](http://www.northcarolina.edu/policy/index.php?pg=vs&id=5606), specifically related to the development of sustainable, high performing facilities. This guideline is endorsed by the President and shall be reviewed every two (2) years by the President. Any necessary revisions and modifications shall be recommended to the Board for its consideration.

# Master Planning

## Sustainability principles related to infrastructure, natural resources, site development, and community impact shall be incorporated into comprehensive master plans.

* Sustainability Guiding Principle – commitment to sustainable design and construction that creates lasting value for the campus communities and the state of North Carolina. The UNC System’s sustainability commitments ensure the highest quality of stewardship, adaptability for future growth and well-being of the campus community. To reduce the UNC System’s environmental impact, all campus projects include sustainability goals that protect and enhance ecosystems for current and future generations of North Carolinians (Source: NCSU Sustainability Guiding Principle).
  + Ecosystems
    - Forests, meadows, wetlands, streams, lakes, and ponds are important to the UNC System and the state’s heritage, as are the natural topography, urban tree canopy, and urban wildlife. All of these features add diversity to the landscape and enrich campus neighborhoods. Ecosystems provide teaching opportunities and learning experiences and contribute greatly to a sense of community and belonging and thus aid the UNC System in its educational, research, and service missions. The campuses will actively preserve and/or enhance natural wildlife corridors and specified Ecosystems. The UNC System will be a model of sustainable environmental stewardship for the state. It will develop the campuses in a way that sustain the natural environment for both the campus communities and its neighbors by following and exceeding state and local environmental standards.
  + Ecosystem Standards
    - Meadows - have value on campus for aesthetic, ecosystem, educational, water efficiency and fuel reduction benefits. Meadows are a temporary landscape feature in the natural succession process, in which meadows eventually become wooded. Meadows require only minimal mowing.
      * Maintain graded future building sites as meadows.
      * For cleared areas that are not planned for student/staff/faculty programming, meadows should be designed.
      * Native grasses and wildflowers should be encouraged to grow in these areas, through naturalization and/or seeding.
      * A mowed edge at the visible border should be maintained in order to uphold continuous UNC System standards
    - Forests - Wooded areas add value to our campus by providing shade, aesthetics, wildlife habitat, air and water quality, as well as recreation and learning opportunities.
      * Preserve, enhance, and increase forest lands and tree cover, when possible
      * Manage trees to provide aesthetic and climate benefits, including planting, trimming, removing, and replanting trees.
      * Plant diverse native tree species to favor native wildlife, reduce non-native species, and eliminate invasive species
    - Streams - Natural drainage ways should be open, rather than being buried and invisible. At the same time, the UNC System protects downstream resources and neighboring properties from destructive runoff.
      * Stream corridors and buffers are protected and enhanced for wildlife habitat.
      * Development within the watershed protects or enhances the vegetative stream buffer, water quality, and stream channel.
      * Storm water controls are located near the source; the impact of storm water runoff is minimized by conserving adequate stream-corridor buffer width.
      * New construction does not deposit piped storm water directly into creeks.
      * During campus development, storm water control methods are used to manage flow to creeks and increase/improve the stream buffer zone.
      * When stream bank stabilization is required, bioengineering concepts are used.
      * Existing conveyances and management measures at creeks, streams, and drainage ways that handle storm water generated from a site under redevelopment are examined and repaired or renovated in a manner to improve the stream channel.
      * Tree canopies are maintained over creeks and streams.
      * Streets and paths are bridged over streams rather than the streams being diverted through culverts.
      * Access and visibility to streams is increased.
    - Storm water - Storm water projects should address runoff as close to the source as possible, upstream of potential erosion and flooding impacts. Each new development project addresses storm water as a campus-wide integrated system with management measures to:
      * Prevent erosion due to land disturbance
      * Manage erosion through the use of appropriate ground cover materials
      * Keep flow to predevelopment levels.
      * Manage storm water close to the source.
      * Storm water conveyances and management measures are developed as features in the landscape where feasible.
      * Minimize contiguous impervious area.
      * Maximize infiltration of storm water into the soil.
      * Consider projects that remove and replace impervious pavement with pervious surfaces, especially in campus areas prone to flooding.
      * Prevent pollution of surface waters.
      * Control nutrient levels leaving the site
      * Comply with or exceed storm water management regulations.
      * Minimize negative impacts on humans and the environment.
      * Be visible for teaching and educational outreach
      * Utilize innovative, low maintenance methods for keeping storm water onsite, such as infiltration devices, vegetative practices, and detention/ retention facilities.
    - Vegetation - The choice of campus vegetation is important for maintaining UNC System aesthetics, research opportunities, wildlife habitat, and human food.
      * Provide examples of rare indigenous vegetative types as valuable teaching tool and an environmental resource.
      * Provide access to Natural Areas with pedestrian pathways.
      * Use predominantly native plant materials in natural and naturalized areas, greenway corridors and along creeks, streams, and drainage ways.
      * Maintain street-tree canopies to provide a continuous habitat for birds and other urban wildlife and to provide shade for pedestrians.
      * UNC System plantings must include appropriate native plant materials adequate to provide food and cover for urban wildlife.
      * Exotic plants may be used in the landscape for diversity, human food, and research purposes, but invasive species of exotic and native plants are not to be used
    - Topography - Topography indigenous to campuses is one of the greatest defining characteristics. The ridges, valleys and other natural land forms are the inspiration for the arrangement of neighborhoods, respecting the lay of the land.
      * Buildings, streets and other infrastructure respond to and enhance natural land forms.
      * Plan for correct solar orientation of buildings to minimize heat gain.
      * Maintain open views from hilltops and high promontories.
* Sustainable Design - The UNC System’s commitment to sustainability and efficient, responsible development takes many forms. For the protection of Ecosystems, it includes creating a campus more inviting for walking than for driving, the use of recycled materials in construction, and the renovation and reuse of existing structures. Whenever feasible, the UNC System places buildings on sites that are in need of repair and designs them in harmony with the natural contours and other features of the land. Proper building siting can have the single largest impact on building performance and often has little or no construction cost implications. During the early design process, consideration of solar orientation, wind, and various climate and microclimate factors, including vegetation, can reduce energy requirements, increase natural ventilation, and improve the quality of interior daylight. Building materials and systems selections are made early in the design process to allow for sustainable choices to be incorporated throughout the design and construction phases of the project development. The design and construction of every building allows for its efficient maintenance, creative adaptability, and renewability. To ensure that these and other important factors are integral to building design, a full life-cycle cost analysis is a part of the early development process. Considerations to reduce negative externalities are included in the project plans and specifications. Examples include: specifying using building materials sourced within a 500-mile radius of the construction site to avoid excessive pollution to the public caused by shipping methods and distances; managing storm water to avoid damages to the public downstream; and reducing or eliminating consumption of fossil fuels, which pollute public air.
  + Sustainable Design Standards
    - Community Connectivity
      * Reduce distances between necessary services by creating walkable, dense, mixed-use neighborhoods with both housing and dining that maximize developed open space and preserve campus natural areas.
      * Make an interconnected network of sidewalks, greenways and streets with slow speeds to reduce traffic congestion and to provide safe, pleasurable walking and biking
    - Site - A building’s long axis is oriented east/west and windows are oriented north/south whenever possible to take maximum advantage of natural light while limiting solar heat gain. Where the long axis cannot be oriented east/west, configure portions of the building’s footprint to achieve the same goals.
      * Space is provided on the south-facing side of each building to accommodate informal gathering places.
      * Buildings located on the south side of a Shared Open Space are designed so that the shadow they cast in the open space is minimized.
      * Building footprints are minimized with multistory construction to ensure each site has space for outdoor common areas and Hearths.
      * Use of green roof technology is encouraged to lessen the impact of storm water effects and reduce the intensity of heat islands.
    - Materials - Life-cycle environmental impact, durability, and long-term maintenance and operation costs are considered when choosing materials.
      * The design lifespan of all buildings, new and renovated, is a minimum of fifty years.
      * Renovation and reuse of existing structures extend the life of existing buildings and reduce consumption of materials.
      * Select materials that are harvested and manufactured locally, have recycled content, or are from rapidly renewable or certified sustainable resources.
    - Recycling and Reuse - Every building has adequate accommodations for the recycling of common material (paper, glass, aluminum, and so forth) easily accessible to individuals and to service providers.
      * To be effective, planning for the reduction and recycling of construction waste must be included in early design phases and careful specifications. Use of manufacturer recycling programs should be utilized to reduce material in waste stream.
      * Projects must follow a Construction Waste Management Plan which specifies a minimum landfill diversion rate of 50% and encourages reuse and recycling of building materials. Construction, deconstruction, and site grading materials should be diverted to beneficial reuse. .
    - Indoor Air Quality and Environment - To ensure healthy indoor air quality, employ adequate outside air changes, use materials with reduced air contaminant emissions, and carefully design and maintain mechanical systems.
      * Design a separate outside exhaust system where chemical use and storage or other air contaminants occur within buildings.
      * Provide occupant control of thermal, ventilation, and lighting systems to support optimum health, productivity, and comfort.
      * Plan for carbon dioxide and humidity monitoring equipment.
      * Ensure that building occupants are not exposed to environmental tobacco smoke.
      * Improve the indoor environment for productive work and study by providing daylighting, acoustics attenuation, and views to indoor or outdoor vegetation.
      * Placement of exterior and interior glass is aligned to bring natural light further into the building. Light shelves, reflective or white ceiling systems, and light colored interior finishes should all be considered to maximize the effectiveness of the daylighting strategy.
      * Place and maintain mats at exterior doors to minimize dirt and pollution in buildings.
      * Locate noisy exterior activities and mechanical equipment to minimize the impact on building occupants, particularly in critical task areas such as classrooms and research and study areas.
      * Locate air intakes far away from loading docks and other sources of poor-quality air
    - Energy - The UNC System strives to exceed the North Carolina State Energy Code for both new and renovated buildings.
      * The optimum level of energy efficiency for the building and systems will be established by schematic design phase.
      * To reduce ozone depletion, existing mechanical equipment that uses CFC-based refrigerants will be replaced.
      * Energy use will be reduced with controls and sensors that minimize consumption when buildings are not in use.
      * Electricity, steam, chilled water, natural gas, and domestic water usage are metered for each building to build an energy consumption database.
      * Commissioning and retro-commissioning are budgeted for each major facility to optimize building systems equipment and minimize energy waste.
      * Employ renewable energy sources and energy-saving building technologies to allow for downsizing of heating and cooling systems.
      * Control heat loss and gain through building envelope design, which includes insulation and glazing/shading choices, and by limiting heat loads from lighting and equipment.
      * Innovative water saving, energy saving and energy generating technologies will be factored into project scopes; solar energy, green roof, and gray water-use features will be considered for campus projects.
    - Water - A water management plan is developed with the project design.
      * Domestic water is metered at each facility and a post-occupancy evaluation measures peak water use data for future planning.
      * Water-conserving fixtures and equipment are used to minimize potable water demand and to decrease wastewater generation. Where feasible, collection and reuse of non-potable water is included in project building and renovation scopes.
      * The UNC System prefers the use of landscaping with plant materials tested for adaptability to the region, including indigenous plants to minimize irrigation needs.

## Master Plans (examples)

## UNC Chapel Hill [http://www.fac.unc.edu/PlansPolicies/CampusMasterPlan](http://www.fac.unc.edu/PlansPolicies/CampusMasterPlan" \t "_blank)

* + - NC State UNC System

<http://www.ncsu.edu/facilities/physical_master_plan>

* + - OTHERS?

## Others considerations for Master Plan efforts:

* + - Better understanding of campus’ needs and goals.
    - Solar orientation, bio-retention ponds, central steam and chilled water, rain water capture for irrigation.
    - Goal toward “net zero” planning, maximize space utilization (minimize new buildings), transportation planning (mass transit and bicycles).
    - Using newly built buildings as transition space for a building undergoing a renovation.
    - Creating swing space (buildings or specific spaces to create flexibility) to support renovations.
    - Student involvement in projects (projects can act as “labs” for students to learn).
    - Flexibility, widespread input.
    - Salvage/repurpose materials from previous projects or site preparation (ductile iron pipe, valves, fittings, etc.).
    - Pedestrian-friendly campus (limit vehicles, road closures), land use guideline, mass transit/bicycle routes.
    - Make building envelope a higher priority.
    - Pedestrian-friendly campus with rain gardens along the path.
    - Include section for “sustainability” in the latest Master Plan, include design principles in the latest Master Plan.
    - Chancellor’s mandate…all major buildings shall be LEED Silver minimum, storm water master plan (to include a formal Storm Water Committee).
    - Sustainability section highly recommended in the Master Plan that touches on all aspects of campus environment/features (not just buildings).

DO WE WANT TO LIST LINKS, OR DO WE WANT TO LIST SPECIFIC COMPONENETS OF MASTER PLANS WE THINK ARE RELEVENT? MAYBE THERE ARE PRINCIPLES OUT THERE THAT UNC SCHOOLS HAVE NOT YET EMBRACED OR INCORPORATED?

# Design and Construction

## Capital project planning and construction processes shall meet statutory energy and water efficiency requirements and deliver energy, water, and materials efficient buildings and grounds that minimize the impact on and/or enhance the site and provide good indoor environmental quality for occupants.

## Sustainable Best Practices (Source: Campus Sustainability Best Practices, *A Resource for Colleges and Universities,* August 2008, Massachusetts Executive Office of Energy and Environmental Affairs <http://www.mass.gov/eea/docs/eea/lbe/lbe-campus-sustain-practices.pdf>

### Small-Scale Energy Efficiency - In order to reduce energy consumption, campuses can implement lower cost efficiency upgrades, employ awareness building strategies around energy usage, and behavior‐changing tactics that offer the opportunity for increased student and community member involvement.

* + - **Light Bulb Replacement**
    - **Energy Efficiency in Laundry Rooms** - Using front-loader washing machines provides substantial water savings.
    - **Thermostat setback**
    - **Plugload management systems**
    - **Equipment sharing – Sharing lab equipment** including ultra low-temperature freezers provides energy savings
    - **VFDs**
    - **Pumps and fans replacement**
  + Large-Scale Energy Efficiency - In an effort to reduce campus greenhouse gas emissions, campuses have implemented higher cost efficiency upgrades. Though requiring more up‐front funding, these projects have a larger long‐term impact.
    - **Building Metering** - Install meters on all campus buildings. Using consumption data to monitor flows of electricity, water, chilled water, and steam allows schools to determine areas of inefficiency.
    - **Performance Contracts** - Energy conservation project with initiatives that range from replacing the toilets, lighting upgrades, major HVAC system upgrades (natural ventilation, high efficiency AHUs, chillers, boilers, VFDs, VAV, DDC, building automation systems), install vending machine controllers, occupancy sensor controls (lighting and fume hoods), improve integrity of building envelopes (roofs, doors and windows, exterior repairs), and upgrade websites to increase energy awareness.
    - **Cogeneration** - Convert conventional coal-fired heating plant to a cogeneration facility fueled by natural gas or biogas, producing both heat and electricity. The overall efficiency of the plant can increase to 75-80% and lead to reductions in greenhouse gases.
  + Renewable Energy - In an effort to reduce the large amount of energy currently generated from non‐renewable resources such as oil, natural gas, or coal, universities are increasingly relying less on fossil fuels and turning to renewable energy resources such as wind, solar, and biomass.
    - **Wind Energy** - Campuses are starting to implement and utilize both small-scale and commercial wind systems.
    - **Biomass** - Replace electric heat with a biomass heating plant that burns wood chips, reducing greenhouse gas emissions. High-tech biomass energy plant that will consume tree waste.
    - **Solar Photovoltaic Energy** - Although the up-front costs of solar projects are usually high, there are utility and government subsidies available to offset some of the initial investment. Large-scale solar parking projects can will supply a percentage of the UNC System’s annual power needs. Structures provide shaded parking and a location for photovoltaic panels that generate megawatts. Solar arrays installed on buildings, combined with dual occupancy/daylight sensors and daylight controls, the building systems will use less energy than conventional systems.
    - **Solar Hot Water** – Solar collectors use sunlight to heat water for rest rooms, cafeterias, science labs, and indoor swimming pools.
    - **Geothermal** - Geothermal heating and cooling system consisting of closed-loops, each buried in the ground near the building that provide the water source for the heat pump.
    - **Renewable Energy Certificates** - Renewable Energy Certificates (RECs) are tradable environmental commodities that represent proof that 1 megawatt-hour (MWh) of electricity was generated from an eligible renewable energy source. Universities should prioritize actual on-site campus emissions through energy efficiency, conservation behaviors, on-site generation, and fuel switching before pursuing RECs. REC initiatives have started by students through a petition proposing that the college purchase energy from a "green" energy cooperative (Connecticut). Students voluntarily pay a special fee to cover the additional costs to the college of the purchase. More than 75% of students signed the petition, and it won overwhelming support from the Student Government Association followed by unanimous approval by the college’s Board of Trustees.
    - **Carbon Offsets** - A carbon offset is the process of reducing the net carbon emissions of an individual or organization, either by their own actions, or through arrangements with a carbon-offset provider. Offsets used by other universities include [forestation, avoided deforestation](http://environment.yale.edu/hixon/initiatives/urban-resources-initiative/,), methane capture and combustion, and [supporting energy efficiency in local communities](http://neutralgator.org/projects/), Offset credits are a less mature market than RECs and do not directly reduce your campus’ emissions, however, some universities have chosen to use them.
  + Green Building Design - In order to reduce greenhouse gas emissions almost immediately, campuses are investing in building energy efficiency by improving the energy performance of existing and new buildings.
    - **White Roofs** - all flat roofs have been upgraded to reflective white roofs, thus decreasing the solar heat gain of the facility and reducing demand for cooling.
    - **Laboratories** – LEED certified labs.
    - **Daylighting** - Daylighting is the practice of placing windows, or other transparent media, and reflective surfaces in buildings so that, during the day, natural light provides effective internal illumination for building users. Colleges and universities maximize the use of daylight in their new buildings in order to enhance the interior environment for learning while reducing the energy consumption that would require power generation for electrical lighting.
    - **Beyond LEED Certification** - The UNC System of British Columbia in Vancouver has begun developing the Centre for Interactive Research for Sustainability (CIRS), a "living laboratory" where both sustainable research and studies on the building's effectiveness as a sustainable working environment will be conducted. It will surpass LEED Platinum certification, and its design goals include greenhouse gas-neutrality and net energy generation using a 250-kilowatt fuel cell. Rainwater collection will provide all drinking water, and all waste, both liquid and solid, will be treated and managed on-site. All workspace will be 100% day-lit, and the building will make extensive use of photovoltaic cells and solar hot water collectors.
  + Water and Ecological Design - In order to tackle climate change and the decline of freshwater resources availability, campuses are conserving water and promoting low impact development (LID) by implementing initiatives that reduce impervious surfaces and the energy needed to supply water.
    - **Green Roofs** - A “green roof” is a roof of a building that is partially or completely covered with vegetation and soil. Green roofs provide energy savings (insulation for both heating and cooling), water runoff reduction, increased roof lifespan, aesthetic improvements, and other environmental benefits. The best green roofs use only plant species native to the state.
    - **Using Native Plants in Campus Landscaping** - In order to combat invasive species threats and to maintain adaptive plants, establish a policy of using native species in campus landscaping that are drought tolerant and adapted to the harsh desert conditions, requiring minimal watering and fertilizers.
    - **LID Techniques** – Adopt a comprehensive landscape master plan that utilizes Low Impact Development (LID) techniques that include, but are not limited to, rain gardens, vegetated swales, and permeable pavers, reducing storm water runoff and recharging groundwater.
    - **Reducing Use of Pesticides** - Bring in goats to help combat weeds on campus. Goats have been used in combination with other organic methods to remove weeds, including cutting and mechanical removal, as well as adding wood chips in the planting beds.
    - **Parking Improvements** - Reduce storm water runoff by utilizing LID techniques in parking areas. By creating a vegetated infiltration trench within an island of the parking lot, it captures, treats, and reduces peak flows of storm water runoff. The trench, which is made of no. 57 stone, geotextile fabric, mulch, and plantings, promote infiltration back into the ground and treat excess runoff prior to downstream release.
    - **Reducing Campus Water Waste and Consumption** - Reduce water use through several strategies—from low-flow showerhead giveaways to conservation website with water conservation tips. Low-flow showerheads use 1.5 gallons per minute and will each save an estimated 7,300 gallons of water annually. In order to reduce unnecessary water waste, decrease campus and facilities water consumption including stopping the use of most automatic irrigation systems, using timers, reducing the watering of its fields from 36 minutes to 6 minutes, and installing drought tolerant landscaping. Stop washing vehicles, except for windows that need to remain clean for safety, in order to save water.
    - **Rainwater Harvesting** – Innovative rainwater harvesting system that will pay for itself, providing water for flushing toilets, as well as for irrigating the native fauna. Water reduction features include: a water collection and reuse system that eliminates a permanent irrigation system by using native, drought-resistant species in the landscaping, and an 8,000-gallon system that collects rainwater from a rooftop storm drain and stores it for reuse in flushing toilets.

## Design and Construction Guidelines

* + UNC Chapel Hill Design Guidelines

[http://www.eis.facilities.unc.edu/DesignGuidelines.aspx](http://www.eis.facilities.unc.edu/DesignGuidelines.aspx" \t "_blank)

* + NC State Construction Guidelines

<http://www.ncsu.edu/facilities/con_guidelines/index.htm>

* + NCSU D&C Standards- Construction Waste Management Plan <http://www.ncsu.edu/facilities/con_guidelines/pdfs/division02_reuse_recycling_and_waste.pdf>
  + NCSU Green Building Checklist for non-LEED projects (< 20,000 GSF) No web link yet
  + NCSU Sustainability Standard Practices in Repair and Renovation No web link yet
  + OTHERS?

## Other considerations

## LEED Certification mandate for projects > 20,000 GSF <http://www.usgbc.org/>

* Involve Building Maintenance and Operations personnel, Environment Health and Safety, Transportation and other UNC System stakeholders in the Master Planning, Design & Construction phases. Most campuses are using some sort of project review process (UNC-CH uses “Dr. Checks”…NCSU uses a Word Document process…UNC-C uses Bluebeam…UNC-G uses Adobe).
* 10-month warranty walk-through by designer and/or contractor.
* Building Information Modeling (BIM)…on all new buildings? When will designers take ownership of the coordination before bid? Liability is still an issue…lawyers haven’t caught up yet…some designers and CMR’s are sharing the model with an indemnification assumption.

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4.0 Campus Sustainability Websites

[Appalachian State UNC System](http://www.appstate.edu/) - <http://sustain.appstate.edu/office-of-sustainability>

[East Carolina UNC System](http://www.ecu.edu/) - <http://www.ecu.edu/cs-admin/campus_operations/sustainability/>

[Elizabeth City State UNC System](http://www.ecsu.edu/) - <http://www.ecsu.edu/chancellor/sac/sustainability/index.cfm>

[Fayetteville State UNC System](http://www.uncfsu.edu/) - <http://www.uncfsu.edu/facilities-management/sustainability>

[North Carolina A&T State UNC System](http://www.ncat.edu/) - <http://www.ncat.edu/divisions/business-and-finance/facilities/sustain/>

[North Carolina Central UNC System](http://www.nccu.edu/) - <http://www.nccu.edu/administration/facilities/sustainability/index.cfm>

[North Carolina State UNC System](http://www.ncsu.edu/) - [http://sustainability.ncsu.edu/about/UNC System-sustainability-office](http://sustainability.ncsu.edu/about/university-sustainability-office)

[UNC Asheville](http://www.unca.edu/) -

[UNC-Chapel Hill](http://www.unc.edu/) - <http://www.sustainability.unc.edu/>

[UNC Charlotte](http://www.uncc.edu/) - <http://facilities.uncc.edu/real-estate-land-use/sustainability/sustainability>

[UNC Greensboro](http://www.uncg.edu/) - <http://facsustainability.uncg.edu/>

[UNC Pembroke](http://www.uncp.edu/) - <http://www2.uncp.edu/fm/sustainability/>

[UNC Wilmington](http://www.uncw.edu/) - <http://uncw.edu/sustainability/>

[UNC School of the Arts](http://www.uncsa.edu/) -

[Western Carolina UNC System](http://www.wcu.edu/) - <http://www.wcu.edu/about-wcu/campus-services-and-operations/facilities-management/energy-management/>

[Winston-Salem State UNC System](http://www.wssu.edu/) - <http://www.wssu.edu/administration/finance-and-administration/facilities/sustainability.aspx>

[NC School of Science and Mathematics](http://www.ncssm.edu/) -