SUSTAINABILITY

"Sustainability refers to the ability of a society, ecosystem, or any such ongoing system to continue functioning into the indefinite future without being forced into decline through the exhaustion or overloading of key resources on which that system depends."

Dr. Robert Gilman, Ph. D.

(President of the Context Institute and Founding Editor of IN CONTEXT A Quality of Humane Sustainable Culture)

The University Green Initiative complements the University's goal to provide leadership in the region and is integral to sustaining the institution's mission. It extends the strong environmental research programs and affiliations with the Environmental Research Laboratory. The University campus is the natural site for the application of the principles being studied and taught there.

To promote the health and well-being of the campus, community, and region, while fostering discovery, education, service, and inspiration, the University will undertake green initiatives at three scales of action: They are University-wide operations, administration, and philosophy; campus planning; and project implementation. The first category covers the organizational infrastructure, educational outreach, and habits of maintenance for the day-to-day and era-to-era life of the University, independent of new planning or capital projects. It provides a necessary umbrella for the other categories, including the second that guides the vision for the physical form and future of the campus, and the third that ensures each individual capital project undertaken adheres to a standard beyond best practices. Together, and in cooperation with the ongoing research at the University into allied subjects, this three-pronged approach outlines a comprehensive sustaining operation. The University should develop a committed policy to address operational issues. The Comprehensive Campus Plan 2003 provides the framework for implementing overall campus strategies. The Design Guidelines address the implementation of open space and building projects on a project-by-project basis.

UNIVERSITY-WIDE OPERATIONS/ADMINISTRATION/PHILOSOPHY

- Institutional Action
- Educational Initiatives
- Integrated Processes and Systems
- Operations
- Energy
- Regional Position
- Transit
- Waste Stream

CAMPUS PLANNING INITIATIVES

- Site Strategies
- Best Planning Practice
- Hydrology
- Landscape: Vegetation and Superstructures

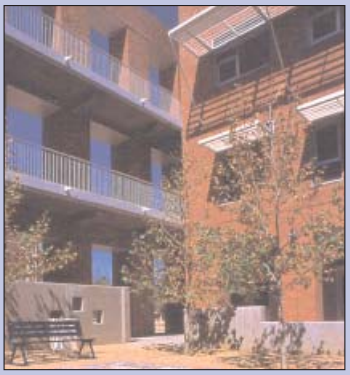
PROJECT IMPLEMENTATION

- Principles
- Following LEED Guidelines
- Sustainable Sites
- Water Efficiency
- Indoor Environmental Quality
- Additional guidelines for design and construction specific to Tucson
- Materials and Resources
- Energy and Atmosphere
- Innovation and Design Process
- Green Power
- Materials

Plan Proposal – Mitigate storm water flow at campus edges with landscape buffer

Plan Proposal – Use photovoltaic cells as shade devices and energy collectors on top of parking decks

WATER MANAGEMENT & SUSTAINABILITY V



Who is the leader on a ship crossing the ocean? It's not the captain or navigator, but the designer of the ship. Everyone on that ship is affected by its design. No matter how good the captain is, if the ship isn't seaworthy, it is going to sink. It turns out that the system we've designed is not seaworthy. It's not air-worthy or soil-worthy. It just ain't worthy. So go out there and be designers who can work at the level of the community, because that's the level at which it is going to happen. The university is the ideal level of community to start with.

William McDonough, Dean
University of Virginia School of Architecture
Remarks to the Campus Earth Summit

Sustainability and "high performance building" are no longer concepts on the fringe of constructing our built environment. Increasingly, the benefits of building in this way are being realized through real economic, public health, cultural and environmental gains. Students coming to the University of Arizona will increasingly demand sustainable practices from the administration. States around the country are adopting policies that require new construction projects to meet minimum sustainability guidelines. University neighbors and the City of Tucson rely on the University for leadership in policy, research, and education.

The Comprehensive Campus Plan 2003 describes many fundamental sustainable planning initiatives, such as building compactly, preserving and enhancing the natural environment and open spaces, creating shade, reducing storm water runoff and preserving historic buildings and plants, among many others. These guidelines will barely scratch the surface of the myriad ways of building sustainably. They are intended as a basic guide to the fundamental issues, including principles for high-performance building, LEED guidelines, the design process, and institutional actions.

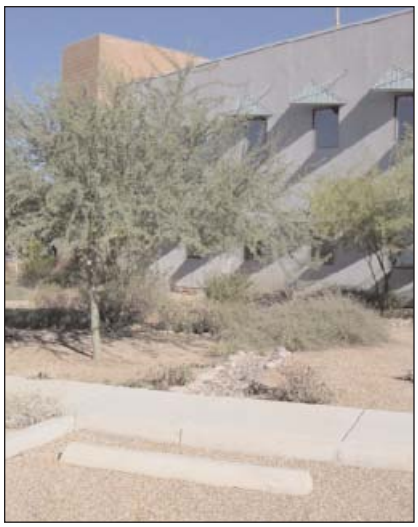
The principles for building sustainably are inextricably tied to the University's mission to discover, educate, serve, and inspire. John Porretto, Executive Vice President at UT-Houston, recognized this in building the Nursing and Biomedical Sciences Building at The University of Texas Health Science Center in Houston. He says of a similar mission:

> *"These principles will also help us to prevent, not create, illness and economic burdens. They will lead us to think in long-range terms. . . Their use will engender sound investments designed to achieve significant savings in operation and maintenance costs. These savings will make it possible to redirect dollars otherwise required for infrastructure to the core mission of the university – the cultivation of knowledge." (from an article by Penny Bonda, FASID, entitled "Zero Tolerance" in GREEN@WORK JAN|FEB|01, www.greenatworkmag.com.)*

Buildings and grounds that uplift the spirit and inspire creativity, collaboration, collegiality and learning are the best investments that a university can make.

Courtyard, linked to a green that is part of a block quadrangle, functions well for intimate or public uses. (Sciences Concourse, the University of Arizona)

Detention basin collects water for tree grove and wildflowers. (Pima Community College, East Campus)



Pervious pavement allows storm water infiltration. (Nature Conservancy Offices, Tucson)

WATER MANAGEMENT

Tucson receives an average of 10 to 12 inches of rain annually. Combined with low humidity and high evaporation, this results in thin, poor quality soils. However, two rainy seasons (summer and winter) make this part of the Sonoran Desert relatively lush compared to many other deserts, at least until periodic droughts occur. Intense summer storms can result in flooding and erosion of shallow desert soils. Water management on the University campus, therefore, consists of managing for too much water during floods and for too little the rest of the time. The University's goal is to conserve storm water on each project site as much as possible, to reduce downstream runoff into city streets and adjacent neighborhoods, to use runoff to supplement landscape irrigation, and to support other means of cooling the campus. All building and open space developments or redevelopments are expected to incorporate passive and/or active water management strategies as features in the landscape, such as:

- On-site solutions including directing runoff to gardens, greens, swales in groves, etc., collecting runoff on rooftops or in cisterns for future use to supplement landscape irrigation, and supply cooling towers and water features.
- District-and-campus scale solutions including reducing the volume and slowing the flow of storm water runoff through the landscape with vegetated swales, porous pavement, and sequences of check dams and catchments along the paths of runoff
- Developing larger open spaces at key storm water runoff locations as multi-purpose greens or groves that also function as detention/retention basins
- Dispersing storm water across stable pervious surfaces, including turf and pervious pavement
- Directing storm water to special leach fields, French drains and other systems designed to disperse water to the root zones of trees and other plants
- Use of low water use plant material and water conserving irrigation systems
- Conservation of potable water by using reclaimed water as the primary source of landscape irrigation water
- Educational interpretation of water conserving measures
- Do not include dry wells, injection wells, or other deep level storm water recharge systems

Refer also to City of Tucson Water Harvesting Guidance Manual and Arizona Department of Water Resources water harvesting and water management guidelines.

SUSTAINABILITY – OPEN SPACE

The Comprehensive Campus Plan 2003 has building footprints and open spaces arranged in a logical way that, as it is implemented, will reduce the need to rely on automobiles, improve pedestrian environments, minimize energy use and water management costs, and improve the quality of life. This section summarizes and clarifies the methods included in the plan that will foster a more sustainable campus through thoughtful open space development.

Wherever possible, the plan uses unconditioned (outdoor) spaces to link buildings and provide places for social, educational, and intellectual interaction. This approach can reduce the gross square footage of buildings needed to meet the campus's program, as well as reduce energy and other costs. The plan and the design guidelines achieve this goal by setting requirements for:

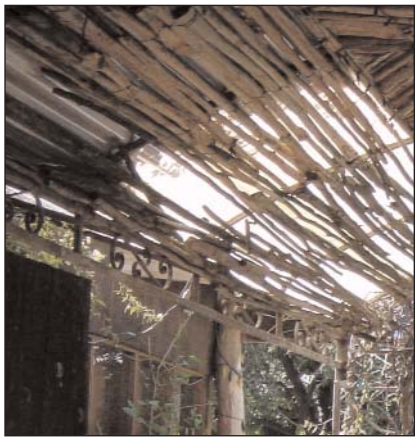
- Structuring and programming outdoor spaces to address user and campus needs
- Improving outdoor comfort by providing a choice of microclimates, adding shade, and collecting air cooled by evaporation from plants, fountains, misters, or cool towers in low lying open space areas.
- Create an inviting pedestrian and bicycle network with convenient transit links. As the planned circulation system is implemented, it will reduce and/or slow traffic and reduce fuel use, emissions, and runoff over impervious surfaces.
- Continue to reduce reliance on traditional storm water management

Plan proposal – mitigate storm water flow at campus edges with landscape buffer

structures and adopt more on-site management approaches. The following practices will improve infiltration of rain water, reduce the need to import water for irrigation, and improve plant health on the campus:

- Less paving and more emphasis on pervious surfaces in greens
- Use biotechnical erosion control solutions in lieu of impervious approaches
- Plant trees and understory plants to use of existing drainage patterns and/or directing on-site storm water to benefit plants
- Store storm water for use in irrigation systems, fountains, misters, and/or cool towers
- Emphasizing use of low water-use plant species and efficient irrigation systems.

Promote a healthy "urban forest" through design, management practices, and tree protection policies. Urban forestry research has shown that healthy trees and plants will cool the campus, reduce energy costs, minimize gas emissions from unshaded parked cars, reduce erosion, and stress, and help people



Shaded patio and garden at the Arizona Inn

Hydrology research at the University's Environmental Research Lab (ERL)

The University of Arizona Campus has been designated an arboretum

heal more quickly. A healthy urban forest requires:

- Regionally appropriate plant selection and biodiversity
- Correct pruning
- Root zone health
- Appropriate irrigation
- Commitment to the University plant protection policy
- A qualified arborist on staff, with knowledge of sustainable landscape practices and authority to make decisions affecting open space resources
- Use materials that meet recognized standards for sustainability.

Design lighting to achieve reasonable lighting levels, in accordance with the Open Space and other University Design Guidelines.

- Design pedestrian lighting to draw pedestrians to a network of safe corridors and open spaces.
- Provide for basic security, using standards for general purpose lighting in areas other than the pedestrian network described above.
- Do not evenly light the entire campus.

Use sustainable construction policies, such as:

- Appropriate construction machinery (i.e., the lightest equipment possible)
- Require site protection in construction documents, including clear designation of protected features and areas; protect soils from compaction; and build with great care near or under trees
- Clarify the need for sustainable practices in pre-construction meetings
- Enforce sustainable requirements during construction

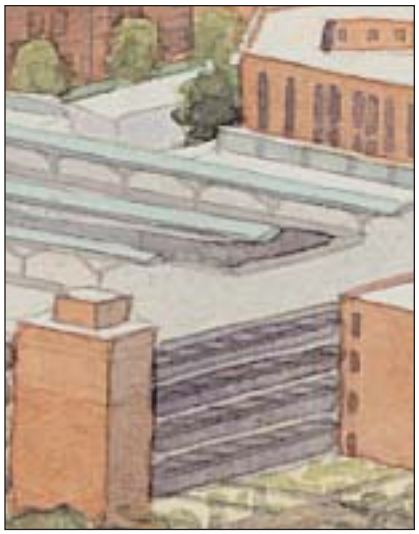
Heal sites damaged by construction or neglect:

- Restore damaged soils
- Use green waste and other compost
- Restore regionally appropriate vegetation
- Use Sonoran Desert native plants, as well as others that will provide forage and cover for native birds

Native flora at Old Main

References: Thompson, J. William and Kim Sorvig, *Sustainable Landscape Construction, A Guide to Green Building Outdoors,* Island Press, 2000.

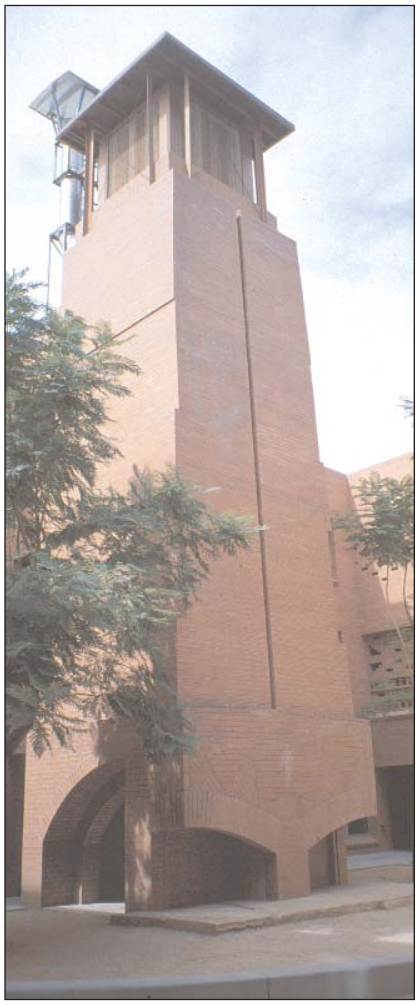
Interior daylighting



Plan proposal: Photovoltaic cells as shade device and energy collector on top of parking decks

What is high-performance building? The Commonwealth of Pennsylvania High-Performance Green Building Guidelines lists the following criteria:

- A project created via cooperation among building owners, facility managers, users, designers, and construction professionals through a collaborative team approach
- A project that engages the local and regional communities in all stages of the process, including design, construction, and occupancy
- A project that conceptualizes a number of systems that, when integrated, can bring efficiencies to mechanical operation and human performance
- A project that considers the true costs of a building's impact on the local and regional environment
- A project that considers the life cycle costs of a product or system. These are costs associated with its manufacture, operation, maintenance, and disposal.
- A building that creates opportunities for interaction with the natural environment and defers to contextual issues, such as climate, orientation, and other influences
- A building that uses resources efficiently and maximizes use of local building materials
- A project that minimizes demolition and construction wastes and uses products that minimize waste in their production or disposal
- A building that is energy, and resource-efficient
- A building that can easily be reconfigured and reused
- A building with healthy indoor environments
- A project that uses appropriate technologies, including natural and low-tech products and systems, before applying complex or resource intensive solutions
- A building that includes an environmentally sound operations and maintenance regimen.
- A project that educates building occupants and users to the philosophies, strategies, and controls included in the design, construction, and maintenance of the project



Cooling Tower at La Colonia del Paz Residence Hall

The U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) program is the generally accepted benchmark for sustainable building. The LEED rating system guides the process through a thorough and understandable checklist. Six sections are identified below and can be found at http://www.usgbc.org:

1. SUSTAINABLE SITES
- Site selection
- Urban redevelopment
- Brown field redevelopment
- Alternative transportation
- Reduced site disturbance
- Storm water management
- Landscape and exterior design to reduce heat islands
- Light pollution reduction

2. WATER EFFICIENCY
- Water efficient landscaping
- Innovative wastewater technologies
- Water use reduction

3. ENERGY AND ATMOSPHERE
- Fundamental building systems commissioning
- Minimum energy performance
- CFC reduction in HVAC&R equipment
- Optimize energy performance
- Renewable energy
- Additional commissioning
- Elimination of HCFCs and Halons
- Measurement and Verification

4. MATERIALS AND RESOURCES
- Storage and collection of recyclables
- Building reuse
- Construction waste management
- Resource reuse
- Recycled content
- Local/regional materials
- Rapidly renewable materials
- Certified wood

5. INDOOR ENVIRONMENTAL QUALITY
- Minimum IAQ performance
- Environmental tobacco smoke control
- Carbon dioxide monitoring
- Increase ventilation effectiveness
- Construction IAQ management plan
- Low-emitting materials
- Indoor chemical and pollutant source control
- Controllability of systems
- Thermal comfort
- Daylight and views

6. INNOVATION AND DESIGN PROCESS
- Maximize benefits of green planning by addressing issues at initial stages of a project

The design process as described by The Commonwealth of Pennsylvania High-Performance Green Building Guidelines follows:

Predesign
- Assemble green team
- Develop green vision
- Establish project goals
- Establish green design criteria
- Set priorities
- Develop performance-based building program
- Establish energy and lighting budget
- Develop partnering strategies
- Develop project schedule
- Review laws and standards
- Conduct research

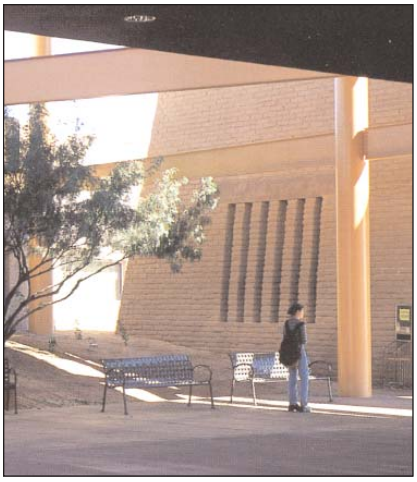
DESIGN
- Confirm green design criteria
- Develop green solutions
- Evaluate green solutions
- Check cost
- Integrate systems
- Refine green solutions
- Check cost
- Document green materials and systems
- Verify material test data

CONSTRUCTION
- Verify submittals for green products and systems
- Commission the systems

OCCUPANCY
- Regularly Confirm System Performance
- Perform Maintenance
- Conduct Post-Occupancy Evaluation

Sustainable environment at Environmental Research Laboratory

Sun shade over glass facade



Thermal mass at Pima Community College

Additional guidelines for design and construction specific to Tucson:

1. Green Power

- Individual buildings should produce rather than use energy photovoltaics (PV) – full cost accounting (life cycle and externalized costs) glazing/PV combinations (screen/scrim effect) building integrated photovoltaics (tiles and other exterior finishes) retrofit or field installations (parking deck roof, remote campuses) possible wind power
- Fiberoptics to take advantage of abundant light selectively
- Passive solar to modify heat pulse
- Direct solar for local water heating
- Emphasis on insulation
- Demand insulation (timed foaming agents)
- Tectonic insulation (shading benefits not just for glazing but for solid envelope)
- Brise-soleil
- Thickened envelope (occupiable or not, rain screens, greenhouse envelopes)
- Canopied roofs (both occupiable and not; can be PVs)

2. Materials

- Establish a renewable, recycled, recyclable palette
- Maintain sources for renewing renewables
- Pursue local procurement
- Reduce, reuse, recycle, renew
- Examine material selection for deferred impact on air and water (extraction, manufacture, transport)

Overhead sun shades

UNIVERSITY-WIDE OPERATIONS, ADMINISTRATION, AND PHILOSOPHY

These recommendations are independent of new planning or capital projects.

A. INSTITUTIONAL ACTION

1. Charter a Sustainable Advocacy Group for the University
2. Write a vision statement
3. Adopt a sustainable platform to guide practice
4. Perform an institution-wide sustainability audit
5. Pursue third party review and certification of all projects (LEED program for buildings and look for institutional criteria and measures as they become available)
6. Institute a Sustainable Advocacy Group for planning and individual projects
7. Join U.S. Green Building Council
8. Keep abreast of local trends, incentives, and regulations
9. Promote innovative and collaborative thinking to make the institution more sustainable

B. EDUCATIONAL INITIATIVES

1. Be a model institution – teach other institutions
2. Keep staff, faculty, students, and neighbors informed on relevant policies, initiatives, goals
3. Operate as a clearinghouse for the many threads of related research going on within the University
4. Create an umbrella organization to bring together RNR, ERL, water resources, geology and soils, and other relevant programs
5. Coordinate classes with the drive for sustainability
6. Tie student projects and exercises into implementation

C. INTEGRATED PROCESSES AND SYSTEMS

1. Foster a holistic view of land and institutions
2. Develop and maintain a comprehensive sustainable master plan
3. Reinforce importance of pursuit of long-range vision and mission for all participants
4. CFP, FDC, G&L need to operate together
5. Integrate core and remote campuses with region
6. Consider sustainability in growth of remote campuses
7. Institute whole-cost accounting, cross-budgeting
8. Integrate capital and operations budgets for planning purposes

D. OPERATIONS

1. Site/vegetation audit and advocacy
2. Integrated pest management, strive to be pesticide-and herbicide-free
3. Seek out environmental products, services and expertise
4. Examine procurement policies for sustainable opportunities
5. Hire consultants with experience in sustainable design and construction
6. Screen vendors
7. Maintain nursery for mature plant source
8. Institute canopy sustaining program
9. Maintain facilities and grounds
10. Reduce light pollution

E. ENERGY

1. Reorient campus power supply to renewable, non-polluting sources
2. Reduce CFCs
3. Eliminate HCFCs and Halons from HVAC&R systems
4. Move physical plant into cogeneration
5. Use direct solar for water pre-heat and building tempering
6. Install evaporative cooling/cooling towers
7. Integrate photovoltaics into supply
8. Consider ground source heat pumps
9. Pursue integration and synergies in utility design

F. REGIONAL POSITION

1. Mitigate carbon balance off-site (e.g. forestry support)
2. Educate public through outreach, research, publication, participation, coordination
3. Balance stewardship, preservation, and conservation of people and place, culture, and community history as well as physical buildings and grounds
4. Support local initiatives for sustainability
5. Strengthen the surrounding neighborhoods and businesses
6. Advocate for mixed-use development
7. Build to improve regional systems like streetscape networks and linear greenways

G. TRANSIT

1. Encourage walking
2. Accommodate more students on and closer to campus
3. Create incentives for faculty and staff to live near campus
4. Provide more on-and near-campus employment for students
5. Encourage and facilitate biking
6. Retool campus transit and facilities fleet for alternative fuels
7. Maintain alternative fueling stations
8. Promote a campus and community car co-op
9. Develop park-and-ride
10. Integrate transit pass into student fees; put parking fees on top
11. Improve city bus service
12. Improve campus shuttle service
13. Institute traffic calming
14. Promote transit-oriented development
15. Integrate transit considerations into remote campus development

H. WASTE STREAM

1. Monitor and safeguard pollution-free operations
2. Provide closed loop for waste generated by animal feed, compost, recycling, recycled content products, building salvage, etc.
3. Composting toilets
4. Reclaimed water, grey water, and storm water harvesting
5. Lead in research on closed loop, industrial ecology systems