Green Projects Entry

Westcave Preserve E.L.C. (o)

Section 1 - Project Overview Information Part 1

Project name:	Westcave Preserve E.L.C. (o)
Project owner:	Westcave Preserve NonProfit Corporation
Project address:	24814 Hamilton Pool Road Round Mountain, TX 78620

Section 2 - Project Overview Information Part 2

Project completion date:	3/2003	*(m/y) format*
Project Site:	Previously undeveloped - Greenfield Site	
Project type:	Interpretative center, K-12 education	
Project site context/setting:	Rural	
Other Building description:	New (100% new)	
Lot size:	0.50 acres	
Building gross floor area:	3030 ft2	
BOMA floor area method used?:	yes	
Number of permanent occupants:	0	
Number of visitors:	150	
Occupants (hours/week/occupant):	4	
Visitors (hours/week/visitor):	4	
Total project cost:	$1,167,850	

Section 3 - Project Overview General Description

General description: A 30 acre nature preserve and canyon 28 miles northwest of Austin, Texas needed to expand its community programs by building a new "wilderness classroom" and provide a meeting place for walking tours to a nearby waterfall and "live" grotto cave. The goal of the two agencies who partnered for the project was to foster the respect and stewardship of the natural environment, provide environmental education, and preserve this sanctuary into the future.

Section 4 - Top Ten Measures

Top Ten Measure 1: Sustainable Design Intent & Innovation

Key environmental aspects: The purpose of the Warren Skaaren Environmental Learning Center at Westcave Preserve is to serve as a wilderness classroom in an established preserve in Central Texas.

The building has to be flexible to accommodate large school groups of 150+ students simultaneously with normal visitor groups of 1-10 people and serve as a community center.

The building has to be an efficient classroom which provides standard teaching tools such as computers, projection screens, marker boards, tack boards, exhibit walls, etc. while making

the space feel like it is part of the outdoors and open to the surrounding preserve.

Lastly, the building has to create an awareness and understanding of the basic environmental systems that we live within. The educational challenge of environmental learning is to simplify the complexities of the natural sciences and ecology to these basic components; air quality, water quality, protection of the soil and the conservation of energy.

As such the design of the structure was conceived as a 3 dimensional textbook. The architectural expression of the building is a framework for analogies between building materials and systems and how they mimic or model natural systems.

Unique innovations include:

1. Water: Water quality and water cycles are demonstrated through the use of a rainwater collection (Photo 2a & 2c) and filtration system. Wetlands and Clivus Multrum (a self-composting restroom) wastewater systems show recycling of materials in nature.

2. Air: Natural ventilation, orientation and a weather station illustrate the physics of air currents and air quality at the site. (Photo 4) (Ventilation fans, high/low operable windows)

3. Geology/Earth: Stone walls illustrate fossils of local sedimentary stones. (Photo 2b) A panel exhibit shows how the canyon was formed over 250,000 years ago. (Photo 3c) 4. Energy: Sustainable energy systems such as a photovoltaic array (Photo 3b), ground source heat pumps, daylighting, R-30 cellulose insulation, large over hangs, attic fans and efficient lighting are integrated into the building. An interactive panel shows how these sustainable energy systems can be controlled to balance energy demand with incoming "clean" solar power.

5. Seasonal Cycles: Seasonal cycles are illustrated by a meridian line (Photo 4) and sky map embedded in the terrazzo floor (Photo 2d) marking the sun's motion (correct to atomic time) during the seasons through an aperture in the ceiling. (Photo 5)

6. Natures Numbers: Also embedded into the terrazzo floor, this exhibit illustrates the enigmatic relationship between the Fibonacci Series, golden rectangle, logarithmic curve and the form of a 90 million year old ammonite.

Top Ten Measure 2: Regional/Community Design & Connectivity

Regional/Community Design:	As an educational center the project serves area schools with 5000-7000 student visits per year. In addition, tours of the preserve are given to 2000-3000 weekend visitors per year and as a community center serves approximately 500-1000 users in meeting groups – including sustainable builders, architects, natural science groups, park and recreational meetings, and miscellaneous conservation groups. Because three-quarters of the use is from school programs, children arrive by bus. Many conservation groups carpool to this remote site. The parking spaces are very limited and include about 50 spaces near the buildings and another 50 approximately 300 feet away. A bus loop and drop off area serve as a convenient access point for children, elderly, and handicapped visitors.

Use other transport options:	75%
Parking spaces per person:	1.00

Top Ten Measure 3: Land Use & Site Ecology

Site ecology:	The Westcave site includes 2 very distinct and adjacent ecosystems. Nature programs at the site focus on the characteristics of the dry, rocky uplands site and the lush riparian canyon with a 40 foot waterfall and towering cypress trees. The building is sited near the boundary between the systems and provides a staging area for trails to view and study upland systems. The building was placed in the only open area on the site and required the loss of one small juniper tree. The building's location serves as a gateway to monitor access to the protected preserve trail. All 'repair' landscape work around the building utilized native plants as a part of a plant exhibit. The original remnant ranch road was retained as the road to the facility. Existing new landscaped areas around the facility are served by the rainwater harvesting system. Site Sustainable Design Innovations include: •Located in an open area on the site for low impact to the preserve. •Location on the site utilizes the existing ranch road and 'pocket' parking in trees. •Location creates a control 'gateway' to the Preserve trail. •North and south ends of the building are near grade for easy ADA circulation and easy connection to the site. •Aligned to Earth's rotation (true north) for earth/sun exhibits and for views of trails to the uplands portion of the site and the canyon. •Headquarters building sited for visual control of the site and proximity to the Manager's/Director's quarters. (refer to Site Plan) •Xeriscaping and plant exhibits replaced site construction damage around the building.

Top Ten Measure 4: Bioclimatic Design

Bioclimatic design:	Because our building is aligned with the earth's axis (true north/south on the western meridian), the daily and yearly cycles are embedded in exhibits in the floor. The building design also responds to this orientation with very large overhangs on the east and west, a protected exterior covered shelter on the north, and small overhangs on the south for passive heating in the classroom. The building section and operable windows, high windows at the cupola, and fan system create and reinforce passive cooling via the chimney effect. South and southwest breezes are funneled into the building in spring and summer. When active mechanical systems are required two small ground source heat pump units are used at 25% of the cost of the energy of standard systems. In addition, a 1700 watt AV photovoltaic array sends 300-350 KWH/month into the grid inverter, providing about 30% of the building's use. The system utilizes a sun tracker system with an interactive joy stick nearby that visitors can move to watch the tracker readjust to the sun direction.

Top Ten Measure 5: Light & Air

Light & Air:	Indoor and outdoor rooms form a continuous classroom/gallery. Functional and spatial

flexibility was created by a simple plan where the indoor and outdoor rooms are considered one continuous space. Circulation and visual connection to the site flow along the 'true' north/south axis of the building. Outdoor 'centers' for energy, air quality, and water cycles are organized along this space. This allows staging of smaller focus groups to have lessons both inside and outside while teachers have visual contact with all groups along a 300 ft. 'axis' space to stage the sequence.

This sequence is important since the actual tour of the canyon is limited to two groups of 30 students each at a time. Most of the year, the building can be cooled by directing natural ventilation. When there is no air motion, two attic fans move the air. When it is too humid the heat pump system is used.

The 'air exhibit' points out to visitors that the canyon can be 20 degrees cooler than the uplands (at the building) and how the building is cooled by convection in a similar way. Daylighting by clerestory windows around the entire building provide sufficient light during the day.

Percent of building area that is daylit:	100%
Percent of building that can be ventilated or cooled with operable windows :	100%

Top Ten Measure 6: Water Cycle

Water Cycle:	The building draws analogies between its collection, filtering, and use of water and that of the site. The roof is a watershed, the gutters are creeks, cisterns contained in the giant pylons are aquifers, and system filters are rock karsts, etc. Water is filtered differently for various uses for the site and building. This rainwater system is part of the buildings sustainable approach which serves as an exhibit for visitors. Wastewater is treated with a wetlands system and the public restroom uses a Clivus Multrum type of self-composting toilet system. Water Cycle Innovations/Exhibits include: •The rainwater system collects roof water into 3 cisterns with a combined 10,000 gallon capacity. Each cistern filters water to different levels. •A complete UV system is demonstrated and will be used for building water when it is approved by the State. •A wildlife open cistern is used for aquatic exhibits and for attracting wildlife. •Clivus Multrum: Restrooms use a Clivus Multrum self-composting toilet system. Access to the system for demonstrations when requested. •Wetlands: A wetlands wastewater system is also used for demonstrations. It is just south of the building and is used for the building waste system.

Precipitation managed on site:	100%
Total water used indoors:	4000 gal/yr
Total water used outdoors:	25000 gal/yr
Percent of total water from reclaimed sources:	100%
Percent wastewater reused on-site:	100%
Calculated annual potable water use:	9.57 gal/sf/yr

Top Ten Measure 7: Energy Flows & Energy Future

Energy description:

This project was designed as a model of flexible energy use based on user need. Compared to most structures, it was designed as a sailboat versus a powerboat where mechanical systems and power use occur only when natural sources are not available.

The optimum proposed to users (as an interactive educational exhibit) is to operate the building without consuming energy from the grid. As an ideal, the user would stay under the 1700 watts provided by the photovoltaic array. The solar array is monitored and displayed adjacent to the "live" power used from the grid. The user is asked to balance energy consumption to the solar panel if possible. This is very possible much of the time and this method has been effective in curbing energy use.

The focus is awareness and use of sustainable components such as 100% ventilation, 100% daylighting, passive solar, etc. to provide comfort and light without grid power. Energy is harnessed from nature as various demonstrations of sustainable principles.

Our solar energy array provides approximately 350 KWH/mon. And the building use varies from 1500-2500 KWH/mon. Much of this energy use occurs when the building is used at night by community and focus groups. The clean solar energy is monitored "live" next to the output of grid energy. Switched operating lights, A/C, fans, etc., are adjacent to the monitors as an interactive exhibit. Students are asked, "Do we need these lights on?", "Do we need the A/C on?" and as they are turned off all see that they do quite well with no energy or with only what is provided by the solar array. Awareness of energy use is the key here. For the highest occupant use during school field trips, the building used very little power due to the use of outdoor areas as educational spaces.

(The area of our building, 3,030 square feet inside, was too small to enter in the Energy Star Target Finder System for Ratings.)

Unique innovations include:

Cooling systems (staged as needed): •Natural Ventilation via orientation and operable windows (chimney effect) •Attic fans on each end of the high clerestory for forced circulation when there are no breezes. •HVAC – Ground source heat pumps used on hot, humid days with large crowds.

Heating System: •Passive – Small overhang at the South classroom. •HVAC – Ground source heat pumps. Lighting: •Daylighting – continuous perimeter clerestory •High Efficiency Uplights – Fluorescent T5 bulbs •Low voltage task lighting for the exhibit walls and blackboard walls

Electrical System: •A 1700 watt Photovoltaic array provides 300-350 KWH/month. A monitor showing the wattage being absorbed from the Sun and a joystick to move the array tracker system are mounted near the array – just south of the building. •Solar power and 'grid' power consumption are displayed with monitors to create an interactive exhibit. Switches for lights, fans, and the A/C system are adjacent to the monitors so that reductions in consumption can be seen. The object is to balance consumption with the 'clean' energy source.

Performance Rating

EPA		
HERS		
Percent total energy savings		
	Base Case	Design Case
Total energy (Btu/sf/yr)		
Electricity (Btu/sf/yr)		
Natural gas (Btu/sf/yr)		
Other: (Btu/sf/yr)		

Heating (Btu/sf/yr)	
Cooling (Btu/sf/yr)	
Cooling capacity (sf/ton)	
Lighting load connected (W/sf)	
Lighting load after controls (W/sf)	
Plug load (W/sf)	
Peak electricity demand (W/sf)	
Percent on-site renewable energy (%)	
Percent grid-supplied renewable energy (%)	

Supplemental Narrative

Top Ten Measure 8: Materials & Construction

Materials description:

The building is located in a preserve and we felt it was important to use natural materials which were appropriate to the region and fit within the context this particular site. For the 5000-7000 children who visit as school field trips, the building is almost indestructible. Kids love climbing on the stone walls for the "fossil hunt" and floors are terrazzo and stone for ease of maintenance as well. The most materials were left unfinished so there are no polluting chemicals in the space.

Basic materials include:

•Stone: Glenrose stone from a nearby quarry. The geological significance is that the Glenrose formation lines the banks of the Pedernales River just below the site. Fossils from the quarry are scattered throughout the walls for exhibits. •Stucco: Natural cement/lime finish with no coating. The stucco is backed by staggered metal studs with 7 1/2" of Celbar (cellulose) insulation. Celbar is efficiently produced - low energy in production - from recycled cellulose. The walls have an R-30 rating. •Glass: Insulated low-E glass was used except at the 'lower' daylighting clerestories along the perimeter where clear glass was used. •Windows & Doors: An operable system was employed for the lower windows and auto-controlled awnings were installed at the high roof clerestory for passive natural ventilation. •Roof: Metal Standing Seam (2") Battenlok 24 gauge (by MBCI). Insulation is 4 3/8" thick by AC Ultra Technology and is HCFC free. The building is shaded by 8 ft. overhangs on the east and west sides. Roof system is R-30 rated. •Roof Decking: 1 1/2" pine tongue and groove from a Texas forest. There is no finish coat on the wood. •Steel Frame: Recycled steel was used. •Concrete Foundation: ?25% Flyash content •Paints: Used on the steel only - PPG's lowest rated VOC.

Durability & Low Maintenance: •Use of stone walls and floors and terrazzo floors that are durable and easy to maintain. •Large overhangs protect glass from rain and dirt. •A/C systems are used only with groups in warm, humid weather.

Top Ten Measure 9: Long Life, Loose Fit

Long life, loose fit:

The simplicity and flexibility of the building has proven to date that it easily adapts to multiple uses and participants. We integrated many exhibits into the physical structure of the building which frees

the space for maximum flexibility of use. School children in groups of 150-175 sit on the terrazzo floor in the "classroom" area in the morning and a community group of 30-35 meet in the afternoon around tables to plan the year-end strategy.

Another group of visitors view exhibits in the space, while another group informally meet under the large roof canopy with canyon wrens and the sound of the river rapids below.

There is no wasted space in the building – no corridors, etc. Because of the buildings flexibility and efficiency, low maintenance and energy use it is expected to serve as a gathering place well into the future.

Top Ten Measure 10: Collective Wisdom & Feedback Loops

Collective Wisdom & Feedback Loops: The essence of sustaining programs, staff, leadership and public participation is summarized in the word partnerships. We adopted an interactive community funding process that's reflected the client's mission and goals. Unlike the typical architectural design period of 2-6 months, this project greatly benefited from a process in which the design concepts were distilled over a funding period of 3 years. A preliminary design evolved first in a charette with the Westcave Preserve Non-profit board of directors and the general manager who had developed the educational programs over 30 years.

Over the next three years, the project design was presented to dozens of public and private funding sources and educational groups. With each meeting we gained new ideas about potential programs as well as enlisted additional support for the project. The nature of the presentations purposely maintained an interactive character and served to expand the client's mission beyond the central Texas focus to larger issues of ecology and how they are connected to the Westcave Preserve environment.

Buildings are expensive and donations and grants are hard to find so it became imperative to make every part of the structure work in support of the educational goals. The integrated exhibits provide support for programs from elementary age levels to college levels, and thus engage visitors of all ages.

Section 5 - Project Economics

Finance: This project was built by donations from trusts, foundation individuals, public utilities, and county funds. We leveraged these donations for a matching grant from the Texas Parks and Wildlife Department for $750,000, which was half of the amount estimated for construction. These partnerships have taken great pride in the building and continue to sustain their non-profit educational facility. Due to the buildings success, private donations have increased.

The building was designed to be used as a zero energy consumption "pavilion" when large school groups visit. This has been the case where large school groups are moving in and out for various earth science programs. When the building is used for a classroom, seminars, community meetings, and the weather is humid (summer) or too cold in winter, then the heat pumps are used to condition the space.

Cost and payback analysis:

Section 6 - Process and Results

PreDesign:	Pre-design: 1. Because the project is in a Preserve, every square inch is thought of as precious. The preserve is fairly small at 30 acres and the allowed development site for buildings, parking, etc was only approximately half an acre. 2. We studied 5 possible sites for the structures. The building site with least impact was chosen. It was fairly flat which provided good accessibility to all sides and open space without trees. 3. We used the remnant ranch road for vehicular circulation 4. Pre-design meetings involved programming space to meet the educational programs that had been successful for the past 25 years. Because only 30 visitors can go on the tour to the falls and grotto at once, the building needed to provide self-guided tours to help stage the canyon tours.
Design:	The design was developed with staff and the Preserve board of directors in charette sessions. The idea of the building as a "wilderness classroom" took shape. It would provide standard teaching tools and equipment in a space which feels like an open-air shelter. Acoustical privacy was created with a Nana-door folding glass wall to separate the classroom from the public entry and exhibit area. Black-out shades are located in the windows to either side of a projection screen and the stone pylons create a recess allowing for A/V programs to have bright images. Slat wall on the east interior wall provides flexible exhibit areas for the plants and animals found in the two ecosystems located on site. Visitors and school groups are encouraged to 'discover' unique exhibits within the walls, the building, and the site.
Construction Process:	Protection of the surrounding site was essential because the project was a preserve. Coordination of material storage, staging of work, and trash management was critical. The contractor became another partner in the process of making this project a success.
Operations/maintenance:	The Preserve is operated and managed on site by two staff and volunteers. All are trained to conserve energy and use the sustainable features as educational tools.
Commissioning:	
Measurement & verification/ post-occupancy evaluation:	

Rating System Name:

Version:

Rating Date:

Score or rating level:

Credits:

Sections 7: Visuals

Exhibit A

Photo1.jpg

Image has been scaled down. Click it to view actual size...

Description: Exterior View over Wildlife Cistern: The building is sited to provide low impact to the site. It is nestled between stands of trees.

Exhibit B

Photo2.jpg

Image has been scaled down. Click it to view actual size...

Description: Water Cistern as part of the building; discovering fossils in the stone; the gutter and scupper to the cistern; the Sky Map

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Exhibit C

Photo3.jpg

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Description: Photo 3a and Photo 3d: Xeriscaping and plant exhibits replaced damage from site construction. The building was sited to have a low site impact. Photo 3b & Photo 3c: Building exhibits include a photovoltaic array with a joystick that moves the array and displays the effects and geologic panel showing the formation of the canyon.

Exhibit D

Photo4.jpg

Image has been scaled down. Click it to view actual size...

Description: Interior View Of Meridian: Seasonal cycles are illustrated by a Meridian line and sky map embedded in the terrazo floor.

Exhibit E

Photo5.jpg

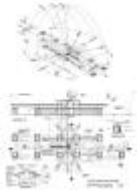

Image has been scaled down. Click it to view actual size...

Description: Sun Angles & Floor Plan: The illustrations show different angles of the sun throughout the seasons marking the sun's motion through the aperture in the roof.

Exhibit F

Photo6.jpg 

Image has been scaled down. Click it to view actual size...

Description: Interactive Use of the Building: The flexibility of the building allows student and community groups to occupy several different areas of the building.

Exhibit G

Photo7.jpg 

Image has been scaled down. Click it to view actual size...

Description: Exterior Porch: A 300 ft. axis extends the length of the building and allows teachers to maintain visual contact with all groups.

Exhibit H

Photo8.jpg 

Image has been scaled down. Click it to view actual size...

Description: Exterior View: Large, 8 foot overhangs, shade the sides of the building. HFCF-free insulation is used in the roof. The wood decking has no finish coat and is from a local source.

Exhibit I

Photo9.jpg 

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Description: Top: Site Plan Inset: Context Plan Bottom: Floor Plan & Key