Sustainability Assessment of Grand Canyon National Park – South Rim

A Partnership Project of the Grand Canyon National Park and Northern Arizona University’s Ecological Monitoring & Assessment Program

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**Executive Summary**

An assessment of sustainability practices at GCNP was conducted from May through September 2008 by a student-faculty team from NAU. The assessment focused on the key areas of energy use, transportation, water use, procurement practices, waste management and communication and outreach, primarily at the South Rim. The approach used included employee interviews, site visits for observations, literature review, and interviews with consultants and other NPS units’ employees. Summarized below are the major recommendations from each area.

**Energy Use:**
1) Continue tracking energy use and trends in all Park facilities/buildings.
2) Aggressively move to replace all incandescent bulbs with compact fluorescents and install LED fixtures where possible.

**Transportation:**
1) Institute travel/trip networking so employees can coordinate out-of-Park travel.
2) Institute vehicle replacement plan that fully utilizes hybrid/fuel efficient vehicles.
3) Encourage employees to carpool/bike and collaborate on in-park travel.
4) Concessionaire contracts should require transition to more environmentally friendly vehicles, e.g. from diesel fleets to other fuels.
5) Bicycle should be available for rent at the park.

**Procurement:**
1) A comprehensive review of the Park’s procurement system should be conducted with the goals of maximizing the purchases of ‘green’ items, tracking inventory, and decreasing employee time spent on procurement. Systems used at Yellowstone or Carlsbad Caverns NPS units may be used as templates. The current system appears to be fragmented, inefficient, and lacking in accountability.
2) All employees should know how to find environmentally friendly products available on GSA’s Advantage website

**Waste Management:**
1) Begin a serious effort to implement composting. This is the most important recommendation for increasing landfill diversion rates. The argument “We tried this and it doesn’t work” conflicts with experience in Yellowstone NP and Alaska, which have similar cold climate situations.
2) Utilize consistent and aggressive waste recycling strategies with respect to visitor participation and collection bins.

**Water Use:**
1) All bathroom fixtures should be low flow models; develop a plan for all urinals in Park to be upgraded to waterless models.
2) Establish a leak detection program for water distribution system.

Communication/Outreach:
1) Aggressively use the Park webpage, materials handed out at Park entrances, and signage within the Park to address visitor and employee participation in waste, water, transportation and other environmentally friendly and sustainable practices at Park.
2) Develop and distribute a pamphlet on sustainability.

Perhaps the most important element in the Park’s effort to improve its sustainability practices is the development of a consistent culture at the Park. There is a wide spectrum of employee perspectives that indicate a significant disconnect between the Park’s goals and employee buy-in. At the very top, Park administration appeared to be unaware of the activities of its own ‘Green Team’. This translates down the line. Though there may be hesitance to use other NPS units as ‘templates’, this may be the most efficient and effective strategy. The internal message is extremely important and without it, the other step-by-step, area-by-area strategies are undermined.
1.0 Introduction

During the summer of 2008 the Grand Canyon National Park (GCNP) partnered with Northern Arizona University’s (NAU) Ecological Monitoring and Assessment Program (EMA) to help improve sustainability practices at GCNP. Specifically, this project consisted of 1) performing a sustainability audit to assess current practices at GCNP, and 2), developing recommendations to improve current and future practices with respect to sustainability.

Personnel working on this report included Kristen Fauria, Geophysics student at University of Oregon, Sanjuana Rico, Environmental Engineering student at NAU, and Kevin Werbylo, Environmental Engineering student at NAU. These students worked under the supervision and direction of Dr. Wilbert Odem, Department Chair of Civil and Environmental Engineering, and Martha Hahn of the Grand Canyon Division of Science and Resource Management.

2.0 Methodology

This project began with meetings between Martha Hahn and other officials from Grand Canyon National Park, and students and faculty from Northern Arizona University, where a general vision for the project was articulated. Two main goals were identified: 1. conducting a general audit of the GCNP’s sustainability practices, and 2. developing action items to help GCNP become more sustainable.

Because auditing for sustainability is still an evolving area of practice, the research team had to create its own sustainability protocol for the audit. “The Sustainable Practices and Opportunities Plan” (SPOP), which was found on the National Park Service webpage, originally served as the backbone for the sustainability protocol. Recommendations and advice from Good Company, a consulting firm specializing in sustainability audits and practices for government agencies, informed the approach for structuring a sustainability audit and collecting measurable information.

From these two main sources the research team developed an audit protocol which included the major categories of: energy and transportation, water, waste management, procurement, communication/ outreach, and green building. The team decided to divide project responsibility using these categories. Kevin was responsible for water and communication/outreach; Kristen focused on energy, transportation, and procurement; and Sanjuana was given the focus areas of green building and waste.

Team members collected data for their section of the sustainability audit by either: 1. creating surveys for Grand Canyon employees; 2. interviewing Grand Canyon employees and other knowledgeable individuals by phone or in person; 3. observing practices in person at Grand Canyon National Park; 4. or looking at previously published energy, water, or waste reports prepared by the park.
During two visits to the park the team met with employees and observations were made at the Bright Angel Trailhead area, wastewater treatment plant, employee housing areas, maintenance facility, visitor center and along bus routes. Data collection also included phone interviews of park personnel, personnel from other National Park Service units, and others from outside the NPS, including concessionaires.

3.0 Findings

Information gathered as described above is presented below. These are presented in the areas of Energy, Transportation, Procurement, Waste Management, Water and Communications/Outreach.

3.1 Energy

GCNP uses a considerable amount of energy in its daily operations.

3.1.1 Yearly Energy Consumption at Grand Canyon National Park

Below are tables which describe GCNP energy consumption for the 2007 fiscal year as taken from the annual GCNP energy report (2007 GCNP Energy Report). *Note: All energy consumption reported in these tables is for Park Service only. All concessionaire and non-NPS energy usage is excluded in these figures.*

### Energy Consumption and Cost Data for Buildings

<table>
<thead>
<tr>
<th>Energy Type</th>
<th>Consumption Unit</th>
<th>Annual Consumption</th>
<th>Consumption in GJ</th>
<th>Annual Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electricity</td>
<td>KWH</td>
<td>12,308,477</td>
<td>44,310.52</td>
<td>1,006,286</td>
</tr>
<tr>
<td>Fuel Oil</td>
<td>Gallon</td>
<td>37,756</td>
<td>4,304.184</td>
<td>82,691.97</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>Cubic Ft.</td>
<td>7,969,900</td>
<td>8,803.552</td>
<td>45,049.39</td>
</tr>
<tr>
<td>LPG/Propane</td>
<td>Gallon</td>
<td>84,257</td>
<td>8,489.553</td>
<td>155,190.5</td>
</tr>
</tbody>
</table>

Standard Buildings/Facilities (Gross Square Feet):*434,031
Total Annual Consumption in Gigajoules (GJ): 52,800

### Energy Consumption and Cost Data for Vehicles and Other Equipment

<table>
<thead>
<tr>
<th>Energy Type</th>
<th>Consumption Unit</th>
<th>Annual Consumption</th>
<th>Consumption in GJ</th>
<th>Annual Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auto-Gasoline</td>
<td>Gallon</td>
<td>19,652.9</td>
<td>2,456.613</td>
<td>54,116.98</td>
</tr>
<tr>
<td>Diesel-Distillate</td>
<td>Gallon</td>
<td>38,241.7</td>
<td>5,277.355</td>
<td>109,208.9</td>
</tr>
<tr>
<td>CNG or LNG</td>
<td>Gallon</td>
<td>168,311.8</td>
<td></td>
<td>153,516.7</td>
</tr>
</tbody>
</table>
3.1.2 Trends in Energy Consumption at National Park Service Buildings

The top five highest energy users at the park are: the 750 HP water pump at Indian Gardens, the reclamation plant, the Visitor Center, the new maintenance offices (as of 2004), and the NPS maintenance Bldg (APS Energy Evaluation).

In order to identify patterns in energy consumption at the park, we tracked energy consumption in the above four buildings (excluding the pump at Indian Gardens*) from 2002 to 2007. The KWH reported on the graphs is the average monthly consumption for each year.

*The Pump at Indian Gardens was excluded because there are two pumps at the Gardens, a 600 HP pump and a 750 HP pump. Therefore any change in energy consumption in one could be attributed to a change in pumping capacity comparatively between the two.

![Energy Consumption in Three Main Buildings at GCNP](image.png)
There appears to be no general trend in energy consumption. Energy consumption in the new maintenance office is increasing while energy consumption in the maintenance building is decreasing. The reclamation plant and the visitor center show no pattern in energy consumption.

3.2 Transportation

Operations at Grand Canyon National Park depend on the use of cars and other vehicles. Visitors, concessionaires, and Grand Canyon employees all rely on vehicles in order to get to the canyon and to accomplish their tasks within the park. Bus systems and a greenway system also exist to serve visitors along the South Rim.

3.2.1 Private Vehicles in Grand Canyon National Park

Of the five million people who visit Grand Canyon National Park each year, most all rely on private vehicles to enter the park. Once within the park, an estimated one in four visitors use the shuttle bus system an average of four times. In addition a portion of visitors arrive by tour buses.

Park employees largely rely on private vehicles to commute within the park, as well as from their homes to their offices. We observed that many Park Service personnel drive trucks and sport utility vehicles.
As seen in the above photo, many of the cars parked in front of the new maintenance facility were either trucks or SUVs. While four-wheel drive vehicles can be easier to drive in the winter months, they are frequently less fuel-efficient than many compact vehicles. We observed one electric car parked at the maintenance building (shown above). However, use of this kind of vehicle in the winter months is probably limited. In addition, there is priority parking at some facilities for fuel hybrid vehicles, as shown. Moreover, we observed that most private park service vehicles were occupied by single passengers.

3.2.2 Park Service Vehicles in Grand Canyon National Park

GCNP owns and operates hundreds of vehicles within the park. These vehicles range from trucks and cars to tractors, ambulances, and other heavy machinery.

Approximately 150 of these vehicles are owned by the park, while another 180 are leased from the General Service Administration (GSA). Most of the heavy machinery is owned by the park while standard cars are usually leased from GSA.

The vehicles leased from GSA have a higher rate of turnover than those which the park owns. The leased vehicles are replaced based on a schedule predetermined by GSA. When vehicles are up for replacement, the department which needs the vehicle orders it for itself.

Many of the leased vehicles can run on ethanol, yet there is no ethanol fueling station in or near the park. The closest ethanol fueling station is located in Phoenix, Arizona, 247 miles away.

3.2.3 National Park Service Maintenance Facility

National Park Service vehicles are maintained by the park’s vehicle maintenance facility. This facility was completed in May 2003, and is Leadership in Energy and Environmental Design (LEED) Green Building Rating System certified. The maintenance facility for NPS vehicles serves as an excellent example of an environmentally friendly and user friendly facility. It is not only clean and inviting, but incorporates many environmental features such as an oil filter crusher.
3.2.4 National Park Service Owned Buses at Grand Canyon National Park

In order to transport tourists around the park, GCNP operates a fleet of buses. The shuttle buses operate on three routes within the park and on one pilot route outside of the park into the nearby city of Tusayan, Arizona.

The shuttle bus service is voluntary and runs year round. An estimated 25% of park visitors use the bus service. Over 4.5 million people board an NPS bus per year, and the park estimates that every visitor who gets on, boards an average of four times.

The fleet is comprised of 29 compressed natural gas (CNG) fueled buses. Twenty of these buses were recently purchased by the park in 2008 to replace the older diesel fleet. The diesel buses are gradually being phased out according to the head mechanic with Paul Revere Bus Company.

Compressed natural gas is a non-petroleum, all accessible alternative fuel. In the event of a spill, CNG is safer than other motor fuels. The fuel used in the CNG buses is supplied from a CNG fueling station at the park.

Grand Canyon National Park owns the CNG buses; however Paul Revere Bus Company is responsible for bus operation and maintenance. Another company called North Star performs a quarterly maintenance inspection for the CNG fueling station.

3.2.5 Xanterra Operated Bus Fleet

Xanterra operates a fleet of 30 buses for visitors in GCNP. Twenty-seven of the thirty buses run on diesel while three newly purchased buses run on compressed natural gas. However Xanterra is looking to replace the diesel buses with cleaner burning alternatives, according to the Director of Environmental Affairs for Xanterra South Rim.

Xanterra is not completely satisfied with the compressed natural gas buses however, and is researching other alternatives such as biodiesel and carbon fuel sources for the 27 diesel fueled buses in the fleet. According to Xanterra, all 30 of these buses will be replaced with alternatively fueled buses as of an unspecified date.
3.2.6 Greenway Systems at Grand Canyon National Park

A greenway is a “scenic trail or route set aside for travel or recreational activities.” At Grand Canyon National Park networks of trails, bike-paths and greenways create an awesome opportunity for visitors to stretch their legs and explore the South Rim under their own power. It also creates the opportunity to lessen the load on shuttle buses and roads by having visitors elect to walk/ride from destination to destination.

Grand Canyon National Park has installed and is in the process of improving an extensive greenway system for bicyclists and pedestrians along the South Rim of the park. Current Greenway construction is also being done in an environmentally friendly manner according to Greenway project manager. For example:

1. The 2.5 miles of greenway under construction alongside Hermit’s Road is being built on top of an old fire road abandoned in 1930 in order to minimize damage to undisturbed areas.

2. The park is rerouting the trail from Maricopa Point to Powell Point in order to protect endangered species.

3. The Park is rerouting the trail around the Orphan Mine area while that area waits for environmental clean-up

4. The 1.5-2 miles of unpaved trails under construction are utilizing recycled materials from the road construction process

When current construction is finished, the historic district will be connected by greenways and bike paths through to the South Kaibab Trailhead. This pedestrian and cyclist route is complimented with other unpaved trails and walking paths.

3.2.7 Proposed Temporal Closures, Providing Opportunities for Bicyclists and Pedestrians

GCNP is also considering temporarily closing Hermit Road to buses once construction is completed. This temporal closure would take place on the western half of the road from 7-10 am from March 1st-Nov 30th. Although Hermit Road is only open to buses during this time anyway, this further bus restriction would mean that the road would only be open to pedestrians and cyclists. Temporal closures on roadways currently take place in other National Parks such as Zion. Temporal closures encourage alternative modes of transportation and allow park visitors to explore the park by foot and pedal.
3.2.8 Greenway Use by Park visitors

We did not observe many visitors using the greenway system to commute between destinations along the South Rim. We concluded that the distances between destinations generally deter walkers, and that bicycling is not an option for most visitors because most visitors do not have access to bicycles at the park.

Currently visitors and staff cannot rent bicycles at the park. According to a project manager there have been plans to rent bikes in the park, but these plans have never been worked on actively. Park employees have commented that a bike rental facility would probably be run by a concessionaire, and that during previous conversations the bike rental would either be located at Old Canyon Plaza or the historic Powerhouse.

3.2.9 Bicycle Facilities at Grand Canyon National Park

We observed that facilities at Grand Canyon National Park do not consistently have bicycle parking. Some facilities like the Albright Training Center lacked bike racks entirely, while the new LEED certified maintenance and facilities building has at least two or three rows of bike racks outside. However, no bikes were parked there during our visits.

3.2.10 Employee Commuting

Grand Canyon employees generally rely on private and park vehicles to get to and from work, and do not use alternative means of transportation. GCNP employees who commute fall into two categories: 1) employees who live in the park; and 2) employees who live in Flagstaff but who must come to the park on occasion.

Employees Who Live in the Park

Employees who live in the park generally drive to work. Few employees ride bikes or take the bus system. The bus system does not run from residential neighborhoods to many of the NPS offices. Few bike paths exist in the interior of the park along the routes employees use to commute. In addition, many employees consider the shoulders along the roads too narrow to safely ride their bikes there. Center Road, along which many employees commute to work, has no shoulder. Several Grand Canyon employees said that the absence of a shoulder on roads within the park, especially Center Road is “an issue”.

It was estimated that a bike path along Center Road would cost approximately $100,000 to build. One employee conjectured that it would be ineffective in increasing employee commuting because GCNP employees like to drive their vehicles and are unlikely to do otherwise in the event of improved infrastructure.

Employees Who Live in Flagstaff and Commute to Grand Canyon National Park

Grand Canyon National Park has been relocating some employees from the park to Flagstaff during the last couple of years. By creating offices in Flagstaff for employees who do not need to be at the canyon to do their work, the park is reducing commuting hours. However some employees still have to commute from Flagstaff to the canyon on a regular or semi-regular basis. For these employees
arranging rides is done on an individual level. There is no official carpooling system, however employees say that they carpool whenever possible.

Before offices were moved to Flagstaff a shuttle bus ran from Flagstaff to the Canyon for park employees, however this has been discontinued.

### 3.3 Procurement

Purchasing at the Grand Canyon is done intra-departmentally which means that employees within each department make purchases for their department. Employees are allowed to make purchases for items up to $3000 and for services up to $2500 according to GCNP chief of contracting. For values greater than these, employees go through a program assistant to make a purchase request. The National Park Service contracting office, located in Flagstaff, Arizona, approves these purchase requests. According to the chief of contracting, the contracting office assumes that the individual making the purchase request has done his or her homework and knows what is best, and therefore approves most purchase requests.

### 3.3.1 Green Purchasing Requirements and Regulations

According to the National Environmental Policy Act (1969), government agencies “are required to systematically assess the environmental impacts of their proposed actions and consider alternative ways of accomplishing their missions in ways which are less damaging to the environment.”

### 3.3.2 Current Purchasing Procedures at GCNP

Grand Canyon National Park currently uses a variety of environmentally friendly and non-environmentally friendly products. The extent to which environmentally friendly or green products are used varies by department. In several departments employees say they try to purchase green. Others commented that they are aware that they should be purchasing whenever possible according to government policy.

Through employee interviews we identified a variety of ways in which employees purchase for the park. Some employees shop on the U.S. General Service Administration Advantage webpage. Government agencies are encouraged to use this webpage (see Appendix A). However in times of immediate need when supplies are low many employees make purchases from the nearby Staples store, where prices are generally higher than on the GSA Advantage webpage and where there is less selection.

The GSA Advantage webpage offers an extensive environmental section of environmentally friendly products. During interviews we discovered that many employees who made large numbers of purchases did not know about the GSA Advantage environmental webpage. However, once shown the webpage one park employee was eager and excited to look through it.

### 3.3.3 Employee Attitudes towards Green Purchasing

The extent to which sustainable purchases are made at Grand Canyon National Park is greatly influenced by the attitudes and opinions of park employees towards green purchasing. This is the case because at Grand Canyon National Park employees have a large amount of control over what is purchased within their department.
However, employee attitudes within the park towards sustainable purchasing vary. Some park employees we interviewed were enthusiastic to improve green purchasing wherever possible and were open to new ideas about how to do so. Others employees were less than enthusiastic about making changes and commented that “we are already doing well with the green thing.”

3.3.4 Park Wide Inventory System

At Grand Canyon National Park there is no park wide inventory system for supplies such as computer paper, cleaning supplies, staplers, tape, ink cartridges, etc. There is an inventory system which keeps track of larger items such as buildings, heavy machinery, and trail systems. However this system does not include smaller supply items which are still significant in the Park’s budget and in the Park’s environmental impact.

3.4 Green Building

There are many buildings at Grand Canyon National Park from a variety of eras, each of which exemplify a different range of environmental friendliness. The strengths and weaknesses of each building with respect to sustainability and energy efficiency could not be investigated due to time constraints. However, we have identified several types of buildings at the park, and have provided a brief overview for each type of building and ways in which sustainability could be improved. See Appendix B for a general outline of green building concepts and Appendix C for suggested building materials and systems.

3.4.1 Employee Housing

Employee housing constitutes a wide range of building types. Much of the employee housing could use some improvements to cut down on energy and water costs. Simple changes such as low flow toilets, aerated sink fixtures and double-paned windows are fast and easy ways to improve sustainability.

3.4.2 Xanterra Operated Facilities

In the interview with Megan Bloomer, the Director of Environmental Affairs for Xanterra, she explained that Xanterra is willing to update some of the existing buildings. With the help and approval of the GCNP, Xanterra would improve sustainability by adding solar panels to existing facilities, by renovating older buildings to become more energy efficient, and by adding reclaimed water lines to supply toilets in some of the buildings.

3.4.3 Historic Buildings

Many buildings at Grand Canyon National Park are historic. Some of the suggested or needed improvements and renovations have not been made to avoid compromising the building’s historic nature. Historians and others at the Grand Canyon National Park are sometimes not willing or able to adapt these buildings due to preservation issues and related regulations.
3.5 Waste Management

A phone interview with Peter Steinkopf, former head of Waste Management for the South Rim at GCNP, was conducted and questions pertaining to the waste management at the South Rim were answered. The type of waste produced at the park is mostly household waste consisting of a little more food waste than average. The Park does not produce any industrial waste. Lumber, pallets and green waste are either burned in the winter or made into wood chips for use around the park.

3.5.1 Waste Disposal Practices

In 2007 approximately 16,541 tons of garbage was sent to the Cinder Hills Landfill in Flagstaff, AZ and 919 tons were recycled, including 130 tons of scrap metal. Approximately $1,439,067 was spent in 2007 to haul the waste to Cinder Hill Landfill. About half the money was to haul the waste and half the money went directly to the landfill. Ashfork Sanitation is contracted to haul the waste.

A company from Tucson called Unicore picks up computer waste. For used batteries, boxes are purchased at $50 each and then filled and shipped back to the company (we were unable to discover the company name) for disposal. Shipping is included in the cost. Oil filters are recycled by Safety Kleen; the filters are crushed to extract remaining oil and the metal carcass is then recycled as scrap. The park uses recycled oil in their vehicles. Cooking oil is picked up by a company contracted by Xanterra.

Everything from Phantom Ranch is taken out by mule. There are no trash bins for hikers; the waste produced by the hikers is to be taken out by the hikers. This practice is referred to as “pack in/pack out”.

3.5.2 Proposed Waste Practices

Xanterra is currently looking into converting used cooking oil into bio-fuel.

3.5.3 Composting

GCNP does some composting mostly consisting of mule manure and bio-solids from the wastewater treatment plant. The composting is done in lagoons by the old wastewater treatment plant. The compost will be used for the permanent cover of the landfill. The park operated an active composter in the past, but it was said to be too labor intensive and the outside temperature was also thought to be a factor in maintaining the core temperature within the compost pile.

3.5.4 Recycling

There are 300 recycling containers around the park in various sizes. Two, four, six and eight cubic yard containers are picked up by Norton Environmental. This company also picks up glass. Recycling containers are distributed to copy rooms, offices, and upon request to anyone who wants one. Custodians dispose of the containers into the recycling dumpsters. The recycling containers around the park are a bit clustered and some have inappropriate labeling (i.e. a list of recyclable materials and in different languages so that foreigners understand that recycle bins are not trash bins). The smaller bins along the rim typically have labeling issues, not the dumpsters that are along the road and in the residential areas. The Park has a goal of a trash diversion rate of 40% from the landfill by the end of FY 2009.
### 3.5.5 Recycling and Xanterra

Within the Xanterra concessions there is a very strict recycling program that diverts approximately 50% of waste from the landfill. Xanterra’s program includes proper labeling of containers and a list of the recyclable materials accepted. Xanterra provides recycling containers in each of its hotel rooms. Once linen is retired from use in hotel rooms, it is used by painters as drop cloths. The next step in the cycle is to shred the linen into smaller pieces for use as rags. All shampoo and conditioner bottles are being replaced with biodegradable ones and the soap packaging is made from recycled material. In the Xanterra restaurants the solid waste goes through a machine in which the waste is compacted and the water is pressed out of the waste. This reduces the weight of the waste for disposal; the water is discharged into the sewer system.

A Xanterra staff member suggested many possibilities for Xanterra to help GCNP become more sustainable. One feasible project would be starting a composting facility which would be a great way to cut the park’s carbon footprint, cut down on waste hauling costs and divert waste from the landfill. Xanterra at Yellowstone National Park helps their composting facility by color coding their waste bags for easier sorting of composting, recyclable and waste materials.

### 3.5.6 North Rim

Seven dumpsters are picked up once a week at the North Rim. Total waste numbers from the South Rim do not include the North Rim except for the recycling waste. They pick up about 900 cubic yards approximately every summer. The North Rim recently bought a high volume organic waste decomposition system from Biotech America. In the system, micro-organisms are used to break down organic waste into a liquid which can safely be disposed of down the drain.

### 3.6 Recycling Outreach

Grand Canyon National Park provides visitors with the opportunity to recycle. In areas of high visitor use, such as the Bright Angel Trail Head, the recycle bins outnumber the general trash bins by a ratio of about three to one. Recycle bins exist throughout the rest of the park as well. With the opportunity to recycle available all around the park, more could be done to reach out to the general public and inform visitors why it is important to recycle. If visitors know the importance of recycling and the positive impact it has on the environment, they may be more inclined to participate.

However, the signage on the bins is inconsistent. These signs are very evident on some bins, and on other bins the signs are very old and often times hard to read. Moreover, although some recycle bins request that materials are sorted, others do not. The park does not require that recyclables be presorted, so requesting that visitors sort the recycling is unnecessary and confusing. Additionally our observations indicate that not all visitors participate in these recycling programs. Recyclable materials are often found in trash cans, and more frequently trash is thrown into recycle bins.
The only methods of visitor outreach beyond the signs on the recycle bins are small signs at the park entrance that read “Grand Canyon Proudly Recycles” and a small recycling ad in the Visitors Guide. The “Grand Canyon Proudly Recycles” sign is small and not particularly noticeable. Also, the sign does not encourage visitor participation nor does it extol the benefits of recycling.

The recycling ad in the Visitor’s Guide is not very big and is located on the bottom right hand corner of page 13. The message should be more prominent in the guide and provide more and better information.

As noted previously, with regard to the signage on the recycle bins, many are only presented in English and people who do not speak English would have no way of knowing what type of material goes into each recycle bin. Most of these signs are very old, hard to read, visually unpleasing, and hard to recognize by park visitors. The signs on the recycle bins in no way attract visitors and encourage them to recycle, which gives the visitors the idea that the park does not care much about recycling. A consistent prominent message regarding waste would improve visitor participation and education.

Another way that the visitors could be motivated with recycling is by using a few metal mesh recycling bins, similar to the ones used in Yellowstone National Park, to have a visual affect and to see what is being recycled.

3.6.1 Employee Recycling

Employees at Grand Canyon National Park have the opportunity to recycle and appear to take advantage of it. In residential areas there is about one recycling dumpster for about every four or five houses. According to employees interviewed, most buildings around the park have both trash containers and recycle bins. This creates environments that encourage recycling both at home and in the office. By talking to employees, it became clear that most are aware of the importance of recycling and recycle on a regular basis.
However, employees could improve their recycling practices by recycling their ink and toner cartridges. By refilling these materials instead of buying new ones, the park could save a substantial amount of money. At Yellowstone National Park, for example, 160 toner cartridges and 243 ink cartridges were refilled, creating a total annual savings of $8,716 and diverting that solid waste from the landfill.

3.6.2 Litter

Littering at Grand Canyon National Park is a problem. The high amount of visitor traffic can create a large amount of litter. Not only is this trash aesthetically unpleasing to visitors, but it is harmful to the environment. In areas close to the rim there is a fair amount of trash on the ground, which can be easily blown into the canyon.

Currently Grand Canyon National Park is addressing this issue by employing one person to pick up trash and litter during the summer months. However, this could be greatly assisted with improved communication and outreach.

We observed that the Park attempts to prevent littering through one sign that discourages littering at the park. In addition, we did not find any information that discouraged littering in the Visitor’s Guide.

3.7 Water

3.7.1 Water Use

As reported to the research team in the water utilities report for the 2007 fiscal year, the total consumption of water at the Grand Canyon was 146,984,210 gallons (2007 GCNP Water Report). A more detailed breakdown of this information can be found on the chart titled *Kilo-Gallons of Water Used – FY 2007*. However, locations of interest are highlighted in the table below.

<table>
<thead>
<tr>
<th>Affiliation</th>
<th>Location</th>
<th>Water Usage (kilo gal.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NPS</td>
<td>Phantom Ranch</td>
<td>1,735.00</td>
</tr>
<tr>
<td>NPS</td>
<td>Buildings and Residencies</td>
<td>23,731.00</td>
</tr>
<tr>
<td>NPS</td>
<td>Total Water Usage</td>
<td>33,600.17</td>
</tr>
<tr>
<td>Non-NPS</td>
<td>Xanterra – North Rim</td>
<td>13,150.23</td>
</tr>
<tr>
<td>Non-NPS</td>
<td>Xanterra – South Rim</td>
<td>92,510.00</td>
</tr>
<tr>
<td>Non-NPS</td>
<td>Total</td>
<td>113,384.04</td>
</tr>
<tr>
<td>Both</td>
<td>Grand Total for Entire Park</td>
<td>146,984.21</td>
</tr>
</tbody>
</table>

The following table lists the top water consumers for the entire GCNP; this includes NPS operations and non-NPS operations (2007 GCNP Water Report). Next to the consumer name is the amount of water consumed in the fiscal year of 2007, measured in thousand gallons. These should be the areas where most of the attempt to change should be implemented because these areas will have the biggest sustainability impact.
### Top Eight Water Consumers at GCNP (most to least)

<table>
<thead>
<tr>
<th>Consumer</th>
<th>Water Usage (kilo gal.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Xanterra – South Rim</td>
<td>92,510.00</td>
</tr>
<tr>
<td>2. Xanterra – North Rim</td>
<td>13,150.23</td>
</tr>
<tr>
<td>3. NPS Buildings and Residencies</td>
<td>23,731.00</td>
</tr>
<tr>
<td>4. North Rim</td>
<td>6,354.44</td>
</tr>
<tr>
<td>5. Delaware North</td>
<td>2,514.00</td>
</tr>
<tr>
<td>6. Phantom Ranch/Pin. Pk.</td>
<td>1,735.00</td>
</tr>
<tr>
<td>7. GRCA Schools</td>
<td>1,527.00</td>
</tr>
<tr>
<td>8. Desert View</td>
<td>1,174.03</td>
</tr>
</tbody>
</table>

#### 3.7.2 Wastewater Generation and Reuse

Efforts are being made at Grand Canyon National Park to conserve water and use it efficiently. The GCNP generates Class A reclaimed water at the South Rim, North Rim and Phantom Ranch wastewater treatment facilities (Welborn, 2008). According to Utilities Manager Dave Welborn, the Grand Canyon treats an average of 500,000 gallons of wastewater every day. Treated wastewater from Phantom Ranch and the North Rim is not currently being reused around the park. Treated wastewater from the South Rim is used by the park and concessionaires for flushing toilets and controlling dust. In the summer, lagoons are filled with this wastewater for fire suppression purposes. This treated wastewater is also used by the concessionaire and school system for irrigation, most visibly at the rim lawns at the Bright Angel Trailhead area. Depending on the season, about 1/3 of the wastewater at the South Rim of GCNP is reused for purposes mentioned above. According to Park Hydrologist Steven Rice, the 2/3 of the wastewater not reused around the park is discharged into a tributary of Coconino Wash, called Bright Angel Wash, located near the South Rim Treatment Plant, where the water is quickly recharged into the subsurface.

#### 3.7.3 Low Flow Appliances

Grand Canyon National Park also conserves water by using low flow toilets and urinals around the park. Utilities Supervisor, Dave Welborn, estimated that “about 75%” of the toilets and urinals used around the park are low flow, with a small percentage being waterless. It was observed on a site visit that toilets in the Bright Angel Lodge public restrooms, Market Plaza Café public restrooms, El Tovar Hotel and the Yavapai Observation Station Public Restrooms all use low flow toilets (with a gallon per flush [gpf] ≤ 1.6). However, toilets at the Canyon View Information Center were not marked with a gpf rating; they appeared to be low flow.
3.7.4 Waterless Appliances

Waterless urinals were not found by the research team at any of the above locations. It was mentioned by park employees that waterless urinals are used at some campgrounds around the park, but none of these locations were visited for observation by the research team. The urinals that the research team did see were generally either flush or automatic urinals, and used about one gallon of water per flush. Moreover installing waterless urinals at high use areas such as the Bright Angel Trailhead or the Visitor's Center could help to significantly reduce water use (see Appendix D).

3.7.5 Water Conservation Signage

The Canyon View Information Center does have signage indicating that recycled water is used in their toilets (picture). However, there are not any signs indicative of recycled water use or low flow appliance use at the other locations mentioned above: Bright Angel Lodge public restrooms, Market Plaza Café public restrooms, El Tovar Hotel and the Yavapai Observation Station. Because these are high traffic areas, they could be used to educate visitors about water conservation and other sustainable practices through signage.

3.7.6 Water Issues Related to Employee Housing

As reported to the research team, many of the employee housing units have older toilets that use five or six gallons per flush compared to available low flow fixtures at 0.8 to 1.3 gallons per flush. Installing low flow appliances in these areas could significantly reduce the water used in residential buildings throughout the park.

3.7.7 Maintenance of Water Systems

According to Dave Welborn, the water system around the park is only fixed when leaks reveal themselves; there is not any scheduled maintenance on the piping system. This means that underground leakage from breaks or old piping, that would otherwise not be visible, could take a long time to be fixed. Piping and other water systems should be routinely checked and maintained by maintenance employees.
3.7.8 Water Use at Phantom Ranch

At Phantom Ranch there is little water use regulation. As a result, large quantities of water are consumed at the park's most remote outpost. The water usage report, put out by GCNP, shows that Phantom Ranch used 1,735,000 gallons of water in 2007 (2007 GCNP Water Report), which is a large amount for such a remote location.

One factor contributing to this number could be the fact that visitors are not limited to length of showers or how many showers can be taken while staying at this facility. One park employee, expressed that water use for showers is less than acceptable at the Phantom Ranch facility. This is not a very sustainable or efficient practice for a location in such a remote, desert setting. In order to reduce water consumption at Phantom Ranch, shower times could be reduced and visitors entering Phantom Ranch could be made aware of the Park's limited water resources especially at this remote location.

3.8 Communications/Outreach

3.8.1 GCNP Official Webpage

On Grand Canyon National Park’s webpage, http://www.nps.gov/grc, visitors can get information about the park and activities within the park. Everything from directions to back country permit information is covered on the webpage. However, the Grand Canyon National Park webpage has no information regarding sustainability at GCNP (Grand Canyon National Park, 2008).

If the GCNP’s webpage made it apparent to visitors that sustainability was an important issue at GCNP, then the visitors would be more aware and willing to participate in the sustainability program and its relevant facets.

3.8.2 Xanterra Webpage

Xanterra does operate a website that has information for visitors about sustainability and other environmental issues (Xanterra Parks and Resort, 2008). This website is informative and easy to navigate.

Moreover, on Xanterra’s national homepage there is a link titled “Environment.” There is a section on Xanterra’s Grand Canyon page that has this same link titled “Environment.” The advantage to having separate park and companywide “environment” sections on the webpage is that visitors can see how Xanterra is dealing with environmental issues both on a local and national level. The companywide “Environment” webpage is found from a direct link from the company’s homepage, this link is very large and apparent at the top of the page. The same can be said for the “Environment” section that is specific to GCNP; the link is very obvious and is on the homepage of Xanterra’s Grand Canyon page. The information on the two “Environment” webpages contains the same general information, but there is some focus on the Grand Canyon on their Grand Canyon webpage. Having this information available on the web is very informative to visitors and is a very effective outreach tool. This page does contain more
information and is easier to find than Yellowstone’s “Greening and Sustainability” webpage, although they cover some of the same issues.

### 3.8.3 Xanterra Visitor Outreach at Park

The largest concessionaire at the Grand Canyon National Park is Xanterra Parks and Resorts, which operates throughout the entire South Rim. Xanterra is limited in how much it can reach out and try to educate visitors, because everything outside of their operation has to go through NPS. But there are locations where Xanterra has a huge influence on visitors, namely the hotels and restaurants operated by Xanterra.

Xanterra does a good job at visitor outreach in the hotel rooms that they operate at the South Rim. All 906 guest rooms are equipped with recycle bins as well as magnets that inform visitors of items that can be recycled and items that cannot be recycled. A copy of Xanterra’s 2007 Sustainability Report is put in each guest room so that visitors can read about different sustainability issues having to do with the concessionaire. The room card that guests use to get into their rooms has literature on it that asks guests to recycle and be aware that recycling does exist at Grand Canyon National Park. The hotels do participate in a conservation practice that involves guests putting their towels on the floor if they want them replaced, or put them on the rack if they do not need them replaced. This keeps the cleaners of the room from replacing every towel daily, which saves on laundry, and in turn, water and the energy to deliver and treat it. The hotels have a similar practice with replacing bed sheets, where sheets are only replaced upon the guest’s request (Bloomer, 2008).

Xanterra also reaches out to visitors at the restaurants and stores that they operate. At Xanterra operated restaurants, menus contain information that tells visitors which foods are sustainable and which are not. This is true for every menu in every restaurant that is operated by the concessionaire. Also, in stores that are run by Xanterra, items that are sustainable are indicated as being sustainable. The intent is that visitors see these things and make an educated decision to buy items and foods that are sustainable.

### 3.8.4 Vacancy of Environmental Position at NPS

The Environmental Protection Specialist position at Grand Canyon National Park is currently vacant. The position has been vacant for months although the exact date that this position became vacant was not given by NPS. The previous Environmental Protection Specialist, Laura Schrage, currently works for Bryce Canyon National Park.

A coordinator of environmental issues at Grand Canyon National Park could greatly aid in promoting sustainability at Grand Canyon National Park. The amount of time that is needed to focus on environmental issues at the park is being compromised because this position is not being filled. This report strongly recommends that Grand Canyon National Park permanently fills the environmental protection specialist position.
3.8.5 Xanterra Director of Environmental Affairs

Xanterra staffs an environmental position, which they call the Director of Environmental Affairs. This position allows a single person to direct all environmental issues concerning Xanterra at GCNP. This allows Xanterra to be very organized with their environmental practices. Xanterra staffs this same position at every park. The Xanterra Director of Environmental Affairs for Grand Canyon South Rim is Megan Bloomer.

4.0 Recommendations

4.1 Energy

- Track yearly energy use by building.
- Identify trends in energy consumption.
- Replace incandescent light bulbs in the park with compact fluorescent bulbs and install light emitting diode (LED) fixtures where possible.

4.2 Transportation

- Create an online system or webpage where employees can post their planned trip information and network with each other to organize carpools.
- Cut down on single driver trips around the park.
- Purchase and lease hybrid and other fuel efficient vehicles when vehicles are up for replacement.
- Encourage employees to carpool and ride their bikes to work.

4.2.1 Bus System

- Educate visitors about the benefits of CNG and the park’s new fleet.
- Include in contracts that Xanterra replace their diesel fleet with a more environmentally friendly one

4.2.2 Greenways

- Install easy to use and accessible bike racks in front of all main buildings along the bike path/greenway.
- Contract with a concessionaire to rent bicycles to visitors at an affordable price.
- Advertise the Greenway system as well as bicycle rental facilities to visitors.
- Provide funding to complete existing Greenway projects.
- Fund regular maintenance of greenways and other trails.
4.3 Procurement

4.3.1 Set-up a park wide purchasing system for products

- In order to standardize the use of environmentally friendly products throughout Grand Canyon National Park, we recommend that the Park create a park-wide purchasing system. This system would:
  - Standardize purchase of environmentally friendly products such as paper towels and disinfectant to be used throughout the park.
  - Eliminate the need for individual departments to make purchases. This would save employee time.

4.3.2 Create a Green Product Warehouse

- Grand Canyon National Park should create a green warehouse where environmentally friendly products are stocked and easily accessible to employees. By creating a green warehouse GCNP would:
  - Make products easier to find
  - Decrease last minute purchasing and therefore save money
  - Make products easier to keep track of and therefore make it easier to identify patterns in use and make it easier to anticipate future needs.

4.3.3 Set-up a park wide inventory system

- Grand Canyon National Park needs a park-wide inventory system (Appendix E) to keep track of supplies so that:
  - The park understands what is has now and can anticipate future needs
  - Products are readily accounted for
  - Areas of excess are identified and modified
  - Loss can be accounted for in the event of damage
  - Employee accountability with respect to green product purchasing is created

4.3.4 Increase employee accountability with respect to green purchasing

By creating a park wide system for purchasing and managing supplies employees would be held accountable to purchase greener products. If this structure is not feasible, GCNP employees should be held accountable for the purchases they make (see Appendix F). Currently there is no way to ensure that GCNP employees are purchasing “green”.

In order to hold employees accountable we suggest that:

- Team leaders audit employee receipts for green purchasing
- Reward employees for outstanding green purchasing
- Discipline accordingly for poor green purchasing (this is very important because if team leaders let non-green purchasing slide, this sends a message that it is okay not to purchase green, and that team leaders really do not care)
- Create a culture where green thinking is the norm


- Educate employees on green purchasing and the GSA environmental webpage (Refer to the Communication/Outreach section of this report for information about how to educate employees about green purchasing)

4.3.5 Create an Intra-net website for purchasing

Grand Canyon National Park should create an intranet site where park employees who make purchases can find an easy to use list of environmentally friendly products. The items on this list should be linked to the GSA webpage so that employees can make purchases with a simple click and without much searching. See Appendix G for a sample list of products that could be included on this intranet site. This recommendation came from NPS employee at Carlsbad Caverns, GoPaul Noojibail.

4.4 Waste Management

As fuel prices rise, the cost of hauling waste from GCNP also rises. Diverting the amount of waste that goes to the landfill will reduce environmental impact and save money that could be used for other projects around the park. Other projects could include composting to reduce the amount of trash hauled, or the selling of grade A compost to residents and locals. Composting has been done in many cold places such as Alaska and Yellowstone National Park, therefore composting at GCNP would be feasible and cost effective. The park is doing a fair job with recycling, but could improve on aesthetics and labeling.

- Educate visitors and employees at GCNP about the importance of recycling and proper disposal of waste (Appendix H).
- Encourage visitors to reuse plastic water bottles or buy and use reusable bottles to cut down on the amount of disposable water bottles in the waste stream.
- More effectively place recycling and trash bins. Wherever there is a trash bin there should also be an adjacent recycling bin instead clustering recycling bins in one location.
- Consider using metal mesh containers to show people what materials go in each bin
- Properly label recycling bins with universal symbols used consistently throughout the park
- Post signs promoting recycling in high visibility locations
- Establish a small propane cylinder recycling program (Yellowstone National Park recycles about 10,000 propane cylinders a year)
- Establish a program for printer ink and toner refills (e.g., Cartridge World, Chandler, AZ, 1-888-99-refill or [http://www.cartridgeworldusa.com/store20](http://www.cartridgeworldusa.com/store20))
- Put recycling containers in shared quarters
- Establish a composting program appropriate to cold weather locations (Yellowstone National Park and Alaska parks have successful composting programs)
- Use compost for:
  - Garden and landscaping - Fertilization
  - Small scale bioremediation or neutralization of soil and water contaminants like gasoline, diesel fuel and oil
  - Erosion control
  - Landfill cover
  - Stream bank restoration
4.5 Communications

4.5.1 Community Outreach
The community outreach portion of the recommendations includes recommendations from a range of general categories, like water and waste, but is focused on involving visitors in sustainability efforts. Detailed information pertaining to individual bullet points is located in appendices.
- Add a sustainability section to the park’s official webpage. Refer to the “greening and sustainability” section that Yellowstone has already developed for their webpage (Appendix I).
- Make new recycling signs around the park using universal symbols and consistent format.
- Improve community outreach explaining why recycling is important.
- Produce signs so that they can be universally read by people from all over the world.
- Develop more signage regarding sustainability in high visibility areas (Appendix J).
- Celebrate key environmental holidays (e.g. Earth Day) in a way that involves park visitors and employees.
- Develop and distribute a pamphlet for visitors to explain how visitors can get involved in helping the Grand Canyon be a more sustainable destination (Appendix K).
- Develop signage in locations using low flow and waterless appliances (Appendix J).
- For all signage, use sustainable materials, preferably recycled plastics and other materials (Appendix J).
- Make sustainable park practices obvious to park visitors.

4.5.2 Littering
Although most of the recommendations with regards to littering pertain to community outreach, littering is such an important and prevalent issue that it seems it needs its own specific recommendations. As mentioned before, more specific information is found in appendices as noted below.
- Develop and post more signs discouraging littering throughout the park (Appendix J).
- Include anti-littering outreach to visitors as part of the Visitor’s Guide or as a part of a sustainability pamphlet.
- Make a priority for park officials to crack down and discipline people that do not properly dispose of their material waste.
- Make a litter bag a mandatory piece of equipment for hikers in the park.
- Open the park for organizations (i.e. schools, churches, etc.) to come and volunteer to clean up the park (especially near the rim).

4.6 Water
Most of the following recommendations to improve water efficiency are in general terms. More detailed recommendations and data can be found in the appendices.
- Implement a replacement plan for all high water use toilets in the park with low water use fixtures (less than or equal to 1.6 gpf).
• Implement a replacement plan for all flush urinals in the park with waterless no-flush urinals, starting with high traffic areas (Appendix D).
• Install faucet aerators throughout the park.
• Check pipes and other fixtures regularly for leaks, not only as leaks reveal themselves.
• Use appropriate amounts of water for laundry (full loads only) and dishwashing.
• Develop a “timed shower system” at Phantom Ranch and other remote locations coupled with outreach explaining the importance of water conservation (Appendix D).
• Find more uses for treated wastewater (e.g., car washing, window washing, concrete materializing, etc.).
Appendix A - Procurement

Use the GSA webpage to purchase environmentally friendly products. Products can be searched for from the Environmental Aisle homepage.

Office Supplies

- Purchase supplies which contain reused and recycled materials.
- Click the recycled content box before searching for materials.
- Purchase products which contain rapidly renewable materials.
- Purchase materials which have been harvested and processed or extracted and processed within 500 miles of the Park.
- Purchase paper products which consist of at least 50% Forest Stewardship Council (FSC)-certified paper products.

Durable Goods, Equipment

- Purchase equipment which is ENERGY STAR labeled.
- Select the ENERGY STAR compliant box before searching for equipment on the GSA advantage environmental webpage.

Furniture

- Purchase furniture which contains post-consumer and/or post-industrial material.
- Click the recycled content box on the GSA advantage environmental webpage before searching for furniture or office supplies.
- Purchase salvaged equipment, either on-site or off-site.
- Purchase equipment which contains at least 50% FSC certified wood.
- Purchase equipment which contains material harvested and processed or extracted and processed within 500 miles of the Park.

Paint Products

- Purchase environmentally friendly paints, primers, and sealants.
- Search for the product of choice on the GSA advantage environmental webpage.

Flooring

- Purchase environmentally friendly carpet from the GSA advantage environmental webpage.
- A variety of non-toxic, recycled content, and environmentally friendly carpet products are readily available from the GSA webpage.

Lamps

- Establish and follow a lamp-purchasing program that sets a minimum level of mercury content and life for all mercury-containing lamp types. Work with suppliers to specify these requirements for all future purchases.
• Consider alternative lighting (daylighting) and LED fixtures where possible. Use compact fluorescent light bulbs in all standard fixtures.

**Food**

• When establishing contracts, specify that food and beverages meet one or more of the following criteria whenever possible:
  • Encourage the use of companies that purchase locally grown and/or organic foods.
  • Products are labeled USDA Certified Organic, Food Alliance Certified, Rainforest Alliance Certified, Protected Harvest Certified, Fair Trade or Marine Stewardship Council’s Blue Eco-Label.
  • Products are produced within a 100-mile radius of the Park.
Appendix B – Green Buildings Guidelines

This appendix includes excerpts from the following reports from the Grand Canyon National Park and Northern Arizona University Partnership 2008 (see full reports for additional details).

- Sustainability Assessment, Bright Angel Trailhead Plaza, Grand Canyon National Park, Stephen Mead and William Nau (October 2008)

- Science and Resource Management Campus Comprehensive Plan, Section 3 - McKee Redevelopment, Sonya Malkhassian and Susan Thomas (December 2008)

Over the last two decades, architects, engineers, builder’s and material manufacturers have worked collectively to create a new type of design system that considers all phases of a building’s life cycle including design, construction, operations, and disposal. This idea is called whole building design or more simply sustainable design. The main objective of sustainable design is to create efficient structures that optimize energy, water, and material usage and minimize the pollution associated with building usage. Buildings that are designed and constructed with these principles in mind are sometimes call High Performance Buildings or Green Buildings.

The U.S. Green Building Council (USGBC) has been instrumental in the rapid rise in sustainability consciousness through their acclaimed program: Leadership in Energy and Environmental Design (LEED). More information on the USGBC and its various LEED programs can be found at: http://www.usgbc.org/ Of particular interest to those not familiar to the LEED program might be the PowerPoint presentation materials created by the USGBC as information resources. Several presentation materials can be found at: http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1720 . The two presentations: “About the USGBC” and “About LEED are excellent overviews.

Typically, sustainable design is guided by six principles:

1. Optimize site selection.
2. Optimize energy usage.
3. Protect and conserve water.
4. Optimize indoor environmental quality.
5. Utilize environmentally friendly products.
6. Optimize the operations and maintenance of the building during its life cycle.

1. Optimize Site Selection
   (L.E.E.D. NC v. 2.2: ‘Sustainable Sites‘ 14 points)

The success of a sustainable design is often dependent upon site selection. The location, landscaping and orientation of a building affect the local ecosystems, transportation opportunities, and energy usage. As an example, one of the strategies behind creating a high performance building is to use the sun to heat, cool, and create lighting for the building. As such, the orientation of the building is often critical to optimizing the design. To maximize and control solar energy, most green buildings are sited with their long axis on a line that points east and west. Because building materials contain large
amounts of “embodied energy,” sustainable design emphasizes reusing existing buildings or redeveloping previously polluted “brownfield” sites.

The Whole Building Design Guide suggests that a designer consider these site design criteria:

- Minimize development of open space by the selection of disturbed land, brownfields, or building retrofits.
- Control erosion through improved landscaping practices.
- Reduce heat islands using landscaping and building design methods.
- Minimize habitat disturbance.
- Restore the health of degraded sites by improving habitat for indigenous species through native plants and closed-loop water systems.
- Incorporate transportation solutions along with site plans that acknowledge the need for bicycle parking, carpool staging, and proximity to mass transit.
- Encourage alternatives to traditional commuting.
- Consider site security concurrently with sustainable site issues.
- Location of access roads, parking, vehicle barriers, and perimeter lighting, among others, are key issues that must be addressed.

In addition:

- Take advantage of the sun, build where the building will not be shaded by trees, landforms, or other buildings. This way if solar panels are to be considered for the building they can be placed and used properly.
- Consider site hazards such as flood risks, erosion and soil contamination (consider a location where soil contamination can be treated so that undeveloped land can be left alone).
- Locate building close to a bike path (offering a bike rack to secure bikes) or public transportation.
- Provide preferred parking for those that have low emitting and fuel efficient vehicles and for those who car-pool.
- Use paving materials with a solar reflectance index (SRI) of at least 29.
- Place building according to wind direction to take advantage of natural ventilation.

2. Optimize Energy Usage

(L.E.E.D. NC v. 2.2: ‘Energy and Atmosphere’ 17 points)

As noted earlier, buildings use a large piece of the nation’s energy production. There are also increasing concerns with energy security and the impact of greenhouse gases on world climate. It is obvious that energy costs will play an increasing role in facility operating and maintenance costs. For instance, some analysts predict that “cap and trade initiatives will cause electrical energy costs to triple in cost over the next five to ten years.” Given these challenges, it is essential that designers find new ways to optimize the energy usage of buildings. Some strategies include:

- Reduce heating, cooling, and lighting loads through climate-responsive design and conservation practices (e.g., insulation, solar exposure).
- Employ renewable energy sources such as daylighting, passive solar heating, photovoltaics, and geothermal.
• Specify **efficient HVAC** and **lighting systems** that consider part-load conditions and utility interface requirements.
• Optimize building performance by employing energy modeling programs and optimize system control strategies by using **occupancy sensors** (such as automatic light sensors) and air quality alarms.
• Monitor performance through a policy of **commissioning**, metering, and annual reporting. Consider metering major mechanical systems to effectively monitor energy consumption.
• Implement energy-efficient retrofits and energy-saving techniques to reduce the building’s energy use. Replace office equipment, maintenance equipment and appliances with energy efficient alternatives.
• Use low energy light bulbs and energy efficient fixtures (e.g., LED).
• Specify appropriate lighting for the purpose and avoiding over-lighting.
• Use energy efficient appliances, look at the energy star program for available appliances.
• Consider supplementary space heaters:
  o **Electricity advantages**
    - electricity is readily available
    - there are no emissions in the home
    - output is controllable – either thermostatically or by timer
    - they can be portable and free-standing, so heat can be targeted to where it’s needed
    - they are convenient and easy to use
    - they have low initial costs
    - they are low maintenance
    - they can be powered using renewable electricity generation
  o **Electricity disadvantages**
    - greenhouse gas emissions from burning oil and coal for generation
    - damming of rivers
    - visual impacts and noise pollution from wind farms
  o **Gas advantages**
    - approximately 80% of the energy used is turned into heat
    - for radiant heaters people like the aesthetics of a flame
    - they can provide high heat output relatively quickly
    - convective heaters can be thermostatically controlled (heat output control only on radiant units)
    - if building near the CNG fueling station there is a possibility that the building could be ran off the CNG like the new LEED maintenance facility building
  o **Gas disadvantages**
    - by-products of combustion should be vented outside
    - reticulated gas may not be available (may have to rely on gas cylinders for supply)
    - moisture is produced when gas is burnt in un-flued heaters
    - initial installation costs are higher than for electricity
    - longer term, there may be issues with security of supply for gas
  o Use a heater with a thermostat
    - put it near a source of thermal mass such as an internal concrete wall - that way the heat will be absorbed and re-radiated at night
• don’t put the heater near a window - a lot of the heat will escape through the glass panes
• don’t put the heater where it will create uncomfortable draughts (heat flows from warm areas to cool ones)
• keep heaters clean - they’ll be more efficient
• Replace gas powered machinery with electric powered equivalencies
• Specify only non-CFC-based refrigerants in all new building HVAC&R systems. Identify existing CFC-based refrigerant uses and upgrade the equipment if economically feasible and/or develop a phase-out plan that identifies a schedule for future replacement”

3. Protect and Conserve Water
(L.E.E.D. NC v. 2.2: ‘Water Efficiency’ 5 points)

Particularly in the American West, fresh water is a scarce resource. Water and energy are also inexorably linked. According to some reports, electricity production uses 48% of the nation’s potable water supply, and the distribution, pumping, and treatment of both water and wastewater requires large quantities of energy. Accordingly, it makes sense to design buildings that will conserve water resources and recycle water efficiently. Some design considerations include:

• Reduce, control, and treat surface runoff.
  o Retain storm water in storage tanks (storm water detention)
  o Use permeable paving
    ▪ gravel
    ▪ open jointed paving with gravel underneath
    ▪ concrete-grass paving
    ▪ porous concrete or porous asphalt
  o Specify green vegetation roofs where appropriate
    ▪ the growing medium protects the waterproof membrane from ultraviolet light
    ▪ they reduce the rate of rainwater run-off
    ▪ noise reduction
  o Feed storm water into bioswales or natural or developed ponds or wetlands
• Use water efficiently through ultra-low flow fixtures, elimination of leaks, water conserving cooling towers, and other actions including “water control systems” sold through GSA website.
  o Install aerators in sinks
  o Install low flow shower heads
• Improve water quality by eliminating pollutants in potable water.
• Recover non-sewage and gray water for on-site use.
• Consider using reclaimed water or harvested rainwater for toilets and landscaping irrigation
• Establish waste treatment and water recycling systems and practices.
• Install “water meters that measure the total potable water use for entire building and associated grounds”. Record meter data on a regular basis.
  o “Install subsystem-water metering to measure and track potable water consumption by specific building systems; prioritize metering for those systems that use the most potable water”
  o Suggest water meters that are available to purchase on the GSA webpage
• Hot water system design
4. Optimize Indoor Environmental Quality (IEQ)
(L.E.E.D. NC v. 2.2: ‘Indoor Environmental Quality’ 15 points)

A report by the World Health Organization in 1984 suggests that 30% of Americans live or work in sick buildings. Other studies show that the indoor environmental quality of a building can have significant impacts on human health, human comfort, and human productivity. To optimize IEQ, sustainable design incorporates strategies that maximize ventilation and fresh air, eliminate materials that “off gas” pollutants like volatile organic compounds (VOCs), and utilize systems that can filter biological and radiological pollutants. Some design criteria include:

- Locate the hot water storage tank near the area of use for the hot water
- Insulating the hot water pipes

- Facilitate quality IEQ through good design, construction, and operating and maintenance practices.
- Value aesthetic decisions, such as the importance of views and the integration of natural and man-made elements.
- Provide thermal comfort with a maximum degree of personal control over temperature and airflow.
- Supply adequate levels of ventilation and outside air to ensure indoor air quality.
- Prevent airborne bacteria, mold, and other fungi through heating, ventilating, air-conditioning (HVAC) system designs that are effective at controlling indoor humidity, and building envelope design that prevents the intrusion of moisture.
- Avoid the use of materials high in pollutants, such as volatile organic compounds (VOCs) or toxins.
- Assure acoustic privacy and comfort through the use of sound absorbing material and equipment isolation.
- Control disturbing odors through contaminant isolation and careful selection of cleaning products.
- Create a high performance luminous environment through the careful integration of natural and artificial light sources.
- Use natural air ventilation
- Conduct a visual inspection of outside air vents and dampers and remove any outside air vent or louver obstructions that restrict full outside air capacity from entering the distribution system”.
- Use grilles, grates or mats to catch and hold dirt particles and prevent contamination to the building interior.
- Prohibit smoking in the building.
- Locate any exterior designated smoking areas at least 25 feet away from entries, outdoor air intakes and operable windows.
- Monitor air contaminants like CO₂ and CO
- Regularly change air filters
- Avoid placing carpets in any of the buildings adhesives, Sealants and Sealant Primers should comply with the LEED standards
Paints should not exceed the following VOC content

- Architectural paints, coatings and primers applied to interior walls and ceilings
  - Flats: 50 g/L
  - Non-Flats: 150 g/L
- Anti-corrosive and anti-rust paints applied to interior ferrous metal substrates should not exceed 250 g/L
- Clear wood finishes, floor coatings, stains, and shellacs applied to interior elements
- Clear wood finishes: varnish 350 g/L; lacquer 550 g/L
- Floor coatings: 100 g/L
- Sealers: waterproofing sealers 250 g/L; sanding sealers 275 g/L; all other sealers 200 g/L
- Shellacs: Clear 730 g/L; pigmented 550 g/L
- Stains: 250 g/L

5. Utilize Environmentally Friendly Products
   (L.E.E.D. NC v. 2.2: ‘Materials and Resources’ 13 points)

All building materials use large quantities of embodied energy. Embodied energy includes all of the energy required to extract, manufacture, transport, and dispose of a material during its useful life. For instance, steel that is manufactured in China may be substantially cheaper than steel manufactured in the United States, but it also has a much higher embodied energy because it has to be shipped across the ocean. At the same time, buildings should be designed to minimize the effect of materials on human health and the environment. For these reasons, it is important to utilize materials that minimize environmental impacts including global warming, indoor air pollution, resource depletion, and waste generation. Some strategies include:

- Renovate existing facilities, products, and equipment whenever possible, such as historic structures or used furniture.
• Evaluate the environmental preferability of products using a life-cycle assessment (LCA) approach.
• Maximize the recycled content of all new materials, especially from a post-consumer perspective.
• Specify materials harvested on a sustained yield basis, such as lumber from certified forests.
• Encourage the use of recyclable assemblies and products that can be easily “de-constructed” at the end of their useful lives.
• Limit construction debris, encourage the separation of waste streams, and encourage recycling during the construction process.
• Eliminate the use of materials that pollute or are toxic during their manufacture, use, or reuse.
• Give preference to locally produced products and other products with low embodied energy content.
• Use renewable materials, made from re-used or recycled content and its extraction causes no environmental problems like pollution or emission of green house gasses

6. Optimize Operation and Maintenance Practices
(L.E.E.D. NC v. 2.2: ‘Energy and Atmosphere’ as noted above and ‘Innovation and Design’ 5 points)

The operation and maintenance of a building generates significant costs during a building’s life. As such it is important for designers to specify products and systems that are durable and require low maintenance. This means creating buildings that are easy to clean and operate. According to the Whole Building Design Guide, operations and maintenance should seek to:
• Train building occupants, facilities managers, and maintenance staff in sustainable design principles and methods.
• Use a building commissioning process to ensure that the building has been constructed according to specifications.
• Purchase cleaning products and supplies that are resource-efficient and non-toxic;
• Use automated monitors and controls for energy, water, waste, temperature, moisture, and ventilation.
• Reduce waste through source reduction and recycling to eliminate disposal off-site.
• Minimize travel by supporting telecommuting programs and enabling teleconferencing.

7. Other considerations

Feedback/Tracking
• “Conduct a survey to identify and address occupants’ comfort and building performance issues. Develop a plan for corrective action to address any identified problems or concerns. Alternative survey ideas are available in the LEED for existing Buildings: Operations & Maintenance Reference Guide.”
  o www.usgbc.org/leed
• Track building operating costs to identify any positive impacts related to the sustainable performance improvements to the building and its operations.
**Bus Shelters**
- Go to the GSA Advantage webpage to find environmentally friendly bus shelters, i-SHELTER

**Landscaping**
- Specify water-efficient, climate-tolerant native or adapted plantings. Implement or maintain high-efficiency irrigation technologies, such as micro-irrigation, moisture sensors or weather data-based controllers. Feed irrigation systems with captures rainwater, grey water (on-site or municipal), municipally reclaimed water or on-site treated wastewater. Consider not operating an irrigation system. Consider use of xeriscaping principles in arid climates.”
- Separate landscape waste “from the waste stream via mulching, composting or other low-impact means”
  - Mulch to “reduce yard waste generation, fertilizer needs and water consumption through retention of organic matter”
- Minimize artificial chemical use by plating locally adapted “plants that need no fertilizer,” use “less polluting alternatives to artificial chemicals, or other low impact maintenance”
- Replace excess paved areas with landscaped areas that use native or adapted plants
- At public building entrances, install low-maintenance vegetation within the landscape design and avoid plants, including trees and shrubs that produce fruit, flowers or leaves that are likely to be tracked into the building.
Appendix C – Green Building Materials and Systems

This appendix includes excerpts from the following reports from the Grand Canyon National Park and Northern Arizona University Partnership 2008 (see full reports for additional details).

- Sustainability Assessment, Bright Angel Trailhead Plaza, Grand Canyon National Park, Stephen Mead and William Nau (October 2008)

- Science and Resource Management Campus Comprehensive Plan, Section 3 - McKee Redevelopment, Sonya Malkhassian and Susan Thomas (December 2008)

Overview:
Detailed specifications for a construction project can run into volumes of information. It is usually necessary and prudent to organize that amount of information according to some recognized convention. One of the most widely recognized, and used, standards in the construction industry is the Construction Specifications Institute’s (CSI) numbering format. From 1996 through 2004 the CSI numbering format, known as “MasterFormat”, contained sixteen divisions. The table below demonstrates that numbering and organization:

**MASTERFORMAT 1996:**
- Division 0 Contract Requirements
- Division 1 General Requirements
- Division 2 Site Construction
- Division 3 Concrete
- Division 4 Masonry
- Division 5 Metals
- Division 6 Wood and Plastics
- Division 7 Thermal and Moisture Protection
- Division 8 Doors and Windows
- Division 9 Finishes
- Division 10 Specialties
- Division 11 Equipment
- Division 12 Furnishings
- Division 13 Special Construction
- Division 14 Conveying Systems
- Division 15 Mechanical
- Division 16 Electrical

By 2004 the CSI, with much input from facility owners, users and constructors; had recognized the need to expand the numbering system to accommodate all the system, technology and process evolutions to date, and to provide room for future expansion. The new numbering system is comprised of Two major Groups: Procurement and Specifications; five sub-groups, and fifty divisions as follows:
Any Owner responsible for many, or large facilities, can benefit from compiling their own standards or “outline specifications” that express their maintenance policies and preferences. The following link is one example of the kind of manual. It was generated for Northern Arizona University which owns in excess of one hundred buildings comprising almost 5.2 million square feet. It is included here in hopes that the Park might find it a useful resource for commercial materials: 

https://www4.nau.edu/cas/Plan-Dev/TechStandards.html. It is compiled according to the older sixteen division CSI numbering format.

Another source for reference, for an example of the benefits of the CSI numbering format for quick retrieval of product and system information is: http://greenformat.com/numberstitles. A quick look at this green building products reference site will reveal that it is organized according to the fifty division CSI Master Format 2004 numbering system. The numbering system and hyperlinks make this a very user friendly information source.

Below are the sustainable outline specification recommendations for green building projects designed under the Grand Canyon National Park and Northern Arizona Partnership for 2008. They are provided in the newer fifty division CSI numbering format. These recommendations are based on initial research and should be confirmed by procurement specialists and green building professionals trained in the specific
topic area prior to final selection. Building systems (e.g., passive solar and green roofs) should be designed specifically for each project by a qualified person in the field.

**Procurement and Contracting Requirements Group:**

**Division 00 – Procurement and Contracting Requirements**

- Three main types of Alternative Project Delivery Methods (APDMs) have been allowed in the state of Arizona, and throughout most of the rest of the United States, since the year 2000. These delivery methods provide facility owners and managers with options to the often adversarial method of procurement known as “Design-Bid-Build”. They consist of the following:

  1. Job Ordering Contracting – Recommended for project with repetitive, easily quantifiable units of work.

  2. Construction Manager At Risk (CMAR). This option brings the Contractor on board shortly after, or at the same time as the Architect. The benefit to the Owner is the availability of the Contractor’s wealth of knowledge available to the Team throughout the design process. The Owner maintains control of and administers two separate contracts – one with the Architect and one with the Contractor.

  3. Design/Build (D/B) This method allows for one contract and a single point of contact. In this method the Owner contracts with the Design/Builder (can be a firm or a General Contractor) Who then hires a designer. This method allows for the “Team” advantage and flexibility needed to produce a successful overall design, provides fewer claims, and faster delivery.

The Design/Build option is typically the best option for unique green designs.

- Building Commissioning - Most green building / sustainable design systems require that the developer hire an independent outside agent to “commission” the building. According to American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE), building commissioning can be defined as “a quality-oriented process for achieving, verifying, and documenting that the performance of facilities, systems, and assemblies meets defined objectives and criteria.” The commissioning process can be used to improve energy performance, train staff for operations and maintenance, and document as built conditions. Organizations that have researched commissioning claim that owners can achieve savings in operations of $4 over the first five years of occupancy as a direct result of every $1 invested in commissioning—an excellent return on investment (WBDG.org, 2008; DOE, 1998).

**Facility Construction Subgroup:**

**Division 03 Concrete**

- All concrete shall be fly ash augmented.
  
  o Suggested sources: Fly ash supplied by Headwaters Resources from the nearby Navajo Power Plant, operated by the Salt River Project and most local Ready Mix plants.

- Local supplier shall determine formula of mixture.
Division 04 Masonry
- Rock masonry shall be of local materials
  - Suggested product: Kaibab Limestone
- Concrete block
  - Suggested product: Navajo FlexCrete Building Systems. FlexCrete block is an autoclaved, aerated concrete block product that is made with high volumes of fly ash in Page, AZ. Available in rectangular blocks, tongue-and-groove panels for walls, floors and roofs, or, as unreinforced panels. All blocks and panels are entirely solid, making it easier for less skilled laborers to place and secure blocks and panels. The FlexCrete blocks and panels can be drilled and shaped like wood, using standard hand tools. Ordinary motors and stuccos adhere to FlexCrete surfaces.

Division 05 Metals
ROOF:
- Be sure roofing is at least 26 gauge
- Baked on enamel, galvanized, and galvalume steel roofs all work with water harvesting systems.
  - Suggested product: Firestone, UNA-CLAD, Energy Star qualified, approximately 25% recycled content, available from Arizona Metal Roofing, LLC, Flagstaff, AZ (for SMR Office Building)
- Green or living roof – moderates internal building temperatures, extends the life of a membrane roof, helps manage stormwater

SIDING:
- Corrugated metal siding fits the Grand Canyon aesthetic. Siding should be treated with an oxidizing technique to speed up the rusty effects that natural weathering would have on the material.
- Recycled metal panels – gauges include: 24 ga., 22 ga., 20 ga, 18 ga.
  - Suggested product: Metal Sales Manufacturing Corporation. Budget price is $5.00 per square foot.

INTERNAL USE:
- Recycled metal panels for walls and partitions – can be purchased with natural weathering steel or Kynar finish. Gauges include: 24 ga., 22 ga., 20 ga, 18 ga.
  - Suggested product: Metal Sales Manufacturing Corporation. Budget price is $5.00 per square foot.

Division 06 Wood, Plastics and Composites
WOOD:
- Lumber – all lumber used in construction should be certified by the Forest Stewardship Council
  - Suggested source: Lumberman’s, Flagstaff, AZ
  - Small-diameter pine products should be considered wherever applicable, such as for columns and beams for outdoor shade structures and roofs such as the Bright Angel Plaza facility

PLASTICS:
- Translucent wall system
Suggested product: 3 Form Eco Resin, Varia line (40% post industrial recycled resin)

COMPOSITES:
- Fiber cement siding
  - Suggested product: James Hardie, HardieShingle Staggered Edge Notched Panel, Thickness: 1/4", Weight: 1.9 lbs./sq. ft., Size: 48" x 16" planks, color: Chestnut (SRM office building)
- Roofing shake shingles
  - Suggested product: Re-New Wood’s ECO-SHAKE shingles, produced with 100% recycled materials made with reinforced vinyl and cellulose fiber. These shingles are designed to resemble and replace wood shake shingles

Division 07 Thermal and Moisture Protection
- R14 rigid foam – to reduce heat loss from the radiant in floor heating system, installed below concrete slab.
- Poly vapor barrier - install below R14 rigid foam insulation under concrete slab to eliminate any gases such as radon from entering into the building.
- Green or living roof – moderates internal building temperatures, extends the life of a membrane roof, helps manage stormwater

Division 08 Openings
WINDOWS:
- Dual pane insulated windows.
- Solar Heat Gain Coefficient (SHGC) and Visible Transmittance (VT) on south walls should be as high as possible,
- U-factor should be as low as possible on all glazing.
  - Suggested product: Anderson 200 Series, Meets Energy Star requirements, VT .65, U-factor .45

Division 09 Finishes
WALLS:
- No Volatile Organic Compound (VOC) coatings
  - Suggested product: Mythic Paints, Ace Home Co Flagstaff, AZ
- Recycled glass tiles – made from 100% recycled glass, the production of each tile uses 50% less energy than the production of similarly sized ceramic tiles and 75% less energy than cast-glass tiles. Available in a wide variety of sizes and colors.

FLOORS:
- Diamond polish finish – improves impact resistance very good finish for concrete floors
- Stain - spray applied, water base concrete and overlay stain that penetrates, EPA and FDA compliant, Non-Toxic, Non Acidic and Environmentally Safe. Protects from Ultra Violet Rays.

Division 11 Equipment
BICYCLE RACKS & STORAGE: Sites should incorporate bike racks, storage and routes to encourage alternative methods of transportation.
RAINWATER HARVESTING:
- Cistern - for water storage to be determined by design.
- Charcoal and UV filtration should be incorporated into design.
  - Suggested product: CorGal Tanks, 6’ –105’ diameter, Southern Arizona Rain Gutters, Tucson, AZ (also specialize in rainwater harvesting design).

Division 12 Furnishings
FURNITURE:
- Office chair
  - Suggested products: Steelcase – Think Chair, Enterprise & Environment Award for best French eco- product designed for the environment, awarded by the French Minister of Ecology and Sustainability (Pollutec). Sustainable Design: Gold Award (IIDEX)

SYSTEMS:
- Systems furniture
  - Suggested products: Steelcase –Series 9000® is SCS Indoor Advantage™ Gold certified for indoor air. Steelcase -Montage® is MBDC Silver Cradle to Cradle® Certified. & SCS. Indoor Advantage™ Indoor Air Quality Certified.
- Moveable glass wall system
  - Suggested products: Environmental Wall Systems (EWS) –95% recycled material, 85% post industrial recycled gypsum, 10% post consumer recycled paper fiber, pass LEED™ criteria for VOC limits on adhesives, Recycled aluminum 65-85% post industrial.

Division 13 Special Constructions
BUILDING CONSTRUCTION:
- Structural Insulated Panels (SIPS) - high performance building panels used in floors, walls, and roofs for residential and light commercial buildings. The panels are typically made by sandwiching a core of rigid foam plastic insulation between two structural skins of oriented strand board (OSB).
  - Suggested product: SIP Home Systems, Inc., Mesa AZ up to 8’ x 24’ panels, maximum Formaldehyde is .07-.10ppm
- Insulated Concrete Forms (ICFs) - These forms consist of two panels that are connected by thick steel ties with a core of expanded polystyrene, the material similar to the Styrofoam used in ice chests. Once the concrete is poured, the wall system can be covered with plaster on the inside, or stucco or veneer on the outside. These wall systems provide good insulation and thermal-mass values, which can effectively reduce heating and cooling loads. Costs are dependent upon quantity ordered, shipping destination, and engineering requirements.

Facilities Services Subgroup:

Division 21 Fire Suppression
- Metal Roofing
- Corrugated Metal Siding
- Limestone Rock Siding
**Division 22 Plumbing**

LOW-FLOW AND HIGH EFFICIENCY FIXTURES: The EPA has mandated that all plumbing fixtures meet the 1.6 gallon per flush (gpf) standard for low-flow operations. Fixtures that meet these criteria often carry the EPA’s WaterSense logo. High efficiency fixtures are a new class of extremely water-efficient fixtures.

- Urinals
  - Suggested products:
    - Kohler: K-4917 Steward S Waterless Urinal.
    - Sloan Valve Company High-Efficiency Urinals (HEU) use only a pint (0.125 gallon) of water to flush.
- Toilets – Several alternatives are available. Dual flush models have two options for each flush selected by the user (average less than 1.2 gpf). Pressure-assist models use water pressure in the line or a device in the tank to add air pressure (average 1.1 to 1.2 gpf). Power-assist models use a pump to add force, dual flush models are also available (average 1 to 1.3 gpf).
  - Suggested products:
    - Caroma Carvelle 270 Dual Flush Toilet, 0.8 gallon per flush option. ADA compliant; allows for a rough-in range of 10-12”.
    - Sloan Valve Company High-Efficiency Toilets (HET) an average of 1.28 gallon per flush, automatic flushometer recommended.

GREYWATER SYSTEM: To be reused and plumbed for toilets then interior planters and lastly sub surfaced below frost line for exterior landscape.

**Division 23 Heating Ventilation and Air Conditioning**

PASSIVE SOLAR HEATING: Utilizes thermal mass to collect, store and re-radiate heat from the sun.

- Trombe wall – A direct heat gain storage mass. Typically a masonry wall of 8” thickness with built in ducting to extend into upper level of building.
- Floating Slab on Grade Construction – insulated concrete floor to reduce heat loss
  - Suggested products: Dow Blue Board, 1” thick and poly vapor barrier
- Insulated masonry walls – insulate fully grouted masonry walls on the exterior side with rigid foam and exterior finish
- Green or living roof – moderates internal building temperatures, extends the life of a membrane roof, helps manage stormwater

PASSIVE COOLING:

- Solar chimney – wind energy pushes air into a chimney where is passes over an evaporative medium, cool air falls to the bottom of the chimney to cool the building
- Green or living roof – moderates internal building temperatures, extends the life of a membrane roof, helps manage stormwater (see source above).
- Use roofing materials having a solar reflectance index (SRI) equal to or greater than the values in the table below. Implement a maintenance program that ensures all SRI surfaces are cleaned at least every two years to maintain good reflectance.
<table>
<thead>
<tr>
<th>Roof Type</th>
<th>Slope</th>
<th>SRI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-Sloped Roof</td>
<td>&lt;2:12</td>
<td>78</td>
</tr>
<tr>
<td>Steep-Sloped Roof</td>
<td>&gt;2:12</td>
<td>29</td>
</tr>
</tbody>
</table>

SUPPLEMENTAL HEATING/COOLING:
- Solar heating - Systems typically combine solar collector with a storage tank and hydronic piping to an in-floor heating system.
  - Suggested products: Hydronic in Floor Heating System. Wirsbo piping, Mountain High Plumbing, Flagstaff AZ
- Small, electric space heaters - may be economical in some locations for supplemental heat.
- Ductless mini-split systems (small heat pump systems) – self-contained systems without duct work, can supply air conditioning and heating with excellent electrical efficiency.

VENTILATION:
- Passive ventilation - Typically, windows or “high out vents” are installed on the leeward side of the building. On the windward side of the building, windows or vents are installed low on the walls. This creates a convection loop that exhausts warm air from the building while bringing cool air into the building.
- Solar powered exhaust fans – ideal for daytime use facilities such as the Bright Angel Trailhead Plaza Restroom.
  - Suggested product: WSE Technologies solar vent fans - typically used for ships and motor homes, move 11.6 cubic feet per minute.

Division 25 Integrated Automation
AUTOMATED HEATING COMPONENT
- Automated built in dampers and venting louvers - incorporated into trombe wall ducting system
  - Suggested source: Verde Sol-Air, Camp Verde, AZ

Division 26 Electrical
- Thermostat - incorporated in different zones of in-floor heating configuration. Areas such as file room and copy room should be set at lower temperature to reduce energy demands.

LIGHTING:
- Tubular skylights – option for daylighting
- LED (Light Emitting Diode) fixtures
- Solar powered light fixtures for outdoor lighting
- Sensors - to automatically manage lighting

Site and Infrastructure Subgroup:

Division 31 Earthwork
- Stormwater management plan
- Vegetated bioswales and rain gardens - utilize stormwater on the site
- Porous or pervious pavement for parking lot and walkways – can be constructed of concrete or interlocking pavers. Use paving materials with a solar reflectance index (SRI) of at least 29
  - Suggested product: UNI-GROUP U.S.A., Eco-Stone interlocking concrete pavers. Runoff reductions of up to 100% depending on project design parameters. Uni Ecoloc designed for any large load or traffic requirements.

**Division 33 Utilities**

- PROPAANE: Option for high efficiency boilers and stoves
- WATER: Rainwater Catchment System, Stored on-site, Grand Canyon National Park main line
- SEWER: Grand Canyon National Park main line
- ELECTRICAL: Provided by Arizona Power Service (APS)

**Process Equipment Subgroup:**

**Division 48 Electrical Power Generation**

- Photovoltaic Equipment – typically a system consists of PV panels and ‘balance of system (BOS) equipment including batteries, charger, controllers, inverters, wires, circuits, grounding circuit, fuses, safety disconnects, outlets and a metal structure to support the PV modules.
  - Suggested source: Architectural & Environmental Associates, Flagstaff, AZ
- Wind Turbine
  - Suggested source: Northern Arizona Wind and Sun, Flagstaff, AZ
- Grid Tied – through Arizona Power Service (APS)
Appendix D - Water Issues

1. Waterless Urinals

During a site visit to the Grand Canyon National Park, many public restroom facilities were visited in an attempt to observe how they could be improved. Restrooms visited included those at the Bright Angel Lodge, Canyon View Information Center, Market Plaza Café, El Tovar Hotel and Yavapai Observation Station. All of these restrooms, with the exception of those at the Canyon View Information Center (where g.p.f. values were not marked), had toilets with a gallon per flush (g.p.f.) value of 1.6, which is low enough to classify them as being “low flow”. However, none of these public restroom facilities was equipped with waterless urinals.

Waterless urinals would be a great addition to Grand Canyon National Park as the park continues to improve its environmental sustainability. It was reported on Falcon Waterfree Technologies’ webpage that one waterless urinal can save up to 40,000 gallons of water each year. However, because of the number of people that visit the park every year, it seems like this number could potentially be even larger at the Grand Canyon. Simply installing waterless urinals would be a huge step in reducing water use at the Grand Canyon.

Water Conservation Benefits

Based on water consumption data provided by the park, the Grand Canyon’s NPS annual water consumption is 33,600,170 gallons, with an annual cost of water of $1,087,974, making the average cost of water about $.032 per gallon. If one waterless urinal saved 40,000 gallons per year, each waterless urinal installed would save $1,280 per year in water cost. Looked at differently, each flush urinal in the park costs the park $1,280 to operate. Waterless urinals would not only save water and energy to deliver it, but it would also save the park operating expense.

Cost Savings

The following table offers a savings analysis for different brands of urinals sold by three different suppliers. After the initial unit cost of a urinal plus $250 per year for maintenance and replacement fees, a waterless urinal still saves anywhere from $555 to about $800 compared to a traditional urinal for the initial year. After the initial year, it was assumed by our team that one waterless urinal would require about $250 in replacements and other maintenance fees, which would still save the park about $1030 each year. Waterless urinals save water and money, and in the end, they end up paying for themselves based on savings.

Not only should waterless urinals be installed into NPS facilities, but they should also be installed in buildings operated by park concessionaires. As shown previously in this report, Xanterra’s South Rim operations are by far the biggest water consumer affiliated with GCNP. Because Xanterra is such a large water consumer, if Xanterra installed waterless urinals, it would significantly impact water conservation throughout the entire park.
On the GSA webpage, there are three suppliers of waterless urinals: Falcon Waterfree Technologies, based out of Los Angeles, California, Waterless Company LLC, based out of Vista, California, and Crest/Good Manufacturing Company Inc., based out of Jericho, New York.

- Falcon Waterfree Technologies carries three models of waterless urinals, ranging in price from $237.75 to $292.17, but the warranty length is only one year (GSA Advantage, 2008).

- The Waterless Company carries two main models of urinals, ranging in price from $393.05 to $408.50, and the warranty length is four years (GSA Advantage, 2008).

- Crest/Good Manufacturing Company has three models of waterless urinals on the GSA webpage, ranging in price from $288.90 to $474.95, but the warranty length is listed as “standard” and does not give an exact period of time (GSA Advantage, 2008).

**Waterless Urinal Comparisons**

**Contractor: Falcon Waterfree Technologies**
**Location: Los Angeles, California**

<table>
<thead>
<tr>
<th>Name of Waterless Urinal</th>
<th>Unit Price ($)</th>
<th>Warranty Length (Yr.)</th>
<th>*Replace ments ($/yr)</th>
<th>^Misc. Fees ($/yr)</th>
<th>Amount Saved ($/initial yr)</th>
<th>Amount Saved ($/proceeding years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1000 Porcelain/Vitreous Urinal</td>
<td>292.17</td>
<td>1</td>
<td>118.16</td>
<td>131.84</td>
<td>737.83</td>
<td>1030</td>
</tr>
<tr>
<td>F2000 Porcelain/Vitreous China Urinal</td>
<td>237.75</td>
<td>1</td>
<td>118.16</td>
<td>131.84</td>
<td>792.25</td>
<td>1030</td>
</tr>
<tr>
<td>F2000A Acrylic</td>
<td>252.17</td>
<td>1</td>
<td>118.16</td>
<td>131.84</td>
<td>777.83</td>
<td>1030</td>
</tr>
</tbody>
</table>

**Contractor: Waterless Company LLC**
**Location: Vista, California**

<table>
<thead>
<tr>
<th>Name of Waterless Urinal</th>
<th>Price ($)</th>
<th>Warranty Length (Yr.)</th>
<th>*Replace ments ($/yr)</th>
<th>^Misc. Fees ($/yr)</th>
<th>Amount Saved ($/yr)</th>
<th>Amount Saved ($/proceeding years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sonora Urinal</td>
<td>408.50</td>
<td>4</td>
<td>93.16</td>
<td>156.84</td>
<td>621.50</td>
<td>1030</td>
</tr>
<tr>
<td>Kalahari Urinal</td>
<td>393.05</td>
<td>4</td>
<td>93.16</td>
<td>156.84</td>
<td>636.95</td>
<td>1030</td>
</tr>
<tr>
<td>Sonora Bottom Drain Urinal</td>
<td>408.45</td>
<td>4</td>
<td>93.16</td>
<td>156.84</td>
<td>621.55</td>
<td>1030</td>
</tr>
<tr>
<td>Kalahari Bottom Drain Urinal</td>
<td>393.05</td>
<td>4</td>
<td>93.16</td>
<td>156.84</td>
<td>636.95</td>
<td>1030</td>
</tr>
</tbody>
</table>
Contractor: Crest/Good MFG. Co. Inc.
Location: Jericho, New York

<table>
<thead>
<tr>
<th>Name of Waterless Urinal</th>
<th>Price</th>
<th>Warranty Length (Yr.)</th>
<th>*Replace ments ($/yr)</th>
<th>^Misc. Fees ($/yr)</th>
<th>Amount Saved ($/yr)</th>
<th>Amount Saved ($/proceeding years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>WES 1000 Waterless Urinal</td>
<td>474.95</td>
<td>sntd ?</td>
<td>209.08</td>
<td>40.92</td>
<td>555.05</td>
<td>1030</td>
</tr>
<tr>
<td>WES 2000 Waterless Urinal</td>
<td>366.83</td>
<td>sntd ?</td>
<td>209.08</td>
<td>40.92</td>
<td>663.17</td>
<td>1030</td>
</tr>
<tr>
<td>WES 4000 Waterless Urinal</td>
<td>288.9</td>
<td>sntd ?</td>
<td>209.08</td>
<td>40.92</td>
<td>741.10</td>
<td>1030</td>
</tr>
</tbody>
</table>

Assumptions used to develop Proposed Waterless Urinal Data Table (on next page)
- Each waterless urinal saves about 40,000 gallons of water each year
- The cost of water at the Grand Canyon is $.032 per gallon
- *Replacements are based on cost of replacement cartridge and accessories multiplied by four (four replacements each year).
- ^Miscellaneous fees are based on a total maintenance cost of $250, including replacements, assuming more expensive urinals need less maintenance.
- Shipping and handling are not accounted for when contacted contractors gave a small estimate (about $40), or were not willing to give an estimate

Other Benefits

The benefits of a waterless urinal do not simply stop at conserving water; these urinals conserve energy and tend to have fairly good aesthetics. Less energy would be needed to transport water to the restroom and wastewater from the restroom to the treatment plant, which would save cost on energy consumption. Not to mention, the cost of treating wastewater at the treatment plant would be reduced due to the reduction in the amount of sewage.

There are also health and aesthetic benefits associated with installing and operating waterless urinals. Waterless urinals do not need to be touched by the users, so there is a great reduction in the transmitting of germs from one person to another. Because the proposed waterless urinals do not hold any exposed water, there is also no breeding ground for bacteria, which can be transmitted to users and maintenance staff via flush urinals. The last major aesthetically beneficial feature to a waterless urinal is the reduction in odor compared to a flush urinal. This reduction in odor comes from the trap at the bottom of waterless urinals that hold in waste odor from the restroom. As can be seen, the benefits of a waterless urinal go far beyond the obvious.

Opportunities & Barriers

One of the Park Facility Management Division’s projects for the year 2009 is “Construct/Repair/Rehab Restrooms Park wide.” This project could be a starting point for the implementation of waterless urinals throughout the park. Because it is probably unreasonable to think that all urinals in the park should be replaced with waterless urinals at one time, this transition could begin with this 2009 project.

From talking with some employees at the park, there does seem to be some resistance to installing more waterless urinals. Employees said that waterless urinals installed in the park’s campgrounds are difficult to maintain and have a bad odor. Although cartridges need to be replaced a couple of times each year, other maintenance that needs to be done on flush urinals (like replacing and repairing valves)
does not need to take place with waterless urinals. Thus, our research indicates that waterless urinals are more cost effective that waterless urinals.

If flush urinals are not flushed after every use, they can cause an odor; this is not possible with a waterless urinal unless the trap is broken. If odor persists, the trap should be replaced.

With waterless urinals, the positives outweigh the negatives from an environmentally sustainable point of view. Installing waterless urinals around the park would be a step in the right direction at improving water efficiency.

2. **Timed Showers at Phantom Ranch**

During a June 30th interview with Jennifer Thompson and Vanya Pryputniewicz it was brought to our attention that showers in Phantom Ranch are not monitored or regulated with regards to water usage. Visitors to Phantom Ranch are allowed to take showers for as long as they want as often as they want without intervention. From a sustainability standpoint, this practice leaves much room for improvement. Showers at Phantom Ranch should be regulated to conserve water. Taking long showers in the arid Southwest is simply not a sustainable practice.

There are many different ways in which these showers could be regulated. The showers could be equipped with timers that only allow water to run for a certain number of minutes, or showers could be paid for based on the amount of time that is spent using the shower. Techniques such as these would be helpful, but should be complemented with visitor outreach. Without understanding the importance of water conservation, some visitors may simply buy more shower time. Thus, changing practices will take developing an understanding of why it is important to conserve water.

3. **Outreach**

For water conservation efforts to be effective, visitors need to understand why water conservation is important and how they can help. This is where outreach to visitors about water issues will become very important. Visitors will be more willing to obey rules and follow regulations if they know the importance of what they are doing and if they know what they are doing is actually making a difference.
Appendix E - Inventory

Definition:
An inventory is “a complete listing of merchandise or stock on hand, work in progress, raw materials, finished goods on hand, etc., made each year by a business concern” or “a detailed, often descriptive, list of articles, giving the code number, quantity, and value of each; catalog.”

Goals of an Inventory System
• Gain “timely and accurate data” about the needs of the organization (how to stock)
• Be able to accurately forecast organizational needs
• Be able to create meaningful objectives in terms of use and consumption

Benefits of an Inventory System for Office and Cleaning Supplies at Grand Canyon National Park

“This type of information is important in order to understand where the park is now with respect to procurement. It is difficult to identify where the park can most easily and effectively go green without knowing where park funds are being spent. Successful businesses include product inventories as part of standard operating procedures. Moreover, if the park knows where money is spent, it can identify areas of excess and cut down on unnecessary purchases. This would save money for the park and reduce waste. In addition, according to workplace psychologists, an environment where the inventory is not accounted for leads to employee theft. Theft also increased operational costs.” (as taken from the report).

Recommendation
Grand Canyon National Park should create an inventory system for its cleaning, office, and other products. This will help GCNP not only become more efficient and be less wasteful with employee time and energy and funds, but will make it easier to implement the use of green products.
Appendix F - Employee Purchasing Accountability

Introduction
A lack of accountability when it comes to purchasing is a major obstacle in the efforts to purchase green.

In order to purchase green, employees need to become accountable for the purchases they make. There also needs to be a change in employee culture with respect to green purchasing.

Culture change however, is very difficult. Below we have outlined steps and requirements for culture change in any environment. These ideas can be applied as GCNP educates its employees about sustainability in order to create an environmentally aware employee atmosphere and a greener park.

In order to increase employee accountability and change employee culture the following must happen:

- Buy-in must happen from the top down and the bottom up.
  - Both upper management and the people working ‘on the ground’ must believe and be invested in the change that they are working towards.
  - All sides of must be willing to work towards the goal.

- People have to understand what they are doing and why it’s important.
  - The goal has to be definable.
  - People first have to be willing to change, but they must know what they are working toward and why.

- Then they have to choose a procedure (how do we make the change happen?).
  - After figuring out what we are doing and why, we have to figure out how we are going to do it.
  - For example: If we decide that we want employees to start riding bikes to work because we want to reduce our carbon footprint (what and why), then we have to decide what bikes we will buy, who we will buy them from, and where we will get the funding.
  - The logistics must be figured out so that people can follow through.

In order for any idea to make sense:

- It has to be definable (sell it).
- We must define what we are doing so that we are able to sell it to employees.

- It has to be reasonable and make sense.
- The requests on employees can’t be outrageous and must be reasonable.

- It has to be enforceable.
- There should be consequences in case employees don’t follow through or comply.
Unpleasant notes on making real change

Some people will resist change of any sort. This is inevitable in any situation where people experience change. Shifting the culture requires changing attitudes by providing leadership, incentives for good performance, and consequences for poor performance. The latter can be unpleasant. However, by allowing people who refuse to change to simply operate as they were (and not change as the organization tries to shift as a whole) you send a very clear message that employees don’t have to change. By allowing people not to change and therefore sending the message that change is not necessary, others will not bother to change.

If an organization wants change then they must offer an environment that encourages change. This includes drawing the line and enforcing that change with consequences. (After clearly defining the change and making it reasonable of course). However some organizations are unwilling to draw the line. Therefore implementation is an organization’s choice. The organization must be willing to enforce the change with consequences if it wants to achieve that change.

Enforcing change is a particular problem in government agencies where many employees are conflict avoidant.
## Appendix G – Selection of Green Cleaning Supplies

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Comments</th>
<th>Stock or NSN#</th>
<th>UNIT (Count)</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purell</td>
<td></td>
<td>8520-01-522-0835</td>
<td>24, 2 oz. bottles</td>
<td>$62.06</td>
</tr>
<tr>
<td>Sanigard Foaming Hand Sanitizer</td>
<td></td>
<td>8009</td>
<td>12 Count</td>
<td>$23.88</td>
</tr>
<tr>
<td>Simple Green</td>
<td>Green</td>
<td>7930-01-306-8369</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hand Soap</td>
<td></td>
<td>8520-00-228-0598</td>
<td>I Gallon</td>
<td>8.09</td>
</tr>
<tr>
<td>General Purpose Liquid Hand Soap</td>
<td></td>
<td>12067</td>
<td>I Gallon</td>
<td>13.32</td>
</tr>
<tr>
<td>Small two ply</td>
<td>Green toilet paper</td>
<td>8540-01-380-0690</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Toilet paper Jumbo</td>
<td></td>
<td>8540-01-378-6218</td>
<td>6 rolls, 4000 ft-roll</td>
<td>26.58</td>
</tr>
<tr>
<td>Scott Surpass JRT</td>
<td></td>
<td>7202</td>
<td>6 rolls, 4000 ft-roll</td>
<td>46.3</td>
</tr>
<tr>
<td>Page C-fold</td>
<td>Green, paper towels</td>
<td>8540-00-291-0392</td>
<td></td>
<td>20.33</td>
</tr>
<tr>
<td>Paper Towel single fold</td>
<td>Green</td>
<td>8540-00-262-7178</td>
<td></td>
<td>18.45</td>
</tr>
<tr>
<td>Glass Cleaner</td>
<td>Green</td>
<td>7930-00-901-2088</td>
<td></td>
<td>25.44</td>
</tr>
<tr>
<td>Urinal Cartridge Kit</td>
<td>Green</td>
<td>CIB-0510-20</td>
<td></td>
<td>590.8</td>
</tr>
<tr>
<td>Formula 66</td>
<td>Green, bio-based</td>
<td>100210</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Citra Cide-Disinfectant</td>
<td></td>
<td>7930-01-412-1015</td>
<td>1 gallon</td>
<td>21.73</td>
</tr>
<tr>
<td><strong>Non-toxic disinfectant</strong></td>
<td></td>
<td>165_(1 GAL JUGS 6 PER CA</td>
<td>6 gallons</td>
<td>81.36</td>
</tr>
<tr>
<td>Glass Cleaner</td>
<td>Green</td>
<td>7930-00-184-9423</td>
<td>1 gallon</td>
<td>7.18</td>
</tr>
<tr>
<td>Trash Bags</td>
<td>33-gallon skill craft brand</td>
<td>8105-01-183-97</td>
<td>33 gallon</td>
<td>24.68</td>
</tr>
<tr>
<td>Trash Bags</td>
<td></td>
<td>8105-01-183-97</td>
<td>33 gallon</td>
<td>24.68</td>
</tr>
<tr>
<td>Furniture Polish</td>
<td>green</td>
<td>7930-01-381-3491</td>
<td></td>
<td>38.27</td>
</tr>
<tr>
<td>Paper Towel Dispenser</td>
<td></td>
<td>4510-01-585-6305</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trash Bag</td>
<td>green</td>
<td>8105-01-183-9769</td>
<td></td>
<td>38.25</td>
</tr>
<tr>
<td>Case Small roll T.P.</td>
<td></td>
<td>214-5490</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix H – Recycling Outreach: WHY Recycling Is Important

Although having recycling opportunities readily available to park visitors is vital to a successful recycling program, so too is relaying the knowledge of why recycling is important. An “out of sight, out of mind” mentality for some people means that they do not worry about their material waste once they have disposed of it, either properly or improperly. At the Grand Canyon, many visitors do not bother to separate their recyclables from trash, or vice versa, they simply throw it “away”. This is why visitors need to be informed of the reasons for recycling and consequences of not recycling their material waste.

Visitors should be informed of the importance of recycling in many different ways: 1) signage around the park, 2) articles in the Visitor’s Guide, 3) informative postings at recycle bins, and 4) postings on the “greening and sustainability” webpage.

Outreach should inform visitors of the purpose and importance of recycling, instilling a sense of importance to recycling as something everyone can do to improve sustainability.
Appendix I - Park Webpage

If greening and sustainability is becoming important to Grand Canyon National Park, it should be made clear to visitors that the Park is taking action in this area. One important way to communicate this to visitors and other members of the general public is through the park’s webpage. Included on the webpage should be a direct link to a “greening and sustainability” page. This link would serve to:

- Communicate to the general public how important the issue of environmental sustainability is in today’s world
- Explain how GCNP is taking the initiative to improve environmental sustainability at the park
- Suggest to visitors how they can help the park become more environmentally sustainable

Yellowstone National Park has already updated their webpage with a “greening and sustainability” link (Greening and Sustainability, 2008). The Grand Canyon National Park can not only take this same step, but improve upon it. There are many ways at which this is possible.

The “greening and sustainability” link on Yellowstone’s webpage has information about what is being done at their park to improve its environmental sustainability, a link to a pamphlet that provides sustainability information to visitors, a link to a sustainability plan developed for the park, and interesting facts and figures about sustainability practices such as recycling and composting. The Grand Canyon could include this same information and include other information and outreach techniques.

Yellowstone’s sustainability page does not have a direct link from the homepage, so it is not as easy to find as it should be. However, because of the importance of the sustainability issue at Grand Canyon, and other parks for that matter, the link to the “greening and sustainability” webpage should be a direct link from the homepage. This will make the specific page accessible to the largest number of visitors possible.

Another important element of Yellowstone’s “greening and sustainability” webpage that could be expanded is the section that gives important facts and figures about what is being done at the park in different areas of sustainability. Yellowstone does a very good job of displaying numbers with regard to recycling; such as tons of recycled materials and tons of materials diverted from landfills, but again there is room for improvement. Grand Canyon National Park’s webpage should include information not only on recycling, but also on the amount of water conserved due to conservation
practices like low-flow bathroom fixtures, faucet aerators, etc, the amount of recycled wastewater being used around the park, the amount of waste being composted, and any other important sustainability information. The more numbers that the public and other visitors see, the more they will believe that the Grand Canyon National Park is taking initiative and improving sustainability, and the more likely they will get involved.

Without a “greening and sustainability” webpage, the park is missing a great opportunity to educate the general public. This change should not be hard to implement. The park already has an existing webpage, and because of Yellowstone National Park’s “greening and sustainability” webpage, Grand Canyon has a model to build on and improve. This will be a significant step to further educate visitors on sustainability issues, and in turn, improve the environmentally sustainability of the park.
Appendix J - Signage

Low Flow Signage

Visitors to the Grand Canyon National Park should be made aware that the park is taking measures to improve its water efficiency and sustainability. Although there was observed signage at the Canyon View Information Center Public Restrooms regarding the use of recycled water in the toilets and urinals, there was no similar signage observed at other locations including the Bright Angel Lodge Public Restrooms, Market Plaza Café Public Restrooms and the Yavapai Observation Station Restrooms. If these restrooms use recycled water in the toilets, there should be signage at each location.

It was observed on a site visit that toilets in the Bright Angel Lodge Public Restrooms, Market Plaza Café Public Restrooms and the Yavapai Observation Station Public Restrooms all use low flow toilets (1.6 gpf). There should be signage at these locations to provide this information to visitors of the park. The more techniques that visitors see the park is implementing to improve its environmental sustainability, the more visitors will accept these practices as norms and participate. If visitors go to a park where green practices are commonly employed and interpreted well, they will learn about sustainability and take pride in participating. One important way to make this clear to visitors is signage regarding water efficiency.

Littering Signage

As documented on a June 19th site visit to the Grand Canyon National Park, it was observed that the park has a significant littering problem. This problem was also reported to our team by Peter Stienkopf during an employee interview. Although there are a sufficient number of trash cans and recycle bins around the park, many visitors leave their trash behind without disposing of it properly. Also documented and observed on the June 19th site visit was the absence of signage and literature discouraging visitors from littering. It seems that more should be done at the Park to discourage visitors from littering.

A very simple and effective technique the Grand Canyon could take to discourage littering would be to develop and post signs around the park informing visitors of the consequences of littering. Although littering does have obvious environmental consequences, an effective technique to discourage visitors from littering would be to inform them of how littering will affect them directly. There should be signage around the park, especially in high traffic areas, that informs visitors that they can be fined for littering and subsequent enforcement to make the consequence real (e.g., “Fines up to (certain $ amount) for littering). Signs should be posted at the park entrance and in high traffic areas like the Canyon Plaza Information Center, Bright Angel Trailhead area, campgrounds, and other large facilities.

Using Recycled Materials for Signage

The park should also use green materials for the signs themselves. A suggested source for the park’s signing needs is the Wood Product Signs, Routed Recycled Plus, Inc., based out of Parlin, Colorado. This sign company has been a sign manufacturer for the U.S. Forest Service and the National Park Service since 1985 and uses recycled materials in the building of many of their products. The company’s webpage is http://www.woodproductsigns.com/index.html, (Wood Product Signs, 2008).
According to the company’s webpage they make national park service signs from “routed recycled plastic, routed western red cedar and reflective HDO Plywood or Aluminum” (Wood Product Signs, 2008). The recycled plastic signs seem to be the most sustainable choice when purchasing signs from this company.

The recycled plastic signs are:

- made from old plastic milk jugs that would otherwise end up in a landfill
- completely non-toxic
- much longer lasting than conventional wooden signs
- free from the use of paint for the sign graphics (Wood Product Signs, 2008)

For reasons mentioned above, all attempts should be made to purchase signs that are made from recycled plastic. Signs developed from recycled plastic are both more environmentally sustainable, as well as they have many other benefits that conventional wooden signs do not offer. Any time that signage is mentioned in this report; it is recommended that signs be developed from recycled plastics.
Appendix K - Sustainability Pamphlet

Visitor outreach and education is a very important element for GCNP to become more environmentally sustainable. If it is made clear to visitors that Grand Canyon is sustainable and environmentally friendly, they will feel more inclined to take part in this effort. Further, the more visitors are educated and aware of the importance behind sustainable practices, the more they will want to take part in these practices. Without visitor cooperation, the Grand Canyon will be very limited to what it can do as far as sustainability practices are concerned. To help with communication and outreach, park, visitors should be presented with a pamphlet at the park entrance that explains: 1) the importance of sustainability, 2) what is being done at the park to improve sustainability, and 3) how visitors can play an active and effective role in improving park sustainability.

1. The importance of sustainability - The purpose of this section is to inform visitors why the park is committed to sustainability. This section of the pamphlet should include alarming facts about issues such as climate change, the impact of depleting natural resources, and explain how different sustainable practices will change these situations for the better. This section will hopefully impart a sense of awareness and urgency to the visitor.

2. What is being done at the park to improve sustainability – This section exposes visitors to an environment where sustainability is not just preached, but is also practiced. This section should include facts and figures about recycling, reuse, alternative fuels, water efficiency, and other measures illustrating that GCNP is improving the environmental sustainability at the park. These important facts and figures should be relevant to park visitors and cover different areas that they will encounter. For example, focus these numbers on tour buses, restaurants, and hotels but avoid information on employee housing, office buildings and other things visitors are unlikely to experience at the park.

3. How visitors can play an active and effective role in improving park sustainability - The section of the pamphlet should be focused on specific actions visitors can take to help make GCNP as sustainable as possible. This should include activities like proper recycling practices, elimination of plastic bottles, using bicycles and walking, and using the bus transit system to experience the park. This is arguably the most important section of the pamphlet and should be focused solely on the visitor experience.
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