St. Mark's Environmental Audit Committee

Report to Session

Contents

Environmental Audit

Executive Summary

The Green Team (aka the Environmental Audit Committee) studied St. Mark's current environmental impact and investigated possibilities for improvement. We examined three main areas: energy use, water use, and purchasing and waste. This executive summary describes the main findings in each of these areas.

Energy Use

In the most recent 12-month period, St. Mark's gas and electricity use led to the release of 179 metric tons of carbon.[1] To put this number in context, the average world citizen uses about 4 tons of carbon per year and the average U.S. citizen uses about 20 tons per year. If we included the carbon produced from church-sponsored travel, office products, food, and other things, our church's carbon footprint would be much greater than 178.8 tons per year.

The upcoming improvements in our heating and cooling system will drastically reduce our environmental impact. Eight-five percent of our gas is devoted to heating the facility. Cooling accounts for a major portion of our electrical usage and heating also accounts for an important share through the use of baseboard and space heaters.[2] Because we will replace a cooling system with a SEER rating of 6–7 with a new system with a rating of 13+, our carbon footprint will be dramatically reduced in coming years.

We conducted a thorough audit of the church property and produced a number of recommendations for lessening our environmental impact. Section 1 of this report provides background related to this part of the audit as well as a number of recommendations. We find that

- St. Mark's could improve its interior lighting by standardizing on one brand of quality compact fluorescent lamps (light bulbs); using dimmable bulbs for church hall sconces; adjusting its use of indirect fluorescents; minimizing its use of theatrical lighting; and using fewer and better lamps in its standard fluorescents.

1. See appendix A for more information on St. Mark's gas and electrical use. The release of carbon into the atmosphere is one of the primary causes of global warming.
2. There is no month in which we do not use electricity for heating and cooling, so we could not precisely estimate the share of electricity usage that was devoted to heating and cooling.

- St. Mark's exterior lighting is problematic in two ways. The wall-mounted floodlights in the courtyard produce excessive glare and some exterior floodlights are insufficiently shielded to control their light output. The latter lights actually violate the city's Outdoor Lighting Code. Opportunities exist for reducing both of these problems.
- St. Mark's could take better advantage of natural ventilation and daylight. The north-facing window behind the altar and the choir loft are two promising areas for natural lighting.
- Adding a manual timer (that requires reset) would help ensure the efficient use of baseboard heaters.
- A move toward a solar hot water heater will pay for itself, especially if our current system is electric.

Water Use

Section 2 of this report covers water use. St Mark's uses over 200 ccf in the summer (150,000 gallons/month) and about 70 ccf (50,000 gallons/month) in the winter. As a point of reference, a typical home uses about 10–15 ccf/month.

The fact that about three times as much water is used in the summer points to outdoor water use as the area of greatest potential for improved water-use efficiency. The preschool and church operate year-round, which suggests that indoor water use in the church should be approximately constant through the year.

Monitoring water use at a time when the preschool and church were not in session indicated significant water leaks from the pipes. While the leaks are an important problem, the need to address this is secondary to the need to improve the outdoor water-use efficiency:

Outdoor water-use efficiency should be improved by:

- *Xeriscaping areas with appreciable shallow-rooted plants.* Shallow-rooted plants, such as the grass in the Columbarium, must be supported with supplemental irrigation. Currently the irrigation system is in disrepair. Replacing these shallow-rooted plants with xeriscaping should dramatically reduce water use.
- *Capitalizing on the use of rainwater and storm water to supplement irrigation of deep-rooted plants.* Because of the abundant impervious surfaces at St. Mark's, there is potential to harvest enough rainwater to continue to support the mesquite trees and other deep-rooted plants. Deep rooting creates a large reservoir for water storage in the soils so that these plants can grow well on infrequent desert rainfall.

- *Bringing the Tucson Organic Gardeners (TOG) into the effort to use water more efficiently.* A water meter will allow the TOG to better determine how much water is used, and this can be compared with the estimated plant water needs determined by the U of A agricultural extension. Further technological improvements (such as a "Smart Timer" and more efficient means of application) may be possible once water use and water requirement are better understood.

The first two items will require significant thought. A plan from a landscape architect would greatly improve the potential for success. Until these improvements are made, the church will continue to benefit from Robin's current strategy of watering when the plants show stress.

Limited opportunities exist for improved water use indoors. Primarily this means selected toilet replacement and continuing to maintain fixtures so they don't leak.

Purchasing/Waste

St. Mark's environmental impact also depends on the types of office supplies, cleaning products, food, and other items it purchases. The Green Team searched for opportunities for the church to use items that require lower levels of energy and resources.

As outlined in the table on page 19, we identified a number of opportunities for lessened environmental impact in our choice of office and other paper products. Our analysis shows that the environmentally friendly alternatives are cheaper in a number of cases, so the change in cost will be fairly minimal. When offering food, St. Mark's can lessen its environmental impact by increasingly serving vegetarian meals, using locally grown pesticide-free vegetables, and supporting local farmers' markets.

A number of opportunities exist for reducing the amount of waste produced by St. Mark's.

- Put clear, easy-access stations for recycling, particularly near the kitchen and coffee hour area.
- Reduce the use of plastic liners for trash cans that primarily collect paper waste.
- Begin a composting site at the Organic Gardens next to the church.
- Reduce the use of paper towel rolls and disposable plates.

The existing dishwasher complicates efforts to reduce usage of disposable plates. The cycle of the existing model (the GE Potscrubber 660) is 74 minutes, while an alternative model (the ASKO 3531) has a 20-minute cycle. A shorter cycle will drastically reduce the volunteer time that is needed to wash permanent dishware. A new dishwasher would

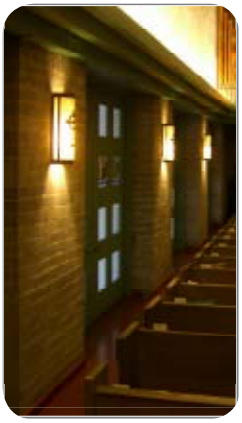
also produce other environmental benefits. For example, the ASKO 3531 uses much less water than the current model (2.5 gallons versus 12.1 gallons) and exceeds the minimum federal energy standard by 141%.

Section 1

Energy Use

Interior Lighting

Generally, compact fluorescents (CFL; self-ballasted, screw in fluorescents) are used throughout the church. The quality varies. The decorative sconces in the church hall require CFLs that are made for dimming because they are controlled by a dimming circuit. Recommendations regarding lighting in the church are:



- Replace all lamps (lightbulbs) not controlled by dimming systems with quality compact fluorescent lamps (CFL): self-ballasted, screw in fluorescents. Typically, offshore brands don't provide the light output, lamp life or color quality of name brands like Phillips, Osram Sylvania, GE, etc. Standardizing on one brand will yield consistent color quality between adjacent lights. A reasonable source for high quality CFLs is Arizona Commercial Lighting.
- Use incandescents or CFLs made for dimming in church hall sconces. Dimmable CFLs (down to 10% light output) are proliferating, they don't flicker and their price has dropped to just over the cost of a quality, nondimmable CFL. Look for brands with the Energy Star seal, such as Neptun. http://www.neptunlight.com/index2.html

Facts to Consider

Generally, fluorescents have 3.5x more light output than incandescents for the same wattage input. About 98% of the incandescent's energy use is waste heat; the rest is light output. When incandescents are dimmed to 80% of their maximum light output, their lamp life (typically 1200 hours) doubles.

Task Lighting

It was mentioned that some members need more reading light in the church hall. Increasing the light output of the sconces with higher wattage CFLs may yield uncomfortable glare from the sources. These sconces are designed to be decorative accents illuminating the perimeter aisles. The best seats for reading light are in the back under the existing downlights.

Indirect Fluorescents

St. Mark's employs the most efficient and effective lighting method: indirect strip fluorescents. As illustrated, these illuminate the upper portion of the walls of the church. The only way to improve on this system would be to replace the fixtures with ones employing T5 high output fluorescents and more effective reflectors to aim the light at the ceiling as well as the wall. More light output at the source, a brighter ceiling and somewhat higher illumination levels in the pews could be achieved with half the wattage and number of lamps.

Theatrical Lighting

Theatrical lighting is effective and expensive to operate and maintain. A cherry picker is needed to replace the lamps in the theatrical fixtures. During the survey, all theatrical lights were on. Robin asked that they be turned off and with one on the cross, we all agreed there was still enough light to perform altar tasks such as cleaning, arranging flowers, etc. The cross also has strip fluorescents behind it for backlit illumination. To reduce energy and operation costs, it's recommended that the strip fluorescents be used in lieu of the theatrical lights whenever possible during the week.

Natural Ventilation and Daylight

St. Mark's could take more advantage of natural ventilation rather than AC during cross-over seasons because of the design of their spaces that include high volumes and opportunities for cross-ventilation. Adams & Associates can provide savings estimates for bypassing the AC. Any future architectural renovations might include the creation of more clerestory, operable windows on the north and

south facades to release heat from higher volumes and enhance natural ventilation. In addition, clerestory windows contribute more free lighting that is distributed deep into spaces with light colored, reflective ceilings. Windows on the east and west are more challenging because of heat gain issues so are best avoided.

Consider revealing the north-facing window behind the altar with a translucent, frosted coating for daylit backlighting. Currently, the cross above the altar has two illumination options:

1. Theatrical light fixtures with inefficient, short-lived lamps.
2. Fluorescent lamps attached to the back of the cross that help to backlight it.

Creating and using a third option of controlled daylit backlighting would be efficient and effective. In addition, daylight has been proven in studies ranging from schools to Walmarts to enhance feelings of well-being, improve performance and increase spending!

Another potential location for daylight access is in the choir loft. Windows on south-facing facades can be controlled to block the higher sun angles of summer rays. Solar film can be applied to glass to mitigate glare and heat gain.

Standard Fluorescents

These are generally four lamp T8 fluorescent fixtures with electronic ballasts and are efficient and effective. In some areas, it may be possible to remove two out of four lamps. Some classrooms and offices are still using T12 (lamp measures 1½" diameter) with magnetic ballasts. These are not only less efficient, the ballasts produce a discernable hum and have a noticeable flicker. They are responsible for prejudicing many people against fluorescents and should be phased out over time.

Occupancy or Vacancy Sensors

Turning lights on when occupancy is detected or off after a period of no occupancy is cost-effective for large, anonymous, commercial facilities. With classrooms and churches, however, educating users has proven to save more energy with significantly less cost.

Exterior Lighting

The issues with the exterior light include light trespassing, polluting the nighttime sky, glare

The wall-mounted floodlights (wallpacks) in the courtyard corridors produce a great deal of glare ranging from the discomfort to disability categories. The adjacent lanterns are generally not used. Replace lamps in these adjacent lanterns with low-wattage (7w) CFLs for use when glare of any kind is undesirable.

The exterior flood lights shown in the following photograph are efficient yet illegal in Pima County and the City of Tucson per the Outdoor Lighting Code. Perhaps these fixtures have been "grandfathered in" despite current codes but they produce issues we need to be aware of. Although the lamps are long-lived and efficiently illuminate a large area of the property, they are insufficiently shielded to control their light output. Too much light trespasses into neighboring properties, pollutes the nighttime sky and creates discomfort glare to people below them. At the very least, we need to shield and aim them more carefully to reduce their negative impact.

"Lighting the night is as important an ecological issue for the planet as global warming."

Health Effects of Light at Night. Stevens, Richard G. Artificial Lighting in the Industrialized World: Circadian Disruption and Breast Cancer. Cancer Causes and Control. 17: 501-507. 2006.

Motion Detectors

Exterior lights operated by motion detectors makes sense for incandescent and fluorescent light fixtures. High-Intensity Discharge (HID) lamps such as metal halides, low- and high-pressure sodium lamps take time to warm up and restrike, so motion detectors are not recommended. St. Mark's has a plethora of HID external lighting. Also, note that CFLs take a few minutes to warm up, so activation of these lamps by motion detection will yield reduced output while the occupant is moving through the area.

Supplemental Heating

Space heaters and baseboard heaters constitute the highest auxiliary loads in these buildings. (Next survey: count number of space heaters and baseboard heaters, list electrical load and guestimate number of hours of use based on Robin's experience. Multiply by electrical rate to generate actual cost of usage.) Robin believes space heater use is carefully controlled by occupants, but baseboard heater use is not. Recommend retrofitting controls to include a manual timer that needs to be reset every 2 hours.

Insulation/Reflective Coatings

Least Expense: Renew caulk joints between walls and windows. Roof already has silver reflective coating. Research whether white reflective has less heat absorption before next coating.

Consider UV coating for south windows without possibility of protective overhangs and west windows.

Hot Water

If our current system is electric, the payback to convert to solar hot water is rapid. If our system is gas, the payback is longer. Instantaneous HW in kitchen makes sense. Can Stan Adams analyze our hot water system?

HVAC

Refer to Stan Adams report.

Solar Energy

Solar panels are still expensive. Twelve panels would generate an average of 300 watts per month for approximately $17,000. TEP may pass on a credit they receive from the federal government for each array installed. A worthwhile solar project could develop out of the following steps:

- Determine a subset of the Church facilities that experiences the greatest number of hours of occupancy.
- Target this area for energy conservation through behavioral modifications and additional insulation (roof, walls, windows).
- Determine how large a solar array would be needed to offset the energy cost of this area.
- Build up this array in phases as funds allow. The technology for solar panels is improving yearly as costs also drop.

Section 2

Water Use

St. Mark's uses over 200 ccf in the summer (150,000 gallons/month) and about 70 ccf (50,000 gallons/month) in the winter. As a point of reference, a typical home uses about 10–15 ccf/month.

The fact that about three times as much water is used in the summer points to outdoor water use as the area of greatest potential for improved water use efficiency. The preschool and church operate year-round, which suggests that indoor water use in the church should be approximately constant through the year.

Monitoring water use at a time when the preschool and church were not in session indicated significant water leaks from the pipes. While the leaks are an important problem, the need to address this is secondary to the need to improve the outdoor water use efficiency.

Outdoor water-use efficiency should be improved by:

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- **Capitalizing on the use of rainwater and storm water to supplement irrigation of deep-rooted plants.** Because of the abundant impervious surfaces at St. Mark's, there is potential to harvest enough rainwater to continue to support the mesquite trees and other deep-rooted plants. Deep rooting creates a large reservoir for water storage in the soils so that these plants can grow well on infrequent desert rainfall.
- **Bringing the Tucson Organic Gardeners (TOG) into the effort to use water more efficiently.** A water meter will allow the TOG to better determine how much water is used, and this can be compared with the estimated plant water needs determined by the U of A agricultural extension. Further technological improvements (such as a "Smart Timer" and more efficient means of application) may be possible once water use and water requirement are better understood.

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Methods

1. Inventory

I did an initial inventory on January 21, 2008. That inventory determined the number and location of each fixture and tested of the integrity of the pipe network, internal water use and external water use.

Since that time, Tucson Water has conducted a 1-week monitoring of use patterns. Twice their equipment has failed, so that data are not yet available. When that becomes available, it should be possible to more accurately understand water use.

2. Water Bill Evaluation

I evaluated the water bill to determine overall water use and seasonal variability in water use.

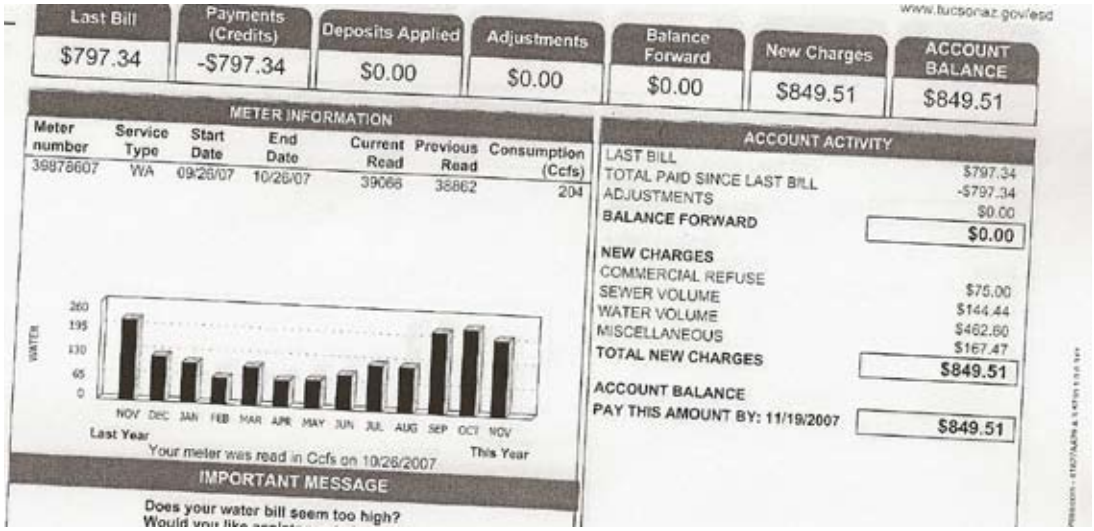
3. Sprinkler Uniformity Test

I performed a sprinkler uniformity test in the Columbarium on March 4 and 5, 2008 to determine how evenly the system waters the grass. This required placing cups in an array across the lawn and irrigating for a set period and then recording the results.

Overall Water Use

St. Mark's uses over 200 ccf in the summer (150,000 gallons/month) and about 70 ccf (50,000 gallons/month) in the winter. As a point of reference, a typical home uses about 10–15 ccf/month.

While 200 ccf is a lot of water, the water use is down from about 400 ccf/month in the summer a year ago. Robin found and fixed some leaks and is managing the water more efficiently. Because St. Mark's is in the commercial and industrial rate structure, summer water use is subject to a surcharge, which is based on the comparison with average monthly water use.



Last Bill	Payments (Credits)	Deposits Applied	Adjustments	Balance Forward	New Charges	ACCOUNT BALANCE
$797.34	-$797.34	$0.00	$0.00	$0.00	$849.51	$849.51

www.tucsonaz.gov/esd

METER INFORMATION

Meter number	Service Type	Start Date	End Date	Current Read	Previous Read	Consumption (Ccfs)
39978607	WA	09/26/07	10/26/07	39066	38862	204

Your meter was read in Ccfs on 10/26/2007

IMPORTANT MESSAGE

Does your water bill seem too high?

ACCOUNT ACTIVITY

LAST BILL	$797.34
TOTAL PAID SINCE LAST BILL	-$797.34
ADJUSTMENTS	$0.00
BALANCE FORWARD	$0.00
NEW CHARGES	
COMMERCIAL REFUSE	$75.00
SEWER VOLUME	$144.44
WATER VOLUME	$462.60
MISCELLANEOUS	$167.47
TOTAL NEW CHARGES	$849.51
ACCOUNT BALANCE	
PAY THIS AMOUNT BY: 11/19/2007	$849.51

St. Mark's water bill September 28, 2007–October 28, 2007.

Inventory

1. Integrity of Pipe Network

On January 21, 2008 (Martin Luther King Day), when no one was at the church, I monitored the meter for 5 hours. During that time about 0.1 ccf of water was used, which represents 75 gallons of water (15 gallons/hour), indicating that 15 gallons an hour leaks from the system. I think this needs to be retested to be confident of the values, but I was not entirely surprised to see significant leaks because many buildings of this age (including my home and many in my neighborhood) have had to be re-plumbed.

In water-bill terms, this loss-rate represents about 14 ccf, which is about what an average home uses in a month.

2. Indoor Fixtures

The following is a list of fixtures in St. Mark's.

Fixture	Number
Bath Sinks	23
Large Classroom Sinks	2
Kitchen Sinks	9
Toilet 1.6 gpf	7
Toilet 3.5 gpf	8
Toilet 5 gpf	3
Toilet Commercial	4
Urinals	6
Drinking Fountains	6
Hose Bibs	7

In general, the fixtures are well maintained. I found one leaky toilet and one sink with a very small leak. The highest-use areas, such as the preschool, had 1.6 gpf toilets. The 5 gpf toilets were in low-use areas (such as the men's bath in the office). Retrofitting the commercial toilets would normally be a good idea, but these, too, are in lower-use areas. Seven toilets appeared to me to be 3.5 gpf toilets, though they may have been 1.6 gpf. Some of these (if 3.5 gpf) probably should be replaced. A sign should be placed in bathrooms that have both 1.6 gpf and higher-use toilets, suggesting people use the 1.6 gpf toilet (full data on attached spreadsheet).

3. Outdoor Water Use

The biggest opportunities for improved water-use efficiency exist outside. Robin has stopped irrigating for the winter and has adopted a strategy of irrigating when plants begin to show stress. The following are some observations.

A. Shallow- and deep-rooted plants are irrigated together, which results in inefficiencies. The Audit Team is aware of the grass planted in the Columbarium with mesquite. However, the periwinkle is often planted with woody plants such as mesquite and oleander. Deep-rooted plants need to be watered less frequently than shallow-rooted plants because a deeper root zone provides a deeper reservoir for water storage.

- **Deep-rooted plants.** In St. Mark's case, many of the deep-rooted plants are well-established, drought-tolerant plants that do not need to be watered frequently and should be well adapted to deep watering with water harvested from impervious surfaces such as roofs or pavement. In extreme drought they could be deep-watered with a hose if need be.
- **Shallow-rooted plants.** The shallow-rooted plants are less adaptable to low water use because they cannot capitalize on the ability to store water for future use in a deep root zone. Robin said that she would expect significant uproar if grass was removed from the Columbarium.

B. Irrigation Systems in Poor Condition. Originally, the irrigation network was probably well designed for its tasks. The timers, sprinklers and emitters are professional quality. However, it has fallen into disrepair. Robin noted that the timer in front of the office has only one location that irrigates, though there are several zones. She noted that pipes for the drip system have been cut. Many of the sprinklers in the columbarium don't spray

properly. Some of these are leaking out the top. Some don't pop up high enough to spray far enough.

C. Irrigation Methods. Bubblers and sprinklers are used at . Mark's. The bubblers are ideal for deep watering. Sprinklers are less efficient because water drops have much more surfaces for evaporation to occur. In my opinion, drip lines could be used in some areas.

D. Tucson Organic Gardeners. A perusal of the Tucson Organic Gardeners raised some concerns for me as follows:

- **Irrigation Schedule.** The irrigation schedule was dated from last year. It should be updated seasonally.
- **Drip Method.** The system had numerous "octopus" heads with drip tubes. In-line emitters in a single tube would be easier to control than the current octopus set up.

Irrigation Uniformity in Columbarium

On March 4 and 5, 2008, I conducted an irrigation efficiency calculation on about half the sprinklers in the Columbarium (zones 2, 3, 4, 7 and 8). This required:

Using catch cans and measuring water depth at the sprinkler and half way between each sprinkler.

Calculating the Distribution Uniformity (DU):

$$DU = \frac{LowQuarterAverage}{Average}$$

Where:

- Low Quarter Average – Average of the water depth at lowest 25%
- Average All – Average of all measurements

The calculated DU was about 30%, which means that the worst irrigated quarter of the lawn gets only about 30% of the average. To provide 100% of the water needed in this section will require 3.3 x 30%. This means that to irrigate all parts of the lawn adequately will require providing 3.3 times as much water to make sure the poorest parts of the lawn are irrigated sufficiently.

To put this in context, the average pool in Tucson evaporates about 6 feet of water in a year, while a lawn uses about 3 feet of water a year. With the calculated DU of 30%, 3.3 x 3' or 10' of water will be required to irrigate the lawn properly, which would be more water than a swimming pool of the same size.

Conclusions

The primary objective for St. Mark's should be to reduce outdoor water use. The evaluation indicated the following:

1. There are significant leaks at St. Mark's that will need to be further evaluated.
2. Some potential exists for improved efficiency inside, but most of the easier fixes have been made.
3. Outdoor water use is poor:
    a. The irrigation system is in disrepair, which means water is not being used as efficiently as possible.
    b. Shallow-rooted plants, such as grass, shrubs and periwinkle, require more frequent watering.
    c. The combination of poor irrigation efficiency and shallow-rooted plants results in extreme water-use inefficiency. The Columbarium is probably the worst case because
        - The Columbarium is an extremely difficult place to irrigate efficiently because of the pillars and trees that break up the path of the spray.
        - Sprinkler irrigation results in more evaporative losses than other kinds of irrigation.
        - Sprinklers are in poor condition.
    d. Tucson Organic Gardeners will need to use a lot of water to properly grow vegetables and non-native trees. There is no immediate way to know how much water they are using, and it appears that the irrigation schedule is not being seasonally adjusted.
    e. Currently Robin is irrigating only when the plants appear to show stress, which should be efficient given the system and the plants.

Recommendations

1. **Leaks.** A leak detection firm should be contracted. I called American Leak Detection. They said it would cost $325 to $500 to find all leaky pipes at St. Mark's.

2. **Indoor Water Use**
   - Signs should be placed in bathrooms with a low-flow and high-flow toilet asking users to use the low-flow toilet if it is available.
   - The one 3.5 gallon toilet in the preschool should be switched out to a High Efficiency Toilet (HET). HETs use 20% less than a 1.6-gallon toilet. One variety of the HET is a dual flush toilet. Not all toilets are the same, so one with a rating of 700 or greater should be purchased. The cost for an HET is about $250.
   - As a second step, older 3.5 gallon toilets should be replaced in areas such as the sanctuary bathrooms.

3. **Outdoor Water Use**
   - **An alternative xeriscaped landscaping scheme should be developed for the following areas with shallow-rooted plants:**
     - Columbarium
     - Areas with periwinkle
     - Shrubs at south side of office

   Irrigating shallow-rooted plants requires that water be applied uniformly and frequently. Inefficient systems may require two to three times the water of efficient systems, which means that unless these systems are maintained, there is a huge potential for water wastage.

   However, the Columbarium, especially, is a treasured place for members of the congregation, so an alternative landscaping scheme should be developed.

   - **Guttering and pervious pavement should be installed so that deep-rooted plants can subsist largely on rainwater:**
     - *Current drainage at St. Mark's:* St. Mark's has an impressively engineered storm water drainage system that captures rainwater and routes it off site. Such a scheme does not lend itself to the use of rainwater for irrigation.
     - *Water use of drought-tolerant trees:* A well-watered desert tree will require some supplemental irrigation. A mesquite tree, for example, uses about 2

feet to 3 feet of water a year, but in a typical year, Tucson gets about 12 inches (one foot) of rain. As such, to keep a mesquite tree growing well it needs supplemental irrigation (which is why mesquite bosques die out when the water table drops depriving them of groundwater; and why mesquite trees on uplands are small and scrawny).

- *Harvesting water for supplemental irrigation:* The abundant impervious surfaces at St., Mark's (rooftops and brick walkways) provide an excellent source to derive the supplemental water. Because the mesquite trees are deep-rooted, the soils in the root zone can store the water.
- *Use of pervious pavers:* Many of the trees are planted so that the only means to get water to the roots is through an opening much smaller than the tree canopy. Most trees need to be irrigated out to the drip line (the place where rainwater falls off the edge of the tree canopy). By replacing brick patio with pervious pavers in some areas, trees can be irrigated beneath the canopy.

- **Tucson Organic Gardeners should be brought into the effort to improve water use efficiency by doing the following**:
  - *Installing a flow meter on the pipe to the TOG plots:* The first step in using the water efficiently is to determining how much water is currently being used by TOG. A meter will cost about $80 to purchase. Installation will be more.
  - *Determining the water needs of the plants:* The AZMET and AZSCED programs should be used to determine how much water the different vegetables need. AZMET determines the water requirements of a reference crop, and AZSCED determines how much more or less water the vegetable uses compared with the reference crop (these are free programs available from the U of A).
  - *Irrigation scheduling should be tailored to the plant needs:* To truly capitalize on the ability to tailor water needs, it may be necessary to replace the timer with one that has the potential to water more zones with more different schedules. This may mean adding pipes, valves and emitters. "Smart Timers" would be ideal because these can adjust water needs based on evaporative demand and soil moisture sensors.

Section 3

Purchasing, Food and Waste

Office and Other Paper Products

The Green Team tallied St. Mark's 2007 purchases for office, cleaning, kitchen and restroom uses and compared the costs of these products with environmentally friendly alternatives for the same purposes. The tables on the following page summarize the information for those products for which alternatives are available.

Products with Green Alternatives of Lower or Equal Cost

Product	2007 Quantity	Unit Cost	Annual Cost	Green Unit Cost	Annual Green Cost	$ Difference with Green
Paper, 20#, 8.5x11, 3-hole, white	5000 sheets	9.98/1000	49.90	10.00/ 1000 *	50.00	0.10
Cartridge, Lexmark 16	4	26.10	104.38	16.49 **	65.96	-38.42
Cartridge, Lexmark 32	9	17.10-19.75	167.56	12.99 **	116.91	-60.80
Cartridge, Lexmark 33	1	18.00	18.00	14.49 **	14.49	-3.51
Cartridge, HP 98	6	16.30	97.77	11.99 **	71.94	- 25.83
Cartridge, HP laserjet	6	66.49-66.99	400.94	44.09 **	264.54	-137.40
Bath tissue	432 rolls	.473/roll	191.20	.33/roll *****	142.56	-48.64

Products with Higher Cost for Green Alternative

Product	2007 Quantity	Unit Cost	Annual Cost	Green Unit Cost	Annual Green Cost	$ Difference with Green
Paper, 20#, 8.5x11, white	55,500 sheets	5.88 – 6.60/ 1000	345.49	8.30/1000 *******	460.65	115.16
Paper, 20#, 8.5x14, white	5000 sheets	9.60/1000	47.99	14/1000 ***	70	22.01
Paper, 24#, 8.5x14, color	26,000 sheets	21.42-22.40/1000	566.32	24/1000 ****	624	57.68
Paper, 24#, 11x17, color	12,000 sheets	33.68/1000	403.36	40/1000 ****	480	76.64
Paper towel, roll	120 rolls	1.133/roll	125.70	1.23/roll *****	147.60	21.90
Paper towel, multi-fold	8 cases of 4000	21.99-25.49/case	190.42	33.00/case *****	264.00	60.08
Trash bags, 13 gal drawstring	8 pkg of 200 bags	11.49-12.69/pkg	96.52	49.00/360 bags	217.78	116.18
Trash bags, 33 gal	8 pkg of 200 bags	14.79-19.99/pkg	130.32	49.00/180 bags	435.56	275.56
Cleaner, all purpose	8 gal (128 oz)	8.88/gal	71.04	2.99/34 oz ******	90.05	19.01

* 30% Post Consumer Waste (3-hole paper not available in 100% PCW), from www.treecycle.com
** Recycled, from Cartridge World, 4592 E. Broadway, 325-7979, www.cartridgeworldusa.com
*** 100% PCW, 100% Processed Chlorine Free and acid free, from www.treecycle.com
**** 30% PCW, acid & chlorine free, from www.treecycle.com
***** 80% PCW and 100% PCF, from Trader Joe's
****** From Trader Joe's
******* PCW, 100% Processed Chlorine Free and acid free, from Discount Office Supplies, online

Notes

- Where a range of prices is shown, the last figure is generally the most recent, in which case that figure has been used to calculate the price difference between actual and green costs.
- Purchasing green products may involve switching to alternative vendors, some on-line and some local.
- The church purchased three white flip chart tablets in 2007, at a total cost of $50.97. An alternative is to use white boards and xylene free, refillable markers that are available on-line.
- The church might reconsider its practices regarding the use of some disposable products, such as:
    - Substitute white for some of colored paper, reducing costs and allowing purchase of paper with higher PCW content.
    - Substitute 20# for 24# colored paper, which will save raw material and is less expensive.
    - Change Sunday bulletin format to fit 8.5 x 11 rather than 8.5 x 14 paper; if the same number of pages was used, this would save paper, and it would be less expensive.

Food

In a groundbreaking 2006 report, the United Nations said, *"raising animals for food generates more green house gases than all the cars and trucks in the world combined."* (UN News Centre, 29 Nov. 2006) A person can drive a Prius instead of a "regular" car and save 1 ton of CO_2 from entering the atmosphere, but by becoming vegan that person can prevent 1½ tons from doing the same. (Newscientist.com)

The largest source of methane, one of the three primary gases that cause global warming, is animal agriculture, according to EPA. Methane is more than 20 times as effective as carbon dioxide in trapping heat in our atmosphere. Nitrous oxide, the third gas, is 300 times as potent as CO_2 in trapping heat. According to the UN, meat, egg and dairy industries account for 65% of worldwide nitrous oxide emissions.

A typical, corn-fed feedlot steer consumes 284 gal of oil in his brief lifetime. Dr. David Pimentel, Cornell economist, says that this is because corn requires heavy use of pesticides and chemical fertilizers, which in turn require oil for production. *It takes about 16 lb of corn to make 1 lb of animal flesh.* In fact, in the US, *70% of all grain, 80% of all agricultural land, 50% of all water and 33% of all fossil fuel are used to raise animals for food.*

According to EPA, runoff from factory farms pollutes waterways more than all other industrial sources combined. What about grass-fed beef? Isn't it better for the environment, less polluting, use less of the resources and is less cruel to the animal? Yes and no, according to my findings. Average, so-called "grass-fed" cattle only spend about 6 months in the pasture. Eating only grass does not fatten them fast enough. The pastures are often irrigated and sometimes sprayed with herbicides. The cattle erode topsoil, destroy vegetation and pollute water. According to Edward Abbey, *"Most of the public lands in the Southwest are, what you might call 'cow burnt.'"* Grass-fed beef is also quite expensive and, given the U.S. appetite for meat, the U.S. rangeland is not sustainable.

What about grass-finished beef? This meat, for example, from the local Saguaro Juniper (www.saguaro-juniper.com) family-owned business is truly free of pesticides and hormones because these animals do not spend time in feedlots and are humanely slaughtered. The cost again is higher than in supermarkets and can be purchased only twice a year at slaughter time.

Perhaps chicken and fish are more responsible options for the conscientious consumer. *Fifty-five times more chickens are slaughtered in the U.S. than pigs and cattle combined. The Humane Slaughter Act excludes birds, however.* According to one study conducted by the USDA, *99% of the broiler chickens that they tested had E. coli and high levels of arsenic.* This has led to overuse of antibiotics and hormones on chickens, which, in turn, has caused serious health concerns for humans. Human drugs are less effective against the newly developed super bugs.

Fish? Most of the fish sold in supermarkets is *farm-raised.* Eighty percent of salmon in the U.S. is farmed. Millions of fish are raised in netted cages in coastal waters. This causes *extreme fecal contamination and diseases.* According to the Norwegian government, salmon and trout farms in Norway produce as much sewage as NYC. To fight parasites and diseases, the *farmers dump pesticides into the water,* which in turn further pollute the coast. *Fish farms are creating a threat to wild fish because they routinely escape.* About 1 million have escaped in the last three years. The farmed fish reproduce much faster than wild fish, and wild fish get diseases from the farmed ones. Furthermore, wild fish are used as feed for the farmed fish because a plant-based diet does not fatten the farmed fish fast enough. *About 5 lb of ocean-caught fish produces 1 lb of farmed fish.*

Now, what then is the socially and ecologically responsible and sustainable food choice? **My conclusion is that we must start by eating a vegetarian diet** (or even a vegan diet — avoiding not only from meat but also eggs and dairy products). As Robert F. Kennedy Jr. said, speaking for Waterkeeper Alliance, " The factory farm industry has polluted thousands of miles of America's rivers, killed billions of fish, pushed tens of thousands of family farmers off their land, sickened and killed thousands of U.S. citizens, and treated millions of farm animals with unspeakable and unnecessary cruelty."

One way to avoid participating in that industry is to **eat vegetables grown pesticide-free as close to home as possible.** An average vegetable bought from a supermarket is a well-traveled one (on the average about 2000 miles). For example, an average tomato was grown in heavily toxic soil in Mexico, on land owned by a multinational corporation and picked when it was still green by an underpaid displaced former farmer. Then it was packed into a refrigerated truck and sent off to Phoenix. A better option is to **get tomatoes from the Farmers' Market, a local coop, or grow them yourself.** At the Farmer's Markets you can also get home-baked breads, other seasonal vegetables, eggs directly from a farmer and even grass-finished beef. In general, it is better to **eat simple, whole foods** because they are healthier for us and they undercut the corporate domination of the food system.

In Tucson, we are fortunate to have a **small local bakery** that sells nearly organic breads directly for wholesale prices (Small Planet Bakery on 7th Street). **Buying in bulk** reduces packaging and keeps the cost down as well.

Other valuable sources are:

- Tucson area Farmers' Markets, (see www.foodconnect.org)
- Civano FM, Sundays 10-2, 5301 S. Houghton
- Community Food Bank FM, Tuesdays 8-12, 3003. S. Country Club Dr.
- Downtown FM, Wednesdays 8-1, South lawn of the Main library
- El Presidio Mercado, Fridays 10-3, corner of Church and Alameda
- FM of the U of A, Wednesdays 9-1:30, Sep-April, Speedway and Mountain

- Oro Valley FM, Saturdays 8-12 summer, 9-1 winter, 11000 N. La Canada
- Plaza Palomino, Saturdays 10-2, 2970 N. Swan
- Rincon Valley FM, Saturdays 8-1 summer, 9-2 winter, 12500 E. Old Spanish Trail
- Santa Cruz River FM, Thursdays 3-6 Feb-April, 4-7 May-Oct, Speedway and Riverview
- Tucson FM at St Philip's Plaza, Sundays 9-1 winter, 8-12 summer, 4380 N. Campbell Av

As to the question of how a vegetarian gets all the *protein* that is so readily available in meat. It turns out that both the *American Institute of Cancer Research and the American Heart Association agree that a plant-based diet is better for our health than meat.* "Choose predominantly plant-based diets rich in a variety of vegetables, fruit and legumes, and minimally processed starchy, staple foods" (www.AICR.org/report2.htm). From www.americanheart.org/Heart_and_Stroke_A_Z_Guide/vegdiet.html we hear that "you don't need to eat animal protein to get enough of the essential and nonessential amino acids as long as caloric intake is sufficient." In fact, in the U.S. the RDA of protein for women is only 47 g and for men 54 g. (Some recommend even lower amounts.) Excess animal protein has been linked to osteoporosis, kidney disease, calcium stones and some cancers. Complete protein is available when legumes are combined with grains, seeds and nuts. Examples include pita and hummus, beans and tortillas and rice and beans. See www.soystache.com/plant.htm for an extensive table of protein sources with other nutritional information.

Recommendations for St Mark's Church Events

- Serve vegetarian food.
- Buy locally grown pesticide-free vegetables.
- Support local businesses like Small Planet Bakery and Farmers' Markets.
- Educate about food production and consumption.

Waste

Most of the waste that ends in the landfill from St Mark's consists of paper towels, disposable plates, bowls, utensils and cups and food. Food-related events organized by St Mark's or by visiting groups produce most of the garbage.

Office goods are recycled well and most cardboard and plastic containers are recycled.

Recommendations

- **Encourage recycling, educate about it and make it as easy as possible.** We need clear, easy access stations for recycling particularly near the kitchen and coffee hour area. Bulletins could use a bin and we should print in the bulletins "Please recycle me."
- **Rethink and reduce the use of plastic liners for trash bags.** For example, 13-gallon trashcans in the bathrooms do not need liners because most of the trash consists of paper towels.
- **Reduce the use of disposable catering products.** Perhaps the day will come when we can use an environmentally friendly dishwasher and shift back to permanent ware. (Please see the report on dishwashers.)
- **Rethink the use of paper towel rolls.** Last year 120 rolls were bought, that is 10 rolls/month.
- **Begin a composting site at the Tucson Organic Gardens next to the church.** Here we could compost all the food that is otherwise thrown to the trash and parishioners could bring their home food scraps and garden waste to the site.

Dishwasher

The existing dishwasher complicates efforts to reduce usage of disposable catering products (plates, cups, utensils,). The cycle of the existing model (the GE Potscrubber 660) is 74 minutes. The table below demonstrates that several alternatives have drastically lower cycle times, which will reduce the volunteer time that is needed to wash permanent dishware. A new dishwasher would also produce other environmental benefits. For example, the ASKO 3531 uses much less water than the current model (2.5 gallons vs. 12.1 gallons) and exceeds the minimum federal energy standard by 141%.

Dishwasher Comparison

	GE Potscrubber 660[1]	ASKO 3531[2]	Hobart SR24H-5
Cost	n/a	$1000-	$3,500-
Cycle time	74m	20m	19 racks/hr
Place Settings		15	
Energy Usage	??	1kWh	7kWh
Water: 1 load	12.1 gallons	2.5 gallons	1 gallon
Water: 572 loads[3]	6,921 gallons	1,430 gallons	1,044 gallons[4]

1. The GE Potscrubber 660 is St. Mark's current model.
2. The ASKO 3531 esceeds the minimum federal energy standard by 141%. Standard energy efficient models only exceed the standard by 40%–50%.
3. 572 is the estimated annual number of loads run in the past year.
4. We estimate water usage for 1,144 loads for the Hobart SR24H-5 because this unit has only 1 rack while the current unit has 2 racks.

Appendix A

Gas and Electric Usage

St. Mark's Annual Energy Use

Electricity	KWH	Gas	Therms
Jan	17,040	Jan	1,036
Feb	15,720	Feb	1,239
March	13,200	March	926
April	13,200	April	864
May	15,120	May	68
June	22,320	June	58
July	30,480	July	72
Aug	24,600	Aug	54
Sept	35,640	Sept	49
Oct	28,200	Oct	57
Nov	12,240	Nov	61
Dec	14,640	Dec	209
Total	242,400	*Total*	4,693
Tons of CO_2 per year	154	Tons of CO_2 per year	25