COLLEGE OF ENGINEERING & COMPUTER SCIENCE
Department of Civil Engineering
777 Glades Road, ENG 213
Boca Raton, FL 33431
tel: 561.297.0466, fax: 561.297.0493
www.civil.fau.edu

Florida Atlantic University

Department of Civil Engineering

"Green Lodging Project Phase 4:
Green Lodging Performance Measures:
Implementation and Monitoring"

Progress Report:
Action Plan Implementation Update

D.E. Meeroff, Ph.D. and P.D. Scarlatos, Dr.-Eng.
Florida Atlantic University, Department of Civil Engineering
777 Glades Road 36/222, Boca Raton, FL 33431-0091
(561) 297-3099 ▪ (561) 297-0493 (FAX)

Laboratories for Engineered Environmental Solutions

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Executive Summary

Buildings account for 40% of all carbon emissions in the United States, and the hotel and lodging industry is among the most wasteful buildings in the commercial sector. Hotels generate as much waste in one week as 100 families generate in a year, and therefore hotels stand to gain the most from improving their environmental footprint. It is important to remember that a hotel is a for-profit business with the ultimate goal of maximizing profit margins. Many "green" initiatives have the quadruple benefit of not only increasing environmental stewardship and improving the health of guests and staff, but also decreasing expenses (from lowered utility and maintenance costs) and potentially increasing revenue (due to higher average daily room rates, revenue per available room, and occupancy levels). Buy-in from management for "green" initiatives tends to be maximized when they are in line with the hotel's ultimate goal of profit maximization.

It has been documented that the Florida Green Lodging Program practices are generally effective in reducing multi-media waste streams and thus resulting in a cleaner environment, financial benefit, and positive publicity to the participating hotel businesses. Green Lodging practices are applied with respect to (a) water conservation, (b) solid waste management and waste reduction, (c) energy efficiency, (d) clean air practices, and e) communications.

This study is the fourth part of a multi-phase project. The first two phases focused on identifying and updating best management practices and pollution prevention technologies for the four key areas of the Florida Green Lodging Program (i.e. a-e above). The first phase focused on (a) water conservation and (b) solid waste management and waste reduction, while the second phase included: (c) energy efficiency and (d) clean air practices. After this information was made available, the third phase focused on targeted pilot projects for selected candidate facilities to implement and monitor to determine the maximum return on the investment in terms of reduced water and energy demands, pollution prevented, tons of waste diverted, and indoor environments protected. This fourth phase documents initial results of projects implemented to achieve the minimum requirements for the one palm designation to provide a clearer understanding of currently available practices and their environmental and economic benefits as well as future conservation initiatives needed to maximize the positive impacts of the Florida Green Lodging Program. It is intended that the best practices investigated here can facilitate implementation in other hotels entering this process in the future. The following report illustrates numerous policies and products a hotel can choose to generate greater sustainability as well as insight into the best methods to achieve a successful implementation of the FGLP.

The study is being conducted using two boutique hotels in Miami Beach, FL. The first property, the Raleigh Hotel, is 4-Star rated hotel with 104 rooms and price points starting from $229 per night. The hotel is located in the historic art deco district on Collins Avenue with direct beach access. Surrounding its famous lagoon pool, the hotel boasts a luxurious sundeck with private cabanas, a restaurant, and tropical gardens. The second

property, the Standard Hotel and Spa, has 105 rooms and suites with price points varying from $245 - $850 per night. Among the amenities of the property are a spa, yoga, integrated wellness center, large and small meeting rooms, several outdoor meditation areas, a saltwater infinity pool, a waterfall massage, a Turkish hamam, an aroma steam room, a clothing optional mud lounge, and the famous Lido Restaurant all overlooking Biscayne Bay. As part of phase 3, on May 12, 2008, a Green Lodging Assessment walkthrough was performed by Karen Moore (Green Lodging Coordinator, Florida Department of Environmental Protection, Tallahassee, FL), Hugh A. Smith (Florida Green Lodging Program ReTAP, FDEP Southeast District, West Palm Beach, FL), Daniel Meeroff, Ph.D. (Florida Atlantic University Department of Civil Engineering), and Lanette Sobel (research associate). The Raleigh Hotel was assessed first at 11:00 AM, and the Standard Hotel and Spa was assessed later that same day starting at 4:30 PM. In summary, both hotels were found to have some of the minimum requirements for the one palm designation already existing on the property, but the assessment team also identified several opportunities for improvement as list in Table 1.

Table 1. Summary of existing pollution prevention practices and opportunities for improvement at both participating hotels.

Category	Raleigh Existing	Raleigh Opportunities	Standard Existing	Standard Opportunities
Water Conservation	• Linen reuse • 1.6 gpf toilets • 2.2 gpm aerators • Drip irrigation • Xeriscaping • Sub-metering	• Towel reuse • HVAC repair • Showerhead replacement • Pool cover • Appliance replacement • Leak detection program • Pre-rinse spray washer	• Linen/towel reuse • 2.2 gpm aerators • Drip irrigation • Xeriscaping • Sub-metering	• Showerhead replacement • Zero flush urinals • Pool cover • Appliance replacement (dishwasher, clothes washer) • Exotic plant removal • Leak detection program
Energy Efficiency	• Energy star appliances • Sensor lighting/dimmers • CFLs (back of house) • Double-paned windows	• Appliance replacement • HVAC replacement • Programmable thermostats • High efficiency lighting • Window tinting	• Energy star appliances • Sensor lighting/dimmers • CFLs (back of house)	• Appliance replacement • Programmable thermostats • High efficiency lighting • Window tinting • Weatherstripping
Waste Reduction	• Limited cardboard recycling • Reusable dinnerware	• Hazardous waste recycling • Eco-purchasing (30% post-consumer recycled content)	• Limited recycling (back of house) • Lease to buy options	• Hazardous waste recycling • Eco-purchasing (30% post-consumer recycled content) • Refillable containers
Clean Air Practices	• Eco-friendly cleaners	• MERV8 filters • Hazardous waste storage • HVAC preventative maintenance and coil cleaning • Microfiber cloths • ETS Control	• Eco-friendly cleaners	• MERV8 filters • Hazardous waste storage • HVAC preventative maintenance and coil cleaning • Microfiber cloths • ETS Control
Communications	• Linen reuse placards • Newsletter	• Additional signage • Employee training/rewards program	• Linen/towel reuse placards	• Additional signage • Employee training/rewards program

In terms of water conservation, an assessment was conducted in Fall 2008. For the Raleigh hotel, the water consumption as measured from the whole building meter was plotted against the monthly occupancy rate to determine the amount of water consumed per occupied room. Taking the average water usage value from October 2006 to July 2008, the amount of gallons consumed per occupied room was 433 ± 69 gpd, which corresponded to an annual usage of 11.8 MG at an annual cost of $86,400. After implementing a towel/linen reuse training program, leak detection/identification, pre-rinse spray washers in the kitchen, irrigation system audit, and ultra low flow faucet aerators, the usage actually climbed to 518 ± 117 gpd, which corresponded to an annual usage of 13.6 MG at an estimated annual cost of $117,100 (computed from the data obtained from August 2008 to October 2008. The decrease in efficiency of 85 gpd per occupied room, at an estimated 1.8 million additional gallons per year and an additional $30,700 per year was attributed to the installation of a new roof mounted chiller and rehabilitation of the associated plumbing network. Prior to beginning the study, the Raleigh elected to replace the chiller unit because the corrosion was significant, the meter completely failed, the unit was hemorrhaging water, and the existing unit was constructed of cast iron instead of more salt-tolerant stainless steel. Unfortunately, the new HVAC system installation was wrought with problems and caused several delays and ancillary outages and breakdowns throughout the property. In other words, as of mid-November 2008, the system did not return to equilibrium since the installation began in late August – early September. It will likely take a few more months to start seeing the effects appear in the utility bills. Furthermore, the line flushing and leak detection/repair process has not been completed. It is likely that the existing meter may need to be replaced as a result of this large capital project. In the meantime, the irrigation meter has documented a 35% decrease in water usage over the same period. This significant improvement is attributable to the mandatory phase 1 water restrictions imposed by the South Florida Water Management District, which mandate once per week irrigation.

As part of the monitoring program, the research team made several measurements of water usage throughout the property. Toilets were measured with a T5 flushometer, and showers and faucets were measured volumetrically with a graduate cylinder and a stopwatch. The results of the preliminary tests are found in Table 2.

Table 2. Summary of water usage testing conducted at the Raleigh Hotel in June – July 2008.

Location	*n*	Toilets	Showerheads	Faucets
Public Space	6	1.8 ± 0.4	n/a	3.1 ± 1.6
Food Services	8	n/a	n/a	4.6 ± 3.0
Guest Rooms	3	1.6	3.3 ± 2.4	2.5 ± 0.1
Back of House	2	1.7	nr	3.4 ± 0.3
Average	**-**	**1.8**	**3.3**	**3.7**
Water Savings*	**-**	**9%**	**19%**	**640%**

If all fixtures are replaced, the best water savings impact is achieved with faucet aerators, according to our analysis. This led the hotel to investigate switching out the existing 2.2 – 2.5 gpm faucet aerators in the common areas. Miami-Dade County Water and Sewer

Department supplied 50 of the 0.5 gpm aerators as a donation to the project. These were installed, and follow up measurements were conducted in September 2008, as summarized in Table 3.

Table 3. Summary of water usage testing before and after installation of 0.5 gpm low flow aerators in the Raleigh Hotel.

Location	*n*	July 2008	Sept 2008	Change	Notes
Public Spaces	6	3.1 ± 1.6	5.3 ± 5.3	+2.2	Aerators were tampered with
Food Services	9	4.6 ± 3.0	3.7 ± 3.2	-0.9	Some aerators were removed
Back of House	2	3.4 ± 0.3	0.7 ± 0.1	-2.7	Leaks also repaired

Unfortunately, in the public spaces, the water usage increased by 2.2 gpm from before. This was attributed to theft and tampering/removal of the aerators by guests and staff. In the food services area, some of the new 0.5 gpm aerators were removed as well, essentially turning the previously 2.2 gpm faucets into >4.0 gpm faucets without any type of aerator, whatsoever. The largest effect was found in the back of house area, in which the aerators and leak repairs effectively changing the flow rate from 3.4 gpm to 0.7 gpm. This translates to a savings of 32.5 gpd or 11,856 gallons per year ($95/year), assuming 1.0 min per person per day, a usage factor of 25%, and average hotel occupancy of 92.8 persons per day.

The Raleigh has also been sub-metering its irrigation and pool systems since October 2006. Since that period, the hotel has saved nearly $15,000 in sewer charges avoids, which computes to $670 per month on average. The savings will only continue to swell because water rates are increased every October by the City of Miami Beach.

Another project that was desired at the Raleigh Hotel was a whole building water softener unit to reduce hardness and scale. A quote was obtained from the vendor for $14,000 for the unit and $1,400 annual operating and maintenance costs. The research team conducted water quality testing in several areas of the hotel, and the results are summarized in Table 4. The conclusion was that the water quality was 50 – 70 mg/L as $CaCO_3$, characterized as "moderately hard," which did not justify the expenditure. In general, the water quality was characterized as carbonate hardness, which is temporary and can be readily removed with heat and/or acid. On in the case of the janitor closet, the fraction of non-carbonate hardness, which is permanent, is not trivial.

Table 4. Summary of water quality testing at the Raleigh Hotel on July 29, 2008.

	pH 00400	Conductivity 47004 mS/cm	TDS 000515 mg/L	Total Alk titration mg/L as $CaCO_3$	Ca Hardness titration mg/L as $CaCO_3$	Mg Hardness titration mg/L as $CaCO_3$	Total Hardness titration mg/L as $CaCO_3$	Total Chlorine test strip mg/L
Janitor Closet	8.5	0.29	176	36	56	0	56	nr
Spigot near Engineering	8.0	nr	140	45	51	0	51	3
Womens Bathroom	8.8	0.28	176	41	43	10	53	2
Boiler Room Filter	8.0	nr	nr	53	48	20	68	nr

On the energy efficiency side, FPL and several vendor partners were contacted to conduct energy audits and estimate potential savings from implementation projects planned. FPL Energy Services sent Lori Pezzulo, Natural Gas Services Representative to

conduct an audit on the natural gas usage, and she documented a potential savings of $8,000 per year in unbundling the price of fuel and delivery. Frank Guzman, a FPL business accounts specialist, conducted a lighting audit and projected savings of $28,181 per year and pre-qualified the hotel to receive $3,996 in FPL Incentives from switching to compact fluorescent lighting in key strategic areas of the hotel. The total number of lighting fixtures to be changed would be 1,062, and the initial costs were estimated at $13,740 with a 3.6 – 5.8 month payback at current monthly energy usage. A vendor partner, IDesign, also conducted a lighting audit focusing on LEDs instead of CFLs. They estimated an annual savings of $183 for the canopy area (10 lamps) with a 9 month payback period, $2,832 annual savings for the lounge area (48 lamps) with a 46 month payback period, and $3,066 annual savings for the hallways (96 lamps) with a 21 month payback period.

In terms of electrical energy, an assessment was conducted similar to the water usage in Fall 2008. For the Raleigh hotel, the energy consumption as measured from the whole building meter was plotted against the monthly occupancy rate to determine the amount of electricity consumed per occupied room. Taking the average energy usage value from October 2006 to July 2008, the amount of kWh consumed per occupied room was 65 ± 13 kWh per day, which corresponded to an annual usage of 1.86 million kWh at an annual cost of $192,175. After implementing back of the house high efficiency lighting, energy star replacement purchasing program, reduced hot water demand from a towel/linen reuse training program, leak detection/repair, pre-rinse spray washers in the kitchen, and ultra low flow faucet aerators, and reduced pump operation from irrigation system repairs, the usage actually climbed to 82 ± 14 kWh per day per occupied room, which corresponded to an annual usage of 2 million kWh at an estimated annual cost of $211,290 (computed from the data obtained from August 2008 to October 2008. The decrease in efficiency of 17 kWh per occupied room, at an estimated 140,000 additional kWh per year and an additional $19,115 per year was attributed to the installation of a new roof mounted chiller and rehabilitation of the associated plumbing network. The delay-plagued installation process caused a number of downstream problems in air conditioning units and other mechanical systems. In other words, as of mid-November 2008, the system did not return to equilibrium since the installation began in late August – early September. It will likely take a few more months to start seeing the beneficial effects of improved HVAC efficiency appear in the utility bills. In the meantime, the irrigation meter has documented a 35% decrease in energy usage over the same period. This improvement is attributed to the mandatory phase 1 water restrictions imposed by the South Florida Water Management District, which mandate once per week irrigation. Thus the irrigation pump usage was reduced with a corresponding decrease in electricity needed to run the pump.

The research team identified 148 different appliances, not including the guest rooms or HVAC equipment, and determined that the typical guest rooms have about 7-15 items. Of those surveyed, Energy Star qualified items (n = 11) accounted for 8% of the total. To increase this value, a policy for replacement of failed appliances with Energy Star

equivalent items was recommended and instituted. It is too early to analyze the effects of this program on the overall energy usage.

The Raleigh also conducted a comparison test with two energy management systems installed in the guest rooms. The first set of rooms used a product from Inn^2 Technologies (Entergize). Using this product which is a card activated energy management system, the difference in energy consumption between the control room and the managed room was 116.8 kWh per month (or 35%) for AC control only. This roughly translates to a monthly savings of $11.91/room. Costs for installation of the unit in all of the guest rooms were quoted as $27,000 with a payback period of 24 months. Another interesting finding of the test was that HVAC usage in the guest rooms comprised only 21% of the total energy cost of the room, which is considered low for South Florida as predicted from FPL. The second set of rooms used a Telkonet product (SmartEnergy), which uses multiple occupancy sensors and allows the hotel manager to access the energy management system over the internet. The test room was found to have the air conditioning operating 24% of the time, and the control room had the air conditioning running nearly 50% of the time.

Other additional energy saving programs implemented at the Raleigh Hotel included a purchase of Green Power from a company called Renewable Choice Energy, a proposal for window film/tinting by a vendor partner company named Madico, which predicted an annual savings of $18,459 at a 12 month payback period. Weatherstripping is also under consideration.

In the area of waste reduction, the Raleigh Hotel is offering recycling of paper, aluminum, cardboard, and other recyclables for staff and also for guests, an eco-purchasing program for consumables with post-consumer recycled content (office paper), bulk purchasing (Eco-lab concentrates), reduced packaging, manufacturer take-back (milk and bread crates), ink/toner cartridge recycling, lease-to-buy option for copiers, refillable containers (Natura Water), and is even investigating the feasibility of community-scale composting.

On July 1, 2008, a waste audit was conducted at the Standard Hotel. The researchers removed all solid waste from 3 of 4 dumpsters, sorted the material into categories, weighed the material, and determined the composition of the waste by weight. The results are summarized in Figure 1. Recyclables were determined to account for 44% of the total solid waste found in the bins with the majority being comprised of cardboard and plastic but also a major contribution from paper products and glass. The two study hotels are fortunate to be located in Miami-Dade County, which offers commingled recycling to reduce the on-site sorting that is required. Another 36% of the waste was characterized as compostable, comprised of kitchen/food waste (20%), leafy/yard waste (11%), and soiled paper waste (5%). The remaining amount left over accounts for only 18% of the total, signifying that if recycling and composting can be accomplished logistically, the solid waste component can be reduced to less than one-fifth of the original capacity, if the city regulations will allow the hotel to reduce its waste storage capacity on site to below

the minimum requirements set by the municipal code. According to previous pricing from the current waste hauler (Waste Management Inc.), the cost of rental for waste containers is approximately 3-4 times higher than the comparable sized recycling container. So by downsizing and optimizing the waste container situation, the Raleigh Hotel has already saved 70% on its waste hauling services bill. It is estimated that since the project began in May 2008, the hotel has been able to divert 123,400 lb of waste from the landfill. This weight is equivalent to 43 Toyota Prius cars.

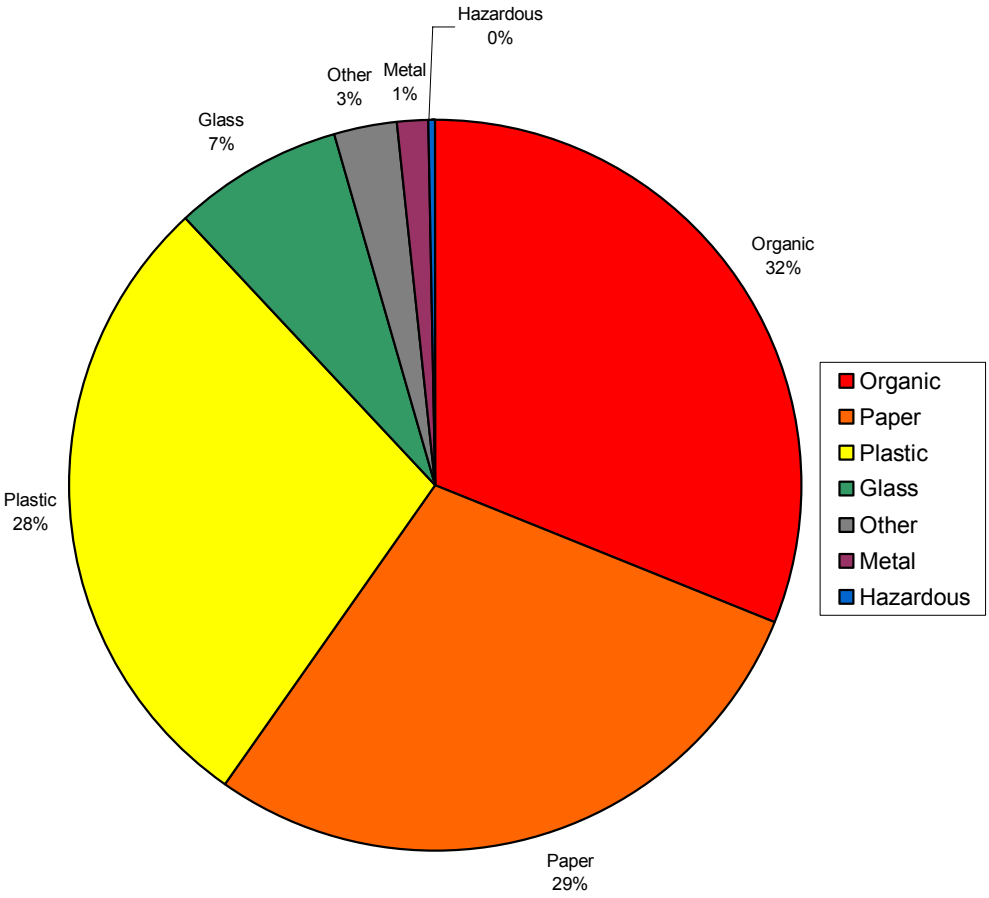

Figure 1. Results of a waste audit conducted on July 1, 2008 showing the breakdown of waste composition at the Standard Hotel, by weight.

In terms of clean air practices, both hotels have switched to environmentally-preferable cleaners from EcoLab's "green" cleaning line (ex. Bardandy, Orange Force, Apex Power), documented their HVAC preventative maintenance logs, begun installing MERV8 filters, instituted efficient set-backs practices for housekeeping, and conducted old testing.

The Palm Beach County Health Department agreed to provide access to IAQ monitoring instruments, training, literature, and survey checklists in support of this research study. Julia Cajacob (Environmental Specialist II, Division of Environmental Health and

Engineering Air Quality Programs) assisted the research team in conducting a pre-implementation air quality survey focusing on: mold/mildew, relative humidity/temperature settings, moisture behind drywall, particulates/dust, VOCs, carbon dioxide, pressurization, and outside air ventilation rates.

For the Raleigh Hotel, we found mold/mildew staining in 45% of the areas tested, leaks/moisture stains in 36% of the areas tested, and dust in 55% of the areas tested. Total volatile organic compounds were also measured with a portable FID/PID total volatiles analyzer (TVA) and averaged for the property: FID: 41 ± 28 ppm and PID: 33 ± 37 ppm. In terms of thermal comfort, our readings indicated that the average temperatures indoors were 82°F ± 5°F at 58% ± 10% relative humidity. These values exceed ASHRAE 62.1-2004 (acceptable summer temperature = 73°F – 79°F and acceptable summer relative humidity = 30% – 60%). The average ventilation rate was 39 cfm/person ± 8 cfm/person, and the average CO_2 levels were 746 ppm ± 170 ppm. These measurements meet ASHRAE 62.1-2004, Sections 4 – 7 (Q > 15 – 60 cfm per person and CO_2 < 1000 ppm). We conducted swab testing for mold in multiple areas of each hotel. One of the samples with the largest diversity of mold recorded during this round of testing was actually found in the second floor administrative offices of the Raleigh Hotel near the GM's office (9 types of mold and bacteria).

The Raleigh hired PM Environmental Services Inc. for follow up testing. They recorded 720 Total Spores/m^3 in the second floor sales office compared to an outdoor baseline of 960 – 973 Total Spores/m^3. For all samples collected, 108 types of mold were found. The primary species of mold was: *Aspergillus/Penicillium*-like, which is generally associated with moisture damage. The contractor's professional recommendations were to finish the server room (currently open the mezzanine), replace water damaged ceiling tiles, and clean/inspect the HVAC units.

In terms of communications issues, each hotel was charged with assembling a Green Book to be made available upon request. Staff members and line employees were made familiar with the hotel's new environmental policy by conducting formal training sessions in three languages (English, Spanish, and Creole). Placards, survey instruments, and signage were developed for letting guests know about the new environmental initiatives of the hotels. Training materials were developed, the new employee orientation manual is in the process of being updated, and technical memos with new environmental implementation policies and practices were developed in support of the program. One such new policy was to implement an Energy Star appliance replacement program. Another was for the new anti-idling policy, and still another dealt with recycling. Another important recommendation from the green team was to seize new opportunities. For instance, emergencies that happen in the moment, routine breakdowns, or even large capital expenditures that have been planned for years should be evaluated for upgrade to newer green options rather than just replacing with the same style inefficient equipment as a knee-jerk reaction.

The manager on duty (MOD) logs were investigated to determine the areas of most need from the perspective of the guest. Among the most common guest complaints documented were: air conditioning complaints, leaky faucets, water temperature too low, shuttle bus breaking down, odors, pests and rodents, unsightly waste issues, and grease trap overflows.

Minutes of green team meetings were recorded and stored in the Green Book, and a suggestion box (one for employees and one for guests) was made available to document feedback and provide a mechanism to nominate the "green" employee of the month through the expanded interconnectedness award. Preliminary results from this study indicate that communication may be the most important area of focus. Both subject hotels have been plagued with a host of obstacles to overcome, such as high turnover rates, and lack of general knowledge, communication, resources (both time and money), and lack of support from upper management. Increased levels of communication would have mitigated many of these challenges and resulted in greater enforcement, higher levels of participation from all levels, and less barriers to implementation.

During the course of the study to date, the research team assembled a number of lessons learned to assist similar hotels in implementing sustainability practices while avoiding some of the pitfalls encountered in this study. Probably the most important item would be to obtain a corporate level mandate in writing prior to initiating the green team. This document should specifically pledging staff time and funding levels, while clearly establishing a process for approval of sustainability projects and granting the green team with some level of autonomy to make decisions and approve expenditures. Another key item would be to make certain that green initiatives are adequately represented in the annual budgeting process, with detailed cost analyses and official quotes from participating vendors. Vendors can often provide detailed estimates of potential savings, which can also be included to conduct the cost-benefit analysis. Another important question that often came up was: who can grant approval if the guest experience is affected? The other major issue was: what is the incentive for line staff? Finally, it is imperative that each department in the hotel hierarchy have adequate representation in the green team, and alternates should be assigned to increase attendance and maintain adequate lines of communication based on consensus decisions made by the hotel community working together.

In looking forward to Phase 5, the participating hotels are investigating the possibility of implementing several new projects including: more audits/assessments (ex. FPL, MIL, IAQ, etc.), "greenify" existing funded projects (ex. chiller, break room renovation), continued on-going staff training, creation of "allergy-friendly" rooms, increase signage, switch to No-VOC paints and donate the old paint to Habitat for Humanity, donate used/spent items to reduce space requirements for storage, "green" water treatment chemicals for cooling towers, ozone laundry systems, kitchen hood demand control ventilation, programmable thermostats, air cooled ice machines, more sub-metering, pre-rinse dishwasher upgrades, switch out heat pumps to more energy efficient systems, dual flush toilets, guest recycling bins by the elevators, 1.0 gpm showerheads, leak detection

programs, occupancy/motion sensor lighting, EMS, weather-stripping and insulation, dispensers for toiletries/amenities, more "Green" cleaners, composting, and finally abolishing bottled water.

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Table of Contents

List of Figures

List of Tables

Description of Approach

Introduction

The Florida Green Lodging Certification Program (FGLCP) is an effort by the Florida Department of Environmental Protection (FDEP) to encourage the tourist industry to conserve and protect Florida's natural resources. Under this program, hotels and motels have been able to help protect the environment, while saving money and generating positive publicity. The purpose of this study is to identify the factors that affect or influence the performance of environmental programs for FDEP Green Lodging Certification. With this information, more cost-effective measures can be identified and implemented. Florida is one of only a handful of states to implement a green lodging program. Others include California, which began its program in 2003, Vermont, which established its program in 1999, and Michigan and Wisconsin, which are conducting pilot phases.

According to the Travel Industry Association of America, business travel expenditures totaled $185 billion in 2000, with $37 billion spent on accommodations alone for 2.6 million rooms per day (CERES 2006). The lodging industry uses an estimated 180-250 billion gallons of water per year (Hemmila 1998; Abt Associates Inc. 2001), generates 0.6-2.8 million tons of solid waste annually (NCDENR 1998; Abt Associates Inc. 2001), and uses the fourth most electricity within the commercial sector. Nationwide, the lodging industry comprised over 51,000 facilities with over 3.1 million rooms in 1999 according to Patricia Griffin of the Green Hotels Association (quoted in Davies and Cahill 2000). According to the Florida Department of Business and Professional Regulation (www.myflorida.com/dbpr), as of March 2005 there were 398,322 hotel, motel and bed-and-breakfast rooms in Florida spread over 4,948 properties. Resort condos and dwellings add another 97,459 units from 10,177 properties. All together, they serve about 35-40 million guests annually, contributing over $14 billion to the local economy (VisitFlorida 2006). The lodging industry is responsible for generating 4% of the state's municipal solid waste per year, uses 625 million kWh of electricity, and consumes billions of gallons of water (Yon 2005).

Project Description

Candidates for Green Lodging Certification require information regarding performance measures for: 1) water conservation, 2) solid waste management and waste reduction, 3) energy efficiency, and 4) clean air practices. This study is proposed to be conducted in multiple phases with the eventual goal of providing scientific data on the actual economic and environmental benefits of green lodging best management practices. Once this information is made available, candidate facilities can target and implement specific measures that provide the maximum return on the investment in terms of reduced water and energy demands, pollution prevented, and indoor environments protected. Results will provide a clear understanding of currently available practices and their environmental and economic benefits as well as future conservation initiatives needed to maximize the impact of the Green Lodging Certification Program.

This phase of the project will begin to evaluate and document the environmental and economic performance as well as the social behavioral impacts of specific conservation projects that can be implemented by Florida's Lodging Industry. Other studies which focus specifically on the actual waste, energy, and water use reductions achieved with the use of pollution prevention strategies have been conducted elsewhere in the country, but none in the Southeast region and none were specific to the hotel industry. Results from this study will be used to further market the value of

the Florida Green Lodging Program with an expected increase of 50% over the current projection of hotels joining the program.

Methodology

Florida Atlantic University (FAU) with input from the Florida Department of Environmental Protection (FDEP) will analyze the data gathered, document findings, and make recommendations for implementing targeted and specific conservation efforts in two participating hotels. The process will be conducted as follows: First, FAU with the assistance of FDEP will coordinate planning meetings with vendor partners, technical partners, and support partners of the Florida Green Lodging Program (FGLP) as well as other project partners that have not yet become official partners of the FGLP. These meetings will outline a menu of options that can be offered in the implementation plan. Next, FAU will conduct a site assessment of the candidate hotel property and operations in preparation for tailoring the implementation plan and preparing the candidate hotel's application for the Florida Green Lodging Program designation. FAU will then meet with the candidate hotels' green implementation team to discuss the possible options that would be acceptable for model guest rooms[1], back of the house, grounds, and lobby areas. Then, FAU and the vendor partner team will prepare a plan that will include recommendations for implementing specific conservation strategies and suitable technologies, preliminary cost estimates to implement the recommendations provided, and the anticipated performance benefits as a result of the recommendations. Next, FAU, FDEP, and the candidate hotels will agree upon a portfolio of conservation projects from the recommended project implementation plan to form a tailored action plan, which will include the monitoring methodology to be used for tracking performance measures. This document must be approved by all parties including the candidate hotel, FDEP, and the team of project partners. The deliverable for this task item is a tailored action plan, which was submitted in June 2008.

Implementation of the action plan included the following steps: 1) vendor fairs in which hotel personnel made time available to review vendors' products and services for potential implementation; 2) staff/employee training; 3) installation, implementation and follow-up surveys and data collection; and 4) wish list budget for upcoming fiscal year.

Site Assessment

On May 12, 2008, a Green Lodging Assessment walkthrough was performed by Karen Moore (Green Lodging Coordinator, Florida Department of Environmental Protection, Tallahassee, FL), Hugh A. Smith (Florida Green Lodging Program ReTAP, FDEP Southeast District, West Palm Beach, FL), Daniel Meeroff (Florida Atlantic University Department of Civil Engineering), and Lanette Sobel (research associate). The Raleigh Hotel was assessed first at 11:00 AM, and the Standard Hotel and Spa was assessed later that same day starting at 4:30 PM.

At least 2 hours was set aside for the assessment. In preparation for the visit, the following information was collected and prepared for review in the Green Lodging Notebook: 1) copies of the application, self-assessment, request for on-site certification, 2) hotel's environmental policy statement, and 3) documentation of the following: a) green cleaners, b) 30% post-consumer

[1] Model guest rooms are sometimes used by hotels to test potential renovation projects before implementing them to entire floors or the entire hotel itself.

content paper goods, c) Energy Star equipment or equivalent, d) minutes of the green lodging program discussed at staff meetings, e) Minimum Efficiency Reporting Value (MERV) rating ≥ 8, f) HVAC maintenance log.

Other requirements included the following:

1. For properties >100 rooms, the assessors will request a list of vacant rooms and ask to see up to 10% of the vacant rooms, depending on the size of the property.
2. The assessors will ask staff they encounter about their part in, and their knowledge of, the Florida Green Lodging Program.
3. The assessors will be looking for the opportunity for guests to recycle containers and paper in the front of house. The assessors will also be looking for these same items, along with cardboard recycling, back of house.
4. At least one of the cleaners used needs to be a "Green" Cleaner. For example, some Ecolab products that would satisfy this criterion are listed below:

   QC 51E General Purpose Cleaner
   QC 52E Glass Cleaner
   QC 91E Neutral Bathroom Cleaner
   Quik Fill 310 Neutral Cleaner
   Quik Fill 510E General Purpose Cleaner
   Quik Fill 520E Glass Cleaner
   Quik Fill Magnum 810 Neutral Cleaner
   Quik Fill 910E Neutral Bathroom Cleaner
   Oasis 139G All Purpose Cleaner
   Oasis 258G Glass Cleaner
   Oasis 305G Neutral Bathroom Cleaner
   Oasis 110G Neutral Floor Cleaner
   Oasis Pro 18G All Purpose Cleaner
   Oasis Pro 34G Neutral Floor Cleaner
   Oasis Pro 43G Glass Cleaner
   Oasis Pro 67G Bathroom Cleaner
   Revitalize 151 Prespray & Extraction Cleaner
   Wash 'n Walk No-Rinse Floor Cleaner
   Eco-Clean Elite Wash 'n Walk Enzymatic Floor Cleaner
   Keystone Wash 'n Walk Enzymatic Floor Cleaner
   GS-37 Industrial and Institutional Cleaners

5. All hazardous waste materials such as enamel paints, parts cleaners, fluorescent bulbs, etc. must be handled properly. Some lists that have Household Hazardous Waste (HHW) collection centers, Small Quantity Generator (SQG) program contacts, and Mercury handlers and transporters information was provided. Note that not all HHW centers collect material from businesses. Thus these services must be contacted prior to the site visit to determine if they service small businesses.

   - Mercury issues: www.dep.state.fl.us/waste/categories/mercury/default.htm
   - Mercury publications: www.dep.state.fl.us/waste/categories/mercury/pages/publications.htm

- Household Hazardous Waste Collection: http://www.dep.state.fl.us/waste/categories/hazardous/pages/household.htm
- Small Quantity Generator Status: http://www.dep.state.fl.us/waste/categories/hazardous/pages/facility.htm
- Hazardous Waste Publications: http://www.dep.state.fl.us/waste/categories/hazardous/pages/publications.htm

The Raleigh

The main findings from the initial walkthrough conducted on May 12, 2008, for the Raleigh Hotel were summarized by Karen Moore and are included in the sections below.

In the communication category, an adequate linen placard was found in the guest rooms; however, she recommends that the following measures be implemented:

1. Information on the features of the hotel's green lodging best management practices should be included in the key packet at check-in for guests.
2. A letter on the hotel's policy statement outlining its commitment to be green should be included in the guest room folder.
3. Additional signage should be created to communicate green practices to guests.
4. A Green Notebook should be created and maintained by the hotel's green team leader.
5. Interviews of random hotel staff members revealed a lack of enthusiasm about going green. This should be addressed with training and education programs.

In the water conservation category, the assessment found that the hotel has already implemented a linen reuse program, but does not have a towel reuse program due to perceived issues with the beach/pool regarding suntan lotions/oils and make-up caking on used towels. For the most part, low flow faucet aerators (2.2 gpm < 2.5 gpm minimum) were found in guest rooms. Showerheads did not appear to be low flow, but the toilets all seemed to be 1.6 gpf. Additional water saving practices noted were: drip irrigation systems on some of the grounds, a 1.42 gpm pre-rinse spray nozzle in the kitchen, and a new dishwasher system that was claimed to use a pre-rinse cycle from the previous post-rinse cycle. Also, the hotel personnel were interested in getting more information on a pool cover to limit evaporative losses.

In the energy efficiency category, the assessment found that the property had one Energy Star photocopier and several plasma television sets. Some sensor lighting and timers outdoors on the grounds and several door sensors for automatic shut-off of closet lights were found. A small number of compact fluorescent lights were found in the kitchen area but not in the front of house. Some of the guest areas had newer double paned windows. The assessment team also was informed that the hotel was in the process of changing the roof chiller system and replacing some of the heat pump units in individual guest rooms, as needed. No programmable thermostats were encountered in the guest rooms. Other opportunities included switching to LCD television sets, expanding the number of high efficiency lighting systems, closing the drapes in unsold rooms, turning off lights in unsold rooms, enforcing HVAC setbacks in unsold rooms, explore window tinting applications.

In the waste reduction category, the assessment found that the property was recycling office paper, newspaper, and corrugated cardboard (aluminum, steel cans, and magazines were not determined). Reusable dinnerware was used in the kitchens, but a large quantity of glass and

plastic waste is being generated during events. Also food was prepared to order in the staff kitchen rather than supplying leftovers. Critical areas for improvement were identified as the following: fluorescent bulb recycling programs, hazardous waste storage/ventilation issues, employee training for recycling sorting, recycling infrastructure for front of house applications may be able to reduce the need for one MSW dumpster, 30% post-consumer recycled content eco-purchasing, source reduction strategies, and refillable ink/toner cartridges.

In the clean air practices category, the assessment found that the property is using an Ecolab product in the laundry, but large bottles of chlorine bleach were found as well. Ventilation issues in the guest rooms were prevalent due to the HVAC design, and the MERV rating of the filter units must be upgraded. AC coils cleaning program needs to upgrade its cleaning agent to an environmentally-friendly product or steam cleaner. It was recommended to contact Ecolab for training and switching to microfiber cloths.

The Standard

The main findings from the initial walkthrough conducted on May 12, 2008, for the Standard Hotel were summarized by Karen Moore and are included in the sections below.

In the communication category, a unique linen placard was found in the guest rooms; however, she recommends that the following measures be implemented:

1. Information on the features of the hotel's green lodging best management practices should be included in the key packet at check-in for guests.
2. A letter on the hotel's policy statement outlining its commitment to be green should be included in the guest room folder.
3. Additional signage should be created to communicate green practices to guests.
4. A Green Notebook should be created and maintained by the hotel's green team leader.
5. Interviews of random hotel staff members revealed a lack of enthusiasm about going green. This should be addressed with training, incentives, and education programs.

In the water conservation category, the assessment found that the hotel has already implemented a towel and linen reuse program. For the most part, it could not be determined if low flow faucet aerators (Q < 2.5 gpm minimum) were found in guest rooms. Showerheads did not appear to be low flow, but the toilets (flushometer style) all seemed to be labeled as 1.6 gpf. Additional water saving practices noted were: the use of an air-cooled chiller-heat exchanger roof system, some xeriscaping, and a saline pool. An ancillary issue is associated with the building water softener system, which may actually be increasing water use in the showers.

In the energy efficiency category, the assessment found that the property had one Energy Star photocopier, hot water heaters, cafeteria washing machine, water coolers, guest refrigerators, and some others, but it could not be determined if any of the other electronics were Energy Star rated. An assessment is underway on this item. A neutron system is being used for outdoor lighting. Some sensor lighting, timers, and motion sensors were found outdoors on the grounds and in maid's closets. A small number of compact fluorescent lights were found in certain areas but not in the front of house. There is an opportunity to expand high-efficiency lighting systems. The self-assessment identified booster pump controls for the water temperature in the dishwashers and off peak hour performance for washing machings. The assessment team found that the roof was in the process of replacement in one of the wings. A tankless hot water heater

was in use (natural gas-type). No programmable thermostats were encountered in the guest rooms. Other opportunities included switching to LCD television sets, expanding the number of high efficiency lighting systems, closing the drapes in unsold rooms, turning off lights interior and exterior in unsold rooms, enforcing HVAC setbacks in unsold rooms and the amenities areas, explore window tinting applications (could also help with noise issues). An opportunity to incorporate energy recovery ventilators was pointed out as well.

In the waste reduction category, the assessment found that the property was recycling office paper (back of house) and corrugated cardboard (newspaper buyback, aluminum, steel cans, and magazines were not determined). No recycling infrastructure for guests was visible. Critical areas for improvement were identified as the following: general commercial recycling program needs to be made more efficient, a fluorescent bulb recycling program must be implemented, hazardous waste storage/ventilation issues near air intake for main building, employee training for recycling sorting, recycling infrastructure for front of house applications may be able to reduce the need for one MSW dumpster, 30% post-consumer recycled content eco-purchasing, source reduction strategies, and refillable ink/toner cartridges.

In the clean air practices category, the assessment found that the property is not using Ecolab products in the laundry or housekeeping. Ventilation issues in the guest rooms were prevalent due to the HVAC design, and the MERV rating of the filter units must be upgraded. The self-assessment claims that carbon monoxide is monitored, but this was not confirmed. Preventative maintenance records are kept by the Standard as opposed to the Raleigh. Mold was visible in at least one guest room and back of the house areas. Rooms smelled musty. AC coils cleaning program needs to upgrade its cleaning agent to an environmentally-friendly product or steam cleaner. It was recommended to contact Ecolab for training and switching to microfiber cloths.

Vendor Fairs

In order to introduce the green vendor participants to the candidate hotels, a series of vendor fairs were hosted by the candidate hotels beginning on July 8, 2008. The purpose of the fairs was to allow the green vendor participants to describe their products/services to essential hotel personnel and decision makers. It also provided the opportunity for the vendors to elicit information necessary to design and create an incentive package for the hotels to implement their products and services.

In the paragraphs below, each of the vendor fairs is described briefly with regards to the date of the presentation, a description of the products/services, potential benefits to the participating hotels, and the potential costs/incentive packages offered.

July 8, 2008

1. Alterna Corp. (Caroma USA)
Alterna Corp. is a company that provides water conservation fixtures, specifically, the following items:

Product	Model
Caroma high efficiency toilets	Sydney 305 Elongated (or others models)
Caroma high efficiency urinals	Cube 3 Ultra (0.13 gpf)
High efficiency showerheads	ecoTap Statesman or GT (1.5 gpm)
High efficiency aerator	ecoTap - 0.895 gpm

Caroma pioneered the first ever dual flush toilet in 1984. The company's dual flush technology reduces water use by over 40% compared to a 1.6 gpf and 72% compared to a 3.5 gpf toilet. Caroma has 36 U.S. EPA WaterSense approved toilets—more than any other manufacturer. Caroma toilets are nearly impossible to clog due to 3.5-inch waste trap, which is nearly double the industry standard.

Caroma's aerators dramatically reduce water flow from sinks without reducing performance. Depending on the product, the hotel's can expect up to 2000% in water savings compared to a sink faucet without an aerator and up to 100 - 300% compared to a faucet with conventional aerators (Q>2.5 gpm)

In order to maximize the benefits, the representative requested that the participating hotels provide the following information:

1. Number of rooms included in study?
2. Current toilet and applicable flush volume (e.g. 3.5 gpf)?
3. Current showerhead or system and flow rate?
4. Current urinal and flush volume?
5. Current faucet and flow rate?

Caroma is offered the following incentive package to each of the two participating hotels:

Product	Free Samples	Discount on additional purchases
Caroma Toilet (any model)	10	50-60% off list price (typ. $165/toilet)
Low-Flow Urinals ▪ Cube 3 Ultra (0.13 gpf) ▪ Waterless	1	50-75% off list price ▪ $750 typ. ($2300 retail) ▪ $400 typ. ($919 retail)
Low-Flow Showerheads ▪ GT (1.5 gpm) ▪ Statesmen (1.5 gpm)	1	50% off list price ▪ $30 typ. ▪ $50 typ.
Low-Flow Aerators ▪ 1.0 gpm ▪ 0.895 gpm	1	50% off list price ▪ $3 typ. ▪ $15 typ.

2. Antrac Commercial Sales and Service, Inc.
This vendor offers the following products/services to be used in the long term study for Florida Green Lodging:

a) Guest Room/Building Controls: WiSuite by Riga Development

1) The Individual guest room HVAC thermostat will be replaced with a "Smart" Thermostat by WiSuite. Six rooms will be selected for a pilot demonstration; three rooms would be monitored and controlled and the other three rooms would be monitored but not controlled. The energy consumed by each room would be measured with small CT's mounted in the electrical closet. A six unit WiPoint (RF) unit transmits and receives the data for these rooms. The "Sold/Unsold" portion of the room occupancy would be captured through an interface with the reservation system and each room would be wirelessly (RF) connected to a small building coordinator that would interface with the Internet. The data would be stored and shared via an off-site server. Inside each room, a variety of occupancy sensors, door switches, lighting and appliance controls as well as other interfaces are available to be used as needed. Communications would be via RF (ZigBee Protocol) and a central monitoring server with the capability of handling many separate buildings and up to 5,000 rooms would be assigned. This could easily be located at Riga Headquarters in Toronto, Ontario, Canada or depending upon discussions with the factory regarding a potentially larger sized study, a server could easily be set up at the hotel's offices. Additional information and controls would be added to the scope of the study using electronic sensors and additional WiPoints (radios). This could include water consumption data loggers and lighting controls as well as electronic door locks. TimeLox is one company that has a ZigBee communications capable model and other devices such as safes, motorized drapery, etc.

2) The cost for a basic guest room study is often waived if the agreement with the hotel is that the hotel will proceed with the complete installation once terms and ground rules covering economics, customer satisfaction etc are established. These costs and "Ground Rules" will change if monitoring is expanded into a larger scope of activity.

3) Using the WiSuite system to compare other products is relatively easy to do. Some modification to existing formats might need to be done depending upon the reports desired. Some examples are:

- Timers could be replaced with WiPoint to demonstrate the value of more precise and flexible control of outside lighting, sprinkler controls, photocells, etc.

- Strap-on sensors could be used to monitor side by side evaluations of faucets, shower heads, low flow toilets, etc and combine that data with user responses.

Product	Description	Offer Package	Potential Savings
WiSuite Energy Management System	Programmable thermostat and environment controls that save energy by climate control of guest rooms.	▪ 5 different pricing options ▪ Can be financed ▪ Energy study can be performed in up to 6 rooms ▪ Free installation in one test room ▪ Can be upgraded to the wireless Zigbee-based WiSuite	▪ ROI = 2 - 2.5 years ▪ Savings of 10 - 20% on energy costs ▪ Total upfront costs = $650 - $1000/room

b) Cooling Tower Water Treatment Services

As per Antrac's vendor-partner agreement with FDEP, the monthly charge for this service will be offered at 5% less than the present monthly service and chemicals (combined cost to the hotel). The only additional costs would be metering pumps, conductivity meters, or other components needed to provide the service if the equipment does not already belong to the hotel. This would be for the Raleigh Hotel only, since The Standard has an air-cooled chiller.

Water meters for makeup water to the tower and bleed from the tower will be made available at cost if they do not already exist. It should be noted that the City of Miami Beach offers a reduced billing option (submetering plan) that most hotels already use. The only question here is if a separate meter for the cooling tower itself already exists. If not, this would be needed to accurately segregate the irrigation usage from the cooling tower usage.

Advantages:

1. Elimination of hazardous, dangerous chemicals from work area. Savings could also be seen in workmen's compensation rates, and impact fees or other related costs. This is an area that needs to be researched as it varies with locality and insurance carriers.
2. Reduction of bleed water, typically at least 50%. Metering process will verify the exact measurable amount.
3. Recycling of bleed water for irrigation or other non-potable purposes.

Product	Expected Results	Offer Package	Potential Savings
Green water treatment chemicals for cooling tower	Maintains a longer life for the plumbing and HVAC system and the chemicals are less hazardous	▪ 5% discount compared to current monthly charges	▪ 5% less than current monthly charges

c) Green Cleaners

Safe Antrac green cleaning alternatives are offered to replace hazardous caustic, acidic and solvent products that are presently being used by the candidate hotels. Some of the products include de-greasers, de-rusters, de-scalers, and non-acidic coil cleaners. The proposed approach would be to use comparable products for initial evaluation and train the hotel

employees on the correct application. Sample(s) would be offered at no charge initially and any additional orders would be at a discount rate.

Advantages:

1. Elimination/substitution of hazardous chemicals from the work area
2. Cost competitive to present products
3. Many of Antrac's products are more effective and less hazardous than the competition on the market today

Product	Offer Package	Potential Savings
Green acid-free coil cleaners for use in ice makers, HVAC, etc.	▪ Match price of current supplier	▪ Equal to or less than what the hotel is currently paying
Degreasers, derusting agents, descaling agents	▪ Match price of current supplier	▪ Equal to or less than what the hotel is currently paying

July 15, 2008

3. Dade Paper

Dade Paper, headquartered in Miami, is the largest independent distributor of supply systems products in the Eastern United States. The company serves over 25,000 customers from 7 regional distribution centers. Thousands of their customers are hoteliers, both major flags and independents. Locally, their customers include the Four Seasons, the Mandarin Oriental, the Palms, and the National among others. As a potential provider of products and services, they recommend that the following products, services and/or practices be considered for the implementation plan:

Implementation of Dade Paper's Greensafe Facilities Maintenance Program, which includes a complete line of housekeeping supplies, equipment and services including:

- Chemical management dilution control systems
- Complete line of housekeeping and cleaning chemicals meeting the standards of the EPA and various NGOs
- Complete line of towel and tissue products from various manufacturers meeting the standards of the EPA and various NGOs
- Controlled use and touch-free towel & tissue systems
- Microfiber cleaning cloths, mops and dusters
- Power floor and carpet cleaning equipment meeting the standards of the USGBC and CRI
- Recycling bins and waste handling equipment
- Water saving automatic faucets and waterless urinals
- Training programs

Implementation of Dade Paper's Greensafe Foodservice Program, which includes products produced with traditional raw materials as well as new technology options in foodservice disposables including:

- PLA (compostable)
- Bagasse (compostable)

- Bamboo (compostable)
- PETE (recyclable)
- Molded Fiber (recycled)
- Recycled Fiber (recycled)

The company website: www.dadepaper.com/greensafe has information on the various products and services available and also describes Dade Paper's staff of highly trained specialists.

In order to maximize the benefits from our products and services, the vendor representatives request that the participating hotels provide the following information:

A current list of housekeeping and foodservice supplies currently used so that a bundle of recommended environmentally preferable products can be developed. A list of special challenges faced on property so specific solutions can be tailored.

Dade Paper is authorized to offer the following incentive package to the participating hotels:

- Multiple local resources including a dedicated Greensafe Specialist as well as support from Dade Paper's Corporate Headquarters, located in Miami, FL
- Best possible pricing on product bundle selected
- Complimentary training and retraining of housekeeping and foodservice staff on proper product and equipment procedures (bilingual)
- Complimentary seminars for all hotel staff on environmental issues pertaining to supply systems
- Complimentary waste stream and recycling audit
- If a chemical dilution system is selected, complimentary dispensing equipment and 24/7 service
- Assistance with LEED-EB:O&M certification
- Marketing support including featuring participating hotel properties on Dade Paper's Greensafe web page and in *DadeDirections,* a newsletter distributed throughout the Eastern United States and Puerto Rico

In summary, Dade Paper is offering compostable and recyclable kitchen products, green housekeeping chemicals, reusable cleaning supplies, free bilingual training services (repeated as needed), free recycling waste audits, best pricing possible, and assistance with LEED-EB certification. Competitive pricing is available and cost savings can be realized through the reduction of waste from bulk purchasing programs, which reduce items that would be disposed of in a landfill. Eco-friendly chemicals for housekeeping will improve indoor air quality in the guest rooms and common areas.

4. SP Recycling Corporation

This corporation is a full service office paper recycling service. The vendor is offering to provide a 7-yard^3 dumpster and pickup service at no cost to the hotels in the study. There have been no official studies that have highlighted this company's benefits. However the savings are fairly easy to quantify. One ton of paper equals 3 cubic yards of waste, so depending on the cost per yard to haul, it can be a significant savings.

SP Recycling Corporation (SPRC) is owned by the world's largest manufacturer of 100% recycled content newsprint, SP Newsprint Company, located in Dublin, Georgia. The mill consumes over

2,000 tons of old newspaper daily to make new newsprint for tomorrow's newspapers. SPRC has partnered with hotel chains all over Florida for a number of years. SPRC provides a 4 or 7 yard^3 container serviced by a front-end loader truck. The hotel staff simply needs to have a separate bag to put the paper in as they make their cleaning rounds. At the end of the shift, the papers are dumped into the supplied bin. The service wants only office paper, newspaper, catalogs, blue prints, and magazines. No plastic bags, phone books, cardboard, or trash, etc. will be collected. Once the bin is full, SPRC sends a truck to pickup the paper. Guests can even get involved if a place on each floor and at the gift shop for paper to be recycled is provided. The bin and the service are provided at no cost. Through this program, the disposal costs, which average $65/ton in this area, are eliminated. For a 500-room hotel, the cost savings vary from $4,400 at 60% occupancy to $7,400 a year at full occupancy. Taking newspapers out of the waste stream also reduces maintenance costs on compactors, etc. In addition to the savings, SPRC is currently paying from $10- $12 a ton for the paper. The price depends on the amount of weight picked up each month. That money can be paid to a charity on behalf of the hotel or used to benefit hotel employees. An estimate of expected savings for a typical hotel is listed below.

# of rooms	Occupancy	Tons/ week	Waste Tons	Waste Savings
100	60%	0.26	14	$ 887.25
250	60%	0.66	34	$ 2,218.13
500	60%	1.31	68	$ 4,436.25
800	60%	2.10	109	$ 7,098.00
1000	60%	2.63	137	$ 8,872.50
100	100%	0.44	23	$ 1,478.75
250	100%	1.09	57	$ 3,696.88
500	100%	2.19	114	$ 7,393.75
800	100%	3.50	182	$ 11,830.00
1000	100%	4.38	228	$ 14,787.50

Waste Savings uses average of $65/ton disposal fees

5. EcoTech Water, LLC.

Ecotech Water, LLC is interested in participating in the current research initiative that Florida Atlantic University (FAU) is conducting with the Florida Department of Environmental Protection's (FDEP) Florida Green Lodging Program and the participating hotels. To this end, as a potential provider of products and services, we recommend that the following products, services and/or practices be considered for the implementation plan: including super high-efficiency water products such as faucet aerators (0.33 gpf), toilets (0.8 gpf), showerheads (1.0 gpm or less), waterless urinals, and rain harvesting systems.

Because of the company's cooperative effort with the Florida Green Lodging Program (Ecotech was one of the original Vendor Partners) and the efforts of Florida Atlantic University special pricing is available. The regular selling price in small quantities on the 0.33 aerator is $33. The incentive price will be $15. The shower regular price is $95, and the incentive price will be $52.

In order to maximize the benefits from these products, the vendor representatives request that the participating hotels provide the following information: (see attached information request form).

WATER CONSERVATION STUDY INFORMATION REQUEST: www.ecotechwater.com
COMPLETE (please use black ink), COPY AND FAX TO: 888-367-5556 OR SCAN AND E-MAIL TO: info@ecotechwater.com

NAME OF PROPERTY: Raleigh Hotel
Address: 1775 Collins Ave. City Miami Beach State Fl. Zip 33139
Person providing information:
Name Mario Barroso Title Director of Engineering
Ph (305) 612-1140 Fax (305) 612-1128 E-mail mbarroso@raleighhotel.com

Type of property: Hotel

APPROXIMATE WATER USER INFORMATION: (per day)

- Number of male plumbing users: Residents:_____Customers:_60_____ Staff:__25_____ Students:_____ Patients:_____ Visitors/Guests:__50_____ Other users:_____
- Number of female plumbing users: Residents:_____ Customers:__60_____ Staff:__25____ Students:_____ Patients:_____ Visitors/Guests:__50_____ Other users:_____

FIXTURE AND FLOW RATE INFORMATION:

* Number of urinals on the property: ADA___2___ STD__6___ Gallons per flush: __1.0_____

- Number of toilets on the property: ADA__10_____STD__106___ Gallons per flush: ___1.6_____ # Floor mount __ALL___ # Wall mount _____ # Flush valve type_____ # Tank type __all_____

- Number of showers on the property:__104__Flow rate in GPM (gallons/minute): __3.3 avg__

* Number of sinks on the property: Hand__120__ Flow rate GPM_3.7 avg__ Commercial __

* Number of days per year property is used: __365__Number of hours per day_24/7_

- Water uses other than toilets/urinals-sinks-showers: Cooling tower__Y__Laundry__Y__Dish Washing_Y__Ice making__Y__#'s per day____Y____Pre-Rinse Spray Valves __1.5__GPM__Y___ Irrigation__N__Vehicle Washing__N__Equipment Washing___Other_____
- Water source for irrigation:__CMB__If from utility co. is there a separate meter__Y___
- Water source for cooling twr__CMB__If from utility co. is there a separate meter__Y__
- Number of Tons of Cooling____?_____ Square feet of parcels being irrigated____1/3 acre_____
- Estimated gallons of water consumed per year__9.7 million gallons per year_____ Number of meters__3_____
- Number of Air Condition square feet in facilities_____Number of Stories of facilities_9__ Size of parcel facilities are located on_____
- Name of sewer & water utility Co.: City of Miami Beach via Miami-Dade Water and Sewer Department
  Account number(s)_____
- REMARKS:_____

PLEASE ATTACH A COPY OF WATER AND SEWER BILLS OR SUMMARY FOR EACH MONTH FOR THE MOST RECENT 12 MONTH TIME PERIOD.

ECOTECH WATER, LLC PH: 877-341-9500 FAX: 888-367-5556

EcoTech will conduct a water audit free of charge and claims to be able to get the building completely off the grid in terms of water through conservation and rain harvesting technology, if

desired. The products will be sold at factory wholesale prices, and they are offering a program to pay for the items out of the measured savings without up front costs.

6. Tropical Lights

Tropical Lights Inc. is a high efficiency lighting vendor that is offering the following programs:

- EcoGreen Awards™ Program: Online Energy Efficient Lighting Conversion & Certification Program for the Hospitality Industry. The EcoGreen Award is a national program providing bulb technology information, sources, and conversion/maintenance tools for facility lighting conversion. A certification plaque and marketing is included with the program and can be used in conjunction with other types of Green certifications. (see www.EcoGreenAwards.com).
- RestaurantLights.com. This program provides electronic table and mood lighting along with high efficiency replacement lamping facility wide. The company carries over 8,000 candle types, fixtures, and accessories with easy online tools to design your own lighting. The EcoGreen Awards™ criteria require replacement of flame candles to environmentally friendly electronic versions to reduce the soot contaminates, excessive heat output and fire safety issues. RestaurantLights.com also supplies specialty high efficiency lamps including, LED linear tubes, LED MR16, LED Par30, Air purifying CFL, Electro luminescent, Induction lamps and systems. These lamp products are not typically carried by lighting suppliers as yet.
- MoodLyte Technologies (www.moodlyte.com). Manufacturer of electronic mood lighting products for the hospitality industry. These electronic candle products are offered in rechargeable and replaceable battery versions.
- FlickerCell Remote™ is a reusable, battery operated, Remote Controlled LED candle lamp cell that flickers like a real candle. Direct replacement for liquid fuel cells, reduce operating costs and is more environmentally friendly. Remote control takes the convenience and cost savings to a new level by adding remote control. No more handling lamps to turn off at closing, which reduces breakage of holders and lowers labor costs. You can now operate electronic candles for weeks at a time without ever touching them. FlickerCell Remote™ fits most existing candle lamps and holders and operates up to 200 hours on replaceable batteries. Both Votive and Tea light sizes are available in Remote and Non-Remote versions. The FlickerLights™ lamp cell are rechargeable, battery-powered candles that flicker, designed to replace liquid wax fuel cells. They are brightness design in the market for use in shaded candle lamps and were low light menu reading is desired. Product literatures and further descriptions are available on the MoodLyte website.

In order to maximize the benefits from these products, the vendor representatives requested that the participating hotels provide the following information:

1. Participate in the EcoGreen Awards™ program thereby providing the complete facility lighting data for pre and post efficient lighting conversion.
2. Advise of team manager for lighting conversion.
3. Name of lighting service supplier, if any.
4. Name of maintenance manager or the staff member that manages lighting in the facility.

The vendor representatives are authorized to offer the following incentive package to the participating hotels:

- Tropical Lights will waive the registration fee of $499.00 for the EcoGreen Award™ program.
- Tropical Lights personnel will also provide assistance and act as advisor in the lighting conversion process, free of charge.
- Tropical Lights offers a 15% discount on lighting products as needed.

7. Renewable Choice Energy

Since its founding seven years ago, Renewable Choice has helped hundreds of companies across the country reduce their environmental footprints and support clean energy development. Renewable Choice has led the growing market for corporate environmental action in two ways. First, connecting with the clients for impactful environmental projects. And second, delivering educational and outreach efforts to communicate initiatives to the world. Renewable Choice's pioneering efforts have been featured in The New York Times, Wall Street Journal, Newsweek, and hundreds of other media outlets across the country. The company provides: 1) Choice Offsets to deliver the highest quality renewable energy and carbon reduction projects in a credible, market-leading way; 2) Choice Programs, which refers to an award-winning outreach effort included free of charge with most purchases; and 3) Choice Innovations, which uniquely extend the value and impact with a Renewable Choice Innovation such as New Growth Wind or School Power.

Basically the company purchases green power (such as wind, solar, biofuels, etc.) through renewable energy certificates (RECs) or "green tags" on another company's behalf and puts the green power back on the grid to support renewable energy innovation. The company is proposing to provide educational services, a carbon footprint contest, and other services. The alternative is paying an additional amount for the 5% of FPL bill for Green Power.

The incentive package includes discounted rates of Clean Source and American Wind and also assistance identifying the hotel's carbon footprint. In addition, Renewable Choice Energy is committed to helping the participating hotels communicate, extend and differentiate its environmental commitment through community outreach (Choice Program) offers unique features and benefits around your commitment level. Links to this program are listed below:

- http://www.renewablechoice.com/business/assets/templates/rce_base/pdf/business_solutions/AmericanWind.pdf
- http://www.renewablechoice.com/business/assets/templates/rce_base/pdf/business_solutions/CleanSource.pdf
- http://www.renewablechoice.com/business/business-calculator.html
- http://www.renewablechoice.com/business/assets/templates/rce_base/pdf/business_solutions/AmericanWindProjectDetail.pdf
- http://www.renewablechoice.com/business/assets/templates/rce_base/pdf/business_solutions/CleanSourceProjectDetail.pdf
- http://www.renewablechoice.com/business/outreach_programs.html
- http://www.renewablechoice.com/business/?id=22

According to the vendor, the Raleigh Hotel has an impact footprint of 1,850,848 kWh. The impact of the Raleigh Hotel's action plan will help to avoid up to 2,522,706 pounds (1,144.28 metric tons) of carbon dioxide emissions from being emitted into the atmosphere. This commitment has an impact similar to: 1) Planting 10,382 trees; 2) Not driving 2,574,190 miles, or 3) Taking 210 cars off the road for one year. The pricing plan is detailed below.

	Percent of Annual Consumption		
Parameters	**5%**	**50%**	**100%**
Electricity Consumption (kWh)	92,542	925,424	1,850,848
Unit Price – Clean Source	$0.0085	$0.00797	$0.00766
Clean Energy Investment - 2008	$786.61	$7,375.63	$14,177.50

According to the vendor, the Standard Hotel has an impact footprint of 2,412,912 kWh. The impact of the Standard Hotel's action plan will help to avoid up to 3,288,799 pounds (1,491.78 metric tons) of carbon dioxide emissions from being emitted into the atmosphere. This commitment has an impact similar to: 1) Planting 13,534 trees; 2) Not driving 3,355,917miles, or 3) Taking 273 cars off the road for one year. The pricing plan is detailed below.

	Percent of Annual Consumption		
Parameters	**5%**	**50%**	**100%**
Electricity Consumption (kWh)	120,646	1,206,456	2,412,912
Unit Price – Clean Source	$0.0085	$0.00787	$0.00750
Clean Energy Investment - 2008	$1,025.49	$9,494.81	$18,096.84

July 29, 2008

8. SkyeTec

SkyeTec is an indoor environmental consulting firm that provides objective and comprehensive quality assessments and analyses for all aspects of buildings from pre-construction through the building's life cycle. Since inception, SkyeTec has been a leader in the indoor environmental industry, helping clients achieve market differentiation through participation in voluntary, third-party moisture intrusion and quality assurance programs. As an unbiased third party, SkyeTec provides accurate assessments of the structural and indoor environmental conditions through our integrated building and environmental sciences expertise. SkyeTec's Diagnostics and Industrial Hygiene (IH) division is the core division of SkyeTec, as our IH capabilities and experience have been the foundation of our business. Assessment services include sampling, monitoring and testing of pollutants, carbon dioxide, asbestos as well as hazardous waste site monitoring, and Phase I & Phase II site assessments. This division also serves numerous insurance companies during Catastrophic events, such as hurricanes, to provide an analysis of water damage and microbial growth to provide a scope of work for remediation and restoration firms. To this end, as a potential provider of products and services, the company is recommending that the following products, services and/or practices be considered for the implementation plan: The SkyeTec Hospitality Program, an indoor environmental quality preventative maintenance program.

In order to maximize the benefits from their product, they are requesting that the participating hotels provide the following information:

1. total square footage of building space on the property

2. number of guest rooms
3. type(s) of HVAC equipment serving guest rooms, guest common areas, restaurants, and offices/admin areas

They are authorized to offer the following incentive package to the participating hotels: SkyeTec services will be provided to the hotels "at cost", and the emergency water loss disaster plan will be provided at no charge to the hotel.

SkyeTec's Hospitality Scope of Services includes the evaluation of all common areas including all guest rooms on an annual basis to evaluate approximately 25 percent of the guest rooms during each quarter. Rooms will be evaluated in conjunction with routine housekeeping activities. The assessment will include visual assessment of accessible areas, a moisture survey, photographic documentation, measurement of temperature and relative humidity, and real-time measurement of temperature, relative humidity, carbon monoxide and carbon dioxide. SkyeTec will prepare a technical report that summarizes the findings of the assessment and provides our recommendations for immediate repairs, mitigation, and/or remediation activities, as warranted.

The visual assessment will include checks for the presence of visible microbial growth, indicators of unusual moisture conditions and/or poor indoor environmental quality, and evaluation of stripped bedding for soiled areas, bed bugs, etc. Photograph documentation will be provided of significant findings. The assessment will include real-time measurement for temperature. The American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE 55, Thermal Environmental Conditions for Human Occupancy) recommends that indoor temperatures generally be maintained between 68°F and 76°F in the winter months and 72°F to 80°F during the summer. The assessment will also include real-time measurement for relative humidity. Elevated indoor relative humidity measurements may be indicative of moisture intrusion into the building, sources of moisture originating inside the building, and/or a malfunctioning or improperly sized HVAC system. Elevated relative humidity can cause condensation to form on surfaces and promote the growth of mold. ASHRAE 55 generally recommends that indoor relative humidity be maintained between 30 and 60 percent for optimum human comfort. ASHRAE 62, Ventilation for Acceptable Indoor Air Quality, recommends maintaining indoor relative humidity between 30 and 60 percent to minimize the potential for microbial growth.

Carbon monoxide is a by-product of the combustion of fossil fuels. Cigarette smoke also contains significant concentrations of carbon monoxide. Where building fresh air intakes are located near parking structures or heavy traffic, carbon monoxide may be introduced into the building and accumulate in poorly ventilated spaces in unacceptable levels. Additionally, poorly ventilated or faulty gas-fired appliances may result in elevated carbon monoxide concentrations in a building. Screening for carbon monoxide can be used in conjunction with a visual evaluation of appliances, fresh air intakes, and smoking area locations to provide building occupants and guests with assurance that carbon monoxide does not present a threat to human health in the building.

The assessment will also include real-time measurement for carbon dioxide. Carbon dioxide is a normal metabolic by-product of human respiration and has become a recognized standard indicator for IAQ. Elevated carbon dioxide (CO_2) concentration can be an indication of excessive building occupant load, poor air circulation, or limited fresh air intake and mixing. ASHRAE recommends that indoor CO_2 levels not exceed 700 ppm above outdoor levels.

A thermal imaging survey of exposed surfaces will be conducted to determine areas of suspect moisture. Areas of suspect moisture will be evaluated using a moisture meter to determine moisture content of the material. The moisture survey will primarily include evaluation of areas in the vicinity of plumbing fixtures, ceilings, and at perimeter walls. Generally, %MC or %WME measurements of less than 17 are considered to be "dry"; measurements between 17 and 20 are considered to be "at risk" for moisture damage; and measurements of 20 percent or greater are considered to be "wet".

The assessment will also include visual observations of accessible HVAC components; including the air filter condition, cooling coils, drain pan, fan blower, interior air handler unit insulation, supply diffusers, ductwork, and other interior components. The assessment will evaluate for corrosion, microbial growth, particulate accumulation, filter type and orientation, and evaluation of maintenance practices. SkyeTec's assessment will also include evaluation of the functionality of exhaust fans in bathrooms, kitchens, and any other locations where exhaust fans are located.

Finally, the program will include a Commercial Water Loss Disaster Plan, free of charge. Because water damage can quickly lead to poor indoor environmental conditions if not mitigated properly, SkyeTec will include its Commercial Water Loss Disaster Plan for the hotels to utilize in the event of a large scale water loss. The plan outlines the following components essential to proper water loss resolution.

The final cost of the service plan is $700 per quarter.

9. Solar is Smart

This is a small business specializing in solar thermal hot water heating. On the average, installing a solar water heater, the water heating bills should drop 50% to 80%. The Solar's Smart system will reduce the electric consumption significantly by trapping the sun's energy to heat the water. Reducing electric consumption means fewer CO_2 emissions from the power plant as less fossil fuels or nuclear materials are used. The Solar's Smart water heating system utilizes renewable energy. The goal is energy independence for hot water heating costs, which makes economic sense. The dollars invested to install this solar hot water system will pay back in savings on the cost of energy consumption. After installation, the cost for hot water is $. The company is offering a discounted price of $600/panel for participation in the project. More information on the unit can be found at www.solars-smart.com.

August 5, 2008

10. Alterna Corp.

Alterna Corporation is also a distributor of design products, such as coconut palm and bamboo-derived materials with virtually no formaldehyde in the product for improved indoor air quality for applications involving trim accessories, desks, vanities, countertops, floors, and just about anything that can be custom designed from wood products.

Bamboo grows very rapidly, and coconut palm is a reclaimed wood material (after coconut palm trees stop producing coconuts, the trees are cut down to make wood products out of them). The vendor provided samples of different types of wood including amber/natural flat grain and amber/natural edge grain and end grain (with the material surface sticking out of the ends to provide a unique look). Strand bamboo, ideal for commercial applications, is produced from compressed shavings at 2900 psi. The material is almost as hard as concrete and twice as hard

as most wood products. It is available in dark strand and honey strand, or Neopolitan (mixed dark and honey strand). The benefits are that the material is green and the air quality can be improved because the products offgas less than 0.02 ppm formaldehyde in the standard product (formaldehyde is not added, it is naturally occurring in the material). The company also markets zero emissions products for coconut palm as hard as red oak, which comes prefinished or unfinished. They also have plywood materials, such as architectural plywood for furniture, wall cabinets, vanities, etc. available in natural, amber, horizontal grain, and edge grain, and a type of wood called zebra wood at a quarter of the price for a thicker piece available in a butcher thickness for countertops. Compared to most standard cabinetry or furniture, which are soaked in formaldehyde or provide just a veneer, for roughly the same price, this product is 100% solid material. The company also has a custom cabinet division that uses all water-based adhesives and materials to keep the product green. Finished products use stains, adhesives, paints, etc. that are certified green, and use woods that FSC (forest stewardship council) certified. No other bamboo manufacturer has FSC certification currently. Also keep in mind that bamboo bought through other companies may not be very green due to the chemicals used to finish the product. Alterna Corp. has control over every aspect of the process, so that the manufacturing has complete accountability and disclosure.

11. Superior Plus Pest Service

This company has been involved in green pest control since the 1970s. Although there is no standard criteria has been established by the government, this company has strived to remain at the forefront of the "green" movement. The basic principle is to keep pests out of the indoor spaces by: 1) sealing doors/windows, 2) sanitation, 3) eliminating sources of food, for instance, produce vendors use cardboard packaging where roaches love to lay eggs, and 4) monitoring to detect an infestation before it is too late.

The company will conduct an initial survey about 10 days before the service. This survey will help identify areas of need. Inspections are done twice a month to monitor progress of the program. Time is the company's biggest investment – communicating, educating, surveying, and inspecting, since no chemicals are employed unless absolutely necessary. If chemicals are needed, then the company tries to use only those agents listed on the OMRI list of organic products. Chemicals that are used are therefore organic and/or natural and used in bait form so that treatment is localized. The retail rate for this service is set at: $85/hr, capped at 8 hours. Incentives offered at this time are: months 1 and 2 to be billed at $50/hr, and remaining months on a 1 yr contract at $75/hr. The benefits for this program are $1,400 – $2,800/yr in savings. Energy savings should occur as well due to sealing/weatherstripping the outside structure to avoid loss of conditioned air.

12. Madico Window Films

This company manufactures window films around the world. In Florida, commercial buildings are large boxes, and if you can keep the heat out of the box, you never need to cool the box. Most people equate window films with a very dark tinted film, but this dark film blocks the same light as the Madico product which is a light film that allows 50% of the daylight to come through vs. only 8% with the darker films. The company also markets a safety film – to protect the window from hurricane impacts and security breaches. The company offered to install solar film on the entire building at a cost of $10,000, or $20,000 – $25,000 for storm mitigation film for safety impact protection (depending on the grade selected). All films are guaranteed for at least 10 – 15 years, if anything breaks down in the film material itself. The FPL rebate program for installing film on

the west side facing windows is: $1/sf, shading coefficient below 0.40. Typical ROI is 3 years or less with an expected 20 – 40% reduction in energy costs, depending on the building and the film. LEED is developing a certification for hotels specifically, and 15 of 34 points on the draft checklist are for energy. The products also meet USEPA's energy star rating and can be used to address occupant comfort and increase light savings from the use of more natural daylight instead of drawing blinds.

The company has agreed to provide a detailed ROI assessment and perform a pilot study if provided with some basic information from engineering pertaining to the cooling tower, guest room set backs, etc. In terms of incentives, the company can secure an FPL rebate (depending on film type chosen) and could make a consideration on film cost and labor in exchange for marketing materials from the study. It was suggested to submeter a pair of rooms with different types of film and compare to similar rooms without the films. The current retail cost for purchase and installation of the film is $4 – $7/sf. Installation takes about 1 hour per room, and films are applied with a water-based adhesive.

13. South Dade Soil and Water Conservation District (SDSWCD)

The SDSWCD is a non-profit and non-funded entity. One of the programs at the agency focuses on taking organic waste and composting it to divert the material from going to the landfills. Businesses that generate compostable wastes are exploding so fast, that our landfill systems can hardly keep up with the additional material. Ignorance, greed and indifference are the three problems that must be overcome today. The SDSWCD has 28 years of successful experience in the composting business and designed the system for Miami-Dade Waste Services to compost the sludge from the Miami-Dade Water and Sewer Department. The SDSWCD method is more productive than the windrow method that has been prevalent for many years. The process is as follows, basically grind all organic waste and in 3 – 6 days, the unit can provide an odorless soil amendment. Chemical fertilizer costs have skyrocketed in the past 2 years (current prices are 3 to 4 times the price from just a decade ago), and chemical fertilizers are not good for our environment because they leach into the aquifer and cause eutrophication of downstream water bodies. The SDSWCD compost is pathogen-free, weed-free, vermin-free, and odor-free. Most hotels do not have the physical space for an in vessel on-site composting unit.

Therefore, the SDSWCD is proposing a partnership with hotels, the City of Miami Beach, Waste Management (WM), and hotel/restaurant associations to do a pilot study for commercial composting. WM will provide separate containers for organic waste and haul the material to the Medley landfill to compost with a commercial composter. It is envisioned that one existing route that contains the two participating hotels and other commercial generators will be used for the pilot study. In this particular area, it is estimated that up to 40% of the waste is recyclable and another 40% is organic, which totals to 80% of waste stream that can be diverted from the landfill. The SDSWCD composting program put back 4.5 million cubic yards of mulch into Miami-Dade County after Hurricane Andrew. WM cannot acquire more landfill space in the County, so they can prolong the life of their current existing landfills by participating in landfill diversion projects like composting. Furthermore, beneficial reuse of the compost on landscaping eliminates the need to purchase chemical fertilizers and avoids the $58 tipping fee/ton at the Medley landfill not including the cost to haul the material. Hotels will continue to pay the fee until WM earns enough off the resale of the compost to pay off the cost of the program. SDSWCD also has a 30 year history of working with compost, and they know how and where to sell it. Whoever is interested in participating in the pilot study to work out the logistics and quality of the program for potential scale-up just needs to fill out a questionnaire as to the amount/type of organic waste they

currently produce to help determine the size of the composter needed. For the two participating hotels, SDSWCD recommends model 840, $114,900, not including the additional costs of grinding, etc. (for a total cost about $150,000) or a lease to own arrangement (lease for 5 years and paid off) can be arranged.

August 12, 2008

14. Ozone Solutions

This company markets a retrofit to existing laundry operations that uses O_3 (ozone) as a cleaning agent to increase the efficiency of the laundry machines and decrease washing times and chemical usage. The system saves electricity (no need for hot water), water, and chemicals. No upfront cost to the hotel is necessary as all products can be paid for out of the savings incurred from installing the products until products are paid for (buy as you save program). Retail costs are approximately $12,000 for system, with an estimated savings/purchase time of 16 months at a nominal savings of $500 – $1500 per month.

Ozone Solutions offers two types of purification systems: 1) RC 7,15,25,45 Recirculating ozone laundry systems and 2) OD-7 (On Demand).

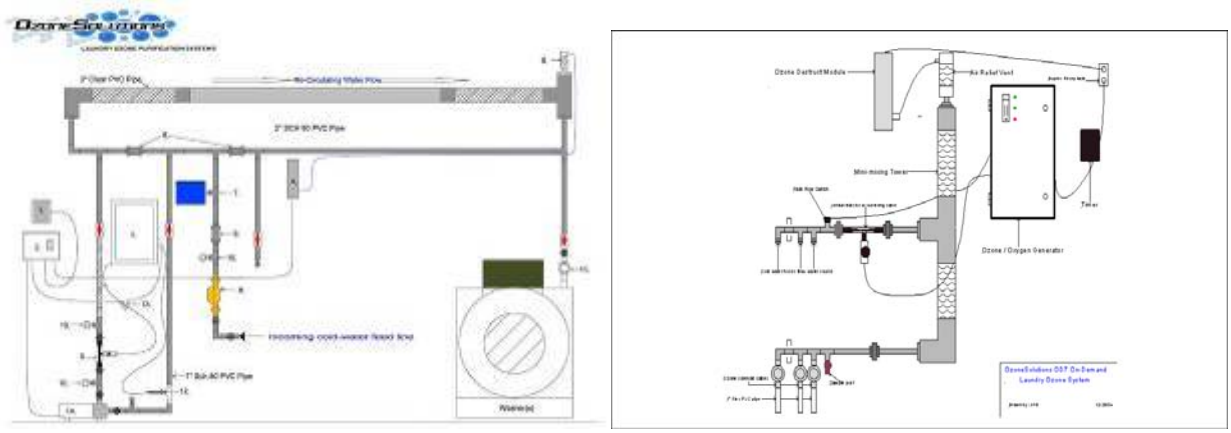


Figure 2. Schematic diagram of RC 7,15,25,45 Recirculating ozone laundry system (left) and the OD-7 on demand unit (right).

If installed, monthly payments would consist (100%) of all utility savings or rebate monies received in the preceding month plus a monthly finance charge of one percent (1%) of the unpaid balance as of the date of the installation of the equipment. Utility savings applied on a monthly basis are calculated per the Savings Formula described below. A monthly report of the metered daily recorded post-ozone water consumption and poundage of linens processed will be compared to the pre-ozone consumptions and poundage to calculate that months savings using the post-ozone monthly poundage with the pre and post ozone hot and total water gallons per pound. The savings on total water consumption will be established by using the monthly metered total pre-ozone water consumption and monthly total post-ozone water consumption divided by the monthly poundage of linens processed to establish a gallon per pound. The post-ozone monthly poundage times the pre and post ozone gallon per pound will establish the monthly

gallons. Pre-ozone monthly usage minus the post-ozone monthly usage divided by 1,000 gallons will establish the monthly savings per thousand gallons. This savings will be multiplied by the current total cost of water and sewer (including all fees and taxes).

Example: Property #1 Pre-ozone used 400,000 gallons in the month of December, and processed 4,000 pounds per day of linen x 31 days = 124,000 pounds of linen in December. 400,000 gallons of water divided by 124,000 pounds = 3.22 gallons per pound. Property #1 Post-ozone used 300,000 gallons in the month of January, and processed 5,000 pounds per day of linen x 31 days = 155,000 pounds of linen in January. 300,000 gallons of water divided by 155,000 pounds = 1.94 gallons per pound. To establish the savings in January, take 3.22 gallons per pound x 155,000 pounds = 499,100 gallons minus 300,000 gallons used in the post-ozone month of January = a savings of 199,100 gallons of total water. 199,100 divided by 1,000 gallons = 199.1 x $ 4.00 (Total cost per thousand gallons) Equals = $ 796.40 monthly water savings.

The savings on natural gas usage for hot water consumption will be established by using the monthly metered pre-ozone hot water consumption and monthly post-ozone hot water consumption divided by the monthly poundage of linens processed to establish a gallon per pound. The post-ozone monthly poundage times the pre and post ozone gallon per pound will establish the monthly gallons. Pre-ozone monthly usage minus the post-ozone monthly usage will establish the monthly savings per gallon. This savings will be converted into therms to determine natural gas savings. The reduced therms will be multiplied by the current total cost of natural gas (including all fees and taxes).

Example: Property #1 pre-ozone uses 250,000 gallons of hot-water in the month of December and processed 4,000 pounds per day x 31 days = 124,000 pounds of linen processed = 2.02 gallons per pound of hot water. Property #1 post-ozone used 50,000 gallons of hot-water in the month of January, and processed 5,000 pounds per day of linen x 31 day = 155,000 pounds of linen processed in January. 50,000 gallons of hot-water divided by 155,000 = .32 gallons per pound. To establish the savings in January, take 2.02 gallons per pound x 155,000 = 313,100 gallons minus 50,000 gallons used in the post-ozone month of January = a savings of 263,100 gallons of hot-water. Formula to calculate therms is 263,100 gallons x 8.3 (weight of water per gallon) divided by .8 (boiler efficiency) x 110 degrees (degree of temperature rise) divided by 100,000 BTU's = 3,002 therms. 3,002 therms x .88)cost of natural gas) = $ 2,641.76 monthly natural gas savings. Example shows total monthly savings of water/sewer and natural gas = $ 3438.16

The property shall provide an electrical outlet, a 1-inch water tap to a cold water source with a shut-off and female threaded connection, and hot/cold water meters to record daily readings of hot/cold water consumption, load counts on chemical dispensers on each washer unless dispenser does not have the ability to record load counts, and the occupancy of hotel. The property shall also provide complimentary rooms for the installers during the installation of the equipment.

Customer Questionnaire

_____

Date_____

Customer Information

Company : Name_____ Owner_____

Street Address_____

City_____State_____Zip Code_____

Phone # _____Fax #_____E-mail_____

Contact Person_____Phone #_____

GM_____Engineer_____

Ex. Housekeeper _____Laundry Mgr._____

Type of Facility_____#Rooms/Beds_____Occupancy_____Chemical Co._____

Chemical Rep._____Phone #_____

Equipment Information

Quanities...Washer Manufacturer/ Model #/ Serial #/ Voltage .....Capacity.....Age.....

_____ _____ _____ _____

_____ _____ _____ _____

_____ _____ _____ _____

_____ _____ _____ _____

Size of waterlines; Hot_____Cold_____Laundry Hours/shifts_____

Analysis Data

Light soil %_____ Cold water temp._____ Cost / Gas therm_____

Med/Heavy soil %_____Heated Hot water temp._____Cost W/S per.1000/gal._____

Daily poundage_____Avg. Labor Rate_____Annual Linen Budget_____

15. Sunshine Solar Solutions

This company is a distributor of green energy solutions. For hotels, they have a few solutions that can help on the energy side for existing properties (no major renovations needed):

- Telkonet Hotel Energy Management Systems. Uses radio frequency instead of cheaper infrared to sense occupants. This system is also more accurate since the signal can go through walls, bed spreads, etc., and also uses a motion and light sensor as backup room occupancy sensors for HVAC control systems. This in-room HVAC controller senses the presence of humans and can set the air conditioning unit to a higher temperature with a set recovery time when the guests leave the room. This system can save a typical hotel about 20-40% on their power bill with an ROI of 12-24 months.
- CFL and/or LED lighting systems. The vendor is offering free CFL lighting up to 5 bulbs per room for a total of $4,000 in incentives, when they are installing the HVAC controllers, they will install the free CFL or LED lighting at the same time. The ROI less than 12 months if these are installed at regular cost.
- Apricus Solar Water heating systems. Solar thermal can produce 30-90% of the hot water for rooms and the kitchen depending on roof area. The ROI is usually less than 4 years depending on the fuel currently used for hot water.
- Solar Panels Plus Solar Pool heating system
- GE Solar or UniSolar Photvoltaic systems (depending on roof audit). The ROI is 8-12 years.

Hotel Solicited Vendors

Inn^2 Technologies, LLC

This company specializes in energy management systems for guest room comfort and energy efficiency. To that end, they offer two types of systems:

- Entergize Guest Room Energy Control System (proactive)
- Energy-Eye Guest Room Energy Control System (passive)

In order to maximize the benefits from our products, they requested that the participating hotels provide the following information:

- Make and model of HVAC equipment
- Annual cost for electricity (is there a separate figure for guestroom energy use?)
- Average annual occupancy
- A copy of the last 3 energy bills

They have offered to install a sample room with one guest room energy control system and compare energy usage to an adjacent room not equipped with a control system. They use a data recording device that provides the ability to capture HVAC on and off time. This comparison will permit extrapolation of the potential energy savings. The installation and test room pilot study will be performed at no charge for each participating hotel. Finally, if the hotels wish to pursue installation in more guest rooms, then the company will offer a deep discounted price based on the type of equipment and number selected.

Natura Water
The Natura Water system is an environmentally-friendly alternative to the waste associated with conventional bottled water. Its proprietary filtration technology, which uses both activated carbon filters and a UV radiation chamber, removes bacteria and eliminates impurities while retaining minerals. The service provides signature glass bottles that are dishwasher safe, reusable and, most importantly, do not add more waste to the landfill.

This company provides its product in some of the most prestigious hotels, restaurants, and corporate offices in the US including The Peninsula Hotel (Chicago, IL), The Montage (Laguna Beach, CA) and Trump National (Rancho Palos Verdes, CA). Normal rental terms are as follows. If a customer chooses to rent the machine, then the monthly lease price for a Model C system is $295 per month, for the Model D system it is $375. Each rental and service contract is for a two-year period and requires a two-month security deposit. Installation is $300. Among other things the rental and service agreement covers staff training to operate the system, includes the semi-annual changing of carbon filters and UV lamp and provides an emergency service at no extra charge. If a customer chooses to purchase the machine, the price for a Model C system is $6,400 and for a Model D is $7,800. An annual service contract, priced at $850 per system, is included along with the installation fee and the semi-annual changing of the filter box with emergency service.

As an incentive to try the Natura Water system and to see the ecological and monetary advantages, the company would be willing to waive both the installation fee and the two-month security deposit for the first C or D system in the participating hotels. The company then asks that the first and subsequent rental payments be paid form the first day of use or the installation date. As part of the "Natura package" with every Model C system, 72 Natura bottles are provided at no charge. With every Model D system 96 bottles are provided at no charge. The retail price for extra bottles is $2.85 for a 600 mL bottle, $3.49 for a 750 mL bottle, and $3.89 for a 1.0 L bottle. Furthermore, the company agrees to offer a discounted rate for a bulk replacement.

Other Miscellaneous by Chef Mark Zeitouni of the Standard Hotel
Finally, the Executive Chef of the Standard Hotel, Mark Zeitouni, solicited a pair of projects on his own. These include a product called Line Bac'r, which is a chemical injection to the sink drains near the garbage disposal designed specifically to eliminate nuisance fruit flies in the kitchen, and the other product is a moisture absorbing filter for the walk-in refrigerators to keep the vegetables crisp, eliminate condensation in inside the chiller unit, and increase the longevity of perishable food items. Since beginning these initiatives, the fruit fly problem has been eliminated and spoilage has been reduced to nearly zero. The investment for these initiatives is approximately $200 per month, and the savings will be calculated in the next progress report after several months of implementation have been recorded.

Major Opportunities

Sustainability Goals, by Department for Hotels AB Miami

At the combined Green Team meeting on June 4, 2008, employees and supervisors from both participating hotels were asked to submit specific project ideas for sustainability implementation in certain areas of the hotels. A brief summary of the list of projects is provided below, by area.

Green Team

1. Make the hotel's Environmental Self-Assessment and Planning Checklist available to the public upon request.
2. Ensure hotel staff is familiar with the hotel's environmental policy and their role in it.
3. Discuss green practices at staff meetings.
4. Communicate environmental initiatives to guests and staff through such avenues as: newsletters, TV, placards in guest rooms, signage, etc.
5. Provide a formal process for guests and staff to give feedback on green practices (suggestion box, survey form, etc.).

Housekeeping

1. Replace existing cleaning products with organic options.
2. Replace existing paper goods with 30% post consumer paper products – Kleenex, toilet paper, note pads in room.
3. Implement a towel reuse program.
4. Implement turndown service.
5. Place recycle bins in rooms – for paper, glass, plastic.
6. No lights on until guests arrives – including radio – triggered by sensor – keycard in wall.
7. No smoking in hotel.

Engineering

1. Implement a low flow shower head program.
2. Cooling tower – use organic chemicals for water treatment.
3. Lights – CFLs or LEDs or high efficiency lighting in all areas.
4. Pool – use organic cleaning chemicals.
5. Attachments to any existing water-using machine/equipment to reduce water consumption (dishwashers, washing machines, bathroom faucets, etc).
6. Programmable thermostats.
7. Computerized Energy Management System (EMS).
8. Install renewable energy generating equipment (solar water heating system).
9. Purchase at least 5% green power through local utility, or purchase green tags (renewable energy certificates) green power generation source in Florida.
10. Use high energy air filters with a MERV (Minimum Efficiency Rating Value) rating of 8 or better.
11. Clean all air handler units and coils at least annually; follow preventive maintenance schedule and keep a record of activities.

Food and Beverage

1. All paper products switch to 30% post-consumer recycled content at a minimum.
2. Locate public access recycle bins by pool area.

3. Eliminate plastic bottled water.
4. Recycle all paper in office/back of house operations.
5. Use soy-based inks for printing and recycle ink/toner cartridges.
6. Practice food composting.
7. Practice bulk purchasing wherever possible.
8. Practice reduced packaging.
9. Exercise manufacturer take-back programs.

Sales and Marketing and Accounting and Front Office

1. Recycle all paper.
2. Use both sides of paper whenever appropriate.
3. Scan when possible.
4. Print emails only when necessary.
5. Promote Green Pilot Program to clients.
6. Recycle ink/toner cartridges.
7. Install shredders for paper recycle bins

Design

1. Purchase sustainable products to include carpet, paint, furniture, etc. whenever possible.
2. Xeriscaping whenever possible.
3. Use native/drought tolerant plant species.

Potential Pilot Projects, by Hotel

Specifically, the Green team members were challenged at one of the weekly meetings to come up with a wishlist of pilot projects that they would like to see in their primary areas of responsibility, given unlimited resources. They are listed in no particular order listed below:

The Raleigh:

- Bamboo flooring inside
- Windows changed throughout the property
- Dual flush toilets installed
- Trash compactor
- Cardboard baler
- Different recycling bins
- Redo water filtration system
- Energy efficient lighting
- Eco-friendly or recycled content carpets
- Change from individual heat pump per room to central a/c
- Towels that dry faster to reduce water and laundry costs
- Recycling mandatory
- Eliminate small glass ketchup bottles from room service

The Standard:

- Implement composting
- CFL recycling (Sylvannia contact per Karen Moore)
- What is the water softener for?
- Green roofs - rooftop garden to grow herbs and possibly vegetables
- Make recycling a priority and place signs to ask guests and staff to recycle

- Optional educational lectures or activities focusing on environmental issues offered to the public and staff
- Solar PV panels
- Solar hot water
- Organic wash for veggies
- Organic spa products and eco-friendly spa products and packaging
- Plants indoors to filter the air
- Signage/designs/messages on towels to convey messages about the environment to guests
- Improve valet program with anti-idling, alternative fuel vehicle shuttles, etc.
- Use acrylic cups instead of plastic
- Carpool, bike rack to encourage alternative fuel transportation
- Convert veggie oil to biofuel
- Air exchangers to reduce heating/cooling load
- Ebooks
- Greywater recycling
- Using half empty water bottles to water plants (etc)
- Vinegar and lemon for cleaning products instead of bleach
- Potatoes as basis for to-go containers
- Use handtowels instead of paper towels
- Training for upper management and staff
- Water saving devices in rooms/laundry/appliances
- Sensor lighting
- Bar area ventilation system (using alternative energy if possible). Apparently the coolers cycle every 38 minutes and eject the warm moist air into the bar area.

FF&E Wish Lists for 2009, by Hotel

Table 5. FF&E Wish List for the Raleigh Hotel 2009 Budget Year.

Project	Estimate Cost	Description	Reason
Section 1: Engineering			
1. POOL HEATERS	**$ 5,500.00**	Purchase 2 new pool heaters to replace 2 of 3 existing heaters	The old heaters constantly break down & have a high risk of breaking this year, possibly affecting pool operations
2. WINDOW CAULKING/ BUILDING SEAL & PAINT	**$ 142,000.00**	Caulk guest room windows, fix stucco, seal walls, & paint outside of building	To insulate & prevent further water leakage into rooms. Completion of this project will eliminate any risk of placing rooms out of order due to leak/moisture issues
3. REPLACE ANTIQUATED DOMESTIC WATER PUMP SYSTEM	**$ 8,000.00**	Replace Domestic Water Pump System	Improve energy efficiency & prevent water loss. Lower energy costs, water loss expense, & greater consistent water pressure throughout building
4. ROOF REPLACEMENT	**$ 30,000.00**	Replace Roof Decks	Prevent leaks & water filtration into building
5. HEAT EXCHANGER ON COOLING TOWER	**$ 7,000.00**	Install heat exchanger for cooling tower system	Create a closed looped system for building condensor water, keep system clean from sand, dirt, etc.

Project	Estimate Cost	Description	Reason
6. REPLACE BLOWER MOTOR FOR GUEST BATHROOM EXHAUST	**$ 2,500.00**	Replace old motor with a new high efficiency cfm exhaust	Improve air exchange & exhaust for guest rooms, reduce stale air smell, mildew, etc.
7. WATER FILTRATION SYSTEM*	**$ 10,000.00**	Replace existing, non-serviceable water filtration system (no access) with new system	Improve water quality for guests & staff; the entire building currently does not have filtered water
8. CORRIDOR A/C UNIT UPGRADE	**$ 8,000.00**	Upgrade non-functional corridor a/c unit for proper energy efficient corridor air-conditioning & dehumidification	Improve air quality in corridors, reduce heat load & humidity in building, improve a/c efficiency of guest room a/c units
9. GUEST ROOM SECURITY LOCKS	**$ 2,945.00**	Re-key all existing security dead bolt locks guest room entrance doors	At this time Guest Relations has no pass key access to guest rooms in an event of an emergency
10. CHEMICAL & ENZYME DRAIN/GREASE TRAP FOR KITCHEN	**$ 2,000.00**	Install feed system to maintain kitchen drains and grease trap.	Keep kitchen drains grease & smell free. Maintain grease trap properly operationally & reduce number of pump outs
TOTAL COST ENGINEERING	**$217,945**		
Section 2: Rooms Division			
1. NEW RUNNER FRONT TERRACE		Purchase new runner for front hotel entrance	General wear & tear
2. FRONT DESK DRAWERS & CABINET OVERHAUL/ WALLPAPER		Fix existing desk drawers. Add rubber cushion under carpet	Drawers do not function well. Rubber cushion will allievate standing for extended period of time
3. GUEST LAPTOP	**$ 1,400.00**	Purchase new laptop for guest use	We currently have 2, but one is 3 years old and on its last leg. Not enough computers for demand
5. LUGGAGE SPACE BOH		Re-design space in back office to incorporate space to store luggage. It would mean moving fax machine & Lodgenet Terminal	Currently, luggage is being stored in walkway towards executive office & back of front desk office
6. SECURITY CAMERAS	**$ 1,400.00**	Install additional security cameras at: stairwell outside accounts, outside property,PH Terrace, Driveway & Washington Lot	Prevent theft at property and add additonal security for guests & employees
7. RADIOS & EARPIECES- GUEST RELATIONS	**$ 5,000.00**	Purchase 15 New Radios & 20 Ear pieces	
8. ROOM KEY CARD SYSTEM		Install new key card system	Security & loss prevention. Current system does not provide enough protection against theft
TOTAL COST ROOMS DIV	**$ 7,800.00**		
Section 3: Catering			

Project	Estimate Cost	Description	Reason
1. CUSTOM PORTABLE BARS (F & B Request as Well)	**$ 4,000.00**	Custom bars that are portable and can fit in elevators	The built bars we have are not nice & clients tend to complain. We also incur rentals sometimes when having to build a lot of them. We could also use this as something that can be rented & make money in return.
TOTAL COST CATERING	**$ 4,000.00**		
Section 4: Food & Beverage			
1. KITCHEN EQUIPMENT : REACH IN FREEZER		Purchase a new energy efficient reach in freezer	The old freezer has a high risk of breaking this year, & therefore may affect kitchen operations
1a. KITCHEN EQUIPMENT: SALAMANDER BROILER		Purchase a salamander broiler	
1b. KITCHEN EQUIPMENT: ELECTRIC HOTBOX		Purchase new hotbox	The hotbox will increase the quality of the food for catering events
1c. KITCHEN EQUIPMENT: SHAFING DISHES FOR BANQUETS	**$ 3,000.00**	Purchase shafing dishes	Keep food warm & presentable for banquet buffets
1d. KITCHEN EQUIPMENT: EMERSION CIRCULATOR		Purchase an emersion circulator	Ability to have diversity in cooking methods
1e. KITCHEN EQUIPMENT: ORANGE JUICING MACHINE	**$ 3,000.00**	Purchase an Automatic orange juicing machine	This machine will cut back on labor & increase quality of our juice
2.NEW FLOORING UPSTAIRS KITCHEN		Install new flooring to replace existing	Wear & Tear
3. PLUMBING PATIO BAR	**$ 3,300.00**	Install plumbing to outside patio bar	
4. REPAIR REFRIDGERATOR DRAWER	**$ 800.00**	Repair refridgerator drawer on the back line	The drawer is broken limiting the amount of space we have, & also raising the temperature of the refrigeration unit.
5. 10' x 10' Screen			
6. MEETING CHAIRS	**$ 5,500.00**	Replacement for folding white chairs	Current chairs are cheap & flimsy
7. POOL LOUNGERS	**$ 5,000.00**	Additional Pool Loungers	Replace broken chairs throughout the year
7. SPEAKERS & WIRING	**$ 30,000.00**	Replace & re-wire existing outdoor speaker systems	Current system does not work properly
TOTAL FOOD & BEVERAGE	**$ 50,600.00**		
Section 5: Accounting			
1. SERVER ROOM		Re-locate Server Room to Accounting Office, Move Accounting Office to part of Ford office	The current location is not set up to allow the system to run correctly. Existing location has a tendency to flood
2. ACCOUNTING OFFICE RE-WIRE		Re-locate outlets	The accounting office is set up with extension cords running around the whole office.
TOTAL ACCOUNTING			

Project	Estimate Cost	Description	Reason
Section 6: Boutique			
1. MIRROR INSTALLATION		Mirror Installation behind shelves & bikini rack	Create reflection of light & increased visibility on merchandise
2. GLASS DISPLAY FIXTURE		Purchase an additional glass case to display merchandise directly outside boutique door	To promote boutique and bring in customers
3. DRAPES		Install new drapes under bench	Current drapes are not fully functionable
TOTAL BOUTIQUE			
Section 7: Sales & Marketing			
1. SPECIALTY SUITE RENOVATIONS		Paint, replace necessary furniture	We are not able to drive the necessary business. Rooms are at a disadvantage against our competitors
2. FORD OFFICE RENOVATIONS		Convert former Ford Office space - this will fall under POMEC & Furnishings: SEPARATE LIST WILL BE PROVIDED FOR DETAILS	Convert former Ford Office space into a revenue producing outlet
TOTAL SALES & MARKETING			
Section 8: Computers			
TOTAL COMPUTERS			
Section 9: Design & Housekeeping			
1. CABANA/OASIS/BEACH FURNITURE		Purchase additional furniture for area, including: lounge chairs, daybeds, & chairs	To replace broken furniture or non-useable items.
2. SHEER DRAPE REPLACEMENTS		Purchase new sheer drapes for cabanas	Wear & Tear
3. UMBRELLAS		Purchase additional umbrellas	Current inventory is not enough for demand
4. GRILL AREA COVER		Purchase a cover for grill openings	Grill is unsightly when area is not in use. All equipment is visible to guests.
5. LOUNGE CHAIR COVERS		Purchase terry cloth covers for lounge chairs- first batch FF & E, additional Operations	Inventory of towels is hard to maintain due to guest's use for chairs, pool, etc. Lounge chair covers will eliminate the inventory needed for towels. They will also aid in keeping pool lounge chairs clean
6. PENTHOUSE RENOVATIONS		Purchase new furniture, drapery, & any additional items - SEPARATE LIST WILL BE PROVIDED FOR DETAILS	Penthouse is not up to standards

Project	Estimate Cost	Description	Reason
7. ADDITIONAL DESIGN PROJECTS TBD		PLEASE REFER TO SEPARATE RALEIGH WISHLIST FOR ADDITIONAL PROJECTS	
TOTAL DESIGN & HOUSEKEEPING			
Section 10: Green Initiative			
1.FAUCET AERATORS GUEST ROOMS		Purchase & Install aerators in all guest room faucets	Saves water & therefore cuts the cost in water bills for hotel
2. RECYCLYING BINS FOR GUEST ROOM FLOORS		Purchase one recycling bin per floor & place at elevator	Allows guest to recycle
3. WINDOW FILM & REFLECTIVE ROOF COATING FOR PENTHOUSE		Install window film to all penthouse windows, Install roof coating on penthouse roof	Filters UVA light into penthouse; decreases energy costs. Roof coating- FPL rebate
4.WEATHERSTRIP GUEST ROOM DOORS		Install weatherstripping to guest doors	Decreases amount of a/c that escapes guest room, therefore creates greater efficiency for a/c units & uses less energy

*** PLEASE NOTE: items denoted with a * in Engineering's wishlist incorporate green inititiave requirements**

Water Conservation

Producing clean water is becoming more costly, increasing the cost of water for consumption. This is exacerbated by permanent water restrictions, limitations on withdrawal, and more stringent regulations and treatment requirements. For each of the participating hotels, a record review was conducted to determine baseline data for water use consumption. Based on utility records and meter readings by hotel staff, the average monthly water consumption values for both hotels are similar.

In terms of perspective, taken as a whole, the entire lodging industry has been estimated to use 154 billion gallons per year (Stipanuk and Ninemeier 1996), and it is estimated that by 2010, water use will climb to approximately 475 gallons per day per occupied room in high luxury facilities (Alexander 2002). In a study completed on tourism in Palawan, Philippines, it was estimated that in the early stages of tourism development in Busuanga West, the amount of water required for a single upscale hotel room would be 396 gallons per day; enough water to support 14 locals at their current standard of living (Alexander 2002). In another example, the Houston-based Green Hotels Association observed water use in a San Antonio La Quinta Inn for a one-month period, the hotel showed a more moderate average of 110 gallons of water being used per guest per billing period (Gerston 2002). Clearly, measured water use at lodging facilities is site-specific and varies considerably.

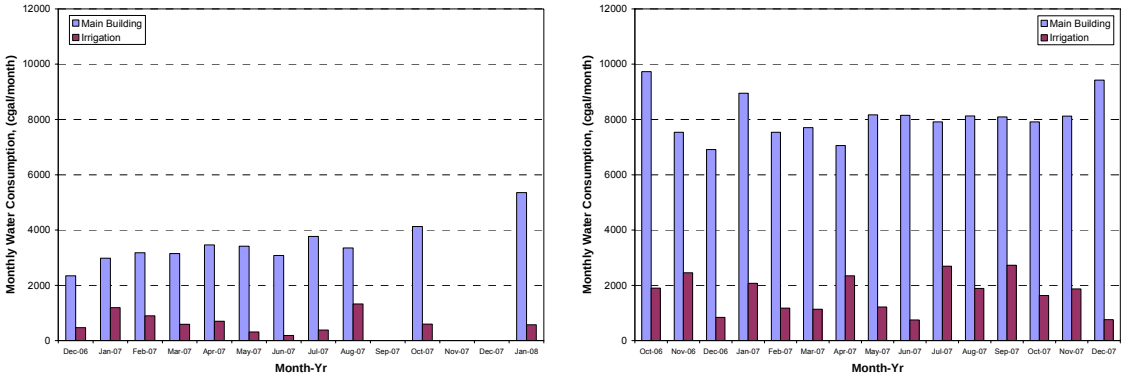
With respect to Florida-specific data, in the mid-1990s, hotels and motels in Southwest Florida used about 22,000 gallons per day on average according to a SWFWMD report (1997). More recently, the average hotel resident in Tampa, FL in 2003 was found to use 114 gpd per occupied room, with values as high as 380 gpd also recorded (White 2004). According to Angelique Bestard (Water-Use Efficiency Coordinator of the Miami-Dade Water and Sewer Department), Miami Beach uses an average of 240 gpcd (personal communication 2008). From estimates of average water use characteristics, Florida hotels typically consume as much as 63 million gallons per day of water (using 154 gpd per room), which totals up to 23 billion gallons of water per year.

Water Usage

The Raleigh averages 810 ± 78 kgal/month inside the building over the period from October 2006 to January 2008. This average has increased slightly to 893 ± 146 kgal/month after including data from January 2008 to July 2008. An additional 170 ± 69 kgal/month is used for irrigation of the grounds during the same initial time period. However this irrigation value has dropped to 129 ± 70 kgal/month after including this year's data from January 2008 to July 2008. This decline in irrigation water consumption can be attributed to the permanent water restrictions and the increased precipitation that occurred over the same period compared to the previous record drought of the preceding year. All told, this comes to an average of 360 gpd per occupied room (and if irrigation is included, the value increases to 430 gpd per occupied room). Taken as representative and projected to annual water consumption, this amounts to 11,760,000 gallons/year or approximately $86,400/year. If we include the time period from January 2008 to July 2008, the general water consumption comes out to 392 gpd per occupied room (and if irrigation is included, the value increases to 456 gpd per occupied room). The annual projected water consumption from this larger data set amounts to 12,500,000 gallons/year or approximately $93,850/year (if late penalties are subtracted out). The average monthly water bill increased from $7,190 to $8,050 by including the 2008 data, and the sewer portion of the bill increased from $3,590 to $4,130 per month. In subsequent progress reports, the research team will report on the savings obtained from implementing improvement projects related to water consumption.

The Standard averages 347 ± 77 kgal/month inside the building over the period from October 2006 to January 2008. This average has increased slightly to 446 ± 169 kgal/month after including data from January 2008 to June 2008. An additional 66 ± 36 kgal/month is used for irrigation of the grounds during the same initial time period. However this irrigation value has increased to 89 ± 58 kgal/month after including this year's data from January 2008 to July 2008. This increase is likely attributable to a combination of a leak in the water line near the meter, several major repairs to the pool area, and the fact that the grounds-keeping staff has ignored the permanent water restrictions that have been in effect for once per week watering. For the previous time period from October 2006 to January 2008, this comes to an average of 110 gpd per occupied room (and if irrigation is included, the value increases to 130 gpd per occupied room). This amounts to 4,980,000 gallons/year or nearly $69,600/year. If we count the more recent data up to July 2008 (occupancy data is not available at press time), the annual water consumption is on the order of 5,579,000 gallons/year or nearly $72,800/year (if late penalties are subtracted out). The average monthly water bill increased from $5,680 to $6,350 by including the 2008 data, and the sewer portion of the bill increased from $2,915 to $3,230 per month. In subsequent progress reports, the research team will report on the savings obtained from implementing improvement projects related to water consumption.

The water consumption data for both hotels is plotted in Figure 3. It is interesting to note that the Raleigh (Table 6) is using double the amount of water compared to the Standard (Table 7); however the Standard is paying nearly double the price for its water compared to the Raleigh. Both properties are paying additional late fees in their water bills. The Raleigh averages $225 per month (and has paid $5,000 in late fees since October 2006), and the Standard averages $580 per month in late fees. The Standard is apparently on a different fee schedule compared to the Raleigh and is paying on average $14.12/kgal per month compared to the $7.35/kgal per month at the Raleigh. For the Standard, we were able to obtain daily meter readings from the hotel staff log books, and we have found some notable discrepancies in the two months of overlapping data collected thus far. For instance, in the month of January 2008, the differences were on the order of 75,000 gallons. This needs to be investigated further with the utility provider.



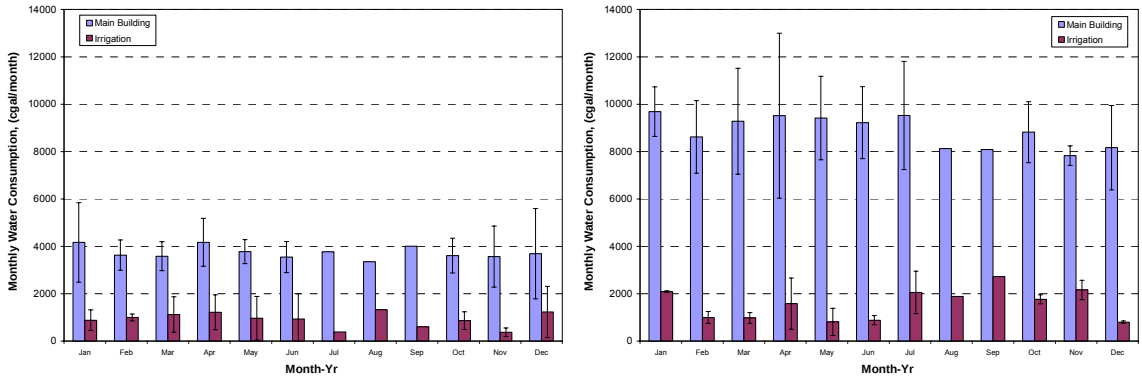


Figure 3. Water consumption data for the Standard Hotel (left) and the Raleigh Hotel (right). The top set is from October 2006 to January 2008, and the bottom set includes average data from October 2006 to July 2008.

Table 6. Water consumption statistics for the Raleigh Hotel.

	02044639 Building			09904238 Irrigation and Pool								
	Current	Previous	Usage	Current	Previous	Usage	Sewer	Storm	Water	Wstimp	Penalties	Total
Oct-2006	237911	228181	9730	191144	189246	1898	$4,135.25	$498.80	$3,244.21	$40.00	$ 567.12	$ 8,485.38
Nov-2006	245447	237911	7536	193595	191144	2451	$3,202.80	$498.80	$2,786.37	$40.00	$ -	$ 6,527.97
Dec-2006	252354	245447	6907	194434	193595	839	$2,935.48	$498.80	$2,161.13	$40.00	$ 652.79	$ 6,288.20
Jan-2007	261302	252354	8948	196505	194434	2071	$3,802.90	$498.80	$3,074.30	$40.00	$ 563.54	$ 7,979.54
Feb-2007	268835	261302	7533	197679	196505	1174	$3,201.53	$498.80	$2,429.26	$40.00	$ 579.38	$ 6,748.97
Mar-2007	276538	268835	7703	198815	197679	1136	$3,273.78	$498.80	$2,466.08	$40.00	$ -	$ 6,278.66
Apr-2007	283591	276538	7053	201162	198815	2347	$2,997.53	$498.80	$2,622.60	$40.00	$ -	$ 6,158.93
May-2007	291760	283591	8169	202381	201162	1219	$3,471.83	$498.80	$2,619.25	$40.00	$ -	$ 6,629.88
Jun-2007	299910	291760	8150	203127	202381	746	$3,463.75	$498.80	$2,481.98	$40.00	$ -	$ 6,484.53
Jul-2007	307820	299910	7910	205818	203127	2691	$3,361.75	$498.80	$2,957.68	$40.00	$ -	$ 6,858.23
Aug-2007	315945	307820	8125	207704	205818	1886	$3,453.13	$498.80	$2,793.07	$40.00	$ -	$ 6,785.00
Sep-2007	324033	315945	8088	210430	207704	2726	$3,987.38	$498.80	$3,492.92	$40.00	$ -	$ 8,019.10
Oct-2007	331942	324033	7909	212059	210430	1629	$3,899.14	$498.80	$3,080.78	$40.00	$ 801.91	$ 8,320.63
Nov-2007	340061	331942	8119	213930	212059	1871	$4,002.67	$498.80	$3,226.77	$40.00	$ -	$ 7,768.24
Dec-2007	349483	340061	9422	214691	213930	761	$4,645.05	$498.80	$3,289.11	$40.00	$ -	$ 8,472.96
Jan-2008	359910	349483	10427	216807	214691	2116	$5,140.51	$498.80	$4,051.39	$40.00	$ 847.30	$ 10,578.00
Feb-2008	369612	359910	9702	217628	216807	821	$4,783.09	$498.80	$3,398.93	$40.00	$ -	$ 8,720.82
Mar-2008	380475	369612	10863	218447	217628	819	$5,355.46	$498.80	$3,773.29	$40.00	$ -	$ 9,667.55
Apr-2008	392453	380475	11978	219263	218447	816	$5,905.15	$498.80	$4,132.46	$40.00	$ -	$ 10,576.41
May-2008	403113	392453	10660	219670	219263	407	$5,255.38	$498.80	$3,574.64	$40.00	$ -	$ 9,368.82
Jun-2008	413410	403113	10297	220688	219670	1018	$5,076.42	$498.80	$3,654.74	$40.00	$ 936.89	$ 10,206.85
Jul-2008	424546	413410	11136	222109	220688	1421	$5,490.05	$498.80	$4,055.91	$40.00	$ -	$ 10,084.76

Table 7. Water consumption statistics for the Standard Hotel.

	02043899 Irrigation and Pool			02044653 Building								
	Current	Previous	Usage	Current	Previous	Usage	Sewer	Storm	Water	Wstimp	Penalties	Total
Oct-2006	27580	26450	1130	35212	32120	3092	$ 2,280.13	$ 353.80	$ 1,812.11	$ 30.00		$ 4,476.04
Nov-2006	27824	27580	244	37869	35212	2657	$ 2,125.86	$ 353.80	$ 1,463.64	$ 30.00	$ 447.61	$ 4,420.91
Dec-2006	28291	27824	467	40215	37869	2346	$ 2,252.08	$ 353.80	$ 1,608.71	$ 30.00		$ 4,244.59
Jan-2007	29482	28291	1191	43194	40215	2979	$ 2,686.86	$ 353.80	$ 4,244.59	$ 30.00	$ 424.46	$ 7,315.25
Feb-2007	30376	29482	894	46374	43194	3180	$ 2,667.30	$ 353.80	$ 2,000.43	$ 30.00		$ 5,051.53
Mar-2007	30967	30376	591	49525	46374	3151	$ 2,645.63	$ 353.80	$ 1,901.67	$ 30.00		$ 4,931.10
Apr-2007	31665	30967	698	52985	49525	3460	$ 2,743.38	$ 353.80	$ 1,995.69	$ 30.00		$ 5,122.87
May-2007	31,978	31665	313	56402	52985	3417	$ 2,694.93	$ 353.80	$ 1,856.47	$ 30.00		$ 4,935.20
Jun-2007	32165	31,978	187	59484	56402	3082	$ 2,418.25	$ 353.80	$ 1,639.68	$ 30.00	$ 493.52	$ 4,441.73
Jul-2007	32549	32165	384	63254	59484	3770	$ 2,970.33	$ 353.80	$ 2,057.07	$ 30.00		$ 5,411.20
Aug-2007	33876	32549	1327	66604	63254	3350	$ 2,586.98	$ 353.80	$ 2,068.50	$ 30.00	$ 541.12	$ 5,580.40
Sep-2007	34481	33876	605	70614	66604	4010	$ 3,493.89	$ 353.80	$ 2,484.52	$ 30.00		$ 6,362.21
Oct-2007	35078	34481	597	74740	70614	4126	$ 3,578.69	$ 353.80	$ 2,537.49	$ 30.00		$ 6,499.98
Nov-2007	35580	35078	502	79220	74740	4480	$ 3,983.93	$ 353.80	$ 2,772.31	$ 30.00	$ 649.99	$ 7,790.03
Dec-2007	37574	35580	1994	84259	79220	5039	$ 4,608.07	$ 353.80	$ 3,663.14	$ 30.00		$ 8,655.01
Jan-2008	38147	37574	573	89615	84259	5356	$ 5,530.97	$ 353.80	$ 3,808.82	$ 30.00	$ 865.50	$ 10,589.09
Feb-2008	39251	38147	1104	93702	89615	4087	$ 3,581.15	$ 353.80	$ 2,702.86	$ 30.00		$ 6,667.81
Mar-2008	40906	39251	1655	97720	93702	4018	$ 3,938.08	$ 353.80	$ 3,114.69	$ 30.00	$ 666.78	$ 8,103.35
Apr-2008	42641	40906	1735	102604	97720	4884	n/a	n/a	n/a	n/a	n/a	n/a
May-2008	44259	42641	1618	106737	102604	4133	$ 3,986.89	$ 353.80	$ 3,134.71	$ 30.00	$ 879.73	$ 8,385.13
Jun-2008	45949	44259	1690	110745	106737	4008	$ 3,868.57	$ 353.80	$ 3,080.45	$ 30.00	$ 750.54	$ 8,083.36

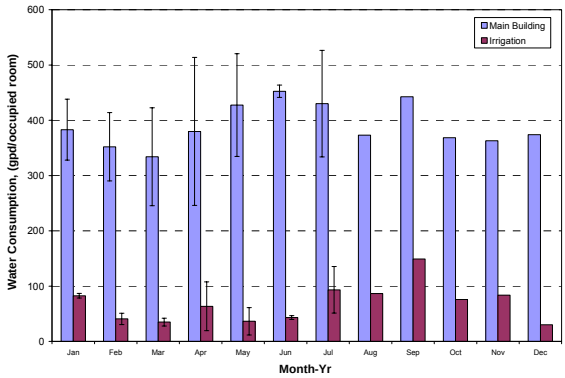


Figure 4. Water consumption data in terms of the usage per occupied room per day for the Standard Hotel (left) and the Raleigh Hotel (right).

According to the utility provider, the water rates for this service area are determined as follows:

166(b). Water in excess of subsection 110-166(a), shall be as follows: $2.21 per 1,000 gallons, effective with billings on or after October 1, 2000; $2.26 per 1,000 gallons, effective with billings on or after October 1, 2001; $2.31 per 1,000 gallons, effective with billings on or after October 1, 2002; $2.44 per 1,000 gallons, effective with billings on or after October 1, 2003; $2.49 per 1,000 gallons, effective with billings on or after October 1, 2004; and $2.54 per 1,000 gallons, effective with billings on or after October 1, 2005; and $2.79 per 1,000 gallons, effective with billings on or after October 1, 2006; and $3.23 per 1,000 gallons, effective with billings on or after October 1, 2007. This value is scheduled to increase again in October 2008.

110-168(a). Sanitary sewer service charge, shall be as follows: $3.73 per 1,000 gallons, effective with billings on or after October 1, 2000; $3.81 per 1,000 gallons, effective with billings on or after October 1, 2001; $3.90 per 1,000 gallons, effective with billings on or after October 1, 2002; $4.03 per 1,000 gallons, effective with billings on or after October 1, 2003; $4.12 per 1,000 gallons, effective with billings on or after October 1, 2004; and $4.21 per 1,000 gallons, effective with billings on or after October 1, 2005; and $4.25 per 1,000 gallons, effective with billings on or after October 1, 2006; and $4.93 per 1,000 gallons, effective with billings on or after October 1, 2007. This value is scheduled to increase again in October 2008.

Water Flowrates

Water consumption surveys were also conducted to physically measure and record actual water usage data from fixtures within each hotel. The following procedures were employed:

- Shower measurements were taken by placing a large plastic container underneath the showerhead and running the water on cold full open for 15 seconds. Water collected in the larger container was then transferred to a smaller plastic container marked to the nearest 0.25 liters.
- Sink faucet measurements were taken by inserting a 2-inch flexible plastic tube over the aerator assembly and running water for 15 seconds into large plastic container. Water

collected in the larger container was then transferred to a smaller plastic container marked to the nearest 0.25 liters.

- Toilet measurements were conducted using a T5 Flushometer. However this instrument can only be used for gravity flush tank-type toilets, not jet siphon or flushometers. Some measurements appear inaccurate, but factory calibration was confirmed. Flushometers at the Standard Hotel were avoided altogether after a couple initial trials proved unsuccessful.

A total of 19 readings were recorded at the Raleigh Hotel for faucet aerators (Table 8). The average flowrate was 3.7 gpm with a maximum of 9.8 gpm and a minimum of 1.4 gpm. Showerheads were variable as well and averaged 3.3 gpm. Bathtubs have not been tested as yet. For the most part, the Raleigh had installed newer 1.6 gpf toilets in most areas visited during testing.

For the Standard, 21 readings were taken for faucet aerators (

Table 9). The average flowrate was 4.6 gpm with a maximum of 10.8 gpm and a minimum of 0.4 gpm. Showerheads averaged 4.0 gpm, bathtubs averaged 7.5 gpm, and toilets averaged over 2.8 gpf, although most units had a 1.6 gpf rating stamped on the bowl.

Table 8. Water flowrates for various fixtures tested in the Raleigh Hotel.

RALEIGH LOCATION	Faucets gpm	Showerheads gpm	Bathtub gpm	Toilets gpf	
Coffee bar (Big sink)	2.5[a]	n/a	n/a	n/a	
Coffee bar (Small sink)	2.5	n/a	n/a	n/a	
Kitchen (Big sink)	9.1[b]	n/a	n/a	n/a	
Kitchen (Room Service sink)	2.9	n/a	n/a	n/a	
Kitchen (Small sink)	9.8	n/a	n/a	n/a	
Martini Bar	2.9	n/a	n/a	n/a	
Men's Employee Bath in Basement	3.2	n/a	n/a	nr	
Men's Guest Bath (Lobby)	4.2	n/a	n/a	nr	American Standard (1.6 gpf)
Men's Guest Bath (Lower level by pool)	2.2	n/a	n/a	nr	
Pool Bar (Hot water sink)	3.0	n/a	n/a	n/a	
Pool Bar (Men's Bath)	5.8	n/a	n/a	nr	Unmarked Two-Piece (1.6 gpf) + 2 Unmarked Urinals
Pool Bar (Women's Bath)	2.6	n/a	n/a	2.4	American Standard (1.6 gpf)
Pool Kitchen	4.2	n/a	n/a	n/a	
Room 215	2.7[a]	1.3	nr	nr	Duravit 2 piece (not listed)
Room 301	2.5[a]	7.4	nr	nr	Duravit 2 piece (not listed)
Room 306	2.4	n/a	nr	nr	Duravit 2 piece (not listed)
Room 306 (Left shower)	n/a	2.3	n/a	n/a	
Room 306 (Right shower)	n/a	2.2	n/a	n/a	
Room 306 (Hand shower)	n/a	3.2	n/a	n/a	
Women's Employee Bath in Basement	3.6[c]	n/a	n/a	1.7	Kohler Two-Piece (not listed)
Women's Guest Bath (Lobby)	1.4[a]	n/a	n/a	nr	
Women's Guest Bath (Lower level by pool)	2.4	n/a	n/a	1.6	Toto Two-Piece (1.6 gpf)
Average	3.7	3.3	n/a	1.9	

[a]Faucet aerator listed at 2.2 gpm
[b]Spray washer
[c]Fixtures visibly leaking

Table 9. Water flowrates for various fixtures tested in the Standard Hotel.

STANDARD LOCATION	Faucets gpm	Showerheads gpm	Bathtub gpm	Toilets gpf	
Woman's Employee Bathroom (2nd Floor)	7.9	n/a	n/a	2.5-3.0	Crane Two-Piece (not listed)
Woman's Locker Room (2nd Floor)	2.1[a]	1.8	n/a	1.5	Toto Two-Piece (1.6 gpf)
Men's Employee Bathroom (2nd Floor)	7.3[b]	n/a	n/a	1.7	Unmarked Two Piece (not listed)
Men's Locker Room (2nd Floor)	2.0[a]	1.7	n/a	1.5	Toto Two-Piece (1.6 gpf) + Urinal (1.0 gpf)
Room 93	1.7	2.1	n/a	nr	Unmarked Flushometer (older model)
Room 92	1.8	4.0	n/a	nr	Toto Flushometer (1.6 gpf)
Room 21	1.9	2.4	10.4	nr	Unmarked Flushometer (older model)
Mud Bath (Hose to Tub)	n/a	n/a	7.9	n/a	
Mud Bath (Rinsing Hose)	n/a	n/a	9.5	n/a	
Mud Bath (Urinating Cherub)	n/a	n/a	2.1	n/a	
Outside Bar (Small sink)	5.8	n/a	n/a	n/a	
Outside Bar (Large sink)	4.9	n/a	n/a	n/a	
Outside Grill	2.4	n/a	n/a	n/a	
Women's Bathroom by Outside Grill	9.2	n/a	n/a	nr	Toto Flushometer (1.6 gpf)
Men's Bathroom by Outside Grill	8.7	n/a	n/a	4.8-8.6[e]	Toto Flushometer (1.6 gpf) + Urinals (1.0 gpf)
Outside shower (Facing Pool)	n/a	2.1	n/a	n/a	
Outside shower (Facing Grill)	n/a	8.7	n/a	n/a	
Outside shower (Facing Restaurant)	n/a	2.5	n/a	n/a	
Large shower by hot tub	n/a	10.3	n/a	n/a	
Breezeway Bathroom (West)	2.4[a]	n/a	n/a	nr	Briggs (1.6 gpf)
Breezeway Bathroom (East)	2.6	n/a	n/a	nr	Briggs (1.6 gpf)
Kitchen (First sink)	10.8	n/a	n/a	n/a	
Kitchen (Spray washer left)	1.9[c]	n/a	n/a		
Kitchen (Spray washer right)	3.3	n/a	n/a		
Men's Bathroom (interior, restaurant)	2.7	n/a	n/a		
Women's Bathroom (interior, restaurant)	3.2	n/a	n/a	1.8	Toto (1.6 gpf)
Women's ADA Bathroom (interior, restaurant)	1.9	n/a	n/a	1.0	
Bathroom by front desk	0.4[d]	n/a	n/a	2.0	American Standard with Flush Valve
Average	4.6	4.0	7.5	2.8	

[a]Faucet aerator listed at 2.2 gpm
[b]Faucet aerator listed at 2.5 gpm
[c]Fixtures visibly leaking
[d]Fixtures visibly leaking, listed as 2.0 gpm
[e]Estimated values

The average flowrate from the Standard Hotel faucets was measured to be approximately 3.7 gpm and the flowrate from the showerheads averaged 3.1 gpm. If the flowrates can be reduced through the use of aerators and low-flow fixtures, the water consumption can be reduced to:

- 0.5 gal/min for faucets (86% reduction)
- 1.5 gal/min for showerheads (55% reduction)

This represents an estimated $21,000 annual savings from reducing the consumption by 3.5 million gallons per year. We also predict that the hotels can further reduce water consumption by 30%, and possibly up to 40% with thoughtful retrofits.

Follow-up testing of individual fixture flowrates was conducted after low flow aerators were installed in certain areas. The results of these tests are found in subsequent sections.

Low Flow Fixtures

Regarding low flow fixtures, specifically according to the FGLP this means that the faucets are using less than 2.5 gpm, the showerheads are running at less than 2.75 gpm, toilets flush at less than 1.6 gpf, and spray nozzles are used in the dishwashing areas for pre-rinsing.

Toilets and Water Closets. Toilets purchased after 1994 should be low-flow and use less than 1.6 gallons per flush to be compliant with the Florida Building Code. Depending on the year the

toilet unit was manufactured or installed, the gallons per flush can be estimated according to the data presented in Table 10. For instance, replacing all pre-1950 toilets with modern 1.6 gpf units, should save an expected 10,000 gallons per guest per year at the same occupancy rate. Put another way, if 100 guests used 1.6 gpf toilets (in place of 3.5 gpf), the estimated annual savings would be on the order of $5,800. La Quinta Inn documented that replacing all public area toilets with ultra-low flush toilets showed a payback period of 2.1 years and an annual water savings of 180,000 gallons per year (Gerston 2002). Water efficient urinals should be installed to replace models that use more than 1.0 gpf (gallon per flush), or alternatively, waterless urinal units can be installed.

Table 10. Estimated annual water use savings for toilet flushing for fixtures of different eras (Vickers 2001).

Year Manufactured	Average Toilet Water Use Rate (gpf)	Daily Use at 5.1 flushes per person per day (gpcd)	Annual Estimated Water Use (gpcy)	Potential Annual Water Use Savings (gpcy)
1994-Present	1.6	8.2	2,993	--
1977-1994	3.5-4.0	20.4	7,446	4,453
1950-1977	5.0-7.0	25.5	9,308	6,315
Pre-1950	7.0	35.7	13,031	10,038

Typical costs for water closet replacements are about $133.50 per urinal ($97.50 for materials cost; $36 for labor (unadjusted CH2M Hill 2002 estimates) and $200-$450 per toilet ($70-$150 for fixture removal and set; $100-$200 for materials cost for water closet installation; $30-$100 for labor) (adjusted CH2M Hill 2002 estimates).

The Raleigh has mostly two-piece gravity tank style systems that are generally in compliance with the 1.6 gpf criterion for low-flow. Many of the units are newer, so the need for replacement due to age is minimal (Figure 6). Flow testing revealed that the average water consumption is 1.9 gpf, indicating that the units are not operating at maximum efficiency. A leak detection program and readjustment of flush valves would assist in reducing this loss in efficiency. Another option would be to consider dual flush options or tank retrofits.

The Standard has mostly pressure-assisted flushometer style toilets (Figure 6), but during our flow testing program, we were unable to confirm the water usage. In several instances, we estimated up to 8.6 gpf in some of the older looking units. Toilet replacement with dual flush units would radically change the design style in the current bathrooms. Thus this might be difficult to implement, but should be considered as an option, particularly for rooms with the older existing flushometer models that are in the cue for replacement.

Figure 5. Typical gravity bowl one-piece toilet in the Raleigh (left). Typical gravity bowl two-piece toilet in the Raleigh (right).

Figure 6. Typical flushometer style toilet in the Standard.

Faucets, Aerators, and Spray Nozzles. Regarding faucets, Federal guidelines mandate that all lavatory and kitchen faucets and replacement aerators manufactured after January 1, 1994 use no more than 2.5 gpm measured at normal water pressure (typically 20-80 psi). Metered valve faucets manufactured after the same date are limited to 0.25 gallons per cycle. According to the Plumbing Code, commercial lavatory faucet-to-personnel ratios of 1:40 are typically used to estimate the number of fixtures required. For example, a facility with 1,000 occupants will have approximately 25 lavatory faucets (1,000/40 = 25 lavatory faucets). This factor is often used to estimate potential savings of water conservation programs. Options for water savings in this category include fixture replacement, leak detection, and installation of aerators. Water audits of commercial facilities have shown that 60% of identified water savings comes from simply installing faucet aerators in all kitchen sink outlets (NCDENR 1999). Expected savings from different types of fixtures are summarized in Table 11.

Table 11. Estimated annual water use savings for faucet fixtures of different eras (Vickers 2001).

Year Manufactured	Average Faucet Water Use Rate (gpm)	Estimated Daily Faucet Use per Person[A] (min/day)	Annual Estimated Water Use[B] (gpcy)	Potential Annual Water Use Savings[C] (gpcy)
1994-Present	2.5	(1.0) 8.1	(650) 7,391	--
1980-1994	2.7	(1.0) 8.1	(702) 8,130	(52) 739
Pre-1980	4.0	(1.0) 8.1	(1040) 11,286	(390) 4,435

[A]1.0 min/day is estimated for industrial, commercial, and institutional faucet use (Vickers 2001).
[B]Value in parenthesis is estimated for industrial, commercial, and institutional faucet use based on 260 days use per year or 71% occupancy (Vickers 2001).
[C]Estimated based on replacement with 2.5 gpm. The value in parenthesis is derived from the lower 1.0 min/day usage rate for industrial, commercial, and institutional facilities (Vickers 2001).

Typical costs for faucet retrofits are on the order of $13-$79 (CH2M Hill 2002) with low flow aerator attachment. Replacement aerators can cost on the order of $3-$33 a piece, or much less if purchased in bulk, although many utilities, such as Miami-Dade Water and Sewer Department, are offering free aerator programs. Replacement washer/gaskets are typically less than $1.00 a piece for bulk contractor packages. Since the upfront costs are minimal and since both participating hotels have issues with faucet flow rates, aerator replacement is recommended for both properties (Figure 7). For the Raleigh, several of the public use restrooms and the kitchen areas had leaky faucets (Figure 8). These areas should be excellent candidates for automatic shut off style faucets. At the Raleigh, approximately 50 of the 0.5 gpm aerators were provided by Miami-Dade County for installation in the public areas. It was interesting to note, that many of the aerators were removed by employees after they were installed. Since the original 2.2 gpm aerators were stored in the engineering office, those faucets then ran without aerators, thereby increasing the water consumption rather than decreasing it. This phenomenon is discussed further below. At the Standard, the pool area restrooms may also be good candidates for automatic shut off style faucets to replace the old style aerator-less gooseneck fixtures. In public restrooms, timed shutoff valves can be installed in the faucets. These valves cut off water flow after a short period of time. An accounting of the faucets in the Standard revealed that approximately 130 aerators would be required to completely convert the hotel to low flow. However, back in July 2008, 30 free 0.5 gpm aerators were provided by Miami-Dade County, but none were ever installed.

Figure 7. Many faucets at the Raleigh did have 2.2 gpm aerators installed as shown (right and left).

Figure 8. Leaking faucet fixture in one of the janitorial closets at the Raleigh (left and right).

Kitchen faucets can waste large amounts of water too, as they are one of the most heavily used water sources in the kitchen. One way to save water is to install pedal-operated faucet controllers to ensure that valves are closed when not in use. Commercial kitchen low-volume, automatic shut-off nozzles typically cost $20-$80. By installing a foot-actuated faucet, one food service facility in North Carolina reduced its monthly water usage by 3,700 gallons; an annual savings of nearly $700 (NCDENR 1999). Another way is to install infrared or ultrasonic sensors that activate water flow. Commonly, rubber gaskets wear out and deform because of the high volume of hot water use. By installing a brass gasket and an automatic shutoff nozzle, a facility could save as much as 21,000 gallons of water per year (NCDENR 1999). Merely replacing spray nozzles with the newer 1.6 gpm models (versus the older 3-4 gpm nozzles) can save 50,000 gallons of water per year and nearly 2000 kWh of electricity per year (White 2004), while saving $50-$70 per month, on a typical 3 hour/day usage pattern (West 2006). The Raleigh has 1.42 gpm pre-rinse spray nozzles in the kitchen, but the Standard may benefit from installing a low flow pre-rinse spray nozzle in the grill area similar to the one found in the main kitchen (Figure 9).

Figure 9. Spray rinse nozzle in the main Standard kitchen area.

Implementation Project: Aerators/Nozzles. In August 2008, the Raleigh hotel obtained 50 of the 0.5 gpm aerators from the Miami-Dade Water and Sewer Department to be installed in the public areas and also several spray wash nozzles for the kitchen. The Standard Hotel is in the process of obtaining a similar number of faucet aerators and spray nozzles as of September 2008.

On August 11, 2008, at the Raleigh Hotel, Dean Frankel (summer intern) and Lanette Sobel (senior project liaison) made repeat measurements of the water flow of the aerators in the public spaces in the Raleigh Hotel (Table 12).

Table 12. Water flowrates tested in the Raleigh Hotel before and after installation of faucet aerators.

	Aug-08	Jul-08	Notes
	gpm	gpm	
Coffee bar (Big sink)	2.3	2.5[a]	Needs large aerator
Coffee bar (Small sink)	2.1	2.5	
Kitchen (Big sink)	9.1	9.1[b]	No aerator
Kitchen (Small sink)	7.3	9.8	No aerator
Martini Bar	0.7	2.9	
Men's Employee Bath in Basement	0.6	3.2	
Men's Guest Bath (Lobby)	16	4.2	No aerator
Men's Guest Bath (Lower level by pool)	2.2	2.2	Still has original 2.2 gpm aerator
Pool Bar (Hot water sink)	8.2/2.2	3.0[c]	0.5 gpm aerators were removed; one replaced with original 2.2 gpm and two with no aerator
Pool Bar (Men's Bath)	6.9[d]	5.8[d]	Still leaking and no aerator
Pool Bar (Women's Bath)	2.3/7.2		Original aerator removed in one of four faucets
Women's Employee Bath in Basement	0.7	3.6[d]	
Women's Guest Bath (Lobby)	0.6	1.4[a]	
Women's Guest Bath (Lower level by pool)	2.1	2.4	
Kitchen basement Fan jet spray, on right	1.7	n/a	
Kitchen basement Fan jet spray, on left	1.6	n/a	
Kitchen upstairs, fan jet spray	1.7	n/a	
Average	**4.0**	**4.0**	

[a]Faucet aerator listed at 2.2 gpm

[b]Spray washer

[c]Hot water only

[d]Fixtures visibly leaking

It is interesting to note that before the installation of the new faucet aerators, the average flow readings for these areas was computed to be 4.0 gpm, and after the installation of the new faucet aerators, the average flow readings also came out to 4.0 gpm. It was discovered that the pool bartenders had removed 2 of the 3 aerators, almost immediately after they had been installed. When asked why, the two bartenders, who claimed that another bartender was responsible for removing the aerators, said that the water flow rate from the faucets with the aerators was insufficient for their needs, as they require a fast water flow to rinse the pitchers and other bartending glassware and tools. This is particularly important when the bar is busy. When asked

why the third aerator was not removed as well, they admitted that they did not use that sink very often, so the aerator was not a problem. When the original aerator was inspected, it was found that prior to installing the low flow 0.5 gpm aerator, a 2.2 gpm aerator was in its place, but now the fixture was without an aerator of any kind.

A demonstration was performed for the two bartenders to measure the amount of water coming out of the faucet with the 0.5 gpm aerator in place. A volume of 520 mL in 15 seconds (0.5 gpm) was recorded. After removing the aerator completely, the volume of water generated in 15 seconds was again recorded. The bartenders were asked to guess how much water was collected. The bartenders estimated that there would be up to 2 full graduated cylinders (2000 mL/cylinder) or a total of 4000 mL. After 2 cylinders were filled and there was still more water to be measured, they adjusted their estimates to 3. The bartenders were shocked to discover that the final volume measured was 7860 mL, almost 4 full graduate cylinders. The bartenders were then asked if the 2.2 gpm aerators (measured at 2080 mL in 15 sec) were effective enough for their purposes and if they would agree to use them if we provided 2 more to replace the 0.5 gpm aerators. They very much agreed. **It might be beneficial to install fan jet spray washers or foot pedal-operated spray nozzles in the pool bar area in the future, so that the bartenders have the speed of delivery necessary to complete their tasks quickly without wasting water.**

The bartenders then asked what would happen, if during the designation visit, the assessors were to discover that the aerators had been removed. It was explained to them the hotel would not be given their One Palm designation due to that action, even if the hotel passed everything else. They seemed shocked.

Showerheads and Bathing Fixtures. Regarding showerheads, substantial amounts of water and energy can be wasted through use of inefficient faucets and showerheads. For instance, a brief five-minute shower can consume 15-35 gallons of water with a conventional showerhead with a flow rate of 3-7 gpm. To be certain, showerheads are found in all the residential facilities (guest rooms) of a hotel, although it is not uncommon to find a few shower facilities in the pool/cabana areas and also in the maintenance (safety showers) or administrative areas (locker rooms) of the lodging facility. Expected savings from different types of showerheads are summarized in Table 13.

Showers and baths account for about 30% of the water use in a typical bathroom (Vickers 2001). Replacing showerheads that use 3.0 gpm or more with more modern units that use 2.5 gpm or less can make a significant difference in the amount of water used per room. The payback period can be on the order of 3-4 years depending on the extent of the project (Alexander 2002). Replacing showerheads will not only save water, but also the cost of heating water. In a recent case study, La Quinta Inn installed low-flow shower heads and aerating faucets in each guestroom, resulting in a savings of $1.50 per room per month. As a case study, the THC Rotorua Hotel in New Zealand installed low-flow shower heads at a cost of $3,060 for the entire property. The annual savings from water conservation alone came to $5,244, with a payback of only seven months.

Table 13. Estimated annual water use savings for showerhead fixtures of different eras (Vickers 2001).

Year Manufactured	Average Water Use Rate (gpm)	Estimated Daily Shower Use per Person[A] (min/day)	Annual Estimated Water Use[B] (gpcy)	Potential Annual Water Use Savings (gpcy)
1994-Present	2.5	5.3	4,863	--
1980-1994	3.0	5.3	5,803	940
Pre-1980	7.0	5.3	13,541	8,678

[A]The average residential indoor water-use rate for showering has been reported to be 8.2 minutes per shower; however, on a daily basis, a total of 11.6 gallons per capita is used for showering at an average flow rate of 2.2 gpm, or 5.3 minutes per capita per day for showering (Vickers 2001).
[B]Values have not been adjusted for industrial, commercial, and institutional shower use or occupancy rate (Vickers 2001).

Typical costs for showerhead replacement are on the order of $34-$75 a piece (CH2M Hill 2002). For the Raleigh, the showerheads in the guest room appeared to be generally older models with caked on scale caused by locally hard water (Figure 10). These appear to be ready for replacement anyway. Therefore, showerhead replacement is recommended. At the Standard, most of the guest rooms are equipped with ultra-luxury decorative downpour style showerheads that are mounted directly overhead (Figure 10). Furthermore, the hotel is operating a supplementary water softening system (more on this later). This has the unintended effect of reducing the hardness to such low levels that the shower user feels as if he/she cannot get the soap off; therefore, using much more water for rinsing and lengthening the duration of showers. In addition, the east wing of the hotel has outdoor bathtubs in the porch areas of each guest room unit as well as showers inside. Opportunities abound for shower/bath tub fixture upgrades at the Standard.

Figure 10. Typical showerhead in the guest rooms at the Raleigh (left). Note that the high hardness in the water has led to visible scaling. Typical downpour style overhead shower fixture at the Standard (right).

Low Flow Appliances

There are many ways to reduce water usage in the kitchen and food service areas of a hotel. For instance, a typical 125-seat restaurant serving 225 meals per day uses about 200,000 gallons of water per year (Hinton et al. 2004). Case histories have shown that water efficiency programs are cost-effective, and most initial costs are retrieved within a two-year period (NCDENR 1999). Other plumbing fixtures of interest for potential water conservation are dishwashers and ice machines. The following water conservation opportunities exist in the kitchen area:

Dishwasher options. All dishwashing machines employ wash, rinse, and sanitizing cycles. There are four main types of dishwashing machines: undercounter, door, conveyor, and flight. Requirements for machine size can be calculated by estimating the amount of traffic that will be served in the food service area. Commercial dishwashers use approximately 1.0-1.5 gpm, while conventional rack washers use 9-12 gallons per cycle. Newer units use only 0.75-2.5 gallons per rack (NCDENR 1999). Undercounter washers use the most water, and conveyor types use the least amount of water. Energy efficient, low flow conveyor washers can reduce water consumption by 43% (NCDENR 1999). An Energy Star® dishwasher saves about $100 over its lifetime, mostly from using less hot water than conventional models. Energy guidelines and water consumption levels for dishwashers are continuing to tighten, and manufacturers are offering more water-saving models. Using an appropriately sized, water efficient model will save a significant amount of water. Other important water saving measures with dishwashers include: 1) Hand wash or scrape without using water prior to loading dishes; 2) presoak items in basins of water instead of using running water; 3) run dishwashers only when full; 4) recycle final rinse water for washing; 5) install electric eye sensors to allow water flow only when dishes are present. In Boston, MA, a dishware-sensing gate saved an estimated 225,000 gallons per year ($2700), and at a cost of only $1200, this measure paid for itself in only 3 months (Vickers 2001); 6) install door switches for convenient on/off access; 7) use steam doors to prevent water loss due to evaporation; 8) install low-temperature machines that rely on chemical sanitizing over high water temperature; and 9) reuse gray water. Gray water is rinse water that is not contaminated with chemicals. This can be used to water plants and supplement city water for irrigation. Water from steam tables and used ice are excellent candidates for reuse.

The Raleigh recently purchased a new dishwasher system that was claimed to use a pre-rinse cycle from the previous post-rinse cycle. The item was in the process of installation at the time of the last walkthrough, so this information will be confirmed.

Water-conserving icemakers. Standard icemakers use water to remove heat. However, newer systems employ an air-cooled instead of a water-cooled unit. Air-cooled machines use air rather than water as the heat sink, saving from $50-100 per month (Gerston 2002) and about 1.5 million gallons of water annually (CDPHE 2002). In single-pass (or once-through) cooling systems, water is circulated once through a piece of equipment and then disposed of down the drain. If the machine has two lines going to the floor drain, then it is a water-cooled system, which can use 800 gallons per day just for cooling the coils and 125-300 gallons per 100 lb ice (NCDENR 1999). This is ten times more water than air-cooled systems. Newer air-cooled units pay for themselves within a short time by eliminating the cooling water for the coils, valued at about $120-$170 per month. For instance, ice machines with water-cooled condensers employing once-through cooling water use about 149 gallons of cooling water per hundred pounds of ice, and since medium-use machines produce almost 400 pounds of ice daily, for a daily total of almost 60,000 gallons of water per day, according to Rick Fischer of Manitowoc Equipment Works (cited in Gerston 2002), there is considerable opportunity to achieve water savings. To improve the efficiency of single-pass cooling equipment: 1) add an automatic control to shut off the system during low usage times by installing a solenoid valve to cut off once-through cooling water when the compressor is not running. Installing a $200 solenoid valve on a 400-pound ice machine would render an immediate payback and a water savings of 1.9 million gallons per year (Gerston 2002); 2) modify the unit to operate on a closed loop that re-circulates water instead of discharging it; and 3) find an alternate use for the once-through effluent, either in boiler make-up supply or for landscape irrigation.

Laundry Facilities

Regarding the laundry facilities, both properties have a modest sized laundry on site to handle a portion of the towel washing and perhaps napkins from the restaurant areas as well. The linens, employee uniforms, and many times towels and napkins (especially during events) are contracted out. As part of the information gathering process, it was determined that both hotels participate in a linen reuse program, but the Raleigh has not implemented a towel reuse policy as yet due to perceived issues with beach/pool usage regarding suntan lotions/oils and make-up caking on used towels. The Standard does have an existing towel reuse program. Both hotels participating in the study have unique placards to inform guests of the linen reuse policy (Figure 11). In addition, the contract laundry service records were obtained to quantify the amount of pounds of linens that are dealt with on a daily basis. The records for both facilities have been obtained are in the process of being analyzed at press time. Remaining data to be collected and analyzed include the appliance information and seasonal variability in loading. **The laundry services both on site and off site will be evaluated further as a potential source of water conservation savings**.

Figure 11. Guest room placards notifying guests about the linen reuse program for the Raleigh (left) and the Standard (right).

A linen reuse program that launders bed linens and towels every third day of a guest's stay, unless requested otherwise by the guest, can save lodging facilities up to 30% on water usage and up to $1.00-1.50 per night, per occupied room, on laundry expenses (Hinton et al. 2004). The American Hotel and Motel Association, which represents over 12,000 lodging facilities in the United States, enacted the "Good Earthkeeping" campaign for reusing guest linens and towels, and this program has been enormously successful. Thus an average-sized hotel of 150 rooms can save about $300,000 per year in only 65% of the guests participate in linen reuse (Vickers 2001).

To establish a linen reuse program, the guests must be informed and given the opportunity to "buy in" to the program. Informational cards should be made available in the guestrooms and bathrooms stating the linen reuse policy. By choosing not to replace bath towels and linen daily, 13.5 gallons of water can be saved per day per guest (PDEP 2000) or up to $6.50 per day (Bujak and Goren 2005). A large San Diego luxury hotel with 400 rooms and over 106,000 room-nights occupied per year saved $118,930 per year with their linen reuse program (Solana Recyclers, Inc. 1999). According to the Texas Water Resources Institute (Gerston 2002), institutional washing machines use about 2.5 gallons per pound of linen laundered. Depending on type of lodging and other factors, such as proximity to the beach, linen use is estimated at 8-12 pounds per day per double occupancy room. Most hotels that have a linen reuse policy only change

sheets every three days unless the guest requests that the sheets be changed or the housekeepers notice that the sheets need changing. Towels that are hanging on the racks should not be changed; only bathroom towels that are on the floor should be replaced.

Another option is to replace obsolete appliances with Energy Star® units, which save water as well as energy. The initial cost is typically higher, but the life cycle costs are substantially lower. For example, full-sized Energy Star® washers use 18-25 gallons of water per load, compared to the 40 gallons used by standard machines. They do this by extracting more water from the load during the spin cycle. This reduces the drying time and saves energy as well as delaying deterioration of linens. Newer top-loading models look like conventional machines from the outside, but use less water and less energy. Many have sensors to monitor incoming water temperature closely. They also rinse clothes with repeated high-pressure spraying instead of soaking them in a full tub of water. Front-loading models are similar to machines used in laundromats. They use a horizontal or tumble-axis basket to lift and drop clothing into the water instead of rubbing clothes around a central agitator. Both top-loading and front-loading Energy Star® qualified washers save water and energy. They also use faster spin speeds to extract more water from clothes, reducing drying time and energy use. An Energy Star® qualified clothes washer saves about $100 over its lifetime (Hinton et al. 2004). Most of the savings comes from using less hot water than conventional models. Large conventional washer-extractor machines use fresh water for each wash and rinse cycle without internal recycling. The capacity of these units range from 25-400 dry pounds per load, requiring 2.5-3.5 gallons of water per pound of laundry. Coin operated machines (16-pound) are slightly larger than residential units (14-pound) and use 35-50 gallons of water per load (Vickers 2001). A Doubletree Hotel in Portland, OR, installed a $200,000 laundry water recovery system consisting of a pumped closed-loop, three-phase microfiltration and recycling system. The older system heated water to 150°F and then discharged it after one use. The new system recycles the warm water through a screen and a microfiltration unit and returned to the washers for another use. In total, this system saves $40,000 per year in water, sewer, and electric bills, paying back the initial costs in less than 5 years (Vickers 2001). Additional water saving options for laundry facilities include: washing loads at full capacity, adjusting water levels for short loads, investigating the recycling of gray water for irrigation purposes, reporting leaks and responding promptly, and replacing washers with front loading systems (Defranco and Weatherspoon 1996). For example, washing only full loads provides immediate payback with no upfront costs.

The Raleigh (Figure 12) and the Standard (Figure 13) have modest laundry facilities that appear to have newer appliances.

Figure 12. Laundry facilities on site at the Raleigh Hotel.

Figure 13. Laundry facilities on site at the Standard Hotel.

Implementation Project: Towel/linen reuse. The benefits of linen and towel reuse programs can be quantified by the amount of laundry reduction, amount of labor time on room cleanup reduction, water savings, electricity savings, amount of detergent reduced, and amount of sheet/towel replacement reduced. For example, at 80% occupancy, a Southwest Florida hotel with 100 rooms saved 87,272 gallons of water, 581 gallons of detergent, and $26,718 in energy costs, water bills, detergents, labor, and sheet/towel replacement (White 2004). If this strategy is selected, the FAU research team will monitor for these items. The Raleigh Hotel has printed special cards to inform the guests about their new towel/linen reuse program to be implemented shortly in October 2008. The Standard Hotel has implemented this program prior to 2008. Monitoring will begin shortly with the analysis of off-site laundry services records.

Sub-Metering

Irrigation systems also can be metered and set to deliver a specified amount of water. Both the Raleigh and the Standard currently have sub-metering installed on the irrigation/pool systems to help reduce the sewer charge on the water utility bill. The Raleigh Hotel has been sub-metering its irrigation and pool systems since prior to October 2006, and from that point until July 2008, the

hotel has averaged $671 savings per month and at least $14,760 since October 20006. The Standard Hotel has also been sub-metering its irrigation and pool systems since prior to October 2006, and from that point until June 2008, the hotel has averaged $432 savings per month and $9,070 since October 20006. This savings will continue to increase because each October, the sewer charges are set higher from the previous year's value.

Table 14. Summary of savings from using the sub-metering program for the pool/irrigation system at the Raleigh Hotel.

Month-Yr	One Meter	Sub-Metering	Savings
Oct-2006	$ 8,186.11	$ 7,379.46	$ 806.65
Nov-2006	$ 7,030.85	$ 5,989.17	$ 1,041.68
Dec-2006	$ 5,453.18	$ 5,096.61	$ 356.58
Jan-2007	$ 7,757.38	$ 6,877.20	$ 880.17
Feb-2007	$ 6,129.73	$ 5,630.78	$ 498.95
Mar-2007	$ 6,222.66	$ 5,739.86	$ 482.80
Apr-2007	$ 6,617.60	$ 5,620.13	$ 997.48
May-2007	$ 6,609.15	$ 6,091.08	$ 518.08
Jun-2007	$ 6,262.78	$ 5,945.73	$ 317.05
Jul-2007	$ 7,463.10	$ 6,319.43	$ 1,143.68
Aug-2007	$ 7,047.74	$ 6,246.19	$ 801.55
Sep-2007	$ 7,613.06	$ 6,454.51	$ 1,158.55
Oct-2007	$ 7,783.01	$ 6,979.91	$ 803.10
Nov-2007	$ 8,151.84	$ 7,229.44	$ 922.40
Dec-2007	$ 8,309.33	$ 7,934.16	$ 375.17
Jan-2008	$ 10,235.09	$ 9,191.90	$ 1,043.19
Feb-2008	$ 8,586.77	$ 8,182.02	$ 404.75
Mar-2008	$ 9,532.51	$ 9,128.75	$ 403.77
Apr-2008	$ 10,439.90	$ 10,037.62	$ 402.29
May-2008	$ 9,030.67	$ 8,830.02	$ 200.65
Jun-2008	$ 9,233.04	$ 8,731.17	$ 501.87
Jul-2008	$ 10,246.51	$ 9,545.96	$ 700.55
Savings to date			**$ 14,760.95**
Average monthly savings			**$ 670.95**

Table 15. Summary of savings from using the sub-metering program for the pool/irrigation system at the Standard Hotel.

Month-Yr	One Meter	Sub-Metering	Savings
Oct-2006	$ 2,972.29	$ 2,492.04	$ 480.25
Nov-2006	$ 2,042.30	$ 1,938.60	$ 103.70
Dec-2006	$ 1,980.35	$ 1,781.88	$ 198.48
Jan-2007	$ 2,935.68	$ 2,429.51	$ 506.18
Feb-2007	$ 2,868.10	$ 2,488.15	$ 379.95
Mar-2007	$ 2,634.37	$ 2,383.19	$ 251.18
Apr-2007	$ 2,927.23	$ 2,630.58	$ 296.65
May-2007	$ 2,625.92	$ 2,492.90	$ 133.03
Jun-2007	$ 2,301.38	$ 2,221.90	$ 79.48
Jul-2007	$ 2,924.42	$ 2,761.22	$ 163.20
Aug-2007	$ 3,292.61	$ 2,728.63	$ 563.98
Sep-2007	$ 3,248.96	$ 2,991.84	$ 257.13
Oct-2007	$ 3,853.97	$ 3,559.65	$ 294.32
Nov-2007	$ 4,065.31	$ 3,817.83	$ 247.49
Dec-2007	$ 5,738.93	$ 4,755.89	$ 983.04
Jan-2008	$ 4,838.06	$ 4,555.58	$ 282.49
Feb-2008	$ 4,235.86	$ 3,691.58	$ 544.27
Mar-2008	$ 4,629.17	$ 3,813.25	$ 815.92
Apr-2008	$ 5,401.10	$ 4,545.75	$ 855.36
May-2008	$ 4,692.82	$ 3,895.14	$ 797.67
Jun-2008	$ 4,649.57	$ 3,816.40	$ 833.17
Savings to date			**$ 9,066.90**
Average monthly savings			**$ 431.76**

HVAC Improvements

Another major opportunity to achieve water savings involves the cooling and heating systems of the lodging facility. Cooling towers use significant amounts of water to operate air conditioning and refrigeration systems. Although cooling towers use 90-95% less water than single-pass cooling systems (Vickers 2001), they are still likely to be a large water user in the overall scheme of a lodging facility. Cooling towers lose water by evaporation, blowdown, or drift and other losses. Thus the system must be replenished by consuming make-up water. In quantitative terms, evaporative losses consume 1-3% of the circulated water. Actually increasing the evaporative effect, increases the cooling effect, but mist eliminator systems can limit the amount of water lost to the air stream. Evaporation typically occurs at 1% of the recirculating flow for every 10°F temperature drop, depending on amount of cooling and ambient weather conditions. This amounts to 2.4 gpm per 100 tons of cooling (Vickers 2001). Evaporated water leaves behind suspended solids that concentrate in the recirculating water flow. This high TSS/TDS water can damage the process piping through scaling, biofouling, and corrosion. Thus this water must be drained off and replaced with make-up water. The amount of bleed-off and make-up water is expressed as the concentration ratio or cycles of concentration. This value, which ranges from 1.0 to 12, indicates the number of times the water is passed through before it is discharged. The water quality (TDS) of the recirculating water can be checked for conductivity, and discharge is then triggered when a preset value is reached. For example, a 120-ton cooling tower in Boston,

MA generated excessive bleed-off because make-up water was added at a constant 4.0 gpm instead of as-needed. Installation of a conductivity controller unit reduced the flow of make-up water by 75% and $14,400 per year, reducing the annual water demand by 1.6 million gallons at a cost of $3500 (Vickers 2001). In most cooling tower systems, the cost of water is typically not as significant as the cost of the energy, but substantial reductions in water consumption are possible with the modifications described herein.

Monitor boilers and cooling towers to insure optimal efficiency. Boilers and steam generators use large quantities of water to make up for amounts lost to leaks and blowdown. Typically, cooling tower water use is minimized in January and maximized in July (West 2006). Reductions in the amount of make-up water are typically achieved by increasing the concentration ratio. For instance, adjusting the concentration ratio from 1.5 to 9 will result in 63% savings in water use (Vickers 2001). An equation was developed to predict the amount of water saved by altering the concentration ratio from the initial level (CR_o) to a new higher level (CR_n) (Kobrick and Wilson 1993):

$$\%\ \text{conserved} = \frac{(CR_n - CR_o)}{CR_o(CR_n - 1)} \times 100\%$$

Use a blowdown meter. In a cooling tower, water is lost through the evaporative cooling process. To replace lost water and maintain cooling function, make-up water must be added. A meter can track the amount of water that is actually discharged as it goes to the cooling tower. Since 90% is lost to evaporation, the facility will only pay for the blowdown water that was discharged not the total amount of make-up water. In this manner, installing make-up and blowdown meters for cooling towers will likely lead to substantial savings in utility bills (CH2M Hill 2002), even if water usage remains the same.

Preventative maintenance plan. Proper maintenance and monitoring of operations can greatly improve boiler/cooling tower efficiency. For instance, a routine inspection and maintenance program for steam traps, steam lines, and condensate pumps can reduce water losses from 15-30% down to just 5% or less (Vickers 2001). Every two weeks, a flue gas analysis on the boiler to test fuel to air ratio settings should be conducted to adjust air to fuel ratio to optimize efficiency. Another cost incurred is related to the chemical agents required to treat the water used in these systems. This can also be an opportunity for reduction in water consumption through the use of more concentrated chemicals, for example.

Implementation Project: The Raleigh Chiller Upgrade. The Raleigh is replacing the central chiller system with a similar design by Evapco Cooling Systems (Figure 14).

Figure 14. Brief information on the new chiller unit to be installed at the Raleigh.

This major capital improvement will be replacing the pan, the casing, the steel support structure, the fan motors, the drive systems, the axial propeller fans, the fan shaft bearings, the cooling tower fill, the water distribution system, the eliminators, the air inlet louver screens, and protective coating finish. This project is desperately needed as the existing unit is in a condition beyond salvaging (Figure 15). The electrical controls will also be replaced. Installation occurred in August 2008, after permits were secured to have the crane remove the existing unit and install the new one on the roof. However, shortly after installation it was discovered that the new unit was not constructed of stainless steel as specified (it was cast iron, which is expected to corrode more

rapidly in a saltwater environment). Therefore, the hotel and the vendor are currently under negotiations to replace the newer unit. As of September 2008, the air handler in the lobby is off-line as well, and many other minor issues associated with the air conditioning system are plaguing the Raleigh and forcing certain rooms to be taken out of service. The successful resolution of this situation is the top priority of the hotel management and staff.

Figure 15. State of disrepair of the Raleigh roof chiller unit (June 2008). Top left: existing unit. Top right: extreme corrosion has taken its toll on the drive motors. Middle left and right: evidence of extreme amounts of water leakage over the sides and through the bottom of the pan. Lower left: algal growth, extreme corrosion,

and ponding underneath the evaporative cooling system. Lower right: blowdown meter not in working condition and located in an unreadable position as well.

An additional recommendation from the water conservation standpoint is to modify the scope of work to include sub-metering of the make-up water, blowdown, and water treatment systems. A closer inspection of the proposed water treatment system reveals that dual biocides (reactive organosulfur and chlorine bleach-based compounds) and scale and corrosion inhibitors (orthophosphate-based) are being proposed. The MSDS for the proposed water treatment chemicals reveals that it is likely that more eco-friendly products can be substituted for the manufacturer recommended chemical formulas. In fact, one of the vendor partners, Antrac, is still trying to convince the engineering staff to switch to more eco-friendly chemical treatment by offering a price incentive that is less than the existing service. It is likely that once the new chiller system installation is resolved, the hotel will eventually switch to Antrac's green water treatment products for scale and biofouling control.

Individual room units are heat pump systems. A typical unit label is shown in Figure 16. It is likely that the Raleigh will consider phasing out heat pump systems in favor of other technologies including split type or PTAC units.

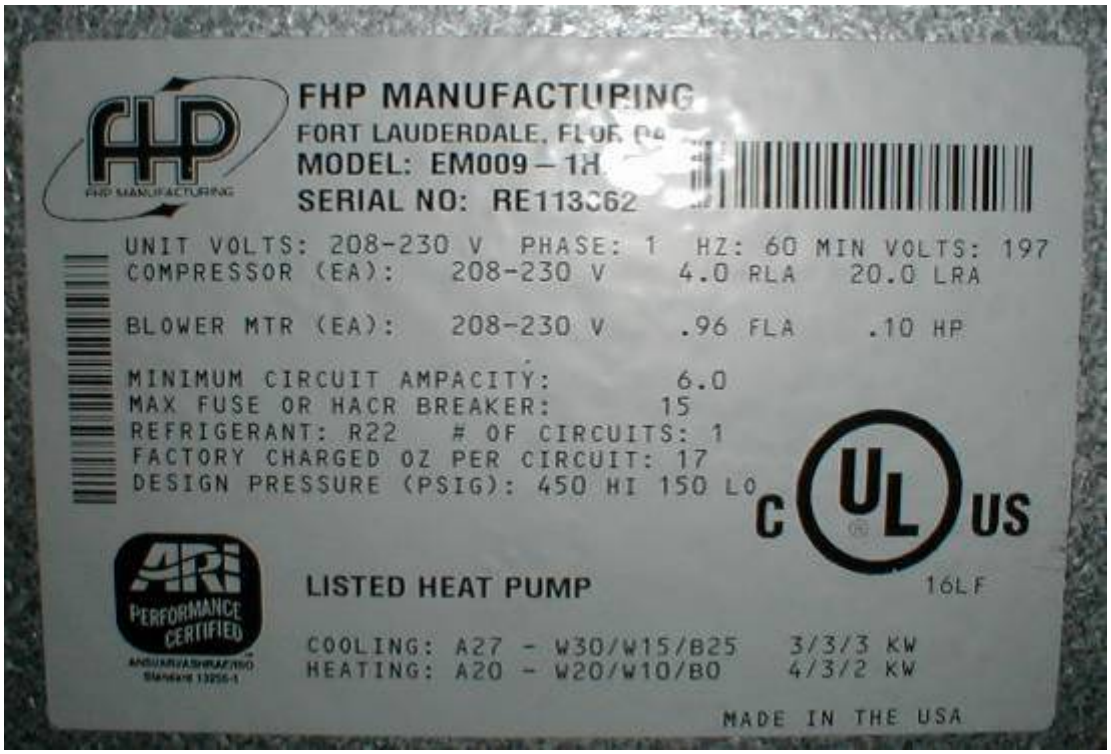


Figure 16. Typical heat pump unit label from the Raleigh.

Figure 17. Typical heat pump unit in one of the Raleigh guestrooms.

By contrast, the Standard Hotel currently uses an air-cooled chiller-heat exchanger roof mounted system for its HVAC needs. The system appears to be functioning at optimum efficiency and appears relatively new. The Standard is also in preliminary design stages for a major plumbing replacement to begin in this fiscal year. This will be a fantastic opportunity to install sub-metering to maximize zonal control of water usage.

Figure 18. Air-cooled chiller heat-exchanger roof mounted HVAC unit at the Standard.

Irrigation/Landscaping

The volume of water typically used for lawn and landscape irrigation in hotels is not well documented. Extrapolating typical irrigation demands in Florida residential areas to hotels would likely lead to gross exaggeration. Outdoor water use in South Florida can be on the order of 30-50% of the total demand. However, estimates from studies in Tampa and Pinellas County, show that on a per capita (guest) basis, the percentage is extremely low, on the order of 2-7% (West 2006). Landscaping use is likely to be variable, depending highly on the area, plant types, climate, rainfall, water costs, maintenance practices (i.e. frequency of sidewalk cleaning), and the number of golf courses, swimming pools, and fountains. There are many available water-saving landscape options designed to promote water conservation:

Xeriscaping. This term, coined by the Denver Water Company to promote water conservation, refers to the art of minimizing water usage for irrigation by proper planning and design, soil analysis, selecting appropriate plants (drought-tolerant or native species), selecting practical turf areas, operating efficient irrigation schedules and systems, use of moisture-retaining mulches, and appropriate maintenance programs. Water-Wise is a water use efficiency program developed by the USEPA to promote conservation efforts like xeriscaping. More information on this program can be obtained by visiting www.epa.gov. The Florida Yards and Neighborhoods Program was developed by the University of Florida Institute of Food and Agricultural Sciences Extension (IFAS Extension) to promote conservation of water, reduce storm water runoff, decrease non-point source pollution, enhance wildlife habitat, and create beautiful landscapes (http://hort.ufl.edu/fyn/object.htm).

Both participating hotels offer some limited areas of xeriscaping. The Raleigh has sandy areas poolside as a transition to the beachfront of the property, and the Standard has patio rock gardens on the west wing. In order to promote Florida-Friendly Landscaping, several measures are recommended:

1. **Efficient watering**. The most straightforward method of minimizing water consumption is to carefully design a landscape that receives sufficient amounts rainfall to thrive, while requiring minimal amounts of supplemental irrigation water. For instance, a lawn in full sun will require more frequent irrigation than a plant bed of drought-tolerant shrubs and groundcovers under a canopy of shade. However, even an ideal landscape can be over-irrigated. Therefore, care must be exercised in irrigation scheduling. If watering is necessary, grounds should not be watered during the daylight hours to reduce evaporative losses; soaker hoses should be used in place of sprinklers; hose connections should be checked for leaks; trees and flower beds should be mulched; and sidewalks, driveways, and parking lots should be swept instead of hosed down (Defranco and Weatherspoon 1996).

The most efficient irrigation methods should be employed. Sprinklers should be used for lawns, bubblers for trees, drip irrigation for gardens and shrubs, and soaker hoses for flower beds and ground covers. Wherever possible, trickle, drip, or soaker hose irrigation systems should be used because they consume less water than sprinklers. For instance, drip irrigation requires 1 gallon of water per hour per foot of irrigation line, while sprinklers use up to 3 gallons per minute. Also, drip lines are close to the roots of the plants, therefore do not allow for evaporation of the applied water. On the other hand, sprinklers create puddles, which evaporate, and water can be lost with the effects of wind and heat. If sprinklers are used, select slow releasing heads, close to the ground, in contrast to those that release a mist, which tends to evaporate more easily. Place sprinklers at the top of sloped areas so that the water that runs off ends up irrigating the entire slope. Heads should be aligned with the areas that they are intended to water. Always check when irrigation systems are operating to insure they are not watering sidewalks and driveways.

Irrigation times. The best time to irrigate is during the early morning or early evening hours when temperatures and wind velocities are at their lowest. Water evaporates quickly during the daylight hours, and during windy conditions, water may not reach targeted areas or may fall onto paved areas. Often, municipalities or water management districts have specified local regulations for watering times. Standard restrictions include no irrigation between the hours of 10 a.m. to 4 p.m. There may be additional restrictions, particularly during drought conditions. Irrigation is not necessary during a rainfall event; therefore, any new irrigation system is required by law (Chapter

373.62, Florida Statutes) to have a rain shut-off device or sensor that will override the system. A system with scheduling options is highly recommended. Not only for the convenience of automatic irrigation, but also because it allows for better planning of water consumption. Rain sensors connected to a system will also prevent watering the lawn after it has rained enough to meet the demand. There are many of sensor systems commercially available, such as Rain Brain (www.rainbrain.com). As a suggestion, irrigation systems should be scheduled to sprinkle the grass for less than 20 minutes and to water the plants on the drip lines for 40 minutes. The number of days per week that the system is being operated varies according to the level of commitment of the participating properties. It is recommended that the owner follows closely the development and response of the landscape to this watering schedule at the beginning and to make adjustments accordingly. There is a possibility that less water could be used.

To this end, on May 7, 2008, a mobile irrigation lab assessment was solicited through the Miami-Dade County Florida Yards and Neighborhoods Program. From the assessment it was determined that the participating hotels are eligible to receive up to $2,850 in grant money for upgrades to the irrigation system. The Mobile Irrigation Lab (MIL) reports are attached for both hotels from preliminary assessments conducted in July-August 2008.

For the Raleigh, the MIL inspection was conducted in August 2008. It identified that the Raleigh has an irrigation timer (Nelson EZ 8300) with 12 zones, of which only 7 are operational. The irrigation schedule is everyday, despite irrigation/water use restrictions. The distribution uniformity was found to be 51%. This value expresses how evenly the water is being applied to a given area. A value of 51% is considered "failing," and it is estimated that by increasing this value to 80% could save up to 360,000 gallons of water per year. An additional note was made that a leak was discovered in the main line from the city meter (Table 16).

Table 16. Summary of mobile irrigation lab findings for the Raleigh Hotel.

Zone	Location	Avg Pressure psi	Avg Flow gpm	Total Flow gpm	Total Sprinklers	Notes
Zone 1	Front area	n/a	n/a	n/a	n/a	Damaged heads and leaks. Needs proper coverage distribution of spray pattern.
Zone 2	Pool area	9	0.5	4	6	Major clogging. Alignment/adjustment needed
Zone 3	Pool area	11	0.7	6	8	Major clogging. Alignment/adjustment needed
Zone 4	Behind the tents	14	0.7	13	19	Major clogging. 14 bubblers and 4 sprays. The sprays need to be upgraded to low flow.
Zone 5	Cabana area beachside	low	n/a	n/a	17	Two broken sprinkler heads, one main line leak losing large quantities. Spray patterns are blocked by large, heavy foliage that needs trimming.
Zone 6	Beach entrance/exit	11	0.7	16	24	Sprinkler heads need adjustment and realigning. Bubblers are not operating (may be clogged or a bad valve)
Zone 7	Cabana areas	11	0.7	8	12	There is a leak in the line, 3 sprays are being blocked by a wood panel

To achieve the 80% distribution uniformity goal, each problem in the 7 zones must be dealt with. The SDSWCD recommends that the hotel reduce the size of wetted areas, repair sprinklers with

worn orifices, repair leaks, and broken valves, properly adjust the head pattern so as not to create overflows on paved areas, unclog emitters and sprinkler heads, realign sprinkler heads, remove vegetation that is blocking water path, add a soil moisture meter or a rain gauge, and create an irrigation water management plan.

For the Standard, the MIL inspection was conducted in August 2008. It identified that the Standard has an irrigation timer (Hunter ICC) with 12 zones, of which only 7 are operational. The irrigation schedule is everyday, despite irrigation/water use restrictions. The distribution uniformity was also found to be 51%. This value expresses how evenly the water is being applied to a given area. A value of 51% is considered "failing," and it is estimated that by increasing this value to 80% could save up to 480,000 gallons of water per year (Table 17).

Table 17. Summary of mobile irrigation lab findings for the Standard Hotel.

Zone	Location	Avg Pressure psi	Avg Flow gpm	Total Flow gpm	Total Sprinklers	Notes
Zone 1	Front	19	1.3	56	42	Three leaks in this zone losing a large quantity of water.
Zone 2	East side fence	19	1.3	56	42	Several clogged sprinkler heads and 3 broken sprinklers.
Zone 3	East side courtyard	23	1.5	41	27	
Zone 4	West side courtyard	21	1.1	50	47	
Zone 5	Three circles area	23	1.6	95	60	One broken sprinkler head.
Zone 6	Mud bath area	19	1.3	11	8	
Zone 7	Outside circles area	19	1.3	12	9	
Zone 8	East side grass area	19	1.3	19	14	
Zone 9	Pool area	24	1.5	35	24	
Zone 10	West side grass area	19	1.3	32	24	
Zone 11	Pool area/yellow cabanas	23	1.5	29	20	Sprinkler heads need to be adjusted and aligned properly.
Zone 12	Bike rack area	24	1.6	19	12	

To achieve the 80% distribution uniformity goal, each problem in the 12 zones must be dealt with. The SDSWCD recommends that the hotel adjust the sprinkler alignment/spacing to provide better overlap and reduce irrigation of pavement areas, unclog emitters and sprinkler heads, realign sprinkler heads that are leaning and causing non-uniform distribution, add a soil moisture meter or a rain gauge, and create an irrigation water management plan.

More tips…

1. Keep all sprinkler heads the same brand/size to enhance uniformity within the zone.
2. Check nozzles for clogging/blockages as a preventative measure.
3. Irrigate only in the early morning when winds are slight and evaporation is low.

4. Adjust irrigation timers according to seasonal rainfall.
5. Only water two days per week as per commercial water use restrictions.

Briefly, the reports estimate that the Raleigh and the Standard could save between 361,000 and 482,000 gallons/year respectively, translating to an additional $3,000/year savings per hotel in utilities costs. The Mobile Irrigation Lab explained that unfortunately, the grant program for this fiscal year ends at the end of September meaning that the upgrades should have been completed and the invoices and cancelled checks turned into the Lab to receive the grant money. Since neither hotel received the reports until September 25, 2008, an extension was requested until mid-October. The Mobile Irrigation Lab expert is scheduled to visit the hotels on September 26, 2008 to train hotel personnel on how to install the rain sensor meter or soil moisture monitor sensor and controller system (provided for free) and explain some things about the program.

2. **Plant selection**. Careful planning and site evaluation are necessary because Florida is a diverse state with multiple climatic zones, soil types, temperature ranges, and precipitation patterns. It is not uncommon for widely different conditions to exist within the same property. Local codes often dictate which species may be planted in certain municipalities. Therefore, the appropriate agencies should be consulted when developing a landscaping plan. Whenever possible, it is recommended to select drought resistant plants that require less water. Many of these will likely be native plants, which tend to thrive only on local rainfall. Remove invasive exotic plants and replace with appropriate natives or other non-invasive exotics. Native and other "climate appropriate" landscape materials can reduce irrigation water use by more than 50%. An additional benefit to using native plants is that they tend to attract wildlife. Grass sod is not easy to irrigate with drop lines due to its complex root system, so sprinklers have to be used. This is another reason to refrain from excessively large grass areas.
Although certain plant species can be adapted easily to the South Florida environment with low volumes of water, it is generally recommended to plant native species whenever possible. Native trees, palms, and shrubs are readily available in local nurseries. The South Florida Water Management District provided a handy brochure, which lists the plant species to be generally avoided as invasive exotics. The guidebook also lists the desirable native species, which are generally drought tolerant. Furthermore, Eco-Logical Solutions recommends, "Go Native!" which is a handbook by Citizens for a Better South Florida. This guide provides a series of suggestions on what plant species are better choices for this region and where to find nurseries that will carry them.

As part of the collection of data for this study, a list of the plant species at each of the hotels was obtained. These are listed in Table 18. Investigation of invasives, exotics, drought intolerant species and inappropriate plant types is still ongoing. Both participating properties were visited on May 7, 2008 for an irrigation efficiency assessment conducted by a partnership with UF-IFAS, Florida Yards and Neighborhoods, and Miami-Dade County. A follow-up visit by the Mobile Irrigation Laboratory is scheduled for later in June 2008. A soil moisture monitor sensor and controller will be installed, repairs and irrigation system upgrades will be installed and then another follow-up visit will document the effects of the changes.

Table 18. List of plants species for each of the participating hotels.

Raleigh	Notes	Standard	Notes
Adonidia palms	exotic	African date palm	exotic
Agave species	exotic	Autograph tree	native
Alexander palms	exotic	Bamboo	exotic
Boxwood shrub	exotic	Banna	?
Bromelliads species	native	*Beloperone guttata* (shrimp plant)	exotic
Carissa shrubs	exotic	Bismark palm	exotic
Chinese fan palms	exotic	Bromeliad	native
Clusia rosea trees	native	Cactus	exotic
Coconut palms	exotic	Cardboard palm (zamia)	potentially exotic
Cordyline species	exotic	Carpentaria palm	exotic
Croton species	exotic	Clerodendrum, firebush	exotic
European fan palms	exotic	Coconut palms	exotic
Fakahatchee grass	native	Crinum lily	potentially exotic (one species is native to florida)
Ginger species	exotic	Crotons	exotic
Green island ficus	exotic	*Duranta erecta* (gold mound)	native
Green liriope plants	exotic	Elephant ear	exotic
Heliconias	exotic	Fakahatchee grass	native
Kentia palms	exotic	Florida sweet bay	Native
Lady palms	exotic	Gardenia	exotic
Madjool palms	exotic	Ginger	exotic
Monstrera deliciosa	exotic	Grand duke jasmine	exotic
Orange birds of paradise	exotic	Gumbo limbo	native
Pandanus sanderi (screw pine)	exotic	Heliconia	exotic
Pandanus utilis	exotic	Japenese honeysuckle	invasive exotic
Pencil cactus tree	exotic	Lady palms	exotic
Philodendron selloum	exotic	Lantana	bad
Plumeria trees	exotic	Liriope	exotic
Sansevieria plants	exotic	Milky way tree	exotic
Sea grape trees	native	*Monstrera deliciosa*	exotic
Silver buttonwood trees	native	Night jasmine	exotic
Thatch palms	native	Oleander	exotic
Travelers palms	exotic	Palmetto grass	?
White begonia odoratas	exotic	*Pandanus utilis*	exotic
White bird of paradise	exotic	Papyrus	exotic
Yellow bamboo	exotic	Peperomina	native
Yucca species	native	Philodendron	potentially exotic (Philodendron selloum)
		Ponytail palm	exotic
		Sea grape trees	native
		St. Augustine Grass	?
		Tabebuia, yellow tree	exotic
		Travelers palms	exotic
		Walking iris	exotic
		White bird of paradise	exotic
		Yellow iris	exotic

Figure 19. Example of plant species in the outdoor pool bar area of the Raleigh.

3. **Fertilize appropriately**. Fertilize in moderation and only during the growing season. Use fertilizers that contain slow-release, water insoluble forms of nitrogen, or use organic compost (possibly from in-house food waste recycling). Many trees and landscape plants demand little or

no fertilizer once they are established. When over-applied, fertilizers aggravate insect and disease problems and create excessive growth issues, increasing the frequency of mowing or pruning. Excess fertilizers can run off into waterways or leach into the aquifer, polluting the source of drinking water.

At the Raleigh, the landscaper is fertilizing with 13-3-13 (N,P,K) for palms and 12-2-8 (N, P,K) for shrubs and others. At the Standard, the landscaper uses 10-4-12 for turf and 12-6-8 for ornamentals. It is possible that the Standard is over-fertilizing on the phosphorus side. After the waste audit was completed on July 1, 2008, the research team met with the landscaper for the Standard Hotel. He revealed that the ornamental plants are fertilized 3x/year with five 50 lb fertilizer bags (750 lbs/yr), and the turf areas are fertilized with one bag of 50 lbs, 4x/year. The average price per bag of fertilizer is $22. He takes the yard waste in his truck to a collection station in Ft. Lauderdale, and pays approximately $50/ton for disposal. He estimates that he disposes about 2 tons/week, plus fuel to Ft. Lauderdale and employee wages. His business is 80% residential, with some hotel contracts. He admits that compost would be more difficult to use…in his words, "*it comes out like soil … is good for planting new landscaping [because soil is devoid of nutrients] but for maintaining, it's more difficult to deal with. For example, some plants don't like mulch – it suffocates the plants. And using compost has much of the same texture as mulch. Granular fertilizer is easier to manage. Also, although compost is supposed to be high in nitrogen, it's not usually.*" In the end, the landscaper admitted that he would work with compost if requested by the client and generally believed in the concept.

4. **Mulching**. Mulching flower beds, shrub beds and trees can have several benefits. It helps the soil absorb water, allows water to better penetrate plants root systems, reduces soil erosion and unwanted weed growth, and moderates large changes in temperature. As the mulch decomposes, the organic content of the soil is increased. Mulch also increases the attractiveness of areas. A 2-to-3-inch layer of organic mulch over the roots of trees and shrubs and in plant beds is sufficient (Hinton et al. 2004). Self-mulching areas can be created under trees, so that leaves can stay where they fall. In a Florida Yard, grass clippings, leaves, and yard trimmings are turned into mulch to return valuable nutrients to the soil. By-products or alternative mulches such as pine bark, eucalyptus and melaleuca, or recycled mulches may be available from your community, after a hurricane cleanup for example. This opportunity should be taken advantage of by consulting the local solid waste management authorities. Often mulch can be made available free of charge.

5. **Replace mowed landscaping with ground cover**. Plan the landscape with minimal use of turf grass. Only plant grass that requires watering and mowing where it is necessary for guest satisfaction. Replace grass with ground cover that requires less maintenance and less water. Try to eliminate small areas of grass, such as parking islands and areas between sidewalks and roadways. These are hard to maintain, require a lot of watering and may be replaced with mulch without losing any of the decorative appeal. The Standard Hotel has areas located on the west wing in the patios that are rock/pebble gardens rather than areas of turf. The Raleigh has sandy areas in the buffer between the beachfront and the pool, in which the turf was replaced with sand to minimize the irrigation water requirements.

6. **Leaks**. If water drips or leaks from sprinklers after being turned off, the sprinkler should be replaced or repaired. Hoses and lines should be routinely checked for punctures and repaired or spliced. When using a hand hose to water new plantings, a nozzle to control the amount of water consumed is recommended. Just as with indoor leaks, outside leaks can increase the water bill

substantially. A leaky faucet that drips one drop of water every second for a year wastes 2,700 gallons of water (Hinton et al. 2004). A visual inspection of all hoses, faucets and sprinklers should be done on a monthly basis. **One of the most important outcomes of conducting the water use audit from the historical utility bills was that a major subterranean leak was detected in the west wing of the Standard Hotel.** This massive leak was discovered in September 2008 and is currently in the process of being repaired. It was also discovered that the building has no moisture barrier between the foundation and the flooring because the water that leaked in between actually lifted up the floor in the lobby restaurant in three places.

7. **Avoid ponding**. Irrigate thoroughly, slowly, and less often. Reduction of irrigation time and application of other appropriate measures can equal a potential savings of 4.5 million gallons of water and $8,833 each year (White 2004). Lawns should be watered so that the soil is moist to a depth of 4-6 inches (Hinton et al. 2004). It is preferable to irrigate thoroughly (so water reaches the root systems) once each week than to water lightly each day. Watering lightly can damage the lawn because only the surface, rather than the roots, may be reached. Watering should be done slowly to avoid runoff. Sandy soil absorbs water quickly but does not retain moisture. Adding mulch will help correct these problems. On the other hand, over-irrigation can also result in problems such as excess water runoff carrying fertilizers and pollutants into our waterways. It can also result in diseases, such as fungus, and in the excessive growth of weeds and pests. Too much water promotes weak growth, which increases the frequency of pruning and mowing as well as likelihood of damage resulting from storms. Less frequent watering encourages deeper root development and healthier turf. Using chemicals to compensate for the results of over-irrigation exacerbates the problem by increasing stormwater runoff pollution.

8. **Use automatic shut-off nozzles**. If watering manually with a hose, the flow should b e controlled with an automatic shut-off nozzle. This prevents the water from accidentally being left running.

In summary, the Raleigh Hotel does employ a limited amount of drip irrigation systems on some of the grounds, but this may be expanded, pending the results of the mobile irrigation laboratory assessment. The Standard Hotel also has a limited amount of xeriscaping, and again, lower flow irrigation systems may be expandable in this site, pending the results of the mobile irrigation laboratory assessment. The Standard also has recently installed a new roof system, which may open up the possibility of rainwater harvesting, as well. The research team is in the process of pulling the stormwater discharge permits from both hotels from the Miami-Dade County Department of Environmental Resource Management. To date, we are aware that the Raleigh discharges to a drainage well on site, and no storage tanks are available.

Stormwater

The first option should be to reduce stormwater runoff. For instance, to remove debris from sidewalks and driveways, sweep or use a blower instead of a hose to wash these areas. Sprinklers should not be watering the driveways or sidewalks. Keeping rainfall and irrigation water on the pervious areas, and out of the storm drains, reduces pollution. Additional ways to reduce runoff include: directing downspouts onto lawns or landscaped beds, using cisterns to collect rain water for irrigation, and using pervious materials such as gravel or mulch for driveways and paths.

Stormwater from a roof runoff collection system be also used for irrigation and other non-potable uses. If this is the case, the tank should be sized to store at least 2-5 days worth of water. It is

recommended that any storage tanks specifically designed for rainwater harvesting be purchased locally in order to avoid freight costs. Pricing, dimensions, and material references for cisterns and storage staffs are available at www.plastic-mart.com. A permeable walkway instead of solid concrete paths for some of the outdoor spaces is recommended. These walkways can be built gaps in between the material to better allow for the irrigation water to be absorbed by the soil, reducing heat island effects and maintaining the natural hydrology of the land. Another choice is to use semi-pervious (or semi-permeable) concrete that will allow for water absorption. It is common to see these walkways built with grass sod in the gaps. However, this is not advisable, due to high maintenance and watering requirements of this design. Loose rocks or gravel are recommended to be used as filler, if necessary.

Buildings and construction alters the natural hydrology of the area by creating more impervious area, which in turn increases the need to install stormwater runoff conveyance systems (pipes, gutters, sewers, etc.). Runoff contains sediments, fertilizers, pesticides, animal droppings, and other contaminants that may have a negative impact on the receiving water bodies. However, if this runoff water is reused to irrigate the landscaping, then the amount of water captured by the stormwater harvesting system can be deducted from the potable water demand for irrigation.

The amount of stormwater runoff captured by a rainwater harvesting system is equal to the storage volume capacity at the site. The harvesting potential is directly dependent on the local annual rainfall and the square footage of the available collection area (usually roof). According to the national weather service, the City of Miami Beach receives an annual average of 46.6 inches of rainfall. Most of this rainfall occurs in the area's distinct wet season from mid-May through early October. The required storage volume can be determined using the following formula:

$$\text{Yearly harvesting potential} = \text{rainfall (in)} \times 1\text{ft}/12\text{in} \times \text{roof area (ft}^2\text{)} \times 7.48\text{gal/ft}^3$$

Water can be conveyed from the roof area to an underground cistern or tank. The buildings for both sites are already equipped with downspouts that are sized accordingly to the roof area they service. In addition, connections to a drainage well provide for relatively easy implementation of an underground or above ground storage tank or cistern connection. During the wet season, the tank will be filled with roof runoff depending on the frequency of precipitation. On the other hand, during the dry season, it may not rain for an extended period of time, so a utility water connection will be provided to maintain the minimum level in the tank. This needs to be taken into consideration when determining tank size. As a recommendation, considering Miami weather patterns, the tank should at least hold water for 4 irrigation sessions. Ecological Solutions has a partnership with AYR Landscape Design and Maintenance, who has experience in designing and installing harvesting systems. For a detailed quote after the decision of how the landscape will be designed, contact Aviv Ifrah at 305.244.7887.

Pool/Spa

Water use in swimming pools and spa facilities varies depending on size, design, climate, and water quality and treatment requirements. Pools are often drained and refilled more often than truly necessary. This frequency should be limited to only when absolutely essential. However, water must be added routinely to replenish losses due to evaporation, splashing, leaks, and filter backwashing. One way to reduce such losses is to invest in an insulated pool cover. About 95% of pool water lost to evaporation can be saved by using a pool cover (CDWR 1998). An average uncovered outdoor pool loses up to 1 inch of water per week during the summer months due to evaporation (Vickers 2001). In addition, lowering the pool water level will help to reduce the

amount of water lost to splashing. If fountains, waterfalls, or other features are used, replace them with water features that use recycled water, and theses water features should be turned off during drought conditions.

Both the Raleigh (Figure 20) and the Standard (Figure 21) have recently upgraded the pool filtration systems to a more water-saving swimming pool filter. However, it is recommended to reduce backwashing and if backwashing is absolutely necessary, the staff should monitor the frequency and duration carefully to optimize water use and efficiency. The backwash water that is generated can be recycled in areas, where appropriate (i.e. lawns, shrubs, etc.). A single backwash with a traditional filter uses 180-250 gallons of water. This water can be saved by cleaning filters by dismantling and rinsing rather than backwashing.

The Raleigh Hotel has a pool water heating issue, and this will be discussed in more detail in the energy efficiency section. Also, the hotel personnel were interested in getting more information on a pool cover to limit evaporative losses.

Figure 20. New pool filtration and disinfection equipment for the outdoor pool and water features at the Raleigh.

Figure 21 New pool filtration and disinfection equipment saline infinity pool at the Standard.

Other Water Conservation Projects

Use recycled water. For example, instead of using the lodging facility personnel and the city water supply, use a commercial car wash that recycles water to wash vehicles. Another potential application to reduce water waste involves the use of reclaimed water or reuse water, which is highly treated wastewater. If available from the local wastewater treatment facility and allowed by local regulations, reclaimed water can be used for watering lawns, shrubs, and flower beds. Reclaimed water is not as yet readily available in Miami-Dade County, and may not become available in the foreseeable future to the City of Miami Beach. Therefore, recycling water can only come from graywater systems and manual reuse of non-potable water.

On-site water treatment. Both the Raleigh and the Standard have on-site water treatment systems. The Raleigh has a non-servicable fiberglass pressure vessel that is apparently packed with media and also serves as a filter backwash pressure tank (Figure 22). The unit is currently bypassed and still visibly leaking. We recommend that the unit be removed, since it is taking up valuable space in the boiler room area. On July 29, 2008, the Raleigh Hotel was considering to replace the building's filtration system with a newer unit to be provided by Culligan. The purpose of the existing unit and the media type in the pressure vessel were unknown, but it was desired from corporate level to investigate putting a filter unit on line. It was determined to identify the water quality treatment goals for the system first. FAU Lab.EES conducted water quality testing to help identify those needs to first determine if softening, disinfection, or solids filtration is actually necessary for the building. This way, Culligan would not sell the hotel a system that is not needed. The Culligan company provided the Raleigh with a sample analysis taken from an irrigation well nearby at the Clevelander Hotel. The report is misleading because the Raleigh does not have an irrigation well, and the cation analysis is incomplete (approximately 16.2 mg/L as $CaCO_3$ of cations were unaccounted for). Upon closer inspection of the report, it was noticed that the copper level was detectable, but they did not check for lead (Pb). It might be worth it to check for lead in such an old building. In looking at the details of the rest of the analysis, we find that the pH is pretty high (9.1), this means that the hardness will tend to precipitate more and cause scaling deposits. All the hardness seems to be in the form of carbonate hardness, which means that the scaling is reversible with some acid cleaning. The color (5.9) is also a bit higher than expected, and this could be due to metals leaching into the water from the older pipes (Pb/Cu), but the iron is very low and the pH high, so the color is probably just natural (TOC = 5.3 mg/L). The turbididty and the TOC numbers seem to suggest biofilm growth in the pipes. It would have been informative if they had measured the chlorine residual to be sure (it should never go below 0.2-0.5 mg/L). This biofilm can be cleaned with shock chlorine to flush and periodic dosing at regular intervals throughout the year. TDS is relatively low, and all of the other parameters seem to be in the ideal range. In terms of looking at hardness for water softening applications, the calcium and magnesium levels provided a hardness of 60 mg/L as $CaCO_3$, which is considered "hard" but the lower limit of treatment is generally considered to be 40 mg/L as $CaCO_3$.

Culligan

9399 W. Higgins Road Suite 1100
Rosemont, IL 60018
TELEPHONE 847/430-2800
FACSIMILE 847/430-2284

Report Date: 6/25/2008 Page 1 of 2

CERTIFICATE OF ANALYSIS

ANALYSIS NUMBER: 0803226 Control Number: 22904

Culligan of Florida
6600 Hiatus Rd.
Tamarac, FL 33321

Customer:
1020 OCEAN DRIVE
MIAMI BEACH FL
Zip Code: 33139
Customer Account #:
cc: JIM.ALAIMO@CULLIGAN.COM

Account Number:

Salesperson JL ALAIMO

SAMPLE INFORMATION:

Analysis Type Requested Standard A Analysis

Sampled: 6/20/2008 Supply/Source: MUNICIPAL WELL Condition: UNTREATED WATER
Received: 6/23/2008 Sampling Point: NOT SPECIFIED Application: Commercial

ANALYSIS INFORMATION:

Turbidity(Method 180.1 R 2.	0.3 NTU	Turbidity after filtration	N.M.
Conductivity(Method 120.1	283.0 MMHOS/CM	Est. TDS by Conductivity	176.6
Color(Method 2120C)	5.9	Color after Acidification	3.5
pH(Method 150.1 R 1982)	9.1	Tannins	<2

Concentrations reported as mg/L (PPM) unless otherwise indicated

CATIONS (Method 200.7)

	As Element	As CaCo3
Calcium (Ca)	18.5	46.3
Magnesium (Mg)	3.3	13.6
Sodium (Na)	31	67.6
Potassium (K)	2.4	3.1
Strontium (Sr)	0.31	0.4
Barium (Ba)	<0.01	
Iron (Fe)	<0.05	
Manganese (Mn)	<0.02	
Copper (Cu)	0.015	
Zinc (Zn)	<0.05	

ANIONS (Method 300.0)

	As Element	As CaCo3
Chloride (Cl)	50.9	71.8
Nitrate As N (NO3)	<0.5	<1.8
Nitrite As N (NO2)	<0.1	<0.4
Sulfate (SO4)	8	8.3
Bicarbonate	58.7	48.1
Carbonate	17.16	16.5
Fluoride (F)	0.5	1.25
Silica (SiO2)	6.77	

	Mg/L	GPG		Mg/L	GPG		Mg/L	GPG
Cations (CaCO3)	130.5	7.63	Anions (CaCO3)	146.7	8.58	Hardness (CaCO3)	60	3.5

Additional Tests

Total Organic Carbon 5.31mg/l Aluminum by ICP <50ug/L

*NA = Not Analyzed NM = Not Measured ND = Not Detected

This report can only be reproduced in its entirety. The results reported here are representative of the sample as received in the laboratory.

Certifications: CA-01133A; IL-000280; NY-11756; WI-399016200; TX-TX269-2003
IA-369

Richard Cook
Manager Analytical Laborator

Analysis Number: 0803226 Page 2 of 2
Consumer: CLEVELANDER HOTEL

FEDERAL SAFE DRINKING WATER ACT

All tested parameters exceeding the maximum concentration levels (MCL) established under the "Federal Safe Drinking Water Act"

	Parameter	Found	MCL
PRIMARY:			
SECONDARY:			

* MCL for Turbidity varies as follows:
1. Municipal Direct Filtration 0.5 NTU
2. Municipal Sand Filtration 1.0 NTU
3. Unfiltered Water Supply 5.0 NTU

TYPICAL POST RO DRINKING WATER UNITS

(Concentrations reported as mg/L (PPM) as the element)

Iron (Fe)	0.0	Magnesium (Mg)	0.1
Manganese (Mn)	0.0	Sodium (Na)	0.9
Zinc (Zn)	0.0	Potassium (K)	0.0
Copper (Cu)	0.0	Chloride (Cl)	2.0
Nitrate As N (NO3)	0.1	Nitrite As N (NO2)	0.0
Sulfate (SO4)	0.1	Fluoride (F)	0.0

These values are typical of new modules on water with a pH of 7-9 at 70-74 F with 500-3000 mg/L total salts operating with 40-70 PSI pressure across the module. Local conditions may yield different results.

DI CALCULATION FACTORS

			GPG	mg/L
Sodium	51.8%	Weak Base Fact X	4.8	81.4
Alkalinity	44.1%	Carbonic Acid	3.8	64.6
Chloride	88.1%	Cation Fact Y	7.6	130.5
Carbonic Acid	42.5%	Silica	0.3	5.62
Monovalent Ions	47.6%	Carbon Dioxide	0.0	0.0
Silica	4.4%	Strong Base Fact Z	8.9	152.2

Analysis Date:

Method	Date	Method	Date
120.1 R 1982	06/24/08	150.1 R 1982	06/24/08
180.1 R 2.0	06/24/08	200.7 R 4.4	06/25/08
2120C	06/24/08	300.0 R 2.1	06/24/08

Based on this irrigation well analysis, the Culligan Company representative offered the following proposal:

Quantity	Description	Total Price
2	Hi-Flo 3e HCE-450-2T, Duplex Softener System	
2	Brine System 30"x50"	
2	Meter Turbine 2" NPT Brass	
2	Meter Cable	
1	MVP Communications Cable	
2	Vacuum Breaker 1.0: PVC	
20/40 lb.	Solar Salt	
Purchase Option Total:		$13,434.00
1	Preventative Maintenance Service	$345.00/quarter
1	Salt Delivery Service	$8.55/40 lb.

The also provided the following information as a justification for the proposal:

The Raleigh currently has:
- Premium 110 room hotel with laundry and kitchen facilities.
- Hard water conditions
- Chronic clogging of shower heads
- Excessive scaling in clothes washing machines

Therefore, the objective is to treat the water to eliminate the observed hard water conditions (dissolved calcium, magnesium and iron). A summary of the benefits of this service is as follows:

Hot Water Heaters
- Reduce utility bills and increase equipment life
- Eliminate scaling and insulating factor from scaling

Laundry
- Reduce Labor and maintenance cost
- Brighter-whiter-softer linens
- Reduce laundry detergent usage by 35%

Ice Machines
- Clear longer lasting ice cubes
- Increase efficiency of ice machines
- Lower energy and maintenance costs

Food Service
- Better tasting food and beverages
- Spot free tableware
- Reduce labor for wiping and rewashing
- Reduce dishwasher soap by 35%
- Eliminate scale build up in dish washer

Housekeeping
- Reduce cleaning chemicals and labor
- Brighter sparking general appearance
- Eliminate shower head clogging/replacement
- Better guest experience

The Raleigh obtains its water from a Miami-Dade County water treatment facility by way of the City of Miami Beach distribution network. The County treatment facilities use lime-softening or nanofiltration as the major treatment process. These technologies should be sufficient to achieve the softening, disinfection, and filtration goals of water treatment for commercial customers. Since the water analysis provided by the vendor was of an irrigation well, the research team decided to conduct water sampling in four areas of the Raleigh Hotel on the basement level. These sites were: 1) Janitor Closet, 2) Spigot near Engineering, 3) Women's Bathroom, and 4) Boiler Room at the existing filtration system. The results of our analysis are found in Table 19. The results indicate that the water quality parameters generally fall within the appropriate ranges, and no special or additional treatment is warranted. The total hardness levels are within the levels expected for this region; however, the free chlorine residual is low and may indicate a biofouling potential in the plumbing lines. This deserves further investigation.

Table 19. Results from water quality testing on July 29, 2008 at the Raleigh Hotel.

	pH 00400	Conductivity 47004 mS/cm	TDS 000515 mg/L	Total Alk titration mg/L as $CaCO_3$	Ca Hardness titration mg/L as $CaCO_3$	Mg Hardness titration mg/L as $CaCO_3$	Total Hardness titration mg/L as $CaCO_3$	Total Chlorine test strip mg/L	Free Chlorine test strip mg/L
Janitor Closet	8.5	0.29	176	36	56	0	56	nr	nr
Spigot near Engineering	8.0	nr	140	45	51	0	51	3	0
Womens Bathroom	8.8	0.28	176	41	43	10	53	2	0
Boiler Room Filter	8.0	nr	nr	53	48	20	68	nr	nr

Another issue found at the Raleigh is a sewage leak at the lift station on the basement level. This should also be addressed (Figure 23). The Standard has a working water softening system (Figure 24). The unit is likely operating at optimum efficiency because the water in the wash water systems is very soft. The research team is in the process of securing the specifications for the water softening system, in order to evaluate if altering the settings or running a parallel bypass will help reduce the chemical demand and improve the water hardness levels, which are apparently set too low.

Figure 22. Non-functional water treatment system for whole building. The unit is leaking (left) and the fiberglass backwash tank (right) is thought to contain filtration media but the tank is not serviceable.

Figure 23. The lift station in the boiler room collects raw wastewater from the lower level to pump to the street manhole. The lines are visibly leaking as seen above.

Figure 24. Water softening system at the Standard (left), and leaky line from the wall (right).

In summary, the major areas identified for water conservation pilot projects include: fixture replacement (toilets, showerheads, faucets, aerators, spray washers, etc.), appliance replacement (ice machines, laundry, dishwashers, etc.), towel reuse, HVAC improvements, leak detection programs, and irrigation improvements.

Energy Efficiency

In the short-term, to successfully reduce energy consumption at both participating hotels, an energy audit should be conducted to identify potential cost-beneficial improvements and to determine where and how the energy usage is distributed on the property. Thus, an energy/mitigation audit will be performed on both participating hotels through a partnership with FPL, which provides electricity-related services to more than 4.3 million customers in Florida, including approximately 490,000 commercial and industrial businesses.

After completing the analysis, targeted energy efficiency pilot projects will be identified. Apriori, we expect the following items to be significant for tailored energy minimization programs:

- Lighting retrofits
- HVAC installations and improvements (including motors, boilers, steam systems, central cooling plants)
- Backup generating systems
- Energy management control systems
- Natural gas
- Power quality solutions

FPL Energy Services, Inc. (FPLES) was contacted to conduct an energy audit of the natural gas systems used by the hotels. FPLES is a subsidiary of FPL Group and an affiliate of Florida Power & Light (FPL) and is a retail energy marketer that provides customized solutions to commercial, industrial, chain, and governmental organizations. Recently a number of states, including Florida, changed the rules that control the natural gas industry. Those deregulatory changes are called "unbundling." In the past, most commercial customers did not have the option of choosing their gas supplier, but now commercial gas customers are able to select a supplier of choice.

How does this work? When gas-fired appliances are turned on, the gas is received from the local utility. This is called "bundled" service, that is, the customer pays for the gas and for having it delivered. Competition only affects the supply of natural gas (purchased portion) – it does not affect the delivery. Through unbundling, the natural gas service can be purchased from an alternative supplier of gas, similar to the phone service, while the local gas utility will continue to deliver the gas through their distribution system. The advantage is in the pricing options offered, such as discount-off-tariff pricing, fixed pricing, and index pricing.

Typically most hotels have natural gas for heating pools, laundry facilities, and kitchen appliances. In this pilot study, both the Standard and the Raleigh have natural gas service. FPLES (Lori Pezzulo, Natural Gas Services) claims that they can save the hotels money over the typical full tariff gas supply of their competitors. To this end, a 12-month history of gas use was obtained in order to conduct an analysis of savings over the tariff gas supply. At press time, this data is not yet available and will be included in the next progress report.

In addition, the FPL business accounts specialist (Frank Guzman) performed an energy audit for the Raleigh Hotel that specifically focused on lighting issues, insulation, windows, air conditioning systems, motors, and reflective roof coatings. Mr. Guzman performed a Business Energy Evaluation of the property on July 28, 2008 to provide a comprehensive analysis of the facility's energy usage and provide the customer valuable information, tools, and resources, to better plan

for, control, and manage their energy expenses. The first step in the audit was to collect a summary of the account history for the past two years. This is shown in Table 20. It is interesting to note that the annual energy consumption has increased slightly (5%) and the power bill cost has increased by 2%.

Table 20. Two-year energy usage history for the Raleigh Hotel.

Billing Date	Days	KWH per Day	kWh	kWd	Load Factor %	Current Bill	Balance Due
07/09/2008	30	5,556	166,680	295	78%	$16,963.18	$33,411.19
06/09/2008	32	5,445	174,240	274	83%	$17,435.47	$16,448.01
05/08/2008	29	4,701	136,320	274	71%	$14,169.02	$14,169.02
04/09/2008	29	4,883	141,600	277	73%	$14,640.88	$14,640.88
03/11/2008	29	4,759	138,000	283	70%	$14,382.15	$14,382.15
02/11/2008	32	4,695	150,240	313	63%	$15,691.40	$33,276.54
01/10/2008	34	4,920	167,280	305	67%	$17,089.89	$33,016.82
12/07/2007	31	4,804	148,920	284	70%	$15,458.05	$31,259.00
11/06/2007	29	5,222	151,440	271	80%	$15,567.44	$15,567.44
10/08/2007	31	5,493	170,280	276	83%	$17,254.06	$34,980.09
09/07/2007	30	5,724	171,720	286	83%	$17,464.07	$17,464.07
08/08/2007	29	5,859	169,920	317	77%	$17,569.59	$17,569.59
Totals/Avg	**30**	**5,172**	**1,886,640**	**288**	**75%**	**$193,685.20**	
07/10/2007	32	5,340	170,880	295	75%	$17,467.05	$31,786.69
06/08/2007	30	5,012	150,360	251	83%	$15,308.02	$14,108.02
05/09/2007	29	4,903	142,200	295	69%	$15,011.16	$15,011.16
04/10/2007	29	4,721	136,920	254	77%	$14,262.35	$14,262.35
03/12/2007	31	4,529	140,400	283	67%	$14,808.60	$14,808.60
02/09/2007	30	4,532	135,960	263	72%	$14,251.95	$14,251.95
01/10/2007	34	4,719	160,440	264	74%	$16,419.27	$31,849.01
12/07/2006	31	4,409	136,680	241	76%	$14,951.57	$31,877.42
11/06/2006	31	4,935	153,000	264	78%	$16,675.71	$16,675.71
10/06/2006	29	5,317	154,200	268	83%	$16,822.60	$16,822.60
09/07/2006	30	5,064	151,920	271	78%	$16,635.82	$16,635.82
08/08/2006	29	5,648	163,800	316	74%	$18,136.93	$36,169.91
Totals/Avg	**30**	**4,928**	**1,796,760**	**272**	**76%**	**$190,751.03**	

The audit also conducted a comparison of average temperature to usage for the months of June 2008, May 2008, and June 2007. The results are shown in Table 21 and reveal that the cooling load is increasing over the previous month and the previous year.

Table 21. Summary of average temperature comparisons at the Raleigh Hotel.

Parameter	Current Month June 2008	Previous Month May 2008	Previous Year June 2007
Total Heating Degrees	0	0	0
Total Cooling Degrees	519	513	490
Days >92°F	1	7	3
Days <45°F	0	0	0
Highest Temperature	93°F	95°F	92°F

Average Low Temperature	77°F	76°F	76°F
Average High Temperature	89°F	89°F	89°F
Lowest Temperature	71°F	67°F	72°F
Average Overall Temperature	82°F	82°F	81°F

Figure 25 contains a summary of the historical billing records for energy consumption at the Raleigh Hotel. An analysis reveals that the general trend is increasing in 8 of the 12 months compared to the previous year's bill. It is interesting to note that the highest energy bills coincide with the slowest season for the hotel in terms of room sales (summer-early autumn).

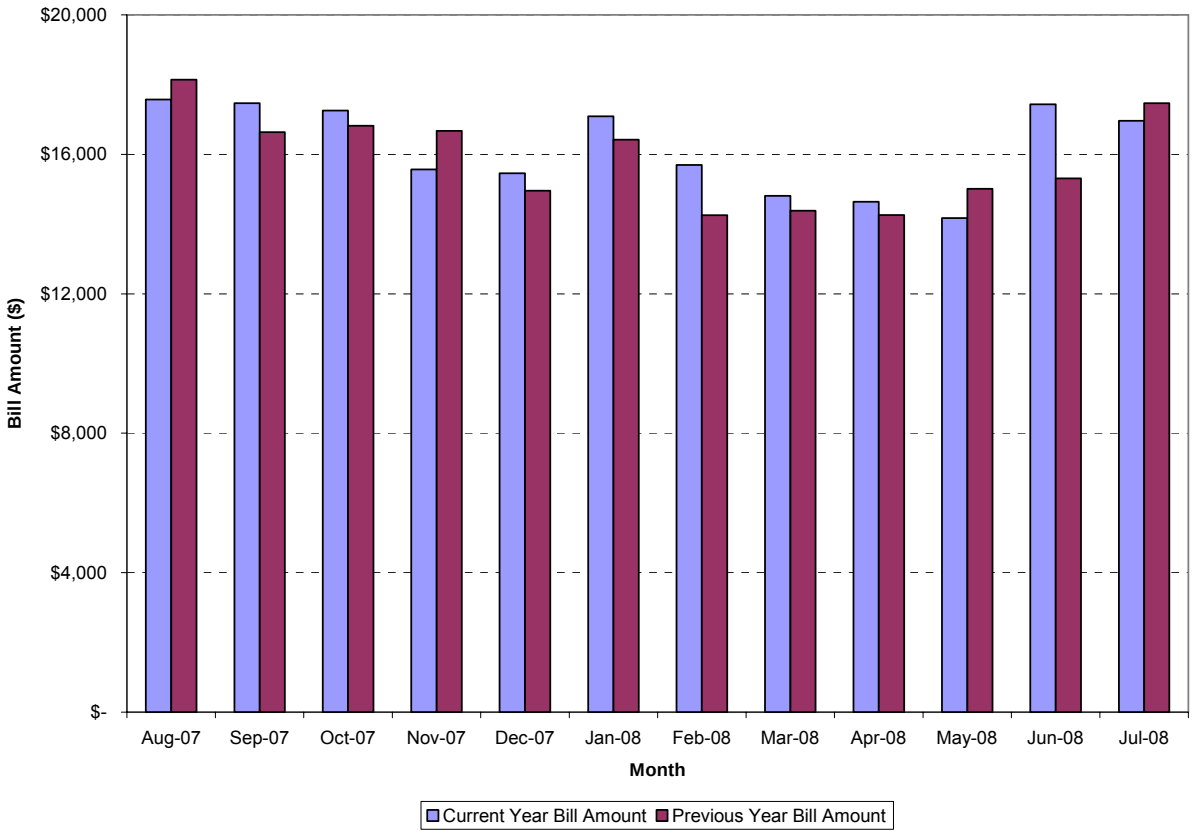


Figure 25. Summary of FPL 12-month historical billing records for the Raleigh Hotel.

The audit makes specific recommendations for the implementation of energy saving measures that potentially amount to $28,181 every year on energy costs, solely from the lighting systems. In fact, the Raleigh also qualified for $3,996 in FPL incentives to help with offsetting the initial capital costs of recommended upgrades.

The specific recommendations were as follows:

- Lighting (more specific recommendations are made in Table 22)
  - Turn off lights when not in use
  - Install timers and photocells

  - Install occupancy sensors or wall timers in areas with transient use
  - Install wall light switches in areas with transient use
  - Install EMS to schedule lights
  - Use lower wattage incandescent lamps
  - Use fluorescent lamps (T-8 with electronic ballasts)
  - Use LED exit sign retrofits
  - Use CFLs and make sure to hard-wire them to qualify for additional FPL incentives
- HVAC
  - Maintain 75°F for cooling and 68°F for heating
  - Clean condenser/evaporator coils
  - Clean replace filters regularly
  - Install timers/EMS to schedule units and control space temperatures
  - Install programmable thermostats
  - Turn off air handler units during unoccupied hours
  - Turn off exhaust fans during unoccupied hours
  - Maintain and clean the cooling tower
  - Install locking covers or tamper-proof thermostats
  - Install a controller that adjusts chilled water temperature based on space and other outdoor temperature/humidity conditions
- Food Service
  - Keep preheat times to a minimum
  - Turn off unneeded equipment
  - Reduce ventilation requirements
  - Repair seal and latches on refrigerator doors
  - Adjust refrigerator thermostats to appropriate settings
  - Insulate refrigerant lines
- Motors
  - Install EMS control systems for load management
  - Keep belts tight
- Building Shell
  - Caulk and seal doors/window openings
  - Install window film or curtains
  - Replace west-facing glass
  - Consider installing a reflective roof coating

Table 22. Summary of recommended lighting changes to the Raleigh Hotel.

Lamp Technology	Number of Fixtures	Lamp Type	Ballast Type	Cost	Savings	Rebate	Payback
Existing: Incandescent	624	A-line Inc.	No Ballast	n/a	n/a	n/a	n/a
Proposed: CFL	624	18 Watt	Hardwire	$9,360	$20,928	$3,120	3.6 months
Existing: Incandescent	438	A-line Inc.	No Ballast	n/a	n/a	n/a	n/a
Proposed: CFL	438	13 Watt	Hardwire	$4,380	$7,253	$876	5.8 months

Just as with the water consumption, historical energy usage billing records (FPL, PESCO, TECO) for both participating hotels were reviewed for approximately 18 months. This analysis is still in progress and will be reported in the following progress report.

Figure 26. Location of propane storage areas at the Standard.

The major areas identified for energy efficiency pilot projects include: Energy Star® appliances, programmable thermostats, sensor lighting, solar lighting, high-efficiency lighting, energy management system, energy recovery ventilators, solar hot water, preventative maintenance programs, individual room units, turning off/unplugging policies, vending mizer, power surge protection, key card lockout, cool roof or high reflective coatings, windows/doors, and purchase green power and carbon offsets.

Energy Star® Appliances

In 1991, the United States Environmental Protection Agency introduced the "*Green Lights*" program that encouraged organizations to upgrade their existing lighting to more energy efficient lighting systems and controls. The following year, a labeling program was launched, which introduced the Energy Star® brand, which identifies energy-efficient products and promotes energy performance that saves energy and protects the environment (USEPA 2004). The label has been expanded to include new homes, commercial and institutional buildings, residential heating and cooling equipment, major appliances, office equipment, lighting, and consumer electronics. The Energy Star® logo makes it easier for businesses and consumers to recognize products that exhibit exemplary energy performance, save money on power bills, and prevent unnecessary pollution. Making Energy Star® equipment a part of the energy management plan at a hotel can significantly reduce energy consumption.

Appliances with the Energy Star® designation save water as well as energy. The initial cost of such appliances may be higher in some instances, but the life cycle costs are substantially lower. For example, Energy Star® qualified washers use 18-25 gallons of water per load, compared to the 40 gallons used by standard machines. They do this by extracting more water from clothes during the spin cycle. This reduces the drying time and saves energy and wear-and-tear on linens. An Energy Star® qualified dishwasher saves about $100 over its lifetime. The savings comes from using less hot water than conventional models (Hinton et al. 2004).

Hotels should consider using ceiling fans in public areas. Ceiling fans can reduce cooling costs because they use only 15% of the energy consumed by a typical air conditioning unit. Energy Star® rated ceiling fan/light combination units are about 50% more efficient than conventional units. This represents a $15 – $20 per year savings on utility bills, plus any additional air conditioning savings gained when the fan is operated properly. For a $150 ceiling fan purchase

with install, the payback period is on the order of 3 months (PA Consulting Group 2001). These savings can be maximized through optimizing the ceiling fan installation and usage. Efficient operation of ceiling fans involves proper anchoring to a ceiling joist and proper balancing of the blades. Any wobbling due to misalignment or inadequate mounting will cause friction losses, which will reduce the operating efficiency of the motor and result in higher electric bills. It goes without saying that the fans should be turned off when the room is not occupied, but if the fan must be used continuously, set the unit to rotate counter-clockwise to induce downdraft "wind-chill" effect. If ceiling fans are in use, the thermostat should be reset to compensate.

In both participating hotels, the ceiling fans in the guest rooms and lobby areas are always on, even if no one is using the space. It is recommended that a policy of turning off the ceiling fans when the room is unoccupied be adopted.

For the Raleigh and the Standard, the research team is currently conducting an audit of all of the electronics and appliances to determine which items are Energy Star® qualified (see Table 23, Table 24). Some of the most common items in the guest rooms are shown in Figure 27, Figure 28, Figure 29, and Figure 30.

Figure 27. Examples of electronics and appliances in a typical guest room at the Raleigh Hotel.

Figure 28. More examples of electronics and appliances in a typical guest room at the Raleigh Hotel.

Figure 29. Examples of electronics and appliances in a typical guest room at the Standard Hotel.

Figure 30. More examples of electronics and appliances in a typical guest room at the Standard Hotel.

In addition to the guest rooms, the office/back of the house areas also have a number of electronic equipment and appliances. These areas are also in the survey that is nearly completed. In addition to replacement of equipment with Energy Star® qualified products, the following best practices should be followed:

1. **Equipment replacement**. Purchasing Energy Star® equipment, which includes built-in power management features that switch to a low-energy mode when not in use, reduces energy consumption and provides additional savings in air conditioning (from excess heat generation) and wear-and-tear. When not in use, be sure to activate the stand-by mode or "sleep" function settings on Energy Star® labeled electronics. For example, an Energy Star® computer, in sleep mode, uses 70% less electricity than computers without power management features. USEPA offers Powerdown Software that decreases CPU power consumption on most computers, while still running. Energy Star® office equipment not only includes computers, but also printers, copiers, fax machines, commercial and industrial transformers, water coolers, television sets, monitors, VCRs, and other items commonly found in hotels. Energy Star® printers can cut printing-related electricity by 65% or more, particularly if multiple users are

networked to a central printer. As an example of savings, fax machines that have earned the Energy Star® rating can reduce energy costs by almost 40% (APPA and ASBDC 2003).

2. **Minimize operation of office equipment**. Office equipment that continuously runs consumes a significant amount of energy in aggregate. Systems should be unplugged when rooms or offices are unoccupied for extended periods. If the machine is equipped with energy saving software or features, be sure to enable those systems. For instance, computers and monitors automatically power down to 30 watts when not in use, and printers power down to 10 – 100 watts, producing less heat, reducing air-conditioning costs, and contributing to a more comfortable work space (APPA and ASBDC 2003).

Figure 31. Back of the house office areas in the Raleigh Hotel.

Figure 32. Back of the house office printers in the Raleigh Hotel.

Figure 33. Back of the house office areas in the Standard.

Table 23. List of appliances and electronics for the Raleigh Hotel, by area.

Location	Equipment	Make	Model #	QTY	Energy Star?
Housekeeping	Washer	Continental Girbau	L1075		no
	Dryer	MaxiDry	CHD75		no
Pool Bar	Dishwasher	Ecolab	?		
	Coolers	GE	1-ES6-GE		no
	Ice Machine	Hoshizaki	? (same as downstairs kitchen)		?
	Blender	Island Oasis	SB-3X	2	?
	Handsinks	Perlick	not known	3	
	Computer/cashier	Micros	workstation 4 system unit	2	no
	Refrigerator	TRUE	?		?
	Cooler/mini fridge	Beverage-air	?		no
	Fan	Air King- High velocity	9420		no
	Cooler	TRUE	?		?
Kitchen	Dishwasher	Ecolab	ET-44		no
	Coffee Brewer	Bunn Dual	Dual 120/208v		no
	Oven	Jade Range	10218771JT		?
	Espresso	Expobar	?		no
	Sandwhich Maker	Star Pro-Max	?		no
	Refrigerator	Continental	1RSE-SS-HD		no
	Cooler	TRUE	TSSO-60-24M-B	3	no
Martini Bar	Computer/cashier	Micros	workstation 4 system unit		no
	Coolers	Beverage Air	?		no
Patio Bar	Cooler	TRUE	TBB-24-48S		no
	Computer/cashier	Micros	workstation 4 system unit		no
	Fan	Air King- High Velocity	9420		no
Pool Grill	Coolers	Delfield	not known		no
	Grill	APW Wyott	Champion Cook series		?
	Fan	Air King High velocity	9420		no
	Water heater	Bradford White	M13016D5-1NCRR		
	Sandwhich maker	Star Pro max	patent no. 6,257,126		no
	Hand sink	Glas Tender	DHSB-14-FL		
	Industrial Sink	Advanced Tabco	FC-3-1818		
	Mini fridge	GE	GMRO4AAMBBB		no
	Microwave	GE	JES735WJ 01		
	Computer/cashier	Micros	workstation 4 system unit		no
	Oven	Imperial	?		
	Fryer	DCS	DCS-FSF-40L		no
	Refrigerator	Delfield	SRRI-S		no
	Freezer	Amana	?		?
Downstairs Kit	Walk-in Cooler	American Panel	FW347711TWL		no
	Oven	Rational	scc-101		
	Pastry Cooler	Traulson	RLT232DUT_HHS		no

Location	Equipment	Make	Model #	QTY	Energy Star?
	Cooler	NSF	D045329		no
	Ice Machine	Hoshizaki	unknown (same as pool)		?
	Ice cream maker	carpigiani	lab 100b		?
	Meatslicer	Berkel	909A		?
Rooms	TV	Phillips	30FW9955/35		no
	Mini Bar Fridge	Dometic	not known		no
	Ipod Player	iHome	iH-5		no
	CD Player	Panasonic	SC-EN5		?
	Iron	Sunbeam	3964-099		?
	DVD player	Phillips	DVP642		no
	Blow Dryer	Sunbeam	1622-000		?
Upstairs (main) Office	Fax Cartridge				?
	2-mini tower fan	wexford	w14b9798		no
	Laptop	HP-compaq	mc6400		no
	Monitor	Westinghouse	LCM-17V25L		no
	Monitor	Dell (old)			no
	2-Monitors	Mag Innovation	LT582s		no
	Monitor	Samsung-sync master	151s		no
	Monitor	Acer	X191W		yes
	Laptop	Gateway	MA3		yes
	6-Desktop comps	HP-compaq	DG 781A#ABA		No
	Printer	HP	CB366A		no
	Printer	HP	color laserjet 2550 pc16		no
	internet fax	canon	HB1-5352 (CZ1)		no
	Printer	HP	Q7815A		Yes
	Tower Fan	Wexford	CT-301RTF		no
	Laptop	HP-compaq	nc-2400		no
	Copier	Sharp	MX-3501N		Yes
	Water Cooler	Brita	rk2000B/0B03		no
	Printer Cartridge	HP 53A - Q7553A			no
Office behind front desk	Fan	Air King-High Velocity	9420		no
	3-desktop comps	HP-compaq	DG 781A#ABA		no
	Tower Fan	Wexford	CT-301RTF		no
	Tower Fan	Honeywell	HY-013		no
	Monitor	Mag Innovation	LT582s		no
	Monitor	Dell	m770		no
	Monitor	Viewsonic	e70f		no
	Desktop comp	Not known	not known		no
	Printer	HP	Laserjet p4014n		no
	Laptop	IBM	T60		Yes
Coffee Bar	Ice maker	Scotsman	SCE170A-1C		no
	Coffee maker	Bunn	CW series		?
	Coffee maker	Bunn	lpg-2e		?
	Espresso machine	Expobar			no

Location	Equipment	Make	Model #	QTY	Energy Star?
	Computer/cashier	Micros	workstation 4 system unit		no
	Refrigerator	TRUE			?
	Blender	Cusinart	CB-18BK55CTXJ		?
	Toaster	Dualit	DO37685		?
Front Desk	Desktop comps	HP-compaq	DG 781A#ABA	2	no
	PRINTER	HP	Laserjet p4014n		no
	MMonitors	Planar	FWT1503Z	2	no
Accounting Office	Desktop comps	HP-compaq	DG 781A#ABA	5	no
	Monitors	Acer	AL1717	5	yes
	Printer/copier	Sharp	MX-M350N		yes
	Printer	HP	Laserjet 4100		no
	Tower Fan	Lasko	LQ4317034534		no
	Tower Fan	wexford	ct-181thtfi		no
Restaurant	Cashier/comp	Micros	workstation 4 system unit	2	no
	Fans	Air King-High Velocity	9420	2	no
	Computer/cashier	Posiflex	tp5700/5800		no

Table 24. List of appliances and electronics for the Standard Hotel, by area.

Location	Equipment	Make	Model #	QTY	Energy Star?
Housekeeping	Washer	Continental			no
	Dryer	Maxi-Dry	CH D75		no
	Ecolab Products	Contains 6.2% phosphorus and 0.3 gram per gallon			n/a
Pool Bar	Dishwasher				
	Coolers	Glas Tender	DB84-L1-SNHELRRJ	2	no
	Ice Machine				
	Computer/cashier	micros	workstation 4 system unit	3	no
	Fan	Lakewood	cm3-1212ALD		no
	Blender	Island Oasis	SB-3X		?
	Cooler	?			
	Industrial Sink	ecoloab			
	Coffee Machine	Expobar			no
	Sink	glas tender	dhsb-14-fl		
Kitchen	Dishwasher	Ecolab	WH-44		no
	Handsink	Advance Tabco	7-ps-80	3	
	Coffee Brewer	Bunn	CWTF15		
	Oven	Rational - Rankin Deluxe	CM102		
	Espresso	Fiorenzato	CE 0035		
	Sandwhich Maker	Star Pro Max		3	no
	Refrigerator	TRUE	T-23		yes
	Cooler	American Panel	FW 3677 LLTNWL	3	no
Office	Laptop	IBM	T41		yes
	Desktop Comp	Macintosh-imac	(not known at moment)	2	yes
	Monitors	HP	7500	10	no
	Desktop Comps	HP	DG 781A#ABA	10	no
	Mini Fridge	Kenmore	unknown		can't determine
	Espresso Machine	Lavazza	9538		
	Monitor	HP	L1908W		yes
	Desktop	IBM	lenovo		yes
	Desktop	Dell (old)			no
	Laptop	Avertech	3200 series		no
	Laptop	Dell	Inspiron-700m		no
	Copier/Printer	Muratec	mfx-2850		Yes (ps)
	Desktop	Macintosh	G4 (unknown)		
	Monitor	Macintosh	Cinema display?		yes
	Printer	HP	laserjet-1320		no
	Printer	HP	laserjet-2300dn		no
	Printer	canon	pixma?		no
	Paper Shredder	Ativa	v260s		no
	Printer	Konica Minolta	2530dl		yes

Location	Equipment	Make	Model #	QTY	Energy Star?
	Printer	HP	Laserjet 4200n		no
	Monitor	Dell	REV-A01		no
	Printer	HP	q2475a		no
Pool Grill	Coolers				
	Hand Sink				
	Oven	Bakers Pride-gas grill			
	Bread Warmer	Alto Shaam			
	Sandwich Maker	Star Pro Max	patent no. 6,257,126		no
	Water Cooler	pure beverage system	21394		no
	Fryer				
	Refrigerator	2-True T-23	T-23		yes
	Freezer	Master B&H			?
Rooms	TV	Sharp	LC-20E1UWM		no
	Mini Bar Fridge	Dometic	not-known (same as raleigh)		no
	Blow Dryers	Sunbeam	1622-000		
	Dvd Player	toshiba	sd395054		yes
	Ceiling Fan	Unknown			?
	Ipod Player	iHome	HiH66WX		no

Programmable Thermostats

Energy control systems that allow management to have centralized control of individual rooms can be a powerful tool for increasing energy efficiency. During periods of low occupancy, entire wings or floors can be closed down to reduce lighting and HVAC system demands in these areas. Guests can be assigned to adjoining rooms to allow the cooling of occupied rooms to act as a buffer or insulator. A programmable thermostat program helps to ensure that unoccupied rooms revert back to a predetermined setback temperature. Some systems include a motion sensor or carbon dioxide sensor to determine if the room is indeed occupied. Sensor lighting, timers, motion detectors, carbon dioxide monitors, and key activated systems are commercially available. Occupancy sensors detect people in a room and automatically turn lights on and off. These sensors cost between $25 and $80 and are an excellent option for spaces that may be unoccupied for portions of the day. Consider installing occupancy sensors in private offices, conference rooms, restrooms, and storage areas. Table 25 shows data from a California Energy Commission/U.S. Department of Energy, Electric Power Research Institute study which determined the maximum energy savings potential under optimized conditions (cited in APPA and ASBDC 2003).

Table 25. Energy savings potential in spaces with occupancy sensors.

Application	Energy Savings
Private Office	25 – 50%
Open Office Space	20 – 25%
Restrooms	30 – 75%
Corridors	30 – 40%
Storage	45 – 65%
Meeting Rooms	45 – 65%
Warehouse	50 – 75%

Pineapple Hospitality piloted programmable in-room digital thermostats at a 132-room Holiday Inn Express in Arkansas. The systems last up to 10 years and cost $100 to install. In the test case scenario, they paid for themselves in 3 – 12 months with 25% energy savings. In the test case, before installation, each block of six guestrooms was tied into a compressor with no control system. Thus it was possible to have four guestrooms placing high temperature demands on a compressor and two others requesting cold climates at the same time, causing the compressor to malfunction. With a programmable thermostat, the operations staff locked in temperature limits of 72 – 74°F in the summer and 66 – 68°F in winter and eliminated compressor shutdowns (Burger 2005).

Programmable units are now available with concealed temperature set points, peak set points, mold/mildew controls, and keyboard lockouts for public areas. Some systems come with a lanai switch input, which allows the unit to shut-off the A/C when the external screen door is ajar, and others come equipped with an electroluminescent display that doubles as a nightlight.

The Raleigh Hotel has analog thermostats, some of which contain mercury switches (Figure 34), so they are an excellent candidate for replacement. The Standard Hotel also does not currently use programmable thermostats (Figure 35).

Figure 34. The Raleigh Hotel guest rooms do not have programmable thermostats.

Figure 35. The Standard Hotel guest rooms do not have programmable thermostats.

Energy Management System

An Energy Management System (EMS) is a program that allows operators to monitor the building's energy load. The most common use is monitoring for the HVAC. An EMS usually includes a computer, an energy management software program, sensors and controls, and in larger systems, a communications network. An energy management system can save 10% to 40% on electric bills. Consider benchmarking and building commissioning to provide a basis of comparison for energy savings. Commissioning is a process in which engineers observe a building and make adjustments to ensure that systems are operating appropriately and efficiently. Commissioning typically occurs when a facility first opens, but re-commissioning periodically can also be beneficial. For a typical 100,000 ft^2 hotel, re-commissioning can achieve about $13,000 (10 – 15% of annual energy bills) in savings per year, from resetting existing controls to reduce HVAC waste while maintaining or even increasing comfort levels for occupants. Commissioning can be costly, however, with professional services estimated at about 5 – 40 cents/ft^2. State of the art, energy management systems are relatively easy to install in new construction. Older properties can be retrofit with off-the-shelf technologies available from some of the Florida Green Lodging Vendor Partners. However, hotels that share indoor areas with retail or merchandising or dining facilities that are operated through leasing or subcontracting can be more complicated.

The Raleigh does not have any energy management systems or devices and does not collect any energy data or readings by hand. The Standard does have some manual monitoring of energy data and also has a neutron energy management system for the lighting systems in the lobby areas. Installation of EMS is an opportunity for both properties to engage in active energy efficiency monitoring and control and is highly recommended.

Sensor or Solar Lighting

Some systems that can assist with energy efficiency include motion sensors to determine if the room is occupied. Sensor lightings, timers, motion detectors, and key activated systems are commercially available. Occupancy sensors detect people in a room and automatically turn lights on and off. These sensors cost between $25 and $80 and are an excellent option for spaces that may be unoccupied for portions of the day. Consider installing occupancy sensors in private offices, conference rooms, restrooms, and storage areas. Table 26 shows data from a California Energy Commission/U.S. Department of Energy, Electric Power Research Institute study which

determined the maximum energy savings potential under optimized conditions (cited in APPA and ASBDC 2003).

Table 26. Energy savings potential in spaces with occupancy sensors.

Application	Energy Savings
Private Office	25 – 50%
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Restrooms	30 – 75%
Corridors	30 – 40%
Storage	45 – 65%
Meeting Rooms	45 – 65%
Warehouse	50 – 75%

In both the two participating hotels, timer lighting (Figure 36) and some limited sensor lighting (Figure 37) is available.

Figure 36. Lighting timer in the Raleigh (left) and the Standard (right).

Figure 37. Closet light sensor at the Raleigh.

High-Efficiency Lighting

Improvements to the lighting design can have considerable effects on the overall energy efficiency and performance of the property. Lighting is a major energy demand in most hotels. According to Florida Power & Light Company (2004), interior lighting accounts for 19% (3.6 kWh/ft^2) and exterior lighting accounts for 4% (0.7 kWh/ft^2) of electricity usage in hotels and motels. Upgrading the lighting systems offers a high-return, low-risk investment. For instance, the Williams Inn in Williamstown, MA saved over 64,000 kWh in one year by installing more efficient lighting. The system cost $830 after utility rebates and saved the Inn $5776 in electricity bills over the first year. This amounted to a payback period of less than one month (USEPA 2004). To reduce energy losses from lighting, the following practices are recommended:

Minimize use of artificial light. This is a pollution prevention concept. Using just enough light reduces the amount of energy consumed for lighting purposes. Hotels should consider eliminating or reducing external lighting not needed for safety or security. External lighting costs can be reduced by using photo-cells that detect ambient light or employing time clock controls that automatically turn off lights when not needed. Another technique for reducing lighting demand is to consider using natural daylight wherever possible. Using natural light will reduce lighting energy consumption; however, heat gain may occur in summer with open draperies and shades forcing the air conditioning systems to work harder. Lights in unoccupied areas should be turned off, whenever possible. Reminder placards for guests and staff to turn off lights when leaving a room can help get more compliance with this practice. Occupancy sensors can be used to detect the presence or absence of people for automatically turning lights on and off, accordingly. Occupancy sensors may reduce lighting energy consumption by 50% or more in some circumstances (Burkett 2007). They are used most effectively in spaces that are often unoccupied, including offices, warehouses, storerooms, restrooms, loading docks, corridors, stairwells, lounges, and conference rooms. Open-plan office spaces, where people may be moving in and out throughout the day, are not good candidates for occupancy sensors. Another technique is to use the lowest wattage lamp necessary to reduce energy requirements without sacrificing light intensity. Very often, spaces are overlit. Removing bulbs in pairs to reduce excessive lighting levels can be effective at reducing energy consumption while maintaining the desired lighting effect. Dimmer controls can also be installed in spaces such as meeting rooms and corridors. Dimmers control light output so that no more light than necessary is produced thereby reducing lighting energy consumption. Another option is to utilize light-colored walls and

ceilings because they act as reflective surfaces for artificial and natural lighting and can result in an increase of 15 – 50% in light intensity. Using natural light for daytime illumination will not only decrease the consumption of energy, but will also create a healthier indoor environment for the building's inhabitants. Another way of bringing the outside environment inside is by providing abundant views of the natural or urban landscape surrounding the building. The combination of daylight and views will create a sense of openness inside the building that may have subliminal effects such as inducing a sense of freedom, relaxation, and appreciation for the natural environment. According to the USEPA (2007), patients in hospitals designed with green building concepts such as daylight and views recover faster. Calculation of glazing factors or (alternatively) a physical measurement of indoor light intensity (every 10 ft spacing with a light meter) can be done by a hired professional to achieve maximum coverage of daylighting. Effects are maximized if at least 75% of the rooms in the building have daylight access and 90% have outside views (USGBC 2005).

Use energy efficient lighting. Maintenance is responsible for about 9% of total lighting costs to a hotel. Since lamp life is the main driving force for maintenance costs, installing longer-life lamps is a simple way to minimize maintenance dollars and reduce labor costs and operating expenses. Energy-efficient lighting solutions can reduce energy expenditures by up to 75%, simply by replacing outdated inefficient lamps. Many hotels have realized important decreases in energy consumption by merely replacing standard incandescent bulbs with energy-efficient compact fluorescent light bulbs. Less than 5% of energy used by incandescent lamps generates useful light. The remaining 95% is wasted as heat loss, which incidentally also increases air conditioning costs. High-efficiency compact fluorescent bulbs are 66% - 75% more efficient than comparable incandescents, last 8 - 20 times longer (> 15,000 hours), and do not emit lost energy in the form of heat, saving up to $30 per lamp annually or up to $82 over the life of the lamp (Sindoni 2006). Other efficient alternatives include: 1) halogen lamps, which last 2 – 4 times longer and are twice as efficient as incandescents, saving $25 over the life of the bulb, but they have high operating temperatures; 2) metal halide lamps, and 3) high-pressure sodium lamps, which generate a yellow light commonly used in parking lots and exterior walls, are 5 – 6 times as efficient as indandescents (APPA and ASBDC 2003). There are also directional lamps, dimmable lamps, and reflector lamps that offer intermediate savings and moderate color rendering index (CRI) improvements compared to conventional incadescents. Diffuse light is more expensive in terms of energy consumption, so focused light, from the use of task or spot lighting halogen lamps, is more efficient (APPA and ASBDC 2003). In 2004, FPL estimated that standard incandescent lamps made up 48% of the total lamp inventory in Florida hotels and fluorescent lamps accounted for 34%, while energy-efficient compact fluorescent lamps accounted for only 15% (FPL 2004). Clearly, there is much room for improvement.

Another replacement program involves swapping out the conventional T12 lamps in favor of the energy-saving fluorescent T8 lamps, which are one-inch diameter compared to the T12 that are 1.5 inch in diameter. A typical fluorescent fixture with two T12 lamps uses 96 watts (Hinton et al. 2004), while a high-efficiency electronic ballast with two T8 lamps uses only 62 watts, representing a savings of 35% on energy consumption. Both systems generate the same amount of light, but the energy efficient T8 lamps produce much better color rendition. Newer 25 watt T8 lamps save up to 21% on energy and last 60% longer than standard 30 watt T8 lamps (Sindoni 2006). T5 lamps offer more power, increased light output (90 lumens per watt), and longer life. Electronic ballasts are available that achieve 90% efficiency in power transfer and saves 2 – 5 watts over standard instant start electronic ballasts. They use the lowest amount of power, while maintaining 100 Lumens per watt with the latest T8 lamps (Sindoni 2006).

Another opportunity to utilize energy efficient lighting is to replace standard incandescent exit signs with light-emitting diode (LED) exit signs. Energy Star® rated LED exit signs use up to 75% less energy and are estimated to last up to 220,000 hours. LED exit signs can operate with less than 5 watts, while conventional incandescent lamps require 40 watts per sign. Over a 10-year period, first costs, energy expenditures, and maintenance requirements for an incandescent sign will run around $380, while a comparable LED unit with a 10-year life would incur overall costs of about $65 (Hinton et al. 2004). According to the USEPA and Department of Energy, 100 million exit signs with incandescent lights are estimated to be in use in the United States. These consume 30 – 35 billion kWh per year. If all were switched to LED, electricity costs would be reduced by $75 million (USEPA and DOE 2007).

Approximately 40% of guests leave the bathroom nightlight on (E Source 2004), and research undertaken by WRA International (cited in www.pineapplehospitality.net) indicates that 16% of travelers actually bring their own nightlights with them on the road. LED night lights can be installed with motion sensors to reduce energy costs while improving guest safety. These will also eliminate the need to leave bathroom lights on throughout the night. Replacing four 100-watt halogen bathroom lamps at a Marriot and a Homes Suites Inn in Massachusetts with motion sensor nightlights demonstrated a payback period of less than one year for a system that is documented to last over 10 years. The newest LEDs have 50,000 hour life cycles (6 – 7 years of regular use) with 50 lumens per watt. Regular incandescent lamps have typically only 10-12 lumens per watt. One of the easiest energy-saving opportunities in guestroom lighting is eliminating the unnecessary extended operation of the bathroom fixtures. Energy Star® fixtures distribute light more efficiently and evenly than standard fixtures. They are readily available in decorative styles including portable fixtures, such as table, desk and floor lamps, and hard-wired options such as dining facilities, kitchen ceilings, under-cabinet lighting, hallway ceiling and walls, and bathroom vanity fixtures. Additional features can offer more energy savings, such as dimmers, automatic daylight shut-offs, and motion sensors for outdoor lighting. Finally, clean bulbs and lighting fixtures will generate more light intensity. Thus for maximum efficiency, remove dust from the surface of the light bulb.

In order to further increment energy savings and indoor environmental comfort level, it is recommended that some areas be fitted with dimmers and/or dimmable CFLs. Currently, there is a limited availability of dimmable CFLs with outputs higher than 15W (equivalent to 65W in an incandescent light bulb). Therefore, these lamps are only recommended for areas with low ceilings where different dimming settings are desirable. An alternative to using high output lamps to compensate for ceiling height is using directed task lighting fixtures. This application is typically seen in kitchens and workspaces, where light has to be focused on the specific task. These fixtures are readily available from numerous manufacturers and are compatible with dimmable and non-CFLs.

Figure 38. Evidence of high efficiency (Energy Star® rated) lighting in place at the Raleigh.

A detailed lighting schedule is currently being assembled to determine the types and numbers of bulbs in use at both properties. Examples of light fixtures are found in Figure 39.

Figure 39. Many of the light fixtures in the Raleigh Hotel (top left, top right, and bottom left) and the Standard (bottom right) are still using old style incandescent bulbs.

The research team is still in the process of quantifying all of the light bulbs and lighting fixture units and types at each of the properties in the study. A sample of the inventory is shown in Table 27 and Table 28 by analyzing the lighting stockroom areas (Figure 40) and conducting a visual inspection of the facilities.

Figure 40. Lighting inventory for the Raleigh.

Table 27. Preliminary lighting schedule for the Raleigh Hotel.

The Raleigh							
Location	**Manfacturer**	**Description**	**Product #**	**Watts**	**Volts**	**Hours**	**Number**
Guest Room							
Bed sconces	Sylvania			100			
Hanging lamp	Sylvania			100			
bathroom sconces	Sylvania			100			
Closet	Sylvania			40			
Minibar							
Suite							
Bed sconces	Sylvania			100			
Floor lamp	SATCO			150			
Bathroom sconces	Sylvania			100			
Bathroom sconces	Sylvania	Halogen		50			
Penthouse							
Living Room recessed	Sylvania	Halogen flood light		50			
Common area hallways	Westinghouse			25			
Common area hallways	Sylvania	Halogen flood light		50			
Common area entrance	Sylvania	Halogen flood light		50			
Entrance chandelier	SATCO	Candelabra		7			
803 chandelier	SATCO	Candelabra		7			
Penthouse bathrooms sconces	Sylvania	Halogen flood light		50			
Corridors:							
East/West	Sylvania			40			
North/South	Sylvania			25			
Elevator	Sylvania			15			
Front entrance	SATCO	Glass pole frosted		25			
Entrance lights	?	Pole (white) Decorative bulb		25			
Rope lights in columns	12 v. 5.5 w per Ft	12 v. 5.5 w per ft					
Canopy lights	?	Spot halogen		50			
Mexican lights	Sylvania			50			
Raleigh Sign	Westinghouse			60			
Lobby							
Recessed lights @ front desk	SATCO	Reflector spotlight		25			
Rope lights in ceiling	120 v 5.5w per Ft						
Front desk lamps	SATCO	Reflector spotlight		25			
Floor lamps	Westinghouse			75			
Coffee Bar:	Westinghouse			40			
Martini Bar							
recessed ceiling lights	Sylvania	Halogen		50			
picture lights	?	Tubular		25			
wall sconces (TBD)	Sylvania	Halogen		50			
Lounge:							
floor lamps	100 watt Sylvania			100			
wall sconces on columns	40 watt Westinghouse			40			
table lamps	40 watt Westinghouse			40			
picture lights	General Electric	Tubular		25			
picture lights	SATCO	cand clear switchboard					
picture lights	Westinghouse	Tubular					
Ballroom							
Recessed lights	Sylvania	Halogen		50			
Pendant lights	Sylvania			100			
Back terrace							
Floor lamps	SATCO	Fan bulb		40			
Floor lamps	SATCO	Appliance bulb		40			
Mexican lights	Philips	Appliance bulb		13			
Bar lights	Allura clear			15			
Tree	Westinghouse			40			
Pool/Oasis							
Palm up lights	Sylvania	Halogen		50			
Mexican lights	Philips	miniature light bulbs 12 v - 2 prong		13			
Cabana	SATCO	Yellow		25			
Grill	Allura Clear			25			
Pool bar	Westinghouse			25			
Pool bar	Westinghouse			75			

Table 28. Preliminary lighting schedule for the Standard Hotel.

The Standard							
Location	**Manfacturer**	**Description**	**Product #**	**Watts**	**Volts**	**Hours**	**Number**
	SATCO	Reflector Flood	s4455	120-130	N/A	2500	
	Halco	Pool Lamp Flood	r40	300	12	N/A	
	Allura	Decorator light bulbs	a3631	25	130	2500	
	westinghouse	n/a	#04112	60	130	5000	
	Sylvania	n/a	2a19	100	120	750	
	Sylvania	n/a	Par38	75	120	5000	
	Phillips	n/a	fl25	75	120	3000	
	SATCO	fan and appliance bulb	s3810	40	130	1500	
	tungsram	reflector indoor downlight	r-20	50	n/a	2000	
	Blue Party Bulb	n/a	BPESL13T/B	13	120	8000	
	Original Ferro Watt Bulb	n/a	f-1920-4	60	120	n/a	
	S14 sign blues	n/a	s14-11c	n/a	130	n/a	
	Phillips Circline	n/a	813182	22	n/a	12000	
	GE outdoor floodlight 90	n/a	17451	90	n/a	2500	
	N/A	Skinng flourescent bulb	f16t4	16	n/a	n/a	
	Osram	special linestra	1106	150	125	n/a	
	GE-soft white flourescent	soft white flourescent	F30	30 (T12)	N/A	18000	
	SATCO	High intensity bulb, bayonet base	S3723		12-16	1500	
	SATCO	Silver crown	S3955	60	130	1000	
	Linestra	OSRAM		60	125	n/a	
	Radium		RAZ2 35 W/O	35	125-130	n/a	
	Philips	Classictone	A60 FR 1073471	40	125-130		
	SATCO	Frosted light bulb	S5030	40	130	2500	
	Carex	Mat pearl		40	130		
	Edison Lame	Victorian bulb	B22 BC	60	110-120		
	SATCO	Frosted liquid bulb		36-40	120-130	5000	
	SATCO	Color reflector (R20/pink medium)		50	130		
	Sylvania	FAISC for large halogen campaign		35	120	400	
	Star Light	Halogen		50	120	2500	
	Philips	Halogen MR16		50		300	
	SATCO	G4 10 Basic Dichromic Reflective	S3517	50		3000	
		Halogen dichromic	G4 10	50	130		
	Feit Electric	High quality halogen reflective flood	MR 16	50	130		
	SATCO	Halogen JDR MR 16 Short narrow flood	S4623	20	120		
	SATCO	Decorative light bulbs candelabra base		7	130	1500	
	Westinghouse	Halogen long life		40	120	1500	
	SATCO	Festoon lamp	S6984	5	12		
	SATCO	Reflective R14	S4700	25	120	1500	
	Westinghouse			10	12	2000	
	TCP		iR3011IB		120		
	TCP		113145B		120		
	Feit Electric	CFL	PLAN	13			
	Philips	Fluorescent Alto Collection T8	F 34T12/CW/RS/EW	34			
	Sylvania	Octron Eco T8	F O 32/741/ECO	32			

Dimmers, occupancy sensors, and photocells can also improve the energy efficiency required for illumination. In rooms where lights could be shutdown after becoming vacant, occupancy sensors should be installed. These sensors scan the room continuously for movement, and switch off the lighting load if no activity is detected in the room after a set interval. Both hotels have installed dimmer switches throughout the property as seen in Figure 41.

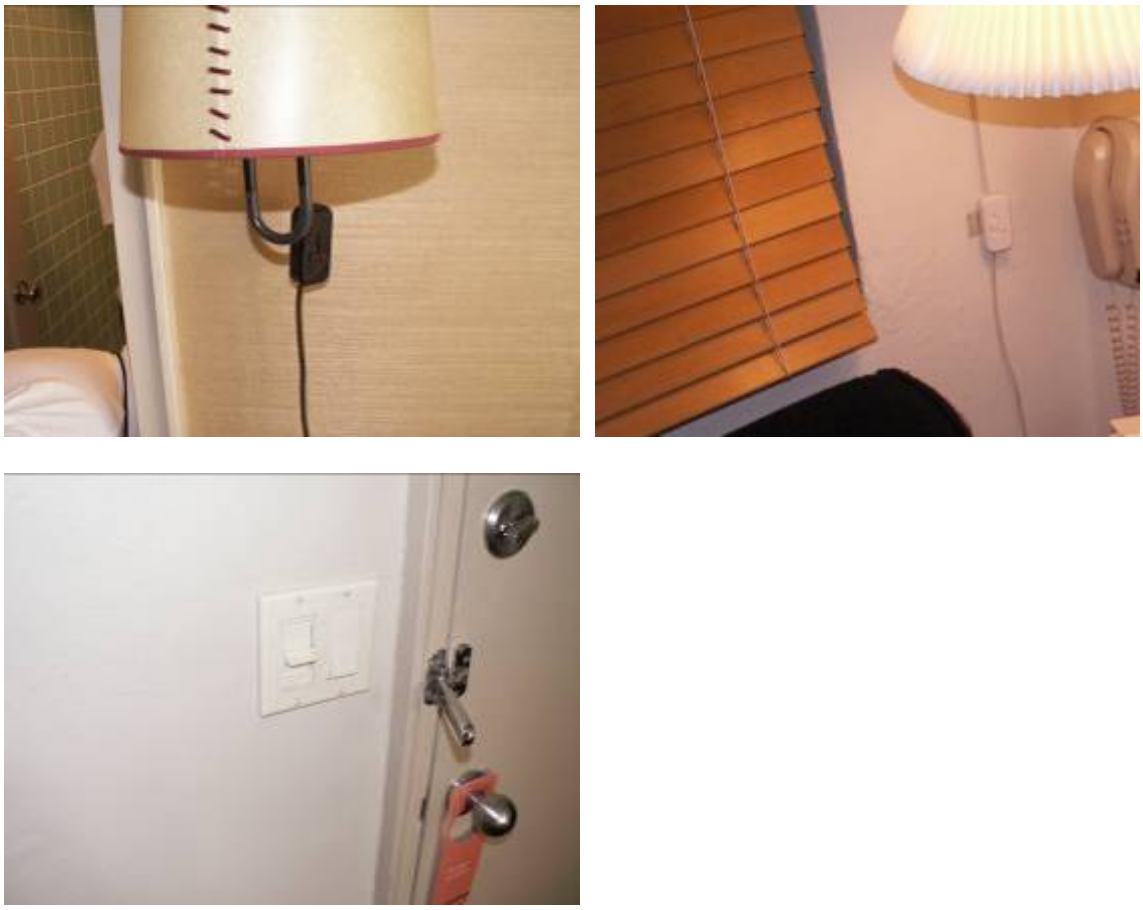


Figure 41. Dimmer switches in the guest rooms of the Raleigh (Left) and the Standard (Right).

A company called "Wattstopper" offers an ultrasonic sensor (UW-200), which also has lighting control features. This product can be obtained through Eco-Logical Solutions. In addition to sensing the occupancy of the room, the amount of light in the room is measured to avoid turning on the lighting loads if sufficient natural sunlight is available through the windows. Occupancy sensing combined with delighting will yield the highest amounts of energy savings possible in the application. These sensors are also capable of controlling two lighting loads. Even when control delays are programmed, these sensors continuously monitor the controlled space to identify usage patterns and automatically adjust the time delay for optimal energy efficiency.

Exterior Lights can be connected to a photocell that will turn off all landscape and exterior lighting when the sun is out. A reliable photocell for residential applications is the Intermatic K4221C. One of these has to be connected to every exterior light circuit and be placed on the outside of the house. Light level tolerance can be easily adjusted.

Additional Lighting Audit – Raleigh Hotel. A vendor called IDesign used a web-based life cycle cost estimator to conduct a lighting comparison for the exterior front canopy entrance, the hallways, and the lounge areas after conversion to LED lamp systems. The model assumed that the lamps were in use for 3650 hours per year at a cost of $0.10/kWh. For the canopy zone, there are currently 500 fixture Watts per lamp with 3000 hours of life and average lumens of 11. The

costs were assumed to be $99 including disposal with an additional $50 labor for replacement. The comparison product (LED Spot Lamp) has 120 fixture Watts per lamp with a lifetime 10 times longer (30,000 hours), and average lumens of 34. The costs are $1,080 including disposal with an additional $50 labor for replacement. The life cycle savings for changing just ten 50-Watt bulbs in the front canopy is computed to be $182.50 per year. The model also conservatively computes the cost of doing nothing as an additional $1,387 per year just in waiting to upgrade the lighting system from halogens to LEDs. There is currently quite a bit of additional power being consumed with the halogen lights. Furthermore, the analysis does not include changing the existing halogen bulbs throughout the year as they burn out. The payback period for this analysis is 9 months. A similar analysis is conducted for the two other areas, and is summarized in Table 29.

Table 29. Summary of life-cycle cost comparisons for potential lighting system upgrades at the Raleigh Hotel.

Location	Type	Number of lamps	Usage hr per year	Lifetime hours	Lumens	Fixture Watts per lamp	Replacement costs	Life-Cycle Savings per Year	Cost of Do Nothing per year	Payback period in months
Canopy	Halogen	10	3,650	3,000	11	50	$149	n/a	$1,387	n/a
Canopy	LED	10	3,650	30,000	34	12	$1,130	$183	n/a	9
Hallway	Incand.	48	8,760	2,500	12	40	$18	n/a	$1,177	n/a
Hallway	LED	48	8,760	30,000	34	12	$97	$2,832	n/a	46
Lounge	Edison	96	8,760	2,500	12	40	$292	n/a	$23,760	n/a
Lounge	LED strip	96*	8,760	30,000	30	4.5	$5,380	$3,066	n/a	21

*8 fixtures: to replace each side of the column, there are (8) bulbs. The calculation includes (8) feet of warm white LED strips, 110 degree beam angle per each side of (3) columns.

Windows and Doors

Open doors and windows allow conditioned air to escape and outside air to enter. This requires additional energy to maintain comfortable temperatures. Windows and doors should be shut when not in use. Hotels may consider installing automatic door closing arms for bathrooms and guest room doors. Any cracks around operable windows, doors, openings, and through-the-wall or window type HVAC units should be sealed with caulk. In addition, damaged weather-stripping allows inside air to leak and outside air to enter. This requires additional energy to maintain comfortable temperatures. Door sweeps, weather-stripping, and gaskets on doors and windows should be inspected often and repaired if damaged. Finally, window replacement technologies should be evaluated because can decrease annual energy costs by up to 15% if properly installed by reducing losses and solar heat gain (FPL 2004). These systems can be used in new construction or window retrofits. Examples include: energy efficient windows, window treatments, or double-paned windows. Types of window treatments include, standard glazing, tinted glazing, reflective glazing, spectrally selective glazings, window films, and insulated glazing. Films reduce cooling loads, improve shatter resistance, block up to 99% of ultraviolet radiation, and reduce glare. The key parameter for windows is the Solar Heat Gain Coefficient (SHGC), which measures how well a window blocks heat from sunlight. The SHGC is the fraction of the heat from the incident sunlight that enters through a window. The lower a window's SHGC value, the less solar heat it transmits. Another parameter is the Shading Coefficient (SC), which can be related back to the SHGC by multiplying by 0.87. It is recommended to install windows with SHGC < 0.40 or SC < 0.45 (Ohlsen 2007). Most standard windows are rated by the National Fenestration Rating Council (NFRC), which will have the SHGC value printed on the label. Additional parameters include the U-factor, which measures how well a product prevents heat

from escaping, and the VT (visible light transmittance) value, which is an optical property that indicates the amount of visible light transmitted. A high VT is desirable to maximize daylight.

Energy Star® qualified windows, doors, and skylights are also available, which can save energy, increase the thermal comfort, and protect interior items from sun damage and fading. For windows, this is accomplished by the following technologies: 1) improved framing materials that reduce heat transfer and insulate better; 2) multiple pane systems that utilize a gas-filled space have a greater energy efficiency, increased impact resistance, and sound insulation; 3) low E (low emissive) glass uses special coatings to reflect infrared radiation that carries heat into the building and also reflects ultraviolet radiation to protect interior furnishings from fading; 4) gas fills using argon or krypton insulate better than air-filled spaces between panes; and 5) warm edge spacers keep the multiple panes apart by using advanced materials, which reduce heat flow and prevent condensation. For doors, energy savings are accomplished using multiple panes, tighter weather stripping, and energy efficient core materials. For skylights, the new energy-efficient technologies for windows also apply. In addition, tubular daylighting devices can also be used to transport sunlight into the core of the building or into closets, bathrooms, hallways, and other spaces without direct access to windows.
When planning a new construction or major renovation, consider orienting windows to the north to take advantage of indirect sunlight and using roof overhangs can help reduce solar heat gain by providing shade from the direct sunlight. Overhangs are much less effective against the lower angles of the east and west sun, therefore reducing the size and number or east and west facing windows can also help reduce energy use. Rather than using overhangs or louvers, strategically planting shade vegetation near the south, east, and west-facing windows will help reduce cooling requirements.

Rebates and tax credits for windows, doors, and skylights are available. The Energy Star® website[2] has a locator tool to help individuals and businesses earn up to $500 in federal tax credits (Energy Policy Act of 2005) and search for local rebates as well. These include sales tax exemptions or credits and rebate programs.

Both the Raleigh (Figure 42) and the Standard (Figure 43 and Figure 44) have issues with the windows (which are older and somewhat protected by the historical preservation society). In addition, the Standard Hotel has issues with noise and condensation, in particular with the jalousie windows.

[2] www.energystar.gov/index.cfm?fuseaction=rebate.rebate_locator

Figure 42. Typical window construction in the Raleigh Hotel.

Figure 43. The Standard jalousie windows with visible condensation.

Figure 44. The Standard operable windows with hand crank on east side of the property (Left). The west wing of the Standard Hotel has different window style (Right).

Window Film. One of the vendor participants, Madico Inc., conducted an energy analysis using Demand Analyzer, an energy simulation software package developed by ITEM Systems. Demand Analyzer utilizes the U.S. Department of Energy's DOE-2 whole-building energy analysis software for estimating energy savings from energy use and operating costs for each hour of the year, using typical weather data for the selected location. Additional information about ITEM Systems and Demand Analyzer is available at http://www.halcyon.com/byrne and DOE-2 information can be found at http://gundog.lbl.gov. In summary, the application of energy conservation window film products to the Raleigh Hotel may result in significant energy cost savings. For the products considered, the projected annual savings is $18,459 and the minimum payback period is 1.02 years (see Table 30). FPL is also providing a rebate of up to $1000 for the installation of window films. This figure is not included in the estimates below. The parameters that were used in the DOE-2 modeling are listed in Table 31.

Table 30. Summary of projected energy savings from window film protection at the Raleigh Hotel.

	Annual Energy Cost ($)	Annual Energy Cost Savings ($)	Installed Cost ($)	Simple Payback (Years)
Raleigh Hotel	198,052	-------	-------	-------
Raleigh Hotel with SL 280/RS 440	179,593	18,459	18,795	1.02

Neither the party presenting this report (AIMCAL), the referenced film manufacturer, nor the film seller assumes liability in connection with the inability to realize the estimated energy savings shown.

Table 31. Summary of building parameters used in the DOE-2 model for the Raleigh Hotel.

Parameter	Raleigh Hotel	Raleigh Hotel with SL 280/RS 440
Building Type	Motel/Small Lodging	Motel/Small Lodging
Vintage	Pre-1978	Pre-1978
Category	Raleigh Hotel	Raleigh Hotel
Climate Zone	FL Miami	FL Miami
Utility Rates	default	default
Floor Area (ft^2)	67536	67536
Aspect Ratio (E-W width / N-S width)	1.0	1.0
Building Azimuth (degrees)	0.0	0.0
Electricity: Energy Cost per kWh	0.103	0.103
Electricity: Demand Cost per kW	0.103	0.103
Electricity: Minimum Demand Cost per kW	0.0	0.0
Electricity: Fixed Cost per Month	0.0	0.0
Electricity: Minimum Cost per Month	0.0	0.0
Electricity: Maximum Effective Rate per kWh	0.0	0.0
Natural Gas: Energy Cost per therm	0.5	0.5
Natural Gas: Fixed Cost per Month	0.0	0.0
Natural Gas: Minimum Cost per Month	0.0	0.0
Natural Gas: Maximum Effective Rate per therm	0.0	0.0
Occupant Density (sq.ft./person): Rooms Occupied 12 Hours/Day	100.0	100.0
Occupant Density (sq.ft./person): Rooms Occupied 24 Hours/Day	100.0	100.0
Occupant Density (sq.ft./person): Office	240.0	240.0
Occupant Density (sq.ft./person): Facilities, Laundry	460.0	460.0
Indoor Occupancy Sensors	No	No
Indoor Lighting (W/sq.ft.): Guest Rooms	1.12	1.12
Indoor Lighting (W/sq.ft.): Corridors	0.5	0.5
Indoor Lighting (W/sq.ft.): Office	1.05	1.05
Indoor Lighting (W/sq.ft.): Facilities, Laundry	0.7	0.7
Outdoor Lighting: Type	Mercury Vapor Lamps	Mercury Vapor Lamps
Electrical Equipment (W/sq.ft.): Guest Rooms	1.41	1.41
Electrical Equipment (W/sq.ft.): Office	0.87	0.87
Electrical Equipment (W/sq.ft.): Facilities, Laundry	1.41	1.41
Thermostat Setting (F): Heating, Setback	63.0	63.0
Thermostat Setting (F): Cooling, Setback	75.0	75.0
Thermostat Setting (F): Heating, Guest Rooms	72.0	72.0
Thermostat Setting (F): Cooling, Guest Rooms	75.0	75.0
Thermostat Setting (F): Heating, Corridor	70.0	70.0
Thermostat Setting (F): Cooling, Corridor	78.0	78.0
Thermostat Setting (F): Heating, Office	70.0	70.0
Thermostat Setting (F): Cooling, Office	76.0	76.0
Thermostat Setting (F): Heating, Facilities, Laundry	70.0	70.0
Thermostat Setting (F): Cooling, Facilities, Laundry	78.0	78.0
Ceiling/Roof Insulation (R-val)	5.0	5.0
Roof Absorptance	0.8	0.8
Air Curtain Entrance	No	No
Adjacent Shading: North	No	No

Parameter	Raleigh Hotel	Raleigh Hotel with SL 280/RS 440
Adjacent Shading: East	No	No
Adjacent Shading: South	No	No
Adjacent Shading: West	No	No
Window Area (sq.ft.): North	1200.0	1200.0
Window Area (sq.ft.): East	1527.0	1527.0
Window Area (sq.ft.): South	1200.0	1200.0
Window Area (sq.ft.): West	1032.0	1032.0
Window Setback (ft): North	0.5	0.5
Window Setback (ft): East	0.5	0.5
Window Setback (ft): South	0.5	0.5
Window Setback (ft): West	0.5	0.5
Window Shading (SC): North	0.8	0.8
Window Shading (SC): East	0.8	0.38
Window Shading (SC): South	0.8	0.38
Window Shading (SC): West	0.8	0.38
Window Glass Type: North	5014,Single, Clear, 6mm	5014,Single, Clear, 6mm
Window Glass Type: East	5014,Single, Clear, 6mm	5038,RS-440, 1/4", clear, single pane
Window Glass Type: South	5014,Single, Clear, 6mm	5038,RS-440, 1/4", clear, single pane
Window Glass Type: West	5014,Single, Clear, 6mm	5038,RS-440, 1/4", clear, single pane
DHW Heater Type	Gas	Gas
DHW Heater Efficiency	0.8	0.8
DHW Tank Insulation	No	No
DHW Pipe Insulation	No	No
DHW Circulation Pump Timeclock	No	No
Ventilation Rate (cfm per person)	20.0	20.0
Duct Insulation	No	No
HVAC System Clocks	No	No
Energy Management System	No	No
Deadband Thermostats	No	No
Heating System	Electric Furnace	Electric Furnace
Cooling System	Packaged Terminal A/C	Packaged Terminal A/C
Heating System Efficiency	0.75	0.75
Cooling System Efficiency	2.2	2.2
Infrared Space Heaters	No	No

Energy Recovery Ventilators

Another technology to consider is an energy recovery ventilation (ERV) system. ERVs reduce the costs of cooling outside air by transferring energy from the conditioned inside air to cool the warmer outside supply air, thereby reducing the temperature differential that the HVAC system has to battle against. The most efficient ERV units meet the ARI 1060 rating with a winter effectiveness that exceeds 65% (Burkett 2007). FPL has incentive grant programs to offset the costs for adding ERV systems.

Solar Hot Water

Currently, the Raleigh has three natural gas water heaters to heat the pool. Two of the units are not in service, and the third is not being used efficiently. This could be an opportunity to switch to solar hot water heating. The Raleigh has limited roof area available for supplying space for a solar hot water heater. However, the natural gas-fired pool heaters are currently offline and could be readily replaced with a solar hot water system. The Standard has already upgraded the roof systems on the property (Figure 45). There is a possibility that the roof area can be used for collecting solar energy for hot water heating in the guest rooms and also for heating the infinity pool. The Raleigh has three newer hot water heaters in the basement boiler room.

Figure 45. New roof installation on east wing of the Standard.

Preventative Maintenance

Preventative maintenance plans are cost effective to establish. The implementation of regularly scheduled preventive maintenance for all of the property's major appliances will increase energy efficiency. This plan should include annual tune-ups, filter replacement, leak checks, caulking, weather-stripping (see Figure 46), sealing, and cleaning.

Figure 46. Air gaps in doorways and windows evident throughout the Raleigh property (left) and also the Standard property (right).

Ceilings and Roof Systems. Insulation reduces the heat flow through the building envelope. Ceiling insulation is a key factor in achieving thermal comfort levels within any building. To maximize energy efficiency, all gaps where air can leak in or out, including those around windows, doors, wiring holes, recessed lights, and plumbing vents must be sealed. Energy savings of up to 15 – 20% have been reported from installing guest room ceiling insulation or radiant barrier systems at a cost of $200 per room. This has a reported payback period on the order of one year (PA Consulting Group 2001). To maximize energy efficiency, the use of at minimum R-19 insulation in the walls and R-30 is preferred for ceilings. Appropriate insulation will reduce heating and cooling loads by making the building tighter, but there is a tradeoff, as tighter buildings will also trap indoor air contaminants.

In terms of roof systems, green roof or cool roof technology may be effective. White or reflective roofing helps reflect heat and keep buildings cool. Cool Roof products are available as Energy Star® qualified based on ASTM E 903 with an incident solar reflectance (ICR) of 0.65 or greater (Burkett 2007). Cool roof materials have a high incident solar reflectance, or albedo, and a high thermal emittance, which is defined as the percentage of energy that a given material can radiate away after it is absorbed. Most cool roof applications for low-slope buildings have a smooth, bright white surface to reflect solar radiation, reduce heat transfer to the interior, and reduce air conditioning demand. On a typical summer day, traditional roofing materials may reach peak temperatures of up to 190°F (88°C). By comparison, cool roofs will not exceed temperatures of 120°F (49°C), reducing the heat gain by 37%.

Another alternative to traditional roofing is a vegetated rooftop garden or "green roof." Unfortunately, in many parts of Florida, green roof technology must also include a rooftop irrigation system to keep the garden alive during the dry season, which could end up being a large seasonal water demand and a large energy demand for pumping that water up to the roof. Both systems help keep the roof material cooler and reduce the heat island effect.

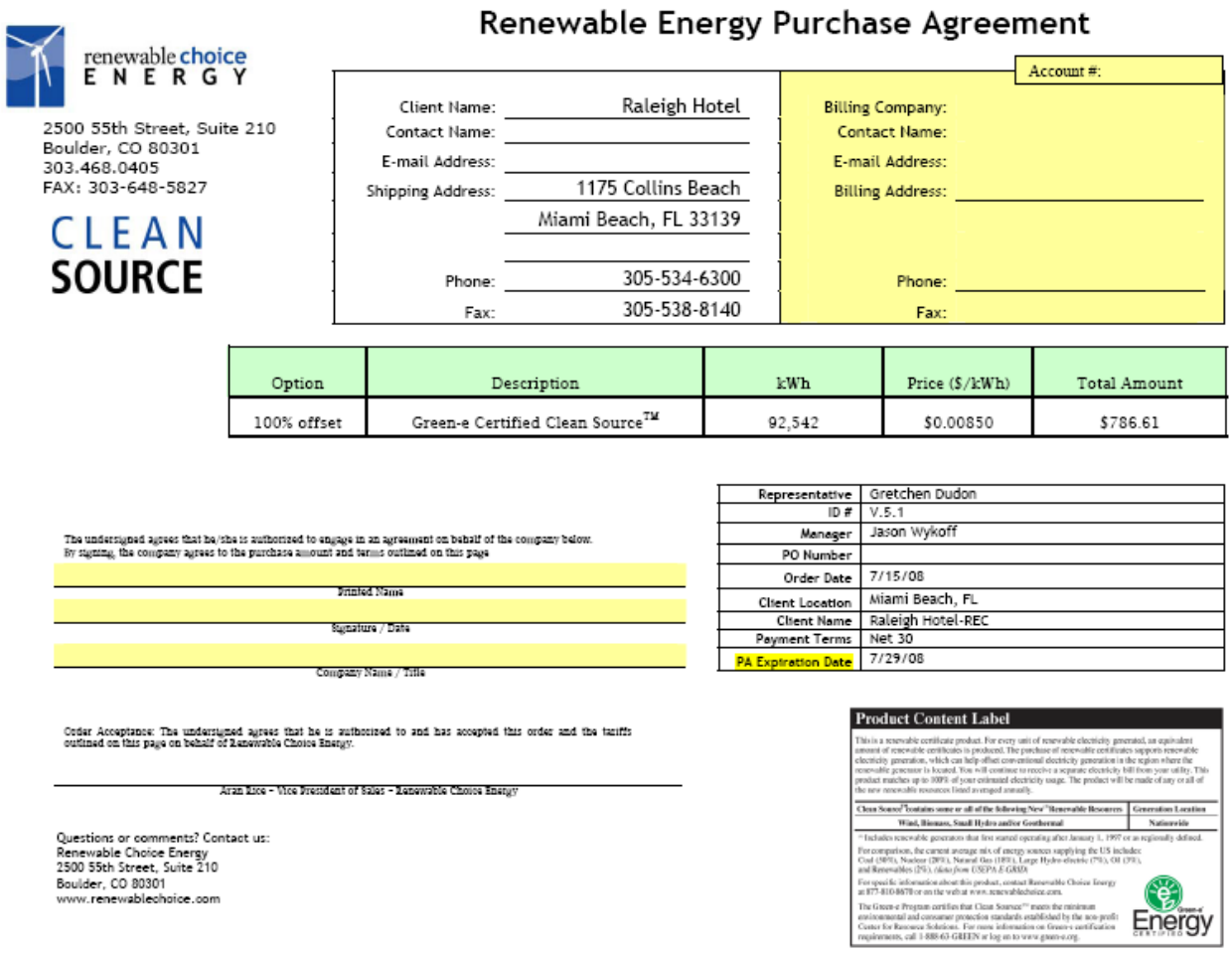
Green Power

Green power is electricity that is generated from renewable resources such as: solar, wind, geothermal, biomass, and low-impact hydro facilities. The USEPA has developed a program called the Green Power Partnership to encourage organizations to utilize green power as a part of an integrated environmental management plan. According to the USEPA, the nation's single largest industrial source of air pollution is the generation of electricity, based on the combustion of conventional fossil fuels (USEPA 2004). The lodging industry can do its part to lower its energy consumption and reduce the environmental impacts of conventional electricity generation by beginning to use renewable energy technologies or by supporting Green Power programs, purchasing green credits offsets, or by directly purchasing renewable energy through the local utility or decentralized power systems.

Additional benefits to Green Power are price stabilization and energy security. By entering into long-term agreements, energy pricing can be locked in over the life of the contract. Furthermore, since these sources do not use fuels, the volatile cost of fuel is eliminated from the cost of energy, and since Green Power does not need to be transported, there is no chance of spills occurring. In terms of energy security, renewables eliminate the need to import fuels, thus the energy source is always available, regardless of international geopolitical conflict.

Florida Power and Light Company (FPL) has a Green Power Partnership initiative called the Sunshine Energy® program for residential customers. For an additional charge of $9.75 per month, customers can subsidize the development of new renewable sources of electricity. For every 10,000 customers who sign up, an additional 150 kW of solar power arrays will be built in Florida. The program ensures the purchase of environmental credits worth 1,000 kWh of electricity produced by renewable energy generation facilities, helping to avoid over 8,000 pounds of carbon dioxide emissions each year (www.fpl.com/sunshine). The 2005 Green Power Leadership award was awarded to FPL for this program. This award is sponsored by USEPA and DOE, for recognizing leading national green power purchasers and suppliers for their commitment to developing new renewable energy sources. The program started in 2004 and has about 23,000 customers enrolled (FPL 2004). Presently, there are no plans to offer this program to business or commercial customers.

Implementation Project: Green Power. As explained in the earlier section on Vendor Fairs, one of the companies that specialize in renewable energy purchasing, Renewable Choice Energy, was solicited to assist the hotels in meeting their green power requirement. For the Raleigh Hotel an agreement to purchase 5% Green-E Certified Clean Source™ energy is shown in Figure 47, which covers 92,542 kWh, and for the Standard Hotel, the agreement for a similar 5% offset is shown in Figure 48, which covers 120,646 kWh.



renewable choice ENERGY

2500 55th Street, Suite 210
Boulder, CO 80301
303.468.0405
FAX: 303-648-5827

CLEAN SOURCE

Renewable Energy Purchase Agreement

Account #:

Client Name:	Raleigh Hotel	Billing Company:	
Contact Name:		Contact Name:	
E-mail Address:		E-mail Address:	
Shipping Address:	1175 Collins Beach	Billing Address:	
	Miami Beach, FL 33139		
Phone:	305-534-6300	Phone:	
Fax:	305-538-8140	Fax:	

Option	Description	kWh	Price ($/kWh)	Total Amount
100% offset	Green-e Certified Clean Source™	92,542	$0.00850	$786.61

The undersigned agrees that he/she is authorized to engage in an agreement on behalf of the company below. By signing, the company agrees to the purchase amount and terms outlined on this page

Printed Name

Signature / Date

Company Name / Title

Order Acceptance: The undersigned agrees that he is authorized to and has accepted this order and the tariffs outlined on this page on behalf of Renewable Choice Energy.

Aran Rice - Vice President of Sales - Renewable Choice Energy

Questions or comments? Contact us:
Renewable Choice Energy
2500 55th Street, Suite 210
Boulder, CO 80301
www.renewablechoice.com

Representative	Gretchen Dudon
ID #	V.5.1
Manager	Jason Wykoff
PO Number	
Order Date	7/15/08
Client Location	Miami Beach, FL
Client Name	Raleigh Hotel-REC
Payment Terms	Net 30
PA Expiration Date	7/29/08

Product Content Label

This is a renewable certificate product. For every unit of renewable electricity generated, an equivalent amount of renewable certificates is produced. The purchase of renewable certificates supports renewable electricity generation, which can help offset conventional electricity generation in the region where the renewable generator is located. You will continue to receive a separate electricity bill from your utility. This product matches up to 100% of your estimated electricity usage. The product will be made of any or all of the new renewable resources listed averaged annually.

Clean Source™ contains some or all of the following New** Renewable Resources	Generation Location
Wind, Biomass, Small Hydro and/or Geothermal	Nationwide

** Includes renewable generators that first started operating after January 1, 1997 or as regionally defined.

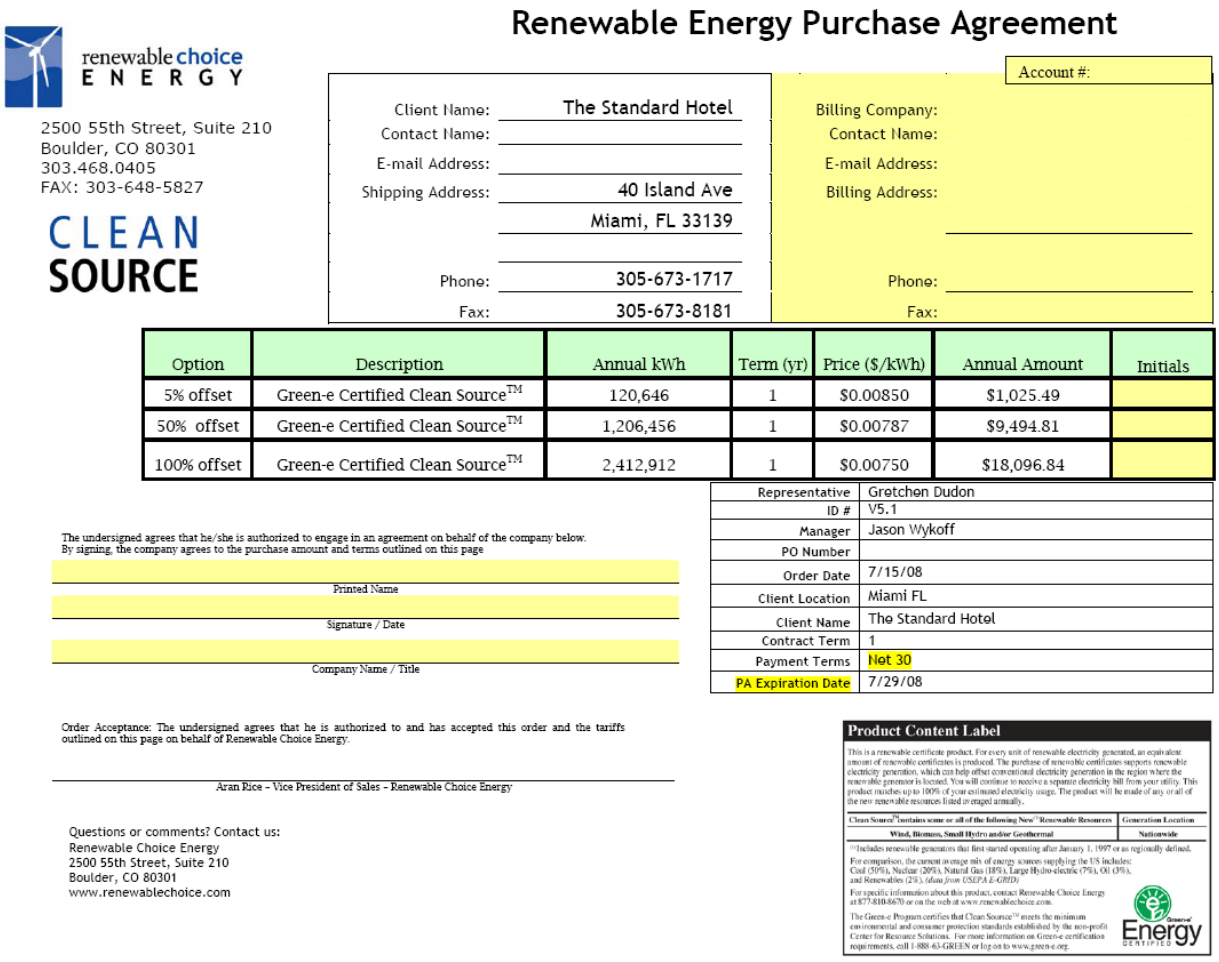
For comparison, the current average mix of energy sources supplying the US includes: Coal (50%), Nuclear (20%), Natural Gas (18%), Large Hydro-electric (7%), Oil (3%), and Renewables (2%). *(data from USEPA E-GRID)*

For specific information about this product, contact Renewable Choice Energy at 877-810-8870 or on the web at www.renewablechoice.com.

The Green-e Program certifies that Clean Source™ meets the minimum environmental and consumer protection standards established by the non-profit Center for Resource Solutions. For more information on Green-e certification requirements, call 1-888-63-GREEN or log on to www.green-e.org.

Green-e Energy CERTIFIED

Figure 47. Renewable energy purchase agreement for the Raleigh Hotel.



renewable choice ENERGY

2500 55th Street, Suite 210
Boulder, CO 80301
303.468.0405
FAX: 303-648-5827

CLEAN SOURCE

Renewable Energy Purchase Agreement

Account #:

Client Name:	The Standard Hotel	Billing Company:	
Contact Name:		Contact Name:	
E-mail Address:		E-mail Address:	
Shipping Address:	40 Island Ave	Billing Address:	
	Miami, FL 33139		
Phone:	305-673-1717	Phone:	
Fax:	305-673-8181	Fax:	

Option	Description	Annual kWh	Term (yr)	Price ($/kWh)	Annual Amount	Initials
5% offset	Green-e Certified Clean Source™	120,646	1	$0.00850	$1,025.49	
50% offset	Green-e Certified Clean Source™	1,206,456	1	$0.00787	$9,494.81	
100% offset	Green-e Certified Clean Source™	2,412,912	1	$0.00750	$18,096.84	

Representative	Gretchen Dudon
ID #	V5.1
Manager	Jason Wykoff
PO Number	
Order Date	7/15/08
Client Location	Miami FL
Client Name	The Standard Hotel
Contract Term	1
Payment Terms	Net 30
PA Expiration Date	7/29/08

The undersigned agrees that he/she is authorized to engage in an agreement on behalf of the company below. By signing, the company agrees to the purchase amount and terms outlined on this page

Printed Name

Signature / Date

Company Name / Title

Order Acceptance: The undersigned agrees that he is authorized to and has accepted this order and the tariffs outlined on this page on behalf of Renewable Choice Energy.

Aran Rice - Vice President of Sales - Renewable Choice Energy

Questions or comments? Contact us:
Renewable Choice Energy
2500 55th Street, Suite 210
Boulder, CO 80301
www.renewablechoice.com

Product Content Label

This is a renewable certificate product. For every unit of renewable electricity generated, an equivalent amount of renewable certificates is produced. The purchase of renewable certificates supports renewable electricity generation, which can help offset conventional electricity generation in the region where the renewable generator is located. You will continue to receive a separate electricity bill from your utility. This product matches up to 100% of your estimated electricity usage. The product will be made of any or all of the new renewable resources listed or staged annually.

Clean Source™ contains some or all of the following New[1] Renewable Resources	Generation Location
Wind, Biomass, Small Hydro and/or Geothermal	Nationwide

[1] Includes renewable generators that first started operating after January 1, 1997 or as regionally defined.

For comparison, the current average mix of energy sources supplying the US includes: Coal (50%), Nuclear (20%), Natural Gas (18%), Large Hydro-electric (7%), Oil (3%), and Renewables (2%). *(data from USEPA E-GRID)*

For specific information about this product, contact Renewable Choice Energy at 877-810-8670 or on the web at www.renewablechoice.com.

The Green-e Program certifies that Clean Source™ meets the minimum environmental and consumer protection standards established by the non-profit Center for Resource Solutions. For more information on Green-e certification requirements, call 1-888-63-GREEN or log on to www.green-e.org.

Green-e Energy CERTIFIED

Figure 48. Renewable energy purchase agreement for the Standard Hotel.

Additional Incentives

Most energy service providers offer energy audits to assist businesses in implementing energy conservation programs. FPL offers a free comprehensive review of facility energy usage through their Business Energy Evaluation (BEE) program. The review includes the following systems: rate schedule, power usage patterns, building envelope (walls, roof, ductwork, windows, caulking, and weather stripping), HVAC, process systems (motors, air compressor, elevators, conveyors, food preparation, refrigeration equipment, and computers), lighting, water heating, and energy management systems. An account analysis is performed that takes into account site-specific factors, such as weather and occupancy data, to compare energy usage with other customers in the commercial sector and in the lodging industry.

Hotels should look for specific rebate programs such as the following:

- Commercial/Industrial Direct Expansion Unit (DX) Program
- Chiller Program
- Thermal Energy Storage Program
- Energy Recovery Ventilator (ERV) Program

- Efficient Lighting Program
- Building Envelope Program
- Packaged Thermal Heat Pump Program

In addition, many utilities offer lower rates for usage during off-peak hours. Hotels should consult with their local electricity service provider to see if "*Time of Day*" rates are offered. This is an incentive program that rewards customers who agree to use appliances during off-peak hours. Regardless of participation in off peak pricing programs, it is recommended to run major energy-consuming electronics during the hours of 8:00 pm - 6:00 am.

Florida Power and Light Company (FPL) offers an additional package called "*Business On Call*." For this incentive program, FPL will temporarily interrupt the air conditioning system of participating customers during periods of peak electricity demand, if required. In return, the participant receives a credit of $2 per ton of air conditioning, per month, from April through October, on their electricity statement, even if FPL is not forced to interrupt service during the billing period. For a 20-ton unit, that totals an annual savings of $280. Because air conditioning cycles on and off during normal operation, customers and employees may not notice the temporary interruption.

A service exists for listing available energy incentive programs at the state and federal level. This service has a webtool for accessing more information from local service providers called the "*Database for State Incentives for Renewables and Efficiency*" (www.dsireusa.org) (Ohlsen 2007). The State of Florida Energy Office (www.floridaenergy.org) also offers incentive programs such as: the Solar Energy Rebate Program, the Renewable Energy Corporate Tax Program (focused on alternative fuel vehicles, infrastructure, and backup power systems), and the Renewable Energy Technology Grant Program.

Federal programs include:

- Energy Efficient Commercial Buildings Tax Deduction
- Business Energy Tax Credit
- Modified Accelerated Cost-Recover System (MACRS) for Green Power
- Alternative/Hybrid/Fuel Cell Motor Vehicle Credits
- Electric Vehicle Tax Credit

Energy Management System (EMS) Pilot Test

Raleigh Hotel – Sunshine Solar Systems EMS

A second vendor was also tested at the Raleigh. This vendor installed a Telkonet product on the same floor as the Entergize™ Energy Control system. Based on the data downloaded on September 11, 2008, the occupancy detection system was working adequately as evidenced by:

1. Cooling time being reduced to 24%, while unoccupied.
2. The unit was only occupied for 32% of the time, about what would be expected for guests sleeping in Miami Beach, FL.

Without occupancy detection, the unit would have run 50% of the time, even though the unit was only occupied for 32% of the time. Note that even though the unit was unoccupied 68% of the time, it only ran 24% of its total run time during this sampling duration. This data combined with

the fact that no complaints were logged during the period would seem to support the effectiveness of the system. This data set is only partial, and further updates will be provided in subsequent progress reports.

Raleigh Hotel – Inn^2 Technolgies (Entergize™ Energy Control System)

A field test was conducted at the Raleigh Hotel, Miami Beach, Florida, to determine the potential reduction in in-room HVAC electrical usage if the Hotel's guest rooms were retrofitted with the Entergize™ Energy Control System ("System"). The Entergize™ System is designed to control energy consumption in hotel rooms, based on the room's occupancy status. The System automatically determines if a hotel room is vacant or occupied and based on this occupancy condition, the system automatically sets the operating ranges of the in-room HVAC system. For purposes of this test, the System was set to shut off an unoccupied room's HVAC system unless the actual in-room temperature exceed 78°F or dropped below 60°F. In an occupied room, the System was programmed to shut off the heating system when the room temperature reached 78°F and the air-conditioning cycle when the room temperature drops below 68°F.

The procedure used to determine the potential reduction in in-room HVAC electrical usage by installing the System, was to retrofit one guest room (Room 601) with the System (Entergize™ Room) and compare its electrical usage to a comparable room (Room 603) that did not have the System installed. Both rooms used in this test are identical in size and shape with base dimensions of 12' by 30' equaling 360 square feet. The rooms are located on the 6th floor with the room window facing the East. Each room is similarly furnished and uses a 208 volt, FHP Manufacturing Company Fan Coil HVAC System - Model EM009, to provide the rooms with heating and cooling.

A Dickson Temperature Data Logger model SK100 (DTDL) was installed in each of the test room's HVAC unit. The DTDL is an electronic monitoring device that periodically records the effective temperature at the output vent. The results of these temperature readings will permit us to establish the time and duration of the "on" and "off" cycles of the HVAC unit. The difference between the actual "on cycle" durations in each of the test rooms over the control test period becomes the basis to project the reduction in energy consumption that was achieved by installing the Entergize™ System in the Hotel's guest rooms.

For clarification purposes, the following graph highlights one 24 hour period during the test period. The indicated temperatures are sampled at the A/C inlet vent to the room and will therefore appear inflated compared to the actual ambient temperature in the room. By examining the sine curves we can establish the duration of time that the HVAC unit switched on and off. In this one day example, the calculated "run time" for the controlled room (601) was 7.2 hours while the "run time' for the regular room (603) was 19.6 hours. Keep in mind that this is a snapshot of only one day that may have experienced different guest circumstances; however, the difference in run time is substantial.

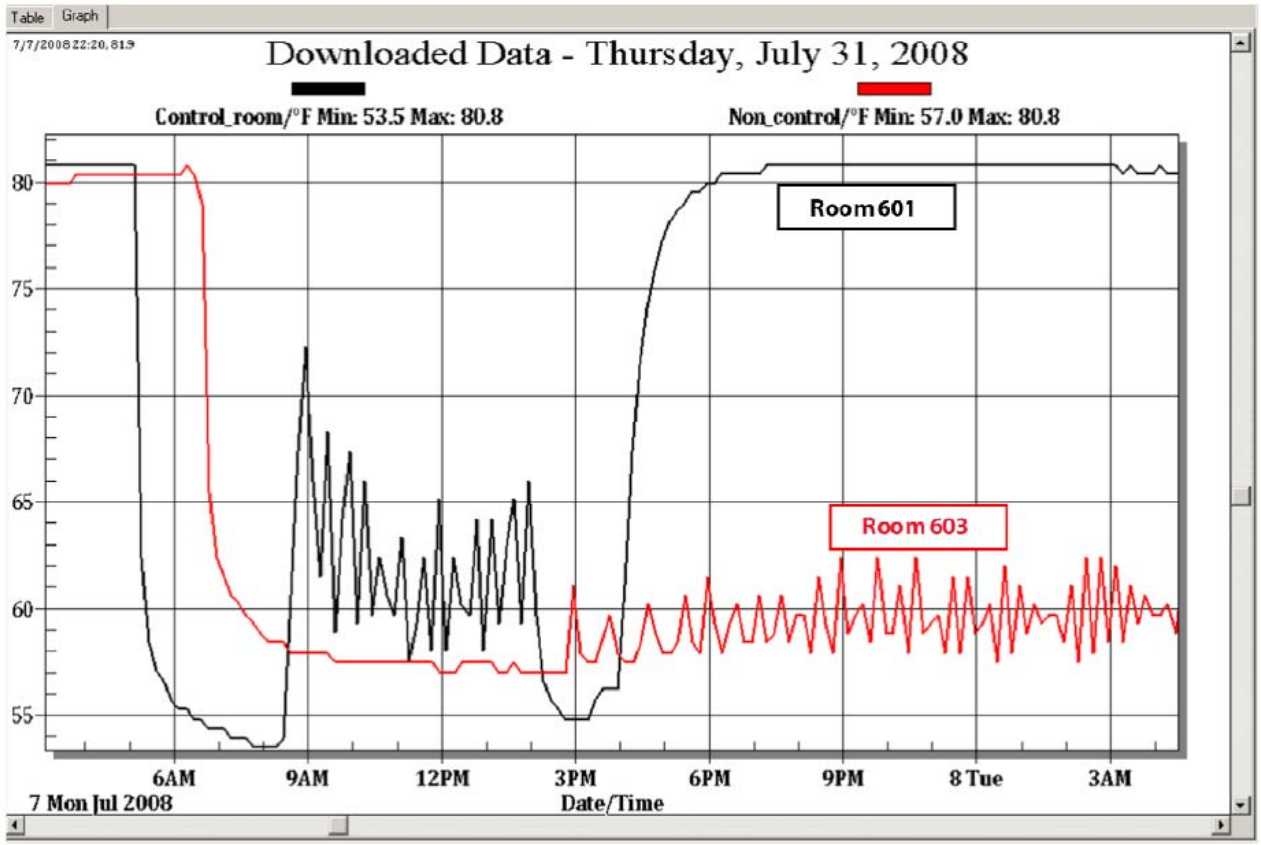


Figure 49. Comparison of downloaded run time data from Inn[2] Technologies, LLC EMS pilot study on July 31, 2008 from room 601 and room 603 at the Raleigh Hotel.

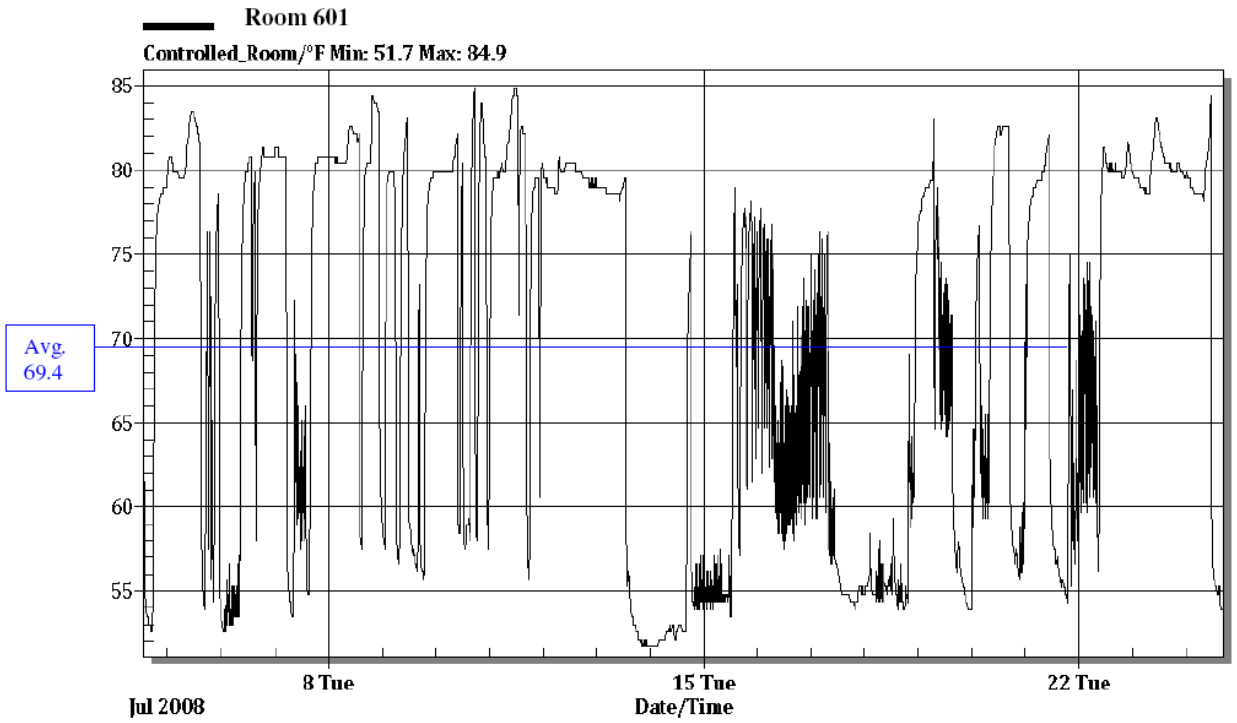


Figure 50. Individual room temperature recordings during test period for the controlled room (601) from July 5 – July 25, 2008.

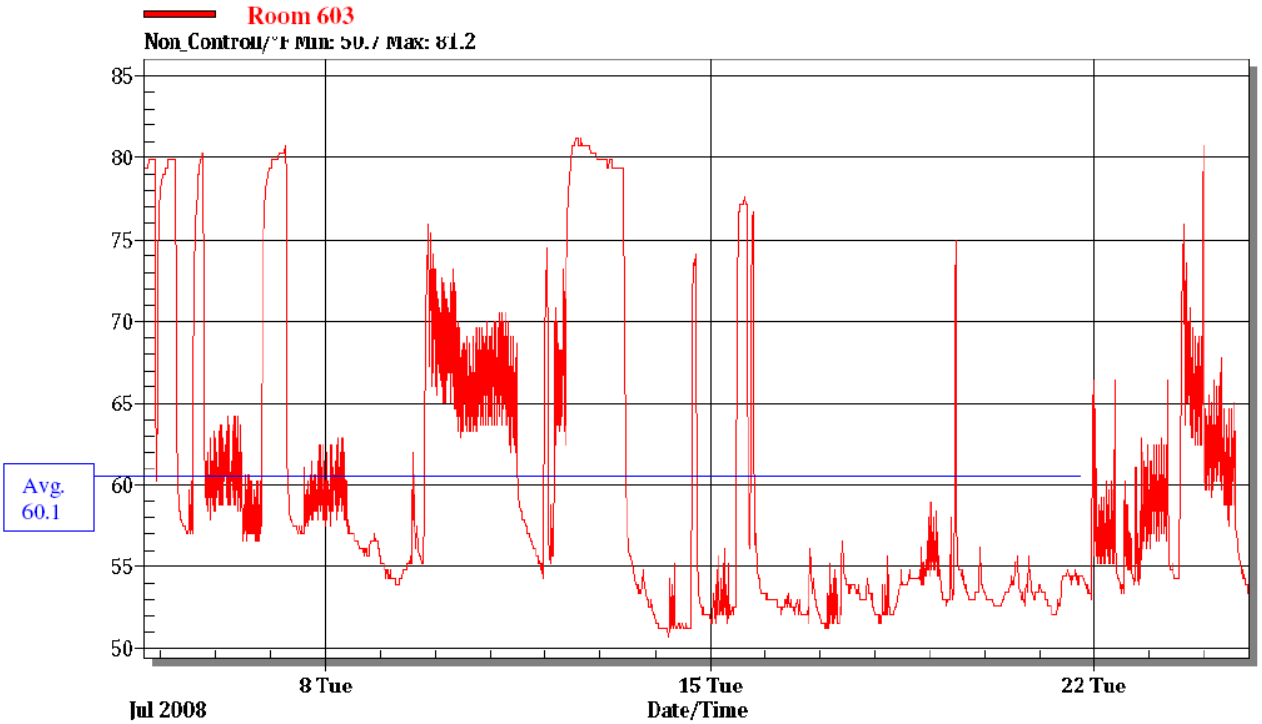


Figure 51. Individual room temperature recordings during test period for the non-controlled room (603) from July 5 – July 25, 2008.

By overlaying the room graphs, we get an unmistakable contrast of HVAC operations. The adjoining rooms cope with the same time, exposure, occupancy, environment and climate conditions. Guest habits towards temperature settings may be different, but over a period of time they will average similarly and become a non-factor.

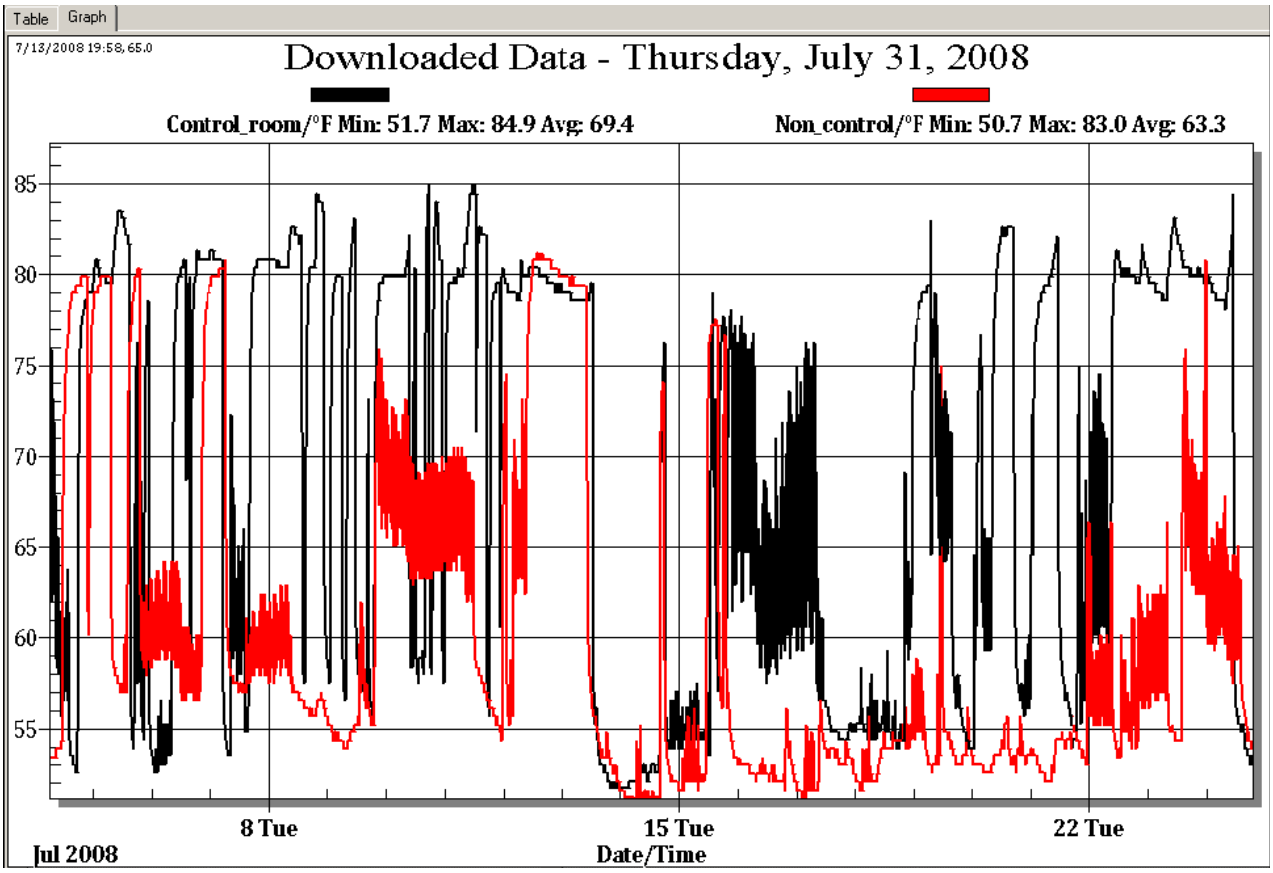


Figure 52. Overlay of individual room temperature recordings from July 5 – July 25, 2008.

In order to determine the power draw of the HVAC equipment at the Raleigh Hotel when in cool operating mode, a recording device (HOBO Data Logger manufactured by Onset Technologies) was employed to sample the amperage or power consumption of the air-conditioner electrical circuit. Pictured in Figure 53 below are the results of the measurement. The HVAC equipment operates at 208 V with two 110 V legs:

- Leg 1 indicates 2.78 amps
- Leg 2 indicates 2.84 amps
- Operating amperage is the average of the two legs: 2.81 amps

To determine the wattage, we can use the following formula: Watts = Volts x Amps. Accordingly, we can determine that the HVAC unit will draw 584 watts (208 X 2.81) during cooling operation.

Since heating is used only sparingly, it was elected not to include the higher heat amperage requirement to avoid skewing the results.

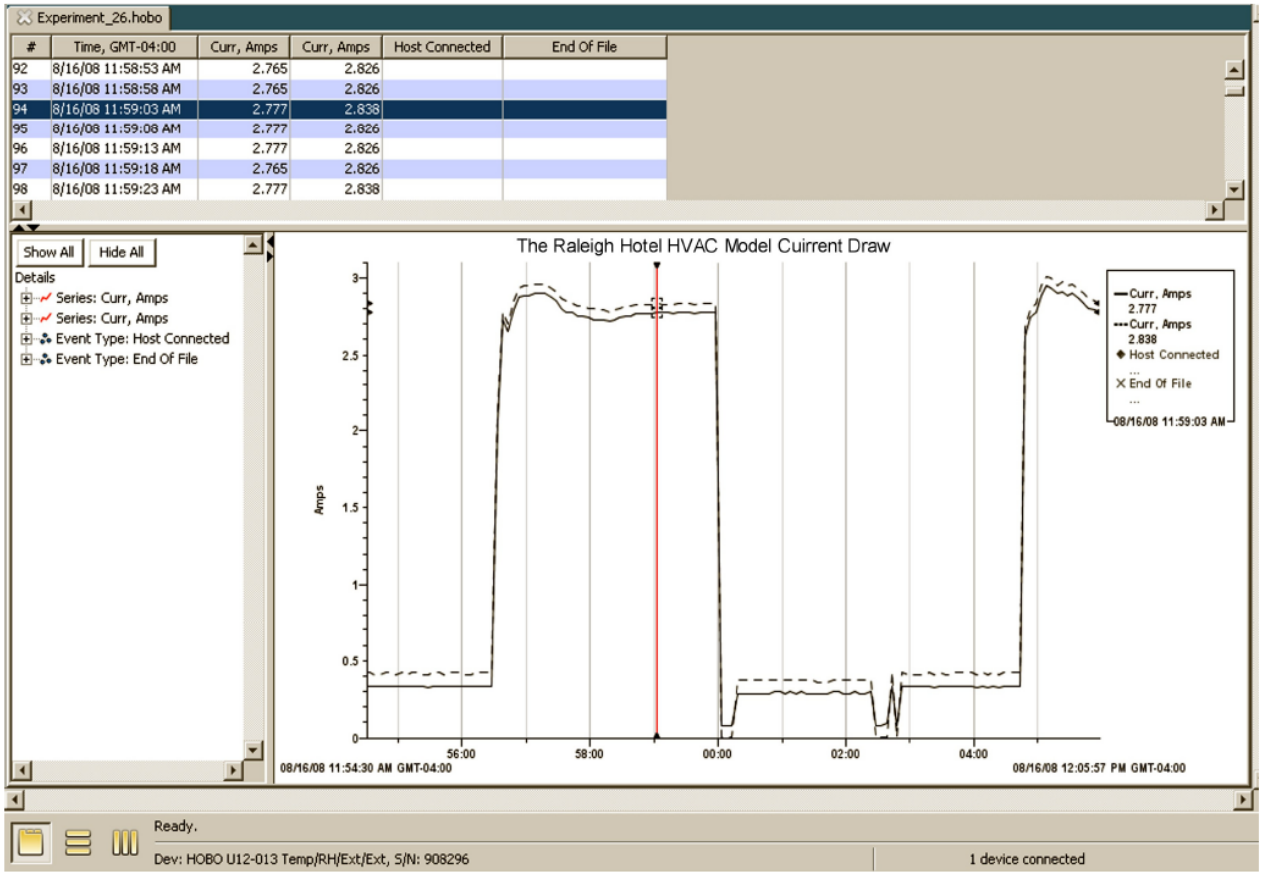


Figure 53. Determination of current usage when HVAC is in operation.

Table 32 summarizes the results of the comparison measurements in the two test rooms and also contains the calculation converting the amperage readings into Watts and then a thirty-day period kWh usage and cost estimate, based on the average amperage for each period at the hotel's current rate for electricity.

Table 32. Active run time computation based on the Dickson data logger summaries during the test period from July 4, 2008 to July 24, 2008 (20 days) at the Raleigh Hotel.

Parameter	Room 601 Controlled	Room 603 Non-Controlled
Minimum Value	51.7°F	50.7°F
Average Value	69.5°F	60.1°F
Maximum Value	84.9°F	81.2°F
Decreasing Periods ("ON") of 10 minute duration	1,488	2,289
Hours "ON" Time Over 20 days	248	382

Table 33. Energy usage summary and costs for the comparison study from July 4, 2008 to July 24, 2008 (20 days) at the Raleigh Hotel.

Room	"ON" hours per 20 days	Estimated "ON" hours per month	HVAC Watts	kWh	Cost
Room 601 Controlled	248 hr	370.1 hr	584	216.17	$22.05
Room 603 Non-Controlled	382 hr	570.1 hr	584	332.97	$33.96

From Table 33, the difference in energy usage between the controlled room and the non-controlled room amounted to 116.8 kWh (or 35%) at a net monthly savings of $11.91/room. The results of this field test show that installing the Entergize™ Energy Control System in each of the Hotel's guest rooms will result in a substantial reduction (35%) in the in-room HVAC energy load. The actual amount of savings will very from month to month, based on occupancy levels, seasonal climate conditions, and individual guest usage patterns.

As a percentage of the entire month's energy usage as per FPL bill the amount attributed to HVAC usage appears lower than expected. If energy usage is assumed to be similar in every guest room, then guest room HVAC usage represents 21% of all hotel usage. Typically this guest room HVAC usage value is closer to 35% – 40% of the total energy usage. Keep in mind that summer months do not lend themselves to maximum savings. Although temperatures are at extremes and place HVAC cooling systems at great demand, even if the room is vacant, there are more times during the summer than other seasons that the system must allow the HVAC to run just to maintain the set back temperature due to the high temperature of the outside air. The total cost to supply and install the Entergize™ Energy Control system in all 104 guest rooms is quoted at $27,000. At this installation price, the system will pay for itself in 2 years at 6% interest.

Standard Hotel – Inn^2 Technolgies (Energy-Eye™ Energy Control System)

A similar test was conducted at the Standard Hotel using the Energy-Eye™ Energy Control System. For clarification purposes, the following graph highlights one 24-hour period during the test period from August 24, 2008 to August 25, 2008. The indicated temperatures are sampled at the A/C outlet vent to the room and will therefore appear inflated compared to the actual ambient temperature in the room. By examining the sine curves we can establish the duration of time that the HVAC unit switched on and off. In this one day example, the calculated "run time" for the Energy-Eye™ controlled room (4) was 9.6 hours, while the "run time" for the regular room (11) was 12.5 hours. It is important to note that Standard Hotel management demanded the set-back temperature not exceed a very conservative 72°-74°F when a room was unoccupied (due to the potential for mold issues) and even with that constraint, the difference in run time is significant.

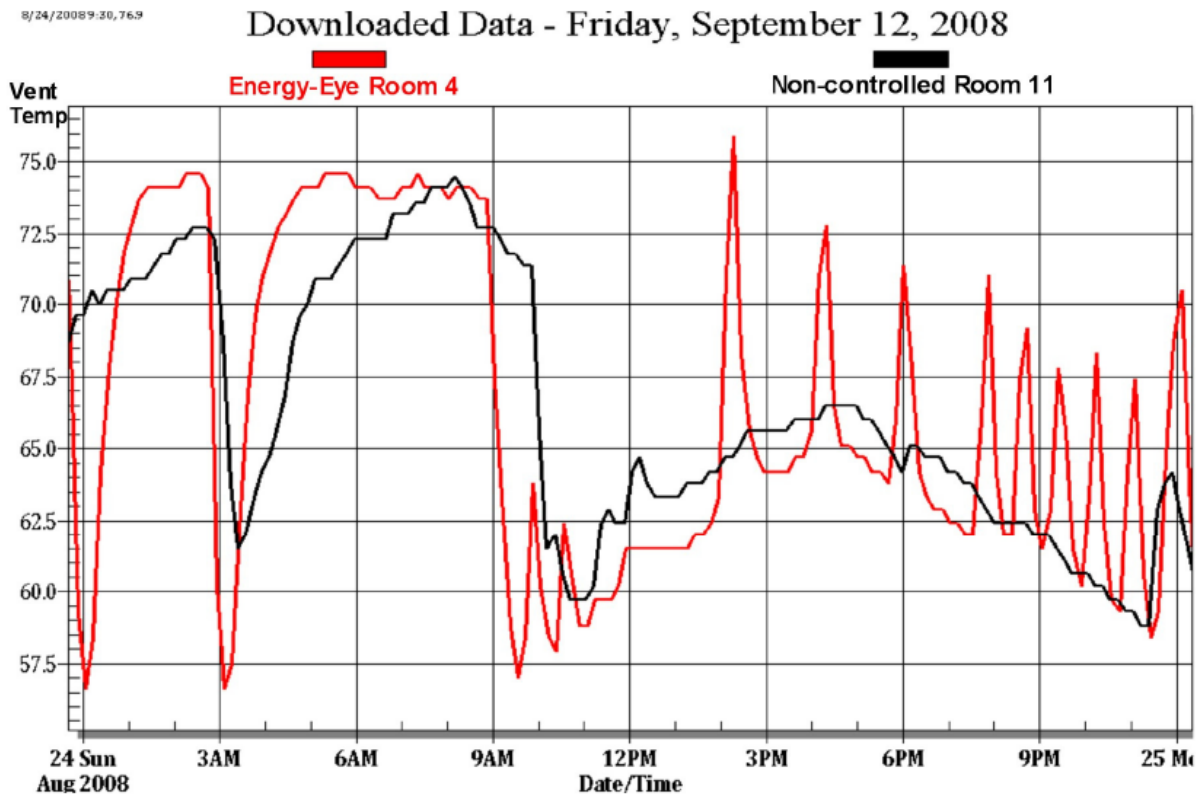


Figure 54. Comparison of downloaded run time data from Inn[2] Technologies, LLC EMS pilot study on August 24-25, 2008 from room 4 and room 11 at the Standard Hotel.

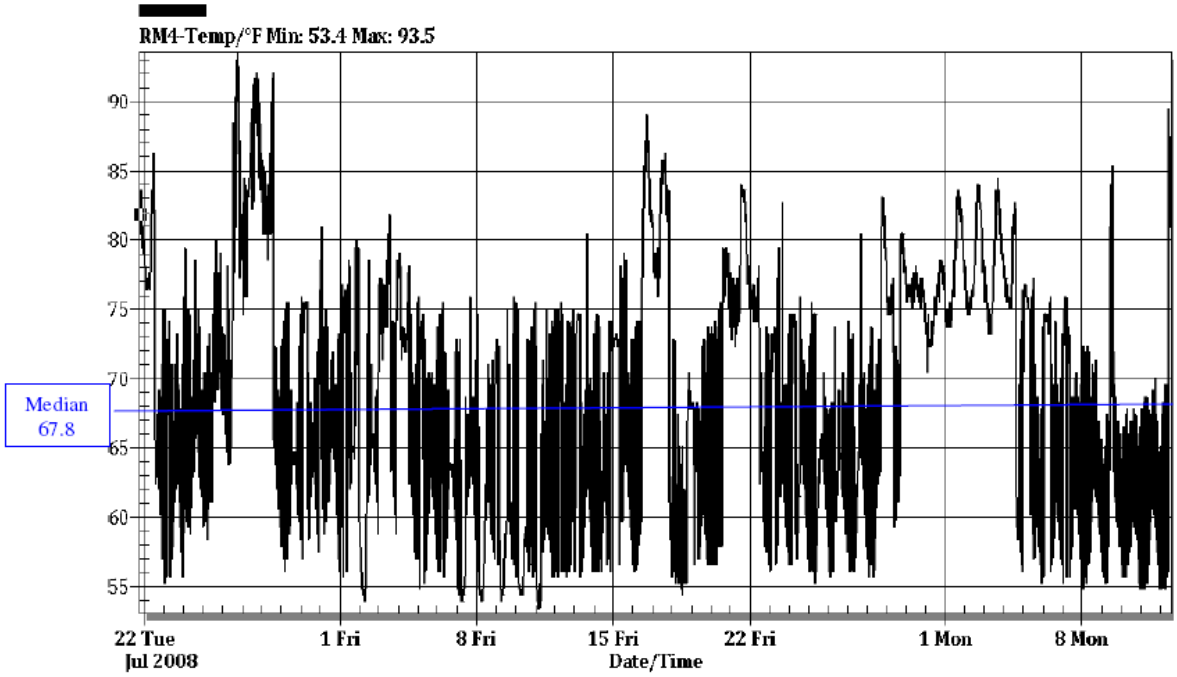


Figure 55. Individual room temperature recordings during test period for the controlled room (4) from July 22 – September 12, 2008.

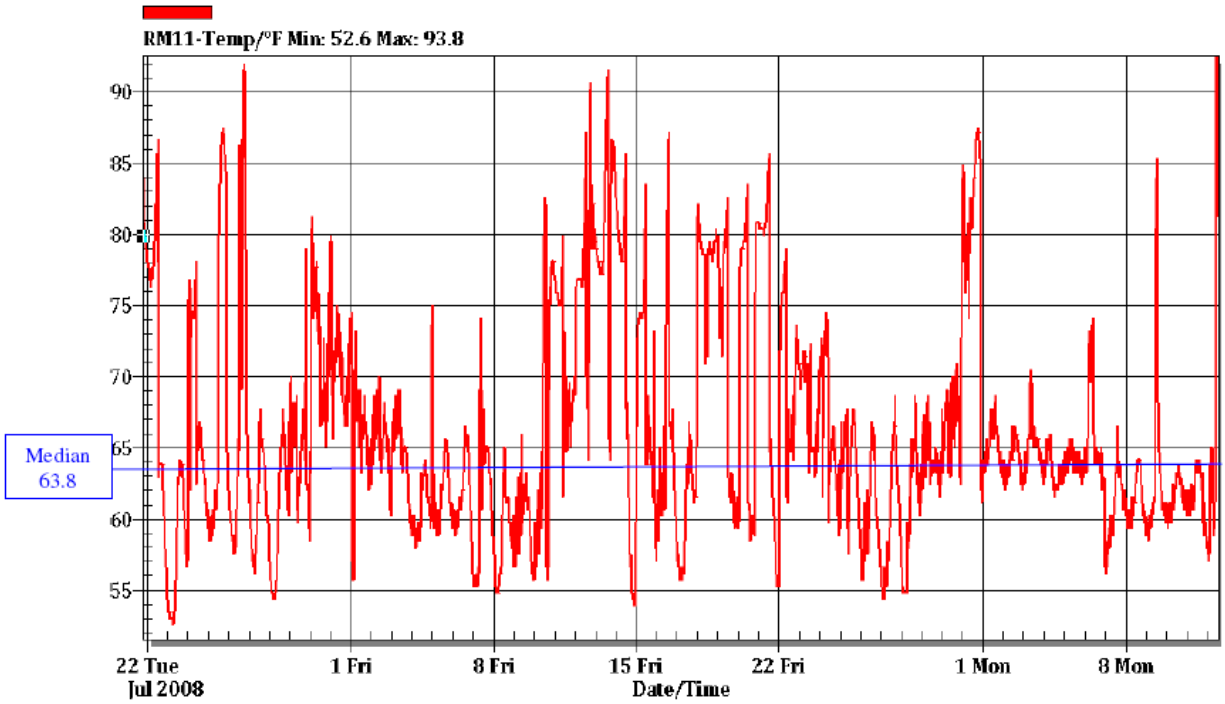


Figure 56. Individual room temperature recordings during test period for the non-controlled room (11) from July 22 – September 12, 2008.

By overlaying the room graphs, we get an unmistakable contrast of HVAC operations. The adjoining rooms cope with the same time, exposure, occupancy, environment and climate conditions. Guest habits towards temperature settings may be different, but over a period of time they will average similarly and become a non-factor.

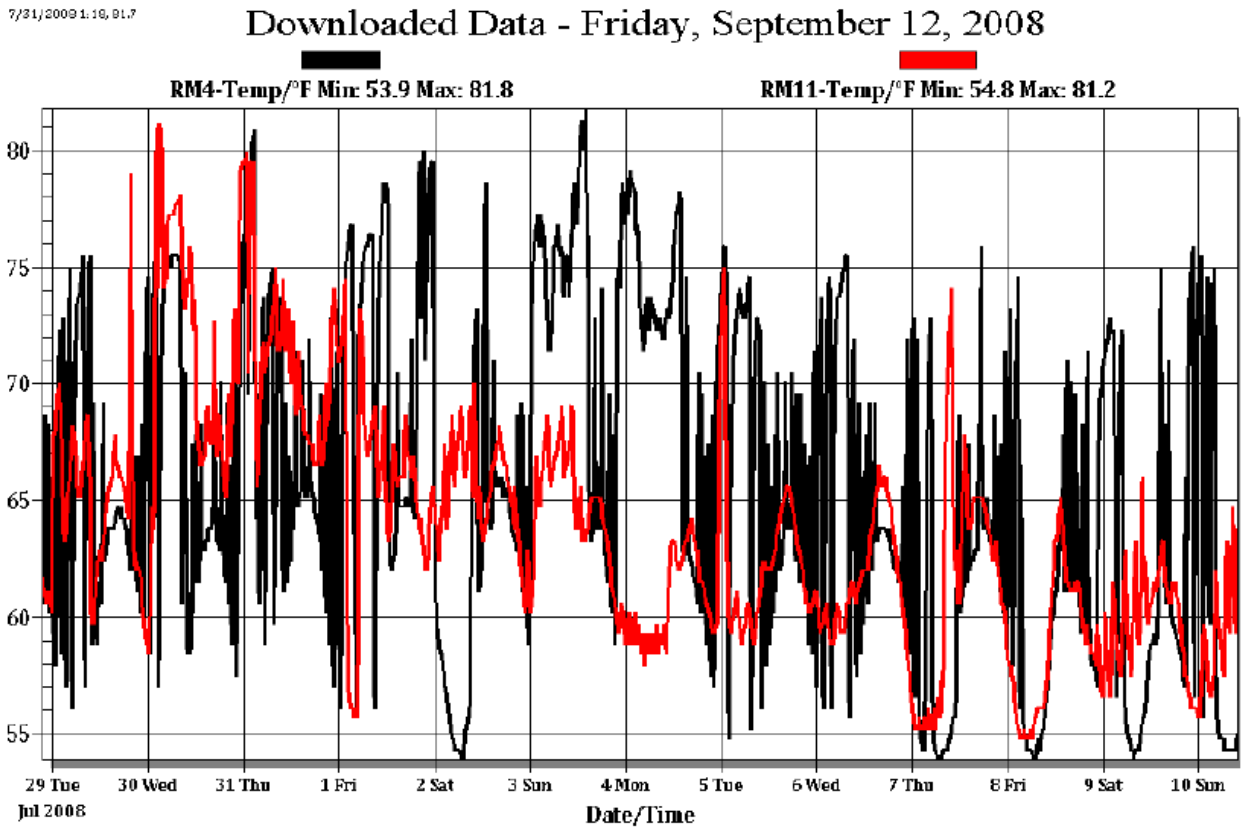


Figure 57. Overlay of individual room temperature recordings from July 22 – September 12, 2008.

The HVAC equipment employed at the property is a Fan Coil system with a separate chiller unit to maintain the temperature of the cooling medium (water). Since heating is used very sparingly, we elected not to include the higher electric heat amperage requirement and permit the savings to be undocumented. In order to determine the power draw of the HVAC equipment at the Standard Hotel when in cool operating mode, an industry-accepted standard formula, which assumes a typical efficiency of 1,000 watts per ton of cooling, as follows: Watts per Room = Chiller Tonnage X 1000 / # of rooms + Fan Watt rating. To compute this value, the following data was used:

1. Chiller tonnage (35)
2. Number of guest rooms (104)
3. In-room fan Watt rating (280)

This combines to give a value of 616.5 Watts per room. Both rooms used in this test are identical in size and shape with base dimensions of 12' by 20' equaling 240 square feet. The rooms are

located on the first floor with the room window facing east. Each room is similarly furnished and uses a 115 volt, Trane Manufacturing Company Fan Coil HVAC System, to provide the rooms heating and cooling.

Table 34 summarizes the results of the comparison measurements in the two test rooms and also contains the calculation converting the amperage readings into Watts and then a thirty-day period kWh usage and cost estimate, based on the average amperage for each period at the hotel's current rate for electricity.

Table 34. Active run time computation based on the Dickson data logger summaries during the test period from July 22, 2008 to September 12, 2008 at the Standard Hotel.

Parameter	Room 4 Controlled	Room 11 Non-Controlled
Minimum Value	n/a	n/a
Median Value	67.8°F	63.8°F
Decreasing Periods ("ON") of 10 minute duration	1,488	2,289
Hours "ON" Time Over 51 days	502.2	692.8

Table 35. Energy usage summary and costs for the comparison study from July 22, 2008 to September 12, 2008 at the Standard Hotel.

Room	"ON" hours over 51 days	HVAC Watts	kWh	Cost
Room 4 Controlled	502.2 hr	616.5	309.63	$34.06
Room 11 Non-Controlled	692.8 hr	616.5	427.14	$46.99

From Table 35, the difference in energy usage between the controlled room and the non-controlled room amounted to 117.5 kWh (or 28%) at a net monthly savings of $12.93/room. The results of this field test show that installing the Energy-Eye™ Energy Control System in each of the Hotel's guest rooms will result in a substantial reduction (35%) in the in-room HVAC energy load. The actual amount of savings will very from month to month, based on occupancy levels, seasonal climate conditions, and individual guest usage patterns. The total cost to supply and install the Energy-Eye™ Energy Control System in all 104 guest rooms is quoted at $27,248, which includes the master receiver/controller, wireless motion sensors and door switches ($225 per room). At this installation price ($37/room), the system will pay for itself in 1.8 years at 6% interest.

Waste Reduction

Miami-Dade County has a 30% recycling mandate for commercial recycling. Enforcement is increasing as the County is looking for new sources of revenue due to budgetary shortfalls. It was determined that it costs more to process municipal solid waste than to recycle. From the perspective of the waste generator, the monthly costs are on the order of $800 per dumpster of municipal solid waste vs. $200 per dumpster of recyclables. Recycled goods are a commodity, and there is a secondary market for their resale.

In the short-term, to successfully reduce waste disposal from these areas, an audit was conducted to determine the types and volumes of waste generated in order to target specific products or materials that contribute the greatest volume and/or weight to the waste stream or which create the most signification disposal problems. To that end, a waste audit was performed to identify the major waste stream components and determine the best opportunities for expanding the current recycling program to reduce waste management costs. Also, the feasibility of composting organic residue and yard clippings was one of the priorities identified by the green team internal self-assessment.

After completing the analysis, the approximate volume of certain components of the typical waste items will be determined. Apriori, we expect the following items to be significant for tailored recycling programs:

- Paper: including glossy magazines, newsprint, mail, office paper, paperboard (cereal boxes), and cardboard. Other paper products generated in large quantities include: paper napkins, paper towels, and paper cups, which are items that generally cannot be recycled.
- Aluminum / Metal: including aluminum, steel, and tin cans generated by F&B as well as aluminum foil.
- Plastics: including water bottles and other plastic containers.
- Glass
- Single-use items including individual packets of sugar, Sweet and Low and bleached paper coffee filters, for instance.

Waste Audit

On July 1, 2008, from 7 am to 10:45 am, the FAU research team conducted a waste audit of the Standard Hotel (see Figure 58). Using a heavy duty top loading mass balance that weighs items to the nearest 0.5 lbs, the team sorted 4 large dumpsters full of waste material and 2 90-gallon toters set aside for single stream recyclables. In addition, the landscapers were also discarding leafy yard waste during the test period, and these items were also included in the audit. Items were sorted according to the categories listed in Table 36. The team sorted the appropriate items into smaller "slim jim" containers that were weighed empty (tare weight) and then weighed full to determine the weight of materials by difference. At the time of the audit, Miami-Dade County was claiming to recycle plastic #1-7, however since then the County has reverted to only #1-3.

Figure 58. Photographs taken from the waste audit at the Standard Hotel on July 1, 2008.

Table 36. Waste audit checklist used at the Standard Hotel on July1, 2008.

Waste Audit Checklist

Date:	1-Jul-08
Time:	7-10:45 am
Location:	The Standard
Performed by:	Meeroff, Frankel, Sobel, Vanessa

CATEGORY	DESCRIPTION	WEIGHT (lbs)
Paper	Cardboard	105
	Other Recylable Paper	82
	All Other Non-Recyclable	40
	TOTAL PAPER	227
Plastic	Type 1-7 Recyclable	104.5
	All Other Non-Recyclable	119
	TOTAL PLASTIC	223.5
Glass	Green, Clear, Brown Recyclable	58
	All Other Non-Recyclable	0
	TOTAL GLASS	58
Metal	Ferrous	7.5
	Non-Ferrous	3.5
	TOTAL METAL	11
Organic	Kitchen/Food	156.5
	Leafy Yard Waste	89
	TOTAL ORGANIC	245.5
Hazardous	All	1.5
	TOTAL HAZARDOUS	1.5
Misc.	Other	23.5
	TOTAL MISC	23.5
	TOTAL WASTE	790

According to Figure 59, an analysis of the waste audit reveals that the largest percentage of the waste material is organic (32%), comprised of 21% kitchen/food waste and 11% leafy yard waste, by weight. Paper and plastic items account for more than half of the total weight (57%), and minor contributions were recorded from glass, metals, hazardous waste, and miscellaneous items.

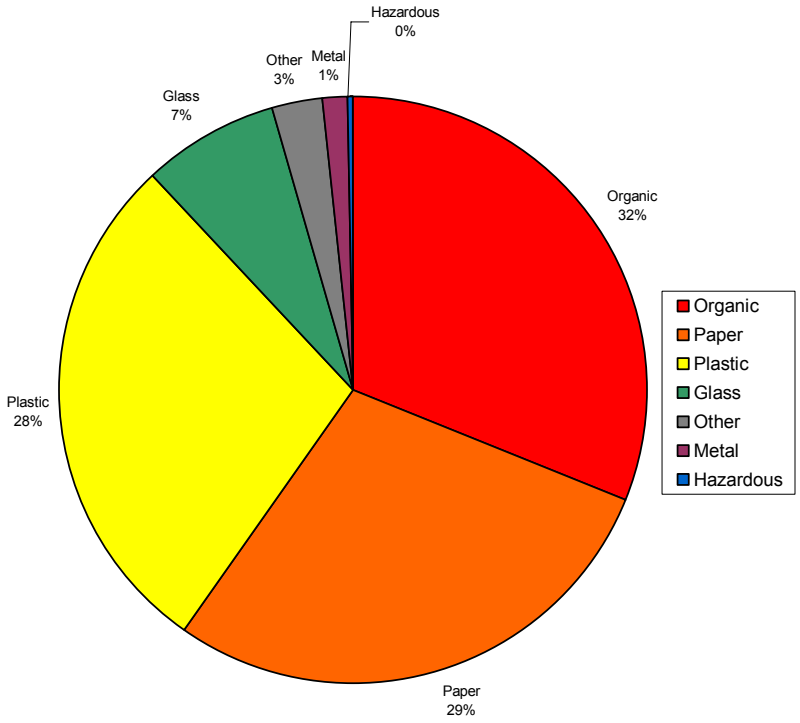


Figure 59. Pie chart developed from the waste audit conducted at the Standard Hotel on July 1, 2008.

Looking closely at the breakdown of waste materials, it was discovered that only 23% of the waste audited was non-recyclable and non-compostable. Nearly 77% of the waste stream could be diverted from the landfill, far eclipsing the 30% target mandated by the County. A major component (36%) is compostable (this includes the food scraps, leafy yard waste, and soiled paper products), but composting curbside collection is not yet available in the County, and on-site systems are not feasible due to space limitations at the Standard Hotel. The recycling component (46%) is not being properly sorted for curbside single stream collection because the number of dumpsters and number of pickups per week has not been optimized to maximize the collection of the recyclables. The staff has been properly trained for the most part to sort the materials correctly at the back loading dock. A random check by security staff and video camera shows that when the recycling bins are full, the staff members resort to discarding recyclables in the municipal solid waste bins. Within the office areas, recycling sorting has been encouraged by providing different bins at the location where the waste is generated. If this waste audit is considered representative of the waste stream generated at the hotel, then 320,000 pounds of waste materials can be diverted from the landfill per year from the Standard Hotel, and the 1.5% of the stream considered hazardous can be avoided through thoughtful product substitution. This would result in an annual cost savings of $15,000 from the rental of waste containers alone.

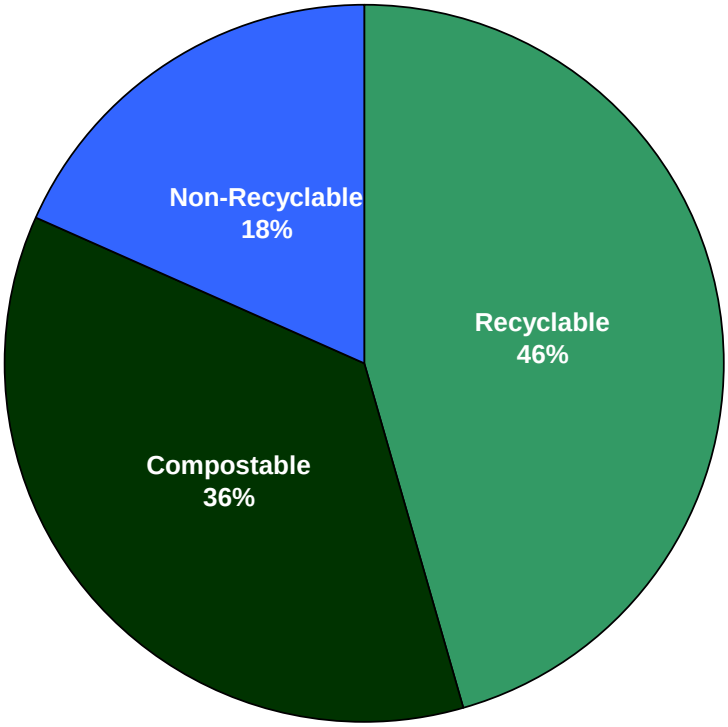


Figure 60. Summary of the breakdown of waste materials by category from the waste audit performed at the Standard Hotel on July 1, 2008.

Just as with the water consumption and energy usage utility records for both participating hotels, the solid waste and recycling historical billing records were reviewed for approximately 21 months. For the Raleigh Hotel, the records go back to December of 2006 (Table 37). During this time period and up until November 2007, the hotel had two 4-yd^3 containers that were picked up daily. After that and up until May 2008, the hotel upgraded to one 6-yd^3 container with daily pickup. However, after instituting an initial recycling program, the service was changed to two 3-yd^3 containers with daily pickup. The original plan cost approximately $2,090 per month. The second option cost considerably more at $3,460 per month on average. The current plan is least expensive option, averaging $1,940 per month. If we extrapolate the last plan to annual costs, this value would be $23,260 per year. If recycling can be instituted such that the number of bins or pickups can be reduced, this would represent a considerable savings.

Table 37. Summary of waste management MSW disposal costs by month for the Raleigh Hotel.

Month	Prorate	7x service	environmental fee	franchise fee	c right of way fee	Penalties	Total	Service Notes
Dec-2006		$ 1,400.00	$ 142.24	$ 246.76	$ 30.84		$ 1,819.84	
Jan-2007		$ 1,593.72	$ 166.80	$ 281.68	$ 35.21		$ 2,077.41	
Feb-2007		$ 1,593.72	$ 152.18	$ 279.34	$ 34.92		$ 2,060.16	
Mar-2007		$ 1,593.72	$ 157.01	$ 280.12	$ 35.01		$ 2,065.86	
Apr-2007		$ 1,593.72	$ 189.00	$ 285.24	$ 35.65		$ 2,103.61	
May-2007		$ 1,593.72	$ 203.77	$ 287.60	$ 35.95		$ 2,121.04	two-4 yd, 7d/wk service
Jun-2007		$ 1,593.72	$ 199.64	$ 286.94	$ 35.87		$ 2,116.17	
Jul-2007		$ 1,593.72	$ 199.64	$ 286.94	$ 35.87	$ 31.82	$ 2,147.99	
Aug-2007		$ 1,593.72	$ 206.22	$ 287.99	$ 36.00	$ 31.74	$ 2,155.67	
Sep-2007		$ 1,593.72	$ 204.54	$ 287.72	$ 35.97		$ 2,121.95	
Oct-2007		$ 1,606.46	$ 220.28	$ 292.28	$ 36.53		$ 2,155.55	
Nov-2007		$ 1,606.46	$ 225.25	$ 329.71	$ 36.63	$ 31.83	$ 2,229.88	
Dec-2007	$ 1,023.10	$ 2,643.00	$ 602.80	$ 768.40	$ 85.38	$ -	$ 5,122.68	
Jan-2008							$ 3,002.29	
Feb-2008	$ -	$ 2,124.99	$ 346.08	$ 444.79	$ 49.42	$ 54.39	$ 3,019.67	6f7 proration, one-6yd 7d/wk service
Mar-2008		$ 2,248.23	$ 398.93	$ 476.49	$ 52.94	$ 44.54	$ 3,221.13	
Apr-2008	$ -	$ 2,248.23	$ 449.32	$ 485.56	$ 53.95	$ -	$ 3,237.06	
May-2008		$ 2,248.23	$ 468.08	$ 488.94	$ 54.33	$ -	$ 3,259.58	
Jun-2008	$ (574.55)	$ 1,498.82	$ 209.29	$ 204.04	$ 22.67	$ -	$ 1,360.27	
Jul-2008		$ 1,498.82	$ 355.00	$ 333.69	$ 37.08	$ -	$ 2,224.59	Two 3yd cm fel scv 7x week service
Aug-2008		$ 1,498.82	$ 360.52	$ 334.68	$ 37.19	$ -	$ 2,231.21	

For the Standard Hotel, the records were reviewed for the period between December 2006 to May 2008 (Table 38). An analysis of the different historical container and pickup plans as well as pricing will be included in the next progress report.

Table 38. Summary of waste management MSW disposal costs by month for the Standard Hotel.

Month	Prorate	7x service	environmental fee	franchise fee	c right of way fee	Penalties	Total
Dec-2006	$ -	$ 1,400.00	$ 142.24	$ 246.76	$ 30.84	$ -	$ 1,819.84
Jan-2007	$ -	$ 1,593.72	$ 166.80	$ 281.68	$ 35.21	$ -	$ 2,077.41
Feb-2007	$ -	$ 1,593.72	$ 152.18	$ 279.34	$ 34.92	$ -	$ 2,060.16
Mar-2007	$ -	$ 1,593.72	$ 157.01	$ 280.12	$ 35.01	$ -	$ 2,065.86
Apr-2007	$ -	$ 1,593.72	$ 189.00	$ 285.24	$ 35.65	$ -	$ 2,103.61
May-2007	$ -	$ 1,593.72	$ 203.77	$ 287.60	$ 35.95	$ -	$ 2,121.04
Jun-2007	$ -	$ 1,593.72	$ 199.64	$ 286.94	$ 35.87	$ -	$ 2,116.17
Jul-2007	$ -	$ 1,593.72	$ 199.64	$ 286.94	$ 35.87	$ 31.82	$ 2,147.99
Aug-2007	$ -	$ 1,593.72	$ 206.22	$ 287.99	$ 36.00	$ 31.74	$ 2,155.67
Sep-2007	$ -	$ 1,593.72	$ 204.54	$ 287.72	$ 35.97	$ -	$ 2,121.95
Oct-2007	$ -	$ 1,606.46	$ 220.28	$ 292.28	$ 36.53	$ -	$ 2,155.55
Nov-2007	$ -	$ 1,606.46	$ 225.25	$ 329.71	$ 36.63	$ 31.83	$ 2,229.88
Dec-2007	$ 483.96	$ 2,124.99	$ 412.79	$ 543.91	$ 60.43	$ -	$ 3,626.08
Jan-2008	$ -	$ 2,124.99	$ 349.44	$ 445.40	$ 49.49	$ 32.97	$ 3,002.29
Feb-2008	$ -	$ 2,124.99	$ 346.08	$ 444.79	$ 49.42	$ 54.39	$ 3,019.67
Mar-2008	$ -	$ 2,248.23	$ 398.93	$ 476.49	$ 52.94	$ 44.54	$ 3,221.13
Apr-2008	$ -	$ 2,248.23	$ 449.32	$ 485.56	$ 53.95	$ -	$ 3,237.06
May-2008	$ -	$ 2,248.23	$ 468.08	$ 488.94	$ 54.33	$ -	$ 3,259.58

Figure 61. Space is always an issue for storage of solid waste and recyclables at the Raleigh.

The major areas identified for waste reduction pilot projects include: Recycling, Eco-Purchasing, Post-Consumer Recycled Content, Bulk Purchasing, Reduced Packaging, Manufacturer Take-Back, Ink/Toner Cartridges, Grease Recycling, and Composting.

Recycling

Recycling is the process by which materials, otherwise destined for disposal, are collected and reused as raw materials for new products (Wagner 1998). Recycling prevents potentially useful materials from being disposed of in landfills or combusted in an incinerator, thus saving energy and natural resources. About 50-60% of a typical hotel's waste stream is recyclable. Instituting a recycling program is a cost-effective way to reduce waste and save money. Waste reduction through recycling programs also offers two financial opportunities: (1) avoiding unnecessary disposal fees and fuel surcharges and (2) generating revenues from the sale of recycled materials.

Probably one of the most important barriers to recycling programs is perceived costs. First of all, disposal costs at a landfill or incinerator, usually $50-$100 per ton of waste (not including transportation charges), are typically higher than processing fees for recyclables at material recovery facilities (MRFs). South Florida tipping fees range from $28/ton for garbage to $40/ton for construction and demolition waste. In addition, hauling costs typically range from $1-2 per mile per ton of material, so there is a distinct advantage for haulers that can access a local facility for recycling (NHDES 2001). Recycling allows a hauler to avoid some or all of the disposal charge (tipping fees), and if the hauler uses a local MRF, all cardboard, glass, plastics, and aluminum can be recycled locally with little or no processing fees. So for the hauler and the solid waste authority, recycling is clearly economical. However, many factors influence the cost effectiveness of recycling, such as the efficiency of collection and source separation, the cost of transportation, and the market value of materials. Thus the impetus remains with the lodging facility to take advantage of this cost savings as well, and for the most part they are. Large properties can generate as much as 8 tons of waste per day, and up to 60% of this material may be recyclable (Hinton et al. 2004). Many hotels and motels in Florida already have some sort of recycling, reduction, reuse program established. Florida's hotel/motel industry has been a nationwide leader in resource management, actively participating since the early 1980s.

One problem is identifying which materials are recyclable and which are the most valuable. In designing a hotel recycling program, consider the following list of commonly recycled materials:

- Aluminum cans
- Antifreeze
- Appliances
- Batteries
- Building materials
- Cardboard
- Carpet
- Cell phones
- Cooking grease
- Computers
- Fluorescent bulbs
- Food waste
- Freon
- Furniture
- Glass jars
- Landscape waste
- Magazines
- Motor oil
- Newspapers
- Office supplies
- Paint
- Plastic bottles
- Plastic buckets
- Radios
- Scrap metal
- Steel containers
- Telephone books
- Televisions
- Wood

It is important to design an effective system to get the materials from the point of generation to the location in which they will be collected by the hauler. There are a wide variety of systems and containers that have been designed for this purpose. In order to maximize the benefit, care must be taken to recover those materials that are most valuable. A study by the Southern Waste Information Exchange (SWIX 2000) found that the materials most often recycled in Florida hotels are as shown in Figure 62.

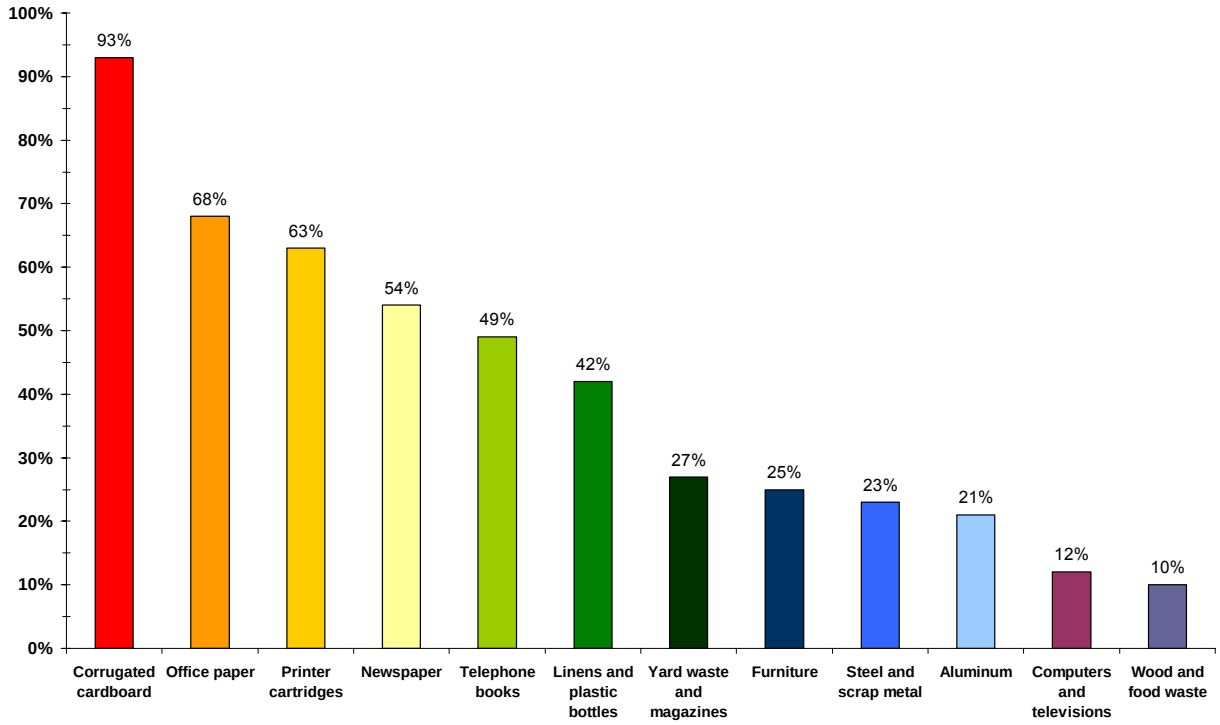


Figure 62. Breakdown of recycled materials from Florida hotels, adapted from (SWIX 2000).

Hotels can also produce volumes of construction and demolition (C&D) waste materials, especially during renovations. These materials are often recyclable. In particular, clean rubble, concrete, plastics, ferrous metals, drywall, light fixtures and ballasts, doors, bathroom fixtures, and wood can all be recovered. Hotels and motels have a variety of options for reducing and recycling C&D waste. Green building techniques may be used in renovation and construction of a hotel. For example, a contractor can reduce wood waste by taking time to measure wood accurately before cutting or donating excess wood material to a local reuse building organization. Untreated wood waste can be collected for composting or mulched and used on site. Another option for C&D waste is to consider donating some of the more useable items, such as old or unwanted furniture, light fixtures, bathroom fixtures, linens, uniforms, equipment, doors, drapes, and appliances to a charity, nonprofit organization, or thrift store or make them available to employees. Carpet companies may also recycle old carpets and pads, especially if replacements will be purchased from them.

One growing opportunity for recycling is referred to as E-Waste, which is generated from obsolete electronic equipment. The rate of introduction of new technologies is making E-waste one of the fastest growing waste streams (Hinton et al. 2004). Most electronic equipment in use today will likely be replace within 3-5 years. Some of the items that fall into this category are communications (telephones, cellular phones, wireless networks and routers), computers, keyboards, monitors, calculators, television sets, VCRs, DVD players, tape recording machines, cameras, video cameras, two-way radios, fax machines, copiers, and printers—basically all of the items listed in the Energy Star® appliance audit. The following describes opportunities and methods for reducing E-waste.

- Electronics are potentially recyclable but contain lead, which can be harmful to the environment if disposed of improperly. All motels and hotels will likely have 1-2 television sets in each guest room. There are additional televisions in lobbies, guest and employee lounges, laundry rooms, bars, restaurants and in-house gyms. Leasing televisions and communications (phone, cable, and internet) services places the burden on the leasing company to recycle these items at the end of their useful life (3-5 years). Keep in mind that coastal hotels may have to replace their electronic equipment more often because the salty air tends to corrode the internal components at a faster rate (Hinton et al. 2004).
- Recycle or donate used electronics. Some lodging properties have a system to sell back items to their own employees or local residents. Others try to donate to local charities. Some outlets have recycling opportunities for cellular phones. Many counties and cities also have electronic recycling days for their communities.
- Develop a disposal plan for batteries. Florida law prohibits the disposal of lead-acid and nickel-cadmium rechargeable batteries into the regular solid waste stream (403.708(13)(a) and 403.7192(3), F.S.). The local household hazardous waste program will typically accept all types of batteries from residents and businesses.

Staff training is one of the most important keys to making a successful recycling program. Just as with water conservation measures, monitoring and quality control will ensure that it all works smoothly. Solicit feedback from staff and administrative personnel. This will help to find out what is working and more importantly what is not working, resulting in higher participation. Some hotels use a newsletter to disseminate information and success stories out to the employees. These newsletters often include information on any new efforts to reduce waste, as well as amounts recycled, amounts diverted, and cost savings. They may also reward employees who have provided useful input or saved the most money. As shown in Figure 63, the employees at the Raleigh and the Standard are generally participating in the office paper recycling program. However, compliance with recycling is still not where it needs to be (Figure 64).

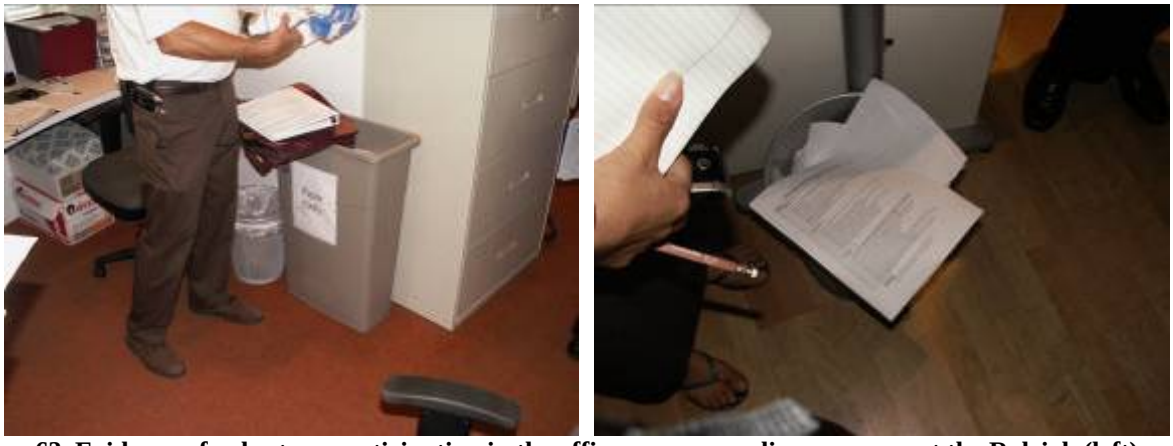


Figure 63. Evidence of voluntary participation in the office paper recycling program at the Raleigh (left) and the Standard (right)

Figure 64. Compliance is still not at acceptable levels at the Raleigh.

Figure 65. Evidence of commingling of waste materials that should be source separated at the Raleigh.

Figure 66. Evidence of commingling of waste materials that should be source separated at the Standard.

Some forward-thinking hotels have implemented recycling programs, which include collection in the guest room as well as containers in the pool areas, main lobby, meeting rooms, and other common areas. In New Hampshire, a 40-room inn generating 36 tons of waste annually was able to recycle 23 tons of waste. The revenue received from just the sale of newspaper was on the order of $47 per ton, while the cost avoided by diverting the newspaper from the landfill was on the order of $100 per ton ($62 per ton tipping fee and $38 per ton fuel surcharge), for a total savings of $147 per ton (NHDES 2001). In total, the recycling program saved up to $3,000 annually when 65% of the material was recycled.

In a Florida case study, a large hotel (over 400 rooms) recycled 81 tons over a six month period and pocketed more than $3,000 in revenue, and a small hotel (less than 100 rooms) recycled 3158 lbs. over a six month period, netting $470 in revenues and reducing the number of solid waste pick-ups to just twice per week (Moore 2002). The Palm Plaza Oceanfront Resort and Beachside Motel in Daytona, FL saved $529 per month through its recycling programs and reduction in the number of waste pulls (Moore 2002).

Typical equipment used for recycling includes roll-off containers, dumpsters, and portable 90-gallon carts. Roll-offs may be covered or compartmentalized for sorting. The larger the container, the less often it needs to be hauled or emptied. The portable carts are convenient for small facilities and also for larger hotels for collecting and storing one or two types of recyclables and

transporting them to a central storage area. Bulky items like cardboard boxes and plastic bottles can take up valuable space in recycling containers, forcing more frequent pick-ups. One way to limit the number of recycling pulls is to use a compactor or a baler. Typically, a 35-yard^3 compactor rental can range from $150-350 per month, on top of which a hauling and disposal fee will be assessed for each pull. Compactors require three-phase power or a converter, both of which can be expensive to install, however. For a roll-off, the rental fee will cost approximately $75, plus hauling and disposal (NHDES 2001). Baling increases the value of recycled materials from $20-40 per ton. A commercial bale is usually 5'x2'x3' and may weigh 600-1,800 pounds. However, baling requires additional equipment, like a forklift, large bins to hold loose materials, storage for bales, as well as additional staff training. If baling is not an option, merely breaking down (flattening by hand) corrugated cardboard boxes allows six times more cardboard to be placed in a dumpster than placing the intact boxes in the dumpster. Finally, another option to reduce pick-up frequency is to consider sharing recycling (and associated costs) with neighboring facilities.

A typical hotel guest room generates 1-2 pounds of waste on a non-checkout day and twice that amount on a checkout day (NCDENR 1998). However, recycling can be a challenge because it may depend too much on guest participation and appropriate separation of waste at the source. Some hotels place recycling bins in the vending/ice machine areas. The bins should be clearly labeled and visible for guests to recycle newspaper, cans, bottles, etc. To minimize cross contamination of recyclables with common garbage, locate a garbage can nearby. The most effective approach is for the housekeeping staff to collect and sort recyclables as the room is being cleaned. This can be addressed by development of a housekeeping SOP (standard operating procedure) that addresses source separation during the cleaning of the room. Recycled waste from guest rooms can be collected using bags or containers on the side of housekeeping carts and then stored in a larger bin on each floor station. Significant amounts of waste can be collected from a guest room each day. Paper products (45%), food waste (40%) including glass and plastic bottles and packaging, and bathroom waste (5%) are the most common items (Hinton et al. 2004). More specific items that can be potentially recycled effectively from guest rooms include the following:

- **Newspaper, magazines, and promotional literature**. Ask guests at check-in if they would like a complimentary newspaper in their rooms. Provide complementary newspapers only when requested. Alternatively, complimentary newspapers can be placed in a central location (i.e. near an elevator, breakfast area, or the front counter) for pick up. Unread newspapers can be returned to the vendor. Newspapers may be donated to pet stores, animal shelters, fish markets, mail and moving companies, detail shops for window cleaning, and retail stores for packing material. Cancel duplicate subscriptions and share journals, magazines, newspapers, phonebooks, rather than receiving multiple copies. Reduce the amount of junk mail you receive. Donate unwanted books and magazines to libraries, schools, nursing homes, abuse shelters, and child care centers. Mailing lists should be kept current, and marketing material should be printed in reasonable quantities. Use email listserv marketing announcements and internet links to a web page instead of direct mail. Recycle phone books seasonally, and donate bibles to religious organizations or prisons.
- **Aluminum cans** (soft drinks, beer)
- **Plastic bottles and containers** (soft drinks, water bottles, toiletries containers). Some recycling contractors in Miami-Dade County currently recycle only type 1 (PETE) and type 2 (HDPE) plastic containers and bottles. These include such items as water bottles, soft drink

bottles, ketchup containers, shampoo bottles, etc. As part of the curbside single stream process,

- **Glass bottles** (soft drinks, juice, beer, liquor). Glass makes up an important component of the material that is recyclable from the kitchen areas along with tin/steel cans, plastic bottles, containers, and corrugated cardboard. During a 2001 study of a hotel's waste stream, 96% of the tin/steel cans were being recycled, which was the highest recycling rate of any other material at the hotel. Approximately 74% of green glass containers, 70% of corrugated paper, 69% of HDPE containers, 63% of brown glass containers, 41.5% of plastic buckets, and 39.5% of clear glass containers were recycled. The recycling rate for aluminum cans was almost 20%, and PET containers were recycled at a rate of 13% (NHDES 2001). Many of these items can be found in the kitchen areas and represent opportunities for recycling.
- **Office paper.** According to the National Office Paper Recycling Program, one office worker generates about 1.5 pounds of recyclable paper waste per day (USEPA 1990). Recyclables should be collected near the point of generation, such as desks, copy machines, fax machines, printers, etc. Items that can be recycled include: copier/fax paper, file folders, self-adhesive notes, and corrugated cardboard boxes. Envelopes should be reused for internal routing. Scrap paper that is clean on one side can be easily used for messages, notes, or draft printing. All collected items for off-site recycling should be stored in a covered dry place, free from moisture (Hinton et al. 2004). Finally, unused files should be archived or converted to electronic storage, and unneeded documents should be purged. Participate in *Clean Your Files Week* or *Clear Out the Clutter Week* celebrated the third week of April.
- **Discarded or leftover materials**. Donate discarded clothing, shoes, uniforms, or leftover bottles of shampoo, lotions, bar soap, and half rolls of toilet paper to charities, homeless and abuse shelters, and churches. Eliminate, or offer by request only, under-used amenities such as shower caps, shoeshine cloths, sewing kits, lotions, and mouthwash. Reuse items if the seal is not broken. Mattresses may also be donated or sold to employees. Donate old linens and towels to charities or other facilities that may use them (homeless shelter, humane societies, veterinarian offices, school, car washes etc). They may also be used for "back of the house" operations, such as rags for maintenance shops, housekeeping and kitchen. Recycle sheets and stained tablecloths into placemats for room service trays, napkins and kitchen aprons. Sheets may also be made into pillow cases, bedspreads into hot pads and urn covers for kitchen use. Purchase sheets with higher thread count for longer wear. Extend the life of draperies by rotating their exposure to the sun. Return laundered garments and dry cleaning to guests in reusable bags or baskets rather than plastic or paper. Donate excess hangers to local dry cleaner or guest laundry service. The Ritz-Carlton in Naples, FL started collecting hangers for reuse in their on-site dry-cleaning facility and saved the costs of purchasing an estimated 7,000 hangers annually (Strickland 2005).

Commercial recycling became mandatory in Miami-Dade County in July, 1992. The County Ordinance requires the following: 1) Owners of commercial establishments in Miami-Dade County must provide a recycling program for their employees and tenants, using the services of an authorized waste hauler or private recycling hauler; 2) the program must recycle three items from the following list of ten: high grade office paper, mixed paper, corrugated cardboard, glass, aluminum, steel, other scrap production metals, plastics, textiles, wood.

The current curbside single stream process in Miami-Dade County recycles the following items:

- Paper products: newspapers, magazines, catalogs, telephone books, printer paper, copier paper, mail, all other office paper without wax liners.

- Cardboard: packing boxes, cereal boxes, gift boxes, beer/soda paperboard boxes, corrugated cardboard; flatten all boxes prior to placing them in the container.
- Plastic containers (narrow necks only): only plastic containers with the triangle label symbol #1, #2, and #3 can be recycled at this time. Bottles only without caps or lids are acceptable.
- Aseptic containers: polycoated drink boxes, juice cartons, milk cartons.
- Glass: glass food and beverage containers (clear, brown and green).
- Metals: aluminum, tin, and steel food and beverage containers.

It is important to note that not all waste materials can be recycled through the single stream process currently in place in Miami-Dade County. Aluminum, glass, plastic, and steel cans and bottles as well as newspapers, cereal boxes, magazines, and junk mail are all placed together in one container (effective April 18, 2008). The items that should not be included in the recycling container are listed below:

- Garbage, refuse, or other non-recyclable wastes such as gas cylinders, tanks, rocks, dirt, building debris, flammables.
- Batteries such as dry cell batteries and lead acid batteries. Button and nickel cadmium batteries from cell phones, computers, etc. should be taken to a participating store such as Radio Shack, Target, Home Depot, etc. for recycling. Size AA, C, and D alkaline batteries can go directly in the garbage.
- Certain glass products such as window or auto glass, light bulbs, mirrors, glass cookware, bakeware, or ceramics.
- Plastic bags. These should go back to the grocery store for recycling, such as Publix.
- Chemicals such as paints, used oil (Figure 67), and pesticides.
- Medical waste and pharmaceuticals. These items should be placed in the garbage and not flushed down the drain.
- Electronic waste and accessories such as personal computers, monitors, televisions, printer cartridges, keyboards, cell phones, CDs and DVDs.
- Fluorescent light bulbs. These items contain mercury and must be disposed of properly. A manufacturer take-back program can be negotiated prior to a bulk order of these types of bulbs.
- Other non-recyclables such as coat hangers, small appliances, and microwave trays

Figure 67. Spent oil collection facilities at the Raleigh (left) and the Standard (right).

Recycling/Waste Management Implementation – The Standard

For the Standard Hotel, the green team is preparing a map locator to supply to employees and guests to show where the recycling bins are kept. At press time, the designer bins have not been received but have been ordered. In terms of the recycling containers that are kept outside on the east side of the lobby building in the alley, the Standard has the following as of September 2008:

- Three 2-yard^3 container for MSW (daily pickup)
- One 2-yard^3 container for cardboard (once per week pickup, working on twice per week)
- Four 96-gallon Waste Management commingled toters by the MSW dumpsters (once per week pickup)
- One 96-gallon Waste Management commingled toter by the outside bar (once per week pickup)
- One 96-gallon SP Recycling toter for paper in the executive office suite, 2nd floor (picked up on an as-needed basis, only when full)

Smaller scale containers are located in the following areas:

- One designer recycling bin in breezeway by the guest bike area for commingled guest recycling
- One designer recycling bin in the opposite breezeway for commingled guest recycling
- One commingled container for back of the house in the break room
- One commingled container for back of the house in the engineering office
- One container in engineering for biohazardous waste
- Two small bins behind the front desk (one for paper and one for commingled)
- Recycling container for ink/toner cartridges

Recycling Implementation – The Raleigh

- Two 3-yard^3 container for MSW (daily pickup)
- Three large plastic bins for cardboard (someone from housekeeping is hauling to the MRF every day)
- Four 96-gallon Waste Management commingled toters by the MSW dumpsters (1-3 times per week pickup)
    - Two 96-gallon Waste Management commingled toter in the trash room
    - One 96-gallon Waste Management commingled toter in the kitchen
    - One 96-gallon Waste Management commingled toter by the pool bar
- One 96-gallon SP Recycling toter for paper in the executive office suite, 2nd floor (picked up on an as-needed basis, only when full)
    - Paper only bins (Executive chef's office, F&B office, and accounting). These satellite bins are blue slim jim types with a recycling sign on the front.
- One "designer" recycling bin in the coffee bar for commingled guest recycling

The Raleigh Hotel actually has several slim jim containers specifically designated with special recycling tops located all over the hotel in areas such as the coffee bar, patio restaurant bar, pool bar, break room, food and beverage department office). As of September 2008, the "designer" bin in the coffee room was removed; the wicker basket was not deemed functional and was replaced.

The commingled bins are stored on the north alley. Each container will have a permanent home marked in colored tape. Yellow for paper, blue for commingled, and green for MSW. At the front

desk area, a pair of small waste baskets will be dedicated to the recycling program. One of the bins will be for paper, another will be for commingles, and there is actually room for a third for the regular MSW. In the maid's closets, on each floor/wing, it is proposed to replace the waste basket with two taller, but half-width sized bins for commingles and regular MSW. In the break room, a slim jim bin is installed for commingles. The green team members have agreed to conduct periodic walk-throughs to make sure that the proper waste baskets are being used.

In terms of the overall costs, Waste Management, Inc. is currently charging $150 for six 96-gallon toters for 1 pickup a week (or $25 per toter per pickup). The previous pricing schedule was for $35/toter). The recommendation was for starting with four toters, for a pickup of 3 times per week, and then making necessary adjustments from this position. The price for this option would be $300 per week. As staff training and commitment increases, participation in recycling will also increase and then the number of toters will be increased to match the new demand. It will be an ongoing learning process, because it is still not certain how much people will be participating in the beginning of the new recycling initiative at the participating hotels. By the time the program is fully underway, it is likely that the hotels could probably require 8 – 10 toters if recycling is maximized to include all of the material that is recyclable on the property. At this level of participation, it would also be recommended to eliminate one MSW dumpster, which will more than cover the cost of the recycling program for the additional toters. It still remains to be seen if the number of MSW dumpsters can be reduced 2 or less down the road. According to the green team members, the ideal situation for solid waste management would be to have two 2-yard^3 dumpsters with pickup 6 days per week. They find that there are much less recyclables collected on Sundays, as there are no deliveries.

The customer service representative for Waste Management for this region, Mike Martinez, put forth the following pricing for exactly how much it would be to reduce service for the Raleigh and the Standard. It would be $750/dumpster (3 yd^3) for the Raleigh and $580/dumpster for the Standard (2 yd^3). There is also a surcharge of 22% that is collected for waste services by the City of Miami Beach, but this additional fee is not charged for recycling. To decrease the MSW service from existing levels, it is required to secure permission from the City of Miami Beach.

Probably one of the biggest challenges to establishing a working recycling program is the fact that both hotels signed a contract with an exclusivity clause to Waste Management, Inc. to service the recyclables. To increase the level of recycling service, Waste Management has come up with a pricing of $150/month per pickup per week, such that 6 pickups per week would cost $900/month. World Waste Services, a competitor, is currently offering $195/month for the same service, so Waste Management is priced higher than World Waste Services. The other benefit to World Waste Services is that they are providing a 2 yd^3 dumpster for the recyclables compared to the 96-gallon toters from WM. Six 96-gallon toters are just about equivalent to a 2 yd^{3}dumpster, but it is harder to put large bulky items in the toters, thus the 2 yd^3 containers are more desirable. The only drawback to World Waste Services is that they can only pickup 6 days per week where Waste Management can do 7 pickups per week if necessary. Unfortunately, due to the exclusivity clause, other recyclers such as World Waste Services cannot compete for the hotel's business in this project.

Eco-Purchasing

In terms of solid waste management, the main lobby and the office sections of the property can participate by focusing on waste reduction strategies such as eco-purchasing programs. In

addition, the main lobby/office is a great place to introduce employees, guests, and visitors to the waste reduction policies of the lodging property by posting highly visible signs and placards in these high-traffic areas.

The first step is to adopt a policy that allows development of an eco-purchasing program. This will permit the hotel to 1) purchase paper products that contain 30% post-consumer recycled content or more, 2) purchase products that have minimal or recycled packaging, or 3) purchase products that are compostable or biodegradable.

The most effective method for reducing waste is to prevent it in the first place. Eco-purchasing is an important component of a hotel's solid waste management program. The practice of eco-purchasing involves evaluating procedures and products based on durability, reusability, recyclability, and post-consumer recycled content, rather than merely on price and quality. It may require a policy change or merely how a product is packaged in order to get the best value.

This process also takes advantage of the concept of life cycle costing. This technique evaluates the total costs associated with a product over its useful lifetime. Life cycle costs include factoring in not only the initial cost, but also repair and maintenance and disposal costs, realizing that both delivery and disposal incur a cost. Life cycle costing should be considered when making purchasing decisions for: disposable napkins, cups, and serving ware; paper towels, individually packaged condiments or amenity items, batteries, and laser toner cartridges, etc.

Figure 68. Examples of items that are candidates for eco-purchasing substitutions at the Raleigh (top) and the Standard (bottom).

While institutional purchasers are inclined to favor green hotel services, they need improved access to environmental information in order to include such considerations in their purchasing decisions. The available information must be put in a form that can be easily implemented by an average hotel manager. Fortunately great strides have been made in this area. For instance, the USEPA has a pair of comprehensive websites with excellent information regarding environmental standards related to purchasing and procurement.

1. EPA Procurement: http://www.epa.gov/epaoswer/non-hw/procure/index.htm
2. EPA Buy Recycled http://www.epa.gov/epaoswer/non-hw/muncpl/buyrec.htm

The average hotel purchases more products in one week than 100 families will typically purchase in one year (Ton 1996). So the opportunity is there to make an important impact on the waste stream. The first step is to develop a materials flow plan, which identifies materials, collection, container size and placement, recycling, reuse, and disposal using a "cradle to grave" or "cradle to cradle" approach. The next step is to keep owners, corporate management, and administration and staff informed about waste stream and recycling opportunities that will save time and money. Then, realistic goals and objectives should be established and specific areas for waste reduction should be targeted. Practical reduction programs must be periodically evaluated in relationship to the overall economic benefits and impacts to time and manpower usage. Establishing an accounting system that tracks monthly waste management costs can be useful in this endeavor. Preparing a monthly report card for tracking waste disposal and reduction information will allow for performance measurement. Some of the most common approaches to achieve eco-purchasing goals include the following:

- **Just in time purchasing.** By simply reviewing buying habits and purchasing only what is needed, the amount of storage space and waste can be reduced. Overstocked inventory may exceed expiration dates and may need to be disposed of without ever being used. Charting the shelf life of items and purchasing only when the item is needed will reduce spoilage.
- **Maximize usage.** Rent seldom used items or equipment, rather than buying them. Repair items rather than purchasing new ones. By replacing worn parts, refinishing surfaces, repairing scratches, dents, and holes, and reupholstering cushions, the useful life of furniture, fixtures, and equipment can be extended.
- **Purchase materials of higher quality that will last longer without replacement.** For instance, sheets with a high thread count for longer wear or reusable containers instead of disposable paper or polystyrene cups. Administrative personnel and staff should switch from disposable to reusable mugs and containers. Consider switching to glass cups, saucers, and cloth napkins. Provide reusable drinking glasses and coffee cups because reducing waste at the source is preferable to recycling.
- **Limit replaceable items in the guest rooms.** Use refillable dispensers instead of small bottles. Use glasses and mugs instead of disposables. Eliminate plastic liners in ice buckets and paper doilies. Eliminate printed information placed in rooms. For example, list television stations on a sticker on the remote control or provide a laminated copy for continuous use instead of a TV Guide booklet. Reduce the size of individual packaged items, such as bar

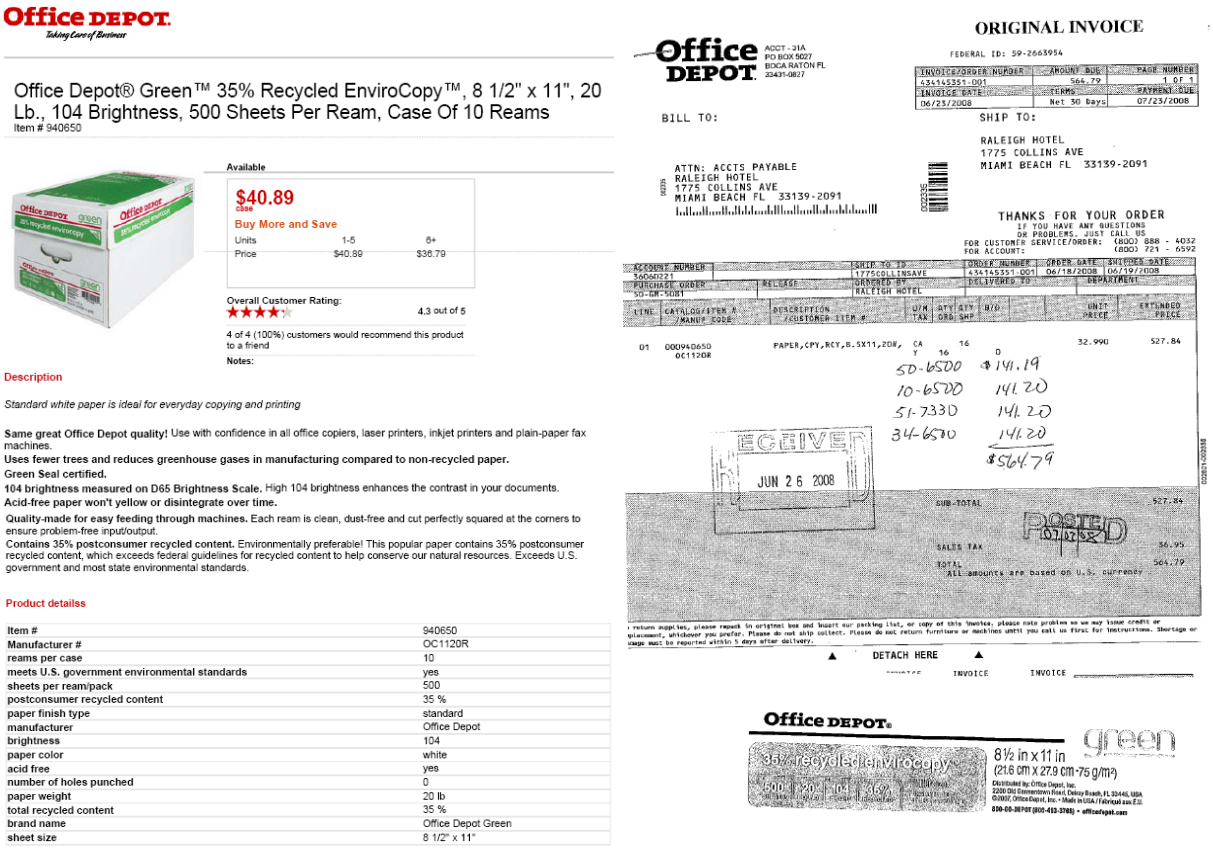
soaps and shampoo. Place half-used toilet paper rolls from guest bathrooms in employee restrooms rather than throwing them away.

Other opportunities for waste reduction in guest rooms, such as use of recycled-content "personal" paper products (i.e. toilet paper, tissues) and use of environmentally preferable cleaning products, can be accomplished without relying on guest participation. Some hotels are reluctant to pursue environmental projects because they are concerned about how the projects will be accepted by their guests. However, according to the Green Hotels Association®, 70-90% of hotel guests participate in linen and towel programs (Ton 1996).

Post-Consumer Recycled Content

Purchase products with recycled content. Everyone should be encouraged to buy recycled products manufactured with post-consumer materials whenever possible. Common items include: letterhead, stationery, tissues, toilet paper, paper towels, computer paper, office supplies, playground equipment, picnic/park benches, and re-refined oils (Wagner 1998). This practice helps to keep the market strong for recycled materials and helps close the loop for recycling programs to help protect the supply of virgin materials from being depleted. As shown in Figure 69, the Standard was not purchasing many products with post-consumer recycled content. Since June 2008, both hotels have purchased paper products with post-consumer recycled content.

Figure 69. The Standard was not using office paper with post-consumer recycled content before the study.



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Available

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case
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Units	1-5	6+
Price	$40.89	$36.79

Overall Customer Rating:
4.3 out of 5
4 of 4 (100%) customers would recommend this product to a friend
Notes:

Description

Standard white paper is ideal for everyday copying and printing

Same great Office Depot quality! Use with confidence in all office copiers, laser printers, inkjet printers and plain-paper fax machines.
Uses fewer trees and reduces greenhouse gases in manufacturing compared to non-recycled paper.
Green Seal certified.
104 brightness measured on D65 Brightness Scale. High 104 brightness enhances the contrast in your documents.
Acid-free paper won't yellow or disintegrate over time.
Quality-made for easy feeding through machines. Each ream is clean, dust-free and cut perfectly squared at the corners to ensure problem-free input/output.
Contains 35% postconsumer recycled content. Environmentally preferable! This popular paper contains 35% postconsumer recycled content, which exceeds federal guidelines for recycled content to help conserve our natural resources. Exceeds U.S. government and most state environmental standards.

Product detailss

Item #	940650
Manufacturer #	OC1120R
reams per case	10
meets U.S. government environmental standards	yes
sheets per ream/pack	500
postconsumer recycled content	35 %
paper finish type	standard
manufacturer	Office Depot
brightness	104
paper color	white
acid free	yes
number of holes punched	0
paper weight	20 lb
total recycled content	35 %
brand name	Office Depot Green
sheet size	8 1/2" x 11"

ORIGINAL INVOICE

Office DEPOT
ACCT - 21A
PO BOX 5027
BOCA RATON FL
33431-0827

FEDERAL ID: 59-2663954

INVOICE/ORDER NUMBER	AMOUNT DUE	PAGE NUMBER
434145351-001	564.79	1 OF 1
INVOICE DATE	TERMS	PAYMENT DUE
06/25/2008	Net 30 Days	07/25/2008

BILL TO:

ATTN: ACCTS PAYABLE
RALEIGH HOTEL
1775 COLLINS AVE
MIAMI BEACH FL 33139-2091

SHIP TO:

RALEIGH HOTEL
1775 COLLINS AVE
MIAMI BEACH FL 33139-2091

THANKS FOR YOUR ORDER
IF YOU HAVE ANY QUESTIONS OR PROBLEMS, JUST CALL US
FOR CUSTOMER SERVICE/ORDER: (800) 888 - 4032
FOR ACCOUNT: (800) 721 - 6592

ACCOUNT NUMBER	SHIP TO ID	ORDER NUMBER	ORDER DATE	SHIPPED DATE
36060221	1775COLLINSAVE	434145351-001	06/18/2008	06/19/2008
PURCHASE ORDER	RELEASE	ORDERED BY	DELIVERED TO	DEPARTMENT
SD-DK-SUBT		RALEIGH HOTEL		

LINE	CATALOG/ITEM # /MANUF CODE	DESCRIPTION /CUSTOMER ITEM #	U/M	TAX	ATT ORD	QTY SHP	W/O	UNIT PRICE	EXTENDED PRICE
01	000940650 OC1120R	PAPER,CPY,RCY,8.5X11,20#,	CA	T	16	16	0	32.990	527.84

SD-6500 $141.19
10-6500 141.20
51-7330 141.20
34-6570 141.20
$564.79

RECEIVED
JUN 26 2008

POSTED

SUB-TOTAL 527.84
SALES TAX 36.95
TOTAL 564.79
All amounts are based on U.S. currency

return supplies, please repack in original box and insert our packing list, or copy of this invoice. please note problem so we may issue credit or replacement, whichever you prefer. Please do not ship collect. Please do not return furniture or machines until you call us first for instructions. Shortage or damage must be reported within 5 days after delivery.

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INVOICE INVOICE

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8½ in x 11 in
(21.6 cm x 27.9 cm-75 g/m²)
green

Figure 70. Proof of purchase of 35% post-consumer recycled content office paper at the Raleigh Hotel.

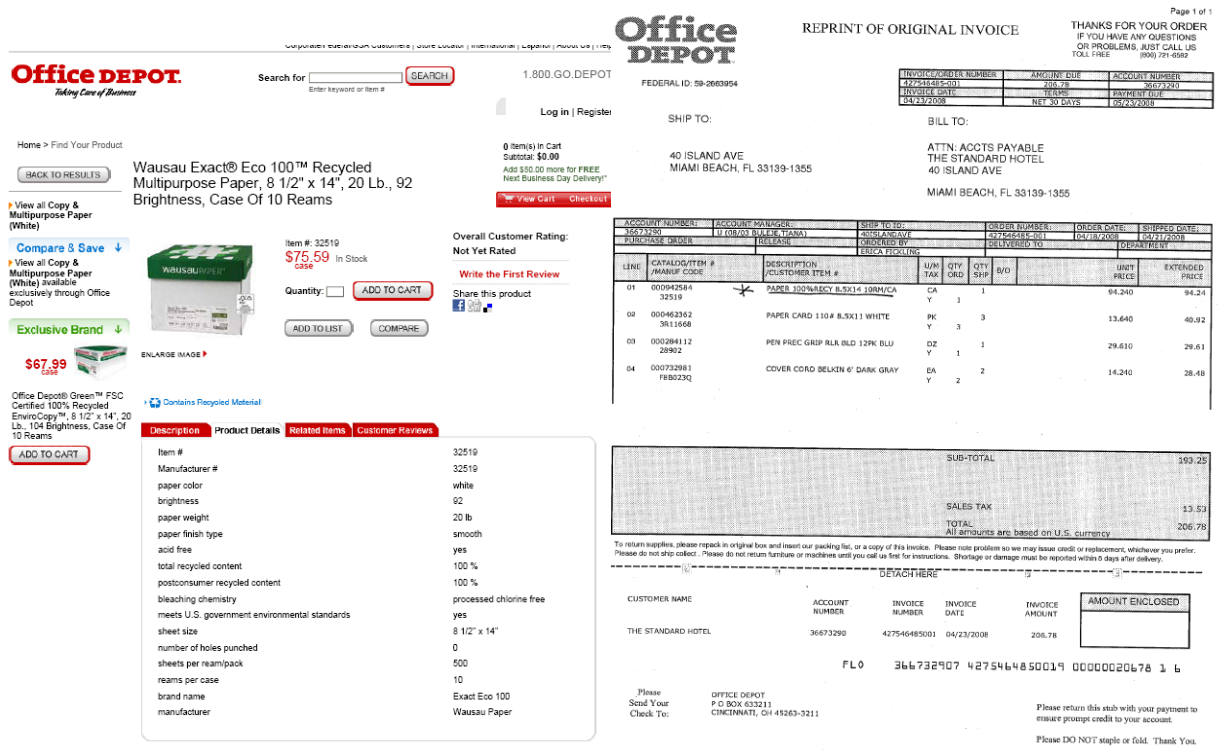

Figure 71. Proof of purchase of 100% post-consumer recycled content office paper at the Standard Hotel.

Reduced Packaging

Purchase from vendors committed to reducing packaging. Examples of easily minimized packaging include: eliminating the non-recyclable, foil-embossed box "gift packaging" of liquor during the holiday season, packing produce and fish in recyclable cardboard or wooden boxes instead of in single-use polystyrene containers, and collecting and reusing shipping pallets instead of disposing of them. The receiving department at the Fontainbleau Hilton Resort and Towers in Miami Beach, FL collects polystyrene packing peanuts from incoming shipments and uses them in the mailroom or drops them off at a local mail service center (Winter and Azimi 1996).

Bulk Purchasing

Buying in bulk in conjunction with refillable or recyclable containers will also minimize packaging waste. Combine supply orders from various departments. Eliminate packaging waste from multiple smaller orders. Also, hotels that make purchases on a decentralized basis cannot benefit from bulk purchasing discounts.

Manufacturer Take-Back

One of the most productive methods for achieving waste minimization is to incorporate negotiated manufacturer take-back policies into the bid package for items amenable to this kind of practice. For instance, pallets used for deliveries can be taken back by the delivery agency and reused. Vendors should be required to take back empty containers for instance as the price of doing

business with the participating hotel. If they are unable to provide this service, then an effort to reuse the items or donate them to employees should be made. For hotels with convention services, incentives can be offered such as reduced disposal fees to convention exhibitors who minimize leftovers and take back excess materials.

Ink/Toner Cartridges

Choose re-manufactured toner cartridges and participate in toner cartridge return programs for refilling/rebuilding for fax machines, printers, and copiers. Reduce the amount of ink/toner needed by using double-sided (duplex) photocopies and printing, or use soy-based and other nontoxic inks. Eliminate unnecessary copying and convert to electronic (set your default printer to adobe pdf) whenever possible. Centrally post memos or route them instead of making multiple copies. Proof-read documents on the computer before printing, and store documents electronically instead of creating hard copies. Use internal email and voicemail. Format draft reports and other files, so that more words will fit on a page by reducing the fonts and margins.

Both participating hotels are currently conducting ink/toner recycling programs.

Composting

Composting is a process, which begins whenever moist organic materials are placed together. The organics naturally begin to decompose and with the proper moisture, temperature, and microbiological conditions, within about one month, the system can produce mature compost. Keeping the materials covered (to reduce odors), aerating the compost (to speed up the maturation process), and routinely turning while adding additional moisture (to control the temperature in the reaction) can accelerate the microbiological process. The final product, called compost, can be used as mulch or a soil amendment in landscaped areas or in the restaurant chef's herbal garden, if appropriate. Compost is an excellent source of organic material and nutrients for rebuilding and enriching soil. A little bit of paper, as well as food waste and mulched landscaping yard waste, are all good candidates for composting materials. Finished compost looks like soil. It should have a dark brown color and an earthy smell.

The local Cooperative Extension Service can provide useful guidelines for setting up and maintaining a successful composting program. The optimal size for a small compost pile is about 3-ft x 4-ft (Wagner 1998). There are many types of composting bins commercially available. However, a simple enclosure can be constructed by securing the ends of a twelve foot length of 2"x4"x36" chicken wire fencing and covering with a tarp or plywood board (Wagner 1998). Alternatively, old trash cans with lids can be modified by cutting one-inch air holes spaced four inches apart all around the can. In-vessel composting containers should be placed in a well-ventilated area to minimize odors and maximize air flow. Compostable materials include chopped yard waste, kitchen scraps, discarded paper napkins or paper towels (Wagner 1998). By using a spinning composter up to 85 pounds of compost can be produced in 30 days. The cost for such a composter is about $150. Areas of the hotel that should be included in any composting program include: office areas (waste paper for bulking and employee generated food waste), food and beverage outlets (leftovers, spoilage, etc.), guest rooms (guest generated food waste, room service, etc.), swimming pool and spa (snack waste), convention/meeting rooms (breakfast, luncheon, other food service leftovers), and landscaping (woody yard waste, grass clippings, leafy waste). Consider prior to enacting: storage, composting area, and who will work the area (grounds or kitchen staff).

Because yard and food waste make up 31% of the waste stream, the participating hotels have started to seriously consider composting the organic portion generated from the food and beverage group. To that end, an experiment was conducted on Saturday, August 16, 2008. At the Raleigh Hotel, all food waste was stored and weighed by the employees. The recovered food waste and other compostable materials generated from the restaurant/kitchen (front and back of the house) weighed 56 lbs. Over the same collection period, the restaurant recorded 124 covers, for an average of 0.45 lb/cover.

Miami Beach Community Composting Pilot Project

With the support of the community and other large quantity generators of organic materials such as schools, resorts, restaurants, supermarkets, and businesses, the participating hotels wish to establish a partnership for a pilot composting project to collect and reuse the organic waste as compost on their property, saving on disposal costs and avoiding landfill expansion. The use of an in-vessel aerobic composter provided by the South Dade Soil and Water Conservation District is the opportunity to produce the final product in as little as three days. The resulting compost is then a rich organic soil amendment that can be used on the site landscaping instead of toxic chemical fertilizers. Users can bag the compost and market it as well.

- Composting can be completed rapidly, resulting in product stabilization/sanitation in 3-6 days.
- In-vessel composting can maintain a rapid decomposition process year-round regardless of external ambient conditions.
- The waste loses all offensive odors within 24 hours of start-up.
- While in the composter, wastes are isolated from the environment until the composting process is complete.

What's in it for hotels/restaurants/groceries/businesses?

The participating hotels, restaurants, grocery stores, and other businesses will be able to add to their mission of pursuing "Green" by recycling all of their own organic waste materials to produce soil amendment products. In addition, the businesses would receive the potential for:

- Positive PR, both locally as well as state and nation-wide.
- Increased market share by standing out from the competition (market differentiation).
- Financial savings from decreased waste expenditures, (since organic waste has a secondary resale market, haulers and solid waste managers can profit from the resale to offset operations costs and potentially pass on those savings to their customers as they do with recycling programs).
- Increased employee morale and customer loyalty due to company's commitment to protect the environment and our natural resources.
- Waste reduction initiatives to help obtain a "green" certification or designation, such as a One Palm Designation from the Florida Green Lodging Program.
- Knowledge that the participating company is taking positive steps towards ensuring a better future.

Independently, hotels and restaurants in Miami Beach do not have the physical space to compost on site with the in-vessel aerobic composting equipment commercially available. Furthermore, to remove any part of the solid waste stream from these hotels would require a obtaining a hauling permit. Waste Management is presently servicing most of the hotels/restaurants and other organic waste generators in Miami Beach, and they have already provided separate containers for commingled recycling to be collected next to the dumpsters that collect the non-recyclable trash.

Businesses work hard to maximize production and reduce costs. Now they can increase their profits by recycling their excess biomass (organic food waste, yard clippings, and waste paper) by utilizing in-vessel composting with aerobic digestion at no additional energy cost.

With the assistance of a collective group of hotels/restaurants and the participation of Florida Atlantic University (FAU) and the South Dade Soil and Water Conservation District (SDSWCD), the following pilot project plan is proposed:

1. The management of the Standard Hotel and the Raleigh Hotel should contact the Hotel Association of which they may be a member and the City of Miami Beach and request that they both support a plan for a pilot program to be conducted to separate organic waste (food waste, paper waste, and yard waste) and have it placed in separate containers alongside the dumpsters.

2. With the support of the partner hotels and the restaurant and lodging association, City of Miami Beach, FAU, and the South Dade Soil and Water Conservation District, we would then arrange a meeting with executives of Waste Management to request that they become a partner in this pilot program by:

- Providing separate "Organic Waste" containers to the participants, similar to the size of the commingled recyclables already provided.
- Collect and deposit the "Organic Waste" at the Medley Landfill site, not to be co-mingled with other solid waste or recyclable.
- Purchase an appropriately sized in-vessel aerobic composter from the SDSWCD and operate it to compost the organic waste that has been collected from the pilot project. Prices range from $8,100 for a 1.0 yd^3 portable unit to $179,900 for a permanent installation with a capacity of 96 yd^3 of material, producing 32 yd^3 per day continuous flow. The cost of a demonstration unit for 30 days is $750, which can be applied to the purchase. These systems are commercially available at dairy, poultry and horse farms, packing houses and school cafeterias all over the country, in places such as Florida, Missouri, New York, Texas, Colorado, Virginia, North Carolina, Mississippi, Kentucky, West Virginia, California, Kansas, Michigan and Hawaii.
- Finished compost is a good substitute for peat, an excellent media for nurseries, landscapers, row crop growers, parks, golf courses, and the residential market.
- Conduct an analysis of the finished compost product using a certified laboratory to assure all parties that the compost is seed-free, pathogen-free, and odor-free material.

Benefits to Waste Management, Inc.:

- Proceeds from container rental/purchase and collection services
- Proceeds from the sale of the composted organic waste to help defray the capital cost of the equipment and operation/maintenance

- Waste Management's mission statement reads: "Think Green: Think Waste Management," see page 24, "Community Partnerships" (www.wastemanagement.com). So this would complement their stated environmental objectives.

To market the finished compost, the SDSWCD would enter into an agreement with Waste Management to distribute the product to established large-scale customers within the South Florida Agricultural community that the SDSWCD have been working with for 30 years. The extreme price increase in the cost of commercial fertilizers makes compost more desirable for landscaping, golf courses, etc. than it has been in the past, since it has no odor and has excellent nutrient value.

The SDSWCD, as a non-profit, governmental subdivision of the State of Florida, has received the USEPA 2nd place award and the 1st place award for Region 4 for composting wastewater residuals, and will work with Waste Management to train staff in the best management practices for composting with the in-vessel aerobic composting unit.

FAU will monitor the success of the program and collect information on compost quality, volume generated, pounds of waste diverted, cost savings, and customer satisfaction.

With the success of this one-year pilot project, all parties would agree to pursue a total project for collection of separated organic waste from all participating hotels, groceries, and restaurants in Miami Beach.

FAU and the SDSWCD could then expand the proven organic waste composting program to other large organic waste producers such as restaurants, hotels, universities, schools, corporate buildings, etc.

Community Pilot Project Flow Chart

Step 1. Site-Sort Organic Waste

Step 2. Collect/Haul Organic Waste

Step 3. Operate the In-Vessel Aerobic Composter Pilot Plant at Medley

Step 4. Produce finished compost for resale to agricultural end users

Other potential partners:

- Azul
- Biscaya at Ritz Carlton in Coconut Grove
- Canyon Ranch
- Casa Tua
- Chef Allen's
- Creek 28
- Doubletree Surfcomber (One Palm Designee, 240 – 320 covers/day)
- Emeril's Miami Beach
- Escopazzo Restaurant (70 covers per day)
- Joley at the Hotel Astaor
- Loews Hotel - Miami Beach
- Mayas Tapas (250 covers per day

- Michael's Genuine Food & Drink
- Oceanaire Seafood Room
- Slow Foods Miami
- South Seas (60-100 covers per day)
- Table 8
- Tantra Restaurant
- The Dilido Beach Club at Ritz Calton South Beach
- The Standard's Lido Restaurant
- Touch Restaurant & Meat Market
- Van Dyke Café, Tiramesu, Le Bon, Spris, Segafredo Café (2500 covers per day)
- Wish
- Design and Architecture Senior High School
- Publix Supermarkets
- Whole Foods

Other Food Waste Reduction Strategies. If medium to large scale composting is envisioned, then switching to biodegradable or compostable trash bags for satellite collection areas for organic waste like food scraps, leaves and yard waste, should be considered. In dealing with food waste, source reduction strategies can also be helpful. Over-preparation, table scraps, cooking losses, and packaging failures can lead to unnecessary accumulation of food waste. At least one hotel waste audit cited in Hinton et al. (2004) showed that the majority of waste in a lodging facility is not produced in the guest rooms, but rather in the food service sector. Therefore, the kitchen areas are prime candidates for solid waste reduction strategies. Banquet scraps are edible leftovers from client functions. Guest plate and food preparation scraps, which typically include unusable portions of fruits and vegetables, cooking losses, spoiled leftovers, packaged failures and spillage, are considered non-edible. Waste oils and grease are leftover from cooking. Food waste is easily amenable to reduction, recovery, and reuse programs. Some recommendations are detailed below.

- **Create a food waste reduction policy for scraps**. Banquet scraps may still have a beneficial use. Too much food prepared or leftovers that have a short shelf life may have secondary usage, such as grilled chicken breast to chicken casserole or chicken soup. This can also be donated to a local food bank or food donor (i.e. Second Harvest) or used in the employee cafeteria. Offer half-sized portions to patrons in the restaurant. To help decide what items should be at half-size, perform a survey with service staff to record the amounts left uneaten. Establish a contact with food banks so procedures are in place. All food must be kept at the proper temperature to be reused and monitored for spoilage.
- **Develop a plan for food scraps**. All plate scraps are non-edible and should be separated into a collection bin labeled "food waste only." Solid food preparation scraps can be dumped into the same bin. This bin can be used for composting. Scrap food can be saved for farmers (pig, cattle, and poultry). However, coffee grounds/salty foods are harmful to livestock and should be composted.
- **Consider donating food waste to local farmers**. Farmers who collect food waste can be found by placing an ad in a local newspaper or visiting a farmers market. The farmer must have a permit to accept waste and must cook meat products prior to feeding it to the animals.

The storage area for food waste and composting should be inaccessible to pests, covered and in a cool place.

- **Contact local wastewater treatment plant to find out about local rendering facilities that accept oils/grease**.

Some additional recommended practices that should be considered are:

- **Buy less food.** This is an eco-purchasing concept. Use just-in-time inventory and use first-in, first-out distribution to keep items fresh. Order food in bulk and closer to the time needed. Many food distributors are able to deliver within a short period of time to reduce storage and spoilage. Track the amount of different types of food that are consumed and purchased. Redesign the restaurant menu to improve secondary use of edible food (i.e. sliced fruit to fruit salad, chicken to chicken salad or soup). Reassess portion sizes to reduce wastage, and purchase locally grown produce, which may last longer and be less expensive due to lower transportation cost. The Totem Pole Restaurant at the Thunderbird Hotel in Bloomington, MN began a food waste reduction program by having the head chef monitor the food inventory, the amount of food per meal, the percent of waste per meal, and type of food commonly disposed in the recycling containers. This resulted in modification of the food preparation practices that achieved a 20% reduction in food waste, resulting in a net savings of $325 (Alexander 2002).
- **Avoid centrally locating items in the restaurant.** Co-locating several items in one part of the restaurant or takeout areas tends to generate more usage and waste. Keep condiments on tables in containers or make patrons ask for items and quantity needed.
- **Avoid over-packaging and limit use of disposable items**. For room service or take-out orders, use silverware, porcelain dishware, aluminum foil, glass cups, and reusable stainless steel plate covers instead of Styrofoam containers, paper cups, cellophane wrapping, and plastic utensils. Offer condiments, napkins, and straws upon request only. In the restaurant, use bulk straws instead of individually wrapped. There will be less paper waste. Use fountains to dispense soda. Replace cocktail napkins with permanent coasters at dinning room tables and bars. Eliminate paper placemats, and switch from paper to cloth dinning napkins and tablecloths. Ask vendors to take back empty plastic containers. If they are unable, clean them out and reuse them in other hotel operations, such as in maintenance and housekeeping or simply give them to employees. Recycle plastic six, four and nine-pack rings. Replace individual condiment packets with bulk dispensers.
- **Limit kitchen staff waste**. Use rubber mats around sinks and dishwashers to reduce glass breakage. Rubber mats will cushion surfaces that tend to cause breakage. Install a magnet on food waste containers to recover flatware that was accidentally thrown away. Use longer lasting spun glass pads for scrubbing pots and pans instead of steel wool. Use washable hats and aprons instead of disposable ones.

Hazardous Waste Minimization

Hotels can generate an extraordinary amount of hazardous waste from paints, adhesives, spent fluorescent lighting, oils, waxes, coatings, batteries, pesticides, cleaning agents, etc. These items should be strong candidates for eco-friendly alternatives by researching for eco-purchasing substitutions. If absolutely necessary, these types of items should only be used in well-ventilated areas and stored properly for a well-defined maximum period of time before disposal.

- **Reduce chemicals**. Laundry and cleaning chemicals should be biodegradable and as least toxic as possible. When possible, use environmentally friendly cleaning agents (MSDS Health Hazard Rating of 1 or less). Minimize the use of bleaches, chemical pesticides, and other detergents and chemicals. For an environmentally friendly alternative to floor wax, use 1 cup of white vinegar mixed with 2 gallons of water to mop linoleum or no-wax floors. Choose refillable pump spray applicators instead of aerosols. Use products in correct concentration and "as recommended." This saves on the amount of product needed. Train staff in the proper storage, use, and safe disposal of any essential hazardous substances to avoid risks to both staff and the environment.
- **Minimize hazardous waste inventory**. Through experience or careful tracking, the exact amount of cleaning chemicals necessary can be determined precisely. Also some vendors are willing to ship products right when you need them. Just-in-time inventory methods can reduce the need to store chemicals and other hazardous products. Find vendors who are willing to ship a product when you need it. Also make sure that all stored materials are date stamped when they arrive and that the older product is always used first.
- **Purchase products with reduced hazardous or toxic material content**. For example, cleaning supplies are available that are vegetable-based (biodegradable) and non-toxic. Non-chlorine bleaching agents, phosphate-free soaps, and VOC-free paints can also reduce pollution (DeFranco and Weatherspoon 1996). The appropriateness of certain product substitutions can be evaluated by inspecting the product label and/or MSDS. Disposable batteries should be replaced with rechargeable batteries in pagers, walkie-talkies, radios, calculators and flashlights. This reduces the amount of lead acid batteries in landfills (lead is the leading toxic substance in landfills). A comprehensive list of opportunities to reduce items with toxic content is found in Table II-1 in Winter and Azimi (1996).

If a large quantity of hazardous waste materials is being stored onsite, the inventory should be reduced by taking spent materials to the Miami-Dade County Home Chemical Collection Center located at 8831 NW 58th Street. The facility is open every Saturday from 8:30 a.m. to 12:00 noon and 12:30 p.m. to 5:00 p.m. and on Wednesday from 9:00 a.m. to 12:00 noon and from 1:00 p.m. to 4:00 p.m.

Figure 72. Inventories of hazardous chemicals on site at the Raleigh.

Figure 73. Hazardous chemical storage at the Raleigh is not well ventilated.

Clean Air Practices

In the short-term, to successfully improve indoor environmental quality from these areas, a baseline assessment was conducted to determine the types and concentrations of indoor air quality pollutants in order to target specific products or materials that contribute the greatest loading or which create the most signification problems. With the assistance of the Pollution Prevention Coalition of Palm Beach County, the research team conducted several indoor air quality surveys on June 12, 2008. Under the supervision of Julia Cajacob (Environmental Specialist II, Division of Environmental Health and Engineering Air Quality Programs), the indoor environmental quality surveys focused on mold/mildew, migrating odors, relative humidity/temperature settings, moisture behind drywall, particulates/dust, VOCs, carbon dioxide, pressurization, and outside air ventilation. Apriori, we expect the following items to be significant for tailored indoor air quality control programs:

- Mold control issues
- Volatile organic compounds
- Migrating odors
- Particulates/dust
- Temperature/relative humidity comfort issues
- Noise
- Low-emitting materials

In summary, the major areas identified for clean air pilot projects include: environmentally-preferable cleaners, HEPA or >MERV8 Filters, HVAC cleaning/replacement, carbon dioxide monitoring, anti-idling, alternative fuel vehicles, outdoor mats at egress, weatherstripping, No-VOC paint, furniture offgassing, indoor finishes VOC control, furniture, finishes, and equipment policy, ETS policy, pest control strategies, mold control setback settings, allergy-free rooms, microfiber cloths, and steam cleaning to replace chemicals.

A preventative maintenance approach to clean air practices will assist in preventing more expensive remediation actions in the future and reduce liability stemming from air quality issues (Hinton et al. 2004). Indoor Air Security Checks (I-ASCs) will help make certain that staff and guests have not left vents and openings, such as doors, windows, access panels, and entranceways in the wrong positions and that temporary seals and enclosures (plastic sheeting, etc.) are in place and properly secured. Areas that are particularly susceptible to contamination should be regularly inspected, cleaned, repaired, or replaced. Items such as older rugs, carpets, floor coverings, mattresses, and bedding which may have become contaminated, damaged, or otherwise defective due to old age and/or disrepair should be targeted for removal on a periodic basis. The HVAC system is also one of these components. For example, the ducting network may be leaking and contributing to the spread of air contamination. The building envelope itself may be contributing as well. For this, it is recommended to inspect windows, door seals, closure fixtures, and building weatherization. Older equipment such as washers, dryers, copy machines, and lawn mowers may contribute excessively to air pollution and should be targeted for replacement. Areas suffering from water damage or moisture collection should also be replaced. These include: walls, wallboards, wall coverings, wallpaper, ceiling tiles, and blanket insulations. Establish in-house procedures (including additions to job descriptions) for routinely conducting scheduled inspections. Particular attention should be given to high-risk areas such as open windows directly above air-conditioning exhausts, kitchen vents, and parking garage

entranceways. Make certain to address water leaks and moisture problems immediately. Water damaged materials (i.e. paper, linens, carpet, etc.) can develop mold growth within 24–48 hours. The Paramount Resort and Conference Center in Gainesville, FL implemented a moisture remediation program, which included sealing the building envelope, sealing the roof by replacing flashing, and installing roof-top air conditioning units that introduce 100% outdoor air that is cooled and dehumidified. End rooms received additional attention, including replacing drywall with materials that resist mold and mildew, sealing interior walls, and installing a moisture barrier (Hinton et al. 2004).

Indoor Air Quality. People spend from 70 – 90% of their time indoors, and we are discovering that indoor air quality is substantially more polluted than outdoor air (Hetes et al. 1995; Davis and Masten 2004). Concerns with indoor air quality (IAQ) have increased since energy conservation measures were instituted during the 1970s. Because of the energy crisis, there was great interest in weatherizing buildings to minimize the infiltration of outside air and make buildings more airtight and more energy efficient. However, the tradeoff was less ventilation with fresh air, which contributed to the buildup of indoor air contaminants and the discovery of a new disease called "*sick building syndrome*."

IAQ refers to the physical, chemical, and biological characteristics of air in the indoor environment. IAQ impacts both comfort and health. Its effects are often difficult to quantify comparatively because the perception of air quality is strongly influenced by other environmental factors, such as temperature and humidity. IAQ is governed by ASHRAE Standard 62 (2004), as a function of:

- Airborne contaminant sources, concentrations, and transport
- Adverse human health effects
- Engineering controls of airborne contamination
- Maintenance of acceptable temperature, relative humidity, and air velocity (ventilation)

Indoor pollution sources that release gases or particles into the air are the primary cause of indoor air quality problems. There are many sources of air pollution in buildings. These include:

- Combustion sources such as fossil fuels (i.e. oil, gas, kerosene, propane, coal, and wood) and carbon monoxide from stoves, furnaces, space heaters, chimneys, fireplaces, or generators.
- Environmental tobacco smoke (ETS)
- Building materials and furnishings such as asbestos insulation, damp carpeting or gypsum wallboard (mold), VOCs from glues and sealants, cabinetry or furniture containing pressed wood products made with formaldehyde, and carpets or fabrics with styrene butadiene rubber (SBR) latex backing material that contain 4-Phenylcyclohexene (4-PCH).
- Products for cleaning and maintenance, such as degreasers, moth repellants, air fresheners, and disinfectants. According to Sierra Environmental Technologies, Inc. (2006), a typical housekeeper uses over 200 pounds of chemicals per year, of which approximately 60 pounds (30%) are considered hazardous (i.e. toxic, corrosive, reactive, or ignitable) according to the Resource Conservation and Recovery Act (RCRA).
- Personal care products such as cosmetics, aerosols, and perfumes.

- Central HVAC and dehumidification devices. Inadequate ventilation leads to the buildup of carbon dioxide and other indoor air pollutants like freon.
- Paints, varnishes, waxes, lacquers, paint strippers, paint thinners, dry-cleaning solvents, and other solvents.
- Office equipment such as copiers and printers (inks and ozone), correction fluid, and permanent markers, just to name a few.
- Outdoor air pollution sources such as radon, dust, particulates, pollen, and other allergens. Radon contamination exhibits no immediate symptoms; however, exposure is estimated to contribute to between 7,000 and 30,000 lung cancer deaths each year (USEPA and USCPSC 1995). Based on a national residential radon survey completed in 1991, the average indoor radon level is 1.3 picocuries per liter (pCi/L). The average outdoor level is about 0.4 pCi/L (USEPA and USCPSC 1995).
- Idling vehicle exhaust from shuttle buses, gasoline-powered golf carts, or lawn mowers (unburnt hydrocarbons, NO_x, SO_2, CO, etc.).
- Biological contaminants such as *Legionella* and other bacteria, spores, mold, dust mites, bed bugs, pests, insects. Pets are also a source of biological contaminants, animal dander (skin flakes, fur, etc.), and other allergens.

Impacts to human health can be directly or indirectly related to the indoor air pollutant sources described in the previous section. The Institute of Medicine (2004) reviewed the health effects of damp buildings and determined that the most effective way to combat mold and other moisture-related indoor air quality issues is to reduce or eliminate dampness in buildings. The study also concluded that there is a significant association between damp indoor spaces and asthma attacks, allergic reactions, and respiratory ailments in sensitive populations. This represents up to 20% of the population of hotel guests and staff (Harlos 2006). Other health effects were also evaluated.

Adverse human health effects from indoor/outdoor air pollutants may be experienced soon after exposure or, possibly as in the case of cancer, many years later. Immediate effects may show up after a single exposure or repeated exposures. These include irritation of the eyes, nose, and throat (respiratory tract), headaches, dizziness, fatigue, and many allergic reactions. Acute effects are usually short-lived and treatable. Simply eliminating or reducing exposure to the source of the pollution, if it can be identified, can be effective at reducing the risk of acute respiratory effects. Symptoms of some diseases, including asthma, hypersensitivity pneumonitis, and humidifier fever, may also show up soon after exposure to indoor air pollutants. On the other hand, symptoms of sick building syndrome can disappear shortly (i.e. hours) after leaving the premises (FEES and Cook 1995).

The likelihood of immediate reactions to indoor air pollutants depends on several factors. Age and preexisting medical conditions are two important influences for acute onset. In other cases, reactions are more related to individual sensitivity, which varies widely from person to person. Some people can become sensitized to biological or even chemical pollutants after repeated exposures. Some effects may be made worse by an inadequate supply of outdoor air or from the heating, cooling, or humidity conditions prevalent. Certain immediate effects are similar to those symptoms generally associated with colds or other viral diseases, so it is difficult to determine

causality with respect to exposure to indoor air pollution. For this reason, it is important to pay attention to the time and place the symptoms occur.

While pollutants commonly found in indoor air are responsible for many harmful effects, there is considerable uncertainty about what concentrations or periods of exposure are necessary to produce specific health problems. People also react very differently to exposure to indoor air pollutants. Further research is needed to better understand which health effects occur after exposure to the average pollutant concentrations and which effects are attributable to the higher concentrations that occur for short periods of time.

In terms of clean air practices, the main lobby and the office sections of the property offer many opportunities for improving the quality of the indoor environment. In addition, the main lobby and the back of the house office spaces are great places to introduce employees, guests, and visitors to the commitment to clean indoor air by posting highly visible signs and placards in these high-traffic areas.

Environmental Tobacco Smoke Control

Both the back of the house facilities and the main lobby should be free from smoking in order to control tobacco smoke and associated contaminants, preventing non-smokers from being subject to exposure. The most effective way of doing this, is to prohibit smoking. Florida State Law (Florida Clean Air Act of 2003), prohibits smoking in the workplace, which effectively takes care of the offices and main lobby, although the law allows smoking in designated rooms at motels and hotels and stand alone bars with no more than 10% of revenue from food sales. However, it is still likely that hotel employees as well as guests will contain a percentage of smokers because approximately 1 in 5 of the American population smokes (Rosenwald 2006). Therefore, it is critical when smoking cannot be avoided, that special areas should be designated to isolate smokers from the general building. Exterior designated smoking areas should be located at least 25 feet away from entryways, outdoor air intakes, and operable windows. These areas should not be located in or near to major access/egress points, alcoves, lobby entrances, or breezeways. In addition, designated smoking areas should not be located near HVAC equipment, air handlers, or ventilation air distribution systems to safeguard nonsmokers and children from the damaging effects of secondhand smoke exposure.

If the designated smoking areas are located indoors, make sure that the room is designed to effectively contain, capture and remove ETS rapidly and completely from the building. At a minimum, the smoking room must be directly exhausted to the outdoors with no re-circulation of ETS-containing air to the non-smoking areas of the building, and enclosed with impermeable deck-to-deck partitions. With the doors to the smoking room closed, the exhaust system should operate sufficiently to create a negative pressure of 1 – 5 Pa (0.004 – 0.020 inches of water gauge) (USGBC 2005). Differential air pressure performance of the smoking room shall be verified by conducting 15 minutes of measurement, with a minimum of one measurement every 10 seconds, of the differential pressure in the smoking room with respect to each adjacent area and in each adjacent vertical chase with the doors to the smoking room closed. The testing will be conducted with each space configured for worst case conditions of transport of air from the smoking rooms to adjacent spaces with the smoking rooms' doors closed to the adjacent spaces.

Uncontrolled pathways for ETS transfer between building spaces should be minimized by sealing penetrations in walls, ceilings and floors, and by sealing vertical chases. All doors in the leading to common hallways shall be weather-stripped to minimize air leakage into a hallway with access to a designated smoking area Acceptable sealing shall be demonstrated by a blower door test

conducted in accordance with ANSI/ASTM-E779-03, Standard Test Method for Determining Air Leakage Rate By Fan Pressurization, and the use of the progressive sampling methodology defined in Chapter 4 (Compliance Through Quality Construction) of the Residential Manual for Compliance with California's 2001 Energy Efficiency Standards (www.energy.ca.gov/title24/residential_manual). Compliance should demonstrate less than 1.25 square inches leakage area per 100 square feet of enclosure area (i.e. sum of all wall, ceiling and floor areas). These practices will have the added extra benefit of reducing energy demand by increasing the building tightness.

Hotel staff should be aware that odors from designated smoking areas can be transferred to other areas of the building by housekeeping (i.e. smoke-impregnated furniture, linens, draperies, window treatments, etc.). Care should be taken to completely clean these items before moving them around in sensitive areas of the hotels such as the outside air intakes, lobbies, elevators, etc., particularly if the hotel has a bar or restaurant or other designated smoking areas, where smoking is allowed.

Finally, some hotels have completely prohibited smoking altogether. For instance, Westin Hotels, which is owned by Starwood Hotels and Resorts Worldwide Inc., banned smoking in 77 of its properties in 2005. Then Marriott International Inc., the nation's largest hotel chain, followed suit and banned smoking in all of its 400,000 hotel rooms in the United States and Canada the following year. Twenty years ago, about 50% of rooms were set aside for smokers, but now only 5% of guests are requesting smoking rooms (Rosenwald 2006).

Figure 74. Non-smoking room at the Standard.

Figure 75. Designated smoking area is located near the employee entrance and propane container storage area.

Other Occupant-Related Issues.

As discussed, some hotels have a stated smoking policy for guestrooms and facilities. Adopting the ETS control strategies identified above will help improve indoor air quality related to tobacco products. Limiting cooking activities in the room will also reduce odors and smoke impregnation. Designate outdoor cooking areas that are well-ventilated to keep these activities out of the guestrooms or provide adequate kitchen-style ventilation. Personal care products such as perfumes, hairsprays, deodorants, and cosmetics cannot be controlled by hotel management, but if adequate bathroom ventilation is provided, these emissions can be vented to the outside so that they do not accumulate in the guestrooms. Furnishings and electronic equipment can be carefully chosen to avoid or limit off-gassing of formaldehyde from pressed wood, VOCs from paints, coatings, or carpeting, and ozone from office or entertainment equipment from building up in the guestrooms. Pets are another source of biological contaminants. This issue can be addressed by

adopting a no pets allowed policy. Providing guest controls for thermal comfort and exhaust ventilation can help reduce complaints and minimize air quality impacts from episodic events, such as cooking. Providing entry mats can help limit tracked in dirt and pollen. Guests may not always be aware of clean air practices and may even ignore placards and promotional materials designed to educate them on hotel policies on the subject. Therefore, most of the activities targeted to improving indoor air quality must not rely on guest participation. For instance, occupants with communicable diseases may not limit their exposure to other guests or centralized HVAC systems. Thus, it is mainly up to the diligence of housekeeping staff to rigorously clean and disinfect guest quarters and perform routine maintenance and air monitoring to avoid incubating infectious biological contaminants.

Environmentally-Preferable Cleaners

The housekeeping staff should be using "environmentally friendly" products whenever feasible. Generally, plant-derived botanicals or eco-friendly cleaners that contain no synthetic organic compounds, no petroleum-based products, and no chlorine are preferable. Many of these products are commercially available or can be homemade, such as vinegar as a local disinfectant instead of chlorine.

1. Toilet cleaners typically contain chlorinated phenols, which are toxic and potentially carcinogenic to the respiratory and circulatory systems.
2. Window cleaners typically contain diethylene glycol or butoxyethanol, which can depress the central nervous system.
3. Spray and wick deodorizers typically contain formaldehyde, which is a respiratory irritant and a suspected carcinogen.
4. Floor cleaners and degreasing agents typically contain petroleum solvents, which damage mucous membranes and lead to acute respiratory problems.
5. Floor strippers often contain ammonium hydroxide, ethanolamine, and butoxyethanol, making this product one of the most dangerous handled by housekeeping staff (Barron et al. 1999).
6. Acidic porcelain cleaners are used for removing hard water deposits (scale) and other stubborn stains. They are formulated with hydrochloric, phosphoric, or hydroxyacetic acid and are corrosive and potentially dangerous for skin burns and lung irritation.
7. Metal polishing agents typically contain tetrachloroethylene or volatile organic compounds, which are potentially carcinogenic.
8. Carpet shampoo typically contains nitrilotriacetic acid and carpet spot removers contain tetrachloroethylene (Barron et al. 1999). These substances are likely carcinogenic.
9. Furniture restoration products may contain tri-butyl tin or formaldehyde, which are toxic and potentially carcinogenic (Barron et al. 1999).
10. All-purpose spray cleaners typically contain alkyl phenyl ethoxylates, ethanolamine, or butyl cellosolve, which damages the central nervous system and attacks bone marrow, kidneys, and the liver.

It is likely that housekeeping and management staff are not aware of the chemical composition of cleaning products. Therefore, material safety data sheets (MSDS) should be posted and read

carefully before selecting cleaning agents to help choose the most safe and environmentally friendly products available. Green Seal is an independent, non-profit organization that evaluates and lists environmentally responsible products and services. Since 1995, Green Seal has partnered with the lodging industry to promote environmentally responsible products and practices within lodging properties. The average hotel purchases more cleaning products in one week than one hundred families typically do in one year (www.greenseal.org). Furthermore, both hotel guests and staff may be exposed to many environmental toxins from products ranging from cleaners to paint to floor coverings. These all represent opportunities to reduce impact and improve sustainability. Certainly, Green Seal is not the only list available for eco-friendly purchasing. Regardless of the certification or manufacturer claims, the substituted cleaning product must have the following characteristics:

1. Biodegradable
2. Contain no known carcinogens, endocrine disruptors, or reproductive toxins
3. Contain no alkylphenol ethoxylates
4. Contain no dibutyl phthalates
5. Contain no heavy metals
6. Contain no ozone-depleting compounds
7. Contain no optical brighteners (fluorescent whitening agents)
8. Contain low VOCs
9. Contain no aquatic toxicity

Even if eco-friendly cleaners are used or not, it is still critical to insure that work areas are well-ventilated (to the outside) using either permanent building ventilation specifically designed for this purpose or using properly sized portable fans. Manufacturer's label instructions should be followed carefully, and the appropriate amount of material should be optimized for the specific purpose by incrementally adjusting product usage until maximum efficiency is achieved with the minimum amount of chemical to get the job done.

If chemicals are spilled, they should be cleaned up immediately so that the excess material does not soak in or becomes entrapped in the ventilation system. Also it is important to make certain that excess material does not runoff into the storm sewer system accidentally. Make the extra effort to instruct sub-contractors, pest control personnel, and housekeeping staff to observe clean indoor air policies, and post notices for guests when chemicals are in use. If notified of the appropriate reason and timeframe, guest complaints can be reduced to a minimum.

Laundry detergents may contain alkylphenol ethoxylates or non-renewable petroleum-based products. Some detergents still contain phosphates. Other chemicals contain endocrine disruptors and carcinogens (used in fragrance). Synthetic fragrances can cause allergic reactions. Choose dish and laundry detergents and all-purpose cleaners that are botanical-based (i.e. corn, palm kernel, or coconut oil). To remove stains on clothes, instead try soaking fabrics in water mixed with borax, lemon juice, hydrogen peroxide, or white vinegar. Vinegar and borax are natural fabric softeners. Adding one-half cup of this mixture to the rinse cycle in place of commercial fabric softener will achieve the desired results.

Avoid antibacterial soaps that promote resistant strains of bacteria. They are not necessary if hand washing is accomplished properly. Bleach and other disinfectants that contain chlorine can generate toxic byproducts such as organochlorines, which are suspected carcinogens as well as reproductive, neurological, and immune-system toxins. Non-chlorine bleach products made from sodium percarbonate or sodium perborate can be just as effective. A solution of 1:1 white vinegar and water can be substituted for almost all disinfection uses. Porcelain and countertops can be cleaned with a paste of baking soda or borax and water or a non-chlorinated scouring powder. Avoid using stain removers with aerosol propellants containing flammable ingredients as well as microscopic particulates that can lodge in your lungs after the water has evaporated. Fragrances can provoke allergic or asthmatic reactions and should also be avoided. If dryer sheets are required, make certain to use the non-scented variety.

For the grounds, lodging facilities should minimize or eliminate the use of toxic herbicides, fungicides, and biocides, fertilizers, and CCA-treated wood that contains copper, chromium, and arsenic. These items will find their way into the HVAC system through the outside air intakes or be tracked into the building through any of the entry points. If termites are a concern, consider replacing pesticide application practices with non-toxic products like Termimesh® systems, which employ a physical barrier approach rather than a chemical inactivation (Upton 2007). If xeriscaping or native plants are used for ground cover, make certain that plants with little or no pollen are selected near building entryways. In addition, plants should be selected that require little or no pesticide or fertilizer application and minimal watering. This will have the effect of minimizing chemical usage and also minimizing the potential for ponded water as a breeding ground for biological contaminants or moisture entering the building. Pallets used to bring in supplies may be built using CCA-treated wood. Specify to your supplier that pallets must not contain CCA.

Another area to pay particular attention to would be the chemical storage facilities. Regular inspections should be conducted to check that cleaning solvents, paints (containing Pb or VOCs), fuels, and other chemicals are properly stored, containers are closed tightly and not leaking or spilling into entryways or running off into storm sewers. It is recommended that work areas be vented independently.

A comprehensive inventory of the housekeeping and engineering chemical products is being undertaken at both properties, including a review of the MSDS for each product. An example of cleaning products encountered is shown in Figure 76.

Figure 76. Housekeeping cleaning chemicals at the Raleigh (left) and the Standard (right).

Implementation Project: Green Cleaners. An assessment was conducted of the Material Safety Data Sheets for all chemicals at both properties involved in this study. Fro the Raleigh Hotel, the following cleaners were obtained: Bardandy, Orange Force, and Apex Power from the green cleaning line of EcoLab. This conversion to green cleaners is still ongoing at the Raleigh, since we have secured the participation of the director of housekeeping on board with the green team. For the Standard, a complete conversion of the housekeeping chemicals to the GreenWorks line and Ecolab green cleaners series of products was recently completed in September 2008. The research team will be conducting interviews of housekeepers on both properties to determine how they feel about the change in products. This analysis will be published in the upcoming progress report.

Air Filtration

If permanently installed air handlers are used during construction, filtration media with a Minimum Efficiency Reporting Value (MERV) of 8 shall be used at each return air grille, as determined by ASHRAE 52.2-1999. Replace all filtration media immediately prior to occupancy.

For added particulate protection, install filtration/air purification systems in mechanically ventilated regularly occupied areas of the building with high efficiency air filtration media prior to occupancy that provides a Minimum Efficiency Reporting Value (MERV) of 13 or better. The HEPA filter is recommended for this purpose. Filtration should be applied to process both return and outside air that is to be delivered as supply air. Be certain that air handling units can accommodate required filter sizes and pressure drops. In terms of particulates, high efficiency filtration is only 40% efficient at removing particles that are less than 0.5 µm in diameter. Unfortunately, more than 98% of the particulate matter found in buildings is less than this size. Furthermore, it is precisely these very small particles that carry the bulk of the human health threat, and due to their small size, these particles remain suspended in the air for very prolonged periods. For instance, a particle with diameter 0.01 µm has a sedimentation rate of 0.02 ft/d or a residence time of 51 days per foot (Newsome 2006). Other technologies that can be adapted for treatment of non-particulate air pollutants include ionization, oxidizers, ultraviolet irradiation, or ozone.

Figure 77. MERV 6 blue filter media cut to fit for the Raleigh individual HVAC units in the guest rooms (left). The Standard also uses MERV6 pleated media filters (right).

Figure 78. Filter media attached to an air handler in the Raleigh using duct tape (left). Note the amount of dirt on the exposed underside (left) and the air gap created (left and right).

Implementation Project: MERV8 Filters. Both hotels are in the process of switching out their older MERV6 filters for newer MERV8 filters. The Raleigh was able to purchase the newer filters without registering the vendor for an open purchase order agreement, so the Raleigh has a small supply on hand, while the open purchase order agreement is negotiated and the credit line is established. The Standard Hotel was not able to make this arrangement; therefore, they are still waiting for approval to obtain delivery and begin installation. This analysis will be published in the upcoming progress report after the filters have been in place for one complete cycle.

HVAC Systems Cleaning/Replacement/Design

Never vent gas clothes dryers or water heaters from commercial clothes washers into the room for heating purposes. This is unsafe. Proper ventilation (as discussed in other sections) will ensure that dryer heat, dust, and lint issues do not become an indoor air quality issue.

Indoor air pollution hazards may be associated with many types of appliances commonly found in the kitchen. Combustion appliances are those which burn fuels for cooking or heating purposes. Typical fuels are gas (both natural and liquefied petroleum), kerosene, propane, oil, coal, and wood. Examples of these kinds of appliances include ranges, ovens, stoves, furnaces, fireplaces, and space heaters. These appliances are usually safe; however, under certain conditions, products of incomplete combustion can be generated. The types and amounts of these pollutants depend upon the type of appliance, the kind of fuel it uses, how well the unit is installed and maintained, and general ventilation practices during use. Some of the common pollutants include carbon monoxide, nitrogen dioxide, sulfur dioxide, particulates, partially unburned hydrocarbons, and aldehydes. Combustion also always produces water vapor, which is generally not considered a pollutant but in the context of hotel moisture control for mold abatement, can act as one by creating conditions of high relative humidity and wet surfaces.

Vented appliances are designed to be used with a duct, chimney, pipe, or other device that will transport combustion pollutants outside. These appliances can release large amounts of pollutants directly into the kitchen space, if the vent system or exhaust fan is not properly installed, or is blocked or leaking. Unvented appliances release combustion pollutants directly into the kitchen and can be potentially more dangerous to human health. Any appliances that

generate carbon monoxide, such as charcoal grills or hibachis should never be used indoors. Carbon monoxide from burning and smoldering charcoal is lethal. There are about 25 deaths each year from the use of charcoal grills and hibachis indoors. Proper selection, installation, inspection, and maintenance of kitchen appliances are extremely important. Appliances should be professionally installed following the most stringent applicable building codes. Improperly installed appliances can release dangerous pollutants in high concentrations and may create a fire hazard. Be sure that during professional installation, backdrafting on all vented appliances is checked.

Providing appropriate ventilation (kitchen hoods and exhaust fans) and correctly locating and using kitchen appliances can also reduce exposures to fats, oils, and grease (FOG) and particulates generated during the food preparation or cooking process. To reduce indoor air pollution, a good supply of fresh outdoor air is required for dilution and also to help carry pollutants up the chimney, stovepipe, or flue to the outside. To improve the efficiency of ventilation in the kitchen, strive to keep doors open to the rest of the kitchen from the room where you are using an unvented or kerosene appliance, and open a window if possible. This allows enough air for proper combustion and reduces the level of pollutants, especially carbon monoxide. If a range is used, consider only operating the unit with a hood fan in place. Make sure that enough outside air is available when using an exhaust fan to pull pollutants outside. If needed, slightly open a door or window, particularly if other appliances are in use. Using a stove hood with a fan vented to the outdoors greatly reduces exposure to pollutants during cooking. For proper operation of most combustion appliances and their venting systems, the air pressure inside the room should be greater than the pressure outside. If not, the vented appliances could release combustion pollutants directly into the room rather than to the outside. Make sure that your vented appliance has the vent connected and that nothing is blocking it. Make sure there are no holes or cracks in the vent. If using a wood stove, open the damper when adding wood to allow more air into the stove. This helps the wood to burn more completely and also prevents pollutants from being drawn back into the kitchen instead of going up the chimney. Visible smoke, or a constant smoky odor inside, when using a wood-burning stove is a telltale sign that the stove is not working properly. Soot on furniture in the rooms where you are using the stove is another indicator. Dishwashing activities may also need to consider separate ventilation, and switching to environmentally-preferable detergents and disinfectants (discussed in the laundry section) is also recommended.

Always use only the correct fuel for the appliance. For example, only water-clear ASTM 1-K kerosene should be used for kerosene heaters. Never use gasoline in a kerosene heater because it can cause a fire or an explosion. Use seasoned hardwoods (elm, maple, oak) that have been aged or cured (dried) instead of softwoods (cedar, fir, pine) in woodburning stoves and fireplaces because the hardwoods burn hotter and more completely. They also form less creosote, which is an oily, black tar that sticks to chimneys and stove pipes. Wet woods form more creosote and smoke. Painted scrap wood or treated wood with preservatives (i.e. CCA) should not be used because they could release highly toxic pollutants, such as lead or arsenic. Plastics, charcoal, colored paper or newsprint, or anything that the stove or fireplace manufacturer does not recommend should be avoided. All kitchen appliances should be used properly. For instance, a range, oven, or dryer should not be used to heat the room. Keep the burners properly adjusted so that the appropriate amount of fuel is consumed. Make certain that doors in older woodstoves are tight-fitting. Old gaskets in woodstove doors may contain asbestos, newer gaskets are manufactured with fiberglass. Always follow the manufacturer's directions for starting, stoking, and putting out fires in woodstoves.

It is recommended that vented appliances be selected whenever possible. Only those that have been tested and certified to meet current safety standards, such as Underwriters Laboratories (UL) and the American Gas Association (AGA) Laboratories, should be considered. Inspect the label to determine if the appliance is safety certified. For example, all currently manufactured vented gas heaters are required to have a safety shut-off device that helps protect workers from carbon monoxide poisoning by shutting off an improperly vented heater. Consider upgrading to newer gas appliances made after 1982 that have a pilot light safety system called an oxygen depletion sensor (ODS). This system shuts off the gas when there is not enough fresh air detected. Older systems will not have this safety feature. Consider purchasing gas appliances that have electronic ignitions rather than pilot lights. Appliances with electronic ignitions eliminate the continuous low-level pollutants generated from pilot lights and are usually more energy efficient as well. Use appliances that are correctly sized. Oversized units will produce more pollutants unnecessarily and are not an efficient use of energy.

There are several commercially available carbon monoxide detectors capable of warning kitchen staff when harmful carbon monoxide levels are reached. Safety devices must never be ignored. When they automatically shut off an appliance, this means that something is wrong. Improper adjustment of gas appliances, indicated by a persistent yellow-tipped flame, can lead to increased pollutant emissions. Request that the gas service provider adjust the burners so that the flame tip is blue. For safety purposes, natural gas, which is odorless, is spiked with small amounts of hydrogen sulfide to impart a rotten egg smell. This is typically done to help alert the user that there is a potentially dangerous leak. Human olfactory senses are capable of detecting minute amounts of hydrogen sulfide; therefore, the smell of fuel should never be ignored. This usually indicates that the appliance is not operating properly or is leaking fuel. If a fuel leak is suspected, shut off the appliance, extinguish any other flames or pilot lights, shut off other nearby appliances, open windows and doors, leave the area, and have it fixed immediately. Have your combustion appliances regularly inspected and maintained to reduce exposure to pollutants. Chimneys and vents should be inspected when installing or changing appliances to determine if modifications are required. For example, if changing from oil to natural gas, the flue gas produced by the gas system could be hot enough to melt accumulated oil combustion debris in the vent. The mobilized debris could block the vent and force pollutants back into the kitchen. Have central air handling systems, including furnaces, flues, and chimneys, inspected annually and properly repair cracks or damaged parts. Blocked, leaking, or damaged chimneys or flues release harmful combustion gases and particles and even fatal concentrations of carbon monoxide. Strictly follow all service and maintenance procedures recommended by the manufacturer, including those that tell you how frequently to change the filter (change filters every 1 – 2 months during periods of use). Proper maintenance is important even for new furnaces because they can also corrode and leak combustion gases, including carbon monoxide. Install and check the operation of smoke alarms and carbon dioxide detectors. Do not forget to check the batteries.

Another aspect is dealing with food waste, which can frequently be a large portion of the waste produced in hotels and lodging facilities (Alexander 2002). At least one hotel waste audit cited in Hinton et al. (2004) showed that the majority of waste in a lodging facility is not produced in the guest rooms, but rather in the food service sector. Over-preparation, table scraps, cooking losses, and packaging failures can lead to accumulation of food waste, release of respirable particles, and accumulation of odors or insects. If preparing foods that have these characteristics it may be necessary to consider providing an area hood to properly ventilate the food preparation areas, just as you would install exhaust fans over gas cooking stoves and ranges. You may want to consider separate functionality or combining ventilation areas depending on the types of

appliances, fuels, and usage patterns. Limit kitchen waste by using rubber mats around sinks and dishwashers to reduce glass breakage. Rubber mats will cushion surfaces that tend to cause breakage. Use longer lasting spun glass pads for scrubbing pots and pans instead of steel wool. The iron metal fibers from steel wool pad can become airborne when dried and inhaled by kitchen workers or land on prepared food and ingested by restaurant patrons.

Loading docks, shop activities, odors from dumpsters, and building exhaust systems located near outdoor air intakes are all potential sources of outdoor pollutants that can potentially degrade indoor air quality. These activities should be carefully planned to minimize the impact to outdoor air intakes and should be properly ventilated even if conducted outdoors. Any activity that produces particles and dust, like trimming landscaping, painting, or wood shop repairs, should be limited or conducted in isolated areas, offsite preferably.

For outdoor cooking areas, special precautions should be in place when operating fuel-burning or unvented combustion sources near entryways or areas that are not well-ventilated. Generators for backup power should also be installed and located properly, periodically checked for leaking fuel and proper operation, and during use, carbon monoxide should be monitored.

Figure 79. To deal with water leakage (right) and noise/rattling issues, plastic panels have been cut and placed under the drip pan in guest room units at the Raleigh (left). This has the effect of blocking the air flow in the closet into the vent, forcing warmer plenum space air into the air handler unit.

Figure 80. Exposed condensate drain running just above a work station in the accounting office. Note programmable thermostat controller for the space.

Both hotels are considering changing their coil cleaning preventative maintenance plan. As of press time, no decision has been made as vendor proposals are being solicited. It is still unclear as to whether or not the hotels will be conducting coil cleaning in-house by purchasing the equipment and the green cleaning chemicals or if they will be sub-contracting the work out to a professional service.

CO_2 Monitoring

Active control of ventilation can be accomplished using airflow tracking, differential pressure sensors, or carbon dioxide (CO_2) monitoring. For each mechanical ventilation system serving non-densely occupied spaces, a direct outdoor airflow measurement device capable of measuring the minimum outdoor airflow rate with an accuracy of plus or minus 15% of the design minimum outdoor air rate should be provided.

Carbon dioxide, which is a natural byproduct of metabolic respiration, is one of the most serious concerns in the field of Indoor Environmental Quality. Levels of CO_2 can be used to indicate the level of occupancy of a particular space. Because CO_2 is a colorless, odorless, and translucent gas, humans cannot sense if levels are too high or too low. However, commercially available carbon dioxide monitoring equipment utilizing dual infrared detectors can measure CO_2 levels from 0 – 3000 ppm. If CO_2 monitoring is conducted in an office for example, the measured CO_2 level can be set to automatically trigger a response if it violates a programmed range. Typical triggered responses would include automatically opening up the supply of additional outside air for ventilation purposes or simply triggering an audible alarm. Carbon dioxide monitoring equipment should be installed at the appropriate intervals (linear spacing and 3 – 6 ft above the floor) for areas with expected densities of 25 or more per 1000 ft^2. Outdoor background levels are 350 ppm CO_2 in the air (and rising due to climate change). ASHRAE 62-2004 recommends less than 1000 ppm CO_2 in the air, because human discomfort begins at levels above 800 – 1000 ppm. Long term health effects can be expected at sustained concentrations above 12,000 ppm CO_2 in the air.

As a rule of thumb, the exhaust outflow should be maintained at less than the outside air inflow. This helps to keep the outdoor contaminants out of the building. A minimum of 0.03 – 0.05 inches of water gauge (7 – 12 Pa) should be maintained in sensitive areas, depending on airtightness.

Zone pressures can be modeled to specify the appropriate airflow between zones and perform balancing adjustments prior to and just after installation for design and operation, respectively. For mechanically vented spaces, the breathing zone outdoor air ventilation rates to all occupied spaces can be increased by at least 30% above the minimum rates required by ASHRAE Standard 62.1-2004 to enhance ventilation. However, this comes at a cost in Florida settings, and energy recovery ventilation systems may be necessary to make this feasible given the energy efficiency tradeoff. Additional ventilation will also increase summer moisture content, so that dehumidification will be required and enhanced mold control systems may be necessary as well. If we design to maintain positive pressure in the building, this will have the effect of increasing air quality and preventing mildew, particularly if the air is HEPA-filtered and dehumidified. In addition if the additional exhaust air is vented through the roof instead of doorways, warm moist air will be leaving the building in larger quantities. This will have the added benefit of increasing the HVAC system efficiency for cooling.

Anti-Idling

Many hotels operate a shuttle bus service, valet parking service, or heavy maintenance vehicles. With these amenities, it is likely that vehicle idling will become an issue, particularly in a high traffic area, such as the entranceway to the main lobby, for example. Excessive idling produces highly concentrated vehicle exhaust emissions. These are certainly not desirable, particularly near the lobby and loading areas. Signboards can be used to encourage drivers to turn off their engines when stopping for extended periods (i.e. t > 30 seconds – 5 minutes). Contrary to popular belief, prolonged idling is unhealthy for engines. Actually starting and stopping the engine is more cost-effective than prolonged idling. Consideration should be given to replacing maintenance vehicles with electric powered golf carts or alternative fuel vehicles (including bicycle power). For shuttle bus service, pollution prevention techniques can be employed to optimize the number of person-trips required. Thus only a minimum number of buses will be in operation, lowering emissions. For valet service, locating the waiting area more than 25 feet from the lobby entrance and providing ample natural ventilation will help to minimize impacts.

Implementation Project: Anti-Idling. Both hotels are in the process of developing a standardized anti-idling policy for the front valet and drop-off areas. This analysis will be published in the upcoming progress report after the policies have been in place for at least several months.

Alternative Fuel Vehicles

Another opportunity is to explore alternatives to gasoline-powered vehicles and non-road engines. Alternative Fueled Vehicles (AFVs) operate without gasoline and instead run on methanol, ethanol, compressed natural gas, liquefied petroleum gas, bio-diesel, electricity, and others. Some AFVs can run on a mixture of conventional and alternative fuels. These hybrid vehicles are more practical unless you have easy access to an alternate fuel supply. If alternatives to conventional fossil fuels are not feasible, then anti-idling campaigns should be focused on these areas as well.

Indoor Environmental Comfort

Controllability of Thermal Comfort Systems. Individuals have widely varying ranges of thermal comfort. Hotels present many challenges from the perspective of dealing with the disparate needs of guest quarters, conference rooms, banquet halls, food preparation, laundry facilities, and swimming pools, to the difficulty of accommodating both smokers and non-smokers. To fully maximize the comfort levels of hotel guests and staff, individual controllability for thermal comfort,

humidity levels (moisture control), and ventilation should be provided. To comply with ASHRAE 55-2004, separate thermal controls must be provided for 50% of the occupants based on air temperature, radiant temperature, air speed, or humidity. Therefore individual thermostats should be provided to maximize personal comfort. To monitor if thermal comfort levels are being maintained properly, the property owner should implement a thermal comfort survey of hotel guests and employees, shortly after renovations are complete (i.e. 6 months). Included in the survey instrument should be the overall satisfaction with the temperature and humidity and ventilation settings as well as real and perceived problems. If over 20% of guests indicate a problem, corrective measures should be developed and implemented.

Indoor air quality can be thought of as a relative quality, depending on individual thermal comfort, microclimate preferences, and the flux of fresh outside air. Therefore, some of the most important factors affecting the quality of the indoor environment are temperature, relative humidity, and air velocity.

The following are some of the parameters recommended by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) for maintaining occupant comfort levels within buildings:

Temperature and Humidity. These two parameters relate directly to the occupant's perception of the indoor quality. Although humidity and temperature pose a health hazard only when their values are in the extremes, designers should strive to maintain both parameters at the optimal levels (ASHRAE Standard 62.1-2004):

- Summer: 73ºF – 79ºF (at 50% RH)
- Winter: 68.5ºF – 76ºF (at 30% RH)

In Florida, it is not uncommon for relative humidity to reach 60 – 80% (FEES and Cook 1995). So maintaining the ideal levels listed above must be achieved through thoughtful design or by equipping the building with temperature and humidity sensors to monitor the environment and control the HVAC settings. Also, smaller individual rooms should be equipped with systems for manual control of the temperature conditions. In coastal environments, humidity will play an important role in indoor air quality.

Vibration and Noise. These parameters, which are a special concern in the design of factories, can produce dizziness and pain for the occupants. Vibrations and noises at certain frequencies (1-20 Hz, more than 120 dB) directly affect certain body organs, specially the eyes and hearing system, producing pain and, sometimes, permanent damage. When the sources of acoustical contamination cannot be avoided, special care should be taken to diminish their impact. The correct design of roofs and walls can lessen the effects of noise and vibration. Curiously, it has been found that offices where there are constant mild murmurs make workers more productive than those that are completely silent.

Outdoor Air Delivery (Ventilation). All buildings should strive to meet or exceed the minimum outdoor air ventilation rates set forth in ASHRAE 62.1-2004 Sections 4 – 7. The building tightness limit is based on 0.35 air changes per hour, but not less than 15 cfm of outdoor air per occupant. The recommended range is 15 – 60 cfm per person. More specific targets are listed for local exhaust fans installed in bathrooms, laundry, and kitchens.

For each space in the building, different criteria (policies, procedures and schedules) for ventilating buildings should be considered. Many factors will affect the ventilation intensity, frequency, and duration. These include functional issues, climate, indoor air conditions, and outdoor air conditions. Seasonal changes in air temperature, relative humidity, precipitation, solar intensity, and wind direction with respect to adjacent air pollution sources can have a considerable impact on ventilation needs.

A balance must be struck between the impacts of optimizing outside air ventilation on energy use and indoor air quality to provide an acceptable equilibrium between energy efficiency and occupant health. To accomplish this, provisions should be made to monitor the ventilation system with active performance feedback mechanisms to maintain minimum design ventilation requirements at all times. Said monitoring equipment should generate an alarm when conditions vary by 10% or more from the appropriate setpoint. Alarms can trigger a building automation system (BAS) alarm to the building operator or can trigger a visual or audible alert to the building occupants

Use Low Emitting Materials. Volatile organic compounds (VOC) are gases emitted from certain solids or liquids. They include a variety of chemicals, some of which may have short and long term adverse effects on human health. Sources of VOCs include paints, sealants, adhesives, caulking, coatings, carpets, insulation materials, and many other common items found in hotels. One factor that makes VOCs a great source of concern is that their concentration indoors tends to be up to 10 times higher than the outside air concentrations (USEPA 2007). If air sampling is conducted, total VOC levels should not exceed 500 $\mu g/m^3$ (USGBC 2005).

Newer materials and furnishings present a higher health risk because VOCs are usually released at a decreasing rate as time passes. Thus, new construction and major renovations are particularly hazardous for inhabitants and builders. Care should be taken in selecting eco-friendly products for the finishes. Many sources are available for these products, and many options are readily and locally available. All adhesives and sealants used in the interior of the building (defined as inside of the weatherproofing system and applied on-site) shall comply with the requirements of the following reference standards:

- Adhesives, sealants and sealant primers should comply with the South Coast Air Quality Management District (SCAQMD) Rule #1168 VOC limits.

Table 39. VOC limits for adhesives, sealants, and primers as stated in SCAQMD Rule #1168 effective July 1, 2005.

Architectural Adhesives	VOC limit*	Specialty Applications	VOC limit*
Wood flooring	100	Sheet applied rubber lining	850
Structural glazing	100	Adhesive primer for plastic	550
Multipurpose	70	PVC welding	510
Ceramic tile	65	CPVC welding	490
Rubber flooring	60	ABS welding	325
Indoor carpet	50	Plastic cement welding	250
Carpet pad	50	Special purpose contact adhesive	250
Subfloor	50	Top and trim adhesive	250
VCT and asphalt	50	Structural wood member adhesive	140
Drywall and panels	50	Contact adhesive	80
Cove base	50		

Substrate Specific Applications	VOC limit*	Sealants	VOC limit*
Fiberglass	80	Single-ply roof membrane	450
Plastic foam	50	Nonmembrane roof	300
Porous material (except wood)	50	Architectural	250
Metal to metal	30	Roadway	250
Wood	30	Other	420

Sealant Primers	VOC limit*
Architectural porous	775
Architectural nonporous	250
Other	750

*Units of g/L less water

- Aerosol adhesives should comply with Green Seal Standard for Commercial Adhesives GS-36 requirements in effect on October 19, 2000, which specify a maximum of 70% VOCs by weight for special purpose aerosols.
- Paints and coatings used in the interior of the building should comply with the following criteria:

  1. Architectural paints, coatings and primers applied to interior walls and ceilings should not exceed the VOC content limits established in Green Seal Standard GS-11, Paints, First Edition, May 20, 1993. These are 50 g/L for flats and 150 g/L for non-flats.
  2. Anti-corrosive and anti-rust paints applied to interior ferrous metal substrates should not exceed the VOC content limit of 250 g/L established in Green Seal Standard GC-03, Anti-Corrosive Paints, Second Edition, January 7, 1997.
  3. Clear wood finishes, floor coatings, stains, and shellacs applied to interior elements should not exceed the VOC content limits established in South Coast Air Quality Management District (SCAQMD) Rule 1113, Architectural Coatings, rules in effect on January 1, 2004. These are 350 g/L (clear wood varnish), 550 g/L (clear wood lacquer), 100 g/L (floor coatings), 730 g/L (clear shellacs), 550 g/L (pigmented shellacs), 250 g/L (waterproof sealers and stains), 275 g/L (sanding sealers), and 200

g/L (all other sealers). Walls should be papered with water-based adhesives, whenever possible.

- Carpet installed in the building interior should comply with the testing and product requirements of the Carpet and Rug Institute (CRI) Green Label Plus program, which has emission criteria in micrograms per square meter per hour. Carpet adhesives should not exceed the VOC limit of 50 g/L. Carpet cushions should follow the CRI Green Label program.
- Natural wood products should only be used that have the Forest Stewardship Council (FSC) certification. Composite wood and agrifiber products as well as laminating adhesives used in the interior of the building should not contain any added urea-formaldehyde resins. Composite wood and agrifiber products include: particleboard, medium density fiberboard (MDF), plywood, wheatboard, strawboard, panel substrates and door cores.
- Within the specifications for any new construction or major renovation project, be sure not to specify any of the following items:
  1. Fiberwood or agrifiber flooring and wall coverings
  2. Preserved wood products that contain formaldehyde
  3. Rugs/flooring that contain a urea-formaldehyde
  4. Paints containing VOCs
- Ensure that VOC limits are clearly stated in each section of the design and construction specifications, where adhesives, sealants, and interior finishes are addressed.

Indoor air quality depends on many factors thermal comfort levels (acceptable temperature and relative humidity settings), control of airborne contaminants, and distribution of adequate ventilation air. Balancing indoor air quality with energy conservation requires deliberate care. Achieving thermal comfort begins with good design and continues with proper building management. The goal is to avoid uneven temperature gradients, radiant heat gains, or excessive losses (i.e. from windows), draftiness, stuffiness, excessive moisture, or high relative humidity (that can promote the growth of mold). Through careful selection of materials, designers can avoid introducing potential pollutant sources. Mechanical systems must be selected and installed with reliable ventilation systems that dilute contaminants and, to the greatest extent possible, supply fresh air on demand in the necessary quantities to the appropriate locations. Even if all clean air objectives are met, achieving an indoor air quality that is acceptable to all guests and staff may not be possible, owing to the diversity of sources and contaminants in indoor air as well as the tremendous differences in individual susceptibility and perceptions with regard to air quality.

Figure 81. Note the amount of dirt coating the air vent grill (left). Air quality in the office spaces at the Raleigh has some workers bringing in their own air purification systems for their desk areas (middle). Evidence of water damage and mold/mildew stains and growth on the air ven grill (right) was spotted during the survey.

Figure 82. Mny of the air handler closets in the Raleigh are used as storage areas and are obstructing the flow of air to the units.

Figure 83. Air handler coils exposed prior to a mold test performed by the research team. This unit is located in the staff office of the spa area in the Standard Hotel. Note the caked on dirt on the inside of the vent grill (right).

Figure 84. Painting activities generated powerful pungent odors at the Raleigh (left) and at the Standard (right).

Implementation Project: Low-Emission Products. The design director at the Standard Hotel instituted a policy to only use no-VOC paints and low off-gassing furniture in future design upgrades to the guest facilities and rooms. To date, the Raleigh is still investigating this policy. This analysis will be published in the upcoming progress report after policies have been in place for several months after a major upgrade.

Mold Issues

Buildings with many water outlets, such as hotels, are particularly susceptible to mold growth, which is a serious issue in Florida. The key to preventing mold growth is moisture control. Ambient humidity levels can be reduced by adjusting HVAC settings or employing a dehumidifier.

- Conduct periodic inspections for condensation, moisture, and signs of mold infestation and document problems.
- Respond rapidly to moisture problems before mold growth sets in by fixing leaks, keeping drip pans clean and flowing unobstructed, and venting or relocating moisture-generating appliances, such as dryers and dishwashers. If indications of conditions favorable to mold growth are encountered, clean and dry the damp spots within 24 – 48 hours of discovery. Materials, such as ceiling tiles, insulation, books, and paper items, which have suffered water damage, may need to be removed, discarded, and replaced. If ponded water is discovered, remove the water with an extraction vacuum. The drying process can be accelerated with portable fans. If porous flooring surfaces (linoleum, ceramic tile, vinyl, etc.) or treated wood surfaces are showing signs of moisture, wipe clean with mild detergent and dry. Be sure to check the sub-flooring for moisture as well. If wallboard is wet, it should be dried in place, if there is no obvious swelling and the seams are intact. If not, it will have to be removed, discarded, and replaced. Wet paneling should be pried away from wall for drying. The wall cavity should be ventilated, if possible. Window drapes should be laundered or replaced. It is important to note, that even if materials are dried within 48 hours, mold growth may or may not have already occurred.
- Prevent moisture problems due to condensation by increasing surface temperature or reducing the moisture level in air (relative humidity). To increase surface temperatures, insulate. To reduce the moisture content, repair leaks and dehumidify (if outdoor air is warm and humid). Relative humidity should be no greater than 60% and ideally between

30 and 50%. If outside air is brought in and cooled without dehumidification, it will be at 90-100% RH, which is a problem (Cummings 2004).

- Provide detection/monitoring equipment such as relative humidity sensors.
- Provide employee training to deal with rapid response to spills, leaks, and other concerns impacting clean air. As with any human health threat, mold issues are no exception. Care should be taken to minimize exposure of mold spores to indoor air to limit the potential for spreading to other areas of the building. Workers should use appropriate protective equipment. Once mold takes hold, it is difficult to eradicate. Experienced environmental professionals such as professional engineers or certified industrial hygienist should be consulted if significant mold remediation work is required.
- As part of an integrated moisture prevention program, perform preventative maintenance activities, such as replacement of interior drywalls with paperless drywall products like DensArmor Plus, which can halt mold growth (Upton 2007).

Figure 85. Visible mold/mildew staining in the Standard guestrooms.

Mold Testing. On June 12, 2008, the FAU research team enlisted the assistance of a partnership with the Pollution Prevention Coalition of Palm Beach County to conduct an indoor air quality survey of the two participating hotels. We intended to conduct a pre- and post-implementation indoor air quality assessment on our two participating properties over the course of the study. The Palm Beach County Health Department agreed to provide access to indoor air quality monitoring instruments, training, literature, and survey checklists. Under the supervision of Julia Cajacob (Environmental Specialist II, Division of Environmental Health and Engineering Air Quality Programs), the indoor environmental quality surveys focused on mold/mildew, migrating odors, relative humidity/temperature settings, moisture behind drywall, particulates/dust, VOCs, carbon dioxide, pressurization, and outside air ventilation. Results are shown in Table 40 and Table 41.

Table 40. Indoor air quality results for the Raleigh Hotel on June 12, 2008.

Date	Room Type	Floor Number #	Mold/Mildew Yes/No	Leaks/Stains Yes/No	ETS Yes/No	Visual Dust Yes/No	FID ppm	PID ppm	Relative Humidity %	Temperature °F	Ventilation Rate cfm/person	CO_2 ppm	HEPA Yes/No	MERV #	Wall Moisture %	Odors Yes/No
6/12/2008	Kitchen1	1	Yes	Yes	No	Yes	n/a	n/a	nr	nr	nr	nr	No	6	nr	nr
6/12/2008	Rm # 612	6	No	Yes	No	Yes	28.9	16.85	58	81	32*	707*	No	6	16 on S wall. 20 i	No
6/12/2008	Outside Paint room	1	No	No	No	Yes	81	31	57	83	29	743	No	6	n/a	Yes
6/12/2008	Inside Paint Room	1	No	No	No	No	31	29	62	83	26	793	No	6	n/a	Yes
6/12/2008	Laundry	1	Yes	No	No	No	n/a	n/a	55	84	43	626	No	6	n/a	n/a
6/12/2008	7th floor a/c	7	n/a	No	No	Yes	28.3	16.5	71	83	117	411	No	6	n/a	nr
6/12/2008	By S wall + bar in restaurant	1	n/a	n/a	No	n/a	51.8	63.81	68	87	143	445	No	6	nr	nr
6/12/2008	Edge of restaurant by pool	1	n/a	n/a	No	n/a	82.4	108	69	88	200	409	No	6	n/a	No
6/12/2008	Executive office	2	Yes	Yes	No	Yes	15.5	3	49	72	20	915	No	6	n/a	No
6/12/2008	server room	2	Yes	n/a	No	Yes	n/a	n/a	44	80	23	840	No	6	n/a	No
6/12/2008	Accounting Office	2	Yes	Yes	No	No	8.88	-5.3	46	77	19*	929*	No	6	n/a	No

Date	Room Type	Other Notes
6/12/2008	Kitchen1	
6/12/2008	Rm # 612	Leaks/stains: Evidence water pouring on closet floor. Dust: closet. Q = 40 cfm/p initially, CO_2 = 950ppm, Q = 18.6 cfm/p after 10 minutes
6/12/2008	Outside Paint room	Odor: smells of VOCs. Dust.
6/12/2008	Inside Paint Room	PID/FID: Did not let it stabilize-could not stand the paint odors/fumes. Dust.
6/12/2008	Laundry	
6/12/2008	7th floor a/c	Intake to outdoors
6/12/2008	By S wall + bar in restaurant	
6/12/2008	Edge of restaurant by pool	PID maybe elevated because of the heat on the furniture (offgassing) or possibly the freshly applied mulch
6/12/2008	Executive office	Water stains on ceiling tile by 2nd desk. Water stain near back left desk on ceiling tile. Mold sample taken outside of managers office.
6/12/2008	server room	Mold sample taken in the server room. Have been leaks in the past (probably from HVAC condensation line)
6/12/2008	Accounting Office	Mold sample taken on vertical a/c vent. CO_2 = 1196ppm; Q = 13.0 cfm/p after 5 minutes. CO_2 = 1347 ppm; 11.0 cfm/p after 10 minutes

Table 41. Indoor air quality results for the Standard Hotel on June 12, 2008

Date	Room Type	Floor Number #	Mold/Mildew Yes/No	Leaks/Stains Yes/No	ETS Yes/No	Visual Dust Yes/No	FID ppm	PID ppm	Relative Humidity %	Temperature °F	Ventilation Rate cfm/person	CO_2 ppm	HEPA Yes/No	MERV #	Wall Moisture %	Odors Yes/No
6/12/2008	Office1	1	Yes	Yes	No	Yes	n/a	n/a	nr	nr	nr		No	6	nr	No
6/12/2008	Room #35	1	Yes	Yes	No	Yes	nr	nr	66	77	61	526	No	6	16	No
6/12/2008	Office-Mark's desk	2	No	No	No	nr	n/a	n/a	48	74	n/a	n/a	n/a	6	n/a	No
6/12/2008	Office-Jen's desk	2	No	No	No	nr	n/a	n/a	53	73	n/a	n/a	n/a	6	11	No
6/12/2008	Office-front door	2	Yes	No	No	nr	7.2	?	51	73	12	1282	n/a	6	12	No
6/12/2008	Room #102	2	Yes	Yes	No	nr	7.4	9	57	78	29	749	No	6	17 (avg)	No
6/12/2008	Outside Room #102	2	n/a	n/a	n/a	n/a	41	60	n/a	n/a	n/a	n/a	No	6	n/a	nr
6/12/2008	Kitchen (hallway)	1	Yes	Yes	No	Yes	20	3	65	78	36	675	No	6	n/a	No
6/12/2008	Kitchen (SW corner by a/c vent)	1	Yes	No	No	No	?	?	n/a	n/a	25	810	No	6	n/a	No
6/12/2008	Kitchen (by air intake by grill)	1	Yes	No	No	No	?	?	n/a	n/a	nr	nr	No	6	n/a	No
6/12/2008	Back of nail salon	3	Yes	No	No	Yes	12.3	16.15	48	78	20	909	No	6	n/a	Yes
6/12/2008	Staff room in spa	3	Yes	No	No	Yes	4.8	3.3	49	78	16	1039	No	6	n/a	Yes
6/12/2008	Yoga room	3	Yes	No	No	No	42.48	35.5	78	82	12	1242	No	6	20*	Yes

Date	Room Type	Other Notes
6/12/2008	Office1	
6/12/2008	Room #35	Three weeks ago there was a water leak in NW corner. Hole in closet ceiling, cracks on wall, water stains. Pulling paint (moisture). Highest reading for moisture by the hole (20%). No moisture reading on wall.
6/12/2008	Office-Mark's desk	
6/12/2008	Office-Jen's desk	
6/12/2008	Office-front door	
6/12/2008	Room #102	17% moisture on south wall, gets higher as you get closer to closet. Closet less than 15%. Northside 1st full panel by bathroom 17%. 20%
6/12/2008	Outside Room #102	
6/12/2008	Kitchen (hallway)	Mold swab sample in this hallway. Dust: by A/C. Mold: SE corner. Leaks/Stains: moisture water droplets
6/12/2008	Kitchen (SW corner by a/c vent)	Mold:on a/c by back exit. Dust: Vent on SW corner
6/12/2008	Kitchen (by air intake by grill)	
6/12/2008	Back of nail salon	Mold: on a/c vent. Dust: a/c. Odor: Toxic nail salon smell
6/12/2008	Staff room in spa	Dust: on coils, in air, on return panel in door to a/c. Mold: in a/c coils. Odor: Oils from massage parlour
6/12/2008	Yoga room	Wall Moisture: over 20% on N wall facing bay, 16% on opposite wall, 18% on west wall, 16% on SW side of west wall, 20% on E wall by
		Note: Outside became overcast and rainy about this time. 12pm. The yoga room also had three windows open when we went in to conduct the tests.

At the Raleigh, the research team found visual evidence of mold/mildew staining in 45% of the areas investigated and leaks/stains in 36% of the areas. The team also encountered visual signs of dust in 55% of the areas tested. Measurements for total volatile organic compounds were recorded using a portable FID/PID total volatiles analyzer (TVA). In terms of average values for the property, the FID unit recorded 41 ± 28 ppm, and the PID unit recorded 33 ± 37 ppm. In terms of personal thermal comfort values, the Raleigh averaged 82°F ± 5°F at 58% ± 10% humidity. These values exceed the set-point levels suggested by ASHRAE Standard 62.1-2004, which sets the acceptable summer temperature range at 73°F – 79°F and the relative humidity in the 30% – 60% range. The average ventilation rate for the indoor areas sampled at the Raleigh is 39 cfm/person ± 8 cfm/person, and the carbon dioxide levels averaged 746 ppm ± 170 ppm. The ventilation rate meets the ASHRAE 62.1-2004 Sections 4 – 7 guidelines of not less than 15 cfm of outdoor air per occupant and the recommended range of 15 – 60 cfm per person. ASHRAE 62-2004 recommends less than 1000 ppm CO_2 in the indoor air environment, because human discomfort begins at levels above 800 – 1000 ppm, and long term health effects can be expected at sustained concentrations above 12,000 ppm CO_2 in the air. The carbon dioxide levels indoors at the Raleigh are generally at the limit, particularly in the executive office suite and the accounting office suite, which are overcrowded due to a shortage of space in the property.

At the Standard, the research team found visual evidence of mold/mildew staining in 77% of the areas investigated and leaks/stains in 31% of the areas. The team also encountered visual signs of dust in 38% of the areas tested. Measurements for total volatile organic compounds were recorded using a portable FID/PID total volatiles analyzer (TVA). In terms of average values for the property, the FID unit recorded 19 ± 16 ppm, and the PID unit recorded 21 ± 22 ppm. In terms of personal thermal comfort values, the Standard averaged 77°F ± 3°F at 57% ± 10% humidity. These values meet the temperature set-point levels suggested by ASHRAE Standard 62.1-2004 (summer: 73°F – 79°F) but are near the upper limit for the relative humidity in the 30% – 60% range. The average ventilation rate for the indoor areas sampled at the Standard is 26 cfm/person ± 16 cfm/person, and the carbon dioxide levels averaged 900 ppm ± 270 ppm. The ventilation rate generally meets the ASHRAE 62.1-2004 Sections 4 – 7 guidelines of not less than 15 cfm of outdoor air per occupant and the recommended range of 15 – 60 cfm per person, accept for the front office area and the yoga room (which is kept at extreme temperatures for advanced yoga workout classes). ASHRAE 62-2004 recommends less than 1000 ppm CO_2 in the indoor air environment, because human discomfort begins at levels above 800 – 1000 ppm, and long term health effects can be expected at sustained concentrations above 12,000 ppm CO_2 in the air. The carbon dioxide levels indoors at the Standard are generally at the upper boundaries of the limit, particularly in the executive office suite and the spa/yoga/salon areas, which were not designed for the current usage of the space.

Mold samples were collected on June 12, 2008 with sterile swabs and incubated at 35°C for 2 – 6 days on nutrient agar plates. All samples were analyzed by the FAU Laboratories for Engineered Environmental Solutions. For the Raleigh Hotel, the following sites were sampled: 1) Room 612 (sampled from the vent grill surface); 2) 2nd Floor Executive Office (sampled from the vent grill surface); 3) Server Room (2nd Floor Executive Office sampled from the A/C condensate pan); 4) Accounting Office (sampled from the vent grill surface); and 5) Accounting Office (sampled from top of the vent grill). For the Standard Hotel, the following sites were sampled: 1) Hair Salon Spa Area A/C Vent; 2) Spa Staff Room A/C Coil; 3) Kitchen Vent Near the Walk-In Refrigerators; 4) Kitchen Dishwashing Area A/C Vent; 5) Kitchen Exhaust Hood Grill Surface; 6) Room 35 (sampled from closet ceiling); and 7) Room 102. In addition, three blank samples were collected

during the sampling event using sterile dilution water that was used to moisten the swabs prior to sampling for mold. All blanks were completely devoid of microbial growth. The results are shown in Table 42.

In general, both hotels were found to have a large diversity of microorganisms, on average (*n* = 5). Mold colonies were found in nearly every sampling location. Of most concern was a dominant bacterial growth with characteristics similar to *Legionella* found in the fan coil of the air conditioning unit of the staff room in the spa of the Standard hotel. For these tests, only diversity was investigated, and specific microorganisms were not isolated or identified.

Table 42. Summary of mold testing results for both hotels (June 12, 2008).

Location	Colony Types	Notes
Raleigh		
Rm # 612	2	▪ White fuzzy growing in concentric circles ▪ Fuzzy white fungal mat with black dots in the furry cotton-like growth ▪ Musty odor
Executive office	8	1. Creamy white circle 2. Yellow with rough edges and black streaks 3. Fuzzy white fungal mat with black dots in the furry cotton-like growth 4. White fuzzy 5. White blob 6. Yellow creamy 7. White creamy with streaks 8. Finger-like black fungus with furry dots in the middle
Server room	9	• Many types of mold with bacterial colonies and full lawn coverage 1. White blobs 2. Fuzzy base with white dots 3. Creamy white smear 4. Yellow smear 5. White dots on cotton-like hair 6. Fuzzy white with hair growing upwards 7. Amorphous white fuzzy with black streaks 8. Orange dots 9. Penicillin looking colony
Accounting Office 1	3	• Mold lawn with bacterial streaks • Yellow with rough edges and black streaks • White fuzzy with yellow base • Smells musty/cheesy
Accounting Office 2	3	• Mold lawn with bacterial streaks • Yellow with rough edges and black streaks • White fuzzy with yellow base • Smells musty/cheesy
Standard		
Hair salon	10	• 10 types of mold, including black furry type and also bacterial colonies • Creamy with black streaks • White fuzzies • Furry white blobs
Spa staff room	5	• Large numbers of bacteria, maybe *Legionella* and 1 type of mold 1. White creamy dots 2. Yellow creamy dots 3. Milky white smear 4 Yellow/orange fuzzy-looking colonies with black streaks
Kitchen (near walk-in refrigerators)	8	• 8 types of mold with large number of bacterial colonies and lawns (musty and fuel odor) 1. Penicillin looking colony 2. White with black streaks 3. Creamy white amorphous blobs 4. White creamy dots 5. White concentric rings 6. Yellow dots

Location	Colony Types	Notes
Kitchen (near dishwashing station)	4	• Mostly bacteria (2 types: tiny orange dots, tiny white/milky dots) • Mold growing on edges, in circle, and lawn • White furry puffs • White fuzz with black streaks
Kitchen (exhaust hood grilll)	6	• About 5 types of mold with bacterial colonies (cheezy/musty odor) 1. Yellowish blob 2. Thick white fuzzy with black streaks 3. Creamy yellow with white fur 4. White smear
Room #35	1	• One mold colony (white fur ball with black hair)
Room #102	2	• Very little bacterial growth on the plate • White fuzzy with colored fur

Based on the preliminary results from this initial round of mold testing, further investigation was authorized by the hotels. One of the vendor participants, PM Environmental Services, Inc. (PMES) was hired to conduct a more thorough assessment of the mold issue. The following is a brief summary of the contractor's findings.

The Raleigh Hotel was constructed in 1940. The hotel still maintains its original building components and finishes. However, the management office has been built out with gypsum board walls, suspended ceiling tiles and carpeted flooring. The accounting office has terrazzo flooring along with plaster walls and ceilings. Based upon previous passive samples collected for microbial growth, there is a concern that microbial amplification is present within the management offices. The passive sampling allowed for air to settle over the sample media and allowed for microbial spores to settle and colonize. This sampling is reliable in determining that microbial spores are present but does not allow for speciation or the determination of airborne concentration. Therefore, PMES was retained to conduct air sampling and an IAQ inspection in order to determine if amplification is present and provide recommendations. The purpose of the scope of work is to perform a mold assessment of the general manager's office and accounting offices of the Raleigh Hotel. This assessment includes air sampling in order to determine current airborne spore levels.

PMES provided a qualified professional to perform a general evaluation of existing conditions of the facility. From this evaluation, protocols outlined below will be optimized in regards to sampling locations and methods. Interviews were conducted to provide needed information concerning the history of the facility as well as any other perceived or real issues concerning the quality of the indoor environment. General comfort parameters (temperature and relative humidity) were monitored for each identified area of the facility with an attached datalogger. PMES also collected air samples for direct identification using the AOC or equivalent air cassette and subcontracted an accredited laboratory to provide identification/speciation of mold spores and enumeration as to the airborne concentration. PMES also collected one sample from within the unit and another sample from the exterior of the building in order to provide a base line level for ambient (fresh air). The fee for this service was $700.

PMES personnel conducted a site inspection on Wednesday, July 16, 2008. During this inspection, the inspector reviewed the management office with the server room and the accounting offices of the hotel. During the inspection and air sampling conducted, PMES collected temperature and humidity levels from the various locations studied. In reviewing the data collected there is a variance to the air conditioning within the management office and the General Manager's office. The General Manager's office was secured and isolated from the

remaining offices. The open offices were subject to the open stairway to the first level for concierge as well as the unfinished mezzanine area where the server is located. Temperatures in the general offices averaged approximately 79°F with the relative humidity of 59%. The general manager's office was recorded at the time of this inspection with a temperature of 75°F and humidity at 55%. The accounting offices averaged a temperature of 73°F, and humidity was recorded at 63%. Industry standards indicate that interior temperature should fall between 73°F – 79°F, and humidity levels should be between 45 – 55% for optimal efficiency, or between 30 – 60%, at a minimum. The exterior temperature during the site visit was 80°F and 64% humidity.

The visual inspection did not identify visible mold on any walls or building components within the two offices, with the exception of visible moisture damage to ceiling tiles. These suspended ceiling tiles are located within the open office areas in front of the General Manager's office. No sampling was conducted on these tiles in order to prevent any disturbance to potential microbial growth within the ceiling plenum. During this inspection, the inspector collected an air samples from the mezzanine, sales office, General Manager's office and the accounting offices within the hotel. Additionally, one sample was collected from outside the dwelling for ambient air comparison. The weather conditions prior to this sampling event were characterized by low precipitation and humidity. There are currently no enforceable regulatory standards pertaining to air, surface, or bulk concentrations of fungi or bacteria. In the absence of a regulatory standard, health and safety practitioners find guidance from the American Conference of Governmental Industrial Hygienists (ACGIH) publication of the Bioaerosols Committee entitled "Guidelines for the Assessment of Bioaerosols in the Indoor Environment." The ACGIH guidelines recommend medical assessment of symptoms, evaluation of building performance and use of professional judgment as primary means for investigating indoor air quality issues. According to the ACGIH, routine air sampling is not recommended because there are no scientific supportable numerical limits to which microbial air samples may be compared. Air sampling is best used as a means to determine if there is amplification of microorganisms within an area as compared to naturally occurring microorganisms outdoors. Air sampling may also be used to document the contribution of identified microorganisms and their sources to a particular air quality problem or complaint.

The laboratory analyses (see Figure 86 and Figure 87) of the exterior air samples indicate total ambient outside air concentration was 960 – 973 total spores per cubic meter (TS/m^3). Interior concentrations within the containments did not exceed the concentrations identified in the comparable ambient air baseline sample collected. However, sample results for the mezzanine identified an airborne concentration 573 TS/m^3. Sample results for the sales office identified an airborne concentration 720 TS/m^3. Sample results for the General Manager's office identified an airborne concentration 60 TS/m^3. Sample results for the accounting office identified an airborne concentration 60 TS/m^3. The primary species of mold identified in the interior samples were *Aspergillus/Penicillium*-Like, which is associated with moisture damaged materials.

Based upon the visual and physical inspection of the office areas in addition to the identified airborne mold spores concentrations from the air samples collected, PMES made the following recommendations.

- **The server room should be finished and separated from the open mezzanine area**. The portable air conditioning unit is drawing air from the open unconditioned air space as well as air from the ceiling plenum and pushing it to the server location. Additionally the door to the server should be closed at all time to keep the open mezzanine separate from the offices.

- **The water-damaged ceiling tiles should be replaced**. During the replacement of the ceiling tiles, an investigation should be conducted to determine the cause of the moisture damage.
- **The HVAC system should be inspected and cleaned**. The air conditioning system should then be inspected on a monthly basis.

The field observations, measurements, and research reported herein are considered sufficient in detail and scope to form a reasonable basis for an Indoor Air Quality Assessment for clearance of the radiation activities for this property.

AEML, Inc.
38 NE 20th Ave. Suite 6
Pompano, FL 33060
Phone: 954-333-8149
Fax: 954-333-8151
www.aemlinc.com

CHAIN OF CUSTODY/ANALYSIS REQUEST

Project # / Job #: 080722K007-013

Page ____ of ____

Company: PM Environmental Services Inc	Sampled By: Stephen Crotty	Payment Type: On Account / Credit Card / Check	
Contact Name: Stephen J Crotty	Project/Site Name: Raleigh Hotel	Credit Card Type: Visa / Master Card / Amex / Discover	
Address: 3007 Greene Street	Project #:	Credit Card #:	
City: Hollywood / State: FL / Zip: 33020	P.O. #:	Name on Card (Print):	
Phone #: 954-921-7007 / Fax #: 877-516-5629	Report (circle): E-Mail / Fax / Both	Signature:	
E-mail: Pcrotty@pmenvr.com	Sample Type: A = Air W = Water T = Tape S = Swab B = Bulk	Turn Around Time (Rush charges may apply) Standard ✓ Other ____	Exp. Date: ___/___

Sample #	Sample Identification	Date	Sample Type	Volume (Air)	Area (Swabs)	MOLD	For Lab Use Only Sample Numbers
1	Server Room 343651	7/16/08	A	150	—	✓	K009
2	Accounting Admin 343652	7/16/08	A	150	—	✓	K010
3	Managers 343647	7/16/08	A	150	—	✓	K011
4	Accounting Payroll 343 655	7/16/08	A	150	—	✓	K012
5	Exterior 343638	7/16/08	A	150	—	✓	K013
6							
7							
8							
9							
10							

Special Instructions/Requirements:

Date	Time	Relinquished By	Company	Received By	Company	Good Condition
April 21, 2008	1700					Yes / No
7-22-08	9:50	FedEx			AEML	(Yes) / No
						Yes / No

Analysis performed is subject to AEML, Inc. Standard Terms and Conditions unless otherwise specified by contract between client and AEML, Inc. AEML-DOC-12-COC-REV03

Figure 86. Chain of custody for mold testing at the Raleigh Hotel on July 16, 2008.

Stephen J. Crolly
PM Environmental Services
3007 Greene Street
Hollywood, FL 33020

AEML, Inc.
Microbiology Laboratories

AEML, Inc.
38 NE 20th Ave. Suite 6
Pompano Beach, FL 33060
Phone: (954) 333-8149
Fax: (954) 333-8151
email: customerservice@aemlinc.com

Project: Raleigh Hotel
Sampled: 7/16/2008
Received: 7/22/2008
Analysis Date: 7/22/2008
Report Date: 7/22/2008
Batch: 1709

AEML Test: A001 Spore Trap Analysis

Sample ID:	080722K009			080722K010			080722K011			080722K012		
Client Sample ID:	343651 Server Room			343652 Account Admin			343647 Manager			343650 Account Rep		
Volume Sampled (L):	150			150			150			150		
Media:	Allergenco D			Allergenco D			Allergenco D			Allergenco D		
Percent of Trace Analyzed:	100% at 600X Magnification			100% at 600X Magnification			100% at 600X Magnification			100% at 600X Magnification		
Spore Types	Raw Count	Count/m³	%	Raw Count	Count/m³	%	Raw Count	Count/m³	%	Raw Count	Count/m³	%
Alternaria	–	–	–	–	–	–	–	–	–	–	–	–
Arthrinium	–	–	–	–	–	–	–	–	–	–	–	–
Ascospores	4	27	5	7	47	8	–	–	–	1	7	11
Aspergillus/Penicillium-Like	73	487	89	89	593	82	8	53	89	8	53	89
Basidiospores	2	13	2	2	13	2	–	–	–	–	–	–
Bipolaris/Drechslera			–			–			–			–
Botrytis	–	–	–	–	–	–	–	–	–	–	–	–
Chaetomium	–	–	–	–	–	–	–	–	–	–	–	–
Cladosporium	3	20	3	9	60	8	–	–	–	–	–	–
Curvularia	1	7	1	–	–	–	1	7	11	–	–	–
Epicoccum	–	–	–	–	–	–	–	–	–	–	–	–
Fusarium	–	–	–	–	–	–	–	–	–	–	–	–
Ganoderma	–	–	–	–	–	–	–	–	–	–	–	–
Memnoniella	–	–	–	–	–	–	–	–	–	–	–	–
Nigrospora	1	7	1	–	–	–	–	–	–	–	–	–
Oidium/Peronospora	–	–	–	–	–	–	–	–	–	–	–	–
Pithomyces	–	–	–	–	–	–	–	–	–	–	–	–
Rust	–	–	–	–	–	–	–	–	–	–	–	–
Smut/Myxomyces/Periconia	2	13	2	–	–	–	–	–	–	–	–	–
Stachybotrys	–	–	–	–	–	–	–	–	–	–	–	–
Torula	–	–	–	–	–	–	–	–	–	–	–	–
Ulocladium	–	–	–	–	–	–	–	–	–	–	–	–
Unidentified Spores	–	–	–	1	7	<1	–	–	–	–	–	–
Total Spores	88	573		108	728		9	60		9	60	
Hyphal Fragments	5	33		2	13		1	7		–	–	
Pollen	–	–		–	–		–	–		–	–	
Debris Rating	3			3			3			3		
Detection Limit	7			7			7			7		

Joshua Krinsky
Technical Director

Results submitted pertain only to the samples as presented on the accompanying Chain of Custody.
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Sample ID:	080722K013
Client Sample ID:	343638 Exterior
Volume Sampled (L):	150
Media:	Allergenco D
Percent of Trace Analyzed:	100% at 600X Magnification

Spore Types	Raw Count	Count/m³	%
Alternaria	1	7	<1
Arthrinium	–	–	–
Ascospores	40	267	27
Aspergillus/Penicillium-Like	35	233	24
Basidiospores	12	80	8
Bipolaris/Drechslera	–	–	–
Botrytis	–	–	–
Chaetomium	–	–	–
Cladosporium	52	347	36
Curvularia	1	7	<1
Epicoccum	–	–	–
Fusarium	–	–	–
Ganoderma	1	7	<1
Memnoniella	–	–	–
Nigrospora	–	–	–
Oidium/Peronospora	–	–	–
Pithomyces	–	–	–
Rust	–	–	–
Smut/Myxomyces/Periconia	4	27	3
Stachybotrys	–	–	–
Torula	–	–	–
Ulocladium	–	–	–
Unidentified Spores	–	–	–
Total Spores	146	973	
Hyphal Fragments	–	–	
Pollen	–	–	
Debris Rating	3		
Detection Limit	7		

Joshua Krinsky
Technical Director

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TESTING CERT #2572.01

Figure 87. Results from mold testing at the Raleigh Hotel on July 16, 2008.

Communication

The question of which improvements should the hotel implement with limited resources is easily answered by which measure saves the most money, right? Well the answer is often not so straightforward. Take the following statement for example: the Hyatt Regency Coconut Point Resort and Spa reduced its water consumption by 28% and reduced its waste by 2.8%. This makes it appear that the water conservation efforts saved 10 times more, but after closer inspection, we can determine that the solid waste disposal costs were 20 times more on an annual basis, so we can conclude that the waste reduction efforts saved the most money. This example illustrates the communication issue that well-intentioned green lodging proponents have, and highlights the divide between the wealth of data in support of green measures and the conflicting message to decision-makers.

Educating guests about pollution prevention and sustainability through guest cards, media boards, and in-house television is a great public relations tool that is received favorably by guests. Many guests are familiar with recycling (for example) from home or work and are more than willing to continue the process when away from home in a hotel. However, hotels often hesitate to establish programs in solid waste management because of the coordination and cooperation needed among management, employees, and guests. Nevertheless, the very real cost benefit remains an incentive (Alexander 2002).

Typical fallacies about recycling can be seen in the lodging industry literature. For example, "Recycling programs can often save money, but if the time required to separate the waste is too great, or the procedure too impractical, frustrations and increased time-pressure on employees could negate any dollar savings" (Florida Hotel & Motel Journal, June 1999). Here is another quote from the same journal: "Waste representatives often fail to encourage their clients to recycle because recycling waste is less expensive to dispose of than commingled solid waste (regular garbage)" (Florida Hotel & Motel Journal, June 1999). This is the difficult environment in which the green lodging movement must overcome.

With regards to water conservation, we will focus on equipment versus behavioral measures. In Seattle, WA, a pilot program investigated water conservation opportunities related both to replacement or significant upgrades to existing equipment, and "behavioral measures" related to equipment maintenance and to employee/guest education. Many commercial water conservation studies have focused exclusively on equipment measures. However, without adequate employee education and establishment of regular maintenance schedules, water savings projected for equipment replacements may not be achieved, leading to distrust in other projected green lodging savings estimates (O'Neill & Siegelbaum and The RICE Group 2002). It is far more likely that a one-time event like replacing all showerheads with low-flow fixtures for example will be undertaken, rather than routine leak monitoring, which is a long-term maintenance issue. A likely reason for this is that the purchase and installation can be done at the management level and contractor level, respectively, but the routine monitoring is typically accomplished by the housekeeping or maintenance staff, which has little incentive. In addition, new shiny faucets, drench-style showerheads, and fancy toilets give the perception of luxury, but luxury is not always compatible with water conservation.

Many water conservation opportunities provide opportunities for energy savings at the same time. For example, two hotels in the west coast of Florida were audited, and the potential water savings equaled approximately one-third of the current water consumption. For the older Westin Hotel,

close to 90% of the projected savings were from "equipment measures" primarily related to upgrades in restrooms, ice machines and laundry equipment. For the West Coast Grand Hotel, a converted office building, close to 90% were for "behavioral" measures, primarily related to maintenance and operation of heating and cooling equipment. What is needed is a commitment to do both in order to achieve the most savings success.

However, determining success is based on more than the water saved in any given year. Rather, success might be measured by whether those changes are part of a long-term strategy that is integral to the hotel's philosophy and practice, versus the "flash in the pan" result of an environmental champion whose departure will impair long-term environmental improvement. (O'Neill & Siegelbaum and The RICE Group 2002).

Finally some hotels are reluctant to pursue environmental projects because they are concerned about how the projects will be accepted by their guests. For the most part, surveys have typically shown that hotel guests are concerned about indoor air quality and the environment, and they are even willing to pay a premium to demonstrate that commitment. In fact, many hotel guests are specifically looking for environmentally friendly hotels or motels. The American Hotel and Motel Association Hotels conducted an informal survey of the Dadeland Marriot Hotel guests who stayed in one of the 38 guest rooms outfitted with futuristic technologies for water conservation, indoor air quality, and energy minimization. Even thought the rooms cost over $10 per night more than the regular rooms, guests specifically requested them when making reservations on following visits (Riggle 1992). Thus, the "green room" concept can enhance the image of their property by showing visible signs of environmental management such as recycling bins or compact fluorescent lights. Hotels that practice energy efficiency, water conservation, and recycling; save dollars and encourage environmentally sensitive guests to choose their hotel over the competition.

In the short-term, the communication piece is being addressed by weekly green team meetings, posters/signage (Figure 88), training materials, placards, videos, a suggestion box, and employee/guest survey instruments. Some of the exciting ideas that came out of the green team meetings were to conduct a weekly seminar/environmental movie night open to staff and guests. Another idea was to film public outreach videos to show on community television channels that are already filming a weekly show in the Standard lobby (Plum TV). Another source of input is the manager on duty (MOD) logbook to keep track of environmental complaints as a performance measure. The green team at the Standard put forth an idea to have a carbon footprint kiosk, in which guests can apply for discounts or incentives if their carbon footprint is below a certain score, or alternatively, they can purchase carbon offsets. Similarly, employees can participate in incentive programs based on reducing their carbon footprint. Finally, it was recommended to host a series of Green Vendor fairs at each of the hotels to inform the community about green products that are available in the market.

One of the interesting things that have come up during the initial stages of this study is that the alarming turnover rate in personnel actually works as a benefit to spread the green concepts to other properties. New personnel are immediately targeted for participation in the green team because of their junior seniority status. These people are generally more motivated and eager to participate to impress the corporate ownership with their initiative and ability to manage projects that will ultimately show benefits to the bottom line.

Figure 88. Signage ordered by the Standard for communicating the hotel's efforts to go green.

To create a successfully implemented green team requires several important dynamics to take place. During the course of this project, the researchers have learned some valuable lessons. Firstly, the green teams of both participating hotels were comprised of upper level managers, mostly due to the fact that they are salaried employees with the autonomy to accomplish their regular tasks on their own schedules. None of the green team members were compensated for their time commitment to the project or to the hotel for their involvement on the green team. Hourly wage employees, who are the most important in terms of implementing sustainability projects on a day-to-day basis were unable to join the green teams and get compensated for their time, in other words, they had to participate on their own time, outside of work hours. Also, topics discussed at the green team meetings sometimes did not lend themselves to discussion with regular line employees. The duties of the green team members was not seen as part of their job description as interpreted by the General Manager's office and the corporate office. Of course, some sort of buy-in is necessary from the GM/Corporate office to start this process, but mandates from corporate, a top-down approach, would have been likely more effective than the grass roots approach taken in this study, although neither hotel was able to employ a top-down approach fro comparison purposes. An effective green team should ideally have a representative from each department of the hotel. However, it is likely indispensable to have a prominent member of the engineering and accounting departments, so that someone who can mandate repairs and

understand the implication of installing new products or implementing new services is available and also someone who can sign checks or can get them signed is also a member of the team to expedite the process. A successful green team should have autonomy to make important decisions regarding sustainability on behalf of the hotel. If a GM or corporate officer will have over-riding authority, then they should directly participate on the green team. This process might have been less difficult if the cost analysis of sustainability projects was incorporated into the following year's budgetary process from the very beginning. After performing the hotel's needs assessment and identifying other areas of improvement to pursue, the plan should have been presented to corporate in their customary budget process format, complete with dollar amounts for materials, installation, and labor (even if labor is in-house). This would have had the effect of judging if the decision-makers were keenly interested in pursuing the project and would agree to set aside the money for its implementation, even if the project was free of start up capital. Most of the financial decisions during the first 6 months of the project seemed to focus on major capital improvements and items listed as "putting out fires" to deal with emergency repairs and replacements. A better understanding of the budgetary/decision-making process is vital for a healthy green team to implement sustainability projects.

Implementation Plan

FAU and the vendor team are charged with preparing a draft plan that will include recommendations for implementing specific conservation strategies and suitable technologies. FAU, FDEP, and the candidate hotels will agree upon a portfolio of conservation projects from the recommended project implementation plan to form a tailored action plan, which will include the monitoring methodology to be used for tracking performance measures. The preliminary implementation plan is outlined below.

ITEMS:	Raleigh	Priority Level	Standard	Priority Level
Communications:	Weekly green team meetings	IP	Weekly green team meetings	IP
	Posters/Signage	IP	Posters/Signage	IP
	Training materials	IP	Training materials	IP
	Placards, videos	H	Placards, videos	H
	Suggestion box	H	Suggestion box	H
	Survey instruments	IP	Survey instruments	IP
	Weekly seminar/environmental movie night	H	Weekly seminar/environmental movie night	H
	Public outreach (Plum TV)	L	Public outreach (Plum TV)	L
	Manager on duty logbook tracking of environmental complaints	H	Manager on duty logbook tracking of environmental complaints	H
	Carbon footprint kiosk	M	Carbon footprint kiosk	M
	Employee incentive programs	H	Employee incentive programs	H
Water Conservation:				
Laundry	Implement Towel Reuse Program	H	Implement Towel Reuse Program	H
	Appliance Replacement	L	Appliance Replacement	L
	Wash only full loads, cold water	H	Wash only full loads, cold water	H
Guest Rooms	Toilet efficiency checks (flush valve adjustment, leak detection, etc.)	H	Toilet efficiency checks (flush valve adjustment, leak detection, etc.)	L
	Toilet replacement	L	Toilet replacement	H
	Consider dual flush options	M	Consider dual flush options	M
	Faucet/aerator replacement	H	Faucet/aerator replacement	H
	Showerhead replacement	H	Showerhead replacement	H
	Automatic faucets in public areas	H	Automatic faucets in public areas	M
Kitchens	Faucet/aerator/spray wash replacement	H	Faucet/aerator/spray wash replacement	H
	Dishwasher replacement	L	Dishwasher replacement	M
	Icemaker replacement	M	Icemaker replacement	M
HVAC Improvements	Capital equipment upgrade	IP	Capital equipment upgrade	NR

ITEMS:	Raleigh	Priority Level	Standard	Priority Level
	Individual room units (consider to replace heat pump with another type of system)	M/H	Individual room units	L
	Install metering	H	Install metering	H
	Preventative maintenance program	H	Preventative maintenance program	H
Irrigation	Irrigation efficiency assessment	IP	Irrigation efficiency assessment	IP
	Plant selection	L	Plant selection	L
	Fertilize properly	L	Fertilize properly	L
	Stormwater harvesting/storage	M	Stormwater harvesting/storage	H
Other	Address water treatment system (boiler room)	H	Address water treatment system (water softener bypass adjustment)	M/H
	Use reclaimed water	NR	Use reclaimed water	NR
	Greywater recycling	L	Greywater recycling	L
Energy Efficiency:				
	Energy Star Appliances	M/H	Energy Star Appliances	M/H
	Programmable Thermostats	H	Programmable Thermostats	H
	Sensor Lighting	H	Sensor Lighting	H
	Solar Lighting	M	Solar Lighting	M
	High-Efficiency Lighting	H	High-Efficiency Lighting	H
	Energy Management System	M	Energy Management System	M
	Energy Recovery Ventilators	M	Energy Recovery Ventilators	M
	Solar Hot Water (pool)	H	Solar Hot Water (to supplement in the guest rooms as well as the pool)	H
	Preventative Maintenance	H	Preventative Maintenance	H
	Individual room units (consider to replace heat pump with another type of system)	M/H	Individual room units	L
	Turning off/unplugging policies	H	Turning off/unplugging policies	H
	Vending Mizer	M	Vending Mizer	M
	Power Surge Protection	M	Power Surge Protection	M
	Key card lockout	H	Key card lockout	H
	Cool roof or high reflective coatings	H	Cool roof or high reflective coatings	L
	Windows/doors	M	Windows/doors	M
	Purchase Green Power and Carbon Offsets	H	Purchase Green Power and Carbon Offsets	H
Solid Waste Minimization:				
	Recycling	H	Recycling	H
	Eco-Purchasing	H	Eco-Purchasing	H

ITEMS:	Raleigh	Priority Level	Standard	Priority Level
	Post-Consumer Recycled Content	H	Post-Consumer Recycled Content	H
	Bulk Purchasing	H	Bulk Purchasing	H
	Reduced Packaging	M	Reduced Packaging	M
	Manufacturer Take-Back	H	Manufacturer Take-Back	H
	Ink/Toner Cartridges	H	Ink/Toner Cartridges	H
	Grease Recycling	M	Grease Recycling	M
	Composting	H	Composting	H
Clean Air Practices:				
	Environmentally-Preferable Cleaners	H	Environmentally-Preferable Cleaners	H
	HEPA or >MERV8 Filters	H	HEPA or >MERV8 Filters	H
	HVAC Cleaning/Replacement	H	HVAC Cleaning/Replacement	H
	CO_2 Monitoring	L/M	CO_2 Monitoring	L/M
	Anti-Idling	L	Anti-Idling	M
	Alternative Fuel Vehicles	L	Alternative Fuel Vehicles	L
	Outdoor mats at egress	M	Outdoor mats at egress	M
	Weatherstripping	H	Weatherstripping	H
	No-VOC paint	H	No-VOC paint	H
	Furniture offgassing	M	Furniture offgassing	M
	Indoor finishes VOC control	M	Indoor finishes VOC control	M
	Furniture, finishes, and equipment policy	H	Furniture, finishes, and equipment policy	H
	ETS policy	H	ETS policy	H
	Pest Control Strategies	H	Pest Control Strategies	H
	Mold control setback settings	H	Mold control setback settings	H
	Allergy-free rooms	L	Allergy-free rooms	M
	Microfiber cloths	H	Microfiber cloths	H
	Steam cleaning to replace chemicals	M	Steam cleaning to replace chemicals	M

Barriers and Challenges

In order to learn more about the how to improve the process for the green team members and staff, our research team conducted several interviews of key green team members and staff members throughout the course of the study. A series of nine targeted questions were asked of specific staff members between July and August 2008. The responses are summarized in the following section, organized by hotel.

The Raleigh Hotel

Ana Godoy (Deputy Engineering Director)

1. Rank the 5 areas of the Green Lodging program in order of importance:
Communication, Water, Waste, Energy, Clean Air

2. What do you like to do on the green team? Not like to do?
I don't like that we have to have so many meetings so frequently.

3. What do you get out of the green team meetings? How can we get others to participate/contribute?
All the vendors are very similar – they all have the 'latest and greatest.' I like learning about the products, but I think it's a waste of time because the hotel doesn't have the money to spend on these new products. The things that are happening right now with the hotel are the priorities – like the lobby ceiling falling down. The things that don't require much upfront are possible, but not so much the higher end items like window films.

Get all of the departments educated/trained and then it will filter down to the employees and raise awareness and have more people participating. Another idea is to develop flyers that say how many trees are saved when we implement a specific environmental project, will get people to recycle, etc.

4. How do you think we can make the meetings more productive?
Vendor fairs – limit it to products that the hotel can afford. Be more selective with vendors and only focus on those the hotel can afford.

5. How would you like to move forward? What would you like to focus on?
Housekeeping is doing all the green cleaning. Recycling is there, but it's not where it needs to be. For the meetings – focus on awareness. We should focus more on training. If the employees are more aware, everything will work better. Get them at the same consciousness level as the green team. We should have started this already, like especially when the recycling started.

6. Knowing what you know now, what would you do differently to obtain the One Palm?
Get a lot of people involved, it takes a while. So don't rush things – do things right. The pace we took was good.

7. Would the green team be better off led by a green team member?

People have more respect for the professor since he has so much knowledge. It is very important that he's around so he can give his input and guide us. Maybe now that we know more, someone from the green team can take over.

8. What would you like to know more about?
If government enforces these green initiatives, it will be much better. So I'd like to know what the government is doing. It would really help us a lot if they enforce it to become more green.

9. Anything else you think would be beneficial for us to know?
No.

Myrna Gonzalez (Purchasing/Accounting)

1. Rank the 5 areas of the Green Lodging program in order of importance:
Communication, Water, Energy, Clean Air, Waste

2. What do you like to do on the green team? Not like to do?
Put more pressure on everybody. Not like to do – nothing, I like everything.

3. What do you get out of the green team meetings? How can we get others to participate/contribute?
I had no motivation originally – our accounting boss put me on the team. But as I started learning, I liked it, and I started implementing many green initiatives in my private life. Through communication, we can get more people to participate/contribute. Once they see the importance, they will.

4. How do you think we can make the meetings more productive?
Assign homework! Not make it voluntary – assign duties to be completed by X date by X person. Make it mandatory, not an option. Have upper management make it mandatory. A real push from management would go a long way. Why now do we have to wait to get our one palm? First it was August, then September, now October. Why? Put more pressure on these people. Team leader needs to be a leader. Tell us what to do and give us deadlines. Sometimes we are like little kids – waiting to be told what to do. If we are not told, we do other things. But put it nicely! And make this a priority.

5. How would you like to move forward? What would you like to focus on?
See above #4. Now that were going to get our one palm, let's not stop, let's continue to get our 2 palm. It needs to be a priority for the team. Focus on energy – safe lighting, more efficient. We will save a lot of money and energy if we change out our lighting. We already saved a lot on waste, so let's focus on energy now. I want to be part of it, but I know it's not going to be easy. We can probably eliminate one more dumpster, increase the recycling toters by 2, and save the hotel an additional $1000/month. (Already saving $1000/month).

6. Knowing what you know now, what would you do differently to obtain the One Palm?
Nothing – I like the way it worked out. But put more pressure, have upper management place more importance on this. For example, we lost 3 months of time. Michael Ryan (Hotel Manager) did not know what we were doing. Accounting said we didn't have any money, but once we looked into it and saw these things would save us money, then I saw that we did have the money.
When you got mad at us…

7. Would the green team be better off led by a green team member?
It is better that the professor leads us.

8. What would you like to know more about?
Energy. Why in this hotel do we not have solar panels? We have plenty of space on top of the roof of the penthouse to put some panels. Why don't we have solar lighting outside? What can we do about that? And there we will save. I like composting – but it may be impossible for us to implement that by ourselves.

9. Anything else you think would be beneficial for us to know?

I want more vendor fairs! For example, the wood for the floors. Maybe we can switch to something more eco-friendly. Give me more vendor fairs!

Carolyn Cugini (Executive Assistant)

1. Rank the 5 areas of the Green Lodging program in order of importance:
Communication (if you don't have that, nothing works), water, energy (it's coming to a crisis), clean air, and waste.

2. What do you like to do on the green team? Not like to do?
I like to get involved with all the various aspects of determining water conservation, finding the best way to conserve energy & bring down the costs for water, energy and waste. Also, I like the fact that what we are doing is beneficial to the environment, not wasteful, but good for the environment. I don't like to have to read a lot of numbers or charts – like data entry.

3. What do you get out of the green team meetings? How can we get others to participate/contribute?
I'm thrilled every time we meet. This is stuff I have always loved – how to get healthier, improve the environment, better efficiency, save money.
By encouraging them, keeping them updated, providing incentives. So it becomes a positive, even a fun thing to be involved in.

4. How do you think we can make the meetings more productive?
They're pretty darn productive as they are. If we assign specific duties to each member, it might help. Better to have things to present and that each person contribute to the meeting.

5. How would you like to move forward? What would you like to focus on?
I would like to assess everything so far – money savings, health, environment. And then examine the next level of initiatives to improve even further. Would like to focus more on the chemicals – and using more non-toxic chemicals.

6. Knowing what you know now, what would you do differently to obtain the One Palm?
Try to involve everyone more from the get go. Maybe create an incentive plan from the beginning. It would have happened faster.

7. Would the green team be better off led by a green team member?
No, because you want someone with the most knowledge and expertise taking the lead. I would always vote the expert to be the leader. We're still learning a lot.

8. What would you like to know more about?
Energy efficiency and water testing and quality of water. I would love to know a whole lot more.

9. Anything else you think would be beneficial for us to know?
Would like for all of us to address reducing power factor cost. I think that would be an amazing study to look at. To understand how it works and what are the most effective steps to take. Vendor fairs are pivotal to our ability to understand what we could do. We'd be stumbling in the dark without this pilot program. Crucial step is us trying to move forward to have screened vendors present us the possibilities.

Lisa Brito (Design Director)

1. Rank the 5 areas of the Green Lodging program in order of importance:
Communication (for sure), water (South Florida has big issues), waste, energy, clean air.

2. What do you like to do on the green team? Not like to do?
Just trying to help organize what is what and to help implement them. Interviewing with different vendors and seeing their products.
I don't like trying to get money from my company to pay for this stuff.

3. What do you get out of the green team meetings? How can we get others to participate/contribute?
Very exciting to see that we can actually do it – it's feasible and not as complicated as most people think it would be. And we can do it in small steps.
More communication to get others to participate – explain why it's good for them, I think people just don't know. (i.e. healthier place to work, people feel good when they do something to improve the environment in any way, etc).

4. How do you think we can make the meetings more productive?
Overall, meetings are pretty productive. At the beginning, with the Standard, it was important to stay on task. Once we started doing it here, it became much more productive – what's the next step and what do we need to do. Especially with the vendors. Good education. Keeping with an agenda from the beginning would have made it more productive. More bullet point directed. This is what needs to be done and let's do it. But I have no complaints. You guys were pretty good about letting us know how to fill in the parts of the puzzle.

5. How would you like to move forward? What would you like to focus on?
Definitely want to keep going – implement more initiatives to green the property. Definitely get the 2 palm. Just a matter of communicating it to the corporate office and making sure we're on the same page.
Would like to focus more on energy and communication. People are starting to pick up what we're doing, but the employees need to know what's going on so we keep going.

6. Knowing what you know now, what would you do differently to obtain the One Palm?
There was a lot of miscommunication. It could have been better explained and presented in a more detailed manner. I know that there was an original contract, but the hotel didn't really realize what needed to be done and the costs involved. (Every property is different and works differently in terms of communication. So the fact that corporate didn't know about this program although the GM and Lucy (design director) from corporate was given a presentation (this was probably our fault, not yours). I would like to have known on paper what it would actually cost us from the beginning. Even though we get a return, there is still an initial cost. Didn't have to be exact. More of a description of what we were actually getting into. Have the controller be involved, not just the GM, to get an overview of the financials. When it comes down to it, it's all about money with hotels. Everyone has the best intentions, but the hotel is only going to do it if it makes financial sense, especially with small boutique hotels.

7. Would the green team be better off led by a green team member?
No. I think it's great that the professor is there. To have someone who is very knowledgeable in the field. All of us are looking up to him. I didn't know anything about this before. It's been really helpful to have him guide us.

8. What would you like to know more about?
Interested in all the different vendors. If I had the time, I would love to keep researching the different types of vendors out there and what they're doing for hotels. I would have not had the opportunity to do the research on my own so for us it was really great to have them come to us with all their presentations and numbers prepared.

9. Anything else you think would be beneficial for us to know?
I think that's about it.

David Briggs (Sous Chef)

1. Rank the 5 areas of the Green Lodging program in order of importance:
Waste, communication, energy, clean air, water. It's hard to rank, all are important

2. What do you like to do on the green team? Not like to do?
I like to motivate the team members. I don't like to follow up with companies that aren't holding up their end of the bargain, like the recycling company, for example.

3. What do you get out of the green team meetings? How can we get others to participate/contribute?
A lot of information. Lots of knowledge about products out there. There is a strong desire of the people on the green team to work. There's a lot of road blocks, but they keep overcoming them. To get others to participate, make them aware. If they know what's going on, what they need to do, then that would get them more involved. Communication. I haven't experienced much resistance when I've approached people.

4. How do you think we can make the meetings more productive?
Perhaps breaking everything down. Doing a general overview and just focusing on one area for each meeting. Like focus on water first, then energy at the next meeting, etc, instead of trying to do everything at the same time.

5. How would you like to move forward? What would you like to focus on?
After we get the one palm, we have a year, so we can pay attention to the details. Hopefully we'll get a return on the one palm things and have more money to play with. Slow things down a bit and concentrate on a couple things. Organize ourselves a little better by focusing on a couple projects that we can complete throughout the year. Start organizing the money for bigger projects. Give ourselves some time to get things done and room for error. Get the new GM involved and see what kind of effort he wants to put into to this process. I would like to focus on composting and energy efficiency, like solar panels. Though I know we're not too good of a candidate for that, but something along those lines. Something that might have a large initial investment but great payoff in the long run.

6. Knowing what you know now, what would you do differently to obtain the One Palm?
Get corporate involved more from the beginning. Which may be special to our company since we are screwed up organizationally-wise. If they were involved more it would have been easier for us from the beginning. Give them a list of everything that they needed to do from the very beginning. Like the letter for the guest book.

7. Would the green team be better off led by a green team member?
No. He (Professor Meeroff) has more knowledge and experience in this process than any of us do.

8. What would you like to know more about?
I know a lot of hotels are joining the FGLP, but why wasn't it done sooner? Why has it taken so long for people to get to this point? And be motivated to do this?

9. Anything else you think would be beneficial for us to know?
Nothing jumps out. Vendor fairs were great.

The Standard Hotel

Charlie Ibañez (Director of Security)

1. Rank the 5 areas of the Green Lodging program in order of importance:
Waste, energy, water, clean air, and communication. I foresee a problem (when we get busy) to dispose of the recycling. It's my job to deal with the waste at the hotel. Energy is something we can accomplish, but we need the extra boost because we don't have the motivation from the powers that be. Water – the $300k project. Difficult to see how we can contribute to clean air – might be due to my lack of understanding. Communication is last because I put it in order of things I don't think we need to worry about. We can accomplish communication. We get the right people to listen to the meetings; we can change the powers that be to be more green. They would benefit to hear all the stuff that I've been hearing.

2. What do you like to do on the green team? Not like to do?
I am a big fan of learning more. The more I learn, the more interested I become. I am a big fan of learning about what is green. Because if you don't know anything about it, people won't give a {expletive}. I don't like to take on added responsibilities.

3. What do you get out of the green team meetings? How can we get others to participate/contribute?
Support for what I need to accomplish to go for the one palm. If we didn't have those meetings, we would have a hell of a time trying to convince these people. We should offer free food to get more people there.

4. How do you think we can make the meetings more productive?
When we have them, we should dedicate more time to them and dedicate goals, priorities, and accountability. Big problem with accountability.

5. How would you like to move forward? What would you like to focus on?
Set our sights on how to get a 2 palm. Stay the course! For the meetings, we have to have the head person there – the person that writes the check, at the meetings. We're not the ones needing convincing – the top dog, corporate needs to be there so they can buy into it. Open lines of communication with corporate. We're not the best people to relay the information from the meetings to corporate. They need to hear it first hand from the (FAU team).

6. Knowing what you know now, what would you do differently to obtain the One Palm?
I've just been instructed to do stuff. Everything was a learning process for me. I don't know. I would hire you guys (FAU team) to come in and conduct meetings.

7. Would the green team be better off led by a green team member?
No. It's best for Dr. Dan Meeroff to do it because he has all the answers. Unless the member had a lot of knowledge about the subject, I see them stumbling. At least someone like Dr. Dan Meeroff would need to get it started. The leader needs to have the answers. You can't have the leader say, 'I'll get back to you on that.' You would run out of gas really quickly.

8. What would you like to know more about?

How to make my own house more eco-friendly, sustainable. Next time I build a house, implement some of those techniques.

9. Anything else you think would be beneficial for us to know?

The biggest part is education. I suggested putting a continuous film in the lobby – people are quick to make fun of things when they don't know and there is a lot that we don't know. Non-threatening information.

Erica Frickling (Executive Assistant)

1. Rank the 5 areas of the Green Lodging program in order of importance:
Communication, waste, energy, water, clean air. Communication to get the word out, a lot of people don't believe in world destruction, global warming. All the rest are important, and just as important, but we need communication. It gets the ball rolling for all the other components below it.

2. What do you like to do on the green team? Not like to do?
I don't know. I like that we all collaborate together and try to find ways to make the property green. The work behind is not fun because it looks like we are the only ones doing it. I don't like battling everyone else that's not part of the team and trying to get them to conform to our mission. I honestly think that if everyone saw the video we saw ("the most terrifying video you will ever see") then it would be easier. I started going to the green team meetings as an activity to get involved in because Chef Mark (Zeitouni) pulled me in, but once I became aware…. You guys took it up a whole other notch.

3. What do you get out of the green team meetings? How can we get others to participate/contribute?
Awareness. Show them that video! We don't know the future, we don't know what will happen. But if we keep preparing ourselves for self destruction, we will eventually self destruct. If we prepare ourselves to avoid self destruction, then we have a better chance of surviving…

4. How do you think we can make the meetings more productive?
I think we've gotten better. Before it was an hour and half of words flying. Since the agendas and meeting minutes got implemented, it's been better.

5. How would you like to move forward? What would you like to focus on?
I would like for all of the initial ideas and concepts to come to fruition (like solar and the office becoming paperless). Over the course of the next 5 years, I would like for all of our ideas to actually happen. I would like to focus on paperless solutions.

6. Knowing what you know now, what would you do differently to obtain the One Palm?
I would have liked to get corporate involved initially – they should have been the team captain. This would have happened a lot smoother and more quickly if it had been mandated through them.

7. Would the green team be better off led by a green team member?
No. Dr. Dan Meeroff has exponential amount of knowledge. He is our shepard and we are his little sheep.

8. What would you like to know more about?
Commingled recycling and how that whole thing works. There's a lot of things – how does energy work? A lot of things I'm ignorant about, that I should know but I don't (ex. solar therma). How things work, why it's better to use one thing vs. another.

9. Anything else you think would be beneficial for us to know?

In our first meeting, should not just be a meet and greet. Should definitely show the video first. And have the implementation plan. Delegate duties off the bat. So there won't be a month or two wasted "conversing." Although it was fun. It became the hang out spot to talk about how we can change the world instead of actually changing the properties. Definitely have the GM involved from the beginning so that you know if its worth it from the start. Can mix play with work, but it was more of a social gathering then a work thing at first.

Delegate small duties out per week. Had I had the list initially, I might have started recycling paper weeks ago, etc, instead of rushing to get things done. They would have been done over a string of time. Give us one task a week instead of all 28 at one time. If we have it spread out, each week, we tick one of the list. Then it's easier to get it done. Instead of doing everything at once. Not necessary to divide it up into water, waste, etc.

10. Have you seen appreciation from your superiors?

Yes. Initially no, but as things progressed and things changed – like we started using less paper in the office – they noticed it and appreciated it. It's still not on the top of their list of things to accomplish but at least there is some awareness.

Jennifer Mohr (Design Director)

1. Rank the 5 areas of the Green Lodging program in order of importance:
Communication, recycling, water, energy, clean air. If people are aware, it starts the ball rolling. Then they are mindful of everything else.

2. What do you like to do on the green team? Not like to do?
Brainstorm, share information, educate myself. Not like to do – talk about mold, ha, ha. Just getting bogged down with too much information, too much minuscia. I'm one of those people that's like OK, so what's next. If we're stuck on one topic too long, it's not using your time wisely. Lightbulbs, for example – usage, types, recycling, products. I did like the green tips.

3. What do you get out of the green team meetings? How can we get others to participate/contribute?
Knowledge, satisfaction that we're moving in the right direction. Get the one palm and spread the word.

4. How do you think we can make the meetings more productive?
Just not get stuck on one topic for too long. Splitting the meetings up so the Raleigh and Standard have their own meetings. We need to be focused on what we want to do, how to move forward, and we both have our own sets of priorities.

5. How would you like to move forward? What would you like to focus on?
I think what our next set of goals would be beyond the one palm, if we get the one palm. Definitely establish someone in the corporate office. We should target the corporate office moving forward. Should spread to the other hotels in the chain. You guys should reach out to the corporate office and promote this company wide. I don't know who it should be up there. Get the proper person to contact. Once we have the success here, it will get the ball rolling. I think it would be great if all the standards are green hotels. And it would keep the momentum going down here. I want to see it evolve as best it can and we should not drop it. Find out if corporate is willing to invest time and money to move forward. We really want their backing to take it to the next level.

6. Knowing what you know now, what would you do differently to obtain the One Palm?
Get corporate involved – have someone representing corporate to get the GMs to move this thing forward. I think we did a lot of this on our own.

7. Would the green team be better off led by a green team member?
No. I like Dr. Dan Meeroff. Dr. Dan Meeroff is an authoritative person. I get that's he's science and data specific. He's super knowledgeable. But we need to capture the team's attention. He knows his stuff, but as far as leading the presentations, his presence can't rally up the gang. I thought Lanette Sobel did a better job in that department. We need more of a show. [Treat us like school kids.] If someone is discussing the variations of mold it's not dumbing it down enough for us. Being led by someone at the hotel, preparing for high season, it will be hard to find someone with the time to commit. It needs to be an outside person. Showing up and delegating responsibility is one thing, but to be real about it, it needs to be someone from outside. And they

need to work with corporate and GM. Various departments would then implement. It needs to be a directive coming from up top.

8. What would you like to know more about?
I know all about [dual] flush toilets now… the two palm – what else is next. What other hotels, our true competition, is doing. Like Morgans Hotel Group.

9. Anything else you think would be beneficial for us to know?
Even though we don't say it, you guys are really appreciated. Even though we got our hands slapped by corporate. Corporate will say its great when this gets down.

Mark Zeitouni (Executive Chef)

1. Rank the 5 areas of the Green Lodging program in order of importance:
Communication - all others don't work without it, clean air, water, waste, energy. All are so symbiotic though – the less energy we use the cleaner the air.

2. What do you like to do on the green team? Not like to do?
{Expletive} bickering. Be a part of it, be active, and try to change the hotel. I have to constantly nag at people to do what they should be doing.

3. What do you get out of the green team meetings? How can we get others to participate/contribute?
Knowledge – have their bosses force them to. If you want your hotel to go green, you have to tell your employees to go green. Green initiatives are not the easy way out – but managers usually want the easy way out. Initially it's more work. The decision makers are looking to make their lives easier, not more complicated. I find that the people that are more interested are the younger, non-policy making employees. Policy makers are the least interested in changing their ways.

4. How do you think we can make the meetings more productive?
Having the head person in the hotel present at the meetings; the decision maker.

5. How would you like to move forward? What would you like to focus on?
Staff training overall. For the green team meetings- actually getting up from chairs and going out to specific areas and spending a little time specifically looking at each area and what we can do there.

6. Knowing what you know now, what would you do differently to obtain the One Palm?
Stronger discipline early on, and having money set aside for the initiatives in place before we even have a meeting, and the person authorized to sign off needs to be at the meetings or they need to empower the green team to sign off. As a hotel, the green team leader needs to become a full time position to organize the meetings, vendor fairs, etc.

7. Would the green team be better off led by a green team member?
The green team leader would need to met with specialists like FAU and learn how to do this before it would make sense for a member to run the green team. We are also running out of time, so we do have time to do this. Would only work if the hotel hired a special green consultant to run this that was part of the hotel.

8. What would you like to know more about?
Water reclamation and making a self sustainable hotel.

9. Anything else you think would be beneficial for us to know?
It better to know the concept and design feeling that the management is going for – with Andre Balasz and the design team – to find out what is more desired by them and go after that. Right now everything gets filtered up to corporate and any way that we can cut the number of people out of the same loop to get to the top would make this a much more feasible and easier process.

Paul Green (Director of Engineering)

1. Rank the 5 areas of the Green Lodging program in order of importance:
Waste, energy, water, communcation, clean air. It's how I see things. For the environment, waste is most important.

2. What do you like to do on the green team? Not like to do?
Learn and educate people. I don't like to attend. Nah, I like to attend some. No answer for what I don't like to do – I'll do anything.

3. What do you get out of the green team meetings? How can we get others to participate/contribute?
Information. Make it fun. Have prizes or something. Make it scary.

4. How do you think we can make the meetings more productive?
Don't make them too long. No more than 1 hour.

5. How would you like to move forward? What would you like to focus on?
Get the second palm. Focus on energy conservation.

6. Knowing what you know now, what would you do differently to obtain the One Palm?
I'd have it implemented when the building was renovated.

7. Would the green team be better off led by a green team member?
No.

8. What would you like to know more about?
Not too much really. How to make it easier to educate someone in simpler terms, like my staff.

9. Anything else you think would be beneficial for us to know?
Not really. You guys do a good job.

10. Have you seen appreciation from your superiors?
Yes. Trying to get the process moved on, so we can get the one palm.

Turnover

One of the interesting and most unexpected phenomena that occurred over the course of this study to date is the alarming rate of turnover, in particular with regards to the active green team members. For instance, the leadership of the green team at the Raleigh has undergone three changes since the beginning of the study in May 2008. The first green team leader was Kevin Arn (associate in F&B). Mr. Arn left the hotel shortly after the initiation of the project, and he was replaced by Kyle Briggs (design director) as captain of the green team. Mr. Briggs was fired in June 2008, and was replaced by Carolyn Cugini (executive assistant to the GM) as green team leader. At the Standard, the green team leadership has shifted among staff members Mark Zeitouni (executive chef), Jennifer Mohr (design director and interim head of housekeeping), and Erica Frickling (executive assistant).

The turnover rate was not confined to the lower management levels. Both hotels have replaced the general manager since summer 2008. At the Standard Hotel, GM Jason Harler was replaced in August 2008 by Helena Blat (hotel manager) just two days after the research team met with him to discuss procedures for utilizing the funds set aside for the greening process and also procedures for communication of green team actions. At the Raleigh Hotel, Alistair Maclean resigned to take another position and was replaced in September 2008 by Albert Mertz, only one month after the research team met with Mr. Maclean to similarly develop procedures for utilizing funds and establishing the hierarchy of communication. One advantage of the new GM is that he comes from a hotel that recently had its One Palm designation site visit and it thus familiar with the FGLP and its needs.

One of the most surprising findings from this unexpectedly high turnover rate is that the replacement person was usually more interested in participating on the green team and more motivated to make a difference. The new personnel generally felt that the green initiative was part of the job description, whereas the previous staff member, who was present before the program was in place, was more apt to shirk responsibility with regards to green team assignments.

Corporate

Another issue that routinely appeared as a barrier is the overarching fear of "Corporate." During the course of the study to date, numerous surprise visits from corporate headquarters have caused delays in the process because of the "drop and do" approach during these inspections. It is interesting to note that the corporate office is not immune to the turnover issue, as many times the corporate officer identified in the communication hierarchy as the person responsible to approve an action item has changed in many occasions as well, further complicating the lines of communication. However, the specter of corporate fear is pervasive as in several instances, personnel on the green team have been fired, reassigned, or saddled with even more responsibilities during these visits, and also on more than one occasion, the "corporate excuse" has been invoked when the green team member was trying to avoid performing an assigned duty for the green team.

Design Issues

Anything that impacts the guest experience, particularly visual, has to go through an extra level of approval from the Corporate Design team. This is related to the "point of differentiation" marketing concept that is particularly critical to the hotel and its financial success. The Corporate Design professionals conduct announced walk-throughs periodically to make certain that all aspects of the guest experience are adhering to the design theme approved by the corporate office. Although cumbersome and necessary, often taking up an important portion of the employee's

time commitment, it is also used as a common excuse to avoid performing functions necessary for the green team.

Guest Complaints

The research made random checks of the Manager on Duty log to determine if there were any recurring complaints that could be addressed by the green team. The results of this analysis are presented below for the Raleigh Hotel:

- Leaking faucets
- Trash - cardboard overflowing and not picked up frequently enough, sometimes needs to be thrown away in MSW dumpster
- Rat problem in outside restaurant terrace (Orkin uses uncovered rat traps which have killed birds)
- A/C units in guest rooms break down frequently
- A/C break downs in common areas or hallways
- Disabled elevator works on and off
- TV and cable system does not always work
- Shuttle bus breaks down often
- Carpets are commonly soaked due to leaking air conditioning units, as well as from water leaks in roof, windows and walls
- Water leak above the seating area right in front of the coffee bar that is facing the front side porch
- Stains on carpet and walls, chipped furniture, A/C system is noisy
- Roaches - especially after heavy rains (apparently a 2 cm gap between wall and floor in the '06' line)
- Basement tends to flood when it rains
- Room #802 has on odor
- Trash room and grease trap smells
- Tree parasite killing sea grape tree in terrace restaurant
- Moisture on west wall/windows exterior

For the Standard, the research team performed a similar analysis.

- Bugs
- Water leaks
- Noise - especially in east wing where the windows are not "city windows"
- Hot water circulation - takes 10 minutes for water to heat
- Issues heating up jacuzzi and keeping it hot
- Mold stains that dripped on guest's clothes from vents
- Poor insulation in 2-story building, so a lot of noise traveling from other units
- Soft water - need to shower for 30 minutes to get the soap off because water is so soft
- Caterpillar bugs in garden go into guest rooms
- Mold in just about every room
- A/C issues - completely out the weeked of May 17, 2008
- Towels not clean and ready in a timely manner
- Rooms 61 - 64 complaints about hearing washer/dryer noises
- Roof leaks

The issue for many of these complaints is that the hotel guest relations department ends up providing the guest a complementary night stay or spa passes or some other offset, which reduces the overall revenue that the hotel is receiving from the rent of the rooms. These issues must be dealt with immediately because they directly impact the hotel's finances in the short term.

Communication

One of the methods used to increase awareness of the FGLP was to conduct a green team meeting together with the Head of Department (HOD) meeting at both hotels. These were conducted on the same day (at different times) on September 17, 2008. The week prior to the HOD meeting, a flyer was mailed with the paycheck stub on September 12, 2008. The purpose of the flyer was to introduce and explain the Florida Green Lodging program and the hotel's green policies and commitment to achieving the one palm designation. In addition, a brief note was included that described the responsibilities for each department to be prepared for the walk-through. At the HOD meeting, Dr. Meeroff presented a brief outline of the expectations for the walk-through, a summary of the projects that each hotel has put in place to achieve the compliance in each of the five categories, and a timeline and list of items needed to achieve the two palm designation by 2009. At the HOD meeting, all of the departments were represented including: 1) Food and Beverage, 2) Spa/Boutique, 3) Housekeeping, 4) Front Desk, 5) Engineering, 6) Administration and General, 7) Executive Office of the General Manager, 8) Accounting/Receiving, 9) Sales and Marketing, 10) Human Resources, 11) Design, 12) Security, and 13) Guest Relations and Valet. The presentation took approximately 25 minutes and was followed by questions and answers. It was then decided to amend the employee handbook for each department to include the roles and responsibilities of staff members to maintain the commitment for the FGLP green initiative. This amendment will also include copies of key memos outlining the property's specific guidelines with regard to environmentally-friendly policies and procedures. Also after the HOD meeting, it was decided to conduct staff training events for the AM/PM meetings by shift. At each of these mini-training events, it was decided to have at least one member from the green team present to verify that all staff members receive accurate information. An attendance form was created to make certain that all staff members have the opportunity to get access to the information and acknowledge that they understand their responsibility to uphold the hotel's commitment to going green. These staff meeting training events began taking place on September 24, 2008. The goal is to provide employees with knowledge of three key items: 1) **Awareness** – an overview of the FGLP and an understanding of the new initiatives, policies, and procedures that the hotel is implementing that ultimately impact how they conduct their work in terms of new roles and responsibilities; 2) **Feedback** – an opportunity to comment on the implementation of environmental initiatives as part of a continuous improvement process through a suggestion box mechanism and also an opportunity to self-police implementation by reporting to their superiors through the chain of command whenever a staff member encounters non-compliance, and 3) **Implementation** – an opportunity to get involved in the successful outcomes of environmental initiatives through proper application of hotel's policies and procedures with regard to the five key components of the FGLP. It was suggested that each manager conduct a brief 2-minute quiz at each staff meeting to make that employees are informed as to what the hotel's environmental policies are. Another suggestion was to start a "Green Blog" on the internal computer network. This is a place in which the Green Book can be stored, minutes of green meetings can be posted, compliance enforcement can be reported, and suggestions for improving implementation can be made.

Incentives

Both hotels currently have a version of the employee of the month award and are considering expanding this award to include a "green" employee of the month. The existing program is called the "Interconnectedness Award," which has a monetary prize as well as a spa pass for the day (Standard) and "Lunch for Two" (Raleigh). It was also suggested that at the end of the year, the employee who has accumulated the most "environmental" points by vote or nomination gets a weekend stay as "green" employee of the year. Managers will get a card to tally the points for the employees, and employees can nominate using the suggestion box. This program will begin implementation in October 2008. It was also suggested that the hotels could offer a "GREEN DAY" monthly event to raise awareness of environmental issues. Examples of potential activities include: a tour of a recycling facility, a trip to the everglades, a tree planting, etc. A similar activity has been organized in the past to benefit local charities. This program requires approval from the general managers before it can be implemented.

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