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"Green Lodging Project Phase 3:
Green Lodging Performance Measures:
Implementation and Monitoring"

-Progress Report: Tailored Action Plan-

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Laboratories for Engineered Environmental Solutions

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Executive Summary

It has been documented that the Green Lodging Certification Program practices are generally effective in reducing multi-media waste streams and thus resulting into 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 third 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: (a) energy efficiency and (b) clean air practices. After this information was made available, the next phase is 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. Results will 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.

The scope of work for Phase 1 (solid waste management/waste reduction and water conservation) was completed in June 2006. Phase 2, which focused on energy efficiency and clean air practices, was similarly structured and was completed in the spring of 2007. Phase 3, reported here, contains a preliminary targeted action plan based on the needs of the two candidate facilities

This report contains the results of a walkthrough assessment, critical review of baseline expenditures for utilities, and data analysis regarding (a) water conservation, b) solid waste minimization, c) energy efficiency and (d) clean air practices obtained from the two participating hotels. A list of potential green vendors was assembled to provide the participating hotels with options for pilot projects to address their most pressing needs.

Disclaimer: FAU does not endorse specific companies, equipment, or organizations. Those choosing to use vendors discussed in this report are responsible for ensuring that products, equipment, or services comply with the requirements of local, state, and federal law. FAU has not tested any claims, products, or services provided by any vendors listed herein. FAU cautions users to personally evaluate the products, services, and compliance status of any company or other organization they intend to use. By accepting this report the client agrees and understands that FAU is not responsible for the implementation of recommendations, and FAU cannot be held liable for any consequences, losses, damages, or injuries caused by the recommendations in this document.

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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. Lastly, 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

Green Vendors

On May 8, 2008, several existing FGLP Vendor Partners and candidates were invited to attend the project kick-off meeting, which was held in the CM building studio 130 at the Boca Raton campus of Florida Atlantic University. The meeting was video recorded so that it could be posted on the project website (http://labees.civil.fau.edu/pp.html). The informative session included a brief overview of the Florida Green Lodging Program, a description of the two participating properties in the South Florida area, a description of the potential benefits to the hotels, vendors, and the community, and a brief outline of the project and timeline of events.

The list of vendors that were invited to participate is found in Table 1.

Table 1. List of FGLP Vendor Partners and Candidate Vendor Partners Invited to Participate in the Study.

Vendor Company Name
AAON coil products
Accelerated Business Solutions
ACI-Architectural Group
Adopted Native
AdvanTek

[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.

Vendor Company Name
AERS
Air On Time
AirTest Technologies Inc.
Alterna Corp. (Caroma USA)
Andrews Filter & Supply Corp
Antrac Technologies
Apogee
Aqua-Green Clean LLC
ASR associates
Aurore - Auroville Renewable Energy
Bairey Energy Systems, Inc.
Balanced Health Center
Biokleen
Broward County Waste & Recycling
BTEX Engineering
Burns Energy Efficient System, LLC
C.D. Solar
Calmac
CaptiveAire
Carr Company
Carrier
CEXP
Chem-tron
Choice Waste Services
Color Wheel Paints & Coatings
Dadepaper
D'Asign Source
doucette industries, inc.
Dream in Green
Dwyer Products
Eagle Roofing
Eco Experience Development, Inc.
Eco Kitchens
Eco Logic Green Building and Consulting, Inc.
Eco-Décor
EcoQuest
Eco-Smart, Inc.
EcoTechWater, LLC.
Energy Automation
ETC
Florida Air Conditioning Distributors
Florida Power and Light
Florida Spray Foam & Coatings
Foodservice Corporation of america
Forensic Architectural Resources
General Electric
Grainger

Vendor Company Name
Green Energy Products
Greenheck
H&R Drapery
HD Supply
Hill York
ICYNENE corp.
IFE Solutions
Inn2technologies
InnFocusMeetings.com
Innovative Service Solutions
Interline Brands
Johnson Controls
KST Coatings
Lennox
Lighting Dynamics
Madico
Melink
Miami Dade Water And Sewer
Microbial Masters
MicroMetl corp.
Natura Water
Natural Environment Energy Homes
Niagara Conservation
Office Depot
Ozone solutions
PM Environmental Services, Inc.
Power Now
Quest Controls
R.G. Mechanical Services
Recycled PC Parts
RMK Inc
Royal Caribbean Cruises, Ltd
Royal Concrete Concepts
SFWMD
Shaklee Corporation
Sherwin-Williams
Simply Green
Solar Solutions - Eco-Nomic Solutions, LL
Solar's Smart
SP Recycling Corp.
Stockholm Environment Institute
Sulabh International Social Service Organization
Sunworks
Superior Plus Pesticides
Sysco
Tech Products
The Energy Store
The Green Home Lady

Vendor Company Name
Therma-Green Corporation
Trane
Trifecta Contruction Solutions
Tri-R Lighting
Tropical Lights
TSAO Design Group
UCNSB / Halstaed (ecoLuxery Showers)
United Electric Sales
Utility Savers
UtilityTrust.org
Veolia Environmental Services
Water Energy/ Green Solution Team
Well-Tech Wellness Products
Window Guard
Winsulator
World Waste Services, Inc
XO Design Group

A copy of the powerpoint presentation that was delivered in the kick-off meeting is included in the appendix, and the full video presentation can be viewed at: http://labees.civil.fau.edu/pp.html. Below is the announcement flyer that was sent to the FGLP Vendor Partners and candidate vendors:

DATE: **Thursday, May 8, 2008**
TIME: **1:00 pm**
WHERE: **Florida Atlantic University Computer Center Building**
CM Building (22), Room 130 (Studio 1)
777 Glades Road, Boca Raton, Florida 33431

The Florida Atlantic University Laboratories for Engineered Environmental Solutions (Lab.EES) would like to invite you to participate in a scientific study under a partnership with the Florida Department of Environmental Protection's Florida Green Lodging Program.

This $121,000 research study will focus on assessing 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. This is your opportunity to market your products and services as featured in high-end luxury boutique hotels on South Beach for an independent scientific study. Results from this study will be used to further market the value of the Florida Green Lodging Program and its vendor partners, statewide.

Vendor partners that are interested in participating in this study should send a representative to attend the Vendor Partner Kick-Off Meeting at Florida Atlantic University's Boca Raton campus on Thursday, May 8, 2008

Below are the minutes from the vendor kick-off meeting:

Date: May 8, 2008
Location: Florida Atlantic University Computer Center Building
CM Building (22), Room 130 (Studio 1)
777 Glades Road, Boca Raton, Florida 33431

Partners/Guests in Attendance:

Tony Ruffini	Dr. Daniel Meeroff	Omar Riveira	Lee Cohen	Jay Cullimore
Jim Collins	Joe Messina	Richard Reiss	Larry Clark	Charles Mordurs
Vicki Eckels	Jason Downey	Laura Craven	Nick Gunia	Rosemary Diehl
Hugh A Smith	Stan Crossland	Terry Hays	Brad Haynes	

Meeting called to order at 1:11 pm
Introductions

- Daniel E. Meeroff, Ph.D. with Florida Atlantic University introduced himself, and asked all those in attendance to introduce themselves to the audience.
- Dr. Meeroff briefly some of the research being conducted by the Laboratories for Engineered Environmental Solutions (Lab.EES) including the previous two phases of the Florida Green Lodging research studies and also described the future of the program.

Brief Overview of the Florida Green Lodging Program

- It is a voluntary, non-regulatory program established by the FDEP to acknowledge and reward environmentally-conscious facilities in the lodging industry.
- The goal of the program is to help Florida's lodging industry become more sustainable, while continually improving environmental performance.
- Water conservation, waste reduction, clean air practices, energy efficiency, and communication practices were discussed and presented briefly.
- Charlie Christ signed Executive Order 07-126 saying that all state agencies must shall conduct meetings and conferences in facilities that have received FDEP designation as part of the Florida Green Lodging Program.
- Currently 146 designated Florida Green Lodges
- Benefits for hotels were discussed.
- Description and virtual tour of hotel partners.

Benefits for vendors

- Opportunity to feature products and services in high-end luxury boutique hotels
- Opportunity for free marketing as participating in a scientific study with independent third party verification of performance
- Opportunity to build relationships with influential hoteliers
- Instant feedback from empirical research
- Results from this study will be used to further market the value of the Florida Green Lodging Program and its vendor partners, statewide
- Opportunity to get the proverbial foot in the door and educate a potential new clientele base
- Opportunity to interact with FAU and the local community
- Insulation from "*Eco-Charlatans*" and opportunities to dispel "*Green washing*"

- Opportunity to break down the barriers to adoption of sustainable practices

FAU research study plan approach:

- Collect Florida-specific data to document savings
  - Vendor partnerships
  - Site assessment
  - Prepare project implementation plan
  - Obtain plan approval
  - Implement demonstration projects
    - Monitor and document results
    - Compile findings
- **Vendor participation**
  - Interested vendors will supply the following information for the participation package:
    - Letter of support
    - Contact information
    - List of applicable products, services
    - Technical literature/product information
    - List of information requested of the hotels (for design/pricing purposes)
    - Partnership strategy (incentives, donations, savings sharing plan, lease option to buy, rebates, free installation, etc.)
- **Core requirements**
  - Water Conservation
    - Towel/Linen Reuse
    - Low Flow Fixtures (Faucets <2.5 gpm; Showerheads <2.75 gpm; Toilets <1.6 gpf; Spray Nozzles)
    - Low Flow Appliances (Dish Washers; Clothes Washers; Icemakers)
    - Automatic Faucets
    - HVAC Improvements
    - Irrigation/Landscaping
  - Energy Efficiency
    - Energy Star Appliances
    - Programmable Thermostats
    - Sensor or Solar Lighting
    - High-Efficiency Lighting
    - Energy Management System
    - Energy Recovery Ventilators
    - Solar Hot Water
    - Preventative Maintenance
  - Waste Minimization
    - Recycling
    - Eco-Purchasing
    - Post-Consumer Recycled Content
    - Bulk Purchasing

        - Reduced Packaging
        - Manufacturer Take-Back
        - Ink/Toner Cartridges
        - Composting
    - Clean Air Practices
        - Environmentally-Preferable Cleaners
        - HEPA Filters
        - HVAC Cleaning/Replacement
        - CO_2 Monitoring
        - Anti-Idling
        - Alternative Fuel Vehicles
    - Communications
        - Training materials
        - Placards, videos
        - Suggestion box
        - Survey instruments
        - Signage
- **Timeline**
    - Vendor Partner Meeting/Webcast (May 8, 2008)
    - Partner Hotel Site Assessments (May 12, 2008)
    - Partner Hotel Green Team Needs Assessments (May 2008)
    - Vendor Participation Packages Target Date (June 2-15, 2008)
    - Develop Project Implementation Plan for Recommended Specific Sustainability Practices First Draft (June 16, 2008)
    - FAU, FDEP, the vendor partner team, and the candidate hotels will agree upon a portfolio of conservation projects to form a tailored action plan (Summer 2008)
    - Conduct Monitoring Phase to Document Results (Summer 2008 – June 2009)

Questions and Answers

- *How did this end up in the Civil Engineering Department?*
    - Environmental engineers are leading sustainable education and have a unique perspective on how to implement best management strategies to maximize benefits.
- *Will green vendors end up on the FAU website? FDEP website?*
    - FDEP is contemplating phasing out the green vendor partner program and is considering moving that information to the sustainability center at UCF (their website) in the future.
- *Will hotels be looking at the list of vendors to "steer" towards?*
    - Yes
- *What endorsements are out there? When? State?*
    - There are many certification programs for vendors and properties. Some were discussed briefly like LEED, green seal, etc. There is no universal endorsement program or set of standards existing, but the future of licensing green vendors by the federal government was discussed briefly by those in attendance.
- *Are there shades of green?*

  - Yes, but the question is how to quantify and relate those shades to users and customers. This study will allow hotels to get real performance data in a timely basis to help them decide what are the most effective solutions for their needs.
- *Talk about Green washing-LEED. What is LEED's effect on Green Lodging?*
  - The importance of education and awareness and urgency was discussed by those in attendance. LEED was presented as an alternative better suited for newer construction for the hotel industry, but the LEED checklist does not necessarily favor the Florida climate and Florida-specific needs as well as the FGLP does. Bottom line is that they can work hand in hand or independently.
- *Green Commission (Miami Beach). What can the city do to get behind?*
  - The City has re-established its Sustainability program with a new active committee and hiring a new professional in the environmental unit. It is actively searching for ways to promote the FGLP and the FAU study in an effort to expand participation in Miami Beach.
- *Will results be posted as they go?*
  - A website (labees.civil.fau.edu/pp.html) was set up to help communicate the progress of the research and post interim reports and information notices. A wiki service is being set up by FAU information resource management to allow registered users to follow the progress of the study in real time by reading the running commentary that is updated fairly regularly. There will be peer-reviewed articles published at the end of the study.
- *When will the finalized report be out?*
  - On June 15th, 2009, the draft final report is due to be reviewed by the FDEP. After the comments are incorporated, the revised final report will be posted on the project website and the FDEP website.
- *If approval is ultimately by hotels, how will vendors know what the hotels need?*
  - Vendors that have submitted their participation packages will be given instructions as to how to proceed with meeting with the hotels. The contact person will be Lanette Sobel, and she will coordinate this process to avoid bombarding the hotel staff with sales pitches.
- *What is the installation process?*
  - It is envisioned that some of this will be handled by the vendors themselves (to expedite installation), some by the hotel staff and FAU students (to minimize additional costs), and some will be contracted out (to ensure professional quality installation work), depending on the product, service, or strategy.
- *On the May 12 walkthrough of the participating hotels, will this be all vendors?*
  - No, the FDEP and FAU team members will conduct this walkthrough assessment. Opportunities will be identified based on meeting the hotel's areas of highest need. It is anticipated that the hotel engineer will be involved in this process too. Vendors will be requested to coordinate separately with Lanette Sobel.

➢ *Will there be competitive evaluation?*
  - The selection process is ultimately up to the hotels to decide. For purposes of the study, we will encourage open competition to extent possible.

➢ *Who pays for what?*

  - Part of the process will involve incentives from the part of the participating vendors. Another part of the process involves capital outlays from the participating hotels. Another part of the process involves additional incentives/grants/rebates from third parties. FAU receives no moneys from vendors nor will contribute any money to install systems or purchase products on behalf of the hotels or this study.
- *Are students getting involved? Champion of each area?*
  - Yes, we have student volunteers and also Tony Ruffini will be working full time on the study. The wiki will allow the Green Team members and the vendor partners to communicate and keep up to date with the latest developments on the project.
- *What about eco-composting?*
  - Both participating hotels are extremely excited about composting. This will likely be one of the targeted focus areas.
- *Life-cycle cost. Will these be part of the evaluation?*
  - These will be evaluated.

After the meeting, a follow-up letter was sent to the potential vendor candidates on May 28, 2008. This letter was created with the assistance of the Florida Atlantic University Associate General Counsel, Jack Ludin.

Company:

I see that you are a vendor listed as a participant in the Florida Department of Environmental Protection's Florida Green Lodging Program. As you may be aware, I am participating in that program as a researcher on behalf of Florida Atlantic University. For more information, please logon to http://labees.civil.fau.edu to learn more information about our study.

I am very interested in working with you as a potential provider of products and services for the two hotels in Miami Beach that have agreed to cooperate with FAU in the Florida Green Lodging Program research study. I am contacting you for two purposes. First, are you willing to forward to me any information you may have as to the environmental benefits of the products and services that you would be willing to provide? Specifically, have any studies been performed to quantify the economic savings from use of your products or services? Secondly, are you willing to provide incentives, donate, or provide your services or products to the participant hotels at a reduced price?

If the answer to these questions are both yes, then please provide the appropriate information and a brief summary of the incentive package to dmeeroff@fau.edu.

I look forward to hearing from you as a fellow participant in the Florida Green Lodging Program research study.

Sincerely,

Daniel E. Meeroff, Ph.D.
Florida Atlantic University Department of Civil Engineering
777 Glades Road, Building 36, Room 222, Boca Raton, FL 33431-0991

At the request of many of the vendor representatives, a sample template letter of willingness to participate was created and posted on the project website. A copy of the sample letter is provided below.

Daniel E. Meeroff, Ph.D.
Department of Civil Engineering
Florida Atlantic University
777 Glades Road, Building 36, Room 222
Boca Raton, FL 33431-0991

Dear Dr. Meeroff:

<INSERT COMPANY NAME HERE> 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:
<LIST APPLICABLE PRODUCTS, SERVICES, PRACTICES, ETC. HERE>

<PROVIDE ATTACHMENTS OR LINKS TO TECHNICAL LITERATURE, CATALOGS, CASE STUDIES, PRODUCT DESCRIPTIONS, ETC. HERE>

In order to maximize the benefits from our product, we request that the participating hotels provide the following information:

<INSERT ATTACHMENT OR LIST>

We are authorized to offer the following incentive package to the participating hotels:

<INSERT HERE: INCENTIVES, DONATIONS, SAVINGS SHARING PLAN, LEASE OPTION TO BUY, REBATES, FREE INSTALLATION, ETC.)

We look forward to working with FAU, FDEP, and the participating hotels on this exciting project.

Yours truly,

<INSERT DECISION MAKER'S NAME AND TITLE HERE>

Vendors Expressing Interest in Participating

- **AirTest Technologies Inc.**

This company features Indoor Air Quality Controls, Carbon Dioxide Demand Control Ventilation, Economizer Analysis, and DewPoint Controls. (www.AirTestTechnologies.com). They have pledged academic discounts in support of the research, and also provided a copy of AirTest's CO_2 Energy Analysis program free of charge.

- **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 Facts
• Caroma pioneered the first ever dual flush toilet in 1984;
• Our 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 virtually impossible to clog due to the industry-leading 3.5 inch waste trap, which is nearly double the industry standard.

In order to maximize the benefits from our product, we request 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 pleased to offer the following incentive package to each of the two participating hotels:

Product	Free Samples	Discount on additional purchases
Caroma Toilet (any model)	10	50% off list price
Cube 3 Ultra urinal	1	50% off list price
ecoTap shower head	1	50% off list price
ecoTap Aerator	1	50% off list price

- **Andrews Filter and Supply**

This company conducts air filtration testing and is pledging to provide testing services under the new ASHRAE guidelines.

- **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:

Guest Room/Building Controls: WiSuite by Riga Development

1) The Individual guest room HVAC thermostat will be replaced with a "Smart" Thermostat by WiSuite. Generally six rooms are selected as the study rooms; three rooms would be monitored and controlled and three rooms would be monitored but not controlled. The energy consumed by each room would be measured typically with small CT's mounted in the electrical closet. A six unit WiPoint (RF) unit transmits and receives data for these rooms. The "Sold/Unsold" portion of the room occupancy would be captured thru 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 HQ in Toronto or depending upon your discussions with the factory regarding the larger "Study", a server could easily be set up at your offices. Additional information and controls could be added to the scope of the study using electronic sensors and additional WiPoints (radios).

This could include water consumption, 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 obviously change if the 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 replaced with WiPoint to demonstrate the value of more precise and flexible control of outside lighting, sprinkler controls, etc
- Photo cells similarly
- 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

Antrac Technologies, Inc. is pleased to offer the following products/services to be used in the long term study for Florida Green Lodging:

1) Cooling Tower Water Treatment Service:

a) As per our vendor-partner agreement with DEP, the monthly charge for this service will be 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 belong to the hotel. This would be for the Raleigh (Shore Club, Delano and Lowes) as The Standard has an air cooled chiller.

b) Water meters for makeup water to the tower and bleed from the tower will be made available at cost if they do not exist. It should be noted that the City of Miami Beach offers an "Irrigation" reduced billing option that most hotels already use. The only question here is if there is a separate meter for the cooling tower itself. If not, this would be needed to accurately segregate the irrigation usage from the cooling tower usage.
c) Advantages
- Elimination of hazardous, dangerous chemicals from work area. Savings could also be seen in workmen's comp 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.
- Reduction of bleed water, typically at least 50%. Metering process will verify amount.
- Recycling of bleed water for irrigation or other non-potable purposes

2) "GREEN CLEANING" Safe Antrac Alternatives to replace hazardous Caustic, Acidic and Solvent products presently being used Some of the products include De-Greasers, De-Rusters, and De-Scalers and Non-Acidic Coil Cleaner.
a) Our proposed approach would be to use comparable products for initial evaluation and train the hotel employees on the correct application.
b) The sample(s) would be at no charge and any additional orders would be at a discount.
c) Advantages
- Elimination of hazardous, dangerous chemicals from the work area
- Cost competitive to present products
- Many of our products are more effective than the hazardous ones on the market today.

- **Avonite**

Avonite Surfaces has a line of recycled products that have been used in many "green" and sustainable projects around Florida. If the designers are interested in using Avontie products, more information would be needed to determine to what extent if any that concessions to the costs could be offered.

- **CaptiveAire**

CaptiveAire manufactures energy management systems for kitchen exhaust hoods. The representative is offering these systems to participants at a discounted rate.

- **Chem-tron**

This is an air-conditioning treatment service. The representative has offered to provide discounts.

- **Choice Waste Services**

This vendor is a recycling service that claims to minimize trash and maximize recycling services. Recycling can provide an economic savings depending on location and the amount of trash that can be diverted. When recycling is an after thought rather than designed into the project from the start, there's no one size fits all. It is impossible to know if recycling will be a breakeven proposition or a money saver. Therefore, they request a site visit to determine available options is required before any agreement can be reached (www.choicewaste.com)

In order to maximize the benefits, the vendor represnetatives request that the participating hotels provide the following information:

1. Current level of trash service: container size and frequency of pickups.

2. Does your current waste contract give first right of refusal for recycling service to your current service provider?

The representatives are authorized to offer the following incentive package to the participating hotels: Choice will provide service for a fair price. However, unlike other service providers, our service includes free consultation and educational assist to help establish a successful recycling program. It is about more than just providing a collection container and a pickup schedule.

- **Dadepaper**

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 these customers are hoteliers, both major flags and independents. Locally, our customers include the Four Seasons, the Mandarin Oriental, the Palms, and the National just to name a few. 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:

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
- Controlled use and touch-free towel & tissue systems
- Complete line of towel and tissue products from various manufacturers meeting the standards of the EPA and various NGOs
- 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 auto 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)

Visit www.dadepaper.com/greensafe for products and services available and information about our 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 we may suggest solutions.

We are 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
- If a chemical dilution system is selected, complimentary dispensing equipment and 24/7 service
- Complimentary seminars for all hotel staff on environmental issues pertaining to supply systems
- Complimentary waste stream and recycling audit
- 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

- **EcoTechWater, 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: (see catalog of applicable products).

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).

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

- **ECT**

This is an energy automation company that is 3 decades old and has electric energy conservation programs that are insured, underwritten by Lloyds of London. The programs are in place to proceed with both hotels in energy conservation work and studies. Also, 100% funding is available. Typically the client pays their electric bill and has cash flow as well. We are a conservative and customer service oriented company.

- **FPL**

FPL has offered to assist in optimizing the natural gas services. Typically most hotels do have natural gas for heating pools, laundry and restaurant facilities, and FPL can save them money over typical full tariff gas supply. If a 12 month history of gas usage is provided, a free analysis of savings over the tariff gas supply will be performed.

- **Genesis**

This is an air filtration company offering filters, disinfection units.

- **General Electric**
- **Grainger**

This is an industrial supply vendor. They are offering send information regarding economic and environmental savings, including research that their vendors have done. In addition, they offer product training, free of charge. As far as pricing for our products, if the two hotels are part of a major hotel chain, chances are they already have a National Agreement for discount pricing. If they are independently owned, or part of a chain that has not established pricing, great pricing discounts can still be offered. A link to the "Green" portion of the Grainger website is provided: www.grainger.com/Grainger/static.jsp?page=rc_green.html

- **H&R Drapery**

H&R Drapery, 1791 Trade Center Way, Suite D, Naples, FL 34109 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, they recommend that the following products, services and/or practices be considered for the implementation plan:

H&R Drapery is a window treatment workroom. They fabricate window treatments (draperies, valances, cornices, shades), bedding, and shower curtains. They are a dealer for Hunter Douglas products. As such they can offer the following products and services for light and heat control as well as room-air improvement through Smart Fabrics:

Fabrication of window treatments, bedding, shower curtains using ADO Smart Fabrics. ADO fabrics are eco-friendly and sustainable. ADO became the first brand manufacturer in the world to succeed at combining a permanent room-air improving function with a long-lasting anti-bacterial effect and fire retardant in one fabric. The individual technologies: ADO ActiBreez® actively improves the room air, while ADO BioProtect® prevents bacteria from collecting in the fibers and SF/Trevira CS ensures that the curtains remain fire retardant. When lined with blackout, draperies reduce the amount of light and heat while providing pleasing esthetics within the facility. They also offer the complete range of Hunter Douglas window coverings for heat and light control.

In order to maximize the benefits from these products, the vendor respresentatives request that the participating hotels provide the following information: the size and scope of the project (sizes and number of windows) and the number/type of products requested. Design assistance can be provided with the house designer, Madeline Lupo, Allied ASID.

They are willing to offer deep discounts to participating hotels based on the size and scope of the project (to be determined). Additionally, to keep costs down, the hotel maintenance staff should measure and install the products. Any errors in measurement however would become the responsibility of the hotel. H&R Drapery can of course provide this service for an additional fee, if that is not acceptable.

- **Halstead/UCNSB/ecoLuxury showers**

This vendor provides eco-shower fixtures, specifically Eco Luxury Showerheads "ecoluxcr" (1.3 gpm) luxury shower that will deliver quality at any pressure. The vendor is also prepared to install the showers and or help install them. The fixture has just had EFI (Energy Federation

Incorporated) list the product. They did their own testing to ensure the claims (www.efi.org/about.html)

Information needed from the hotels:
1) Static Pressure of shower on each floor of hotel
2) Average number of guests per room
3) Yearly occupancy rate
4) Total number of rooms and total number of showers in facility
5) Type of energy used to heat water
6) Cost of energy to heat water
7) Cost for water
8) Cost for sewerage

They are authorized to offer the following incentive package to the participating hotels:
Provided Free of Charge for the Study: after 4 months, having proven the monetary savings and quality of our product, the hotel can go on a payment plan where they pay 50% of the money saved each month until the showers are paid for.

- **Hill York**

Outdoor air ventilation management systems. Hill York in their own words is the oldest, largest – and, arguably, the greenest – air-conditioning contractor in Florida, is now offering a multi-parameter Demand Control Ventilation (DCV) strategy to its South Florida customers. Aircuity's OptiNet system provides efficient outdoor air ventilation management that results in both energy reduction and improved indoor environmental quality. Key to this is OptiNet's unique ability to sense levels of CO_2,TVOCs, actual dew point, CO and particulate (small, respiratory size -- 0.3 - 2.5 micron diameter -- particles) present in the outdoor air and in the facility's ventilation systems and indoor areas. This multi-parameter DCV strategy, that considers both human (CO_2) and non-human (TVOCs and particulate) pollutants is the most comprehensive method of determining the optimum ventilation rates at any given time.

- **Insulation Soy, Inc.**

This vendor supplies insulation products made of soy foam. They have agreed to provide social/economic benefits documentation and are willing to offer products at reduced pricing and other financial incentives for the participant hotels. They claim that customers typically experience 40% savings from their pre-existing HVAC electric costs.

- **Madico**

Madico is a window film company that has products that can take an existing window's SHGC down to as low as 0.17. There is a load study program that was performed on the product but it is somewhat dated. A new study was recently performed and is coming from the IWFA to show potential savings/ROI.

- **Natura Water**

This vendor is a water purification outlet.

- **OzoneSolutions**

This is a vendor that sells the OD-7 OzoneSolutions laundry ozone system and the RC-7 TBD System. More detail about OzoneSolutions and what they are willing to offer for the research study is found in a separate agreement document. OzoneSolutions offers two types of

purification systems our OD-7 (On Demand) and our RC 7,15,25,45 recirculating ozone laundry systems.

- **Quest Controls**

Quest Controls is an EMS company based in Palmetto FL. They claim to be a leading designer and manufacturer of intelligent automation systems. Quest products provide direct and/or remote cross-application monitoring and control capabilities to protect the hotel owner's investments. Quest provides its Customers with the ability to monitor and control HVAC systems, lighting, and other electrical devices; environmental factors such as temperature, humidity, smoke, fire, safety, gases, along with other equipment such as refrigeration and door access control. Quest Controls system can manage air exchange system and other "free AC" programs. Quest Controls is also working with FPL also on their "Business On Call" program.

The Quest specialized site solutions also include helping customers:

• Manage Energy Consumption
• Reduce maintenance costs
• Increase productivity
• Extend the life of critical and expensive operating equipment
• Improve product safety
• Reduce potential liability
• Cut repair and unscheduled site visits by 3rd party contractors

Quest Controls understands the need to complete a comprehensive study and would be willing to support this study at reduce fees on the hardware. The vendor is not authorized to support these activities totally free of charge and will not be able to quote a price until a site visit survey to determine a list of equipment has been conducted. Visit www.questcontrols.com for additional information.

Testing programs with national retail chains, have shown that the systems reduce energy cost between 15% to 22%. One test located in Doral FL, where the test was supervised by the customers' Corporate Energy Manager, resulted in a 21.5% electricity use reduction. We have similar results with other national restaurant chains saving the customer over $12,000 or 16% of their total electricity bill.

- **Royal Caribbean Cruises, Ltd**

Ginger Garte, Sr. Environmental Regulatory Analyst, Safety & Environment Royal Caribbean & Celebrity Cruises is working with the Innovation group to see if the research from their fleet could be used to present the FAU research team with some energy efficient and green efforts. The office is located at 1050 Caribbean Way, Miami, FL 33132-2096, 305.982.4849 (office) 305.539.6478 (fax).

- **SaveWater R Us**

This vacuum boosted high performance showerhead company performed a research assessment for water and sewer costs.

Raleigh				
# of Sinks		104		
# of Showers		104		
# of Rooms		104		
Water cost per 1000 2007	$	3.23		
Sewer cost per 1000	$	4.93		
Assumptions				
Persons per room		2.2		
% of occupancy		75%		
# of room/nights		28,470		
# of guests staying per year		62,634.0		
additional guests visiting per year		36,000.0		
total guests		98,634.0		
Minutes sink use pp/per day		10		
Minutes per day shower		12		
		Current GPM flow rate	New GPM flow rate	Savings
Sinks		2.2	1	1.2
Showers		2.75	1.5	1.25
Sink Gallons per person/night		22	10	12
Shower Gallons per person/night		33	18	15
Sink Gallons per year		2,169,948	986,340	1,183,608
Shower Gallons per year		3,254,922	1,775,412	1,479,510
Total Gallons saved				2,663,118
Water/Sewer Cost savings Sinks / yr.				$ 9,658.24
Water/Sewer Cost savings Showers / yr.				$ 12,072.80
Total cost savings				$ 21,731.04
Cost of standard spraySink Aerators incl. tax	$	334.95	Payback in months	0.42
Cost of 1.5 gpm Showerheads incl. tax	$	8,896.84		8.84
Total Cost incl. tax	$	9,231.79		5.10

1.0 gpm non vacuum boosted dual thread aerators
1.5 gpm vacuum boosted showerhead

If non-vacuum boosted chrome-plated plastic 1.5 gpm showerhead is used, the savings do not change, but the payback becomes:

Cost of standard spraySink Aerators incl. tax	$	334.95	Payback in months	0.42
Cost of 1.5 gpm Showerheads incl. tax	$	1,441.08		1.43
Total Cost incl. tax	$	1,776.03		0.98

1.0 gpm non vacuum boosted dual thread aerators
1.5 gpm vacuum boosted showerhead

(727) 892-3334
www.savewaterus.com

- **SPNewsprint**

This is a full service office paper recycling service. 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. The vendor is offering to provide a 7 yard dumpster and pickup service at no cost to the hotels in the study.

- **Star Paper Printing and Design**

This vendor offers green marketing materials services.

- **Tri-R Lighting**

This vendor works with an induction lighting product and is teaming with Johnson Controls. A 2006 study done by Southern California Edison on induction lighting for automobile dealership outdoor display areas was provided by the vendor. It covers the engineering and conservation issues you would expect but goes one step further by providing consumer acceptance data collected through customer surveys. While this report deals only with the parking lot application studied, it does validate the energy savings, reduced carbon footprint, and superior light quality in all areas of lighting needs. The vendor is willing to work with the hotels on incentives or other approaches to assist in implementing the program.

- **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. EcoGreen Award is a national program providing bulb technology information, sources, and conversion/maintenance tools for your 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. www.EcoGreenAwards.com

RestaurantLights.com
We specialize in providing electronic table and mood lighting along with high efficiency replacement lamping facility wide. We carry over 8,000 candle, fixture and accessories with easy online tools to design your own lighting. EcoGreen Awards™ criteria requires replacement of flame candles to environmentally friendly electronic versions to reduce the soot contaminates, excessive heat output and fire safety issues.
http://www.restaurantlights.com/catalog/default.php?cPath=49

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 http://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 under the following brand names:

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, very low purchase price and operates up to 200 hrs. 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 our product, the vendor representatives request 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 whoever manages lighting in the facility.

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

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

- **Water Energy/ Green Solution Team**

This vendor has developed a Green Laundry System that can greatly reduce the amount of water and energy needed to provide superior linen care. Since neither of the two hotels participating in this study has internal laundry facilities, it is likely that this product is not applicable.

- **Well-Tech Wellness Products**

This vendor provides personal care products that are considered organic, natural, or green. Information about the environmental and economic benefits of our products is available on the website. Specifically, they claim that they can substantiate cost savings because of concentrated formulas and also provide information regarding the savings to landfills, carbon dioxide emissions, etc. The vendor is offering an affordable membership rate to be able to offer products at significant savings. Education and training for staff regarding product usage, etc., would be provided at no cost.

- **Winsulator**

This vendor provides a window product that reduces energy consumption and insulates against noise. The vendor provided several scientific studies that have shown environmental and

economic benefits. As far as donations, the vendor is willing to provide financial incentives to help depending on the size/scope of the pilot projects.

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 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.

A copy of the original assessment report provided by Karen Moore is found in the appendix.

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 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, it could not be determined if low flow faucet aerators (x < 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.

A copy of the original assessment report provided by Karen Moore is found in the appendix.

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.

Water Conservation

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). 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.

The Raleigh averages 810 ± 78 kgal/month inside the building over the period from October 2006 to January 2008. An additional 170 ± 69 kgal/month is used for irrigation of the grounds during the same time period. 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).

The Standard averages 347 ± 77 kgal/month inside the building over the period from December 2006 to January 2008. An additional 66 ± 36 kgal/month is used for irrigation of the grounds during the same time period. 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).

The water consumption data for both hotels is plotted in Figure 1. It is interesting to note that the Raleigh (Table 2) is using double the amount of water compared to the Standard (Table 3); 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 $210 per month, 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.

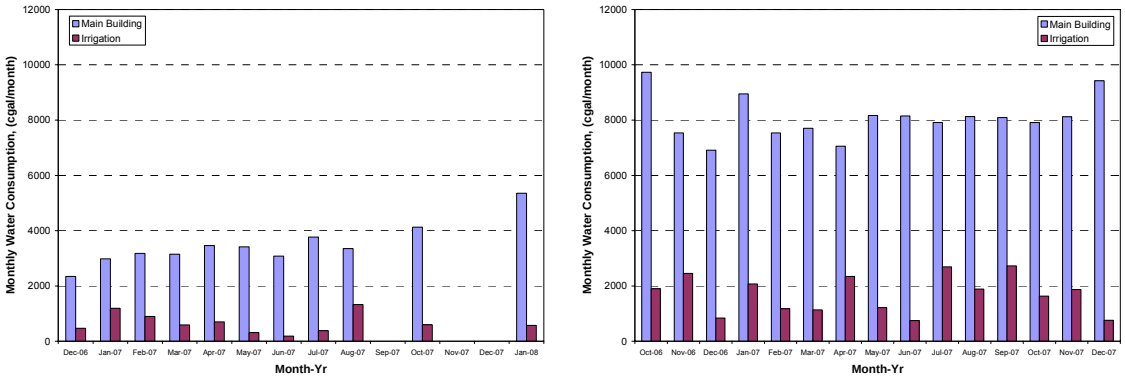

Figure 1. Water consumption data for the Standard Hotel (left) and the Raleigh Hotel (right).

Table 2. Water consumption statistics for the Raleigh Hotel.

	02044639 Building			09904238 Irrigation and Pool								
Month	**Current**	**Previous**	**Usage**	**Current**	**Previous**	**Usage**	**Sewer**	**Storm**	**Water**	**Wstimp**	**Penalties**	**Total**
10/10/2006-11/13/2006	237911	228181	9730	191144	189246	1898	$4,135.25	$498.80	$3,244.21	$40.00	$ 567.12	$ 8,485.38
11/13/2006-12/11/2006	245447	237911	7536	193595	191144	2451	$3,202.80	$498.80	$2,786.37	$40.00	$ -	$ 6,527.97
12/11/2006-1/10/2007	252354	245447	6907	194434	193595	839	$2,935.48	$498.80	$2,161.13	$40.00	$ 652.79	$ 6,288.20
1/10/2007-2/13/2007	261302	252354	8948	196505	194434	2071	$3,802.90	$498.80	$3,074.30	$40.00	$ 563.54	$ 7,979.54
2/13/2007-3/13/2007	268835	261302	7533	197679	196505	1174	$3,201.53	$498.80	$2,429.26	$40.00	$ 579.38	$ 6,748.97
3/13/2007-4/10/2007	276538	268835	7703	198815	197679	1136	$3,273.78	$498.80	$2,466.08	$40.00	$ -	$ 6,278.66
4/10/2007-5/09/2007	283591	276538	7053	201162	198815	2347	$2,997.53	$498.80	$2,622.60	$40.00	$ -	$ 6,158.93
5/09/2007-6/11/2007	291760	283591	8169	202381	201162	1219	$3,471.83	$498.80	$2,619.25	$40.00	$ -	$ 6,629.88
6/11/2007-7/11/2007	299910	291760	8150	203127	202381	746	$3,463.75	$498.80	$2,481.98	$40.00	$ -	$ 6,484.53
7/11/2007-8/10/2007	307820	299910	7910	205818	203127	2691	$3,361.75	$498.80	$2,957.68	$40.00	$ -	$ 6,858.23
8/10/2007-9/11/2007	315945	307820	8125	207704	205818	1886	$3,453.13	$498.80	$2,793.07	$40.00	$ -	$ 6,785.00
9/11/2007-10/15/2007	324033	315945	8088	210430	207704	2726	$3,987.38	$498.80	$3,492.92	$40.00	$ -	$ 8,019.10
10/15/2007-11/13/2007	331942	324033	7909	212059	210430	1629	$3,899.14	$498.80	$3,080.78	$40.00	$ 801.91	$ 8,320.63
11/13/2007-12/11/2007	340061	331942	8119	213930	212059	1871	$4,002.67	$498.80	$3,226.77	$40.00	$ -	$ 7,768.24
12/11/2007-1/10/2008	349483	340061	9422	214691	213930	761	$4,645.05	$498.80	$3,289.11	$40.00	$ -	$ 8,472.96
Averages			8087 ± 780 cgal			1696 ± 688 cgal			$2,848.37		$ 210.98	$ 7,187.08

Table 3. Water consumption statistics for the Standard Hotel.

	02043899 Irrigation and Pool			02044653 Building								
Month	**Current**	**Previous**	**Usage**	**Current**	**Previous**	**Usage**	**Sewer**	**Storm**	**Water**	**Wstimp**	**Penalties**	**Total**
12/12/2006-1/11/2007	28291	27824	467	40215	37869	2346	$ 2,252.08	$ 353.80	$ 1,608.71	$ 30.00		$ 4,244.59
01/11/2007-02/14/2007	29482	28291	1191	43194	40215	2979	$ 2,686.86	$ 353.80	$ 4,244.59	$ 30.00	$ 424.46	$ 7,315.25
02/14/2007-03/13/2007	30376	29482	894	46374	43194	3180	$ 2,667.30	$ 353.80	$ 2,000.43	$ 30.00		$ 5,051.53
03/13/2007-04/10/2007	30967	30376	591	49525	46374	3151	$ 2,645.63	$ 353.80	$ 1,901.67	$ 30.00		$ 4,931.10
04/10/2007-5/10/2007	31665	30967	698	52985	49525	3460	$ 2,743.38	$ 353.80	$ 1,995.69	$ 30.00		$ 5,122.87
05/10/2007-06/13/2007	31,978	31665	313	56402	52985	3417	$ 2,694.93	$ 353.80	$ 1,856.47	$ 30.00		$ 4,935.20
06/13/2007-07/12/2007	32165	31,978	187	59484	56402	3082	$ 2,418.25	$ 353.80	$ 1,639.68	$ 30.00	$ 493.52	$ 4,441.73
07/12/2007-08/14/2007	32549	32165	384	63254	59484	3770	$ 2,970.33	$ 353.80	$ 2,057.07	$ 30.00		$ 5,411.20
08/14/2007-9/12/2007	33876	32549	1327	66604	63254	3350	$ 2,586.98	$ 353.80	$ 2,068.50	$ 30.00	$ 541.12	$ 5,580.40
09/12/2007-10/16/2007												
10/16/2007-11/14/2007	35078	34481	597	74740	70614	4126	$ 3,578.69	$ 353.80	$ 2,537.49	$ 30.00		$ 6,499.98
11/14/2007-12/??/2007		35078			74740							
12/??/2007-01/11/2008	37574			84259								
01/11/2008-02/12/2008	38147	37574	573	89615	84259	5356	$ 5,530.97	$ 353.80	$ 3,808.82	$ 30.00	$ 865.50	$ 10,589.09
Averages			657 ± 355 cgal			3474 ± 770 cgal			$ 2,338.10		$ 581.15	$ 5,829.36

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.

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.

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 4). 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 5). 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 4. 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 5. 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

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 neither has 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. Both hotels participating in the study have unique placards to inform guests of the linen reuse policy (Figure 2). 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.

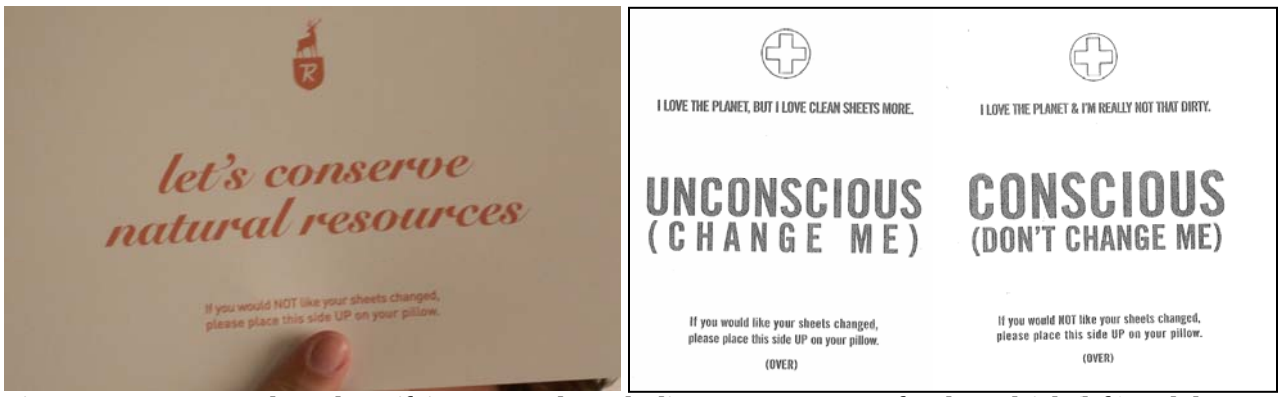

Figure 2. Guest room placards notifying guests about the linen reuse program for the Raleigh (left) and the Standard (right).

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 3) and the Standard (Figure 4) have modest laundry facilities that appear to have newer appliances.

Figure 3. Laundry facilities on site at the Raleigh Hotel.

Figure 4. Laundry facilities on site at the Standard Hotel.

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.

Low Flow Fixtures

Regarding low flow fixtures, specifically 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 than1.6 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 6. 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 6. 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 and Aerators. 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 7.

Table 7. 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 $3.00 a piece, or much less if purchased in bulk, although many utilities 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 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.

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.

Showerheads and Bath Tub 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 8.

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 8. 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.

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.

The Raleigh is replacing the central chiller system with a similar design by Evapco Cooling Systems (Figure 11).

Figure 11. 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 12). The electrical controls may also be replaced or refurbished.

Figure 12. Current state of disrepair of the Raleigh roof chiller unit. 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 are available in the appendix. It is likely that more eco-friendly products can be substituted for the manufacturer recommended chemical formulas.

Individual room units are heat pump systems. A typical unit label is shown in Figure 13. It is likely that the Raleigh will consider phasing out heat pump systems in favor of other technologies including split type or PTAC units.

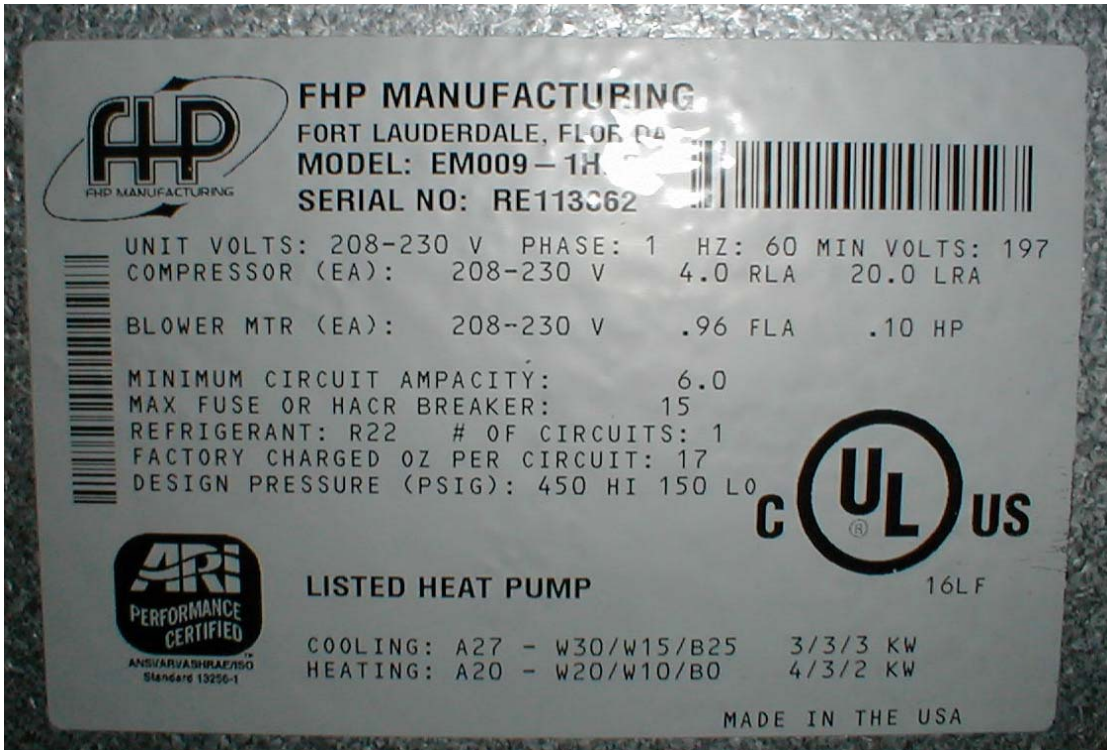

Figure 13. Typical heat pump unit label from the Raleigh.

Figure 14. Typical heat pump unit in one of the Raleigh guestrooms.

The Standard 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 15. Air-cooled chiller heat-exchanger roof mounted HVAC unit at the Standard.

Irrigation/Landscaping

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.

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). 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).

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.

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.

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.

6. **Employ the most efficient irrigation methods**. 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.

7. **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.

8. **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.

9. **Metering**. Irrigation systems also can be metered and set to deliver a specified amount of water.

10. **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.

11. **Reduce stormwater runoff.** 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.

12. **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.

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 9. 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 9. 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 16. Example of plant species in the outdoor pool bar area of the Raleigh.

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

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:

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

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 17) and the Standard (Figure 18) 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 17. New pool filtration and disinfection equipment for the outdoor pool and water features at the Raleigh.

Figure 18 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 19). 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. The sewage leak should also be addressed (Figure 20). The Standard has a working water softening system (Figure 21). 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 19. 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 20. 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 21. Water softening system at the Standard (left), and leaky line from the wall (right).

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.

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

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 22. 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 10, Table 11). Some of the most common items in the guest rooms are shown in Figure 23, Figure 24, Figure 25, and Figure 26.

Figure 23. Examples of electronics and appliances in a typical guest room at the Raleigh Hotel.

Figure 24. More examples of electronics and appliances in a typical guest room at the Raleigh Hotel.

Figure 25. Examples of electronics and appliances in a typical guest room at the Standard Hotel.

Figure 26. 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 27. Back of the house office areas in the Raleigh Hotel.

Figure 28. Back of the house office printers in the Raleigh Hotel.

Figure 29. Back of the house office areas in the Standard.

Table 10. List of appliances and electronics for the Raleigh Hotel, by area.

Raleigh Area	Appliance Type	Make	Model Number	QTY	Energy Star?
Housekeeping	Washer	Continental Girbau	L1075		
	Dryer	MaxiDry	CHD75		
Pool Bar	Dishwasher	Ecolab			
	Coolers	GE	1-ES6-GE		
	Ice Machine	Hoshizaki			
Kitchen	Dishwasher	Ecolab	ES4000		
	Handsink				
	Coffee Brewer	Bunn Dual	Dual 120/208v		
	Oven	Jade Range	10218771JT		
	Espresso	Expobar			
	Sandwhich Maker	Star Pro-Max			
	Refrigerator	Continental	1RSE-SS-HD		
	Coolers (3)	TRUE	TSSO-60-24M-B		
Martini Bar	Sink	Beverage Air			
	Coolers	TRUE	TBB-24-48S		
Patio Bar	Cooler				
Pool Grill	Coolers	Delfield			
	Hand sink				
	Oven				
	Fryer	DCS	DCS-FSF-40L		
	Refrigerator	Delfield	SRRI-S		
	Freezer	Amana			
Downstairs Kit	Walk-in Cooler	American Panel	FW347711TWL		
	Oven	Rational			
	Pastry Cooler	Traulson	RLT232DUT_HHS		
	Cooler	NSF	D045329		
	Ice Machine	Hoshizaki			
Rooms	TV	Philips			
	Mini Bar Fridge				
	Blow Dryers				
	DVD Player	Philips			
	Radio	Nakomich Soundspacel			
	iHome				
	Ceiling fan				
Offices	Computer				
	Copier				
	Scanner				

Table 11. List of appliances and electronics for the Standard Hotel, by area.

Standard Area	Appliance Type	Make	Model Number	QTY	Energy Star?
Housekeeping	Washer	Continental			
	Dryer	Maxi-Dry	CH D75		
Pool Bar	Dishwasher				
	Coolers				
	Ice Machine				
Kitchen	Dishwasher	Ecolab	WH-44		
	Handsinks (3)	Advance Tabco	7-ps-80		
	Coffee Brewer	Bunn	CWTF15		
	Oven	Rational - Rankin Deluxe	CM102		
	Espresso	Fiorenzato	CE 0035		
	Sandwhich Makers (3)	Star Pro Max			
	Refrigerator	TRUE	T-23		
	Coolers (3)	American Panel	FW 3677 LLTNWL		
Pool Grill	Coolers				
	Handsink				
	Oven	Bakers Pride - Alto Shaw 500-30			
	Fryer				
	Refrigerator	True T-23			
	Freezer	Master B&H			
Rooms	TV				
	Mini Bar Fridge				
	Blow Dryers				
Offices	Computer				
	Air Purifier				
	Printer				
	Printer				
	Copier				
	Scanner				

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 12 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 12. 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 30), so they are an excellent candidate for replacement. The Standard Hotel also does not currently use programmable thermostats (Figure 31).

Figure 30. The Raleigh Hotel guest rooms do not have programmable thermostats.

Figure 31. 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 13 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 13. 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%

In both the two participating hotels, timer lighting (Figure 32) and some limited sensor lighting (Figure 33) is available.

Figure 32. Lighting timer in the Raleigh (left) and the Standard (right).

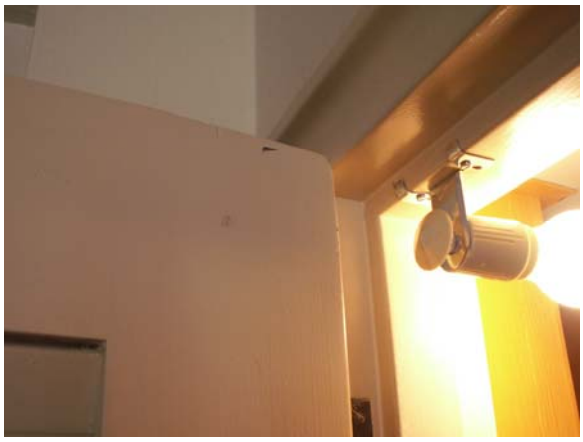

Figure 33. Closet light sensor at the Raleigh.

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 34. 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 35.

Figure 35. 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 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 14 and Table 15 by analyzing the lighting stockroom areas (Figure 36) and conducting a visual inspection of the facilities.

Figure 36. Lighting inventory for the Raleigh.

Table 14. 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 15. 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 are to be left on 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.

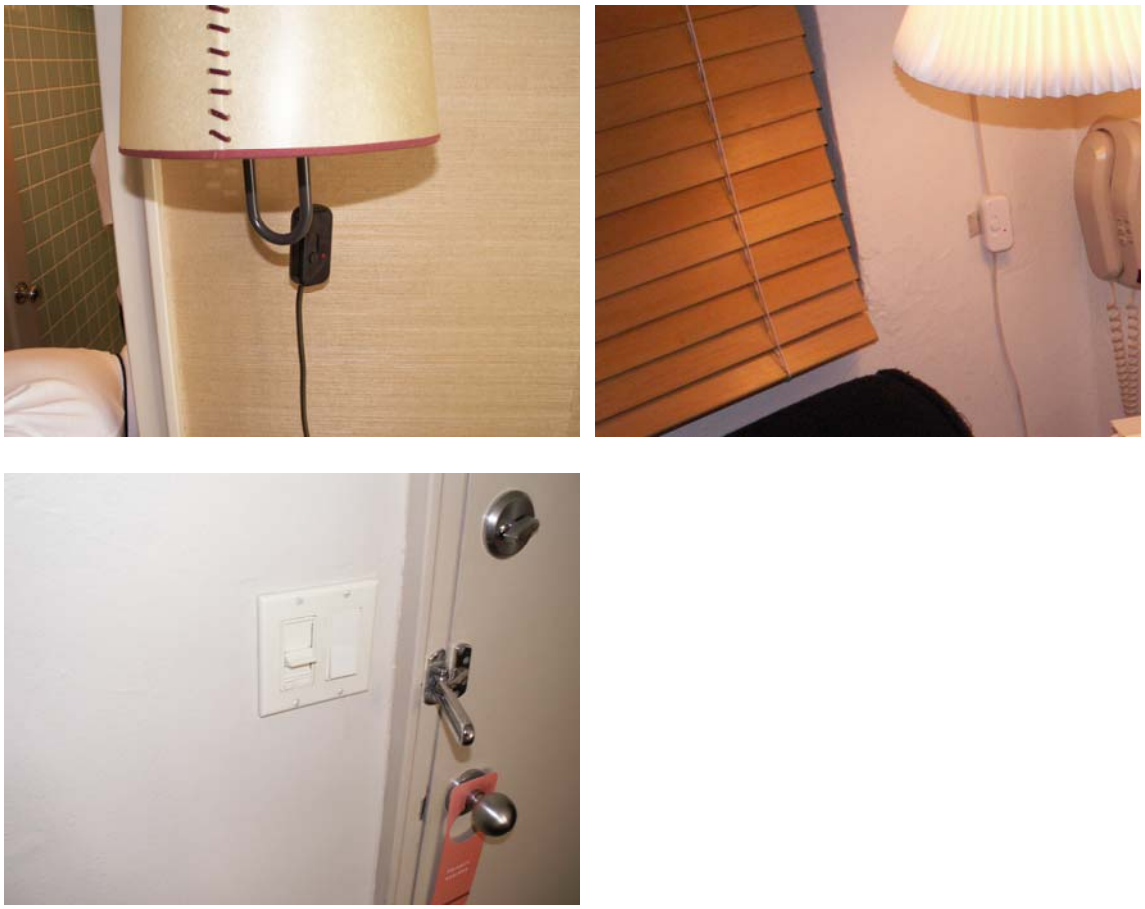

Figure 37. Dimmer switches in the guest rooms of the Raleigh (Left) and the Standard (Right).

A company called "Wattstopper" offers an ultrasonic sensor (UW-200), which also has delighting 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.

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

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

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 38) and the Standard (Figure 39 and Figure 40) 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 jalocy windows.

Figure 38. Typical window construction in the Raleigh Hotel.

Figure 39. The Standard jalocy windows with visible condensation.

Figure 40. 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).

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. 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 41). 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 41. 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 42), sealing, and cleaning.

Figure 42. 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.

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

Waste Reduction

In the short-term, to successfully reduce waste disposal from these areas, an audit should be 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. Thus, a waste audit will be performed on both participating hotels in order 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 possibility of composting kitchen residue was asked to be investigated.

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.

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 18 months. This analysis is still in progress and will be reported in the following progress report.

Figure 43. 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 44.

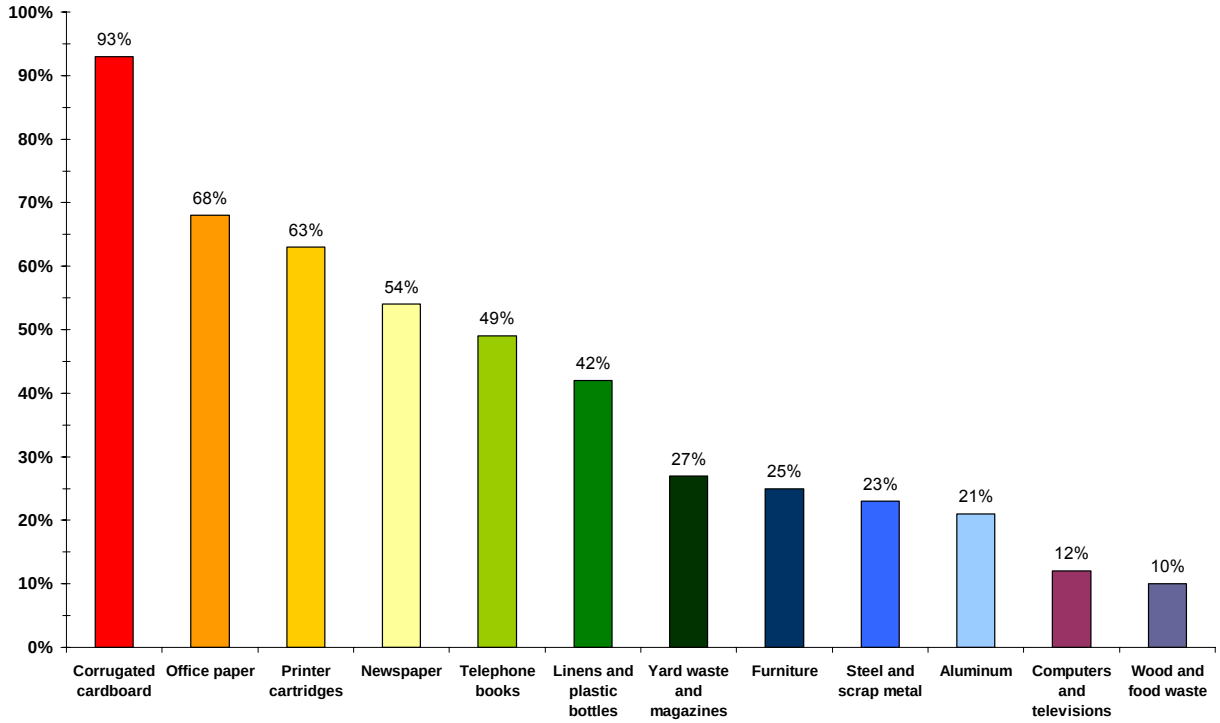

Figure 44. Breakdown of recycled materials from Florida hotels, adapted from (SWIX 2000).

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 45, 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 46).

Figure 45. Evidence of voluntary participation in the office paper recycling program at the Raleigh (left) and the Standard (right)

Figure 46. Compliance is still not at acceptable levels at the Raleigh.

Figure 47. Evidence of commingling of waste materials that should be source separated at the Raleigh.

Figure 48. 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)
- **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 officer 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, #3, #4, #5, #6, #7 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 49), 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 49. Spent oil collection facilities at the Raleigh (left) and the Standard (right).

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 50. 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 51, the Standard is not currently purchasing many products with post-consumer recycled content.

Figure 51. The Standard is not currently using office paper with post-consumer recycled content.

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.

Composting

Because yard and food waste make up 30% of the waste stream, some hotels have started to seriously consider composting the organic portion of their waste stream generated from the food and beverage group. 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).

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. For instance, Ecological Solutions recommends a product called BioBags available at www.biobagusa.com or www.biodegradablestore.com BioBags are made from corn, an annually renewable resource, and the BioBags are claimed to fully compost in 30-60 days in composting conditions.

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**.

Other Kitchen Waste Reduction Practices. 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. 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 52. Inventories of hazardous chemicals on site at the Raleigh.

Figure 53. 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. Some of the results are found in the appendix. 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

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).

The major areas identified for waste reduction 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.

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 54. Non-smoking room at the Standard.

Figure 55. 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 56.

Figure 56. Housekeeping cleaning chemicals at the Raleigh (left) and the Standard (right).

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 57. 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 58. 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).

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

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.

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: 73 – 79ºF (at 50% RH)
- Winter: 68.5 – 76 ºF (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 16. 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 61. 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 62. 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 63. 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 64. Painting activities generated powerful pungent odors at the Raleigh (left) and at the Standard (right).

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 65. Visible mold/mildew staining in the Standard guestrooms.

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 66), 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.

Figure 66. Signage ordered by the Standard for communicating the hotel's efforts to go green.

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

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APPENDIX

Clean air survey

1. **Obtain map/blueprints of building**
2. **Count the number of staff/job category to distribute checklists**
3. **Obtain names/contact info for outside contractors for HVAC, pest control, etc.**
    a. **Hazardous materials hotline number**
    b. **Local health department**
    c. **State health department**
    d. **Carpet cleaner**
    e. **IAQ consultant**
    f. **Mechanical systems engineer**
4. **Meet with engineering to become familiar with HVAC system operation and design**
5. **Set up a filing system for documents involving indoor environmental quality**

Ground level

- Ventilation air flow
- Outdoor air intakes free from obstruction/blockages
- No animal/bird droppings near outdoor intakes
- No dumpsters near outdoor intakes
- No painting, roofing, maintenance near outdoor intakes
- No potential sources of pollutants nearby
- No vehicle engines/idling near outdoor intakes or egress
- No exterior pesticide applications
- Roof downspouts away from building shell
- No sprinklers near building
- Clean walk-off mats at every egress
- Is outdoor air supply at least 15 cfm per person?
- Is CO_2 > 1000 ppm
- Pollen levels?

Roof

- In good repair
- Evidence of ponding
- Outdoor air intakes open at minimum setting
- Plumbing stacks >10 ft away from outdoor air intakes
- Exhaust fans operating and air flowing out
- Exhaust air outlets within 10 ft of outdoor air intakes
- Evidence of leaks in attic
- Air handler operating properly?
- Dampers operating properly?
- Fans operating properly?
- Moisture/mildew/mold near unit?
- Drain pan clean and draining?
- Coils clean?
-

Rooms

- Temperature and humidity (30-60%) settings
- Is condensation present?
- Are drafts or direct sunlight causing a problem?
- Air flowing in and out
- Supply and exhaust fans free of obstruction
- No objectionable odors
- No signs of mildew or mold
- No signs of water damage
- Clean and free of dust
- Free of evidence of pests
- Occupants report any problems

Bathrooms

- Operating exhaust fans
- All drains have traps
- Traps filled with water

Maintenance

- Odorous/hazardous chemicals used with proper ventilation and building unoccupied
- Air exhausted from chemical/custodial/waste storage areas

Combustion appliances

- Fuel odors detected
- Exhaust hoods operating
- Flue systems free of leaks, disconnections, soot, deterioration

- Soot on outside of components

Other

- If building was built before 1980, is paint inside or outside free from peeling/flaking [lead paint hazard]
- Radon measurements?

Florida Green Lodging Program

www.FloridaGreenLodging.org

Florida Atlantic University
College of Engineering & Computer Science

Green Lodging Phase 3

Daniel E. Meeroff, Ph.D.
P.D. Scarlatos, Ph.D.
Department of Civil Engineering
Laboratories for Engineered Environmental Solutions

August 15, 2007

FDEP Green Lodging Program

Overview

- What is the Florida Green Lodging Program?
  - It is a **voluntary**, **non-regulatory** program established by the FDEP to acknowledge and reward environmentally-conscious facilities in the lodging industry
  - The goal is to help Florida's lodging industry become sustainable while continually improving environmental performance

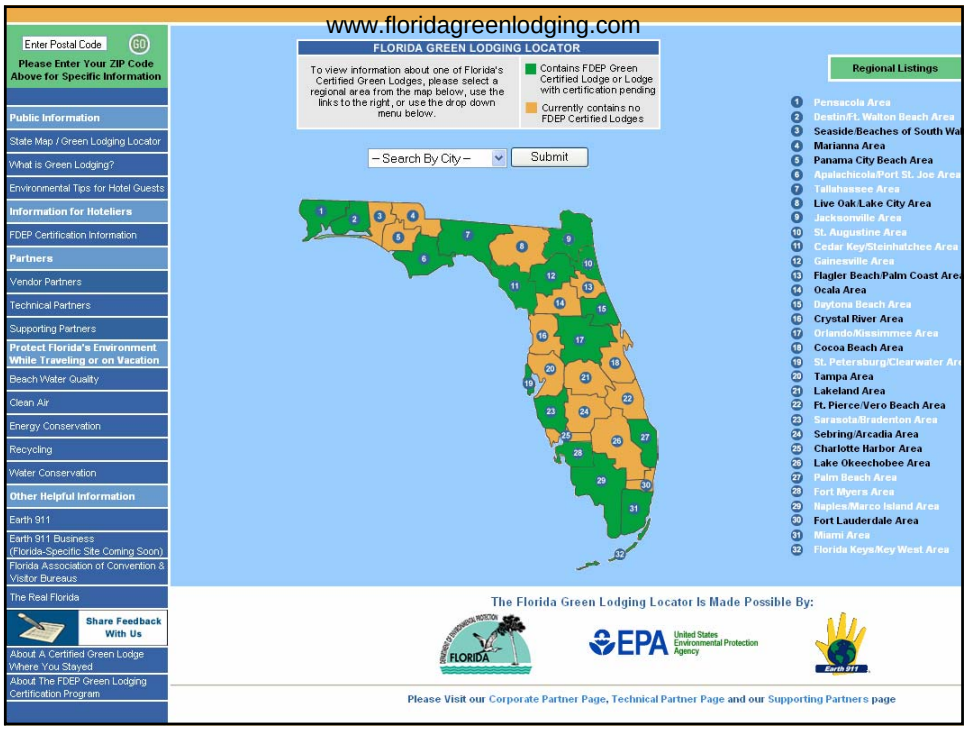
Governor Christ

- Signed Executive Order 07-126
- This applies to all 114,756 State Government employees

STATE OF FLORIDA
OFFICE OF THE GOVERNOR
EXECUTIVE ORDER NUMBER 07-126

Establishing Climate Change Leadership by Example: Immediate Actions to Reduce Greenhouse Gas Emissions from Florida State Government

3. Effective January 1, 2008 state agencies and departments under the direction of the Governor may not contract for meeting and conference space with hotels or conference facilities that have not received the DEP "Green Lodging" certification for best practices in water, energy, and waste efficiency standards, except when certified to the Governor by the responsible agency head that no other viable alternative exists..



Requirements

One Palm Certification

1. **Conduct Environmental Baseline Assessment**
   - Complete the Environmental Self-Assessment & Planning Checklist
2. **Commitment & Organization**
   - GM Support
   - Green Team
   - Environmental Compliance
3. **Core Requirements**
   - Water conservation
   - Energy minimization
   - Waste reduction
   - Clean air practices
   - Communication plan
4. **Schedule On-site Certifying Visit**

Achieve Excellence

- ## Two Palm Certification
  - **Maintain One Palm Certification Status for 1 year**
  - **Update environmental self-assessment**
  - **Develop performance improvement goals**
  - **Implement performance improvement goals**
  - **Evaluate progress**
    - *Florida Green Lodging Performance Worksheet*
      - Seasonal Effects
      - Changes in Economy
      - Effects of Occupancy Rates
  - **Schedule on-site certifying visit**

Continual Improvement

- **Three Palm Certification**
  - **Occurs when a hotel is Two Palm certified and has shown continual improvement for three consecutive years**
  - **Must maintain or improve its high level of commitment to the Florida Green Lodging program**
  - **Update environmental self-assessment**
  - **Develop new performance improvement goals**
  - **Implement new performance improvement goals**
  - **Evaluate progress**
  - **Schedule on-site certifying visit**

Numbers

- 146 Certified Green Lodges
  - Stretching from Key West to Pensacola
  - Only 12 in South Florida
  - From luxury resorts with thousands of rooms to a bed and breakfast with just seven units

Benefits for Vendors

- Free marketing
- Feature your products and services in high-end luxury boutique hotels
- Build relationships with hoteliers
- Independent third party verification of performance in a scientific study
- Instant feedback
- Results from this study will be used to further market the value of the Florida Green Lodging Program and its vendor partners, statewide

FLORIDA ATLANTIC UNIVERSITY

Phase 3 Objective

- This $121,000 research study will implement specific sustainability projects that can be implemented by Florida's Lodging Industry focus on assessing:
- **Environmental benefits**
- **Economic performance**
- **Social behavioral impacts**

FAU Study Phase 3 Approach

Collect Florida-specific data to document savings:

1. Vendor partnerships
2. Site assessment
3. Prepare project implementation plan
4. Obtain plan approval
5. Implement demonstration projects
   - Monitor and document results
   - Compile findings

Vendor Partnerships

May 8, 2008

Vendor Partners

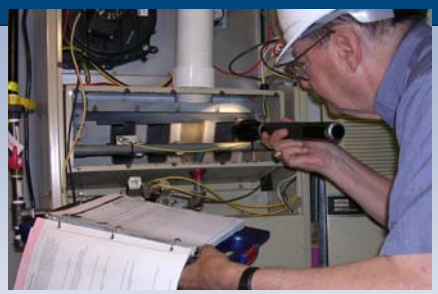
Through this public-private partnership, these Partners provide Florida's lodging industry with technical assistance, products and/or services that conserve energy, reduce water consumption, preserve the quality of air and reduce the generation of solid waste in hotels and motels across the state

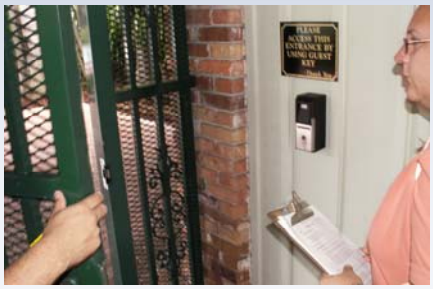
Technical Partners

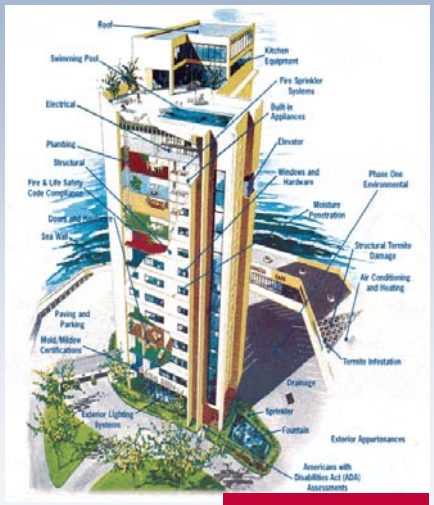
RUES Hotel Selection

The FDEP Green Lodging Certification Program's Technical Partners provide direct technical assistance to the Florida Green Lodging Certification Program and to many of the participating hotels and motels.

Site Assessment







May 12, 2008

Partner Hotels

The Standard

- Prestigious
- Luxury
- Boutique

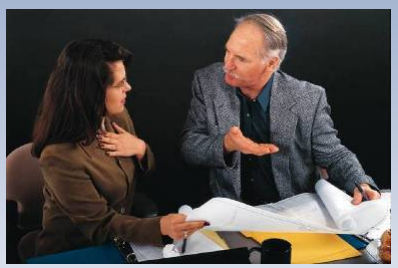
- Frequented by Celebrities

Prepare Implementation Plan

- **Working together with hotel staff, owner, flag, management company, and vendor partners**

June 15, 2008

Approve Implementation Plan

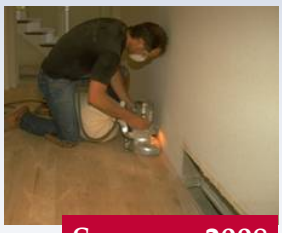


- Get everyone on board

- Obtain approval to proceed

Summer 2008

Demonstration Projects



Summer 2008

Monitor Progress

Vendor Participation

- We need the following items for the participation package:
  1. Letter of support
  2. Contact information
  3. List of applicable products, services
  4. Technical literature/product information
  5. Partnership strategy (donations, savings sharing plan, free installation, etc.)

Core Requirements

Water Conservation

- **Towel/Linen Reuse**
- **Low Flow Fixtures**
  - Faucets <2.5 gpm
  - Showerheads <2.75 gpm
  - Toilets <1.6 gpf
  - Spray Nozzles
- **Low Flow Appliances**
  - Dish Washers
  - Clothes Washers
  - Icemakers
- **Automatic Faucets**
- **HVAC Improvements**
- **Irrigation/Landscaping**

Energy Efficiency

- Energy Star Appliances
- Programmable Thermostats
- Sensor or Solar Lighting
- High-Efficiency Lighting
- Energy Management System
- Energy Recovery Ventilators
- Solar Hot Water
- Preventative Maintenance

Waste Minimization

- **Recycling**
- **Eco-Purchasing**
  - Post-Consumer Recycled Content
  - Bulk Purchasing
  - Reduced Packaging
  - Manufacturer Take-Back
  - Ink/Toner Cartridges
- **Composting**

Clean Air Practices

- Environmentally-Preferable Cleaners
- HEPA Filters
- HVAC Cleaning/Replacement
- CO_2 Monitoring
- Anti-Idling
- Alternative Fuel Vehicles

Communications

- Training materials
- Placards, videos
- Suggestion box
- Survey instruments
- Signage

Contact Us

Email: dmeeroff@fau.edu
Phone: (561) 297-2658

www.civil.fau.edu

Florida Green Lodging Program

Assessor Checklist ~~for On-site Review~~ Preliminary walk through for FAU Study (Good Candidate)

Instructions

The purpose of this form is to guide the assessor(s) through the on-site certification review process. Sections II and IV are checklists designed to compliment the guidance hotels have received previously regarding certification. Your role as an assessor is to verify that certain requirements have been met. This form must be completed during the site visit and returned to FDEP within 3 days afterwards. If you have any questions, please contact the FGL Program Office at (850) 245-8707.

SECTION I: Visit Information

Hotel Information

Name of Hotel		The Raleigh Hotel		
Address	**Street**	1775 Collins Ave		
	City	Miami Beach	**Zip Code**	33139
Main Phone Number		786-253-2222 or 415-812-9799		
Point of Contact		Lynette Sobel or Kyle Briggs		
Date of Visit		5/12/08 @ 11:30 am 104 Rms		

Assessor Information

Name of Lead Assessor	Karen Moore
Name of Asst Assessor	Hugh Smith, Dan Meroff

SECTION III: Summary of Findings

After you have completed your walk-through of the property, take a few minutes to review the findings in Section II and transfer that information to the list below. Place an ☒ to indicate that a requirement has been satisfied. If all of the requirements for a particular media have been met, place an ☒ for "Yes" next to that category. If the hotel fails to meet the minimum requirements for a particular media, please discuss with the Green Team leader or General Manager to try to resolve before indicating "No" next to that category.

Communication (Complete: ☐ Yes ☐ No)

1. All of the following communication efforts are required for certification.

   - ☐ COM-1: Application/environmental policy is available to the public upon request.
   - ☐ COM-2: Hotel staff are familiar with the hotel's environmental policy and their role in it.
   - ☐ COM-3: Green practices are discussed at staff meetings (documentation will be required such as meeting agendas or minutes).
   - ☐ COM-4: Environmental initiatives are communicated to guests and staff through such avenues as: newsletters, TV, placards in guest rooms, etc…
   - ☐ COM-5: Formal process for guests and staff to provide feedback on green practices has been established (e.g. suggestion box, survey form).

NOTES: Linen Placard - Staff not enthusiastic

Recommend: Info in Key pocket Letter for In-room Book Signage Green Notebook

Water Conservation (Complete: ☐ Yes ☐ No)

1. At minimum, three of the following water conservation efforts must be implemented for certification.

   - ☐ WC-1: Towel reuse program offered in guest rooms. NO - Need to implement
   - ☑ WC-2: Linen reuse program offered in guest rooms.
   - ☐ WC-3: Low flow faucets (that use 2.5 gallons or less per minute) in guest rooms. 2.2 gpm
   - ☐ WC-4: Low flow showerheads (that use 2.75 gallons or less per minute) in guest rooms. ??
   - ☑ WC-5: Low flow toilets (that use 1.6 gallons or less per flush) in guest rooms.
   - ☐ WC-6: Automatic faucets or toilets in public restrooms.
   - ☐ WC-7: Water efficient clothes washing machines
   - ☐ WC-8: Water efficient dish washers (that use less than 3 gallons per minute).

2. List water conservation projects implemented:

   - ☐ WC-9: Button on closet light
   - ☐ WC-10: Drip Irrigation Spray Knozzle - 1.42
   - ☐ WC-11: _____

NOTES: Dishwasher - rinse water ??

1.42 GPM Pre-rinse

Energy Efficiency (Complete: ❑ Yes ❑ No)

1. At minimum, two energy efficiency efforts must be implemented for certification.
   - ❑ EE-1: Energy Star-rated equipment (other than lighting). List: Wave Plasma TV's → Copiers
   - ❑ EE-2: Programmable thermostats. No
   - ☒ EE-3: Sensor lighting indoor/outdoor – Timers
   - ❑ EE-4: High energy efficient lighting (must be "front of house"). Describe: Kitchen
   - ❑ EE-5: Energy Management System.
   - ❑ EE-6: Support green power by doing one of the following:
     - ❑ Install renewable energy generating equipment (e.g. solar water heating system),
     - ❑ Purchase at least 5% green power through local utility, or
     - ❑ Purchase green tags (renewable energy certificates) from a green power generation source in Florida.

Recommend EnergyStar LCDs

Need to expand CFLs

2. List energy efficiency projects implemented:
   - ❑ EE-6: Double windows
   - ❑ EE-7: _____
   - ❑ EE-8: _____

CFLs in Kitchen

NOTES: Door Sensor – AC cutoff

Recommend: Close Drapes – + turn off Lights on in rooms –

Need tinted windows

Waste Reduction (Complete: ❑ Yes ❑ No)

1. All four waste reduction categories below must be implemented for certification.

   - ❑ WR-1: Provide opportunity to recycle the following materials (at least one must be available to guests):
     - ☒ WR-1a: office paper
     - ☒ WR-1b: newspaper
     - ❑ WR-1c: aluminum cans
     - ❑ WR-1d: magazines
     - ❑ WR-1e: steel cans
     - ☒ WR-1f: corrugated cardboard

Need to Expand – Employees Need training a lot of recyclables in trash Work on infrastructure Front of House Reduce one more dumpster

   - ❑ WR-2: Purchase minimum 30% post-consumer recycled content for one of the following products:
     - ❑ WR-2a: office paper
     - ❑ WR-2b: toilet tissues
     - ❑ WR-2c: paper towels
     - ❑ WR-2d: paper napkins

* Haz. Waste Storage issue * Ventilation

   - ❑ WR-3: Institute one of the following source reduction activities:
     - ❑ WR-3a: Bulk purchasing. Describe: _____
     - ❑ WR-3b: Reduced packaging. Describe: _____
     - ❑ WR-3c: Manufacturer take-back. Describe: _____

   - ❑ WR-4: Use recyclable or refillable ink cartridges and toner cartridges

Uses Waste Management

continued...

* Need help w/ fluorescent recycling *

Waste Reduction (continued)

2. List additional waste reduction projects implemented:

- ❑ WR-5: _____
- ❑ WR-6: _____
- ❑ WR-7: _____

NOTES:

Food made for staff

Clean Air Practices (Complete: ❑ Yes ❑ No)

1. All of the following clean air practices must be implemented for certification.

- ❑ CA-1: Use environmentally preferable cleaners.
- ❑ CA-2: Use environmentally preferable filters Minimum Efficiency Rated Value (MERV 8).
- ❑ CA-3: Clean all air handler units and coils at least annually; follow a preventive maintenance schedule and keep a record of activities.

2. List additional clean air practices implemented:

Chlorine

- ❑ CA-4: Ecolab Laundry
- ❑ CA-5: _____
- ❑ CA-6: _____

NOTES: Ecolab

Reusable dinnerware

No guest Room - Ventelation

* Glass + Plastic generated

Pool layer information

Drip irrigation once / wk

* Work on Cleaning AC units + Cooling tower - antrac

* Work w/ Ecolab on training *

Switch to Ecolab Greenline - Microfiber Clothes - Steam

❑ **SECTION IV:** .Passed Yes_____ NO_____

Notes/Comments:

Need Staff + management commitment
Many energy opportunities
Did not check Room ACs or Cooling tower
Check on MERV 8 filters

SECTION V: Assessor Signatures

Did you meet with the General Manager at any time during this visit to discuss their participation in the Florida Green Lodging Certification Program?

❑ Yes If no, explain: _____

Please list the other Green Team staff you spoke with during your visit.

On-site Assessor Review

To the best of my knowledge and abilities, the hotel property was found to have the elements of a Florida Green Lodge as indicated in this checklist. No false or misleading information is presented in this report.

_____ _____
Signature of Lead Assessor Date

_____ _____
Signature of Assistant Assessor Date

Return report to:

Florida Department of Environmental Protection
ATTN: Green Lodging Program
2600 Blair Stone Road, MS 4570
Tallahassee, FL 32399-2400
Karen.S.Moore@dep.state.fl.us

Green LODGING FLORIDA

Florida Green Lodging Program

Assessor Checklist for ~~On-site Review~~ FAU Walk-through

Instructions

The purpose of this form is to guide the assessor(s) through the on-site certification review process. Sections II and IV are checklists designed to compliment the guidance hotels have received previously regarding certification. Your role as an assessor is to verify that certain requirements have been met. This form must be completed during the site visit and returned to FDEP within 3 days afterwards. If you have any questions, please contact the FGL Program Office at (850) 245-8707.

SECTION I: Visit Information

Hotel Information

Name of Hotel		The Standard		
Address	**Street**	40 Island Avenue		
	City	Miami Beach	**Zip Code**	33139
Main Phone Number		305-807-33457 or 673-1717		
Point of Contact		Mark Zeitouni		
Date of Visit		5/12/08 @ 4:30 pm		

Assessor Information

Name of Lead Assessor	Sheileen Smith
Name of Asst Assessor	Karen Moore

SECTION III: Summary of Findings

After you have completed your walk-through of the property, take a few minutes to review the findings in Section II and transfer that information to the list below. Place an ☒ to indicate that a requirement has been satisfied. If all of the requirements for a particular media have been met, place an ☒ for "Yes" next to that category. If the hotel fails to meet the minimum requirements for a particular media, please discuss with the Green Team leader or General Manager to try to resolve before indicating "No" next to that category.

Communication (Complete: ☐ Yes ☐ No)

1. All of the following communication efforts are required for certification.

   - ☐ COM-1: Application/environmental policy is available to the public upon request.
   - ☐ COM-2: Hotel staff are familiar with the hotel's environmental policy and their role in it.
   - ☐ COM-3: Green practices are discussed at staff meetings (documentation will be required such as meeting agendas or minutes).
   - ☐ COM-4: Environmental initiatives are communicated to guests and staff through such avenues as: newsletters, TV, placards in guest rooms, etc…
   - ☐ COM-5: Formal process for guests and staff to provide feedback on green practices has been established (e.g. suggestion box, survey form).

NOTES: Work on staff training + commitment
Green Book
Incentives to staff

Water Conservation (Complete: ☐ Yes ☐ No)

1. At minimum, three of the following water conservation efforts must be implemented for certification.

   - ☐ WC-1: Towel reuse program offered in guest rooms. – Need to implement
   - ☑ WC-2: Linen reuse program offered in guest rooms.
   - ☐ WC-3: Low flow faucets (that use 2.5 gallons or less per minute) in guest rooms.
   - ☐ WC-4: Low flow showerheads (that use 2.75 gallons or less per minute) in guest rooms. ?
   - ☑ WC-5: Low flow toilets (that use 1.6 gallons or less per flush) in guest rooms.
   - ☐ WC-6: Automatic faucets or toilets in public restrooms.
   - ☐ WC-7: Water efficient clothes washing machines
   - ☐ WC-8: Water efficient dish washers (that use less than 3 gallons per minute).

2. List water conservation projects implemented:

   - ☐ WC-9: _____
   - ☐ WC-10: _____
   - ☐ WC-11: _____

NOTES: Air Cooled Chiller - Heat xchang
Salt Pool

Energy Efficiency (Complete: ❑ Yes ❑ No)

1. At minimum, two energy efficiency efforts must be implemented for certification.
   - ❑ EE-1: Energy Star-rated equipment (other than lighting). List: _____
   - ❑ EE-2: Programmable thermostats. NO
   - ❑ EE-3: Sensor lighting indoor/outdoor. timers / motion sensor in maid closets
   - ❑ EE-4: High energy efficient lighting (must be "front of house"). Describe: Need
   - ❑ EE-5: Energy Management System.
   - ❑ EE-6: Support green power by doing one of the following:
     - ❑ Install renewable energy generating equipment (e.g. solar water heating system),
     - ❑ Purchase at least 5% green power through local utility, or
     - ❑ Purchase green tags (renewable energy certificates) from a green power generation source in Florida.

2. List energy efficiency projects implemented:
   - ❑ EE-6: Setbacks for Spa area
   - ❑ EE-7: _____
   - ❑ EE-8: _____

NOTES: Tankless Hot Water Heater - gas

Waste Reduction (Complete: ❑ Yes ❑ No)

1. All four waste reduction categories below must be implemented for certification.

   - ❑ WR-1: Provide opportunity to recycle the following materials (at least one must be available to guests):
     - ❑ WR-1a: office paper
     - ❑ WR-1b: newspaper
     - ❑ WR-1c: aluminum cans
     - ❑ WR-1d: magazines
     - ❑ WR-1e: steel cans
     - ☑ WR-1f: corrugated cardboard

     Need to expand - Need info. to guest Set up infrastructure for guests (Waz waste?) a lot of opportunity

   - ❑ WR-2: Purchase minimum 30% post-consumer recycled content for one of the following products:
     - ❑ WR-2a: office paper
     - ❑ WR-2b: toilet tissues
     - ❑ WR-2c: paper towels
     - ❑ WR-2d: paper napkins

     Waste Management - Numerous garbage dumpsters Many Pickups (6 containers) 800 / container

   - ❑ WR-3: Institute one of the following source reduction activities:
     - ❑ WR-3a: Bulk purchasing. Describe: _____
     - ❑ WR-3b: Reduced packaging. Describe: _____
     - ❑ WR-3c: Manufacturer take-back. Describe: _____

     Paper - 2 pickups 1 wk

   - ❑ WR-4: Use recyclable or refillable ink cartridges and toner cartridges

     Comingles - 3 90-gal 125 / month

continued...

Need Fluorescent recycling

Waste Reduction (continued)

2. List additional waste reduction projects implemented:

   - ❑ WR-5: _____
   - ❑ WR-6: _____
   - ❑ WR-7: _____

NOTES:

Clean Air Practices (Complete: ❑ Yes ❑ No)

1. All of the following clean air practices must be implemented for certification.

   - ❑ CA-1: Use environmentally preferable cleaners.
   - ❑ CA-2: Use environmentally preferable filters Minimum Efficiency Rated Value (MERV 8).
   - ❑ CA-3: Clean all air handler units and coils at least annually; follow a preventive maintenance schedule and keep a record of activities.

2. List additional clean air practices implemented:

   - ❑ CA-4: _____
   - ❑ CA-5: _____
   - ❑ CA-6: _____

NOTES:

Air Cooled Chiller
Replacing Roofing

Evidence of Mold - (per Dan)
Room smelled musky - Suspect AC units in Rooms
Work w/ Ecolab on Cleaning (green) products
Use Steam!
Need MERV 8 Filters

☐ **SECTION IV:** .Passed Yes_____ NO_____

Notes/Comments:

Great Opportunity for Energy Conservation (ERVs)
AC / Lighting
Cleaning
Expand Recycling
Communication - (air)

SECTION V: Assessor Signatures

Did you meet with the General Manager at any time during this visit to discuss their participation in the Florida Green Lodging Certification Program?

☐ Yes If no, explain: _____

Please list the other Green Team staff you spoke with during your visit.

On-site Assessor Review

To the best of my knowledge and abilities, the hotel property was found to have the elements of a Florida Green Lodge as indicated in this checklist. No false or misleading information is presented in this report.

_____ _____
Signature of Lead Assessor Date

_____ _____
Signature of Assistant Assessor Date

Return report to:

Florida Department of Environmental Protection
ATTN: Green Lodging Program
2600 Blair Stone Road, MS 4570
Tallahassee, FL 32399-2400
Karen.S.Moore@dep.state.fl.us

Green LODGING FLORIDA

The Standard

Florida Green Lodging Program

Environmental Self-Assessment and Planning Checklist

Introduction

The environmental self-assessment and planning checklist will help you evaluate your facility's environmental performance, identify opportunities for improvements, and enhance your environmental program. The guide includes questions on how your facility manages solid waste, hazardous waste, energy, indoor air quality, and water. The Florida *Green Lodging* Program (FGLP) designed the questions to encourage you, and your colleagues, to think about new ways to manage your facility and identify ways to reduce your environmental impacts.

This self-assessment guide asks for baseline data including annual solid waste disposal, energy use, and water consumption. Documenting this data will help you prioritize actions. Tracking changes in the data will enable you to document results and report successes. If you have never done a facility wide assessment, completing this assessment should be the first thing you do prior to starting any environmental initiative. This data will be crucial for identifying areas for action, as well as for measuring success.

The assessment form is broken into sections that are designed to help you assess the current state of your facility. You may also find that different sections may need to be completed by staff in different departments in your hotel/motel; this is a great way to get them involved in the process!

Finally, this checklist can help you set achievable goals and prioritize key action plans to significantly improve your facility's environmental performance.

Thanks for being a leader!

SECTION I: Commitment to Environmental Performance

Current Practices	
What kind of help can you expect? List the potential members of your Green Team: ☐ Mark Zeiler ☐ Lanette Sobel ☐ Erika Frickerling ☐ Vanessa Lane ☐ Paul Green ☐ _____ ☐ _____	*A "Green Team" is responsible for ensuring that all the environmental practices, in which the hotel is participating, are being performed timely and correctly. A "Green Team" is usually comprised of individuals from each area of the hotel, namely: Housekeeping, Engineering, Kitchen, Front Office, Maintenance, and Upper Management.*
Are your environmental efforts visibly communicated to the guests, staff, shareholders, vendors and to the public? ☐ Yes ☒ No If Yes, please specify which communication efforts you are using: ☐ Application/environmental policy must be available to the public ☐ Staff know where policy is located ☐ Convey environmental initiative to guests through newsletters, TV, or placards in guest room ☐ Ability to receive feedback ☐ Staff meetings ☐ Document new employee training ☐ Other _____	*This is to inform the guests and public, which environmentally conscious programs the property is currently following. It also lets guest know why certain things are being done or not done. This is usually communicated by: signs in the lobby, in-room collateral, direct mail, website, annual reports, and advertising.*
Is your property currently certified by any of the following programs? ☐ Energy Star ☐ Green Seal ☐ Green Globe ☐ Waste Wise ☐ Buy Recycled Business Alliance ☐ Water CHAMPS Other _____	
NOTES and other observations:	

SECTION II: Water Conservation

Baseline Data	
Calendar year: 2007	Water used = _____ gallons Wastewater generated = _____ gallons

Current Practices	
Have you had a Water Assessment done within the past 24 months? ☒ Yes ☒ No If so, when within 7 days	*Refer to BMPs for further information.*
Have you recently checked and adjusted the following equipment to maximize efficiency? Boilers/Cooling Towers: (Timer) ☒ Yes ☐ No If so, when _____ Ice Machines: ☐ Yes ☒ No If so, when _____ Hot Water Heater: ☐ Yes ☒ No If so, when _____ Dishwashers: ☐ Yes ☒ No → Booster Pump to control temp. If so, when _____ Washing Machines: ☒ Yes ☐ No If so, when _____ } only at night	*Dishwashers can utilize Low Flow Pumps, Energy Efficient Boosters, and Counter Current Rinsing to recycle final rinse water.* *By increasing the spin cycle, you can decrease drying time by as much as half.*

SECTION II: Water Conservation *(continued)*

Are you currently practicing either the Linen or Towel Reuse Options? Linen Reuse Option: ☒ Yes ☐ No Towel Reuse Option: ☐ Yes ☒ No	
Do you currently use Reclaimed Water for any of the following purposes? ☐ Irrigation ☐ Cooling Towers ☐ Toilets ☐ Laundry N/A If reclaimed water is recycled: _____ gallons _____% of total water	*Reclaimed Water is waste water that is used for other purposes.*
Are you currently practicing Xeriscaping on the property grounds? ☒ Yes ☐ No	*Xeriscaping is the practice of using Florida Native plants and the removal of exotics. The theory is that plants native to Florida are drought resistant and therefore need less water.*
Applicable regulations? ☐ Stormwater ☐ Pretreatment ☐ Wastewater Permit	
NOTES and other observations:	

SECTION III: Energy Efficiency

Baseline Data	
Calendar year: _____	Total energy use = _____ kwh

Current Practices	
Do you currently use an Energy Management System (EMS)? ☒ Yes ☐ No Ghost room ~~as~~ less when not used (room check)	*An EMS system is a PC based program that helps collect, analyze, and display data collected from the property's major energy consuming appliances. It will help you make choices of when and how long to run certain equipment.*
Do you currently take advantage of "Time of Day" rates by using appliances during off-peak hours? ☒ Yes ☐ No Washing Machines	*Most Utility providers offer lower rates for off-peak hours. It is wise to run major energy consuming electronics during the hours of 8:00 pm and 6:00 am.*
Do you currently have a Preventative Maintenance Plan in place for all of the property's major appliances? ☒ Yes ☐ No	*It is cost effective to set up and follow a preventive maintenance plan (PMP) for all of the property's costly appliances. A PMP should contain things from annual tune-ups to replacing air filters.*
Are you currently using any of the following Energy Star Rated Appliances or Equipment? ☒ Hot Water Heaters ☒ HVAC – chill water system ☒ Washing Machines ☒ Clothes Dryer ☒ Copiers ☒ Monitors ☒ Televisions ☒ Dishwashers (chef) ☒ Refrigerators ☒ Freezers ☒ Water Coolers ☐ Other: _____ Cafeteria, gut room	Tankless heater gas
Are you currently using a programmable thermostat program? ☒ Yes ☐ No ☒ Yes, manually	*A programmable thermostat program helps ensure that unoccupied rooms revert back to a predetermined temperature. Some include a motion sensor to determine if the room is occupied.* turns on closet

SECTION III: Energy Efficiency *(continued)*

Are you currently using High Efficiency Lighting? ☐ Yes ☒ No If yes, please specify the percentage of high efficiency lighting in each of the following areas? Guest Rooms _____ Outdoor Lighting _____ 24/7 Lighting _____ Back of House Lighting _____ Emergency Exit Signs _____	*High efficiency lighting is compact fluorescent bulbs that are 66% - 75% more efficient than its comparable incandescent, lasts 8 times longer, and does not emit lost energy through heat.* None yet
Are you currently using Sensor Lighting in any of the following areas? Outdoor Lighting (Timers or Photo Sensors) ☒ Yes ☐ No Percent _____ Back of House (Motion Sensors) ☐ Yes ☒ No Percent _____	Neutron System Timer Setback for Spa
Does the property currently have Tinted or Double Paned Windows? Double Paned: ☐ Yes ☒ No Percent _____ Tinted: ☐ Yes ☒ No Percent _____	f
NOTES and other observations:	

SECTION IV: Waste Reduction

Baseline Data

Calendar year: _____ Solid waste disposed = _____ lbs

Hazardous waste disposal = _____ lbs (or drums)

Current Practices

Do you currently have a Recycling Program in place for any of the following materials? ☐ Aluminum ☐ Plastic ☐ Steel ☐ Glass ☒ Cardboard ☐ Mixed ☒ Paper ☒ Office Paper (double sided) ☒ Newspaper ☐ Toner Cartridges ☐ Carpet ☐ Electronics ☐ Fluorescent Lamps	Waste Management Green Team 2 pickups / wk 80 / month 125 / month - corrugated
If yes, where are your collection bins currently located? ☐ Lobby ☐ Guest Rooms ☐ Elevator ☐ Landings ☐ Pool ☐ Kitchen/Bar ☐ Near Vending Machines ☐ Front Office ☐ Staff Facilities ☐ Conference Room	800 / container 3 containers 1 garbage 1 mixed 1 OCC
Do you currently use a Trash Compactor? ☐ Yes ☐ No	*Garbage Compactors will reduce the overall volume of waste, therefore decreasing the amount of pick-ups per month; thus decreasing the cost for service*
Do you currently Compost any of the following materials on site? ☐ Yard Trash ☐ Food Waste ☐ Other: _____	

SECTION IV: Waste Reduction *(continued)*

Are you currently practicing any of the following Waste Reduction techniques? ☒ Exercising any Lease vs. Buy options on Computers and Other Electronics * If yes, on which products: ☐ Using any refillable containers rather than single use applications * If yes, on which products: ☐ Practicing "Just in Time Buying" ☒ Utilizing reusable versus disposable goods ☐ Purchasing products in reusable/returnable containers ☒ Purchasing products in Bulk/Concentrate ☐ Requiring Vendors to take back pallets, non recyclable boxes and crates ☐ Formally request suppliers to reduce packaging ☐ Stopping unwanted Free Newspapers ☐ Duplexing (2 sided copies)	*"Just in Time Buying": This is the practice of buying products just before you run out. The theory is that employees use more of a product just because there is plenty more on the shelf.* *To stop delivery of unwanted free newspapers, we encourage the practice of asking at check in or using a door hanger to refuse.*
Hazardous Waste Generator status? ☐ Large Quantity (LQG) ☐ Small Quantity (SQG) ☐ Conditionally-Exempt (CESQG)	
NOTES and other observations:	

SECTION V: Clean Air Practices

Current Practices	
Does your property currently test for the following gases? Carbon Monoxide: ☒ Yes ☐ No Radon: ☐ Yes ☒ No	
Has your property been tested for the following materials? chf Lead Paint: ☐ Yes ☐ No If so, when _____ Asbestos: ☐ Yes ☐ No If so, when _____	
Do you currently maintain a relative humidity between 35 and 55%? ☒ Yes ☐ No ☐ Unsure	*Maintaining a relative humidity between 35 and 55% helps prevent the growth of mold.*
How do you currently ensure that your property is sealed from the environment? ☐ Properly installed weather stripping ☐ Use of pressure stabilization	*By maintaining positive pressure inside the building, water and moisture can be kept out.*
Have you recently checked your HVAC system for the following? Mold and Bacteria: ☒ Yes ☒ No If so, when monthly Obstructions to air flow: ☒ Yes ☐ No If so, when _____ Clean drip pans: ☒ Yes ☐ No If so, when monthly ☐ Other: _____	

?

SECTION V: Clean Air Practices *(continued)*

Are you currently using any of the following to help increase the quality of your indoor air? ☒ Exhaust Fans vented to outside not attic ☒ Dehumidifiers (spa) ☐ High Efficiency filters other than HVAC filters ☒ High Efficiency Air Filters for HVAC ☒ Smoking Rooms are well ventilated or properly filtered ☒ Ensuring high moisture areas such as Kitchen & Laundry are well ventilated	pleated filter *Filters: Minimum Efficiency Rating Value (MERV) of 8 or better.* *Refer to BMPs for further information.*
Do you use environmentally preferable cleaners? ☐ Yes ☒ No (chef) If so, which:	*Preferable cleaners are cleaners that are not toxic to humans, degradable, non-corrosive, and low in VOC's. Refer to BMP's for list of preferable cleaners.*
Is a preventive maintenance plan documented with logs for air handling unit cleaning and filter exchange? ☒ Yes ☐ No	

aerosal - not acid based
Anhac -

Ecolab -

SECTION VI: Environmental Improvement Projects

After your Green Team has completed the Environmental Self-Assessment Checklist (Sections 1-5) review your findings. In what ways would you like to improve your hotel's environmental performance? Review the list of best management practices provided at www.dep state.fl.us/greenlodging for ideas. Then write in the spaces provided below the specific improvement projects that your team plans to implement.

Water Conservation

Eco-friendly water filtration system
Main water to the hotels - rooms, etc.

Energy Efficiency

light bulbs

Waste Reduction

Recycle paper, cardboard, plastic

Clean Air Practices

Section VII: Green Team Recognition

Please have all members of the Green Team sign below indicating their participation in the environmental self-assessment and planning process. Use additional paper if necessary.

MARK ZEITOUNI	F+B Director, Exec. Chef	
Green Team Leader	Title	Date
ERICA FRIEDRINGA, Office	Office Mgr	
Green Team Member	Title	Date
VANESSA LANE, KITCHEN	Pastry Chef	
Green Team Member	Title	Date
PAUL GREEN,	Chief Engineer	
Green Team Member	Title	Date
Green Team Member	Title	Date
Green Team Member	Title	Date

Send completed Environmental Self-Assessment and Planning Checklist to:

Florida Department of Environmental Protection
ATTN: Green Lodging Program
2600 Blair Stone Road, MS 4570
Tallahassee, FL 32399-2400

or

Karen.S.Moore@dep.state.fl.us

Green LODGING FLORIDA

Wednesday, May 21, 2008 4:24:53 PM

mbarroso@raleighhotel.com
dmeeroff@fau.edu
Attachments: tower info.pdf (133.7KB)
blastoffaerosol msds.pdf (90.1KB)
citrafizz msds.pdf (95.4KB)
foamawayaerosol msds.pdf (91.2KB)

These are the chemicals I use for cleaning the a/c coils and for drains, the company Momar is the parent company of Aquatrol which is doing our new cooling tower treatment system. You can contact the same person that I sent you his contact info earlier if you have any questions. I've also attached the MSDS info for these 3 products, as well as the info on treatment system for the cooling tower.

Blast Off – High velocity coil and filter cleaner
Foam-Away – Foaming coil and filter cleaner
Citra-Fizz – Thermo-chemical drain line opener

http://www.momar.com/www/index.php

Mario Barroso
Director of Engineering
The Raleigh Hotel
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Miami Beach, Fl. 33139
(305) 612-1140 - direct
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www.andrebalazasproperties.com

M A T E R I A L S A F E T Y D A T A S H E E T

QUICK REFERENCE **FOAM-AWAY™ A.C. COIL & FILTER CLEANER (AEROSOL)**

MOMAR, INCORPORATED
1830 ELLSWORTH INDUSTRIAL DRIVE
ATLANTA, GEORGIA 30318

HEALTH	1
FLAMMABILITY	1
REACTIVITY	0
PERSONAL PROTECTION	A

EMERGENCY TELEPHONE NO.: INFOTRAC 1-800-535-5053
OTHER INFORMATION CALLS: 404-355-4580

DATE PREPARED: May 29, 2007

SIGNATURE OF PERSON RESPONSIBLE FOR PREPARATION Edwl Hatchett

SECTION 1 – IDENTITY

PRODUCT NAME: FOAM-AWAY™ A.C. COIL & FILTER CLEANER (AEROSOL)
CHEMICAL NAME: Mixture
CHEMICAL FAMILY: Aqueous surfactant mixture
FORMULA: Water based foaming coil and filter cleaner

SECTION 2 – HAZARDOUS INGREDIENTS

PRINCIPAL HAZARDOUS COMPONENT(S)	CAS NO.	THRESHOLD LIMIT VALUE
1) Propane	74-98-6	1000 ppm
2) Butane	106-97-8	800 ppm
3) Isopropyl Alcohol	67-63-0	400 ppm
*4) Diethylene glycol monoethyl ether	111-90-0	Not established

*This product contains a toxic chemical subject to the reporting requirements of Section 313 of the Emergency Planning and Community Right-To-Know Act of 1986 (40CFR372).

SECTION 3 – PHYSICAL & CHEMICAL CHARACTERISTICS (FIRE & EXPLOSION) DATA

BOILING POINT: 212°F
SPECIFIC GRAVITY (H_2O=1)= 0.99
VAPOR PRESSURE (mm Hg): 50
PERCENT VOLATILE BY VOLUME (%): 10
VAPOR DENSITY (Air = 1): Unknown
EVAPORATION RATE (BUAC=1): Slower
SOLUBILITY IN WATER: Soluble
REACTIVITY IN WATER: None
APPEARANCE AND ODOR: White foam with light citrus odor.
pH: 10 - 10.6
FLASH POINT: Nonflammable per flame projection.
FLAMMABLE LIMITS IN AIR % BY VOLUME: Lower: 1.8 Upper: 9.5
EXTINGUISHER MEDIA: Foam, dry chemical, carbon dioxide.
AUTO-IGNITION TEMPERATURE: Unknown
SPECIAL FIRE FIGHTING PROCEDURES: Keep containers cool using water spray. Use proper equipment to protect personnel from bursting containers.
UNUSUAL FIRE & EXPLOSION HAZARDS: Contents under pressure. Do not expose to temperatures exceeding 120°F as containers may vent, rupture or burst.

SECTION 4 – PHYSICAL HAZARDS

STABILITY UNSTABLE ☐
STABLE ☒

CONDITIONS TO AVOID: Open flames

INCOMPATIBILITY (materials to avoid): Strong oxidizers

HAZARDOUS DECOMPOSITION PRODUCTS: Carbon oxides and unidentified organic compounds.

HAZARDOUS POLYMERIZATION MAY OCCUR ☐ WILL NOT OCCUR ☒

SECTION 5 – HEALTH HAZARDS

THRESHOLD LIMIT VALUE: Not established

PRIMARY ROUTE OF ENTRY: EYE ☒ DERMAL ☒ INHALATION ☐ INGESTION ☐

SIGNS AND SYMPTOMS OF EXPOSURE

1. Acute Overexposure: Liquid may cause eye irritation. Inhalation may cause nausea, dizziness, and headache. May cause skin irritation.
2. Chronic Overexposure: Not known

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE: Pre-existing skin conditions.

CHEMICAL LISTED AS CARCINOGEN OR POTENTIAL CARCINOGEN

1. National Toxicology Program: Yes ☐ No ☒
2. I.A.R.C. Monographs: Yes ☐ No ☒
3. OSHA: Yes ☐ No ☒

OSHA PERMISSIBLE EXPOSURE LIMIT: Not established

ACGIH THRESHOLD LIMIT VALUE: Not established

OTHER EXPOSURE LIMIT USED: Not established

EMERGENCY AND FIRST AID PROCEDURES

1. INHALATION: Remove from exposure. Treat symptomatically.
2. EYES: Flush with large amounts of water for at least 15 minutes occasionally lifting lids. Get medical attention, if irritation persists.
3. SKIN: Wash with running water until skin is free of soapiness. Wash contaminated clothing before reuse. If irritation persists, get medical attention.
4. INGESTION: Drink 1-2 glasses of water or milk. DO NOT induce vomiting. Get medical attention.

SECTION 6 – SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION: Not required

VENTILATION

LOCAL EXHAUST: Adequate MECHANICAL (GENERAL): Adequate

SPECIAL: None OTHER: None

PROTECTIVE GLOVES: Rubber EYE PROTECTION: Safety glasses

OTHER PROTECTIVE CLOTHING OR EQUIPMENT: Rubber boots and apron if splashing likely.

SECTION 7 – SPECIAL PRECAUTIONS AND SPILL/LEAK PROCEDURES

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE: Do not get in eyes, on skin or clothing. Wash thoroughly after handling. Do not store at temperatures above 120°F. Do not puncture or incinerate.

OTHER PRECAUTIONS: Keep containers closed. KEEP OUT OF REACH OF CHILDREN!

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: Absorb on mineral clay material. Shovel into container for disposal.

WASTE DISPOSAL METHODS: Dispose of in accordance with federal, state, and local authorities.

M A T E R I A L S A F E T Y D A T A S H E E T

QUICK REFERENCE **CITRA-FIZZ**

MOMAR, INCORPORATED
1830 ELLSWORTH INDUSTRIAL DRIVE
ATLANTA, GEORGIA 30318

HEALTH	3
FLAMMABILITY	0
REACTIVITY	2
PERSONAL PROTECTION	F

EMERGENCY TELEPHONE NO.: INFOTRAC 1-800-535-5053
OTHER INFORMATION CALLS: 404-355-4580

DATE PREPARED: May 16, 2003

SIGNATURE OF PERSON RESPONSIBLE FOR PREPARATION Edwl Hatchett

SECTION 1 – IDENTITY

PRODUCT NAME: CITRA-FIZZ
CHEMICAL NAME: Not applicable
CHEMICAL FAMILY: Caustic Blend
FORMULA: Powder mixture – Drain line opener and maintainer

SECTION 2 – HAZARDOUS INGREDIENTS

PRINCIPAL HAZARDOUS COMPONENT (S)	CAS NO.	%BY WT.	THRESHOLD LIMIT VALUE
1) Sodium Hydroxide	1310-73-2	50-55	(ACGIH-TWA) 2 mg/m^3

This product does not contain any toxic chemicals subject to the reporting requirements of Section 313 of the Emergency Planning and Community Right-To-Know Act of 1986 (40CFR372).

SECTION 3 – PHYSICAL & CHEMICAL CHARACTERISTICS (FIRE & EXPLOSION) DATA

BOILING POINT: Not applicable
SPECIFIC GRAVITY (H_2O=1)= 60-70 lb/ft^3
VAPOR PRESSURE (mm Hg): Not applicable
PERCENT VOLATILE BY VOLUME (%): 0
VAPOR DENSITY (Air = 1): Not applicable
EVAPORATION RATE (BUAC=1): Not applicable
SOLUBILITY IN WATER: Complete
REACTIVITY IN WATER: Exothermic – add to water slowly
APPEARANCE AND ODOR: White free flowing powder – citrus odor
pH 1% Solution: 10-12
FLASH POINT: (T.C.C.) Not applicable
FLAMMABLE LIMITS IN AIR % BY VOLUME: Lower: Not applicable Upper: Not applicable
EXTINGUISHER MEDIA: CO_2, dry chemical, water spray, foam
AUTO-IGNITION TEMPERATURE: Not established
SPECIAL FIRE FIGHTING PROCEDURES: Not combustible, but in contact with moisture may generate sufficient heat to ignite combustible material. Contact with some metals generates flammable hydrogen gas. Wear full protective clothing.
UNUSUAL FIRE & EXPLOSION HAZARDS: Avoid adding water to the product, which will result in a violent exothermic reaction.

SECTION 4 – PHYSICAL HAZARDS

STABILITY UNSTABLE ☐
STABLE ☒

CONDITIONS TO AVOID: In presence of moisture, reacts with aluminum, tin, zinc, and alloys of these metals to form flammable hydrogen.

INCOMPATIBILITY (materials to avoid): Reacts vigorously with water, acids, chlorinated hydrocarbons, acetaldehydes, acrolein, aluminum, chlorine, trifluoride, hydroquinone, maleic anhydride, and phosphorous pentoxide.

HAZARDOUS DECOMPOSITION PRODUCTS: Carbon oxides, smoke, and fumes

HAZARDOUS POLYMERIZATION MAY OCCUR ☐ WILL NOT OCCUR ☒

SECTION 5 – HEALTH HAZARDS

THRESHOLD LIMIT VALUE: 2 mg/m^3

PRIMARY ROUTE OF ENTRY: EYE ☒ DERMAL ☒ INHALATION ☒ INGESTION ☒

SIGNS AND SYMPTOMS OF EXPOSURE

1. Acute Overexposure: Causes severe skin and eye burns. Inhalation can cause tissue damage in upper respiratory tract. Ingestion can cause severe burning to mouth, tongue, throat, and stomach.
2. Chronic Overexposure: Pneumonitis can follow exposures. Death can result from swallowing.

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE: Pre-existing respiratory, eye, and skin conditions

CHEMICAL LISTED AS CARCINOGEN OR POTENTIAL CARCINOGEN

1. National Toxicology Program: Yes ☐ No ☒
2. I.A.R.C. Monographs: Yes ☐ No ☒
3. OSHA: Yes ☐ No ☒

OSHA PERMISSIBLE EXPOSURE LIMIT: 2 mg/m^3

ACGIH THRESHOLD LIMIT VALUE: 2 mg/m^3

OTHER EXPOSURE LIMIT USED: None

EMERGENCY AND FIRST AID PROCEDURES

1. INHALATION: Remove from overexposure to fresh air. If breathing is difficult or discomfort occurs, obtain medical attention.
2. EYES: Flush immediately with large amounts of water for at least 15 minutes holding lids apart. Get medical attention.
3. SKIN: Wash with water for 15 minutes while removing contaminated clothing. Wash clothing and boots before reuse. If irritation persists, get medical attention.
4. INGESTION: Drink 1 to 2 glasses of water or milk. DO NOT induce vomiting. Get immediate medical attention.

SECTION 6 – SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION: NIOSH approved vapor and dust respirator required for exposures to dust, mist, or sprays.

VENTILATION

LOCAL EXHAUST: Usually adequate

MECHANICAL (GENERAL): Normally not required

SPECIAL: None

OTHER: None

PROTECTIVE GLOVES: Neoprene

EYE PROTECTION: Goggles plus a face shield

OTHER PROTECTIVE CLOTHING OR EQUIPMENT: Impervious protective clothing and chemical resistant shoes, rubber boots, and apron

SECTION 7 – SPECIAL PRECAUTIONS AND SPILL/LEAK PROCEDURES

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE: When dissolving in water, use cool water below 100^{0}F. Add slowly to surface of water with constant stirring to avoid spattering. Wash thoroughly after handling.

OTHER PRECAUTIONS: Keep containers closed and away from moisture. Separate from acids, metals, explosives, organic peroxides, and easily ignitable materials. KEEP OUT OF REACH OF CHILDREN! Do not cut or weld empty container.

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: In case of spillage, scoop to nearest clean waste container. Dilute residue with water, neutralize with mild acid and absorb onto dry material.

WASTE DISPOSAL METHODS: Dispose of in accordance with federal, state, and local regulations.

M A T E R I A L S A F E T Y D A T A S H E E T

QUICK REFERENCE **BLAST OFF™**

MOMAR, INCORPORATED
1830 ELLSWORTH INDUSTRIAL DRIVE
ATLANTA, GEORGIA 30318

HEALTH	1
FLAMMABILITY	0
REACTIVITY	1
PERSONAL PROTECTION	A

EMERGENCY TELEPHONE NO.: INFOTRAC 1-800-535-5053
OTHER INFORMATION CALLS: 404-355-4580

DATE PREPARED: July 17, 2007

SIGNATURE OF PERSON RESPONSIBLE FOR PREPARATION Edwl Hatchett

SECTION 1 – IDENTITY

PRODUCT NAME: BLAST OFF™
CHEMICAL NAME: Mixture
CHEMICAL FAMILY: Aqueous surfactant mixture
FORMULA: Water based coil and filter cleaner

SECTION 2 – HAZARDOUS INGREDIENTS

PRINCIPAL HAZARDOUS COMPONENT(S)	CAS NO.	%BY WT.	THRESHOLD LIMIT VALUE
*1) 2-Butoxy Ethanol	111-76-2	4.5	400 ppm

*This product contains a toxic chemical subject to the reporting requirements of Section 313 of the Emergency Planning and Community Right-To-Know Act of 1986 (40CFR372).

SECTION 3 – PHYSICAL & CHEMICAL CHARACTERISTICS (FIRE & EXPLOSION) DATA

BOILING POINT: Not established
SPECIFIC GRAVITY (H_2O=1)= 0.95
VAPOR PRESSURE (mm Hg): 50
PERCENT VOLATILE BY VOLUME (%): Not applicable
VAPOR DENSITY (Air = 1): Unknown
EVAPORATION RATE (BUAC=1): Slower
SOLUBILITY IN WATER: Soluble
REACTIVITY IN WATER: None
APPEARANCE AND ODOR: White liquid with orange odor.
pH: 9.9
FLASH POINT: Nonflammable per flame projection.
FLAMMABLE LIMITS IN AIR % BY VOLUME: Lower: Not established Upper: Not established
EXTINGUISHER MEDIA: Foam, dry chemical, carbon dioxide.
AUTO-IGNITION TEMPERATURE: Unknown
SPECIAL FIRE FIGHTING PROCEDURES: Keep containers cool using water spray. Use proper equipment to protect personnel from bursting containers. Wear self-contained breathing apparatus.
UNUSUAL FIRE & EXPLOSION HAZARDS: Contents under pressure. Do not expose to temperatures exceeding 120°F as containers may vent, rupture or burst.

SECTION 4 – PHYSICAL HAZARDS

STABILITY UNSTABLE ☐
STABLE ☒

CONDITIONS TO AVOID: None

INCOMPATIBILITY (materials to avoid): Strong oxidizers

HAZARDOUS DECOMPOSITION PRODUCTS: Carbon oxides and unidentified organic compounds.

HAZARDOUS POLYMERIZATION MAY OCCUR ☐ WILL NOT OCCUR ☒

SECTION 5 – HEALTH HAZARDS

THRESHOLD LIMIT VALUE: Not established

PRIMARY ROUTE OF ENTRY: EYE ☒ DERMAL ☒ INHALATION ☐ INGESTION ☐

SIGNS AND SYMPTOMS OF EXPOSURE

1. Acute Overexposure: Liquid may cause eye irritation. Inhalation may cause nausea, dizziness, and headache. May cause skin irritation.
2. Chronic Overexposure: Not known

MEDICAL CONDITIONS GENERALLY AGGRAVATED BY EXPOSURE: Pre-existing skin conditions.

CHEMICAL LISTED AS CARCINOGEN OR POTENTIAL CARCINOGEN

1. National Toxicology Program: Yes ☐ No ☒
2. I.A.R.C. Monographs: Yes ☐ No ☒
3. OSHA: Yes ☐ No ☒

OSHA PERMISSIBLE EXPOSURE LIMIT: Not established

ACGIH THRESHOLD LIMIT VALUE: Not established

OTHER EXPOSURE LIMIT USED: Not established

EMERGENCY AND FIRST AID PROCEDURES

1. INHALATION: Remove from exposure. Treat symptomatically.
2. EYES: Flush with large amounts of water for at least 15 minutes occasionally lifting lids. Get medical attention, if irritation persists.
3. SKIN: Wash with running water until skin is free of soapiness. Wash contaminated clothing before reuse. If irritation persists, get medical attention.
4. INGESTION: Drink 1-2 glasses of water or milk. DO NOT induce vomiting. Get medical attention.

SECTION 6 – SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION: Not normally required.

VENTILATION

LOCAL EXHAUST: Adequate MECHANICAL (GENERAL): Adequate

SPECIAL: None OTHER: None

PROTECTIVE GLOVES: Rubber EYE PROTECTION: Safety glasses

OTHER PROTECTIVE CLOTHING OR EQUIPMENT: Rubber boots and apron if splashing likely.

SECTION 7 – SPECIAL PRECAUTIONS AND SPILL/LEAK PROCEDURES

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE: Do not get in eyes, on skin or clothing. Wash thoroughly after handling. Do not store at temperatures above 120°F. Do not puncture or incinerate.

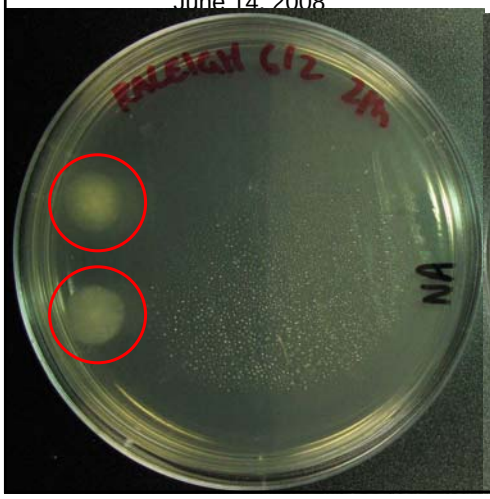
OTHER PRECAUTIONS: Keep containers closed. KEEP OUT OF REACH OF CHILDREN!

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: Absorb on mineral clay material. Shovel into container for disposal.

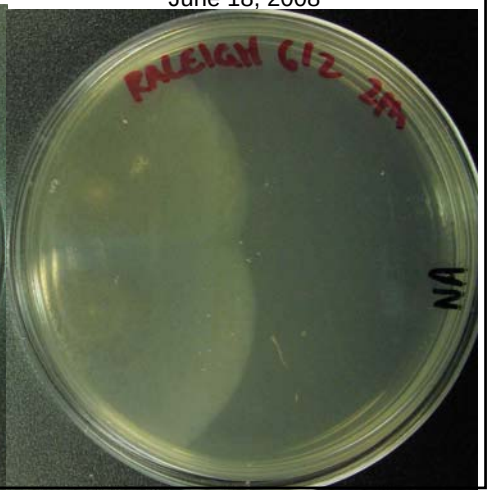
WASTE DISPOSAL METHODS: Dispose of in accordance with federal, state, and local authorities.

- Raleigh
- Room 612
- Sampled from vent grill
- Two types of mold
  - White fuzzy growing in concentric circles
  - Fuzzy white fungal mat with black dots in the furry cotton-like growth
  - Musty odor

June 14, 2008

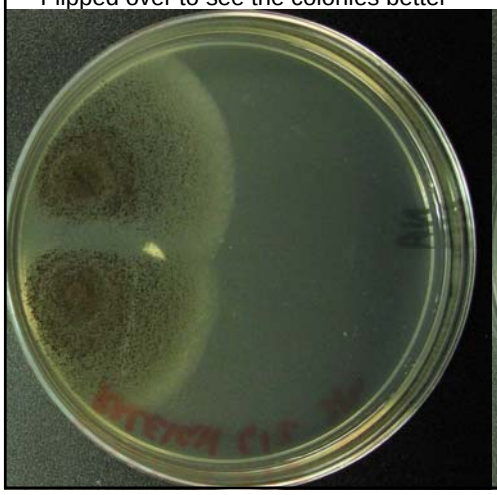


June 18, 2008

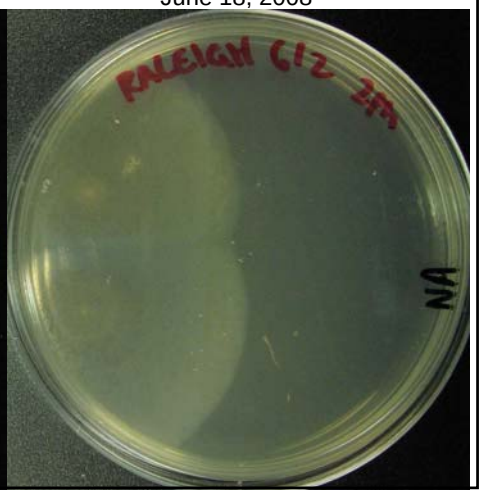


- Raleigh
- Room 612
- Sampled from vent grill
- Two types of mold

Flipped over to see the colonies better



June 18, 2008



- Raleigh
- 2nd floor office vent
- About 5 types of mold with bacterial colonies too
  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

June 14, 2008

June 18, 2008

- Raleigh
- Accounting office vent grill surface
- Mold lawn with bacterial streaks
  - Yellow with rough edges and black streaks
  - White fuzzy with yellow base
  - Smells musty/cheesy

June 14, 2008

June 18, 2008

- Raleigh
- 2nd Floor office A/C pan
- About 6 types of mold with bacterial colonies full coverage with lawn

June 14, 2008

June 18, 2008

- Raleigh
- 2nd Floor office A/C pan
- About 6 types of mold with bacterial colonies full coverage with lawn
  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

Flipped over to see the colonies better

June 18, 2008

- Raleigh
- Accounting office
- Top of vent grill
- Mold lawn with bacteria
  - Yellow with rough edges and black streaks
  - White fuzzy with yellow base
  - Smells musty/cheesy

June 14, 2008

June 18, 2008

- The Standard
- Hair salon area A/C vent
- 10 types of mold, including black furry type and also bacterial colonies
  - Creamy with black streaks
  - White fuzzies
  - Furry white blobs

June 14, 2008

June 18, 2008

- The Standard
- Kitchen area vent for A/C near the fridge
- 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

June 14, 2008

June 18, 2008

- The Standard
- Room 35
- Sample taken from closet ceiling
- One mold colony (white fur ball with black hair)

June 14, 2008

June 18, 2008

- The Standard
- Room 35
- Sample taken from closet ceiling
- One mold colony

Flipped over to see the colonies better

June 18, 2008

- The Standard
- Kitchen dishwashing area A/C vent
- 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

June 14, 2008

June 18, 2008

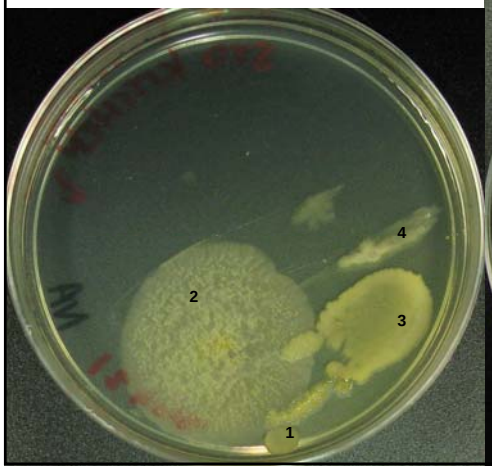
- The Standard
- Kitchen exhaust hood grill surface
- About 5 types of mold with bacterial colonies

June 14, 2008

June 18, 2008

- The Standard
- Kitchen exhaust hood grill surface
- 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

Flipped over to see the colonies better

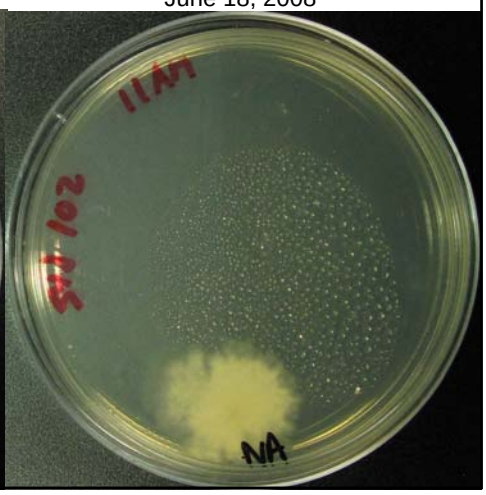


June 18, 2008

- The Standard
- Room 102
- 1 type of mold
- Very little bacterial growth on the plate
  - White fuzzy with colored fur

June 14, 2008

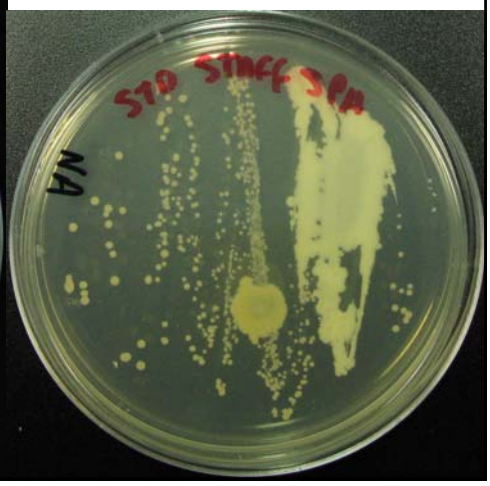
June 18, 2008



- The Standard
- A/C coil in the staff area of the spa
- 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 fuzzer with black streaks

June 14, 2008

June 18, 2008



- Blanks all negative