

# Conserving Water & Power Costs in the 21st Century

David Hoover

Each year the Utilities Commission, city of New Smyrna Beach, produces an annual operations summary to provide us with the ability to evaluate overall performance for the Water and Water Reclamation Department. This data all boils down to two bottom-line indicators for these operations:

- A. Cost per 1,000 gallons
- B. Kilowatt-hours per 1,000 gallons

With over 30 years of these fact-filled reports as reference material, trends can be reviewed easily. The two largest components of the overall cost equation for potable water and domestic wastewater service (which now includes reuse irrigation supply as well) have been 1) electric expense and 2) treatment chemicals.

As our operating staffs observed the electric contribution steadily rising with increased electric rates, we responded by using capital funds to purchase more efficient pumps and motors. Our specifications were detailed to provide pumps that averaged 85-percent effi-

ciency and motors that were closer to the 90-percent efficiency rankings. The motors would also be inverter duty only so they could be operated via variable speed/variable frequency drives (VFDs). Then as funding opportunities arose, all larger distribution (potable and reuse) pumps would be controlled by VFDs, rather than fixed-speed starters.

Over the past 15 years, the practice of replacing older, less-efficient, fixed-speed pumps and motors with much better equipment allowed us to contain ever-rising pumping costs for distribution systems. All of the largest pumps would be controlled by a VFD and a pressure feedback loop so that we could maintain a set operating pressure over a wide range of demands.

This practice provided ease of operation, as well as a more constant quality of supply to the customers. It also reduced costs and wear/tear associated with on-and-off cycling needed to respond to demand changes with fixed-speed units.

*David Hoover is director of the Water Resources Department, Utilities Commission, city of New Smyrna Beach. The utility provides potable water, reclaimed water, and domestic sewer service for 51,000 customers.*

Our staff developed a working relationship with ICON Technologies, so we could understand what type of VFDs best suited our needs. Mark Tempest and his staff provided the technical assistance necessary for us to defray conversion costs by learning to install and program these units for ourselves. This was all very successful teamwork, thanks to the exceptional customer service they offered.

To help evaluate how changes in day-to-day operations affected kilowatt-hours per 1,000 gallons, a new spreadsheet was devel-

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Operating these two 250-horsepower reuse distribution supply pumps at multiple settings on the VFD with slightly lowered pressure overall resulted in water conservation and energy savings that really added up.



Above: Steve Whitaker of ICON Technologies conducts a course on advanced VFD capabilities/operation at the water reclamation facility training room. Right: One of the work stations at the meeting. Each station included an individual laptop computer so maintenance technicians could enter commands to a mock VFD control unit.



Dave Hoover conducts a workshop on energy conservation/optimized operations. Seated from left are water production superintendent Rob DeLoach, field operation superintendent Bill Dean, water reclamation supervisor George Moore, and senior chemist/compliance specialist Curt McKenzie.

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oped in 2000 to provide more frequent review than was available previously from the annual summary data. It was apparent that this work was successful when we reviewed monthly electric bills, and we were satisfied that we were achieving the initial goals.

About two years ago, as gasoline prices were approaching \$4 per gallon, I began to realize that while driving my vehicle, I was increasing my manual use of the cruise control and watching my engine RPM much more closely in order to increase fuel efficiency. The idea of doing the same thing with the VFDs and distribution system pressures—choosing more than one set point to reduce psi whenever possible by changing this setting a few times a day—began to take shape.

I was also under the impression that at both production facilities there was a perception that slightly higher-than-average operating pressures equated to higher sales, so that could be a good thing under certain circumstances. If, however, the revenue for additional water sold was less than the additional power costs, this premise was actually counter-productive and wasteful of both water and power.

A workshop was held with the water reclamation facility supervisor, George Moore; the water production supervisor, Rob DeLoach; the field ops supervisor, Bill Dean; and our compliance specialist/chemist, Curt McKenzie, so we could formulate an aggressive strategy to:

- A. More clearly define acceptable potable/reuse system operating pressures for each shift—one set pressure 24/7 was not justified.
- B. More clearly define the tasks/ goals for each production facility shift (water/reclaimed water).



**UTILITIES COMMISSION**  
City of New Smyrna Beach, Florida  
MEMORANDUM

DATE: December 21, 2009  
TO: George Moore  
FROM: Dave Hoover  
SUBJECT: REUSE OPERATIONAL GUIDELINES/ENERGY CONSERVATION

Electric  
Water  
Wastewater

This further refine and clarify existing operating guidelines, as well as adding some new details to try and obtain more energy conservation and reduce ever rising electrical bills.

- I. Primary Goal – to maintain satisfactory reuse supply pressure while accomplishing certain secondary goals each day (and using minimum horsepower to close).
- II. Secondary Goals
  - A. Maximize usage of reuse supply to the residential irrigation systems of 732 customers between the hours of 12:00AM – 6:00AM through pressure choice.
  - B. Filling/controlling various operating levels of 2MG tank \*\*\*\*\*
  - C. Providing water to 7 commercial reuse ponds
- III. Other Aspects/Options
  - A. Operation of the 13 acre reuse pond
  - B. Use of WRF plant and pond irrigation to achieve more non-outfall days
  - C. 4" irrigation system irrigation
  - D. Final option – River outfall/disposal (when pond has no room)

Shift	PSI	Planned Goals
1 <sup>st</sup> Shift (MIDS)	1. 70 2. 65 3. 60	II. A. (continued) 1. (12 midnight – 6:00AM) to maximize use by automatic irrigation 2. Rest of shift <b>NOTE: If reuse tank is dropping too fast, take pressure downward to minimum of 60 psi, as needed. 70 = low demand, 65 = moderate demand, may use 60/very high demand + 75/very low demand</b>
2 <sup>nd</sup> (Days)	65 60*	II. B (continued) Filling 2MG tank (target minimum of 14-18') ***** II. C (continued) Filling seven (7) commercial ponds 1) Dry periods/high demand – need to decrease residential by use of 60 psi 2) Wet periods/low demand – may need to increase to 65 psi III. C.(continued) River outfall if III A & B will not be adequate (very wet periods)
3 <sup>rd</sup> (EVES)	60	II.B. (continued) Filling 2MG tanks (target 10-12' minimum for 1 <sup>st</sup> shift) *****
Outfall - Open	55- 60	Regardless of shift, if outfall valve is open, 60 psi will be maximum pressure to operate with to save costs

**NOTE: Flows < 3MG – use (1) or (2) 100 HPs on manual to reduce hours on 250's \*\*\*\*\* If pond is too full, and demand is low, discontinue cycling tank. Run it at an even level, augmenting as much as is needed to do that, so the pond level is decreased more effectively than by using other options.**  
Finally, **these are general guidelines** devised to help delineate daily duties and coordination of activities to best manage our business. It **remains a starting point only**, and intended to be refined by operators and management working together.

Figure 1

C. More effectively coordinate work among the three shifts each day.

It was suspected that the pressures necessary during peak demands could be trimmed significantly while still providing adequate pressure for the customers' needs. By establishing new limits with lower pressures and defining operational parameters more concisely, we anticipated that more benefits could be derived from our costly investments in the VFD technology through more manual adjustments of this control equipment/instrumentation over the course of each day.

## Reclaimed Water Production & Supply

This reuse operation was our starting point because it was a simpler model than the potable water system, which had multiple pumping stations.

Our two 250-horsepower reuse pumps shared one Yaskawa VFD and formerly had operated around the clock at 75 pounds per square inch. The supply was being delivered to two general classifications of customers: residential and commercial (with their own ponds and re-pumping).

Figure 1 is a copy of our reuse operational guidelines. As indicated, it established our tar-

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The offices of the Water Resources Department are shown with the department's 13-acre reclaimed water pond. This borrow pit was dug in the 1960s when Interstate Highway 95 was built to provide fill dirt for an overpass. After its conversion, reuse quickly jumped from 60 percent to the mid-80 percent range because it greatly expanded the department's ability to control management of the product when demand was very low or very high.

**WRF/REUSE OPERATION CHOICES –  
USE OF OPTIONS AVAILABLE IN RESPONSE TO  
13 ACRE POND LEVEL TRENDS/DEMAND  
12/2009**

- I. **Low Demand/Pond in Rising Trend** – the most important to react quickly to!!
- a. Pond rising, but still < 28' – adjust reuse pressure, so amount used by residential automated irrigation/medians increases  
**Mids = 70psi      Days/Afts = 60psi**
  - b. Pond continues to rise > .5'/week and is now > 28'  
**Mids = 75psi      Days/afts = 65psi**
  - c. Once we have initiated a., and had to increase to 70 psi, we should **quickly proceed with adding these next options** until the rising trend is leveled off, and we don't have to implement 75/65psi operation as well (and ultimate river losses). Additionally, modify the routine on day shift of "building a tank" to achieve 14-18' level – now try and *keep the tank within a narrower operating range by using our pond augmentation to reduce the dropping level in the 2 MG reservoir, and draw the over filled pond down sooner. Then -*
- |  | Cumulative Total |
|--|------------------|
| 1. turn on WRF irrig loop III = .324MGD      | .324MGD          |
| 2. add loop IV = .360                        | .684             |
| 3. add <b>newest</b> zone by west fence = .1 | .784             |
| 4. add powerline irrig (all 2000') = .75     | 1.534            |
| 5. add west side 13 acre pond irrig = .691   | 2.225            |
| 6. add loop II = .756                        | 2.981            |
| 7. add loop I = .324                         | 3.305            |
| 8. add east side 13 acre pond irrig = .691   | 3.996            |
- d. Pond reaches 31' – fill both reject tanks
  - e. Pond exceeds 31' – River Outfall as needed, until pond recedes to 30' or less, while all other options within reason continue to absorb as much flow as possible.
- II. **Moderate Demand** – pond relatively steady state within a small range
- a. **Mids = 65psi      Days/Afts = 60**
  - b. Use irrigation as needed only
  - c. Return any filled reject tanks to plant flow
  - d. Use well 24 1x/wk for 2 hrs, sample chlorides with Curt 1x/month
- III. **High Demand/Pond decreasing trend in progress**
- a. Pond decreasing, and level <28' – adjust pressure so amount used by residential/medians is reduced  
**Mids = 60psi      Days/Afts = 60psi, and in extreme condition could go to 55psi**
  - b. Begin rotating golf course ponds
  - c. Alternate using 13 acre pond ~1MGD MGD and well 24 for 12 hrs/day ~ .25MGD
  - d. When pond reaches 24.5, can still use well 24 every day for 10 hrs/day ~ .21MGD
  - e. Can drain any filled reject tanks, or an unused train to augment
  - f. No irrig here except 2 hrs/wk/zone to save grass

**IN GENERAL** – any increase/decrease in 13 acre pond level >1ft per week, or >1.5' in two weeks, means it is time to change from Moderate demand scheme to HIGH or LOW options. Also, any significant trend that remains the same for 3 weeks should also be responded to with first level changes in this plan. Then it will no longer be an "all or nothing" plan, and trend changes can be sensed sooner so that the responses too can be earlier and more gradual, while actually becoming more effective.

Figure 2

Continued from page 21

get pressures and correlated these to the different conditions of each shift. This strategy accomplished several things:

- A. It lowered higher than average pressures to what we thought were satisfactory.
- B. It conserved electricity.
- C. It conserved the resource.

It is apparent that when we consider the different conditions encountered while fulfilling these tasks, one supply pressure will not

match those needs as well as using three different settings. The higher pressure desired for use in zone irrigation is not necessary when filling ponds through a control valve we could open or close (as well as control the percent open settings) at our discretion.

Also, when demand was very high, we could reduce pressures slightly on midnights (reducing the amount of reuse supplied to residents) and leave a higher portion than otherwise for commercial users. Conversely, when

demand is very low, pressure on the midnight shift could be raised slightly to increase the resident use when commercial use tended to fall off (Figure 2). This most recent refinement (varying the midnight's pressure more effectively) was just added in 2009 and has raised our reuse usage to 97 percent, based on the running 12-month average, taking maximum advantage of the number of customers we have and the investments we've made in storage ponds, tanks, and our own irrigation systems.

### Other General Facts

The operators at the 7-million-gallons-per-day Class A tertiary treatment plant work 24 hours per day, seven days per week in three shifts to conduct all business necessary to treat domestic wastewater effectively and distribute the product efficiently to a customer base that first began to be developed in 1991 following the implementation of the Indian River Lagoon Act. The Utilities Commission quickly understood that improving wastewater treatment to the extent that this waste product could become recycled water was the way to move into the future and become better stewards of the environment and our natural resources.

Steady investments had to be made, including building the new \$17 million treatment plant in 1998, but these would pay off in the development of what we defined as our first "alternative water project". Ultimately, this would reduce demand on our

deep wells and help conserve fresh water here in coastal Volusia County.

On the midnight shift, the primary goal was to have adequate product and supply pressures for our 800 residential irrigation systems and a few roadway medians. During the day shift, supply concerns were filling about eight reuse storage ponds (the equivalent to potable reservoirs). The afternoon shift finished off whatever pond filling was needed and then worked to rebuild the level of the reuse stor-

Figure 3

age tank so the water was there for the next morning's peak residential demand.

By 2000, our reclaimed water usage had increased to approximately 60 to 70 percent of the treated flow. In 2005, we acquired some funding from Forever Florida to allow us to modify a 13-acre borrow pit for active reuse and recovery storage. The pond was adjacent to the water reclamation facility and was used very easily to further improve our performance. In the four years following the pond's completion in 2006, we have averaged 84 percent reuse utilization.

The final steps in this puzzle were to modify plant irrigation systems for better use and construct a few more medium-sized irrigation zones on Utilities Commission properties, where the limited reuse distribution system was located nearby and connection was feasible. Then our irrigation use could contribute to recharging groundwater systems.

Our field ops supervisor, Bill Dean, constructed these improvements with in-house expertise. We essentially sought to become a significant user so that in times of excess, we would take up this slack rather than discharge to the river. Coupled with the implementation of the pumping strategies already reviewed, our reuse utilization increased to the highest level to date.


## Potable Water Supply

The same approach for applying a more developed plan and using slightly reduced pres-

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Irrigation zones are located on Water Resources Department property next to the water reclamation facility. When residential and commercial usage is minimal because of wet weather, the department irrigates its own property, rather than using its Indian River outfall and losing freshwater to the saline environment of the estuary.

**UTILITIES COMMISSION**  
City of New Smyrna Beach, Florida  
**MEMORANDUM**

  
Electric  
Water  
Wastewater

**DATE:** March 22, 2010 (UPDATED)  
**TO:** Water Production Operations Staff  
**FROM:** Rob DeLoach  
**SUBJECT:** Updated Pump Station Operations With New Third Avenue Upgrade

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Now that we have Third Avenue Pump Station back online we need to include it in our overall operation of our system. This is the general plan for ROUTINE Operations. When deviation is needed for fires or other extreme conditions do what you need to and log what was the reasoning for the change.

**I. Tank Level goals (operating range for tank volumes):**

- a. **Days-**
  - 1) Complete draining South Beach to 10 feet
  - 2) Fill South Beach to 20 feet while draining Third Ave. to 10 feet
  - 3) Start filling Third Ave and draining Smith St
- b. **Afternoon--**
  - 1) Complete filling Third Ave to 20 feet
  - 2) Complete draining Smith Street to 5.5 feet
  - 3) Start filling Smith St to 8.8 feet
- c. **Nights-**
  - 1) Complete filling Smith St. to 8.8 feet
  - 2) Drain South Beach to 10 feet
- d. **Once a week -** 1) Cycle Glencoe Pump Station 2MG tank down to 15 feet

**II. Pressure Goals:**

- Glencoe Pump Station: 70 – 85 PSI
- Smith Street Pump Station: 60 – 80 PSI
- Third Ave. Pump Station: 55 – 70 PSI
- South Beach Pump Station: 55 – 70 PSI

In general, we'll be cycling 3<sup>rd</sup> AVE and S Beach tanks approx 2/3 full to 1/3 as the routine tank volume so water doesn't become too "aged", which causes problems with disinfectant residuals. Smith Street tanks will remain as shown (almost full to about 1/2 a tank). NOTE: At 3<sup>rd</sup> Ave and SBPS – don't pump from the tank if the filling cycle is in progress (don't use pumps if fill valve open).



UTILITIES COMMISSION  
City of New Smyrna Beach, Florida  
MEMORANDUM



DATE: March 22, 2010 (UPDATED)  
TO: Water Production Staff  
FROM: Rob DeLoach  
SUBJECT: WTP PRESSURE GUIDELINES/VFD CONTROL

Since May, 2008 the following guidelines were implemented to reduce some of the operating pressures and more effectively establish goals for each shift so that the KWH/1000 gallons is reduced, and pressure that we operate during high demand are trimmed during shifts where only system demand must be met and lower pressures are sufficient.

**Water Production Pressure and Tank Filling Guidelines 2010**

**I. General –**

1. When not filling tanks (Smith Street and South Beach) run at a system pressure of 60 to 65 PSI
2. When filling tanks (Smith Street or South Beach) keep the pressure at the tank being filled greater than 50 PSI.
3. Keep the other tank (Smith Street or South Beach) pressure greater 50 PSI
4. Adjust Glencoe Pressure to what is needed to fill tank.  
**Under routine conditions - Do not run pumps at the tank you are filling, and when pumping the tank fill valves should be closed.**

**II. Normal Tank Cycling Goals-**

- A. **Night Shift**  
- Drop South Beach 1 MG tank to at least 16 Feet  
- Fill Glencoe 2 MG tank as needed
- B. **Day Shift**  
- Drop Smith Street tanks to at least 6 Feet  
- Fill South Beach 1 MG tank
- C. **Afternoon Shift**  
- Fill Smith Street tanks  
- Cycle Glencoe down to 18 feet once a week on Friday

These are general goals and guidelines for routine situations. If higher pressures are needed, or other deviations from these guidelines are necessary, please implement them. Log these events and explain, so the guidelines may be refined as needed. Our overall objective is to supply adequate (not max) pressures, while performing the secondary goals of tank reserve and cycling each day, and efficiently conserving power costs. Thanks for your expertise in achieving this new wave of pumping refinements.

Figure 4

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sures in potable water supply was also implemented. Figures 3 and 4 are the corresponding control measures as they related to potable water service for our 51,000 customers.

**General Facts**—The 10.4-million-gallons-per-day Class A lime softening plant operates 24 hours per day, seven days per week. The primary day shift tasks are meeting customer demands while managing the withdrawal of water from five different ground storage reservoirs.

In the evenings, when customer demand drops off, operators switch their focus to cycling the reserves (completing the drawdown and beginning the fill operations). Therein lies a steady demand state for production volumes from the plant, and we all know that plants produce water of more consistent quality when they are operated smoothly.

**Results**

A monthly spreadsheet for kilowatt-hours per 1,000 gallons used here to track electric bills for water and reclaimed water quickly indicated that substantial savings were being achieved (18 percent for each area). Over a longer duration while potable water electric consumptions be-

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**THE WATER RESOURCES DEPARTMENT TEAM**—Front row from left: instrumentation technician Bill Sylvia, water reclamation facility operators Dave Pogany and Leslie Wind, administrative specialist Melinda Johnson, water reclamation facility lead operator Bob Bigus, and department director Dave Hoover. Back row from left: maintenance mechanic Mike Camber, lift station operator Jolene Ledger, water reclamation facility operators Don Fisher and Mike Frazier, electrician Rob Van Nieuwland, maintenance mechanics Kevin Ferris and Dan Neider, and laboratory technician Keith Suever. Not pictured: Water reclamation facility operators Steven Blankshein and Joseph Sciara.

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came 17 percent less than pre-strategy months, the water reclamation sector rose to 22 percent. These savings, extended for an annual figure, equated to approximately \$100,000 for potable water pumping, and approximately \$140,000 for reclaimed. These graphs are shown in Figures 5 and 6.

It is evident from “before and after” lines on the graphs that not only are the kilowatt-hours per 1,000 gallons reduced in each of these distribution systems, but the cost range (standard deviation) is much narrower—an other indicator of overall improved management and more consistent operation at both treatment plants.

## Summary

Significant cost avoidances may be possible by changing your pressures (and pump speeds) a few times each day. In the same way that a home’s thermostat can be adjusted to less extreme settings and two settings can be used each day instead of one, this principle may be used to reduce pressure and pumping costs in water distribution, either potable or reclaimed, while still providing customers satisfactory service.

Even modest pressure reductions may result in substantial cost avoidances over the long haul, as well as less waste at the customer’s home that may be the end product of higher pressure. As Tom Evans, our Peerless Pump representative, has always said, “When using a VFD as flows increase, the head changes increase as a square function and the energy demands as a cubed function” (example: a 100-horsepower motor operated with a VFD and running at 75-percent speed only consumes uses 50 percent of the power used when operated at full speed). This helps describe how much a slight reduction in pressure could reap substantial savings on electric costs.

The Utilities Commission’s experience has been that the overall plan outlined in this article helped achieve the highest reuse utilization (97 percent) and lowest gallons-per-day-per-connection data for potable customers (195) ever seen over many years of operational refinements.

The conservation benefits that reclaimed water production has brought to our operations area, as well as the close interrelations that now exist as described previously, have led to the re-naming of our department this year. Our new title is the Water Resources Department, and it’s easy to see why this nomenclature more accurately describes the role of both water and water reclamation operators in the new millennium. ◊

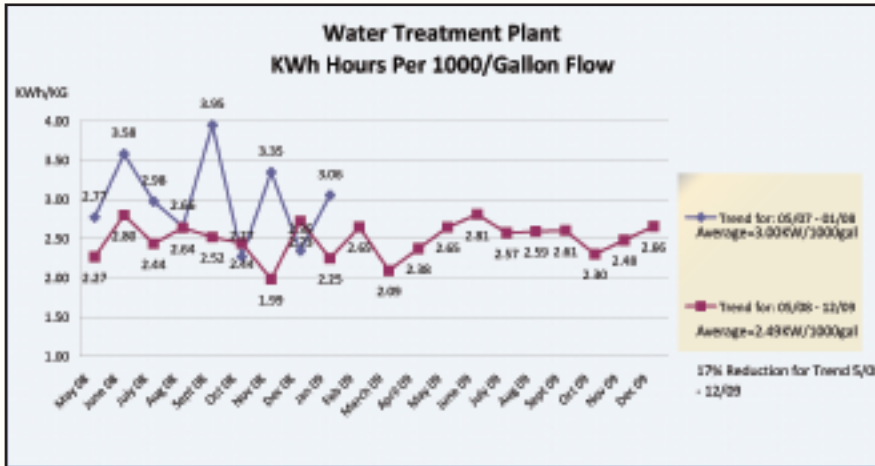


Figure 5a

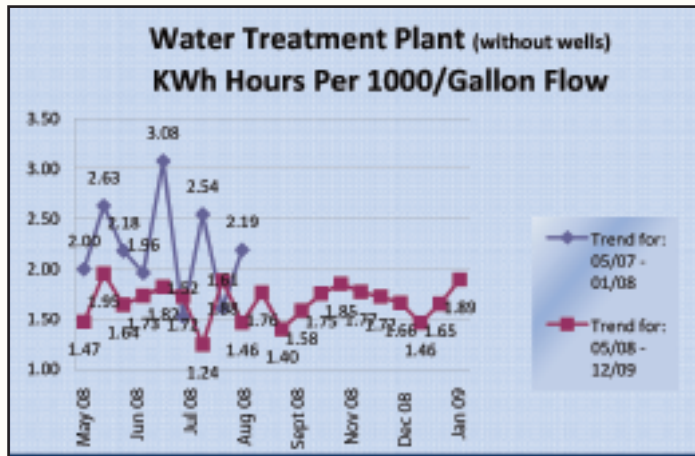


Figure 5b

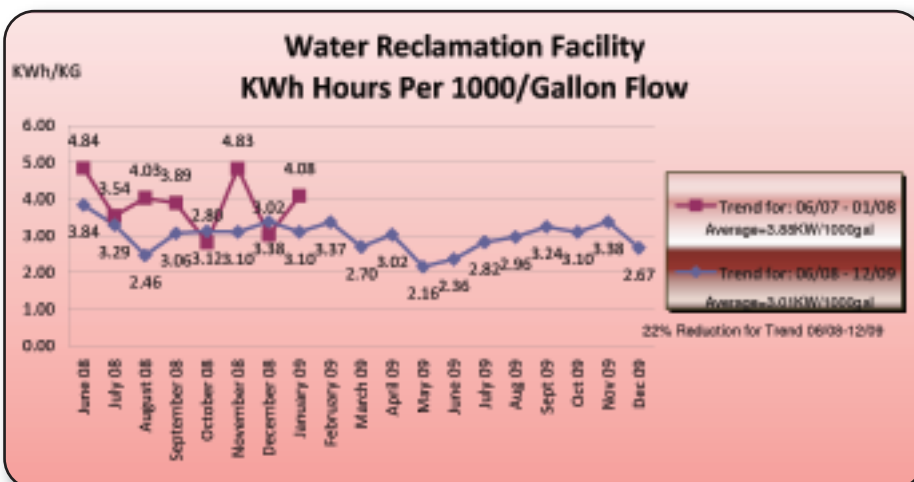


Figure 6