Rio Verde Team 2: Water Supply

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Problem Statement

Rio Verde has been awarded certification to the Audubon International's (AI) Sustainable Communities Program for their commitment to sustainability. This is a prestigious honor and award that the community is proud of and they are committed to keeping their certification and lowering their usage rates. This report will focus on the water supply usage of the area, with a emphasis on residential water usage. The Rio Verde community faces a distinctive water supply challenge. Not only is the community located in the desert, but there are no city water services. Residents must rely on well water or pay to have service trucks come and fill their holding tanks, or a combination of both (Nash, 2009). The community has 9 wells in total to live off of. Rio Verde Utilities Inc. takes care of the water and sewage services (Manta Media), but to better their situation, they reached out to us to help them reduce their usage to avoid continuing challenges.

In regards to the economic aspect of the water supply for Rio Verde, the community battles the problem of not having city water services due to the fact that they do not live within the city limits of Scottsdale. The policy that Scottsdale has requires that cities have to be within Scottsdale allotted city limits to receive water services from the city of Scottsdale's municipality. Due to this restriction, Rio Verde residents spend 34% more for water per gallon than Scottsdale residents.

Pertaining to the environmental impact of the water supply for Rio Verde, the surrounding ecosystem is obstructed by the activities the community has on the watershed, which includes endangered species. From a social perspective, adaptation to new habits concerning water management and conservation can be a lasting struggle for those whom are set in their habits and routines. Guaranteeing that adequate educational material is presented to the residents of the Rio Verde community is a must-have in order for lifestyle changes to take place, as well as

a follow up later on to assess how effective dissemination of information has been. To conserve the restricted supply of water in the community the residents can implement policies to guide their change in behavior.

Case Study

Rio Verde's AI membership allowed us to construct part of our analysis by looking at resources available from Audubon's online information. Our team split the information between outdoor use and indoor water usage. For outdoor use there were several steps that could be taken to help minimize water use. This is mostly in relation to Rio Verde's golf courses. Suggestions include:

1. Mow grass to 3 inches as this keeps the soil to root interface cooler and wetter.
2. Leave turf at a two-inch height during winter to make it less likely to be ruined by pests, frost, mold, and other negative impacts.
3. Routine inspection of equipment, watering technology, hoses, tubes, etc. to ensure the grass is maintained properly.
4. Watering overnight, or early mornings to reduce evaporation. This is particularly important as Rio Verde is in an arid environment.
5. Rio Verde uses gray water for their course and this practice should be continued (Audubon International, 2016).

Rio Verde places a large emphasis on maintaining a pristine golf course. However, the steps above will help them conserve water for all their outdoor uses. For example, when we visited Rio Verde in early March, they were watering their golf course at 10 in the morning. By doing this overnight, the reduce the chance of evaporation. This helps save water and money.

The second aspect of our case study was to look at Audubon's resources and recommendations regarding indoor water use. We found the following recommendations:

1. Replace older toilets to newer ones that use less water. New low flow toilets can save up to 3 gallons per flush.
2. Install low flow showerheads. Again, this can help saves gallons of water for each use.
3. Change behavior to turn water off while brushing teeth and doing dishes to conserve water (Mackay).

Many of these recommendations, in addition to our research, led to the basis of an educational piece. Sal, from Rio Verde, stressed the importance of conveying the preciousness of water to the community. These recommendations not only help save this resources, but can save residents money. This is a win win as it makes it easier to communicate with and convince residents to make changes. Coupled with our data analysis, the following section, we created a solid foundation of recommendations for Rio Verde to improve water use.

Data Analysis

To better understand the water issues at hand, our team conducted two site visits to record observations, meet with community leaders to discuss the project and obtain water meter data from Rio Verde Utilities Inc. We maintained contact through email and phone calls with Sal Celona. We recorded that the xeriscaping had drip lines to all the plants, which is a cause of over watering and increases the community's water consumption. From one of the site visits, Sal shared with us that the community waters the communal citrus trees with 60,000 gallons of water a month. Even if the watering was cut in half each month, the trees would have more than enough water to thrive. They are currently being over watered, like much of the other vegetation in the area.

In effort to gather more information to make specific recommendations for the community, we partnered with another Rio Verde Team focused on recycling. We sent them questions to add onto the survey that they were going to have sent out in the community newsletter. We did not want to send out our own survey and overwhelm the residents. The survey was not distributed to the Rio Verde residents and as of yet has still not been sent out. The questions were as follows:

1. Have you received a SRP home performance with energy star audit on your home with free energy saving giveaways?
2. Would you be interested in a home energy audit to find ways to lower your home energy usage and make your home more comfortable?

    If yes, please put your contact information below to receive a coupon code for $50 off the $99 home energy audit, a large reusable bag, toilet tank bank and 5 LED light bulbs also qualifying for rebates.
3. How many water efficient appliances do you have in your home?
4. Do you have natural landscape in your yard?

    If so, how often do you water?
5. Do you run the dishwasher only when it is full?

We partnered with Bonnie Dekavallas, the owner of Arizona Renewable Measures to offer SRP home energy audits to the community in effort to help them lower their consumption of water as well as energy. SRP's home energy audit measures how efficient by testing your hot water heater, ducts, air conditioning unit as well as a pressure test of your home. The information is process and Bonnie reaches out to customers with suggestions on how they can save energy thus, save money. With the audit, customers get five LED light bulbs and a toilet tank bank that

saves them one gallon of water per flush. The community has taken advantage of this new relationship and is working with Bonnie to provide the home energy audit at a discounted rate for Rio Verde residents.

As part of this project, our group was given a set of data to analyze in order to share recommendations with Rio Verde about how to move forward with water conservation measures. The data consisted of eight different spreadsheets spanning the years 2008 through 2015, containing meter measurements of gallons of water used per month for each address or household in the Rio Verde community. The spreadsheets were indexed by account numbers, house numbers, and addresses within the community, with a date of measurement alongside the gallons used per month. Once the data was given to our team, we reorganized the data by account number in ascending order, and by month so that we could see the levels of water use for each household or unit as the year progresses. After reorganization, several metrics were calculated to assess the validity of the data, and to show if any progress had been made on the water conservation front.

Although the data is helpful in some respects to our consultation work, there are certain characteristics of the data that make it hard to draw definitive conclusions about the status of the Rio Verde Community's water consumption. First off, our team received the data five days prior to our deliverable deadline for a comprehensive presentation. This made it difficult for our team to have time to analyze the data in more detail and provide recommendations to promote water supply sustainability for the community. Many of the account numbers in the data set included multiple entries for some months, or no data at all for other months.

There were data entries that contained negative numbers for gallons consumed in that time period, which is most likely a clerical error on the part of whoever collected the data. There

were also certain outlier entries that listed unexplainably high levels of water use for a single month, most notably an entry that listed consumption of well over two million gallons of water in a one-month period. The most important characteristic about the data set is that there is no clear delineation or separation of residential water use numbers from water used for landscaping purposes. Landscaping uses significantly larger amounts of water than residents do, so being able to separate the two is crucial in determining where water use can be reduced in the community.

Average monthly water consumption per household was calculated using the total gallons consumed by the community in a given month and dividing it by the number of homes using water in the community. This metric could be better described as the average monthly water consumption of each unit in the community, given that residential and landscaping water use have been lumped together. This metric was also developed into a line graph showing the progression of water use across the year. A chart was also constructed that detailed the total gallons consumed per month for each year, as well as a +/- score that showed the increase or decrease in water consumption for each month from year to year. In addition, an aggregate line graph was constructed to show the progression of water consumption across the months for each year from 2008 to 2015.

	2008	2009	2010	2011	2012	2013	2014	2015
January	17818491	13306670	16760730	13582750	15778392	13341420	13996760	14273214
February	13246340	15102920	12269720	15268580	14422174	16284309	14561030	12909193
March	13482376	14135870	14297421	16795784	15148740	14686270	14639002	18286302
April	16046045	16831685	15951509	15770166	18273158	18004530	18146251	15809463
May	16019185	14984778	15290119	16374030	14541438	15367480	14629069	14222705
June	14652081	15297242	17926441	16159830	15103362	14453620	17392577	16211998
July	16985629	15558155	16073496	16412720	17716950	18728844	16521786	16225854
August	16289820	16226880	19020925	17704933	18595310	16357300	17009238	16381657
September	17234070	17567200	16559115	16207958	15265000	18113930	17958796	17962458
October	16695940	18100200	16972554	15932747	19229671	16529620	15346021	18329261
November	17703800	17180626	17790321	20009106	16978074	16022872	15270630	16363837
December	16216510	18767774	16575899	15100847	14655486	17327070	17023880	17777689
TOTALS	192390287	193060000	195488250	195319451	195707755	195217265	192495040	194753631

Fig 1. Water consumption per month for years 2008-2015. Totals in gallons.

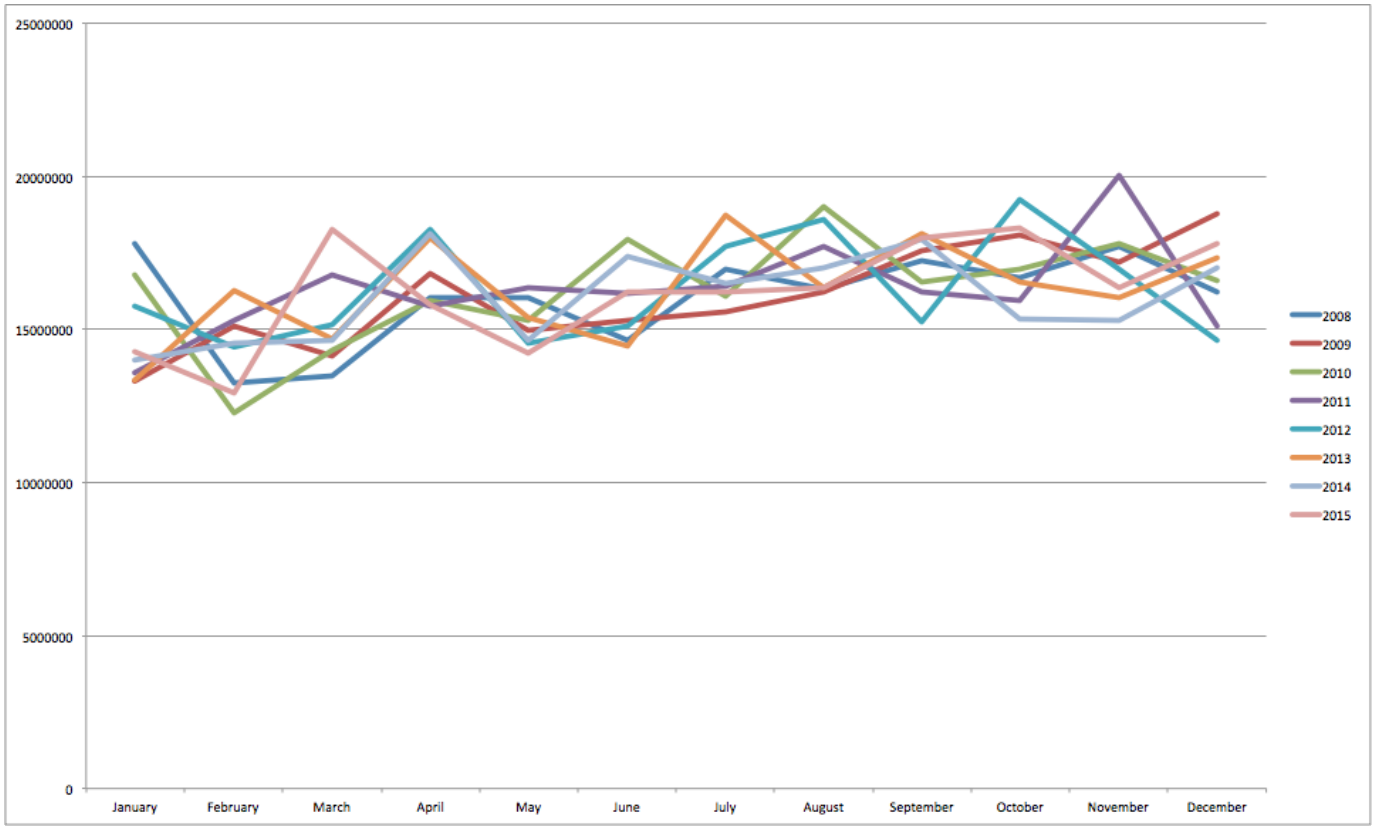

Fig 2. Graph of water consumption per month, years 2008-2015. Measured in gallons.

Year	# of Homes	Gallons
2008	1773	192390287
2009	1793	193060000
2010	1894	195488250
2011	2020	195319451
2012	2154	195707755
2013	2317	195217265
2014	2458	192495040
2015	2671	194753631

Fig 3. Chart of number of homes per year, alongside gallons consumed.

Following an initial presentation of our findings and conclusions to Sal Celona, as a representative of the Rio Verde community, our group engaged in a follow up discussion to discuss shortcomings of our research and future work that can be done to process the data. Sal pointed out to us that the Rio Verde community is largely populated by residents that leave the community during the warmer months of the year to live elsewhere, returning once the weather has become more pleasant. This means that from April until October, there should be a decrease in water consumption. Sal would like us to illustrate this using the data, comparing water consumption during the times of the year when their population is depleted and when it's more robust. In addition, the data can be further parsed into separate echelons of water consumption showing the number of households using between 1,000-5,000 gallons, 5,000-10,000, etc. This could help determine a separation point between residential and landscape water use, helping determine which units are the worst offenders in terms of water consumption.

Suggestions

After analyzing the data from the years 2008 through 2015, our team has come up with some recommendations that would make future data collection more meaningful and useful to the Rio Verde community. An excel spreadsheet or "tool" was devised for collection of water usage data for the year 2016, suggesting that entry of monthly water usage rates be entered into individual columns for each month of the year. With this design, it makes it much easier to calculate sums, averages, standard deviations, and other metrics that help give insight into the data. The spreadsheet only allows for one entry per month, eliminating the possibility of multiple entries in a given month. We also highly recommend that data for residential water use and landscaping water use be logged in separate spreadsheets so that analysis can be performed

without mixing the two together. Water use from landscaping is much higher than residential water use, so having separate data is essential to pinpointing solutions for reducing water use.

One way of going about this change in data collection could be to appoint a single person or small team to a Water Ambassador position on the board committee. Their main objective will be to create and maintain ongoing water conservation tips and tricks for the members as well as the community at large. The Water Use It Wisely campaign has a lot of helpful hints on how to conserve at a residential level. These tips could get a designated section in the newsletter where a couple suggestions are listed. The Water Ambassador would also be responsible for researching ways to implement conservation efforts amongst a community. This might involve digging deeper into the lack of conservation by looking into the psychology behind habits and how best to change or minimize them over time.

As a starting point Redman delineates the difference between declarative knowledge and procedural knowledge where the former uses facts to describe how processes work while the latter uses a how-to approach (2012, p. 16). Redman utilizes these definitions to outline that just knowing that there's a drought or where a community gets its water from isn't going to persuade people to reduce their consumption. However declarative knowledge can also be used to combat the overuse if procedural knowledge is paired with it. In his example he relates this idea to the unfamiliarity of plants' watering needs versus overwatering native desert plants. In other words, "declarative knowledge does not predict...participation in sustainable behaviors" (Redman, 2012, p. i-ii). This is the type of issue the Water Ambassador team could look at solving within the community.

In addition to the restructuring of data collection, we also recommend expanding on the survey questions listed above to include social-behavior questions about individual water use.

Questions such as “How often do you do laundry?”, “How often do you shower?”, “Do you leave the water running when brushing your teeth?”, and “Do you own a pool?” could be beneficial in examining individual water use patterns and determining specific contributors to high water use. These types of questions get residents to think about their own behavior in a sustainable context. So even if they don’t provide very accurate information it still provides a service by getting people thinking about their role within sustaining Rio Verde’s water supply. After completion of the survey and data collection for social-behavioral information, intervention techniques can be deployed such as community meetings, workshops, and other events to promote responsible water use.

To focus on minimizing the need for water on the golf courses there are a couple of alternatives we discovered. One matter-of-fact procedure would be a turf removal program that pays the community anywhere from $0.25-$1 per square foot of turf removed (Greening Planet Earth). Some programs also offer to plant native plants in the same area at an additional cost. These earnings could then be put toward a fund for placing synthetic turf over smaller surface areas than before. This way residents’ golf games don’t have to suffer for the benefit of the desert. Or Rio Verde could take a page out of Colorado’s book. One of their AI certified golf courses, Colorado Flatirons Golf Course, increased their use of high density polyethylene pipes (HDPEs) which resulted in a decrease of about 39% in their water and electricity use. This is possible because these pipes direct water toward specific dry spots rather than over watering the grass overall. It’s important to take into account evapotranspiration rates and times for the Rio Verde area with these pipes as well because if the grass gets watered during the hotter parts of the day, the value of incorporating these additions could be lost both economically and environmentally.

After group deliberation, we collectively decided that implementing outreach to other communities for program structures and recommendations would be key to helping Rio Verde reach their goals and maintain their AI certification. This is especially important considering that Rio Verde shares its watershed with other communities. Rio Verde's water is not isolated to the community, so outside outreach is important. Our team got Sal Celona in contact with Traci Conaway, the recycling coordinator for the City of Chandler to help better construct and implement community waste collection. Traci has many years of managing solid waste on a city wide scale. Traci and Sal are working together to revamp and improve recycling for Rio Verde as a whole. This new partnership will help Rio Verde maintain their AI certification for years to come.

Conclusion

Rio Team 2 learned that all parties involved need to be committed to submitting their deliverables to the other parties on time. This allows for multiple parts of the project to meet deadlines as well as preventing hiccups in the process. We were able to pull together to have our work done on time but getting the data less than a week before our presentation to the stakeholders was an uphill battle. Overall this experience was enlightening and helped the team be able to recognize and harness each member's strengths to finish the task at hand. Rio Verde has work to do to reach their goals and our in class work as well as the partnerships we help set up will have lasting effects to aid the community even after this course is finished. We are grateful for this experience and look forward to watching Rio Verde prosper and continue to be a sustainable community.

Resources

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