

**Spanish Fork Irrigation-Water Conservation Study
Project ID: CEEEn_2018CPST_004**

by

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A Capstone Project 30% Completion Report

Submitted to

**Chris Thompson, P.E.
Spanish Fork City Public Works**

**Department of Civil and Environmental Engineering
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Executive Summary

PROJECT TITLE: Spanish Fork Irrigation-Water Conservation Study
PROJECT ID: CEEEn_2018CPST_004
PROJECT SPONSOR: Spanish Fork City
TEAM NAME: JAW

Spanish Fork City began a water conservation program this last summer that provided residents a Rachio smart irrigation controller professionally installed for free. These smart controllers use precipitation, temperature, and wind data from multiple nearby weather stations to constantly adjust watering schedules. They start up automatically when needed in the spring, ramp up watering as temperatures rise and ramp down in the fall. Eventually, they will automatically notify residents to turn off the sprinklers when watering is no longer needed at the end of the season. The residents operate them from their smart phones and receive notices when the controller automatically suspends watering because of wind or rain.

The goals of this project will be to provide an accurate representation of pressurized irrigation water usage before and after the controllers were installed. City billing information, SCADA data, and reports from the water department of SFC will be utilized in creating this representation. Students will analyze if the new sprinkler system implemented during this summer has contributed to peak reduction for the city of Spanish Fork. Then, the team will recommend an optimal schedule to set smart controllers to best reduce peak demand and estimate the cost benefit of the reduced water usage both in water right acquisition and water right annual maintenance costs.

This coming semester the team will meet these project requirements using the data collected from this semester. Collected data includes monthly water usage from 2011 to 2017, and monthly household usage of three control groups for 2017 and 2018.

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Introduction

The City of Spanish Fork installed 678 Rachio sprinkler systems this past summer. The city expects these automated controllers to reduce peak volume times, water usage, and related costs. The JAW team is working with Spanish Fork's Public Works department to collect and analyze the city's past water data. The team is also collecting data for a control group which will compare households with and without the controllers. After analyzing the data, the team will see the effects from the Rachio installations. This semester the team primarily collected data so next semester's work can focus on analyzation. This report will provide an overview of the team's work these past months, including their project schedule, assumptions, challenges, results, and reflection.

Schedule

October 2018

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	1	2	3	4	5	6
7	8 Team: Lead Measures & Status Report 2 (1 hour)	9 Individual: Work on creating demand curves (3)	10	11 Team: Lead Measures & Status Report 2 update (1)	12 Whitney: weekly contact with Chris Thompson (0.5)	13
14	15 Team: Status Report 3 (1)	16 Individual: Work on creating demand curves (3)	17	18 Team: Status Report 3 update (0.25)	19 Josie: weekly contact with Chris Thompson (0.5)	20 Angie: Contact Dr. Williams about meeting 10/23 (0.25)
21	22 Team: Status Report 4 (1)	23 Team: Meet with Dr. Williams (0.5)	24	25	26 Angie: weekly contact with Chris Thompson (0.5)	27
28	29 Team: Status Report 5 (1)	30 Team: Meet with utility department (1)	31			
	Monday Assigned team tasks Update Calendar Talk about individual tasks			Thursday/Friday Weekly contact with client and update on assigned tasks	Thursday/Friday Weekly contact with client and update on assigned tasks	

November 2018

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
				1 Josie: Status Report 6 (2) Team: Demand curve update (1)	2 Whitney: weekly contact with Chris Thompson (0.5)	3
4	5 Angie: Status Report 7 (2)	6 Team: Study demand per capita (3)	7	8 Team: go over Status Reports (1)	9	10
11	12 Team: Comparison Study Results (1)	13 Whitney: Status Report 8 (2)	14	15	16	17
18	19	20 Team: 30% Completion Report (2)	21	22	23	24
25	26	27	28	29	30	
	Monday Assigned team tasks Update Calendar Talk about individual tasks			Thursday/Friday Weekly contact with client and update on assigned tasks	Thursday/Friday Weekly contact with client and update on assigned tasks	

Assumptions & Limitations

At the beginning of the project, the team assumed the need to have data extending back 10 years that could be used to analyze trends and determine if there was correlation between the implementation of the water conservation program and reduction of peak demand usage of pressurized irrigation. Originally, daily and monthly historical data was desired - one of the greatest limitations of the project was the availability of this desired data.

The team learned early on that the system for recording flow data had become much more accurate over the past year, and that data before 2017 was more of an approximation. The historical information that was available before 2017 was monthly usage back to 2011 (Figures 1-6, Appendix A). Even though monthly data is less specific, it will help the team create an image of water usage before the water conservation program.

An assumption that is impacted by the use of monthly data is that of environmental and population conditions being similar in years being analyzed to find the effect of a water conservation program (i.e. it was not a year with a higher amount of precipitation that caused a reduction in water usage). This assumption is limited by nature in the fact that each year has different environmental circumstances that will affect water usage. In further analysis, weather, temperature, rainfall, and population change will need to be taken into consideration. Analyzing the annual trends between 2011-2017, the team can determine an average growth factor that will envelop differences in environment and population and help the team yield meaningful results.

Another tactic used in dealing with the limitations of this assumption of equivalent conditions is the comparing of percentages instead of amounts. This was and will be used for years with daily data, 2017 and 2018. For example, peak daily water usage before the controllers were installed in 2018 occurred on average at 10:00 PM. The demand at this hour was 7.49% of the total daily water usage (Figure 1). In 2018, after the smart controllers were installed, the peak still occurred at 10:00 PM at a flow of 7.11% of the total daily water usage (Figure 2). Figures 1 and 2 are based off data from Tables 8 and 9 in Appendix A. Even though circumstances, such as temperature and rainfall, of the days were different, this percent of volume can be compared to show a difference in water usage. This example evidences peak reduction due to the installation of 678 smart controllers in 2018.

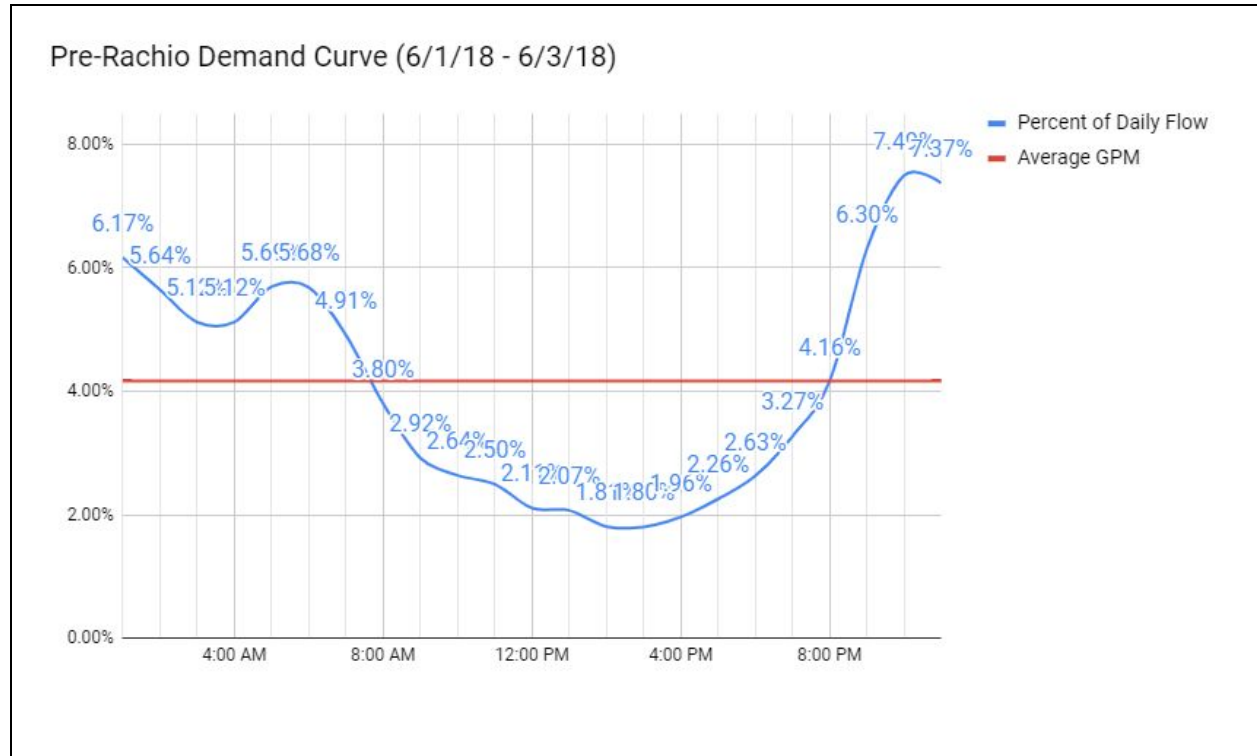


Figure 1: Hourly percentage of average daily flow of 3 days before smart controller installations in 2018

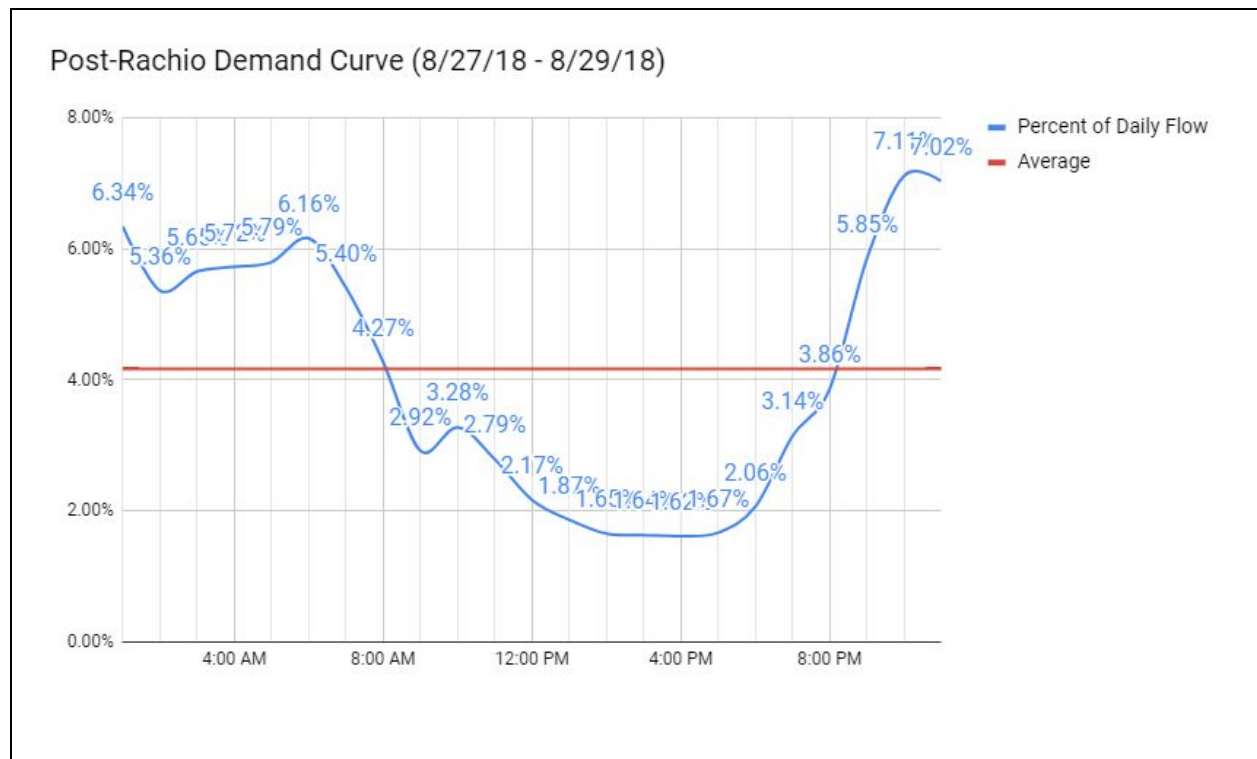


Figure 2: Hourly percentage of average daily flow of 3 days after smart controller installations in 2018

Results

This semester the team mainly collected data. This included monthly usage well data from 2011-2017, hourly data from June 1-3 and August 27-29 of 2018, and sprinkler household data. The monthly well data can be seen in Tables 1 through 7. From this well data, the team will analyze peak demands across recent years. From the household data, control groups will be created that will help the team evaluate how the Rachio controllers are affecting peak demands and water usage. This household data was obtained recently and is still being organized by the team so a table of this data has not been included in this report. The hourly data for the six dates in 2018 has been collected and analyzed. The June dates have data before the Rachio installations and the August dates have data for after. The team found that the peak demand was reduced from 7.49% to 7.11%. This data is displayed in Tables 8 and 9 and the results are shown in Figures 1 and 2.

The number of connections in the water system in Spanish Fork increased by 4% in 2018. Despite this growth in connections, with Rachio controllers there was only a 1.2% of the city's supplied water for drinking and irrigation; the supplied water was increased from 10,230 ac-ft in 2017 to 10,345 ac-ft in 2018. The team's work for next semester will yield analytical results for all the stated data collections, which will provide further information regarding water conservation and cost benefits from the Rachio installations.

Lessons Learned

First, the team encountered problems with knowing what data would be used for comparison between water usage before the sprinkler controllers were installed and the water usage after. Due to the fact that previous years' data was not as accurate or organized, and had missing values, the team didn't know how useful it could be. In addition, because all the Rachio sprinkler controllers were installed during this summer, there was limited data to analyze that is "post-installation." Finally, the team was not sure how certain environmental factors (e.g. hot weather, rain) would affect the comparison between pre- and post-Rachio.

The team members learned the importance of having close communications with the faculty mentor, in their case Dr. Williams. He explained why more data is always better for analysis. Therefore, even when previous years' data is inaccurate, the decision was made to use all data available. In spots where information is missing, the team will fill the blanks with estimated values. To the team's knowledge the system for recording flow data has become much more accurate over the past year, and data before 2017 is more of an approximation. Therefore, pivot tables will be created to organize this data and help with later analysis, as well as creating an image of water usage before the water conservation program.

The team discussed and decided the best data comparison would be to compare June 1-3, 2018 to August 27-29, 2018 because this is accurate data from this year representing before and after the sprinkler controllers were installed. In comparing to previous years, it was decided to obtain data from those days (6/1-6/3 and 8/27-8/29) from the past five years to create a robust comparison between how water usage per capita has existed in past years, and how that compares to this year's data which includes the integration of the smart irrigation controllers.

To create more accurate comparisons between data, the team decided to compare within years and not across years. Meaning that although the data of last year won't be as accurate as the data from this year, 2017 will not be compared directly to 2018 data. Instead, there will be a comparison between June 2017 and August 2017, in which both will have the same level of error and a percent difference can be obtained between them that will be comparable to 2018.

The team has monthly data from 2011 to present, which will be used to find historical peak volumes for recent years. This will give an idea on how peak volumes are being affected with the new sprinkler system and eventually how or if the sprinkler system is providing a cut cost. The team will use maximum usage days of past years and continue with our specific dates for June and August from 2017 to compare.

Finally, in order to have a better use of the data, 3 control groups of 40 houses within the same area (wind fan vs non wind fan) will be created. This evaluation will be only for 2017 and 2018, and will give us a trend that will be later discussed with Dr. Williams for further analysis.

Conclusions

The team has learned about how to effectively gather and compare data between years that would provide meaningful results in regards to water conservation. Monthly data can be used to look at trends. This is important because as total usage goes up, peak reduction is essential in having an effective system. A 1% annual increase in water usage may not seem significant, but long-term that trend will lead to expenses in regards to water rights acquisition and the need to add to the pressurized irrigation system. Daily data can be used to determine how people behave differently with the use of smart controllers.

The team conclusion at this point is that peak reduction was made possible by the water conservation program. With the 678 controllers installed, the highest daily peak demand was reduced from 7.49% to 7.11% of total daily water usage. Also, with the 4% growth in connections to the Spanish Fork City water systems in 2018, we were able to help conserve water and have an approximate (December drinking water estimated) 1.2% increase in supplied water for both drinking water and pressurized irrigation, with a measured value of 10,230 ac-ft in 2017 and 10,345 ac-ft in 2018. This peak reduction and conservation will be proved further in the coming semester with evidence from the 3 control groups.

Recommendations

At the current point in the project, the capstone team recommends that the city continue with rigorous data collection so that in the future, daily measurements can be used to analyze city pressurized irrigation use.

In creating even greater results, a new watering schedule will be recommended based on results of data analysis in the coming semester. This schedule will need to be created using trial and error. Because the controllers can be controlled from the city dashboard, such iterations may be possible. Currently the smart controllers' schedules are formatted according to geographical position and address, as shown in Figure 3.

Acronym	Description	Time Block Start	Time Block End
NFO	Non-Wind Fan Area Odd Address	3:45 AM	6:00 AM
NFE	Non-Wind Fan Area Even Address	8:00 AM	10:00 AM
F12	Wind Fan Area Addresses ending with 1 or 2	10:00 AM	3:00 PM
F34	Wind Fan Area Addresses ending with 3 or 4	11:00 AM	4:00 PM
F56	Wind Fan Area Addresses ending with 5 or 6	12:00 PM	5:00 PM
F78	Wind Fan Area Addresses ending with 7 or 8	1:00 PM	6:00 PM
F90	Wind Fan Area Addresses ending with 9 or 0	2:00 PM	7:00 PM
NA	Non-Adjustment Requestees	-	-

Figure 3: Current recommended watering schedule

The wind fan area referred to in Figure 3 is a section of Spanish Fork near Spanish Fork canyon that is affected by more wind during the night. In Figure 4 below, it appears as the red area within the wind boundary line. It is recommended that homes within this are water during the day because wind evaporates water 6 six times more than the sun. The schedule that the team compiles at the completion of the report will continue to take the wind fan area into consideration.

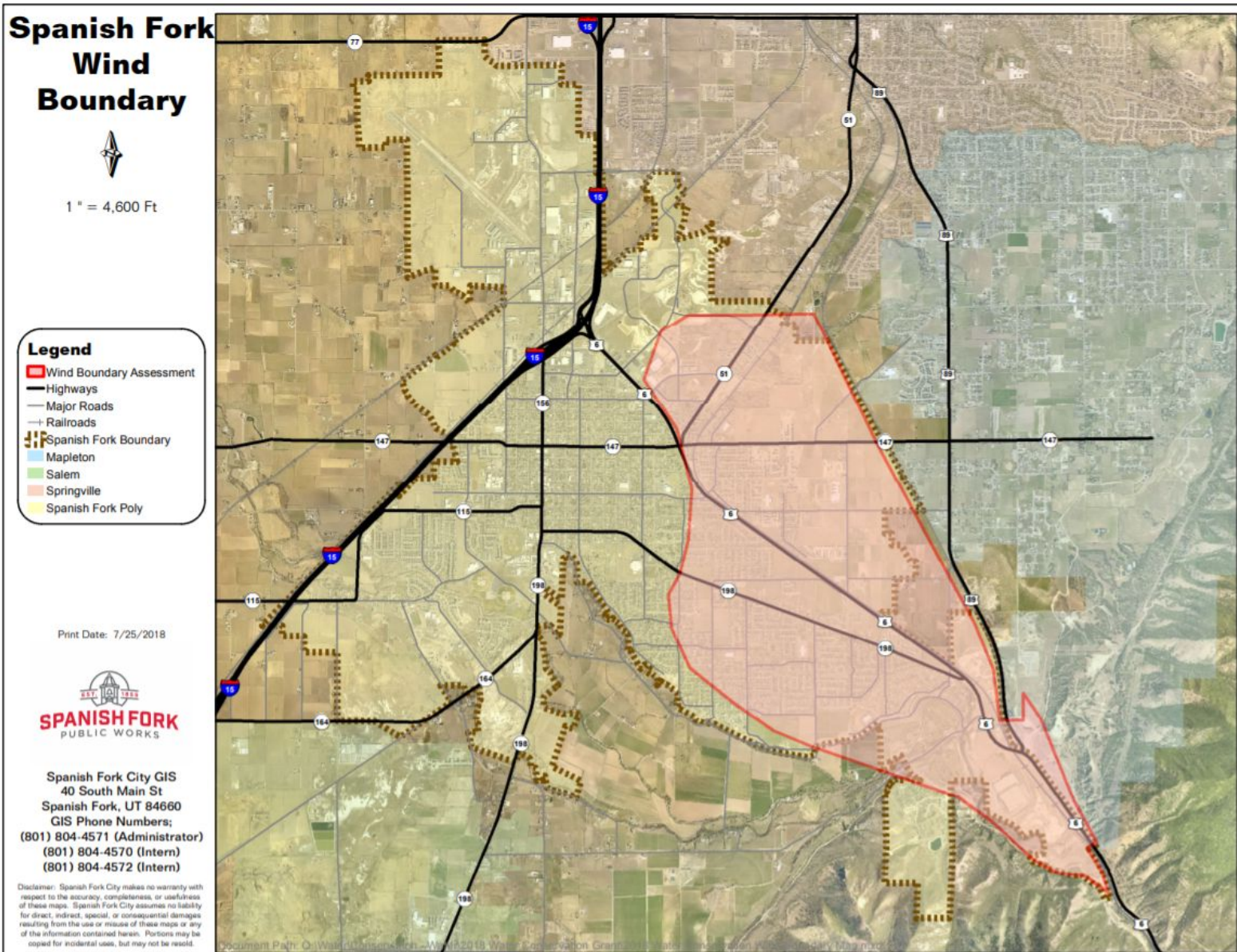


Figure 4: Map of Spanish Fork wind boundary

Appendix A

Table 1: Historical Data from 2011

Year	Month	Memorial Well	Fairgrounds	#2 Cemetary Well	#1 Cemetary Well	Canyon Elementary Well	Canyon Road Well	2550 East Booster	Darger Springs	Darger Bypass	Malcomb PI Booster
2011	1	0	0	0	0	28361	-28736	0	13	19	0
2011	2	0	0	0	0	39421	-32920	0	0	0	0
2011	3	0	0	0	0	20070	0	0	0	0	0
2011	4	0	0	0	0	-138	1613	0	13271	0	0
2011	5	0	3	3645	0	4532	0	0	24669	0	0
2011	6	33988	12182	14057	8320	48038	18975	3182	27150	0	0
2011	7	18536	30876	23131	13506	48848	19110	34653	22686	0	0
2011	8	37738	9857	14936	10246	65928	24700	37313	29825	0	7316
2011	9	15512	0	2928	1132	4838	18821	17618	32179	0	0
2011	10	0	0	0	0	131	17664	0	1917	0	0
2011	11	0	0	0	0	20	2519	0	0	0	0
2011	12	0	0	0	0	17542	368	0	0	0	0

Year	Month	Golf Course Booster	Olsen Well	Ball Park PRV	Ensign Bickford Well
2011	1	0	0	18906	18906
2011	2	0	0	15703	15703
2011	3	0	0	17221	17221
2011	4	6	0	3	12268
2011	5	0	0	3	16664
2011	6	33000	0	3466	16664
2011	7	88682	0	1017	20427
2011	8	80461	0	8800	17393
2011	9	148558	0	265	21398
2011	10	5709	0	5615	9671
2011	11	0	0	18897	18897
2011	12	0	0	19763	19763

Table 2: Historical Data from 2012

Year	Month	Memorial Well	Fairgrounds	#2 Cemetary Well	#1 Cemetary Well	Canyon Elementary Well	Canyon Road Well	2550 East Booster	Darger Springs	Darger Bypass	Malcomb PI Booster
2012	1	2101859	457803	58697	214751	693227	647660	239962	425446	0	63107
2012	2	2101859	457803	58697	214751	711917	655901	239962	425446	0	63107
2012	3	2101859	457803	58697	214751	723473	655901	239962	425446	0	63107
2012	4	2101859	457803	58697	214751	723759	671329	239962	426162	0	63107
2012	5	2101859	457803	64610	214751	742960	693141	246111	450385	0	63107
2012	6	2105033	457803	78522	214751	792867	720764	278204	477496	0	63107
2012	7	2144718	484058	4618	245666	884668	778801	298160	512842	0	63107
2012	8	2192296	491201	17330	263115	928210	808222	307869	545917	0	63107
2012	9	2244813	492119	29183	277105	998120	836453	309856	579477	0	63107
2012	10	2246207	492119	33751	278964	50197	852365	309856	608872	0	63107
2012	11	2246207	492119	33751	278964	62297	857052	309856	623588	0	63107
2012	12	2246207	492112	33751	278964	62297	857052	309856	623588	0	63107

Year	Month	Golf Course Booster	Olsen Well	Ball Park PRV	Ensign Bickford Well
2012	1	621006	0	506737	
2012	2	621006	0	523997	
2012	3	621006	0	541845	
2012	4	621006	0	554280	
2012	5	636999	0	554280	
2012	6	758458	0	554291	
2012	7	838824	0	554367	
2012	8	940685	0	554552	
2012	9	92098	0	555267	
2012	10	227058	0	555287	
2012	11	265243	0	556136	
2012	12	265243	0	574293	



Table 3: Historical Data from 2013

Year	Month	Crab Creek	Cold Springs	Malcomb Springs	Malcomb Boosters	Oak Boosters	Memorial Well	Fairgrounds	#2 Cemetery Well	#1 Cemetery Well
2013	1	972039	972039	858646	24981	316261	2246207	4779099	337518	278963
2013	2	685193974	972039	908055	24868	317216	2246207	4779099	337518	278964
2013	3	738689900	972039	967596		317909	2246207	4779099	337518	278964
2013	4	782659	972039	16509	25204	318825	2246207	4779099	337518	278964
2013	5	826228	972039	71199	26387	320110	2246207	4779099	390310	279179
2013	6	873693	972039	142644	33856	323627	2259231	492119	514606	286283
2013	7	911485	972039	203453	37252	329063	2299302	513264	757034	304740
2013	8	952491142	972039	278916	43410	334455	2343999	530745	973979	328457
2013	9	993702	972039	349155	45120	339613	2381415	546033	207519	351924
2013	10	40835713	972039	398090	45120	342055	2390825	546033	315838	360507
2013	11	125291942	972039	500571	47305	344013	2390825	546033	334683	360507
2013	12	141222	972039	500571	47305	343965	2390825	546033	334683	360507

Year	Month	Canyon Elementary Well	Canyon Road Well	2550 East Booster	Darger Springs	Darger Bypass	Malcomb PI Booster	Golf Course Booster	Ball Park PRV	Ensign Bickford Well
2013	1	62297	862397		623588	30506	63107	26524.3	591963	17520
2013	2	62297	862397		623588	30506	63107	26524.5	608950	17520
2013	3	62297	867540	309837	623588	30506	63107	26524	628246	17520
2013	4	62297	870075	309837	623588	30506	63107	26524.5	637656	17520
2013	5	71790	870780	309837	639492	30506	63107	26524.5	637656	17520
2013	6	123866	889973	332758	658420	30506	63107	362087	638308	17520
2013	7	166825	927937	374570	686485	30506	631	495150	641136	17520
2013	8	213695	960413	415634	718480	37044	43410	654155	645188	17520
2013	9	255731	989962	468570	753015	44416	43410	792371	648915	17520
2013	10	283458	13160	456570	776170	47199	63107	842138	649945	17520
2013	11	300621	23844	466876	785660	47198	631	842138	662719	17520
2013	12	300621	26844	466876	785668	47158	63107	842138	670613	17520



Table 4: Historical Data from 2014

Year	Month	Crab Creek	Cold Springs	Malcomb Springs	Malcomb Boosters	Oak Boosters	Cold Springs Lower	Memorial Well	Fairgrounds
2014	1	166270	972039	563373	51526	344748		2390825	546033
2014	2	205243	972039	619267	61981	345465		2390825	546033
2014	3	244453	972039	670001	74457	346213		2390825	546033
2014	4	279094	973957	713316	82525	346961		2390825	546033
2014	5	301968	52608	782531	95928	348910	6882.22	2390825	546033
2014	6	352419	98205	840745	102238	352127	7104.54	2390825	546033
2014	7	385371	112332	903999	103002	356983	7350.95	2390825	547577
2014	8	420610	140567	983253	103106	362880	7593.96	2390825	554338
2014	9	458958	155912	57817	103106	367458	7847.32	2390833	554338
2014	10	495272	164998	118362	103148	370745	8068.02	2393862	554338
2014	11	537397	178314	170766	103148	373730	8282.42	2393862	554338
2014	12	572849	188753	209144	103148	375202	8326.38	2393862	554338

Year	Month	#2 Cemetery Well	#1 Cemetery Well	Canyon Elementary Well	Canyon Road Well	2550 East Booster	Darger Springs	Golf Course Booster	Ball Park PRV	Ensign Bickford Well
2014	1	33468	360507	301220	25914	456876	785668	842138	679991	17520
2014	2	33468	360507	306630	30295	456876	785668	842138	700005	17520
2014	3	33468	360507	320198	36436	456876	785668	842138	720108	17520
2014	4	33468	360507	333000	40409	456876	785668	842138	732131	17520
2014	5	41190	360507	336936	61219	456876	808537	871814	732131	17520
2014	6	56593	363919	357269	96145	456876	827580	973225	732132	17520
2014	7	78921	375308	376754	142693	456876	852760	114449	732132	17520
2014	8	97344	395482	451908	188488	456876	879907	251933	732132	17520
2014	9	99970	398590	506806	212432	456876	900256	33266	732136	17520
2014	10	3309	398590	541981	221705	456876	920731	369404	732318	17520
2014	11	3309	389590	549685	225282	456876	934608	369404	732319	17520
2014	12	3309	389590	549685	225282	456876	934608	369404	744479	17520

Table 5: Historical Data from 2015

Year	Month	Cold Springs Lower	Memorial Well	Fairgrounds	#2 Cemetery Well	#1 Cemetery Well	Canyon Elementary Well	Canyon Road Well	2550 East Booster	Darger Springs	Darger Bypass	Malcomb PI Booster
2015	1	8326.47	2393862	554338	33095	398590	549085	255282	456876	934608	0	0
2015	2	8343	2393862	554338	33095	398590	549085	255282	456876	934608	0	0
2015	3	8343	2393862	554338	33095	398590	549685	255282	456876	934608	0	0
2015	4	8422.97	2395162	554338	33195	398590	549685	225436	456876	934608	0	0
2015	5	8630.14	2397597	554338	33195	398590	552375	241508	456876	957321	0	0
2015	6	8776.31	2400032	554338	33480	398590	562846	248020	456876	967813	0	0
2015	7	8981.83	2447374	567442	34392	425431	629056	275349	456876	994114	0	0
2015	8	9218.14	2473013	578338	35304	453631	700108	308314	456876	22077	0	0
2015	9	9431.65	2473965	580476	48108	454597	760588	331279	456876	45632	0	0
2015	10	9644.24	2473965	580476	49144	454597	818179	349110	456876	695381	0	0
2015	11	9823.8	2473965	580476	49144	454597	842311	630182	456876	84040	0	0
2015	12	9823.8	2473965	580476	49144	454597	842495	361162	456876	84040	0	0

Year	Month	Golf Course Booster	Olsen Well	Ball Park PRV	Ensign Bickford Well
2015	1	369404	0	765433	17517500
2015	2	369404	0	780414	17517500
2015	3	369404	0	793959	17517500
2015	4	369404	0	797368	17517500
2015	5	369404	0	797806	17517500
2015	6	370008	0	797806	17517500
2015	7	434237	0	798815	17517500
2015	8	576728	0	799204	17517500
2015	9	695381	0	799211	17517500
2015	10	787676	0	799211	17517500
2015	11	795601	0	-	17517500
2015	12	795601	0	815409	17517500



Table 6: Historical Data from 2016

Year	Month	Cold Springs Lower	Memorial Well	Fairgrounds	#2 Cemetery Well	#1 Cemetery Well	Canyon Elementary Well	Canyon Road Well	2550 East Booster	Darger Springs	Darger Bypass
2016	1	9823.8	2473965	580476	49144	454597	842828	361281	456876	84040	0
2016	2	9823.8	2473965	580476	49144	454597	842828	361281	456876	84040	0
2016	3	9823.8	2473965	580476	49144	454597	842828	361263	456876	84040	0
2016	4	9846.6	2473965	580476	49144	454597	842828	361282	456876	84040	0
2016	5	226	2473965	580496	49159	454968	850752	375733	456876	90068	0
2016	6	118112	2473965	581483	50696	456771	894711	390279	456876	111571	0
2016	7	3820.5	24803.13	598325	70651	47749.7	96319.2	423746	456876	13752.5	0
2016	8	59591	2522574	24224	93917	510278	38676	461835	456876	166605	0
2016	9	81691	2549146	624234	61307	532924	98119	499375	456876	195313	0
2016	10	102090	2549146	624234	87164	538935	98119	507438	456876	210199	0
2016	11	118952	2549146	624234	87164	538935	98119	507438	456876	212341	0
2016	12	1194.83	2549746	624234	8716	538935	98119	507438	456876	212341	0

Year	Month	Malcomb PI Booster	Golf Course Booster	Olsen Well	Ball Park PRV	Ensign Bickford Well
2016	1	0	795601	0	831354	17517500
2016	2	0	795601	0	848460	17517500
2016	3	0	795601	0	850629	17517500
2016	4	0	795601	0	857645	17517500
2016	5	0	798508	0	85754	17517500
2016	6	0	801162	0	857963	17517500
2016	7	0	911057	0	858437	17517500
2016	8	0	48223	0	860461	17517500
2016	9	0	211474	0	860564	17517500
2016	10	0	326997	0	860564	17517500
2016	11	0	357980	0	860564	17517500
2016	12	0	357980	0	8874158	17517500

Table 7: Historical Data from 2017

Year	Month	Cold Springs Lower	Memorial Well	Fairgrounds	#2 Cemetery Well	#1 Cemetery Well	Canyon Elementary Well	Canyon Road Well	2550 East Booster	Darger Springs	Darger Bypass	Malcomb PI Booster
2015	1	119438	25497	624234	8716	538935	98119	507438	456876	212341	0	0
2015	2	119438	25497	624234	8716	538935	98119	507438	456876	212341	0	0
2015	3	119438	25497	624234	8716	538935	0	507438	456876	212341	0	0
2015	4	119494	25497	624234	8716	538935	0	507438	456876	212341	0	0
2015	5	1310.66	25497	624234	8716	538935	0	507438	456876	212341	0	0
2015	6	156845	25497	624234	87545	538935	5282	5243.6	456876	222375	0	0
2015	7	180306	2568874	624234	16076	559766	77732	565462	456876	249187	0	0
2015	8	208088	2612444	624287	34069	587315	19831	602677	456876	279905	0	0
2015	9	2392.49	2620741	624287	53935	590342	23887	644713	456876	312180	0	0
2015	10	2604.37	2620741	624287	64600	590342	266290	649861	456876	322110	0	0
2015	11	0	2620741	624287	64600	0	0	0	456876	326869	0	0
2015	12	2725.5	2420741	624287	64600	595700	297440	660879	456876	326870	0	0

Year	Month	Golf Course Booster	Olsen Well	Ball Park PRV	Ensign Bickford Well
2015	1	357980	0	0	17517500
2015	2	357980	0	900701	17517500
2015	3	357980	0	912252	17517500
2015	4	364632	0	922414	17517500
2015	5	369555	0	922428	17517500
2015	6	485256	0	922438	17517500
2015	7	640634	0	922438	17517500
2015	8	728411	0	922454	17517500
2015	9	728411	0	922516	17517500
2015	10	728411	0	922516	17517500
2015	11	728411	0	0	17517500
2015	12	728411	0	935107	17517500

Table 8: Hourly Flows for 6/1/18 - 6/3/18

Pre-Rachio GPM	Average GPM	Percent of Daily Flow
10,885	4.17%	6.17%
9,960	4.17%	5.64%
9,034	4.17%	5.12%
9,041	4.17%	5.12%
10,049	4.17%	5.69%
10,030	4.17%	5.68%
8,662	4.17%	4.91%
6,708	4.17%	3.80%
5,153	4.17%	2.92%
4,658	4.17%	2.64%
4,407	4.17%	2.50%
3,725	4.17%	2.11%
3,656	4.17%	2.07%
3,194	4.17%	1.81%
3,181	4.17%	1.80%
3,468	4.17%	1.96%
3,984	4.17%	2.26%
4,639	4.17%	2.63%
5,773	4.17%	3.27%
7,348	4.17%	4.16%
11,124	4.17%	6.30%
13,228	4.17%	7.49%
13,006	4.17%	7.37%
11,597	4.17%	6.57%

Table 9: Hourly Flows for 8/27/18 - 8/29/18

Post-Rachio GPM	Average	Percent of Daily Flow
12,204	4.17%	6.34%
10,327	4.17%	5.36%
10,883	4.17%	5.65%
11,020	4.17%	5.72%
11,161	4.17%	5.79%
11,858	4.17%	6.16%
10,410	4.17%	5.40%
8,229	4.17%	4.27%
5,621	4.17%	2.92%
6,314	4.17%	3.28%
5,372	4.17%	2.79%
4,181	4.17%	2.17%
3,596	4.17%	1.87%
3,187	4.17%	1.65%
3,151	4.17%	1.64%
3,118	4.17%	1.62%
3,218	4.17%	1.67%
3,975	4.17%	2.06%
6,054	4.17%	3.14%
7,433	4.17%	3.86%
11,260	4.17%	5.85%
13,694	4.17%	7.11%
13,531	4.17%	7.02%
12,829	4.17%	6.66%

Josephine Paxton

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Education

Bachelor of Science in Civil and Environmental Engineering

Brigham Young University

- GPA: 3.75

Relevant Skills and Coursework

- Mathematics Minor
 - Microsoft Office, ArcGIS (central application: ArcMap)
 - Fluid mechanics/hydraulics, statics/dynamics
- current:* structural analysis, soil mechanics, transportation

December 2019

Provo, UT

Work Experience

Research Assistant

Dr. Daniel P. Ames, Ph.D., P.E.

- Conduct user study for the Vuepod, BYU 3D/stereoscopic immersive visualization system for viewing Lidar data sets
- Prepare and offer a presentation on the Vuepod at Utah's Conference for Undergraduate Research

August 2013 – April 2014

Provo, UT

Research Assistant

Dr. Dawn Teuscher, Ph.D.

- Use the video analysis platform Studiocode to analyze the reasoning and motivation behind middle grades teachers' decisions (e.g. curricular resources, student needs and struggles, reflection and revision)
- Present research at the Utah Council of Teachers of Mathematics conference

April 2017 – current

Provo, UT

Administrative Intern

Spanish Fork City Public Works

- Improve the Capital Facilities Plans for the city water, wastewater, fleet and garbage, and electric departments
- Participate in the implementation and analysis of a city-wide water conservation program
- Develop rate studies, city-to-city comparison studies and annual reports for all departments

September 2017 – current

Spanish Fork, UT

Accomplishments and Activities

Service

Religious

- Joint leader over female group (ages 18 to 29) in local congregation and as missionary volunteer

Community

- Member of Utah Healing Arts, a program for providing music to nursing homes in Provo and surrounding cities (25 hours)
- Volunteer at food drives organized by The Salvation Army in Grandview, Washington (18 hours)

Educational

- 2014 Phi Eta Sigma Honor Society inductee
- Conversant in Spanish
- Recipient of BYU Academic Scholarships (Fall 2014-Winter 2019)

Character

- Completed 3 marathons
- Manage two jobs for over a year while full-time student

Whitney Robison

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EDUCATION

Brigham Young University

April 2019

GPA: 3.44

Provo, UT

Civil Engineering Major

- Mathematics Minor
- Passed the FE exam

EXPERIENCE

BYU Civil Engineering Department

Provo, UT

Teacher Assistant for Hydraulics

September 2018 – current

Helped students with hydraulic equations and concepts
Communicated regularly with professor

Café Zupas

Orem and Spanish Fork, UT

Line Server and Catering Driver

Summers 2017 – 2018

Interacted daily with positive assistance and energy for countless customers
Paid strict attention to details, including memorization of ingredients for 35+ menu items
Complied to attentive shifts with precise prepping, serving, and cleaning procedures

BYU Mathematics Department

Provo, UT

Teacher Assistant for Calculus

September 2015 – December 2015

Used Excel for the data reporting of about 50 students
Assisted professor with grading assignments three times a week
Worked independently

Caldera Engineering

Provo, UT

Receptionist

Summers 2012 – 2014

Handled mass amounts of documents and organized past-order form files
Arranged and coordinated annual company events and foreign business trips
Answered and transferred phone calls for 40 employees

SKILLS

-
- Practice with ArcGIS, AutoCAD, and surveying equipment
 - Proficient in Microsoft Office
 - Great communication skills with colleagues and customers

ADDITIONAL INFORMATION

-
- Student member of ASCE and ITE
 - Interests: travel, hikes, puzzles

Angie Ayaviri Dominguez

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Education

Bachelor of Science in Civil Engineering

December 2019

Brigham Young University

Provo, Utah

- GPA: 3.66
- ASCE membership

Associate of Science

July 2014

Brigham Young University- Idaho

Rexburg, Idaho

- Full Academic Scholarship
- Magna Cum Laude Honors

Skills

- Proficiency in InfoWater and ArcGIS programs
- Basic Knowledge on AutoCAD
- Writing, speaking and reading in Spanish (Native)

Experience

Civil Engineer Intern

September 2017 – Present

Public Works

Spanish Fork, Utah

- Co-design the main city drinkable water model using InfoWater.
- Conducted 10+ traffic counts during select time periods. as directed.
- Learned to provide customer service by attending to customers needs through phone calls and personal interactions

MTC Seminar Specialist

July 2018 – August 2018

Provo Missionary Training Center

Provo, Utah

- Ushered 30+ meetings in Spanish, English and Portuguese
- Maintained very professional agenda for religious leaders.

MTC Spanish Interpreter Trainer

September 2016 – July 2018

Provo Missionary Training Center

Provo, Utah

- Interpreted for up to 25+ different meetings that Non- English missionaries experience during their stay at the MTC.
- Translated 100+ documents from English to Spanish and vice versa for their distribution around other MTC's around the world

Teacher's Assistant

April 2014 – July 2014

BYU-Idaho Geology Department

Provo, Utah

- Conducted pre-tests with hands-on demonstrations
- Tutored groups of up to 15 students which led increased knowledge of material

Service

Full-Time Religious Missionary

November 2014 – May 2016

The Church of Jesus Christ of Latter-Day Saints

Saint George, Utah

- Organized 50+ tours per day through visitor centers.
- Communicated with people in person, over the phone, through e-mail, and online chat in Spanish and English.

Volunteer Tutor 2014

January 2014 – July

BYU-Idaho Spanish and Physics Department

Rexburg, Idaho

- Tutored one to one students once a week for 2+hours