AURORA WATER

Water Use Inefficiency Mapping and Identification Integrated with the System Incentive Program (SIP) Project

CWCB Final Grant Report

June 2014

The City of Aurora

Water Conservation Division

Contents

Executive Summary

The City of Aurora Water Department and its partners have completed the *Water Use Inefficiency Mapping and Identification Integrated with the System Incentive Program (SIP) Project*. This report details the work undertaken and the end results of the System Incentive Program. Overall the project provided Aurora Water Conservation (AWC) an innovative way to track and assess water use throughout the City. The original criteria for the development of the Water Use Efficiency Database was one dimensional, but as AWC continues to work with the Efficiency Database, it has become apparent there are more ways to utilize information it provides. The original intent of targeting inefficient outdoor water users at the end of every season, using a map of the entire city that grades each tax parcel based on their water use efficiency, was achieved. Additionally, the Water Use Inefficiency Database is also giving Aurora Water the ability to develop:

- Single Family Volume Allocation based on lot size
- Neighbor comparison tool
- Land Use driven water projections as part of our Integrated Water Master Plan (IWMP) and Water Conservation Plan (WCP)
- Water Use trends related to demographics
- Reporting data for HB1051
- Sitemap data management
- Improved accuracy of sitemaps and water budgets
- Volume Allocation Program for CII customers
- Impervious data for IWMP
- Potential Storm Water uses
- SIP program
- Interactive Water Budget Map

While the Efficiency Database has become an integral way to assess customer water use, there are limitations of the Database that need to be addressed to make it more effective. During the outreach phase of the project AWC attempted to enroll 200 participants in the SIP. By using the Water Conservation Calculator these customers could become eligible for additional rebate incentives. AWC contacted 343 customers that were inefficiently using water either inside or outside of the home. 12 % of the customers contacted scheduled an indoor or outdoor audit. The free audits were offered as a way to help promote the Calculator and gather some of the input data that corresponds to the more technical portions of the Calculator. Only 5% of the customers contacted by AWC used the Calculator. Based on this data, AWC would need to contact approximately 4,000 customers to achieve the original goal of having 200 customers use the Water Calculator. The other limitation AWC ran into was the accuracy of the vegetation data at the parcel level that impaired data collection. Even though there were barriers in accomplishing the original project's goal, the benefits of the Efficiency Database are worth the investment.

1.0 Project Background

In 2007, Aurora Water submitted a Water Conservation Plan to the State. In this plan, it was determined that the conservation potential for single-family indoor water use was 5,800 acre feet if all fixtures were retrofitted. In looking at the overall conservation goals for all sectors, the plan stipulates a 10% reduction in per capita demand over the next 25 years (from 2007), saving a targeted 100 – 150 acre-feet per year. To meet this goal Aurora Water Conservation (AWC) wanted to change the way water conservation was implemented. The System Incentive Program (SIP) allows AWC to find and contact highly inefficient customers in order get them involved in our programs. The programs currently available to Aurora Water customers include indoor and outdoor water audits, toilet, irrigation, and Xeriscape rebates. The goals of the SIP are to switch AWC's rebate programs from reactive to proactive and help customer make the most cost effective decisions for their households based on customized data profiles.

Typically, water conservation has been a reactive program helping customers as they contact staff for assistance, regardless of whether the programs they choose to participate in are really the best option for them. Americans, even those in dry Western climates, greatly underestimate the amount of water their appliances use and the difference retrofits or behavior changes will make in their total use (Figure 1). AWC believes that customers understanding where and how much water they use is the first step in beginning to conserve. With the Water Conservation Calculator customers will receive an analysis of their current water use and conservation potential.

The Water Conservation Calculator is the foundation of the SIP. The Calculator was created in 2011 as an education tool. As customers are contacted and enrolled in the SIP, the Calculator is used to determine what their best retrofit options are based on a customized return on investment (ROI) table. AWC incentivizes these changes by offering additional rebate funds for participating customers. The end goal of the SIP is to have 200 customers complete the Calculator and make the suggested retrofits and behavior changes on an annual basis.

As the 'low-hanging fruit' of conservation efforts disappear due to conservation successes, AWC will move forward in its programs by tailoring rebates to customers based on actual gallons and dollars saved. In the future, the AWC retrofit program will have a greater water savings for a lower cost because of increased targeting of highly inefficient water users and by working with all customers to retrofit their system and change behavior based on data.

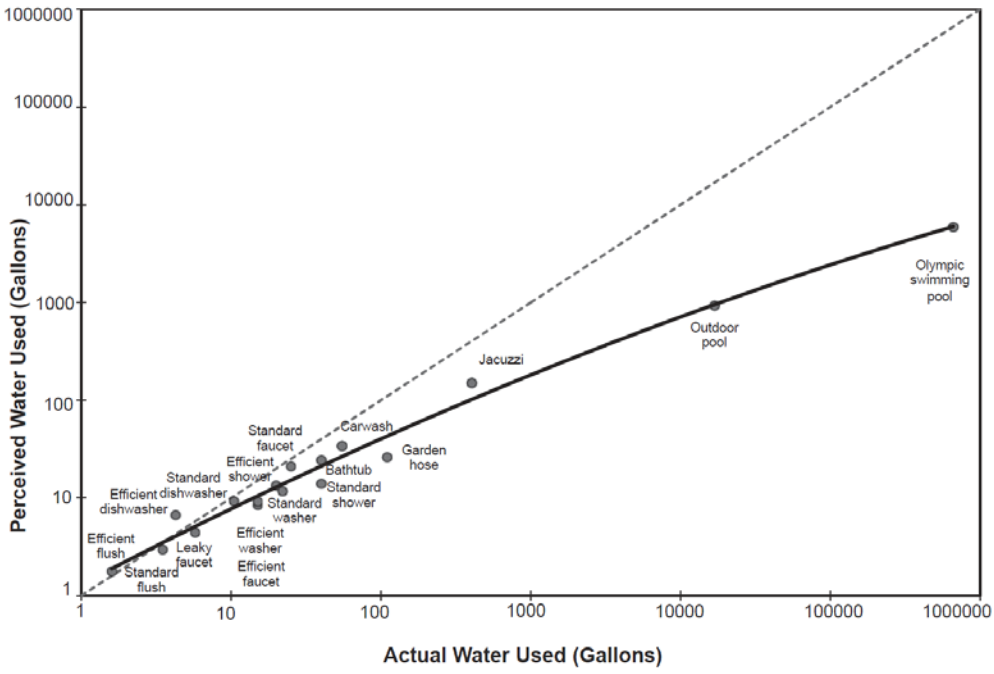


Figure 1: Mean Perceptions of Water Use. Mean perceptions of water use as a function of actual water use for 17 different behaviors and activites. Error bars for 95% confidence intervals are omitted because they are typically no taller than the symbols themselves. The diagonal dashed line represents perfect accuracy. (Attari, 2014)

2.0 Budget

Altogether, the proposed budget for the project was $167,071. The final expenditures amounted to $151,679. One of the larger discrepancies was in the in-kind services provided by Aurora Water. This is mainly due to a lack of response from customers to the SIP portion of the grant. See Appendix A for more details on the specific funding breakdown for the project.

3.0 Project Implementation

The project was designed to take place over a two year period, however due to data and online calculator issues, the project got extended six months. Once the grant was approved, AWC contracted with AMEC to develop a map of the city showing both pervious and impervious areas and linking those areas with tax parcels and water use data. AWC then began identifying those customers who were extremely inefficient in their water use, separating the list between indoor and outdoor inefficient users. The following sections discuss in detail how the project was implemented.

3.1 Land Cover Analysis, Database Development, and Geoprocessing

In order to find the top 200 most inefficient water users, AWC contracted with AMEC Earth & Environmental. AWC worked with AMEC to map landcover, classify vegetation

health, map water use, and to create a water-efficiency calculation tool. To map the landcover throughout Aurora, AMEC used 2010 aerials utilized to perform an image classification process. Surfaces were mapped into 4 layers: vegetation, impervious, bare-earth (unpaved, dead vegetation, mulch, etc), and water/shadow. The vegetation layer was also classified by three levels of 'health' (chlorophyll response in infrared band): high, medium, and low.

Working with AWC staff, AMEC created a Water Efficiency Database by combining tax parcels, vegetative landcover, and historic water consumption. It supports calculations for recommended water use per parcel, and also allows comparisons to be made between *recommended* water use (RWU) and *actual* water use (AWU) to rate per-parcel efficiency. Since the resulting data is all GIS-based, it is easy to display parcels by degree of consumption or by efficiency rating, search or query as needed, perform calculations, and map or report desired information (Figure 2).

Figure 2: Water Use Efficiency Map – Parcels can be analyzed and displayed by water use efficiency.

AMEC also developed a process and automated tools that allow for easy editing and information updates. As AWC staff work with the data, edits are being made to the default vegetation-zone information to provide more accurate RWU values. The final database was delivered to AWC in June of 2013. Currently, AWC is working with AMEC to update the system so that AWC can find the most inefficient customers on an annual basis without relying on consultants (Appendix F).

3.2 Database Editing, Conservation Calculator, and Building Customer Contact List

AWC began to use the Efficiency Database to put together a list of the top 200 inefficient users to contact in August of 2013. Unfortunately, several issues arose that stopped this from being an automated process and made the work much more time intensive than accounted for in the original timeline. First, certain areas of Aurora have low quality 4th band LiDAR imagery. In those cases a very small section of vegetation was detected even if a customer was watering a large area of vegetation. Similar issues arise when a new home is involved because in 2010, the year of the imagery, the parcel didn't have a building or landscape, but there was water consumption by 2012, the year water use was pulled for (Figure 3). Another factor skewing data was the misalignment of the vegetation and parcel layers, especially in older sections of Aurora. This tended to show corner lots in older sections as only having a section of their vegetation and usually never accounting for tree lawn vegetation (Figure 4). These errors seem to be lessened in the 2014 DRCOG imagery that AWC is using for manual corrections of the data. Finally, some parcels were classified as single-family residential when in reality they were a nursing home, business, or multifamily residence.

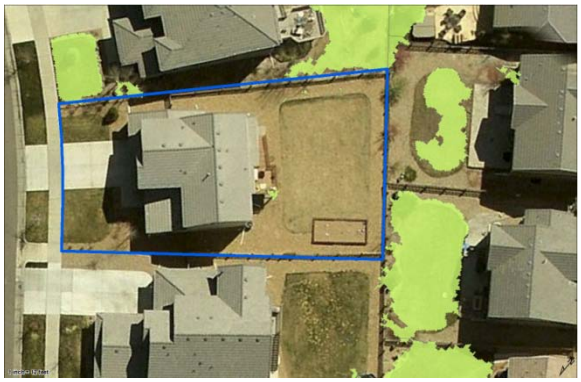


Figure 3: New Home Vegetation – Similar errors in vegetation classification were made for new homes and areas with low quality 4th band imagery.

Figure 4: Misalignment of Vegetation and Parcel Layers - The misalignment of vegetation and parcel layers resulted in inaccurate efficiency ratings of some parcels.

Other issues, not involving the Efficiency Database, included new owners and customers who had dramatically lowered their water use by fixing a leak or changing behavior since 2012. These issues together resulted in 52% of what the Database classified as the top inefficient users actually being potential SIP customers to contact. The only way to filter out those who shouldn't be contacted was by looking through the Aurora Water billing system and checking the properties vegetation manually. AWC collected the first 200 customers to contact by September 2013.

Setbacks impacted the Online Water Conservation Calculator that added to a delay in the original timeline. Because the Calculator was built in 2011, and hadn't seen use in over two years, there were multiple issues that were discovered and needed to be addressed before SIP customers could be contacted. The biggest issue was that the calculator was not built to record data for the water conservation team to analyze. The Calculator only provided an ROI, return on investments, table to the user entering data. AWC worked with the City's IT department to resolve the issues surrounding the Calculator and to create a ROI export tool (Appendix B). The ROI exporter allows AWC to see the customer's information, the item they would consider making a behavior or retrofit change with, the water savings per year, and the Return on Investment (ROI) for making each water use change. If the ROI for replacing a fixture was less than 4 years, Aurora Water offered additional rebate incentives to promote the change. The calculator errors were resolved in February 2014 and AWC began contacting customers for the SIP.

A SIP database was created for all potential SIP customers. Once the first 200 users were entered into the SIP database AWC created a letter template for customers who were inefficient indoor and customers that were inefficient outdoor (Appendix D). AWC also created a lot size comparison tool to complement the letter. Peer pressure has been seen as a great incentive to conserve in several municipalities across the country (Sommer, 2014) (Schmit, 2010)(Kaufman, 2009).AWC believed that by showing each customer how they compare to others with the same lot size more customers not incentivized by cost savings would participate.

3.3 System Incentive Program

197 staff hours were spent on implementing the System Incentive Program

Each potential SIP customer was assigned a member of the AWC staff to be their contact person. 42 letters were sent each week to customers. These letters encouraged customers to sign up for an audit or to complete the Water Conservation Calculator. If they did complete the calculator and had an ROI of less than 4 years AWC would provide the following rebates in addition to our current rebate program:

- $5 per aerator (3 max)
- $15 per showerhead (2 max)
- An additional $15 per toilet (2 max) [total of $90 for HET and $165 for UHET]

In total, seven members of the conservation team spent about an hour a week working directly with SIP participants. If no action had been taken two weeks after the letter was sent, the customer's contact would call to see if they were interested in working with Conservation. About half of customers didn't have a phone number recorded in our

billing system; therefore team members sent a reminder letter to those customers. One month after the initial letter was mailed we marked customers not interested in the SIP database and no longer followed up with them. Occasionally, a staff member was contacted past the one month mark and the customer continued with the program.

There were a few customers that had negative reactions, but overall the reaction was positive. Most customers were interested in an irrigation or indoor audit. The response rate has increased since June 1st, most likely because customers are seeing their first summer water bill. Very few customers were interested in completing the Online Calculator. The four most likely reasons for the lack of interest in the Calculator are:

- The customer was not already considering a rebate
- The Calculator is time intensive
- A large number of SIP properties were new homes that were not eligible for toilet, shower, or aerator rebates due to the homes age
- Most of the contacted customers had high outdoor use so the extra rebate money didn't apply to them

3.4 Results

Out of the customers contacted, AWC had 12 % schedule an audit and 5% use its Water Conservation Calculator. Based on this data, to get the 200 customers needed in our original proposal AWC would have to contact approximately 4,000 customers.

Although we only had a few customers complete the Online Calculator, no customers applied to receive rebate money as of June 1st. Therefore, there is no water savings analysis to be done in accordance with the original scope of the project. The four indoor audits that have taken place as of June 1st all showed a significant reduction in water use. The sample size and monthly use is too limited to draw any real saving estimates (Figure 5).

The customers that signed up for outdoor audits had not received an audit as of June 1st. We can however estimate the amount of water that will be saved if customers use the audit suggestions to achieve at least 80% efficiency. If the 31 inefficient outdoor only audit participants achieved 80% efficiency they would save on average 11.4 gal/sqft for a total of 1,755,200 gallons a year (Figure 6). 2011, the most recent year that AWC has a two year savings recorded for, had 214 audits that saved an average of 2.7 gal/sqft. However, no predictions can be made from this data because of the small sample size and the fact that we haven't seen an actual change in water use yet.

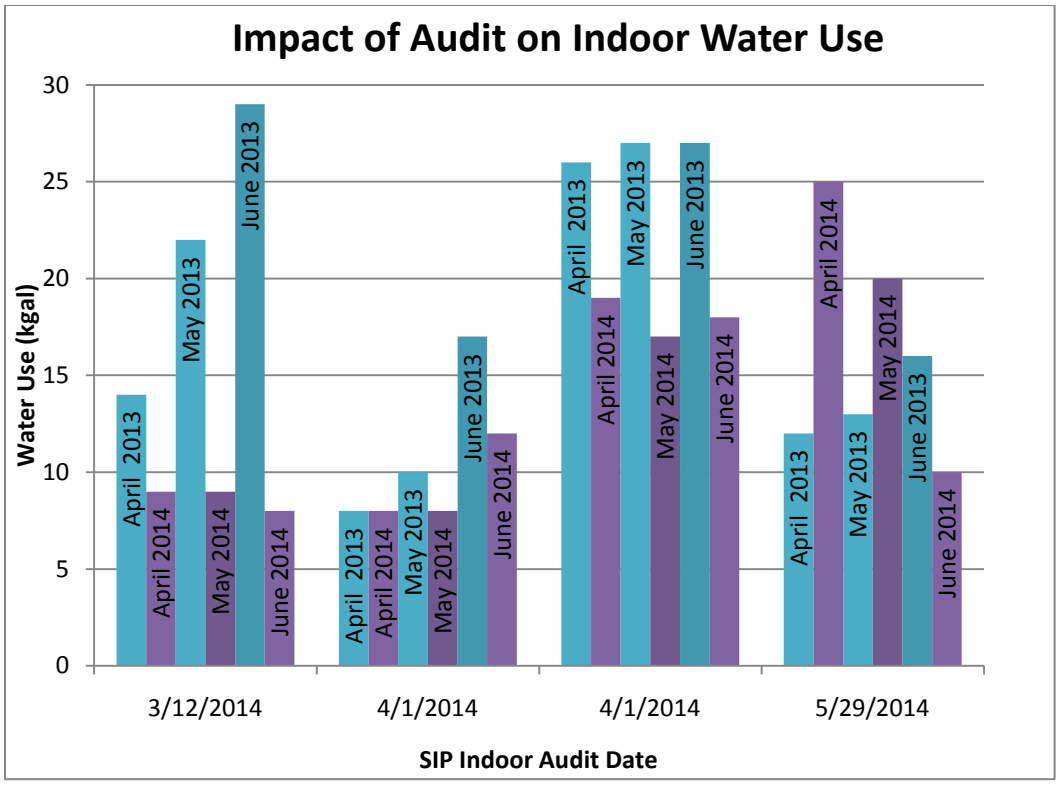


Figure 5: Comparison of SIP Water Use Before and After Audit. The water use per month for SIP customers who had an indoor audit. You can see their use for April-June 2013 and 2014 to analyze probable savings of the indoor audit.

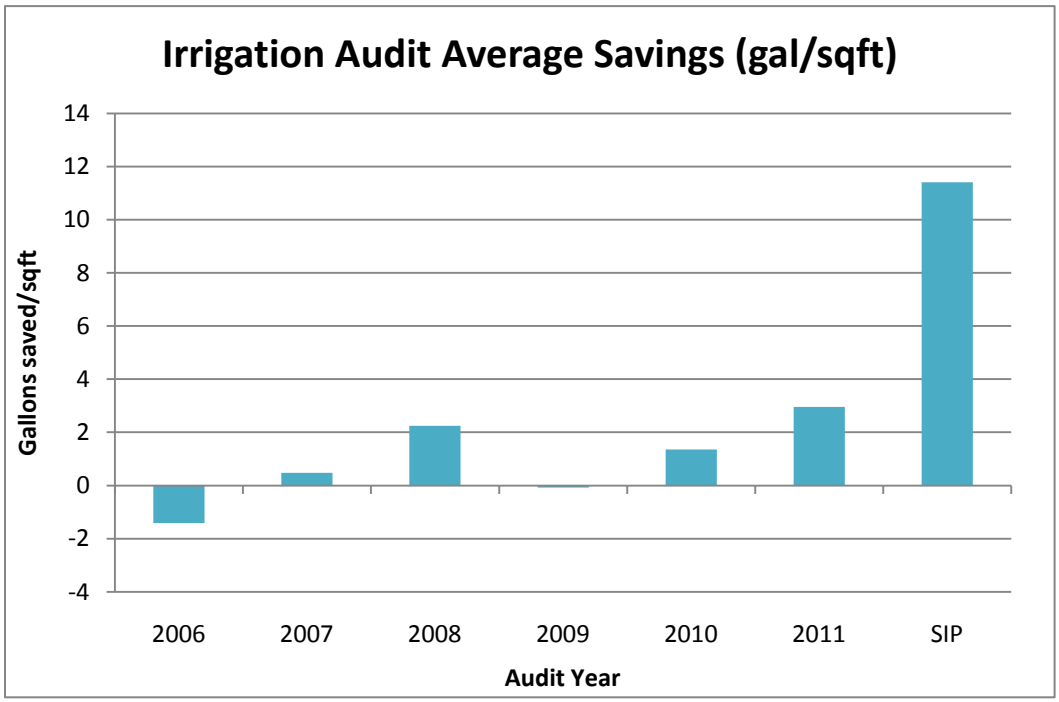


Figure 6: Potential SIP Irrigation Audit Savings. The gallons of water saved per square foot of irrigated landscape is listed for all the years that AWC has completed irrigation audits. The gallons per square feet is also listed based on the potential savings of SIP customers for comparison.

4.0 Post-Project Monitoring/Wrap-up

4.1 Future Implications of the Water Efficiency Database

4.1.a Single Family Volume Allocation based on lot size

Aurora Water is in the process of analyzing the impact of a theoretical water budget based tier structure for each lot size of single family residential customers. If implemented the rate structure for a single family residence would be tiered based on the water budget for their lot size.

A single family bill will be tiered as follows:

Tier 1: Indoor Use based on average household size
Tier 2: 100% efficiency for lot size
Tier 3: 110% efficiency for lot size
Tier 4: 125% + efficiency for lot size

Lot Sizes	Min. Sqft	Max. Sqft
Small	3,700	5,999
Standard	6,000	8,999
Large	9,000	14,999
Estate	15,000	No Max

AWC can create a tailored budget that incentivizes over-users to conserve water while rewarding efficient customers. The Water Efficiency Database allowed AWC to get the average vegetation area per each of Planning's lot sizes: small, standard, large, and estate. AWC can predict an efficient usage for each lot size by assigning 28" year to the average high chlorophyll vegetation and 15" year to the average low chlorophyll vegetation. Average and efficient use are very similar for each lot size.

4.1.b Neighbor comparison tool

The neighbor comparison tool was developed using the Water Efficiency Database to help illustrate the difference in water use between the average neighbor with similar water needs and the SIP customer's water use (A neighbor is defined by similar lot sizes). In the future this could be used to create an efficient use line on a bill to illustrate what average is or to rate each customer as efficient, inefficient, or very inefficient. The neighbor comparison tool could also work alongside a Single Family Volume Allocation and for the Interactive Customer Map.

4.1.c Land Use driven water projections as part of our Integrated Water Master Plan (IWMP)

Part of the 2014 Water Conservation Plan and part of Aurora Water's Integrated Water Master Plan (IWMP), involves using Land Use to predict future water demand on a factor besides population. With the Efficiency Database, AWC is able to see an accurate breakdown of the water use and vegetation needs per subzone. AWC is currently working with Clarion Associates to accurately predict the water-land use nexus to tie

into Aurora's Planning Department's Land Use Allocation Model. This model will project out water demand in 5 year increments to the 2070 planning horizon. The Land Use Allocation Model's projections will be used to narrow the projected water demand forecast for Aurora.

4.1.d Water Use trends related to demographics

An area AWC plans to use the Efficiency Database in the future is estimating demographic trends in water use using Census tract and block data. AWC would use this data to improve the marketing and implementation of conservation programs.

4.1.e Reporting data for HB1051

As AWC continues to update the Database we will have a more accurate Irrigated Acre number to report for each customer class in the Water Efficiency Data Portal. Currently AWC can only report the non-potable irrigated acres, but as we improve the database we will be able to report irrigated area more accurately for all customer classes.

4.1.f Sitemap data management and Improved accuracy of sitemaps and water budgets

A sitemap is created to determine eligibility for a xeriscape rebate, to get an irrigation audit, or to receive a free design consultation from a registered landscape architect (Figure 7). The sitemap is an aerial imagery of the customer's property that also has the square footage of the different types of vegetation present. In the past, AWC would use the measure tool in GIS. While the measure tool gives a good estimate of the different areas of vegetation it was very easy for the user to make an error or double count an

Figure 7: Completed Sitemap. Sitemaps are used to determine eligibility for a xeriscape rebate, to get an irrigation audit, or to receive a free design consultation from a registered landscape architect

area. There was no way to redo a small section of vegetation or verify the information at a later time. By editing the Efficiency Database it is easy to see the area measured and to go back and make changes (Appendix C). The Database has already saved countless hours and made our vegetation area numbers more accurate. Also, the time spent making hundreds of maps a year only benefited those particular customers, but now contributes to making the Efficiency Database more accurate for analysis in other projects.

4.1.g Volume Allocation Program for CII customers

In early 2014 AWC began to work with the Water Billing division to determine the feasibility of adjusting CII and Multifamily customer's water allocation. By restructuring the way Aurora Water allocates water to large properties we can increase water conservation, water efficiency, perceived fairness, and billing simplicity. AWC can serve our customers better by changing their water allocation to what they truly need to operate and grow their business. The Water Efficiency Database will allow Aurora Water to map out customer properties and provide a more accurate water budget and yearly allocation with minimal effort. Water can be conserved by decreasing water allocations to customers that have allocations based on a history of overwatering and inefficiencies. Conversely, Aurora Water can provide enhanced customer service by increasing water allocations for those that were vastly under allocated because of a vacant property or increased clientele. By revamping the allocation amount for large properties we can also make sure that businesses are held to the same accountability during the summer months and drought periods as Aurora Water's single family residential customers. The Efficiency Database is vital to changing Allocations for large properties. We can assign meters and parcels to a group, or parent meter. We can use a customer's high water use vegetation and low water use vegetation in combination with either their CII average (Brendle, 2006) or their winter quarter average.

4.1.h Watering Variance Program

Like the Volume Allocation Program, the Water Variance Program needs to group meters and vegetation areas together for each customer. Each year CII customers apply for the Variance Program in order to water outside of the day of the week restrictions Aurora enforces during the summer months. The variance is in place to allow large properties to effectively water their entire properties which otherwise might not be possible on a three day or less restriction. However, to insure customers are not wasting water AWC gives each property an annual water allocation. If they exceed this amount properties may lose their variance status.

To determine their allowance, applicants submit all the meters associated with the property and the total irrigated square feet. From this data AWC creates a fluctuating allocation based on the irrigated area and the weather. The Efficiency Database will

allow for staff to easily check the irrigated area numbers submitted and to create a more accurate account of the vegetation needs. AWC has been able to enroll 305 customers into this program allowing AWC to monitor 18% of Aurora's water consumption that previously hadn't been monitored.

4.1.i Impervious data for IWMP

BBC Research & Consulting is using the impervious data from the Efficiency Database as one of many inputs for a statistical model that produces water demand forecasts for the City of Aurora. The model is still under development but at this point, BBC anticipates pairing the impervious data with lot size to evaluate the proportions of single family parcels that may require some type of irrigation

4.1.j Potential future Storm Water data

There are lots of reasons Aurora Water's Engineering Division could and will use the impervious data from the Water Efficiency Database, but for now it is just being used to approximate imperviousness for hydrologic/hydraulic evaluations when doing storm water master planning. Aurora Water will also use the impervious data in the future for conducting a preliminary sample for an impervious area based storm water rate structure evaluation.

4.1.h Interactive Water Budget Map

A possible precursor to a budget based tier program is an online interactive water budget map. AWC would like to eventually use the Database to create and interactive irrigation map of the city, similar to the map completed by the City of Greely. From the irrigated area AWC would automatically calculate the monthly budget residents should aim for during the months of April-October.

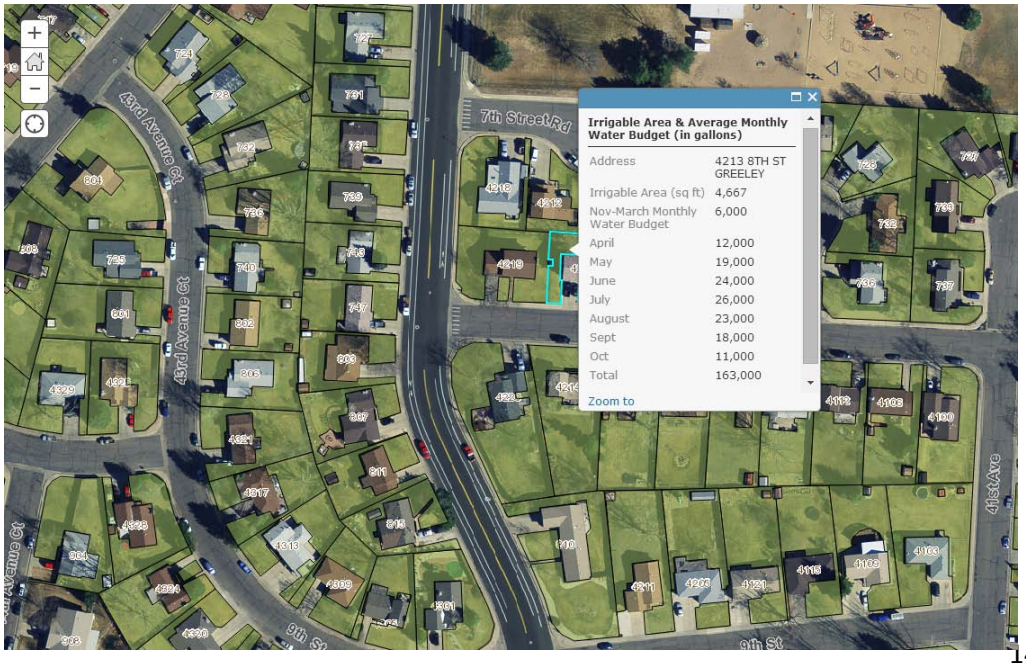


Figure 8 Greely's Water Budget Webmap 2014. Aurora Water Conservation would like to create an interactive map like Greely to inform customers of a water use goal during the summer months.

4.2 Contacting Highly Inefficient Customers

Even though the response rate was low, the potential savings per customer is high enough to continue sending the high use letters each year. Instead of doing a detailed contact and follow up process, next year AWC will send more letters to the highest overusers. The targeted audience will lose some accuracy, due to the previously mentioned limitations of the database, but AWC believes it will increase the number of participants and decrease the time spent cleaning the data. In 2015, AWC will most likely send a letter to any single family residential customer with a WQA of 20,000 gallons or more or an outdoor use twice the average for their lot size or more.

4.3 Water Efficiency Database Update

As mentioned previously, AWC is working with AMEC to update the Database. In order to maintain the Water Efficiency Calculator database, Aurora Water Conservation (AWC) staff needs to be able to efficiently and consistently manage change in parcel boundaries, vegetation zones, meter groups, and consumption data. Currently, edits are being made only to parcel boundaries and vegetation zones. AWC would like to have detailed guidance documentation that defines the appropriate workflow and provides instructions for data edits and management, so that maintenance is simplified. The existing efficiency-calculation tool does not currently update all attributes related to an edit (only the recommended water-use values), and references only 2012 consumption data. AWC would like all relevant attributes to update automatically, and to include new consumption data when available. The file-size of the database has also been an efficiency issue, so AWC would like to make it more manageable and responsive. Once Aurora Water enters into a contact with AMEC the work is scheduled to be completed within several months (Appendix F).

4.4 System Incentive Program

The System Incentive Program (SIP) is still the direction AWC wants to move for processing all of our conservation rebates. Especially since our toilet rebate program will terminate with Colorado's adoption of Senate Bill 14-103, which will phase-out the sale of certain low-efficiency plumbing fixtures like toilets. AWC still wants to give customers a way to improve their efficiency, but

Total Annual Water Usage (gal)	Total Annual Water Savings (gal)	Percent Savings
95,231	32,768	34%
207,070	59,709	29%
65,644	15,768	24%
42,042	11,507	27%
20,903	2,531	12%
71,643	12,286	17%
56,470	7,818	14%
56,442	2,129	4%
60,123	6,938	12%

Figure 9: Potential SIP Savings per Customer. For each recent indoor audit and potential water savings was calculated based on making the SIP incentive changes (showerhead, aerator, toilets)

with a higher savings rate potential then is currently seen with our toilet rebate program. Toilet savings have decreased over time per participant, but the SIP program gives AWC a way to make sure that we are using funding the best way possible to decrease consumption.

When AWC examines the potential annual savings for making the SIP incentive changes for those that have had an audit recently, the ROI results show a significant savings for most customers (Figure 9). That's why all customers can now access the Water Conservation Calculator to "Bump Up Their Rebates" (Figure 10).

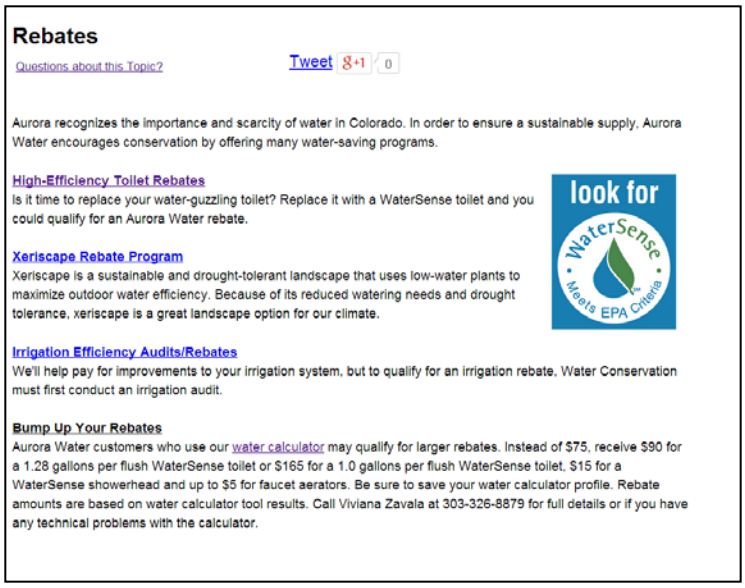


Figure 10: Bump Up Your Rebates. All AWC customers can now participate in the SIP. By filling out the Calculator customers can receive additional rebate funds and learn more about their water use.

Additionally, after each indoor water audit, staff members will create a profile for their customer based on the information collected during the audit. The customer will only need to fill in the retrofit and behavior change tab of the Calculator.

Customers who complete the Calculator will see the water and cost savings for each potential retrofit and behavior change they make. If the potential change ROI is equal to or less than 4 years AWC will extend additional rebate funds to the customer. Those additional funds will be the same as mentioned in Section 3.3.

Appendix A: Budget

Updated Project Budget

Task	AMEC ($)	AMEC Hours	Grant ($)	Aurora ($)	Aurora Water-Hours	Aurora Water In-Kind ($)	**Total Cost**
Project Setup	7,096	60	5,401	1,500	8	296	**$ 7,197**
Land Cover Analysis	70,627	793	57,813	13,000	13	481	**$ 71,294**
Database Dev/Geoproc.	35,802	384	35,802	2,750	79	2,923	**$ 41,475**
Project Implementation	0	0	0	0	620	23,940	**$ 23,940**
Land Cover Maintenance	9,969	133	9,969	0	0	0	**$ 9,969**
Project Administration	8,756	72	8,756	0	0	0	**$ 8,756**
Reporting and Analysis	0	0	0	0	120	4,440	**$ 4,440**
TOTAL	**132,250**	**1,442**	**117,741**	**17,250**	**840**	**32,080**	**$ 167,071**

Cash	$ 17,250
In-Kind	$ 32,080
CWCB Grant Monies Requested	$ 117,741
TOTAL	**$ 167,071**

Money Used

Task	AMEC ($)	AMEC Hours	Grant ($)	Aurora ($)	Aurora Water-Hours	Aurora Water In-Kind ($)	**Total Cost**
Project Setup	7,096	63	4,991	2,104	31	1,147	**$ 8,243**
Land Cover Analysis	69,105	956	57,813	11,292	149	5,495	**$ 74,600**
Database Dev/Geoproc.	44,026	513	33,961	10,065	83	3,071	**$ 47,097**
Project Implementation	0	0	0	0	250	6,716	**$ 6,716**
Land Cover Maintenance	0	0	0	0	0	0	**$ -**
Project Administration	14,849	221	8,875	14,849	34	1,258	**$ 24,982**
Reporting and Analysis	0	0	0	0	40	1,480	**$ 1,480**
TOTAL	**135,076**	**1,753**	**105,641**	**38,309**	**587**	**19,166**	**$ 163,116**

Cash	$ 40,176
In-Kind	$ 16,484
CWCB Grant Monies Used	$ 95,019
TOTAL	**$ 151,679**

Money Remaining

Task	AMEC ($)	AMEC Hours	Grant ($)	Aurora ($)	Aurora Water-Hours	Aurora Water In-Kind ($)	**Total Cost**
Project Setup	0	3	410	604	23	851	**$1,046**
Land Cover Analysis	1,522	163	0	1,708	136	5,014	**$3,306**
Database Dev/Geoproc.	8,224	129	1,841	7,315	4	148	**$5,622**
Project Implementation	0	0	0	0	369	17,225	**$17,225**
Land Cover Maintenance	9,969	133	9,969	0	0	0	**$9,969**
Project Administration	6,093	149	119	14,849	34	1,258	**$16,226**
Reporting and Analysis	0	0	0	0	80	2,960	**$2,960**
TOTAL	**2,826**	**311**	**12,100**	**21,059**	**253**	**12,914**	**$3,955**

Cash Remaining	$21,059
In-Kind Remaining	$12,914
CWCB Grant Monies Remaining	$12,100
TOTAL	**$3,955**

Appendix B: Sample Calculator Results

Profile Title	Email	Account Number	Item	Cost	Rebate	Water Usage Old	Water Usage New	Water Savings Per Year	Cost Savings	ROI WO Rebate	ROI W Rebate	Last Updated
123 N Main St	123@auroragov.org	1234-4321	Secondary Toilet	220	0	3942	876	3066	26.061	8.4417	8.4417	6/5/2014 16:55
123 N Main St	123@auroragov.org	1234-4321	Primary Shower	30	0	6898.5	4599	2299.5	19.5458	1.5348	1.5348	6/5/2014 16:55
123 N Main St	123@auroragov.org	1234-4321	Secondary Shower	30	0	2956.5	1971	985.5	8.3768	3.5813	3.5813	6/5/2014 16:55
123 N Main St	123@auroragov.org	1234-4321	Primary Bathroom Sink	5	0	7450.4	2483.5	4966.92	42.2188	0.1184	0.1184	6/5/2014 16:55
123 N Main St	123@auroragov.org	1234-4321	Secondary Bathroom Sink	5	0	3193	1064.3	2128.68	18.0938	0.2763	0.2763	6/5/2014 16:55
123 N Main St	123@auroragov.org	1234-4321	Kitchen Faucet	5	0	7095.6	7095.6	0	0	0	0	6/5/2014 16:55

Appendix C: Vegetation Before and After Edits

Appendix D: Sample Letter

AURORA WATER

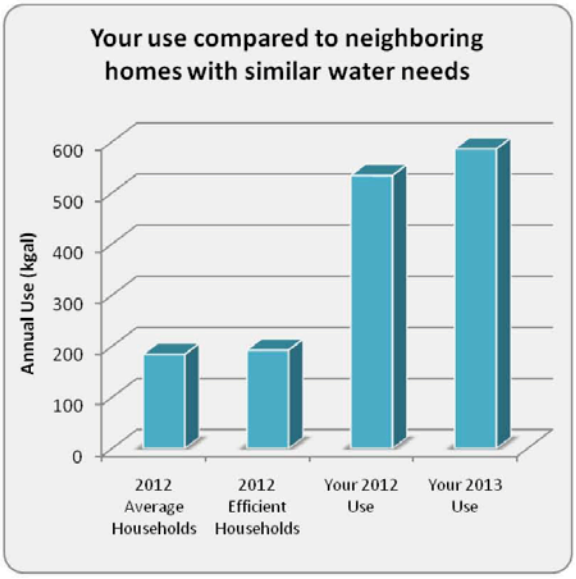
Aurora All-America City 2008

Dear [redacted]

While we should probably thank you for being one of our best customers, we don't want you to spend so much of your hard-earned cash on your water bill.

Our research shows that your outdoor water usage is higher than most other customers – even with larger yards, there are some simple things you can do to start saving money right away.

If you sign up for a **free sprinkler system audit**, a trained irrigation specialist will evaluate your system for efficiency, identify and list any items that need to be repaired and will help you learn how to program your clock effectively.



In the meantime, you should check out our online water calculator – it's an incredible tool that gives you a clear understanding of how much water you're using and when. It even lists some of the simple and inexpensive changes you can make so you save even more. Plus, anyone who uses the calculator could qualify for additional customized savings and rebates. Just make sure to save your profile every 15 minutes to qualify for extra rebates! To participate, go to: **apps2.auroragov.org/WaterConservationCalculator/**

But that's just the beginning. Our Water Conservation Division has a wide range of programs, including indoor water audits, free conservation and gardening classes and a variety of rebate opportunities.

Water is a precious resource in Colorado, so conservation is our top priority. Saving money is yours. Let's work together.

Sincerely,
Melissa Grove
Water Conservation Specialist
Aurora Water Department
Phone: 720-859-4375
Email: mgrove@auroragov.org

15151 E. Alameda Pkwy, Ste 3600 • Aurora, Colorado 80012 • www.aurorawater.org

Appendix E: Bibliography

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Appendix F
DRAFT AMEC Proposed Scope of Services:
Water Efficiency Calculator Support -
Tool Enhancement & Guidance Manual Development
June, 2014

Introduction
In order to maintain the Water Efficiency Calculator database, Aurora Water Conservation (AWC) staff needs to be able to efficiently and consistently manage change in parcel boundaries, vegetation zones, meter groups, and consumption data.

Currently, edits are being made only to parcel boundaries and vegetation zones. AWC would like to have detailed guidance documentation that defines the appropriate workflow and provides instructions for data edits and management, so that maintenance is simplified. The existing efficiency-calculation tool does not currently update all attributes related to an edit (only the recommended water-use values), and references only 2012 consumption data. AWC would like all relevant attributes to update automatically, and to include new consumption data when available. The file-size of the database has also been an efficiency issue, so AWC would like to make it more manageable and responsive.

This scope describes the support services AMEC proposes to provide to Aurora Water Conservation (AWC) in order to enhance the Water Efficiency Calculator database and tools developed as part of the Water Conservation System Incentive Project.

Any software, business processes or files developed by AMEC for AWC as a result of this project, whether electronic or otherwise, shall become the sole property of AWC.

Reference Information
The following definitions provide context for the primary acronyms used within the scope description:

*Water Efficiency Database (**WED**)* – General term for the geodatabase that houses all associated data (including parcels, meters, meter-groups, addresses, consumption, landcover, and vegetation per parcel) and the use-efficiency calculation tool.

*Recommended Water Use (**RWU**)* - The baseline recommended usage is calculated from formulas, provided by AWC, that include factors associated with vegetated square footage, turf type, wind, and exposure.

*Use-Efficiency Calculation Tool (**tool**)* – General term for the ArcGIS Desktop Add-in tool that calculates RWU for each property, and compares RWU with actual consumption to output a use-efficiency rating.

*Parcel Vegetation Zones (**PVZ**)* – Geodatabase feature class that represents vegetation per parcel (or meter group) and contains zone values such as Zone Number, Turf, Wind, Exposure, and Area; attributes for Parcel ID, Location, and Group ID are automatically calculated within this layer when existing vegetation-zone polys are edited/split (not automatic for new vegetation polygons added in).

*Master Water Consumption (**MWC**)* – Geodatabase feature class that represents property geometry (parcels and meter group boundaries) and contains all the per-property metrics for lot

area, vegetation area, actual water use, recommended water use, and use-efficiency; this is the layer to which the 'tool' outputs calculations.

AMEC's Proposed Scope of Services

Task 1 – Editing and Data Management Support

These are the primary types of edits / maintenance activities related to the Water Efficiency Database that AWC needs to be able to effectively manage:

1) Vegetation Zones - add, delete, reshape, cut PVZ polygons into zones as necessary; maintain correct topology {*Note: AWC has already established a process for this edit type; AMEC will not provide additional editing instructions.*}

2) New / Modified Parcels - add, reshape, or split parcel records in the MWC as necessary; maintain topology and relationships

3) Meters – add new meters as they come online (or delete if removed from service)

4) New / Modified Meter Groups – create new meter groups or modify existing ones where necessary

5) New Consumption Data – currently database only has 2012 consumption info; add new annual consumption (water use - WU) data each year, while preserving the old for historical tracking

Since non-GIS-savvy users (primarily interns) may be making a concerted PVZ-update effort during 2014, it will be important for AWC to have easy-to-follow editing instructions with standard procedures for each task. In addition, AWC staff managing the database need to understand the processes for maintaining meter and consumption data while preserving necessary data relationships. AMEC will develop standardized workflows and a Guidance Manual that provides instructions for making parcel edits, for modifying or creating new meter groups, and for adding new consumption data. Along with the Guidance documentation, AMEC will provide one hands-on training session for AWC staff.

AMEC will also clean up the schema of the PVZ and MWC databases to remove unnecessary fields (such as Veg_hig/med/low, and other landcover values). This nominal effort goes hand-in-hand with the tool enhancements that will be made in Task 2.

The final deliverable for this task will be a redesigned Water Efficiency Database to be used with the enhanced Tool developed in Task 2; all existing edits will be carried forward so that no previous effort is lost.

Total estimated effort: 80 - 100 hours (~$10,000 - $12,000)

Task 2 – Tool Enhancement

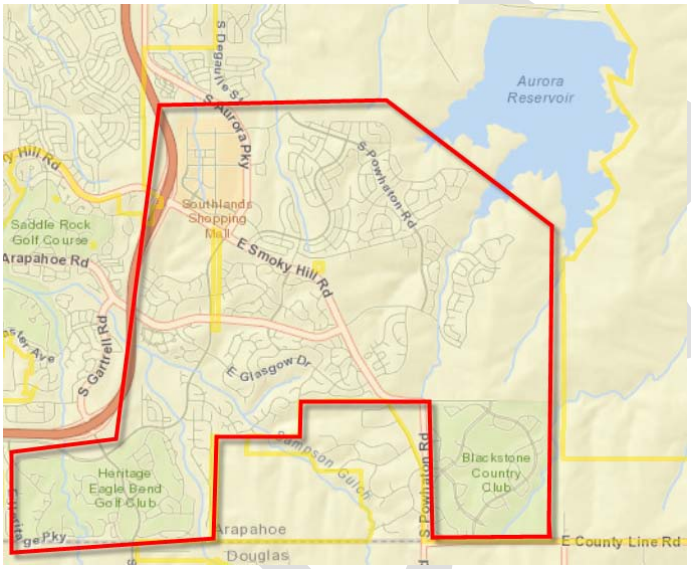
The current version of the tool (ArcGIS Desktop Add-in based on the ArcGIS .NET SDK) will be recoded to accommodate: calculation of additional metrics (see appendix), adjustments to database schema, change-tracking, and additional years' consumption data. The tool modifications will improve data integrity and improve edit/calculation efficiency. Added functionality will allow users to choose allocation year for efficiency calculations. The final deliverable will be an updated ESRI add-in tool that will fully replace the original tool for future calculations.

Total estimated effort: 40 – 60 hours (~$4,500 - $6,500)

Task 3 – Site-Specific Vegetation Update

The landcover information currently in the Water Efficiency Calculator database was mapped from 2010 aerial imagery using a semi-automated image-classification process. AWC is now using more recent 2014 imagery to evaluate properties, and would like to keep the vegetation data as current as reasonably possible. In most areas change in landcover is manageable by hand (with localized visual review, digitizing, and manual edits).

Where significant change is expected to have occurred or where issues with the previous imagery prevented accurate mapping, new vegetation data can potentially be extracted on a larger scale using image-classification techniques. The approach can be used as necessary to help AWC keep the vegetation data current in an efficient and cost-effective manner.



AWC staff has identified the area south and west of the Aurora Reservoir, and east of E-470, as the initial focus area for a 2014 reclassification (shown at left in red). AMEC will use the newer 2014 DRCOG imagery at six-inch resolution to extract vegetation within the identified extent, and will integrate the resulting PVZ and MWC update for the associated parcels.

Total estimated effort: 30 – 40 hours (~$3,000 - $4,000)

Task 4 – Testing and Integration

Once the database and tool modifications are complete, AMEC will fully test functionality and debug prior to delivery. To ensure smooth transition and operation, AMEC will assist with on-site setup and integration of the updated WED and tool, and provide an interactive training for AWC staff using the Guidance Manuals prepared in Task 1.

Total estimated effort: 12 - 16 hours (~$1,500 - $2,000)

Data Required from AWC

The following information and/or data will be provided to AMEC by AWC for purposes of this project:

- Copy of Current Water Efficiency Calculator Database (MWC and PVZ)
- 2013 Annual Consumption Data
- Current meter data (any new meters since initial MWC development)

AMEC's Key Staff

Due to their previous experience with, legacy knowledge of, and skill sets specific to the Water Efficiency database design and operation, AMEC will perform the scope of services described herein with the following key staff:

- **Carrie McCrea – Senior Project Manager**
- **Daniel Gwartney – Remote Sensing Scientist**
- **Yukun Xing – Developer / GIS Analyst**

Other qualified staff will be utilized at the AMEC Project Manager's discretion where appropriate to support the scope of work, and will be billed at a 3.1 labor multiplier.

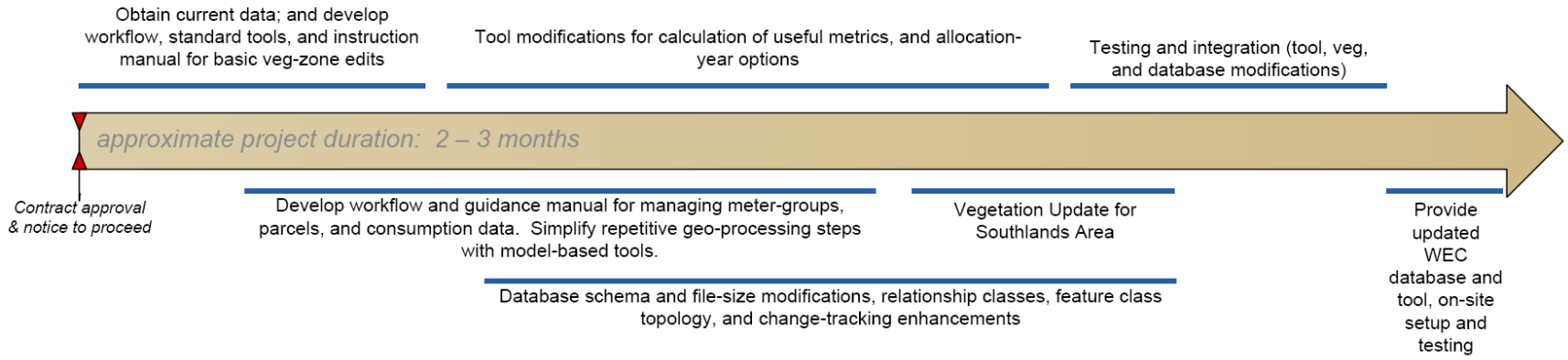
Project Cost

Approximate general hours have been identified per task, above. Detailed project cost will be determined once the final scope of work and project budget have been agreed upon by the City and AMEC.

The cost for the scope of services will be based on the staff and rates listed in the table below.

Staff Type	Rate
Senior Technical Lead / PM	$130
Remote Sensing Scientist / Developer	$100
GIS Analyst	$85

Appendix F
DRAFT AMEC Proposed Scope of Services:
Water Efficiency Calculator Support -
Tool Enhancement & Guidance Manual Development
June, 2014



APPENDIX

Parcel_veg_zones (conceptual new output)				
Field	**Type**	**Description**	**Subtype**	**Default Value**
Group_ID	Short	Group ID number		
Parcel_ID	Text	Parcel ID number		
Location	Text	Meter ID number		
~~**Shape_Length**~~	~~Double~~	~~Polygon shape length~~	-	-
ZONE_Area	Double	Polygon shape area		(change field name to reduce confusion w/multiple 'shape_area' fields)
Zone_Num	Short	Zone number	Numbers 1-6	
Turf	Text	Type of turf in specified zone	Kentucky Bluegrass Annuals Shrubs/Perrenials Trees Native Grasses Xeriscape	Kentucky Bluegrass
Wind	Text	Type of wind in specified zone	Breezy Sheltered Persistant	Sheltered
Exposure	Text	Type of exposure in specified zone	Full Sun Partial Sun Full Shade	Full Sun
Description	Text	Any description details		

Master_Water_Consumption (conceptual new output)				
Field	**Type**	**Description**	**Subtype**	**Default Value**
Group_ID	Short	Group ID number		
Parcel_ID	Text	Parcel ID number		
Location	Text	Meter ID number		
~~**Shape_Length**~~	~~Double~~	~~Polygon shape length~~	-	-
Lot_Area	Double	Polygon shape area		need to auto-populate after edit
~~**BE_Area**~~	~~Double~~	~~Bare earth area~~		-
Veg_Area	Double	Vegetation area		need to auto-populate after edit
~~**IA_Area**~~	~~Double~~	~~Impervious surface area~~		-
~~**Water_Area**~~	~~Double~~	~~Water area~~		-
~~**Veg_hig**~~	~~Double~~	~~High condition vegetation~~	-	-
~~**Veg_med**~~	~~Double~~	~~Medium condition vegetation~~	-	-
~~**Veg_low**~~	~~Double~~	~~Low condition vegetation~~	-	-
AWU_2012	Double	Actual water use (year)		modify
AWU_2013	Double	Actual water use (year)		modify
RWU_YEAR	Text	AWU input year for RWU calcs		add field; have tool auto-pop
Rec_WU	Double	Recommended water use		tool auto-populates

RWU_diff_GAL	Double	Difference in gallons of recommended and actual water use		tool auto-populates
RWU_diff_Pcnt	Short	Percent difference of recommended and actual water use		tool auto-populates
PCNT_RWU	Text	Percent of recommended water use actually using. 70-90% = stressing plants, 90-110% watering efficiently, 111-130% = using more water than necessary, >130% = over exceeding amount allowable.	<70 70-90 90-110 111-130 >130	tool auto-populates
High_Use_Prop	Text	Is this property considered high use?	Y N	tool auto-populates