

MEMO PROPOSAL – DRAFT FINAL

DATE: August 17, 2016

TO: Jeff Tannler, Area Director, Statewide Active Management Areas
Arizona Department of Water Resources

FROM: Gary Woodard & Tim Bayley

SUBJECT: Enhanced municipal water demand models for municipal services areas
within the Tucson Active Management Area

Background

In 2013, Montgomery and Associates completed a project to model and forecast single family residential (SFR) demand for Tucson Water, Metro Water, and Community Water of Green Valley, as well as provide forecasts for Pima County as a whole (collectively “the TAMA models”). The project was run through Southern Arizona Water Users Association (SAWUA), with administrative support provided by Tucson Water. Funding agencies included the three modeled water providers plus SAWUA, Arizona Department of Water Resources (ADWR), Central Arizona Project (CAP), and Bureau of Reclamation.

A subsequent SFR demand modeling and forecasting project for Maricopa County water interests concluded in 2015. Seven municipal providers were modeled: Chandler, Gilbert, Glendale, Mesa, Peoria, Scottsdale, and Tempe. The project was administered by SRP, with additional funding provided by ADWR, CAP, and Bureau of Reclamation.

These two projects made great strides towards understanding and quantifying historical patterns of decline in municipal water demand. They also identified and projected key factors of SFR demand, and forecast changes in SFR demand through the year 2020.

The results of these projects have impacted planning and management decisions made by several of the participating parties. Impacts include: municipal water providers using model results in updated Assured Water Supply projections; Tucson Water re-evaluating future infrastructure capacity needs; future demand assumptions in ADWR’s new management plan for the TAMA, and new lower demand figures for AWS applications; CAP expanding the municipal component of their CAP:SAM model; Arizona Department of Environmental Quality (ADEQ) contemplating how to update assumptions about wastewater flows generated by new development; and Community Water of Green Valley

successfully arguing for inclusion of demand trends in a rate case before the Arizona Corporation Commission.

Program Description & Goals

While the modeling and forecasting exercise for municipal providers in the TAMA has resulted in better-informed decision making, the analysis raised a number of new questions that could not be addressed within time and budget constraints of the original project. In addition, the Maricopa County modeling exercise benefitted from data and information sources not available at the time of the Pima County project, plus additional analysis and model development.

The purpose of this proposed project is to update and enhance the TAMA models by:

1. incorporating new data and projections, including PAG population projections and CAP scenarios of population distribution, and extending forecasts out to 2025;
2. performing new analysis and adding model components similar to those developed for the Maricopa County models, including dishwashers and kitchen sink usage, front yard turf, and enhanced dashboard functionality for scenario analysis; and
3. improving model coefficients by estimating the impacts of rebate-triggered changes in indoor use and changes in outdoor turf and swimming pools by linking these changes with billing records for statistical analysis.

Scope of Services/Deliverables

Based on conversations with several interested parties and our experience in modeling SFR demand in Pima and Maricopa Counties, we propose the following tasks to enhance the TAMA water demand forecasting models:

1. Update and extend models: Existing models are based on data series that typically end in 2012. These would be updated to 2014 or 2015 data, as available. Key databases are the Pima County Assessors Office databases through fiscal year 2017, which are current through calendar year 2015. Other data are from federal sources that are updated annually. The TAMA models currently forecast out to 2020. The new forecast horizon will be extended to 2025.

Deliverable: None. Model enhancements are incorporated in the enhanced TAMA models that are included in **Task 8**.

2. Determine forecast needs and barriers to use: Interview planners and managers at water providers to understand how water demand models and forecasts can better meet planning and management needs. In addition to identifying key potential uses of improved demand forecasts, M&A will identify legal and institutional roadblocks to using model results to update and revise planning assumptions and meet regulatory requirements.

Deliverable: Findings will be summarized in tabular format and included in the technical memorandum.

3. Modify population growth and distribution scenarios: The Pima County models currently require user input via a dashboard interface on population parameters (e.g., birth rates) and rates of new home construction. Few water resources professionals are comfortable making such assumptions. By contrast, the Maricopa County models make use of recently completed population projections from MAG (low, medium, and high growth scenarios). Outputs from these scenarios are inputs to an economic model developed for CAP by Applied Economics that forecasts spatial distributions of population based on factors such as transportation costs and preferences for living in urban cores vs. suburbs or exurbs.

Since the TAMA models were completed, PAG has developed low, medium, and high population projections, and CAP has generated population distributions as a function of several development scenarios for Pima County. Like the Maricopa County models, the current dashboard user inputs for birth rates and home construction rates will be replaced by inputs for overall population growth forecasts and population distribution patterns resulting from different development pattern scenarios.

Deliverables: New dashboard interface and scenario options will be incorporated into the enhanced models, which are **Task 8** deliverables.

4. Examine outdoor demand tastes and preferences: Within the TAMA, indoor residential demand typically exceeds outdoor demand. However, outdoor demand is critically important for water resource planning because it represents consumptive uses, is highly seasonal, and contributes substantially to peak demand. Current understanding of indoor demand trends and drivers is more complete and less susceptible to changes in tastes and preferences, providing greater confidence in forecasts of indoor demand. By contrast, recent decreases in outdoor demand are driven largely by changing tastes and preferences that are poorly understood and may be more changeable.

This is particularly true of swimming pool removals, which appear to be surging, but for reasons that are poorly understood. M&A will utilize focus groups and a targeted survey to examine how tastes and preference are affecting the waning popularity of backyard swimming pools and how pool removals may trend in the future. The process will begin

with two focus group discussions of about 5 persons each, led by an experienced expert in conducting choice analysis. Participants will have recently removed a backyard swimming pool. This will not be a random or representative sample, but is intended instead to reveal all factors and issues considered by these homeowners, which will be covered in the survey. This will be followed by a targeted phone survey by FMR, which has considerable experience performing survey work for Tucson Water. The survey will reveal the relative importance of various incentives and disincentives to pool removal, as well as how the homeowners felt about the removal after the fact. It will also provide insights into how those who have removed pools differ from the larger population of pool owners

Deliverables: Results of the focus groups will be described in the technical memorandum. Survey results will be tabulated and described in the technical memorandum. Conclusions drawn from these efforts, and analysis of what types of households are more likely to remove pools, will be reflected in model coefficients, and in a new model dashboard feature that will allow users to influence future rates of pool removal.

5. Better characterize changes in turf: Previous analysis measured reduction in the penetration rate of backyard turf occurring over a seven-year interval ending in 2012. More detailed analysis will rely on images from intermediate years to identify the specific year of turf change. These dates will be cross-referenced to data on resales so that the role of new home owners in landscape modifications can be estimated. In addition, M&A will work with CAP to attempt to use their multi-spectral images, for one recent point in time, to identify artificial turf. If successful, visible light images from previous years will be used to attempt to determine the year that the artificial turf was installed. As with the analysis of turf removals, these dates will be cross-referenced to determine the importance of new home owners on installation of artificial turf.

Remote sensing work will be performed by Flat World, a subcontractor who performed similar analysis for the Maricopa County modeling project. M&A will rely on CAP to make the initial determination of artificial turf.

Deliverables: Results of turf change analysis will be reflected in revised coefficients in the TAMA models. The patterns and trends revealed by the analysis will be included, including in tabular and graphic formats, in the technical memorandum.

6. Better characterize changes in backyard pools: Changes in the number of pools and rate of pool cover usage will be analyzed using remote sensing data for a minimum of 500 randomly selected homes per service area. Similar to turf, re-analysis will narrow the window when new pools are constructed or removed to determine impacts of new home ownership. Also, pool cover usage will be examined to determine if usage is primarily associated with new pools and “abandoned” pools, as was found in Maricopa County.

The actual analysis of remote sensing images will be done by Flat World, in tandem with the **Task 5** analysis. Four different pool conditions – none, full, empty, covered – will be noted, and intermediate images examined to determine the year in which the condition changed. The identification of specific lots where pools were removed will be used in the **Deliverable 4** survey.

Deliverables: A summary of patterns and trends in pool installations and removals, including tables and graphs, will be included in the technical memorandum. The patterns and trends revealed will influence the revised model coefficients.

7. Quantify impacts of indoor and outdoor water use changes using billing data:

Current TAMA demand models estimate water demand associated with particular appliances, fixtures, and landscape features as the product of penetration rates, frequencies of use, and water demand per use. The first two factors are based on statistical analysis of household level data, but water demand per use is typically derived from an engineering estimate. For example, swimming pool usage is based on evaporation rates, and largely ignores filter back-flushing, leaks, etc. M&A will derive more realistic statistical estimates of water demand for specific water use activities.

Data on rebates for appliances and fixtures (provided by Tucson Water) will be linked to billing data to support statistical analysis of impacts on indoor demand. Impacts of turf and pool changes on outdoor demand will be similarly estimated based on pinpointing the year of change with remote sensing data discovered in **Tasks 5 and 6**, and linking that to billing data. A combined time series – cross sectional approach will be employed to eliminate self-selection biases and remove the influence of inter-annual variances in demand due to climate fluctuations and other short-term phenomena.

Deliverables: Model coefficients based on engineering estimates of demand will be replaced with coefficients based on observed real-world demand impacts. The findings will be described in detail, including tables of regression results and in graphs, in the technical memorandum.

8. Technical memorandum, hand-over of new TAMA models: A technical memorandum will concisely describe project findings. A meeting will be held for participating parties to summarize findings and to hand over the enhanced models.

Deliverables: Technical memorandum, enhanced TAMA water demand models.

Schedule & Budget Overview

The project will begin within a month of funding, and is expected to last 9 months. Schedule by deliverable is shown in the Gantt Chart below.

TASK	Sep	Oct	Nov	Dec	Jan	Feb	Mar
1. Update model, extend forecasts							
2. Planning needs, barriers to model use							
3. New population growth and distribution inputs							
4. Survey outdoor tastes and preferences re pool removals							
5. Better characterize turf changes with remote sensing							
6. Better characterize pool changes with remote sensing							
7. Quantify impacts of rebates, outdoor changes w/billing data							
8. Drafting of technical memorandum, meeting							

The project budget is summarized below.

BUDGET SUMMARY

TASK	STAFF¹	OTHER	COST
1. Update model, extend forecasts	Zivic , Woodard		8,000
2. Planning needs, barriers to model use	McKenna , Woodard	travel	9,000
3. New pop. growth & distribution	Zivic , Woodard		7,000
4. Outdoor tastes, preferences	Weber , Woodard	panel, survey	24,000
5. Better characterize turf	Bayley , Woodard	remote sensing	17,000
6. Better characterize pools	Woodard , Bayley	remote sensing	14,000
7. Quantify impacts of rebates, outdoor changes with hhold-level billing data	Woodard , Zivic		20,000
8. Project coordination, produce tech memorandum, and hand off models	Bayley , Woodard		19,000
TOTAL			118,000

¹**Bold** indicates task lead(s) on deliverable



August 31, 2016

Mr. Jeff Tannler
Director, Active Management Areas
Arizona Department of Water Resources
1110 W Washington Street, Suite 310
Phoenix, AZ 85007

Dear Mr. ^{Jeff}Tannler,

I write in support of the use of TAMA Water Management Assistance Funds to update and expand the water demand models that were developed by Montgomery & Associates for municipal water providers in Pima County. Central Arizona Project provided both financial and data support for the original project, and we have incorporated a number of its results into CAP's service area planning efforts. Analysis from both the Pima County demand project, and the parallel effort in Maricopa County, have been used to improve the municipal demand portion of our CAP:SAM model. CAP: SAM is the primary tool we use to evaluate CAGR's future water supply obligations, and it is being used extensively for supply and demand modeling in the West Salt River Basin and Lower Santa Cruz Basin Studies.

The scope of the proposed project aligns well with research questions that are of interest to CAP. We anticipate that the project will help reduce some of the uncertainties in our municipal demand forecasts. In particular, we look forward to analysis of residential landscape changes at the household level, especially related to turf and pools, based on remote sensing and metered water usage. The analyses of rebate programs on indoor demand should also produce useful insights.

It is our understanding that Tucson Water has agreed to manage the project contract, and that there is interest and support from other entities in the Tucson AMA. To help support this new project, we anticipate making a direct contribution of \$10,000, plus indirect support in the form of data and model outputs, including output from our economic model of development patterns for future growth, as well as our high-resolution multi-spectral remote sensing data.

Sincerely,

A handwritten signature in blue ink, appearing to read "Ken Seasholes", is written over a light blue horizontal line.

Ken Seasholes, Manager
Resource Planning & Analysis

Cc: Suzanne Ticknor



September 1, 2016

Mr. Thomas Buschatzke, Director
Arizona Department of Water Resources
1110 W Washington Street, Suite 310
Phoenix, Arizona 85007

Re: Letter of Support for Update of Water Demand Models for Select Providers in TAMA

Dear Director Buschatzke:

Metropolitan Domestic Water Improvement District (District) supports the Arizona Department of Water Resources (ADWR) use of Conservation and Augmentation Funds in the Tucson Active Management Area (TAMA) to enhance and update the water demand models for select providers in TAMA and for Pima County as a whole. The District used the results of the previous modeling effort in applying for renewal of our assured supply designations at the Metro Main and Metro Southwest-Diablo Village service areas. The model also helped the District to better understand the downward trends in demand and was a factor used in the District's rate design process.

The District understands that the new model will have an enhanced dashboard interface to explore how different growth rates and various patterns of new development impact service area demands. We anticipate that the proposed work will help us better understand how changes in landscapes are affecting outdoor demand and will be useful in our water resources planning.

Water providers throughout the nation face an era of increasing supply and demand uncertainties. This paradigm has caused water providers in TAMA and the Phoenix Active Management Area to cooperate more in water resource planning and innovative water supply management opportunities. An updated county model of municipal demand will improve our understanding of the trends and changes in behavior that are reducing per-customer demand. Such insights should be valuable to the District and other water providers in the TAMA.

Sincerely,

A handwritten signature in black ink that reads "Joseph Olsen". The signature is written in a cursive, flowing style.

Joseph Olsen, P.E.
General Manager

c: Jeff Tannler
Michael Block



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August 16, 2016

Re: Thomas Buschatzke, Director
Arizona Department of Water Resources
1110 W Washington Street, Suite 310
Phoenix, AZ 85007
C/O Jeff Tannler, Director of AMAs
jmtannler@azwater.gov

Dear Director Buschatzke:

Community Water Company of Green Valley ("CWC") strongly supports the proposal to improve the modeling and scenario forecasting tool previously developed by Montgomery & Associates ("M&A"). We supported that previous effort, and have found both the model and the analysis of historic demand data, to be of great value.

CWC recently hired M&A to update and broaden specific portions of the earlier model as part of a recent rate case with the Arizona Corporation Commission. The existing model, plus an updated analysis of historical data, were used to make a case for incorporating forecasts of continued declines in demand in our new rates. Our case was made stronger by being able to present demand forecasts for other municipal water providers in Pima and Maricopa Counties. Just last week, the ACC approved rates that incorporate future declines in demand in new rates. I believe this to be a first.

CWC believes this proposal is an excellent use of our Water Management Assistance Funds, and we look forward to receiving its results.

Sincerely,
Community Water Company of Green Valley

Arturo Gabaldón
President