Differential Water Rate Methodologies

Executive Summary

As further described herein, the panel confirmed that differential water rates between inside City and outside City customers are part of standard rate setting options outlined in and endorsed by the M1 manual. Determination of the best methodology for how such rates for outside City customers should be calculated should be based on the policy objectives of such rates and the unique characteristics of the utility and its customer base. The panel acknowledges there is not a singular "right" answer to differential rate analyses and that a wide range of reasonableness exists. There is an increasing trend in Arizona and other states of legal challenges to differential rates, so any factors involved in developing such a rate should be based on the best available data wherever possible.

In the case of Tucson Water, the panel believes that the most supportable approach to determining differential rates involves employing the "utility basis" and establishing a differential rate of return for purposes of establishing outside City rates. Panel members suggested engaging a rate of return expert to get a preliminary evaluation of the return of equity used to determine the rate of return for outside City customer rates prior to jumping in completely to an in-depth analysis, as the analysis is likely to be costly and time consuming. This preliminary evaluation could valuable insight into whether or not to further pursue the analysis and, ultimately, a differential rate structure.

The panel recommended Tucson Water to engage in more discussion, outreach, and education on differential rates with stakeholders, policy makers, and customers. They felt it was important for these groups to better understand why outside City customers are different, the financial responsibility carried by the utility and ultimately the overall City, and that rates of return are "allowed" and are part of many utility rates, particularly those regularly reviewed and approved by the ACC.

Differential Analysis Subject Matter Expert Panel

Summary of Discussion and Recommendations

With the repeal of Tucson Water's differential rate in November 2023 amidst ongoing litigation related to the rate, the City's Mayor and Council directed staff to conduct an in-depth analysis to determine if the utility should consider pursuing a differential rate that addresses both the procedural concerns of the last differential rate process and also addresses other legitimate criticisms of the cost-of-service methodology used to support the differential rate. To do this, Tucson Water brought together a panel of experts to review the previous methodologies used to substantiate the policy-based differential the Mayor and Council adopted, review the related criticisms, and give feedback as to whether Tucson Water was in a position to justify a differential rate and if so, whether such a differential might be better developed or strengthened. The panel members were selected based on their expertise specific to water utility cost of service and rate development. They, and the firms they represent, have worked with utilities across the nation to develop water rates, and all have conducted detailed analysis of the cost differentials between inside and outside city customers. Their experience and credentials are outlined in their resumes that accompany this report (Attachment A).

The panel was brought together for two three-hour meetings with Tucson Water staff and Tucson Water's contracted rate consultants, Galardi Rothstein Group and Raftelis. The panel was provided with presentations from Tucson Water staff and Tucson Water's contracted rate consultants and were asked to review supplemental materials outside those meetings specific to data, methodologies, and criticisms, and challenges of Tucson Water's last adopted differential rate that was discontinued November 1, 2023. The agenda for those meetings with a listing of supplemental materials provided to panel members is in Attachment B of this report.

Once the panel developed an understanding related to the unique characteristics of Tucson Water's service area, rate structure, customer usage characteristics, and the data and methodologies used in the prior differential analysis and the criticism and challenges to that analysis, they were asked to opine on the following: 1.) Does the utility have a defensible framework for pursuing a differential rate? 2.) Is Tucson Water's definition of the two usage populations (unincorporated vs incorporated) valid? 3.) What were the weaknesses of the last analysis? 4.) Should any additional data or usage characteristics be further analyzed and factored into a future analysis? 5.) Was the methodology used to determine the differential range appropriate? 6.) What changes if any would the panel recommend?

This report summarizes the panel's feedback as it relates to the above outlined discussion points. The panel was also welcome to offer any other insights, feedback, or criticism they might have related to Tucson Water's prior enacted differential rate and/or the basis for a future possible differential rate. This report was drafted by Tucson Water staff to capture the discussion and feedback at each of the two meetings. A draft was provided to the panel for their review and modification to ensure it accurately captured the ideas and feedback they provided during the panel meetings.

Overall, all panel members agreed that a utility's decision to pursue a differential rate is provided for under what is referred to in the industry as the M1 Manual. This manual, Principles of Water

Rates, Fees and Charges (M1) is published by the American Water Works Association and is regarded as the standard for determining and setting water rates. The manual outlines the two primary water rate development methodologies: cash basis and utility basis. Tucson Water has historically used the cash-basis to develop its water rates. However, the M1 manual provides that the industry considers a municipal utility the equivalent of a private utility for purposes of rate setting for customers outside their municipal jurisdiction. The difference is based on whether the customers are owners or non-owners of the system. Customers outside the city are classified as non-owners. As outlined in the M1 manual, the utility can then use the utility basis approach and include a rate of return component in the development of outside city customer cost of service and rates. The cost of service includes a return on the utility's plant in service and other capital facilities. The methodology used is the utility basis and has been used throughout the nation by investor-owned and municipally-owned utilities with customers outside their jurisdiction. The precedent for applying a return on investment and using the utility basis to determine a differential rate for non-owners is well established. The panel members seemed to unanimously agree that Mayor and Council's adoption of a differential rate was entirely within industry standard approaches and methodologies and standard practices as outlined in the M1 manual.

Additionally, the panel agreed with City staff and its rate consultants that Tucson Water's determination of areas and customers subject to the differential rate versus those who are not is complicated by pre-existing agreements and contracts such that it is not a simple "inside" vs "outside" determination as it is in some other utilities that serve customers outside their jurisdictional area; however, the panel agreed that these complications do not limit the appropriateness of the utility assessing a differential rate for outside City customers. When establishing a rate differential, Tucson Water classified inside City customers as those customers in incorporated areas and with pre-existing contracts or agreements with the City, versus outside City customers as those who resided in unincorporated areas and without a pre-existing contract or agreement. Simply, the two groups became un-incorporated who paid differential rates versus incorporated who did not pay a differential rate. For the purposes of this report, the groups will be referred to as inside and outside.

The panel did offer insights related to the strengths and weaknesses of the overall analysis and data used that served as the basis for two technical memos that were published to support the differential rate. The subject matter expert panel's thoughts and input are as follows:

Regarding the analysis outlined in the Phase II technical memo to further demonstrate a cost-based justification for the differential, the panel wanted to verify that the rate base excluded contributed capital. They also wanted to verify that the allocation of distribution assets between inside and outside on the basis of inch-miles within the respective service areas for purposes of allocating O&M, depreciation, and rate base, also excluded contributed capital. Water staff confirmed that the rate base excluded contributed capital and associated distribution, but in the case of determining the allocation of inch-miles of distribution piping between inside and outside, contributed capital was not excluded. This is because the utility does not have data in the GIS and financial system to document the specific location and segments of distribution piping that were contributed. The inch-miles of distribution piping was used in the Phase II analysis as the allocation basis for the readiness to serve O&M costs, distribution depreciation and distribution rate base. Because contributed assets were not excluded from the count of inch-miles in outside

and inside service areas, there could potentially be an argument that the contribution of assets between inside and outside are not equal and that a greater percentage of contributed assets belongs to either inside or outside customers which could affect the accuracy of the allocation percentages between inside and outside customers. Tucson Water confirmed that it does not and will not have a way to ascertain the distribution of contributed capital related to the inch-miles of distribution piping. Regardless of this data limitation, the ongoing responsibility for the maintenance and future replacement of these assets is the responsibility of Tucson Water so distributing O&M, depreciation, and rate base on the basis of where the infrastructure resides - irrespective of whether it was contributed or not - is not necessarily flawed or incorrect. The panel concurred that this data limitation should not preclude the City from moving forward in implementing differential rates

A further question related to the determination of whether distribution infrastructure was classified as an inside or outside asset was asked. Specifically, if distribution infrastructure in jurisdictional boundaries was only serving outside customers, was the inch-miles of that distribution pipe allocated to outside or inside customers? It was clarified that this distinction was based solely on what portion of the distribution piping fell within jurisdictional boundaries versus outside jurisdictional boundaries irrespective as to whether the distribution line served inside or outside customers. The panel noted that this way of allocating distribution lines likely served to benefit outside customers since lines within the City could be solely used for purposes of moving water through the City to serve outside customers. The panel also noted that this also heavily depended on the characterization of what infrastructure is considered distribution versus transmission. It was clarified by staff that the distribution infrastructure was defined based on 8 inch and below whereas transmission was anything larger than 8 inches. Although the assignment of these assets and whether the distinction between distribution versus transmission infrastructure is an area that could be further analyzed in a future analysis, the panel suggested that it might not be a worthwhile exercise particularly if there is no way to determine which of those segments are contributed.

The panel also had questions related to the determination of peaking factors since one panel member seemed to recall that peaking in more arid southwestern climates is typically relatively homogenous. They wanted to better understand the accuracy of the peaking data (max day and max hour). In the case of the Phase II analysis, five years of historical monthly sales data for customer groups was used to derive the max hour and max day. A more ideal calculation of peaking factors would be based on AMR data where the consumption data is measured on shorter more regular intervals than the monthly class consumption meter reading billing data that was used based on availability of data. The panel advised that without AMR data, pump station data can sometimes be used but it can be difficult to work with. In the absence of pump station data, the methodology used in the Phase II analysis was the same as that used with other customers and how they typically normalize the data. Tucson Water's rate consultants further clarified that pump station data would be difficult to use for this purpose for Tucson Water, since the water is not coming from centralized reservoirs but is coming from a system of interconnected wells and other sources.

There was considerable discussion related to the rate of return and specifically the cost of equity that is used to calculate the rate of return component of the utility basis. It was discussed that cost of equity and, ultimately, the rate of return are subject to interpretation because there are several

approaches that experts in this field use to identify what constitutes appropriate, recommended levels. Because there are several approaches, this component can turn into a point of contention and debate by experts on either side of a rate challenge. Rates developed on a cash basis are typically easier to defend because they do not include the cost of equity component. The M1 manual suggests 4 different options for determining an appropriate cost of equity for municipally owned systems. The fact alone that there are 4 options demonstrates that there is no one perfect or preferred approach when determining this factor. The panel suggested that, in the event that the City decides to pursue an outside rate using the utility basis methodology, Tucson Water consider hiring a cost of equity expert who would evaluate the characteristics of our utility and recommend the most appropriate approach and the resulting recommended cost of equity value.

The panel also discussed that Tucson Water has an exceptionally strong equity position because it has been retiring debt and moving towards cash-funded capital. This dynamic is not typical within the industry. There was concern that the most simplified rate of return calculation may potentially be insignificant and possibly less than the imputed rate of return calculated in the Phase II analysis of 8.87%. Additionally, the determination of cost of equity and rate of return is not a static value, it changes as interest rates change, as the utility's capital funding portfolio potentially shifts from pay-go to debt, and other factors. An analysis must anticipate and consider some of these potential changes over time so that the rate is not adjusting significantly from rate cycle to rate cycle, and also so that the City does not move to a differential rate structure only to find that the expected relationships of contributions from inside vs outside customers vary significantly over time from the initial calculated relationships.

The panel also asked about the basis or rationale for escalating the differential based on the escalating usage tiers. There was concern that this increase did not correlate directly to any specific imputed rate of return or cost-based calculations. It was suggested that, in order to achieve the Mayor and Council's objective of further encouraging conservation in outside customer groups, consideration might be given to establishing a different tiered rate (customer class) for outside customers as part of evaluating a differential.

Overall, the panel confirmed that differential rates are part of standard rate setting options outlined in and endorsed by the M1 manual. Determining the best methodology for how such a rate should be calculated is one that should be based on the policy objectives of such a rate and the unique characteristics of the utility and its customer base. The panel acknowledges there is not a singular "right" answer to differential rate analyses and that a wide range of reasonableness exists. There is an increasing trend in Arizona and other states of legal challenges to differential rates, so any factors involved in developing such a rate should be based on the best available data wherever possible and those factors that are more subjective could be strengthened by the involvement of industry experts particularly in the case of developing a cost of equity for the utility if the City continues on a path to basing differential rates using the utility basis rather than cash basis.

The panel was convened a third time on July 29, 2024, to further discuss rate development methodologies and provide feedback to the City regarding the best possible methodology to use in developing a differential rate. Attachment C is an outline of the various possible differential rate development methodologies that was put together by the City's rate consultants. This outline was reviewed and discussed with the panel at the scheduled meeting. The following provides the

panel's overall thoughts related to those methodologies and their recommendation of the best option to pursue in the event the City decides to develop and adopt a rate differential.

First the panel evaluated the methodology used to determine the outside City rate based that was used to defend a rate differential in 2021. Specifically, the panel was asked if the allocation of plant-in-service (fixed asset) values should be further refined by including considerations such as reserve capacity or allocation of specific assets to inside versus outside. The panel felt that the calculations to determine reserve capacity of each well would be extraordinarily complicated and counter to the true nature of the Tucson Water system. The system is an overall network that moves water throughout infrastructure located both inside and outside jurisdictional boundaries to meet demand requirements. [1]Ultimately, the system is a regional interconnected system without discrete assets that specifically belong to or support only one user group.[1] The panel also confirmed that the exclusion of donated assets from the rate base calculation is appropriate as the utility is not entitled to a rate of return because they were not funded by the utility. Additionally, the basis for plant in service cost should be on original cost and not replacement cost. This aligns with the methodology used by Tucson Water and its rate consultants as part of the first differential analysis.

The panel then reviewed the initial study's allocation basis for operation and maintenance cost. It was again reaffirmed by the panel that as a regional system it is not recommended to directly allocate maintenance costs to inside/outside service groups. The most appropriate way to allocate O&M costs is to continue on the basis of usage characteristics of these groups such as peaking and total use demands. It was acknowledged that the eventual move to Advanced Metering Infrastructure (AMI) will provide better data to support peaking calculations in the future, but the current methodology of using monthly billing data is consistent with the M1 manual methodology and is adequate to ascertain differences in peaking between the customer groups.

One area that Tucson Water discussed as a possible weak point that was a point of contention when the differential rate was legally challenged was the rate of return (or cost of equity). This rate is typically policy driven but can be calculated based on a more in-depth cost of capital study. A review of Arizona Corporation Commission approved water utility rate cases found a wide range of approved rates of return. For purposes of Tucson Water's initial analysis, a range of rates was used from 5% to 10%. The panel felt that the utility basis of rate setting allows for a fair amount of discretion in setting the rate of return and that the range used was reasonable. Hiring a cost of capital expert would certainly be an option for further refining this range if the City felt it absolutely necessary, but some panel members advised that the City would then need to be prepared to accept those results which could ultimately be lower than what the system requires particularly given the impacts of the City's concerted move to a pay-go program for funding capital reinvestment.

The panel then discussed the following methodologies:

[1] This is, of course, with the exception of the isolated systems that Tucson Water currently operates and maintains. However, a sale of these systems is currently being negotiated and is expected to be completed this FY (FY25).

A. Cash Needs
B. Hybrid Approach – Utility Basis with Cash Residual
C. Hybrid Approach – Utility Basis with Rate of Return Differential
D. Rate Differential Approach

The specifics of each of these methodologies and pros and cons are outlined in Attachment C. Ultimately the panel felt, given the characteristics of Tucson Water, its service area, and its customers, that either of the hybrid approaches would be the best option. It was felt that the calculations related to methodology A would be easier for a non-expert to understand. Under either methodology B or C, the City would conduct an analysis with multipliers that should be used consistently moving forward with a commitment to conduct a rate study of a recurring basis (every 5 or 10 years) to validate the multiplier and where it falls outside the acceptable range, adjust where needed. Ultimately in either methodology B or C, the issue of the appropriate rate of return is the challenge. Panel members suggested engaging a rate of return expert to get a preliminary evaluation of the return of equity used to determine the rate of return prior to jumping in completely to an in-depth analysis as the analysis is likely to be costly and time consuming. This preliminary evaluation could provide valuable insight into whether or not to further pursue the analysis and, ultimately, adopt a differential. It should be noted that a major legal challenge to outside city rates in Texas was recently resolved by the state's Public Utility Commission in favor of the reasonable of an outside city rate differential. This will provide additional legitimacy to the concept of differential outside rates. However, action on North Carolina's State legislative bill to limit differential rates could also provide a negative l insight on legitimacy of rate differentials and the rates of return used.

Overall, the panel advised that more discussion, outreach, and education on differential rates with stakeholders, policy makers, and customers is recommended. They felt it was important for these groups to better understand why outside City customers are different, the financial responsibility carried by the utility and ultimately the overall City, and that rates of return are "allowed" and are part of many utility rates, particularly those regularly reviewed and approved by the ACC.

Should the City decide to further pursue a differential rate analysis and move into Phase II of this study, the panel is available to further review and provide feedback throughout that process.

Attachment A

Subject Matter Expert (SME) Panel Members Experience and Credentials

Dan V. Jackson, MBA

Vice President and Principal in Charge

Education

Master of Business Administration, University of Chicago, 1984; Specialization in Finance/Accounting

Bachelor of Arts, University of Chicago, 1982; Major in Social Sciences
Dean's Honor List

Areas of Expertise

Rate Design

Cost of Service

Financial Forecasting

Valuation Analysis

Acquisition Analysis

Privatization Analysis

Economic Impact Analysis

Expert Witness Testimony

Affiliations

Member, American Water Works Association

National Association for Business Economics

Other

The Forgotten Men (fiction) – Mediaguruz

Rainbow Bridge – Fiction – Mirador Publishing

39 Years' Experience

Mr. Jackson has 39 years of experience as an international financial expert, having completed utility rate/cost of service studies and long-term financial plans for clients throughout the USA and five sovereign Pacific nations. He also has served as an expert witness in state court, federal court and before several public utility commissions. Mr. Jackson's prior experience includes positions with Deloitte and Touche and Reed-Stowe and Company. In 1997, Mr. Jackson co-founded Economists.com LLC, an international consulting firm with offices in Dallas and Portland, Oregon. Willdan acquired Economists.com in 2015, and Mr. Jackson now serves as Vice President.

Mr. Jackson has prepared over 400 utility rate studies for over 100 clients in Texas, 200 clients across the USA, and 5 sovereign nations during his long career. He has given dozens of lectures and presentations before professional associations on utility rate issues. Mr. Jackson is also an accomplished author; his newest novel **Rainbow Bridge** is now available on Amazon.com and in selected bookstores and has won the prestigious Feathered Quill Award for animal-based literature.

Water/Wastewater – Rate Studies and Long-Term Financial Plans

Mr. Jackson has served as project manager for over 400 water and wastewater rate studies and long-term financial plans. His clients have primarily been cities and public utilities located in Texas, Oklahoma, Arkansas, Arizona and across the USA. He has given over 300 public presentations on rate and long-term financial plans for city councils and ratepayers throughout the USA. His clients have ranged from Arizona and Texas border communities to Northwestern metropolises, rural water districts, urban suburbs and inner-city communities.

Electric – Rate Studies and Financial Plans

Mr. Jackson has managed over 25 electric rate studies across the USA. He has helped set electric rate policy in 5 nations, and has met with senior government officials and regulatory agencies to develop appropriate guidelines. He is frequently engaged by the Asian Development Bank to prepare electric tariff analyses and assess the impact of solar PV on the cost of service for Pacific utilities. He has provided expert witness testimony supporting electric rate designs.

Solid Waste and Stormwater – Rate Studies and Financial Plans

Mr. Jackson has managed over 15 solid waste and 10 stormwater rate studies and financial plans, across the southwest United States and the Pacific Region. He has provided expert witness testimony supporting electric rate designs on numerous occasions.

Water/Wastewater – CCN/ System Valuations and Acquisitions

Mr. Jackson has prepared approximately 50 water and wastewater CCN and system valuations, for the purpose of enabling utilities to acquire additional service territory. A critical component of these analyses was the impact of the acquisitions on the user rates for both existing ratepayers and the acquired territories.

Water/Wastewater – Impact Fee Studies

Mr. Jackson has prepared approximately 25 water and wastewater impact fee studies for utilities throughout the United States.

International Experience

Mr. Jackson is recognized as an international expert on utility financial planning and tariff (rate) design by the World Bank and the Asian Development Bank. Under their direction, he has assisted in projects that have brought potable water to villages in developing nations. He has worked on these engagements in the independent nations of Fiji, Samoa, Palau, Kiribati, and the U.S. territories of American Samoa and the Commonwealth of Northern Mariana Islands. He has worked independently for water, wastewater and electric utilities in Guam, Tuvalu and the Kingdom of Tonga.

Water/Wastewater – Rate Studies and Long-Term Financial Plans

Texas – Dallas/Fort Worth

- Allen
- Balch Springs
- Burleson
- Cedar Hill
- Celina
- Cleburne
- Denison
- Denton County FWSD 1A
- Coppell
- DeSoto
- Duncanville
- Denton County FWSD 8C
- Ferris
- Grand Prairie
- Fairview
- Garland
- Hutchins
- Frisco
- Heath
- Little Elm
- Hackberry
- Kaufman
- Kennedale
- Josephine
- Mesquite
- Midlothian
- McKinney
- Princeton
- Parker
- Oak Point
- Rowlett
- Prosper
- Plano
- Rockwall
- Royce City
- Richardson
- Venus
- Sachse
- Sherman

Texas — Statewide

- Alvarado
- Amarillo
- Aqua Water Supply Corporation
- Beeville
- Brownsville PUB
- Brady
- Castroville
- Cibolo Creek Municipal Authority
- Combes
- Crystal Clear SUD
- Del Rio
- Donna
- El Paso County WCID #4
- El Paso County Tornillo WCID
- Edinburg
- Galveston
- Fairfield
- Harlingen WaterWorks
- Galveston County WCID
- Groesbeck
- Harker Heights
- Hempstead
- Hewitt
- Hondo
- Jonah Special Utility District
- Kempner WSC
- Laredo
- Laguna Madre Water District
- La Villa
- Leander
- League City
- Liberty Hill
- Los Fresnos
- Marble Falls
- Marfa
- McLendon-Chisholm
- Mercedes
- New Braunfels
- North Fort Bend Water Authority
- Paris
- Port Arthur
- Port of Houston Authority
- Primera
- Raymondville
- Robinson
- Robstown
- San Juan
- Schertz
- Seguin
- Selma
- Schertz-Seguin Local Govt Corp.
- Sonora
- Southmost Reg. Water Authority
- Tomball
- Troup
- Venus
- Waller
- West Harris Co. Reg. Water Auth
- West University Place
- Webb County
- Whitehouse
- Winona
- Yancey Water Supply Corporation

Arizona

- Bisbee
- Carefree
- Chloride Domestic Water Imp District
- Cottonwood
- Eloy
- Goodyear
- Marana
- Oro Valley
- Prescott
- Queen Creek
- Show Low
- Tonto Village DWID
- Winslow
- Buckeye
- Casa Grande
- Clarkdale
- Douglas
- Florence
- Holbrook
- Miami
- Patagonia
- Prescott Valley
- Safford
- Somerton
- Wellton
- Yuma
- Camp Verde Sanitary District
- Chino Valley
- Clifton
- Eagar
- Flowing Wells Improvement Dist.
- Jerome
- Nogales
- Payson
- Quartzsite
- San Luis
- Tombstone
- Willcox

Arkansas

- Bryant
- North Little Rock Wastewater Utility
- Community Water System
- Conway
- Russellville
- Benton Washington RPWA
- Hot Springs
- Hot Springs Village

Oklahoma

- Ada
- Edmond
- Lindsay
- Altus
- Miami
- Chickasha
- Pryor

International Regulated Utilities – Pacific and Caribbean

- Water Authority of Fiji
- EPC, Independent State of Samoa
- Guam Power Authority
- Palau Public Utilities Corporation
- Commonwealth Utility Corp Saipan
- Virgin Islands Telephone Company
- Kiribati Public Utilities Board
- American Samoa Power Authority

Stormwater – Rate Studies and Long-Term Financial Plans

- Hot Springs, AR
- Balch Springs, TX
- Prescott Valley, AZ
- Hewitt, TX
- Coppell, TX
- Bryant, AR
- San Marcos, TX

Solid Waste – Rate Studies and Long-Term Financial Plans

- Duncanville, TX
- Frisco, TX
- Hewitt, TX
- Mercedes, TX
- San Luis, AZ
- Somerton, AZ
- Goodyear, AZ
- Altus, OK
- Miami, OK

Impact Fee Studies

- E. Medina Co. Special Utility Dist, TX
- Harlingen, TX
- Los Fresnos, TX
- Seguin, TX
- Wellton, AZ
- Yuma, AZ
- Cibolo Creek Municipal Auth., TX
- Laguna Madre Water District, TX
- Marble Falls, TX
- San Luis, AZ
- Prescott, AZ
- Hot Springs, AR
- Crystal Clear SUD, TX
- Liberty Hill, TX
- Mesquite, TX
- Marana, AZ
- Prescott Valley, AZ

Shawn Koorn

Utility Rates and Finance

Shawn is an Associate Vice President and Senior Professional Associate with HDR. He leads the Utility Rates and Finance Group that provides financial planning and economic review towards development of rate and cost of service studies for wastewater, water, stormwater, electric, and solid waste utilities. This information is communicated utilizing technical abilities and presentation skills in a clear and concise manner.

Shawn also has experience with regulatory filings before public service commissions. He has developed testimony to support water and sewer rate studies before different public service commissions. His experience and knowledge of "generally accepted" rate setting techniques allows him to develop excellent testimony to support his client's position.

Shawn is a co-instructor for the AWWA Rate Setting Essentials Seminar. This three day seminar discusses the theories and methodologies used to establish cost-based rates. Shawn is a contributing author of the AWWA M1 and M54 Manuals and has presented numerous papers on financial planning and rate setting topics at national conferences.

EDUCATION
Bachelor of Science, Economics, Central Washington University

Bachelor of Science, Business Administration, Central Washington University

PROFESSIONAL MEMBERSHIPS
Washington Finance Officers Association, Education Committee, Member

American Water Works Association, Rates and Charges Sub-Committee, Member

INDUSTRY TENURE
25 years

HDR TENURE
24 years

RELEVANT EXPERIENCE

Anchorage Water and Wastewater Utility, Water and Sewer Cost of Service Study, *Anchorage, AK*
Over the past 20 years HDR has assisted AWWU in the development of water and wastewater cost of service and rates. The results of the study are presented to the Regulatory Commission of Alaska and final rates are implemented based on the study recommendations. Recently Shawn reviewed and updated AWWU's water and wastewater comprehensive cost of service studies. He provided comments on the cost of service studies to provide a more equitable allocation of costs to its customers. Shawn also assisted the utility with developing testimony as it related to the revenue requirement analysis to present to the Regulatory Commission of Alaska. Shawn is currently assisting AWWU in the review of fire protection charges and the methodology for the current water and wastewater cost of service studies for submitting to the RCA.
Role: Project Manager

Seattle Public Utilities, Local Water and Sewer Rate Review and Wholesale Water Rate Study, *Seattle, WA*

HDR assisted Seattle Public Utilities (SPU) in the review of its wholesale water cost of service allocation approach. In addition, HDR is also provided a review of SPU's water and sewer rates and developed alternative rate structures and approaches. As a part of the study, HDR reviewed SPU's water cost of service model and provided input on changes and revisions that would better reflect industry standards and SPU's customer and system operation characteristics, particularly as it related to the issue of peak use demands. HDR also worked with SPU staff to review the current water and sewer rate structures and compared them to SPU's current rate setting goals and objectives. HDR developed a "white paper" which reviewed conceptual water and sewer rate structures and provided the advantages and disadvantages of each structure. From HDR's white paper, SPU staff developed the actual rates to review the customer bill impacts. The results of the analyses were provided in separate technical memorandums for review by the SPU management team and the Citizens Advisory Committee. HDR presented the results of the review and analysis to SPU's Rate Advisory Committee.
Role: Project Manager

EPCOR Water Services, Water and Wastewater Rate Study, Edmonton Alberta
HDR assisted EPCOR with the development of a water and a wastewater cost of service methodology and models. EPCOR is regulated by the Alberta Utilities Commission and provides both wholesale and retail water service and retail wastewater and drainage services. The development of the water cost of service analysis not only must equitably allocate costs between the wholesale and retail customers, but also provide an equitable cost allocation between the various retail customer classes of service. This includes residential, multi-family, commercial, and the university. The development of the cost of service analysis is based on the AWWA base extra-capacity methodology. HDR has worked with EPCOR staff to identify the infrastructure necessary to provide wholesale service, negotiated with the wholesale customers, and provided testimony to the AUC related to the analysis. For the wastewater cost of service, HDR worked with staff to develop an equitable allocation of costs based on how EPCOR incurs wastewater treatment and collection costs. The study was developed and a written report provided to EPCOR for implementation.
Role: Task Lead/Project Manager

City of Santa Barbara, Water and Wastewater Rate Studies, Santa Barbara, CA
HDR has assisted the City in developing both water and wastewater rates over the past 8 years. Key to each study was the development of a financial plan including a capital funding plan. This provided the cost basis for the level of revenues necessary to prudently fund each utility. Next a cost of service analysis was developed to meet the requirements of Proposition 218 and developed rates to reflect the study results. HDR worked with the City's water commission for each study to effectively present the key study issues and gain policy direction. The final study results were presented to the City Council for adoption and implementation.
Role: Project Manager

City of Minneapolis, Water Treatment and Distribution Services, Water Cost of Service Approach and Methodology, Minneapolis, MN
HDR assisted the City in the review of their cost of service model and approach. HDR specifically reviewed the issues of public and private fire protection, development of peaking factors, review of inside/outside rates, and fixed charge components. For each of the issues, HDR developed a technical memorandum discussing the industry standard approach, the City's current approach, and alternatives to consider. HDR worked collaboratively with City staff to review and discuss each memorandum and develop recommendations and next steps.
Role: Technical Lead

Education
M.U.R.P., University of Wisconsin at Milwaukee,
A.B., Politics & Government, Ripon College

Registrations
NA

Memberships and Affiliations
American Water Works Association

Water Environment Federation

Other Information
Length of service in the profession: 40 years

Year joined Jacobs: 1981

Location: Arlington, VA

Mike Matichich

Senior Advisor

Experience Summary

Mike Matichich leads our firm-wide financial services consulting team, which helps clients identify and implement funding, financing, and rate strategies, including exploring emerging forms of finance and grant funding. He has 40 years of experience in helping to development and implement rate programs that have included customer assistance programs and other elements to address the impact of utility fees on low income and other disadvantaged customers. He served as the subcommittee chair for the Affordability Subcommittee to AWWA's Rates & Charges Subcommittee for more than ten years, and in that role was a lead developer of AWWA's first Affordability policy statement. He has served as project manager for cost of service and rate studies that have helped major water, wastewater, and stormwater utilities implement rate increases required to support required capital programs while maintaining strong financial performance in coverage and balances.

Select Relevant Project Experience

Project Manager, Financial Capability Assessment (FCA) and Affordability Study, Salt Lake City Department of Public Utilities. Served as PM for study using recently released EPA and industry guidance documents that identified financial impacts and burden on households of projected wastewater and water capital and operating expenditures. The study looked at the impact of water, wastewater and stormwater fees on residential customers for the service area overall, and also in neighborhoods that were identified as areas of potential concern from an environmental justice perspective using tools such as EPA's EJScreen and new metrics developed by industry associations and a recently published EPA guidance on financial capability. The study is being used to inform financial, policy, and stakeholder outreach efforts of the utility.

Task Lead, Cost of Service and Rate Study for Washington Aqueduct, , Washington, DC. Served as lead financial consultant for a cost of service and rate study for the Washington Aqueduct, which provides wholesale water to the District of Columbia, and Arlington County and the City of Falls Church, in Virginia. The study was conducted using both the base extra capacity and commodity demand methods of cost allocation, to help address questions raised by the customer communities regarding the equity of the allocation of costs among customers. Mr. Matichich oversaw the development of a customized cost allocation model that utilized methodologies consistent with water industry rate guidance documents, such as AWWA's M1 Manual, that he has helped to develop. He made presentations to senior Aqueduct staff, and also to key stakeholder groups, including representatives of the Aqueduct's customer communities.

Rate and Alternative Analysis Task Lead, City of Fairfax, VA. Served as task lead for alternative analysis and rate forecast task for the City of Fairfax, VA. In 2010, the City initiated a study of several options to meet future water supply needs for its customers. The options ranged from making more than $40M in upgrades/rehabilitation to the City's water treatment plant and dams, to getting

out of the water treatment business and purchasing treated water from one of two major regional water purveyors. Mr. Matichich oversaw development of a customized evaluation and rate forecast model that allowed the City to compare rates for its retail customers for a 20-year forecast period under the identified options. Mr. Matichich developed presentation materials and participated in presentations to several stakeholder groups, including the Fairfax City Council and representatives of area regional water purveyors.

Project Manager, Comprehensive Rate and Financial Plan, Cleveland Division of Water and Division of Water Pollution Control. Cleveland, OH. Served as project manager for a suite of rate, cost of service, and strategic financial planning studies for the City of Cleveland's Division of Water and Division of Water Pollution Control. CWD is a major regional water provider, which provides water service to more than 400,000 customer accounts in the City of Cleveland and more than 60 suburban communities in Northeast Ohio, WPC provides wastewater collection and stormwater management services throughout the City of Cleveland. The Cleveland City Council adopted the recommended rate and fee increases for a four-year period, which included double-digit rate increases in two of the years to address significant capital needs operating cost requirements. To cushion the blow of the required increases on low-income customers, Mr. Matichich led analyses and rate modeling that supported development of CWD's first low-income bill discount program, which was initially implemented to provide a 20% discount for qualifying low-income customers. As part of this effort, he and his team helped coordinate arrangements with the Cleveland Housing Network, the agency responsible for qualifying participants for the LIHEAP winter energy assistance program in the Cleveland area, to manage the qualification of participants for the low-income water bill discount program.

Senior Financial Consultant, Financial, Rate and Affordability Studies, Louisville and Jefferson County Metropolitan Sewerage District (MSD), KY. Provided senior technical review to studies and financial model development that supported the MSD in the development of negotiating strategies and in executing consent orders for a wet weather program initially estimated to be $2 billion. Continued role as senior advisor in the development of financial plans and cost of service studies as the MSD has worked to implement the negotiated program. Led development of rate and financial planning studies as part of the update to Louisville Water Company's long-range master plan. As part of the planning effort, the team conducted several rate and financial studies, including review and update of key financial metrics, evaluating whether to create a new rate class for large multi-family residential customers, adjusting the Company's rate structure and bond timing. Created a robust rate/financial planning model to compare numerous capital program and financing scenarios. Served as senior financial consultant in development of a Consulting Engineer's report for inclusion in the Official Statement for a $119 million revenue bond issuance. The revenue bond sale received an AAA S&P rating and AAA Moody's rating.

THE FOSTER GROUP

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The Foster Group offers financial and engineering management consulting services to a broad customer base, specializing in services for municipal utility clients in the United States. Our principal experience includes: evaluating critical business issues impacting municipalities that provide utility services and advising principals in charge; managing financial planning, cost of service, and rate design studies for water and wastewater utilities; preparation of Consulting Engineer's and/or Feasibility Consultant Reports in conjunction with issuance of municipal revenue bonds; development of other feasibility reports; design of financial management information systems; consulting assistance regarding contractual and other relationships amongst municipalities, and expert witness services in utility litigation matters.

The Foster Group maintains cooperative arrangements with several other professional service firms, large and small, to facilitate effective delivery of a wide variety of specialized consultative services.

The President of The Foster Group is Mr. Bart Foster, who has a lengthy career in providing strategic consulting services to municipal entities. Mr. Foster previously served as a director of a large consulting practice in an executive capacity, ultimately responsible for all management consulting services to municipal clients in the United States. His comprehensive experience includes both executive level and comprehensive analytical involvement in all aspects of business consulting services for municipal utilities. As such, Mr. Foster specializes in both executive briefings and detailed analyses. Mr. Foster possesses expertise in the use of technology for economic, financial planning, program management, and presentation applications. Mr. Foster's combined technical, financial, and computer skills have proven well suited to address the challenges facing municipally owned utilities.

Over the past twenty years The Foster Group has performed utility financial management and rate related studies encompassing a total volume of work in excess of twenty million dollars. A sampling of our representative experience follows.

Representative Experience

Miscellaneous Business Consulting Services, Great Lakes Water Authority, Detroit, Michigan (2016 to present)

Serves as business advisor and financial and rate expert for extensive financial planning and management consulting assistance for the Great Lakes Water Authority. Specific projects have included general consultation regarding financial management issues, expert witness testimony in matters related to water and sewer rate disputes, assistance in addressing customer community issues, consultation regarding coordinating Regional GLWA utility and Local Detroit utility operations and business plans, preparation of feasibility consultant reports for several bond prospectuses, development of long-term financial plans and planning procedures,

consultation regarding cost of service allocation and service charge design methodologies, assistance with improving accounting policies and procedures, development and implementation of several financial management systems, strategic assistance regarding the planning and monitoring of capital improvement programs, leadership participation in the Authority's outreach efforts with it's contractual customer communities, and development of financial management tools and procedures.

Miscellaneous Business Consulting Services, Detroit, Michigan (1986 through 2015)

Served as business advisor and financial and rate expert for extensive financial planning and management consulting assistance for the Detroit Water & Sewerage Department. Specific projects have included general consultation regarding financial management issues, expert witness testimony in matters related to water and sewer rate disputes, assistance in addressing customer community issues, preparation of feasibility consultant reports for several bond prospectuses, development of long-term financial plans and planning procedures, consultation regarding cost of service allocation and rate design methodologies, assistance with improving accounting policies and procedures, development and implementation of several financial management systems, strategic assistance regarding the planning and monitoring of capital improvement programs, leadership participation in the Department's outreach efforts with it's contractual customer communities, and development of financial management tools and procedures.

Business Consulting Services, Kalamazoo, Michigan (1989 to present)

Serves as business advisor for extensive financial planning and management consulting assistance for the City of Kalamazoo and its Department of Public Utilities. Provides consulting advice to the City Manager on General Fund business matters and to the Public Services Director, the City Manager and the Wastewater Utility Advisory Board, made up of representatives of contractual wholesale customers and retail customers outside the City limits as well as City staff on utility financial planning, rates, and related matters. Participates in group designing new service agreements with outside City customers. Past assignments have included regular water and sewer rate studies since 1989, successful expert witness services in wastewater rate arbitration processes, and analyses and investigation of potential alternative governance scenarios.

Financial and Rate Consulting Services, Southeast Oakland County Water Authority (2008 to present)

Serves as business advisor regarding utility financial matters and as rate consultant to support the Authority's water charges to its wholesale customers.

Contract Negotiation Services, Muskegon County, Michigan (2016 to present)

Provides consulting assistance regarding wastewater service agreements and interpretation of utility charge requirements contained therein, including preparation of amendments to contract provisions and implementation assistance.

Expert Witness Services, Dearborn, Michigan (2016)

Provided consulting assistance and testimony regarding the City's water and sewer rate practices.

Feasibility Consultant, Bexar Metropolitan (Texas) Water District, (2010)
Served as feasibility consultant and produced Financial Feasibility Report included as an appendix to the official statement issued in connection with the District's issuance of Waterworks System Revenue Bonds.

Business Consulting Services, Jupiter Island, Florida (2008 - 2009)
Served as business advisor for extensive financial planning and management consulting assistance for the Town and its Utility operations, including preparation of feasibility analyses in support of the Town's issuance of revenue bonds.

Business Consulting Services, Confidential Client (2006-2007)
Served as advisor to the City as it investigates issues surrounding competitive challenges regarding its municipal electric and gas utilities, including and potential sale and/or changes in governance.

Financial and Rate Consulting Services, Ann Arbor, Michigan (2007)
Participated in a study of a new rate structure for the City's stormwater utility. Also served as Executive in Charge of business advisory services to the City of Ann Arbor as it investigated modifications to the cost recovery practices of its Storm Water Utility. Key issues included development of user fees that reflect robust cost of service principles and meet strict legal guidelines in the State of Michigan. Also provided consultation to the City regarding its sewer rates, including meetings with the Michigan Department of Environmental Quality regarding user charge issues.

Expert Witness Services, Bay County, Michigan (2007 to 2011)
Successfully served as Executive-in-Charge for expert witness services provided to the County Department of Public Works in water rate disputes with contractual customers. Assignments have also included serving as advisor on related business issues.

Expert Witness Services, Lee's Summit, Missouri (2005 to 2012)
Served as business advisor to the City in its Utility Financial matters, including arbitrator in a water rate dispute with the City's wholesale water providers.

Education

B.S., Mechanical Engineering, University of Kansas, 1983

M.B.A., Finance, University of Kansas, 1985

Registered Professional Engineer: Kansas

Affiliations

AWWA, WEF

Attachment B

SME Panel Meeting Agendas and Materials

City of Tucson Differential Analysis

First SME Meeting

March 12, 2024

Attendees:

Tucson Water Representatives:
- Silvia Amparano, Tucson Water Deputy Director
- Chris Avery, Assistant City Attorney
- Amber Kerwin, Rates and Revenue Manager

Tucson Water Contracted Rate Consultants:
- Deb Galardi, Principal, Galardi Rothstein Group
- Harold Smith, Vice President, Raftelis

Subject Matter Experts:
- Michael Matichich, Economic and Financial Consulting Team Lead, Jacobs
- Shawn Koorn, Associate Vice President/Senior Professional Associate, HDR
- Bart Foster, President, Foster Group
- Dan Jackson, Vice President, Willdan Financial Services

Agenda

1.) Introductions

2.) Discuss SME Panel Role and Scope – Silvia Amparano

3.) Discussion of Policy Objectives and Process for Rate Analysis – Silvia Amparano

4.) Overview of Tucson Water's Service Area and Rate Structure– Amber Kerwin
   a. Service Area
   b. Rate classes

5.) Review of Prior Differential Analysis – Deb Galardi and Harold Smith
   a. Supported by previously distributed Phase I and Phase II Differential Analysis Technical Memos
   b. Methodology
   c. Data
   d. Findings and Recommendations

6.) Legal Challenges – Chris Avery

7.) Questions/Discussion

8.) Next Meeting Date

Differential Analysis

Subject Matter Expert Panel

Discovery Phase, First Meeting

March 12, 2024

CITY OF TUCSON | TUCSON WATER

Agenda

- Introductions
- SME Panel Role and Scope
- Policy Objectives and Process
- Overview of Tucson Water's Service Area and Rate Structure
- Review of Prior Differential Analysis
- Legal Challenges
- Questions and Discussion
- Next Meeting Date

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Policy Objectives

Better align costs and cost recovery within Tucson Water's service area based on different usage characteristics:

- Differences in average consumption
- Greater infrastructure demand

Recognize that certain pre-existing contracts and agreements limit ability to differentiate cost recovery within or with:

- Other incorporated jurisdictions within TW water service
- Tribal areas: Pascua Yaqui and Tohono O'odham
- Tucson Unified School District (TUSD)
- Government agencies

CITY OF TUCSON | TUCSON WATER

SME Panel Scope

Phase I Discovery:

- Advise whether the presented information is material and provides a defensible framework for pursuing a differential rate.
- Advise on what additional data may help further substantiate a differential rate
- 2 3-hour meetings planned

Phase II Cost of Service and Rate Development:

If it is determined sufficient information and data exists to support a differential rate and M&C approve moving forward, the panel will be asked to:

- Advise on differential rate development methodology
- Advise on cost-of-service allocation factors and data to support
- Advise on rate setting considerations
- 3 3-hour meetings planned

All feedback will be captured by staff during meeting discussions and summarized for the panel's final review and approval. This information may be included as part of Council briefing materials.

CITY OF TUCSON | TUCSON WATER

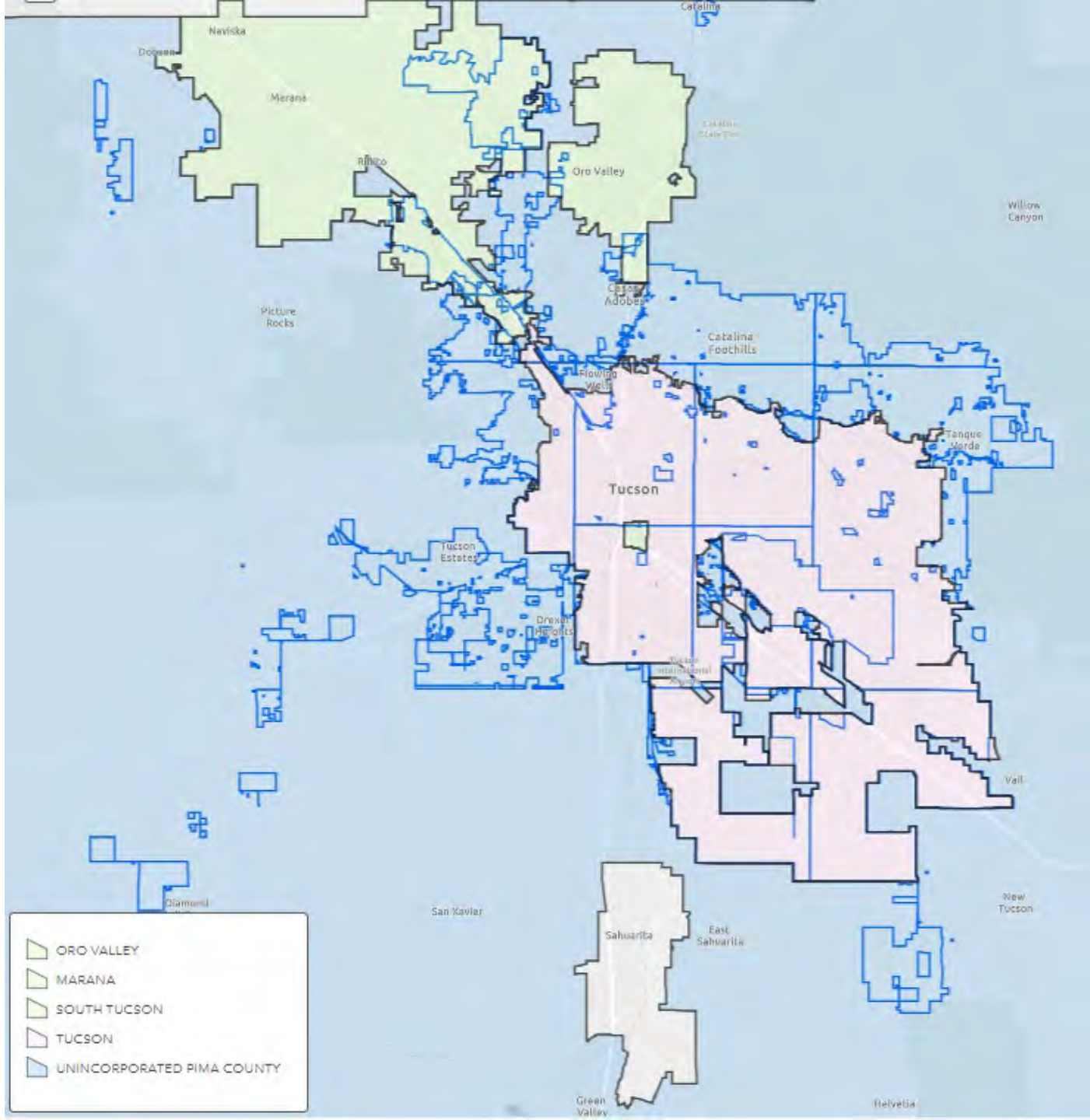
Tucson Water Current Rate Structure

- Reclaimed COS to be recovered from reclaim $ 10,633,494
  Reclaimed to be Allocated $ 7,828,627 *
  Potable COS $ 231,242,814
  Potable difference in schools peaking costs to $ 316,475 *
  $ 250,021,411

Customer Class	(1) Allocated COS ($1,000)	(2) Rate Design Adjustments* ($1,000)	(3) Adjusted COS ($1,000)	(4) Adjusted COS w/o CAP ($1,000)	(5) Revenue under Existing Rates ($1,000)	(6) Revenue Shortfall ($1,000)	(7) % Revenue Increase Required
Residential	137,878	2,877	140,755	120,155	113,968	(6,187)	5.4%
Multifamily	34,087	2,781	36,868	29,728	28,209	(1,518)	5.4%
Commercial	49,414	2,616	52,029	43,296	41,090	(2,206)	5.4%
Industrial	3,268	53	3,321	2,733	2,592	(141)	5.4%
Construction Water	2,528	(6)	2,523	2,158	1,972	(186)	9.4%
Community Garden	73	(21)	52	39	38	(2)	5.1%
Fire Sprinkler Service	3,995	(155)	3,840	3,841	3,508	(333)	9.5%
Public Fire Protection							
Sub-Total Potable	231,243	8,145	239,388	201,951	191,377	(10,573)	5.5%
Potable Difference in schools peal	316	(316)					
Total Potable	**231,559**	**7,829**	**239,388**	**201,951**	**191,377**	**(10,573)**	**5.5%**
Reclaimed	**18,462**	**(7,829)**	**10,633**	**10,633**	**10,079**	**(554)**	**5.5%**
Utility Total	**250,021**		**250,021**	**212,584**	**201,456**	**(11,128)**	**5.5%**

Water Service Area

- Extends far beyond COT jurisdictional boundaries
- Has customers in 3 other incorporated areas
- Has customers in 2 tribal lands
- ~30% of customers are in unincorporated areas



Prior Differential Analysis and Rates

Differential Rates:

Applied to potable service only

Charge/Fee	% Increase on Rate
Monthly Service Charge	+10%
Tiered Monthly Usage Charges	
Tier 1	+10%
Tier 2	+20%
Tier 3	+30%
Tier 4	+40%
Flat Rate (MH, MF, C, IN, CG)	+10%
Tier 1 & Tier 2 Summer Surcharges (IN, C)	+10%
CAP Surcharge	+10%
Conservation Fee	+10%

Applied to customers in unincorporated Pima County excluding:

- TUSD
- Tohono O'odham and Pascua Yaqui
- Government Agencies (later exempted)

Excludes:

- Fire Protection
- Reclaimed

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Analysis and Adoption Timeline

General Data Collection and Evaluation to Determine Cost Based Differential and Propose Diff Differential Rate Structures

M&C give direction to proceed with NOI on basis of following policy-based differential structure:

Charge/Fee	% Increase on Rate
Monthly Service Charge	+10%
Tiered Monthly Usage Charges	
Tier 1	+10%
Tier 2	+20%
Tier 3	+30%
Tier 4	+40%
Flat Rate (MH, MF, C, IN, CG)	+10%
Tier 1 & Tier 2 Summer Surcharges (IN, C)	+10%
CAP Surcharge	+10%
Conservation Fee	+10%

June 8, 2021: Public Hearing. Decision to extend to June 22nd

June 22, 2021: Differential Rate Adopted

M&C Direct Staff to conduct Cost of Service Analysis

Analysis conducted with Phase I and II findings that support range of policy-based differential rates

October 19, 2021: Differential Rates Re-Adopted

December 1, 2021: Differential Rates go into Effect

October 1, 2023: Gov't Accounts Exempted

November 1, 2023: Differential Discontinued

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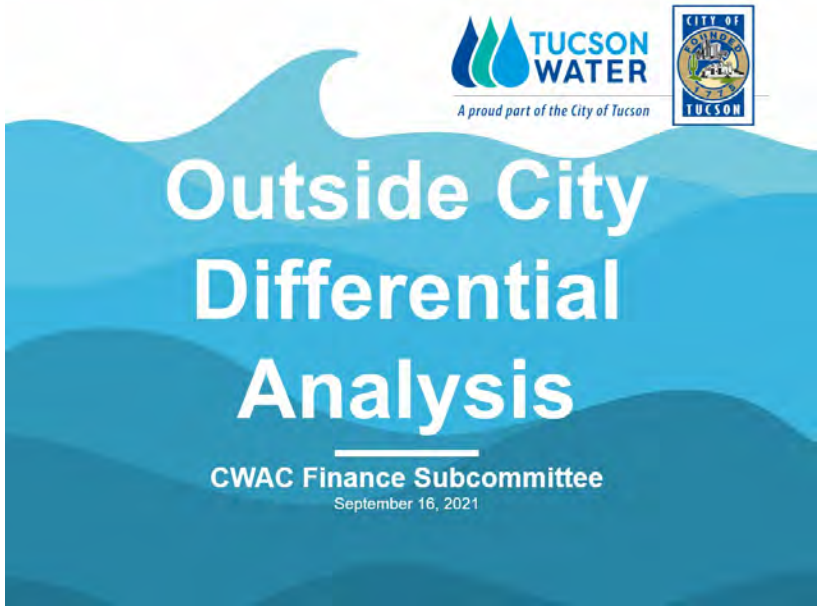
Review of Prior Analysis

Overview PowerPoint:



Additionally supported by supplemental reading material:

- Phase I Outside Differential Analysis Technical Memorandum
- Phase II Outside Differential Analysis Technical Memorandum
- June 8, 2021 Mayor and Council Public Hearing/Rate Adoption Agenda Materials
- June 22, 2021 Mayor and Council Public Hearing/Rate Adoption Agenda Materials
- October 19, 2021 Mayor and Council Public Hearing/Rate Adoption Agenda Materials

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Legal Challenge

Pima County successfully challenged the 2021 differential rate in the Maricopa County Superior Court:

- Both the City and the County have appealed that ruling.
- A future differential rate will not include Pima County or any other governmental entity.
- It is likely that this entire process will be subject to another court proceeding.
- All non-privileged e-mails, notes, data, and reports could be evidence in that proceeding, and should be preserved and archived by City employees and any other parties for ready accessibility in the future.

CITY OF TUCSON | TUCSON WATER

Questions and Discussion

Discussion Prompts:

- Is data to substantiate and justify a cost-based differential sufficient?
  - What other data could we look at?
- Thoughts on methodology:
  - Utility vs Cash Basis
- What other possible weaknesses do you see in the analysis, the data, the methodology?

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Next Meeting Date and Tentative Agenda

Date: April 22 – May 16th

Agenda:

- Continued discussion from last meeting
- Follow up on action items from last meeting
- Presentation from staff on data available to support a cost-based differential
- Discussion of best methodology to proceed with future possible analysis and rate development

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TUCSON WATER

A proud part of the City of Tucson

Outside City Differential Analysis

CWAC Finance Subcommittee

September 16, 2021

Background

- Tucson City Council approved assessing differential rates to customers located in unincorporated Pima County (Outside City Customers).
- Approved Differentials:

Monthly Service Charge	10.00%
Usage Charges	
Tier 1	10.00%
Tier 2	20.00%
Tier 3	30.00%
Tier 4	40.00%
CAP/Conservation Charge/Summer Surcharges	10.00%

- Policy decision that Outside City Customers are to be treated as “non-owners” for rate setting purposes.
- GRG/Raftelis performed Phase 1 Outside City Differential Analysis.

Phase 1 Outside Differential Analysis

- Revenue requirements for entire Tucson Water system determined using the Utility Approach.
- Revenue requirements allocated between Outside City Customers and the rest of Tucson Water's customers based on demand.
- Range of differentials determined by comparing allocated revenue requirements to revenue under existing rates.

	Cost of Equity					
	5.0%	6.0%	7.0%	8.0%	9.0%	10.0%
Outside City Revenue Under Existing Rates	$ 58,607,302	$ 58,607,302	$ 58,607,302	$ 58,607,302	$ 58,607,302	$ 58,607,302
Outside City Revenue Requirements	$ 62,186,494	$ 64,481,947	$ 66,777,400	$ 69,072,853	$ 71,368,307	$ 73,663,760
Cost Justified Differential	**6.1%**	**10.0%**	**13.9%**	**17.9%**	**21.8%**	**25.7%**

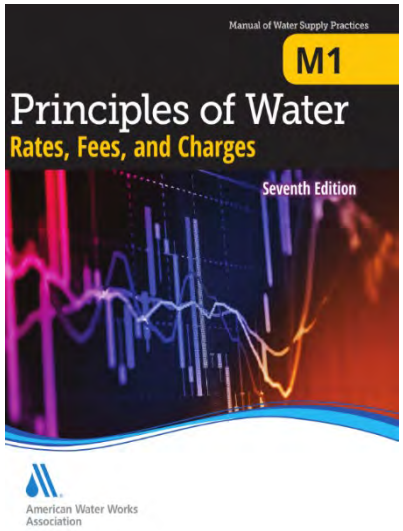
PHASE 2 OVERVIEW

- Utility Basis with Differential Rates of Return Approach
  - Hybrid approach included in M-1 Manual.
  - Uses a differential rate of return to recognize utility ownership status.
- System-wide revenue requirements determined using the Cash-Needs Approach:

  Annual O&M Costs
  + Annual Capital Costs (Debt service + Rate funded capital)
  Cash-Needs Revenue Requirements

- Cash-Needs revenue requirements recast as Utility Approach revenue requirements:

  Cash-Needs Revenue Requirements
  O&M Costs
  - Depreciation
  Required Return on Rate Base



2017 American Water Works Association (AWWA)

Revenue Requirements*

CASH-NEEDS

Operation & Maintenance Expenses	$	112,539,677
Utility Tax		6,489,736
Pilot/In Lieu of Property Tax		2,000,000
Capital Requirements		101,562,771
Total Revenue Requirements	$	222,592,184

UTILITY BASIS

Operation & Maintenance Expenses	$	112,539,677
Utility Tax		6,489,736
Pilot/In Lieu of Property Tax		2,000,000
Depreciation		29,691,941
Required Return on Investment		71,870,830
	$	222,592,184

*Based on FY2020-21 Test Year; excludes allocated reclaimed costs

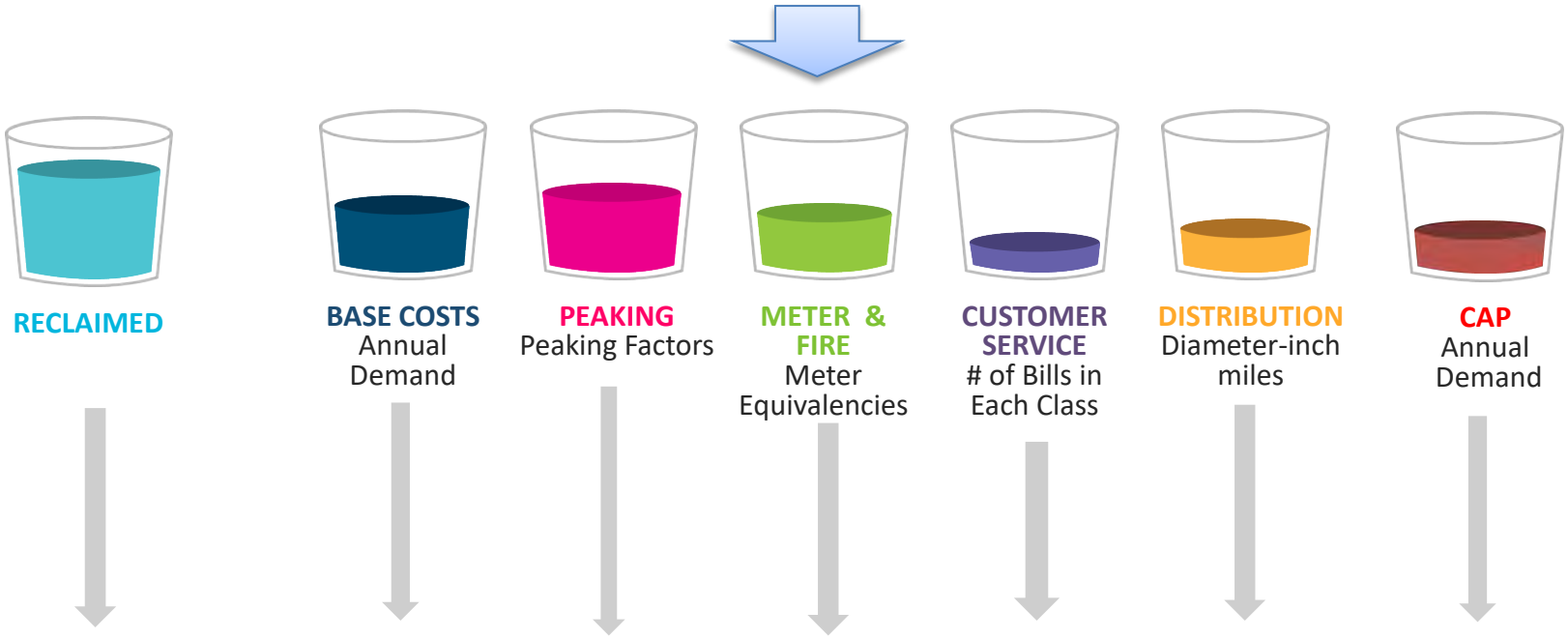
Imputed Rate of Return

- Imputed Rate of Return on Rate Base
  - The rate of return on rate base required to generate a return that when combined with O&M Expenses and Depreciation results in Utility Basis revenue requirements equal to the Cash-Needs revenue requirements.

Required Return on Rate Base	$ 71,870,830
Divided by Rate Base	$ 810,386,764
	8.87%

Cost-of-Service Analysis

Revenue Requirement Components (O&M, Depreciation, Rate Base)



Reclaimed

Potable Inside City & Outside City Customer Classes

Cost Allocation Factors

Allocation Factors	Inside	Outside	Total	Basis
Base Usage	73.07%	26.93%	100%	FY2020-21
Max Day Peaking	70.43%	29.57%	100%	3-year average
Max Hour Peaking	72.27%	27.73%	100%	3-year average
Customer Accounts	71.62%	28.38%	100%	FY2020-21
Meter Equivalents	73.44%	26.56%	100%	FY2020-21
Distribution Diam-Inch-Miles	63.65%	36.35%	100%	8" and below

Cost-of-Service Results

Revenue Requirement Component	Total	Inside City %	Outside City %	Inside City $	Outside City $
O&M	$ 112,539,677	71.70%	28.30%	$ 80,688,357	$ 31,851,320
Utility Tax	6,489,736	100.00%	0.00%	6,489,736	0
Pilot/In Lieu of Property Tax	2,000,000	70.70%	29.30%	1,413,982	586,018
Depreciation	29,691,941	71.13%	28.87%	21,119,033	8,572,908
Subtotal	$ 150,721,353	72.79%	27.21%	$ 109,711,108	$ 41,010,245
Rate Base	$ 810,386,764	70.45%	29.55%	$ 570,943,150	$ 239,443,614
Return on Investment	71,870,830	Policy Basis			

Range of Rate of Return Differentials

- **Differential Outside / Inside Rates of Return a policy decision**
  - Key considerations: Relative cost structures (e.g., utility tax), risks (not confined to potential GO debt remedy), regulatory practice/ legal precedent, etc.
  - Policy decision reflects judgments regarding implications of ownership status

ROR Differential	1.00%	1.50%	2.00%	2.50%	3.00%	3.50%	4.00%	4.50%	5.00%
Inside City ROR	8.57%	8.43%	8.28%	8.13%	7.98%	7.83%	7.69%	7.54%	7.39%
Outside City ROR	9.57%	9.93%	10.28%	10.63%	10.98%	11.33%	11.69%	12.04%	12.39%

Range of Outside-City Rate Differentials

- Outside City Differential = Outside City Unit Cost/Inside City Unit Cost
  - Unit Cost = (Allocated cost + return on rate base) / usage
- Results reflect an array of assumptions, policy decisions and outcomes:
  - Cost allocations follows TW past practices informed by extensive stakeholder engagement.
  - Reflect key considerations (e.g., ownership, risk) and AWWA guidance.
  - TW cost-based differential of 5% with no RoR differential
    - Peaking factor and distribution system cost differences

ROR Differential	1.00%	1.50%	2.00%	2.50%	3.00%	3.50%	4.00%	4.50%	5.00%
Inside City Unit Cost	$5.33	$5.30	$5.28	$5.25	$5.22	$5.19	$5.16	$5.13	$5.11
Outside City Unit Cost	$5.82	$5.90	$5.98	$6.05	$6.13	$6.21	$6.28	$6.36	$6.44
Outside City Differential	9%	11%	13%	15%	17%	20%	22%	24%	26%

DISCUSSION

TECHNICAL MEMORANDUM

To: John Kmiec, Interim Utility Director, Tucson Water

From: Harold Smith, Raftelis Financial Consultants, Inc.

Subject: Outside Differential Analysis

CC: Deborah Galardi, Galardi Rothstein Group

On June 22, 2021, the City of Tucson Mayor and Council approved a rate differential for Tucson Water customers located within unincorporated Pima County (Outside City Customers). This decision was policy based and goes into effect on December 1, 2021. Mayor and Council further directed Tucson Water to conduct a cost-of-service analysis using standard industry practices to determine the cost basis for differential rates. The results of the cost-of-service analysis are supplemental to the policy basis already used to approve the differential rate.

Tucson Water engaged Raftelis to develop a range of possible cost-based differentials as the first step in this cost-of-service analysis. The analysis performed by Raftelis involved using readily available data to develop revenue requirements for the entire Tucson Water system using the utility basis, allocating those revenue requirements between inside city customers and Outside City Customers and then comparing the revenue requirements for Outside City Customers to the revenue generated by Outside City Customers under Tucson Water's existing rates. The difference between the calculated revenue requirements and revenue at existing rates serves as an approximation of a cost-based rate differential. The second phase of the cost-of-service analysis will refine the differential rate range presented in this Memorandum and will address the detailed information now decided by Mayor and Council, namely the differential rate schedule to be implemented (Option 7 from the original Notice of Intent), the projected differential rate revenues, and the projects and programs within the utility where Mayor & Council directed that the revenues be used.

Overview of the Utility Approach

The utility approach for determining revenue requirements is typically utilized by investor-owned utilities, and also for governmental utilities that are regulated by state public service agencies. The utility approach provides for a utility to recover operating and capital costs as determined by generally accepted accounting principles. In addition, the utility is provided a return on its investment in utility plant-in-service and other capital facilities. O&M costs are typically based on the utility's operating budget and capital costs are estimated based on actual or projected depreciation and adjusted for additions, retirements, "contributions in aid of construction," and "customer capital advances."

Under the utility approach, a return is calculated by applying a rate of return on the investment by the owner of the utility (typically the original cost of assets less accumulated depreciation and adjustments). The utility's investment is defined as a "rate base." In situations where outside-city service is provided, two separate rate base values can be determined, the rate base for inside-city service and the rate-base for outside city service. The utility's return should provide for the payment of interest on outstanding

debt, the funding of certain capital items, and a payback (dividend) to the investors of the utility. In situations where a municipal utility is the service provider, this dividend is sometimes used to offset the revenue requirement to be recovered from inside-city rates, thereby lowering the rates paid by inside-city customers. Tucson Water has been directed to use the differential rate revenues within the utility to fund programs in the areas of financial resilience, water resources resilience, and infrastructure resilience.

The most widely recognized method for selecting an appropriate rate of return is the weighted average cost of capital (WACC) approach. This approach can be used by both public and private utilities and represents the weighted average of the utility's cost of debt (outstanding bonds) and cost of equity. A utility's average cost of debt is the average interest rate that it pays on all its outstanding bonds and loans. Since a utility is often required to issue debt at various times to meet capital needs, the average cost of debt reflects both the utility's financial strength and the prevailing market interest rates at the time each bond series is issued. Therefore, the average cost of a utility's debt should be weighted based on the duration of payments and the amount of funds outstanding for each bond series. The cost of equity for an investor-owned utility represents its average cost of debt, as well as a risk premium and return on investment, or dividend for its investors. For a government utility, the cost of equity generally represents its average cost of debt and a risk premium. Once the average cost of debt and average cost of equity are determined for a utility, the WACC is determined by weighting the cost of debt and equity by the proportion of debt to equity as presented in the utility's balance sheet.

As mentioned previously, If the utility is governmental, the return is still appropriate, although the utility is "nonprofit." As with investor-owned utilities, the return is used to pay interest, and possibly, along with depreciation, retire principal on debt and fund certain capital items. In some instances, however, the dividend component for government utilities may be eliminated because a return or profit component may be excluded from revenue requirements. However, if the government utility has customers who are "non-owners" of the system, a return to the utility (such as the treasury bill rate or the municipality's current investment rate) may be appropriate to be charged to the non-owner customers.

The major advantage of the utility approach is that there is typically less interpretation when establishing revenue requirements than under the cash-needs approach. In other words, the utility approach provides for a less subjective methodology for identifying revenue requirements. A major disadvantage of the utility approach is that in a governmental environment, revenue requirements that would be recovered under the utility approach could be significantly more or less than is required for cash flow purposes.

When setting outside-city rates, use of the utility approach is most appropriate when there is a clear distinction between owner customers and non-owner customers because the utility approach allows for the development of rates that recover a return on the owner's investment in the system thereby compensating them for the risk incurred to construct the utility system. In cases where the distinction between owner and non-owner customers is not clear, for instance when the utility's legal or policy driven service area extends beyond the parent municipality's corporate limits, justification of a return on investment may be complicated by a number of factors.

Data Used In the Analysis

Data used for the analysis was derived from a variety of sources and brief descriptions of each data set are provided below:

- *Customer Demand Data* – Customer demand data for FY2019 was used for this analysis. However, detailed demand data regarding consumption within each of Tucson Water's rate tiers was not available for FY2019 so the FY2019 data was calibrated based on actual revenue generated by water sales to the Outside City Customers in FY2019. This calibration involved determining the percentage of consumption for customer classes with tiered rates that fell within each rate tier. These percentages were then applied to FY2019 demand to develop an approximation of consumption within each tier for FY2019.
- *Operation & Maintenance (O&M) Expenses* – O&M expenses were derived from Tucson Water's FY2019 budget. FY2019 was chosen as the test year because it was the rate year for cost of service analysis used to develop the rates currently in effect.
- *Rate Base and Depreciation* – Rate base and depreciation was determined using asset data from FY2019. Similar to the customer demand and O&M expense data, FY2019 was chosen as the test year because existing rates are based on FY2019 data. Additionally, asset data that excluded contributed capital was readily available for FY2019.
- *Cost of Capital*- Tucson Water's weighted average cost of debt was based on outstanding water debt as of July 1, 2020 included in "City of Tucson, Arizona; 2020-21 Summary of Outstanding Debt" prepared by Piper/Sandler.

Revenue Requirements

For this analysis, revenue requirements for the entire Tucson Water system were determined using the utility approach and then a portion of the system revenue requirements were allocated to the Outside City Customers. Under the utility approach, a utility's revenue requirements are comprised of O&M expenses, depreciation, and a return on rate base.

<u>Operation & Maintenance Expenses</u>

As mentioned previously, for this analysis Tucson Water's O&M expense are based on the FY2019 budget. Costs associated with operating and maintaining the reclaimed water system were excluded from the analysis. A portion of the FY2019 budgeted O&M expenses are allocated to the Outside City Customers based on their proportionate share of consumption.

Schedule 1 shows the system O&M expenses and the allocation to Outside City Customers.

<u>Rate Base</u>

The rate base, or the value of the assets used to provide service to the Outside City Customers, was determined by first excluding the value of contributed assets from Tucson Water's net plant in service. Additionally, the value of all reclaimed water assets was excluded from rate base. The value of the remaining assets was then allocated between inside city customers and Outside City Customers based on each group's proportionate share of consumption.

Schedule 2 shows the development of rate base and the allocation to Outside City Customers.

Rate of Return

Given time constraints for the analysis, Raftelis did not perform a cost of capital study. As mentioned previously, the rate of return is typically set equal to the utility's WACC. As discussed previously, s utility's WACC is comprised of its weighted average cost of debt (WACD) and the cost of equity. The determination of Tucson Water's WACD is demonstrated in Schedule 3. As shown, Tucson Water's WACD is 4.57%.

Since Tucson Water is a municipally owned water system, it is difficult to determine a cost of equity. AWWA's M-1 manual suggests four different options for determining an appropriate cost of equity for municipally owned systems. These options include:

1. Base the cost of equity on the return allowed by regional regulatory bodies in recent rate cases for similar utilities.
2. Perform a discounted cash-flow analysis.
3. Use a risk-free rate with an appropriate risk premium.
4. Use a multiplier on top of the WACD.

Given the time constraints for performing the analysis the only feasible option was to use recently allowed costs of equity for water utilities regulated by the Arizona Corporation Commission as a proxy for Tucson Water's cost of equity. However, review of recent rate cases did not reveal any decisions for utilities that would be considered similar to Tucson Water. Therefore, it was decided to calculate cost justified outside differentials using a range of cost of equity values. Research of recent ACC rate cases did reveal a wide range of approved rates of return on rate base. Given this information it was decided to calculate outside city differentials using cost of equity values ranging between 5% and 10%.

In order to recognize that Outside City Customers have contributed to the equity in the system by virtue of paying rates and system equity fees that funded the assets that comprise the system, the calculation of system equity includes a downward adjustment commensurate with the Outside City customer's share of revenue.

Schedule 3 shows the development of the rate of return on rate base.

Depreciation

Depreciation was derived from Tucson Water's asset records and only depreciation on those assets included in rate base was included in the system revenue requirements. Similar to O&M expenses and rate base, depreciation was allocated to Outside City Customers based on consumption.

Table 1 below shows the revenue requirements under five different cost of equity scenarios.

Table 1
Outside City Revenue Requirements Under Various Cost of Equity Assumptions

	Cost of Equity					
	5.0%	6.0%	7.0%	8.0%	9.0%	10.0%
Operation & Maintenance Expenses	$ 35,834,858	$35,834,858	$35,834,858	$35,834,858	$35,834,858	$35,834,858
Depreciation	$ 8,750,060	$ 8,750,060	$ 8,750,060	$ 8,750,060	$ 8,750,060	$ 8,750,060
Return on Rate Base	$ 17,601,576	$19,897,029	$22,192,482	$24,487,935	$26,783,388	$29,078,841
Total Outside City Revenue Requirements	**$ 62,186,494**	**$64,481,947**	**$66,777,400**	**$69,072,853**	**$71,368,307**	**$73,663,760**

Determination of Outside City Differential

To determine the appropriate outside city differential, outside city revenue requirements are compared to the revenue that is generated by Outside City Customers at the existing rates that are assessed to all customers, both inside and outside the city limits. The percent difference between these two values is the percent increase to existing rates that would be required for revenue from Outside City Customers to equal outside city revenue requirements. Table 2 below shows the resulting outside differentials under each cost of equity assumption.

Table 2
Outside City Differential Under Various Cost of Equity Assumptions

	Cost of Equity					
	5.0%	6.0%	7.0%	8.0%	9.0%	10.0%
Outside City Revenue Under Existing Rates	$ 58,607,302	$58,607,302	$58,607,302	$58,607,302	$58,607,302	$58,607,302
Outside City Revenue Requirements	$ 62,186,494	$64,481,947	$66,777,400	$69,072,853	$71,368,307	$73,663,760
Cost Justified Differential	**6.1%**	**10.0%**	**13.9%**	**17.9%**	**21.8%**	**25.7%**

Conclusions

Results of the limited analysis described in this memo indicate that by using standard industry practices for determining rates for outside city customers an outside city differential can be cost based, but that the magnitude of the justified differential is highly dependent upon the assumed value for Tucson Water's cost of equity. Additionally, a more detailed analysis of O&M expenses and rate base could yield different allocations of costs to the Outside City Customers resulting in outside city revenue requirements that are different from those that resulted from this analysis.

Phase 2 of this cost-of-service analysis will be to assess an outside city differential based on cost-of-service principles alone. It should be noted, however, that it is not uncommon for utilities to charge a higher rate to outside city customers on a policy basis and Arizona law allows for the assessment of higher outside city rates as long as the higher rates are "reasonable". That is the basis of the action already taken by the City of Tucson Mayor and Council. Measures of reasonableness may include comparisons of rate differentials in other communities, as well as general considerations of risk, ownership relationship, and cost of service. Recent surveys of other Arizona utilities indicate that many utilities that assess rates to outside city customers have no cost justification for the higher rates, and rate differentials range from 10% to 50%. This cost of service analysis is supplemental to the recently established policy basis for Tucson's differential rate.

Schedule 1 - O&M Expenses

O&M Expenses

			Outside City %	Inside City %	Outside City $	Inside City $
Director's Office						
Customer Outreach Unused	$	1,319,114	27%	73%	$ 352,115	$ 966,999
Security Unit	$	572,197	27%	73%	$ 152,738	$ 419,459
Personnel Services	$	789,206	27%	73%	$ 210,665	$ 578,541
Director's Office Unused	$	3,617,975	27%	73%	$ 965,756	$ 2,652,218
Subtotal: Director's Office	**$**	**6,298,492**			**$ 1,681,275**	**$ 4,617,217**
Customer Service						
Billing Office	$	4,017,919	28%	72%	$ 1,125,017	$ 2,892,902
Westside Metering Services	$	3,862,351	28%	72%	$ 1,081,458	$ 2,780,893
Eastside Metering Services	$	2,703,322	28%	72%	$ 756,930	$ 1,946,392
Subtotal: Customer Service	**$**	**10,583,593**			**$ 2,963,406**	**$ 7,620,187**
Business Services						
Financial & Office Services	$	1,214,304	27%	73%	$ 324,138	$ 890,166
Information Services/Support	$	-	27%	73%	$ -	$ -
Pueblo Billing System Project	$	3,841,780	27%	73%	$ 1,025,498	$ 2,816,283
Subtotal: Business Services	**$**	**5,056,084**			**$ 1,349,635**	**$ 3,706,449**
Water Quality						
Reclaimed Water System	$	4,036,220	0%	100%	$ -	$ 4,036,220
Clearwater Facility Operations (CAVSARP)	$	5,166,500	27%	73%	$ 1,379,109	$ 3,787,391
CAP Water Purchases (CAVSARP) (7200-249)	$	10,965,787	27%	73%	$ 2,927,129	$ 8,038,658
Clearwater Facility 2 Operations (SAVSARP)	$	5,190,085	27%	73%	$ 1,385,404	$ 3,804,681
CAP Water Purchases (SAVSARP) (7210-249)	$	7,554,209	27%	73%	$ 2,016,467	$ 5,537,742
Maintenance Management Program	$	-	27%	73%	$ -	$ -
Technical Support	$	235,556	27%	73%	$ 62,878	$ 172,679
Water Quality Lab	$	2,176,431	27%	73%	$ 580,961	$ 1,595,470
TARP Management	$	1,244,594	27%	73%	$ 332,223	$ 912,371
AOP	$	2,474,367	27%	73%	$ 660,490	$ 1,813,877
Water Production Admin Support	$	863,823	27%	73%	$ 230,583	$ 633,240
Water Production Plant Operation	$	1,133,168	27%	73%	$ 302,480	$ 830,688
Water Treatment Plant Maintenance	$	760,069	27%	73%	$ 202,888	$ 557,182
Water Production Plant Instru/Cntrl	$	5,673,352	27%	73%	$ 1,514,404	$ 4,158,948
Compliance & Regulatory Support	$	604,632	27%	73%	$ 161,396	$ 443,236
Environmental Performance	$	-	27%	73%	$ -	$ -
Subtotal: Water Quality	**$**	**48,078,793**			**$ 11,756,412**	**$ 36,322,381**
Planning & Engineering						
Backflow Prevention	$	-	27%	73%	$ -	$ -
Admin. & Project Support	$	723,400	27%	73%	$ 193,099	$ 530,301
Plant Design	$	1,060,562	27%	73%	$ 283,099	$ 777,463
Distribution Design	$	789,853	27%	73%	$ 210,838	$ 579,015
Construction	$	950,887	27%	73%	$ 253,823	$ 697,064
Mapping/GIS	$	1,222,152	27%	73%	$ 326,233	$ 895,919
Water System Evaluation	$	736,141	27%	73%	$ 196,500	$ 539,641
System Planning	$	939,940	27%	73%	$ 250,901	$ 689,039
Research & Technical Support	$	1,829,749	27%	73%	$ 488,420	$ 1,341,329
Subtotal: Planning & Engineering	**$**	**8,252,683**			**$ 2,202,913**	**$ 6,049,771**

Schedule 1 - O&M Expenses

O&M Expenses

			Outside City %	Inside City %	Outside City $	Inside City $
Water Operations						
Maintenance Management Program (7297)	$	716,660	27%	73%	$ 191,300	$ 525,360
Equipment Maintenance	$	2,607,115	27%	73%	$ 695,925	$ 1,911,190
Control Systems	$	1,997,427	27%	73%	$ 533,179	$ 1,464,248
Property Management	$	2,511,699	27%	73%	$ 670,455	$ 1,841,244
Well Maintenance	$	452,284	27%	73%	$ 120,729	$ 331,554
Quality Control	$	1,754,177	27%	73%	$ 468,248	$ 1,285,929
North Maintenance	$	1,812,325	27%	73%	$ 483,769	$ 1,328,556
System Support	$	7,119,712	27%	73%	$ 1,900,485	$ 5,219,226
Central Maintenance	$	2,599,844	27%	73%	$ 693,984	$ 1,905,860
East Maintenance	$	1,712,822	27%	73%	$ 457,209	$ 1,255,614
System Improvements - Potable	$	2,851,188	27%	73%	$ 761,076	$ 2,090,112
System Improvements - Reclaimed	$	277,805	27%	73%	$ 74,155	$ 203,650
West Maintenance	$	1,964,723	27%	73%	$ 524,449	$ 1,440,274
Subtotal: Water Operations	**$**	**28,377,781**			**$ 7,574,963**	**$ 20,802,817**
Other Budgetary Requirements						
General Expense (7437)	$	4,462,291	27%	73%	$ 1,191,132	$ 3,271,159
Groundwater Withdrawal Tax	$	45,000	27%	73%	$ 12,012	$ 32,988
Superfund Tax (7437-289)	$	540,000	27%	73%	$ 144,144	$ 395,856
SAWARSA Settlement	$	-	27%	73%	$ -	$ -
New Program (see below)	$	-	27%	73%	$ -	$ -
Enhanced Water Quality Treatment Plant	$	-	27%	73%	$ -	$ -
CAGRD Membership	$	-	27%	73%	$ -	$ -
In Lieu of Property Tax (7438-289)	$	2,020,400	27%	73%	$ 539,311	$ 1,481,089
CAP Water Purchases (non Clearwater) (7437-249)	$	5,848,420	27%	73%	$ 1,561,136	$ 4,287,284
CAP Annual Capital Payment (existing alloc.) (7437-250)	$	8,435,174	27%	73%	$ 2,251,625	$ 6,183,549
CAP Annual Capital Payment (add'l 8206 AF allocation)	$	-	27%	73%	$ -	$ -
CAP Purchase - Back Capital 8206 (P)	$	-	27%	73%	$ -	$ -
CAP Purchase - Back Capital 8206 (I)	$	-	27%	73%	$ -	$ -
Admin. Serv. Chg. (Pmt to GF: direct srvcs) (7438)	$	2,671,969	27%	73%	$ 713,236	$ 1,958,732
Admin. Serv. Chg. (Pmt to GF: indirect srvc) (7438-297)	$	8,009,441	27%	73%	$ 2,137,983	$ 5,871,458
Low Income Program (7400)	$	1,262,750	27%	73%	$ 337,070	$ 925,680
Capitalized O&M Expense (7439)	$	(6,566,300)	27%	73%	$ (1,752,761)	$ (4,813,539)
New Program (7NEW)	$	3,823,166	27%	73%	$ 1,020,529	$ 2,802,637
Mail Services (7247)	$	565,076	27%	73%	$ 150,837	$ 414,238
Subtotal: Other Budgetary Requirements	**$**	**31,117,387**			**$ 8,306,254**	**$ 22,811,133**
Total: O&M Expenses	$	137,764,813			$ 35,834,858	$ 101,929,955

Schedule 2 - Rate Base and Depreciation

RateBase

Asset Type	Depreciated Net Plant Investment [1]	Outside City %	Inside City %	Outside City $	Inside City $
Land - Other	$ 45,661,445	27%	73%	$ 12,188,542	$ 33,472,903
Wells	$ 169,636,454	27%	73%	$ 45,281,550	$ 124,354,904
Treatment Plant	$ 101,023,967	27%	73%	$ 26,966,620	$ 74,057,346
Buildings	$ 42,226,393	27%	73%	$ 11,271,613	$ 30,954,779
Pumping Equip.	$ 27,125,657	27%	73%	$ 7,240,730	$ 19,884,927
Tanks and Reservoirs	$ 190,429,213	27%	73%	$ 50,831,822	$ 139,597,391
Transmission Mains	$ 247,039,617	27%	73%	$ 65,943,001	$ 181,096,616
Distribution Mains	$ 270,167,064	27%	73%	$ 72,116,478	$ 198,050,587
Services and Meters	$ 146,067,747	27%	73%	$ 38,990,287	$ 107,077,460
Hydrants	$ 42,005,780	27%	73%	$ 11,212,725	$ 30,793,055
Reclaimed Water System	$ 156,176,999	0%	100%	$ -	$ 156,176,999
General Plant	$ 80,594,103	27%	73%	$ 21,513,218	$ 59,080,886
	$ 1,518,154,438			$ 363,556,586	$ 1,154,597,852

Depreciation

Asset Type	Depreciation[1]	Outside City %	Inside City %	Outside City $	Inside City $
Land - Other	$ -	27%	73%	$ -	$ -
Wells	$ 4,411,000	27%	73%	$ 1,177,441	$ 3,233,559
Treatment Plant	$ 2,526,000	27%	73%	$ 674,273	$ 1,851,727
Buidlings	$ 1,056,000	27%	73%	$ 281,881	$ 774,119
Pumping Equip.	$ 678,000	27%	73%	$ 180,981	$ 497,019
Tanks and Reservoirs	$ 3,999,000	27%	73%	$ 1,067,465	$ 2,931,535
Transmission Mains	$ 3,891,000	27%	73%	$ 1,038,636	$ 2,852,364
Distribution Mains	$ 5,782,000	27%	73%	$ 1,543,406	$ 4,238,594
Services and Meters	$ 3,798,000	27%	73%	$ 1,013,811	$ 2,784,189
Hydrants	$ 672,000	27%	73%	$ 179,379	$ 492,621
Reclaimed Water System	$ 2,499,000	0%	100%	$ -	$ 2,499,000
General Plant	$ 5,967,000	27%	73%	$ 1,592,789	$ 4,374,211
	$ 35,279,000			$ 8,750,060	$ 26,528,940

Notes:

1 - Data from "Vail Wheeling_1-14-20"

Schedule 3 - Cost of Capital

Rate of Return

Cost of Debt

	Par Amount	Outstanding Principal	% of Total	Interest Rate	Cost of Debt
Series 2010A Obligations	$ 38,510,000	$ 38,510,000	8.46%	5.87%	0.497%
Series 2011 Obligations	$ 30,965,000	$ 1,500,000	0.33%	5.00%	0.016%
Series 2012 Obligations	$ 31,555,000	$ 9,095,000	2.00%	3.78%	0.075%
Refunding Bonds, Series 2013A	$ 34,280,000	$ 21,085,000	4.63%	4.60%	0.213%
Refunding Bonds, Taxable Series 2013	$ 18,825,000	$ 6,005,000	1.32%	2.63%	0.035%
Series 2013 Obligations	$ 21,065,000	$ 18,065,000	3.97%	4.75%	0.189%
Series 2014 Obligations	$ 35,630,000	$ 33,130,000	7.28%	4.09%	0.298%
Series 2015 Obligations	$ 20,570,000	$ 18,470,000	4.06%	4.35%	0.176%
Refunding Bonds, Series 2015	$ 46,640,000	$ 46,640,000	10.25%	4.82%	0.494%
Refunding Bonds, Series 2016-A	$ 71,805,000	$ 44,060,000	9.68%	5.00%	0.484%
Series 2016 Obligations	$ 17,215,000	$ 16,425,000	3.61%	3.67%	0.132%
Series 2017 Obligations & Refunding	$ 106,970,000	$ 88,575,000	19.47%	5.00%	0.973%
Series 2018 Obligations	$ 23,935,000	$ 23,435,000	5.15%	4.04%	0.208%
Series 2019 Obligations	$ 13,195,000	$ 13,195,000	2.90%	4.38%	0.127%
Series 2020 Obligations	$ 45,765,000	$ 45,765,000	10.06%	4.37%	0.439%
Jr. WIFA Series 2012	$ 4,000,000	$ 2,658,662	0.58%	2.80%	0.016%
Series 2012 Refunding Bond	$ 15,245,000	$ 645,000	0.14%	1.90%	0.003%
Series 2011 Obligations	$ 16,000,000	$ 9,633,040	2.12%	2.79%	0.059%
Series 2010 Obligations	$ 2,750,000	$ 1,572,044	0.35%	2.93%	0.010%
Series 2009B	$ 1,000,000	$ 486,015	0.11%	3.60%	0.004%
Series 2009A	$ 2,500,000	$ 1,260,865	0.28%	3.38%	0.009%
Series 2008 Obligations	$ 17,800,000	$ 7,679,214	1.69%	3.55%	0.060%
Series 2007 Obligations	$ 6,500,000	$ 2,396,334	0.53%	3.21%	0.017%
Series 2006 Obligations (Drinking Wat	$ 4,500,000	$ 1,670,514	0.37%	3.32%	0.012%
Series 2005 Obligations	$ 2,997,000	$ 786,393	0.17%	3.11%	0.005%
Series 2004 Obligations	$ 5,500,000	$ 1,112,800	0.24%	3.20%	0.008%
Series 2003 Obligations	$ 8,300,000	$ 1,145,306	0.25%	3.44%	0.009%
	$ 644,017,000	**$ 455,001,187**			**4.570%**

Weighted Average Cost of Debt **4.570%**

Cost of Equity

Net Plant Investment	$ 1,518,154,438
Outstanding Debt	$ 455,001,187
Equity in System	$ 1,063,153,251
Less: OC Contributed Equity	$ (283,790,579)
Adjusted System Equity	$ 779,362,672

Cost of Equity **5.00%**

Cost of Capital

			% of Total	Cost	
Outstanding Debt	$	455,001,187	37%	4.570%	1.68%
System Equity	$	779,362,672	63%	5.00%	3.16%
	$	1,234,363,859		WACC	4.84%

Rate of Return **4.84%**

Schedule 4 - Units of Service

Meters

Meter Count	Meters				Equiv. Meters			
Meter Size	TU	OC Non-TU	IC		TU	OC Non-TU	IC	
5/8"	59,402	12,795	133,165		59,402	12,795	133,165	
3/4"	1,815	391	4,068		2,449	527	5,488	
1"	5,093	1,097	11,417		10,423	2,245	23,366	
1.5"	492	106	1,104		1,865	402	4,184	
2"	1,035	223	2,320		6,090	1,312	13,651	
2.5"	2	0	5		17	4	39	
3"	12	3	27		138	30	310	
4"	14	3	32		273	59	615	
6"	10	2	23		396	86	892	
8"	1	0	2		60	13	134	
10"	-	-	-		-	-	-	
12"	-	-	-		-	-	-	
				Total Meters				Total Equivalent Meters
Total	67,876	14,620	152,161	234,657	81,112	17,472	181,843	280,427
					29%	6%	65%	

Consumption

	Usage (CCF)	
TU	10,101,253	27%
Non-TU	3,559,386	9%
Inside	24,181,281	64%
Total	37,841,920	

Schedule 5 - Outside City Revenue Requirements and Differential

Outside City Revenue Requirements

Utility Approach Revenue Requirements

Operation & Maintenance Expenses	$	35,834,858
Depreciation	$	8,750,060
Return on Rate Base	$	17,601,576
Total Outside City Revenue Requirements	$	62,186,494

Return on Rate Base

Outside City Rate Base	$	363,556,586
Rate of Return		4.84%
Return on Rate Base	$	17,601,576

Determination of Outside City Differential

Outside City Revenue Under Existing Rates	$	58,607,302
Outside City Revenue Requirements	$	62,186,494
% Difference		6%

Tucson Water
FY 2023 – FY 2027
Water Rate Revision Process and Proposal

Tucson Water (TW) has updated the water rate development process and is proposing rate & fee adjustments based on revenue requirements of Tucson Water's Fiscal Year 2023 through Fiscal Year 2027 Financial Plan (the Plan). The recommendations are as follows:

It is recommended to:

1) Increase the CAP Surcharge (Water Resource Fee) by $0.30/Ccf to $1.00/Ccf effective January 1, 2023

2) Continue a multi-year rate cycle over four years at 5.5% revenue increases each year effective at the start of fiscal year.

FY 2024	5.5%
FY 2025	5.5%
FY 2026	5.5%
FY 2027	5.5%

Financial Planning and Ratemaking Overview – As an enterprise fund of the City of Tucson, Tucson Water covers all costs of doing business with revenues from its operations, including maintaining and delivering high-quality, reliable water service, planning for current and future water resource and infrastructure needs, promoting water conservation throughout the community, and providing utility bill assistance for low-income customers. Water sales generate more than 85% of Tucson Water's revenues, and water rates must therefore be carefully calibrated to recover the utility's projected annual operating expenses, capital improvement needs, and debt service requirements. Rates were last adjusted by Mayor & Council in May of 2018 for FY 2019 and FY 2020. A rate increase planned for FY 2021 was not implemented in recognition of the economic challenges resulting from the COVID-19 pandemic.

Tucson Water's yearly Financial Planning process begins with the development of a five-year Financial Plan, followed by a cost-of-service analysis, and finalized by a rate design process which culminates with Mayor & Council issuing a Notice of Intention to Increase Water Rates, public hearings, final Mayor & Council action, and, ultimately, implementation of rate increases to coincide with the July start of the City's Fiscal Year. Throughout the process, TW staff confers on a regular, transparent basis with CWAC and its Financial Subcommittee, ensuring that recommended water rate adjustments are kept to the minimum necessary, consistent with Mayor & Council policies and City Code.

Staff recommends a 5.5% revenue adjustment each of the next four fiscal year. Using the FY 2023 through FY 2027 Financial Plan and the Cost-of-Service model as a basis, TW and its rate consultants have proposed a rate schedule option. The Rate Smoothing with Reclaimed Rate Increase Model represents a weighted average single-family residential rate increase of 5.4%.

The CAP Surcharge is set to fund the cost charged by Central Arizona Water Conservation District for CAP commodity charges. Due to the drought declarations, the rates have drastically increased. The CAP Surcharge is currently set at $0.70/Ccf and it's recommended to increase by $.30/Ccf to $1.00/Ccf effective January 1, 2023. The CAP surcharge is applied to all potable water customers (residential, commercial, industrial, etc.). By increasing the CAP surcharge to $1.00/Ccf, the utility will collect an estimated $38 million on an annual basis. The average residential customer using 8 Ccfs/month will pay $2.40 more a month. Staff is also recommending renaming the CAP Surcharge to the Water Resource Fee.

CWAC and the Mayor & Council have historically considered rate changes on a yearly basis, and most recently a two-year basis. However, given the emerging issues in the water industry and the Colorado River

basin, Tucson Water is proposing a four-year rate increase plan starting with the increase of the CAP surcharge to $1.00/CCF starting January 1, 2023, followed by staged water rate increases taking effect FY24 through FY27. A four-year rate plan will provide stable and reliable water sales revenue, while still following annual budgeting and financial planning processes. It will also provide increased cost accountability from City staff over the four-year period while advancing several key objectives that can only be accomplished over a multi-year time period including technological advancements and enhancing the annual CIP to $85 million per year plus estimated annual inflation to address aging infrastructure needs.

To initiate a rate increase process that allows for the January 1, 2023, increase of the CAP surcharge a Notice of Intention to Increase Water Rates must be adopted at the September 27, 2022, regular meeting of Mayor & Council.

Ratemaking Objectives

Within standard industry practices, utilities have flexibility to select specific approaches that are aligned with local policies and objectives. For Tucson Water, promoting water conservation has been a key ratemaking objective for many years. Tucson's conservation-oriented rate structure has been in place for more than two decades and has contributed to the reduction in water usage per account that Tucson Water continues to experience. Other factors likely affecting reduced per capita water demands are the increasing use of water-efficient appliances, continued economic challenges, and the adoption of desert-adapted landscaping.

In addition to water conservation, the CWAC has made improved rate resiliency an important objective in the last several years. Rate resiliency is paramount for Tucson Water to carry out its mission related to water reliability. In FY 2016, CWAC and Tucson Water recommended and implemented changes to the rate block structure, reducing the upper limit of Block 1 from 10 Ccf to 7 Ccf. This change to the block structure has provided additional resiliency for the utility, and additional conservation incentives to customers. We recommend no further changes to the block rate structure at this time.

Furthermore, for revenue stability purposes, CWAC and Tucson Water continue to believe it important to maintain revenue recovery from fixed monthly service charges. The current fixed charges generate approximately 27% of TW's water sales revenue, while approximately 80% of the utility's costs are fixed. Tucson Water's fixed charges continue to be well below average in the industry and region.

In previous plans, to balance conservation and revenue stability goals, staff and CWAC propose incrementally increasing the base rate to generate at least 30% of total annual revenue requirements.

Tucson Water's cost-of-service and rate-design analysis, are intended to continue balancing revenue stability goals with other rate setting objectives, including continued promotion of water conservation, and managing rate impacts on customers. The following sections discuss the ratemaking process from development of the Financial Plan through Rate Design.

Financial Plan

Tucson Water's FY 2023 through FY 2027 Financial Plan (Attachment A) provides the Mayor and Council with an overview of TW's projected revenues as well as operating, capital improvement, and debt service requirements. During the timeframe covered by the Plan, the City of Tucson (the City) has assumed the purchase of its entire allocation of Colorado River water on an annual basis and built in funding for targeted infrastructure investment to provide for system reliability. Tucson Water recognizes the need to maintain affordable rates for its customers. The utility must also meet critical short-term infrastructure needs that ensure its ability to provide safe, clean, and reliable drinking water to more than 740,000 people.

The Plan includes an increase of the CAP Surcharge to $1.00/Ccf in January 2023 and a revenue increase of 5.5% beginning in July 2023 (FY 2024), and 5.5% each future year of the Plan. The Plan includes debt issuance of $60 million and use of $30 million of fund balance in the next five years. During the current

fiscal year, Tucson Water has managed its operating and capital improvement budgets to stay within available resources, consistent with prior planning efforts. The recommended Plan will allow Tucson Water to meet its financial obligations, maintain regulatory compliance, and ensure public health and safety. The Plan also provides funding for key Mayor & Council priorities, including payment assistance for low-income customers and continuation of conservation and rainwater/stormwater investments.

Separately, the FY 2023 through FY 2027 Conservation Program Financial Plan is funded annually at $3.7 million, maintaining the Conservation Fund at a level necessary to meet the objectives of the Conservation Program, while allowing the development of new programs as directed by Mayor & Council. The Conservation Fee has no proposed increase and will remain at $0.10/Ccf in FY 2023 and all future years of the plan.

A brief summary of the elements of the recommended Plan follows:

- Revenues: The Plan continues to include a forecast of water sales based on the most recent 5-year trends and forecast of development-related revenues (System Equity Fee, CAP Water Resource Fee, and connection fees) consistent with current-year estimates. The forecast for development-related revenues is relatively flat with revenue levels similar to those in the prior Plan. Water-sales revenue under existing rates is forecasted to increase gradually over the life of the plan. As previously mentioned, the per capital consumption forecast is projected to decrease; however, expected account growth will offset this projected decline in per capita consumption. Customer account growth is assumed to have peaked in FY 2021 at 1.0%. The plan projects that account growth will gradually slow over the life of the plan and level off at .3% annually reflecting approximately 740 new customers annually. The estimated gradual increase in water sales revenue is projected to be inadequate to cover annual costs without the recommended rate increase.

  Differential rates as adopted by Mayor and Council are included in the revenue forecast. Fiscal Year 2023 revenues are projected at $9.5 million.

- Capital Project Requirements: The Plan provides for a FY 2023 through FY 2027 capital program of $451.3 million. Major areas of focus include advanced metering; Regional Transportation Authority (RTA) and other roadway agency work relocating water facilities; proactive PFAS contaminant remediation; Infrastructure Reliability & Integrity System (IRIS) identified main, control system upgrades, reservoir rehabilitation, and infrastructure improvements; and necessary infrastructure replacement.

- Capital Financing: In accordance with Mayor & Council Water Policies, the Plan continues to finance the capital program with a combination of current revenues/reserves and debt financing, including bond proceeds and water system revenue obligations. This Plan continues the issuance of water system revenue obligations as the primary long-term debt instrument, with a goal of reducing overall debt in the long term. This plan includes the utilization of existing cash reserves and a debt issuance of $60 million to fund a portion of the capital program in FY2023 through FY2025 with capital projects in FY2026 and FY2027 being funded with a combination of rate revenue and reserve fund balances (Pay-As-You-Go). The utility reached its goal to reduce the debt service requirements and is 100% Pay-As-You-Go this fiscal year.

- Infrastructure Reserve: The Plan maintains an infrastructure reserve fund with a target balance of 10% of water sales revenue (or $20 million) to provide the utility a contingency for the unexpected or emergency capital repairs of aging infrastructure or similar unanticipated projects, without negatively impacting the planned capital program.

- Water Debt Service: Based on current interest rates, the Plan provides for principal and interest payments on existing debt obligations and all new water debt issues during the Plan period. This

reflects the continuation of TW's plan to improve financial sustainability. New water revenue debt is conservatively assumed to be repaid over 20 years with interest rates of approximately 4.5%.

- Debt Service Coverage: Mayor & Council Water Policy requires 175% debt service coverage on *all* debt ("coverage" refers to the amount of operating revenue that exceeds operating expenses and provides confidence to the bond purchasers that TW will be able pay the debt service on the bonds and revenue obligations). This policy is more restrictive than adopted bond covenants (included in bond sale ordinances), which require the 175% coverage on *senior lien* debt only. All years of the proposed Plan exceed the bond covenant requirements for both the *senior lien* debt and *all* debt covenants by exceeding the Mayor & Council policy of 175% coverage. Debt service coverage on *all* debt ranges from 212% to 349% for all years. Bond ratings agencies continue to rate the utility favorably in assigning AA, Aa2 high grade/stable outlook ratings.

- Operating Requirements:

    - CAP-Related Operating Expenses: The Plan reflects the purchase of the City's full allocation (144,191-acre feet) of CAP water for recharge as long as it is able. With worsening drought conditions, the City is expected to have its allocation reduced; however, the overall cost for total water might be the same in the cost charged by CAP to cover their fixed costs. The City may pursue other water resource options if made available. The Plan also provides funding for the projected operating costs required to meet the recharge and recovery objectives mentioned above. Total CAP commodity-related expenses are projected to range from approximately $27.7 million in FY 2023 to $43.2 million in FY 2027.

    - Operations & Maintenance: Tucson's Water FY 2023 operating request is $210.4 million. Increases compared to FY22 are primarily due to the increasing cost of CAP based on the expected tier 2 declaration and the increased cost of personnel.

    - Low-Income Assistance Program (LIAP): The Plan funding is $2.2M in FY 2023, and then increases by approximately $90,000/year over the remaining Plan years.

    - The Payment in Lieu of Tax (PILOT) amount is $2 million in FY 2023. The Plan includes the PILOT in all years of the Plan. The PILOT is assessed to Tucson Water by the City to recover the "lost property tax revenue" that the City would have collected if the utility were a private business.

- Customer Assistance, Relief & Emergency (CARE) Program: Tucson Water, with the support of CWAC, has developed the CARE program. Currently Tucson Water offers financial assistance in the form of payment arrangements, bill discounts, and fixture repairs for qualifying customers. Qualifying customers at 100% of poverty level would receive 75% off water bill, 125% of poverty level is 50% off water bill, and 150% of poverty level is 25% off water bill. This program allows increases to the base rate while not overly affecting low-income participants.

  Earlier this year, Tucson Water expanded its customer assistance program by adding an emergency/special hardship fund to support residential customers who are experiencing a financial hardship due to job loss, serious illness, or family loss. Those eligible could receive a credit of up to $150 annually based on need. Tucson Water also offers a Safety Net as a last resort for qualified customers who are unable to achieve solutions through normal payment options. The four basic components include deferred water shut-off, waiver of recent delinquent charges, interest free payment plans, and financial assistance. When combined these elements provide the time and means for customers to manage their way through a temporary crisis. The LIAP application process

was also streamlined to add automatic qualifiers for eligibility and allows self-certification of total household individuals.

- Community Garden Rate Class: Affordability of water and connecting to the water system has been identified as one of the primary barriers of expanding community gardens in Tucson. To address this issue, a three-year pilot was implemented in 2018 that reduces both upfront costs and monthly use charges for theses qualifying customers. Community gardens as defined by City of Tucson Unified Development Code (Article 11.3.2.B) as "*An area of land operated non-for-profit to grow and harvest food crops primarily for the use of its members who typically cultivate individual garden plots."* Qualifying customers can apply to receive a garden water rate if they have a designated irrigation meter providing water to the garden only. For customers without an irrigation meter, this program will provide financing to install a dedicated irrigation meter and backflow device for garden watering. Once the irrigation meter is installed, the customer will be eligible to receive the garden water rate and a payment plan is calculated and added to the monthly utility services statement. Officially adopting the community garden as a rate class will allow this program to continue in the community and add benefit to the water system by moving this type of service to an irrigation meter. Currently, fifteen community garden customers are in this rate class.

- Cash Reserves: Mayor & Council Water Policies establish that TW shall maintain cash reserves of 5% of annual water sales revenues. In 2002, the Mayor and Council requested that the target reserve level be increased to 10%. A more recent metric included in the Plan is number of days of working capital/cash reserves, which is the criteria utilized by bond rating agencies to evaluate the utility's financial stability. Compared to other utilities in our rating category (AA, high grade/stable outlook), TW has a relatively low number of days of working capital/cash reserves. Similarly rated utilities typically maintain 120 to 570 days of working capital. The proposed plan has a decrease in cash reserves but does not drop below the 120 minimum threshold.

Cost of Service

Determining how much of the total required water sales revenue will be generated by each customer class is the next step in the ratemaking process. Although the TW proposed Financial Plan requires an overall annual revenue increase of 5.5% for FY 2024, the *cost of service* for a given customer class may dictate that the revenue increase for that class will be higher or lower than the overall 5.5% revenue increase. The process of determining which portion of a water sales revenue increase will be borne by each rate class is known as *cost-of-service allocation*. For the rate-setting process, Tucson Water is recommending the Rate Smoothing with Reclaimed Rate Increase Model.

Rate Smoothing with Reclaimed Rate Increase Model: To produce a rate structure option that further reduces the risk of "rate shock" for the Residential rate class, TW staff worked with rate consultants to develop the Rate Smoothing with Reclaimed Rate Increase Model. As indicated in Table 1 below, the Rate Smoothing with Reclaimed Rate Increase Model allocates costs more equally among the different rates classes, keeping revenue increases no lower than 5.4% for every class. As with the previous Rate Smoothing Model, $316,475 in school peaking costs, and lowered reclaimed system costs of $7.8 million are reallocated pro-rata across all the potable rate classes. There is some risk of creating revenue instability with the Rate Smoothing with Reclaimed Rate Increase Model. While the model reduces the rate load on the Residential class, it reallocates cost to the other customer classes which are a smaller percent of total customer accounts. Should these smaller customer classes or business sectors experience an economic downturn they may not generate the planned water revenues anticipated by the Rate Smoothing with Reclaimed Rate Increase Model. The Reclaimed rate was last increased in FY 2020, with all other customer classes receiving regular rate increases.

Table 1: Cost of Service, Rate Smoothing with Reclaimed Rate Increase Model

Reclaimed COS to be recovered from reclaim	$ 10,633,494	
Reclaimed to be Allocated	$ 7,828,627	*
Potable COS	$ 231,242,814	
Potable difference in schools peaking costs to	$ 316,475	*
	$ 250,021,411	

Customer Class	(1) Allocated COS ($1,000)	(2) Rate Design Adjustments* ($1,000)	(3) Adjusted COS ($1,000)	(4) Adjusted COS w/o CAP ($1,000)	(5) Revenue under Existing Rates ($1,000)	(6) Revenue Shortfall ($1,000)	(7) % Revenue Increase Required
Residential	137,878	2,877	140,755	120,155	113,968	(6,187)	5.4%
Multifamily	34,087	2,781	36,868	29,728	28,209	(1,518)	5.4%
Commercial	49,414	2,616	52,029	43,296	41,090	(2,206)	5.4%
Industrial	3,268	53	3,321	2,733	2,592	(141)	5.4%
Construction Water	2,528	(6)	2,523	2,158	1,972	(186)	9.4%
Community Garden	73	(21)	52	39	38	(2)	5.1%
Fire Sprinkler Service	3,995	(155)	3,840	3,841	3,508	(333)	9.5%
Public Fire Protection							
Sub-Total Potable	231,243	8,145	239,388	201,951	191,377	(10,573)	5.5%
Potable Difference in schools peal	316	(316)					
Total Potable	**231,559**	**7,829**	**239,388**	**201,951**	**191,377**	**(10,573)**	**5.5%**
Reclaimed	**18,462**	**(7,829)**	**10,633**	**10,633**	**10,079**	**(554)**	**5.5%**
Utility Total	**250,021**		**250,021**	**212,584**	**201,456**	**(11,128)**	**5.5%**

Rate Design

The final step in the ratemaking process is the development of new *monthly water rate schedules* estimated to generate the targeted revenues and meet conservation and revenue stability objectives, while attempting to mitigate ratepayer pocketbook shock. The rate schedule is designed to:

- Generate targeted class revenue increases, through adjustments to usage rates;
- Continue to provide, via the proposed usage rates, a signal to conserve water;
- Increase the portion of overall revenue recovered through the fixed monthly service charges from 27% to 30%;
- Continue to recognize the system-wide benefit of the reclaimed water system.

Under advisement from TW's rate consultant, CWAC opted to leave the current block rate structure for single-family residential customers unchanged (Block 1: 0-7 Ccf; Block 2: 8-15 Ccf; Block 3: 16-30 Ccf; Block 4: >30 Ccf). Block 1 single-family residential (SFR) users continue to be the largest group of residential water consumers, with 65.8% of SFR consumption in Block 1.

As with prior approved rate structures, increasing the water consumption rate in the high-usage blocks continues to be an unreliable source of revenue. To help provide revenue stability, the current fixed base-rate percentage will be increased gradually to close to 30% over the four-year rate setting period. An increase of the base rate by itself will represent no new revenue for the utility, but rather an adjustment of the proportion of fixed to variable revenue. This action would provide greater long-term revenue stability, improving Tucson Water's standing among bond-rating agencies. In future years, additional evaluation of the block rate structure will be undertaken to further stabilize rates.

While difficult to mitigate pocketbook shock and still meet other rate schedule objectives, the proposed Smoothing with Reclaimed Increase rate schedule would provide a reasonable approach to that end.

Customers in each rate class would see bill increases under the Smoothing with Reclaimed Rate Increase schedule option.

The *single-family residential customer class* is Tucson Water's largest class with approximately 87% of customer accounts. Approximately 66% of single-family customers use, on average, 8 Ccf per month, and the average customer uses 7 Ccf per month during the winter, and 9 Ccf per month during the summer. The rate schedule option meets CWAC's objectives for improved rate resiliency by maintaining the portion of revenue recovered from fixed charges, and slightly shifting revenue recovery from Blocks 3 and 4 (less than 15% of customer usage) to Blocks 1 and 2, to more accurately reflect cost of service. Sample monthly bill impacts for various usage levels are reflected below:

Overall Rate impacts, typical Single Family Residential FY2024 to FY2027
(Rate Smoothing with Reclaimed Rate Increase Model)

Single Family Total Utility Bill

Ccf/Month	2023	2024	2025	2026	2027
0	$16.33	$17.52	$18.81	$20.19	$21.72
3	$25.84	$27.38	$29.04	$30.81	$32.76
7	$38.52	$40.51	$42.68	$44.97	$47.48
8	$43.44	$45.63	$48.02	$50.54	$53.28
9	$48.36	$50.75	$53.36	$56.11	$59.08
15	$77.88	$81.47	$85.40	$89.53	$93.88
20	$125.33	$129.47	$134.60	$139.98	$145.53
0		$1.19	$1.28	$1.39	$1.52
3		$1.54	$1.66	$1.78	$1.94
7		$1.99	$2.17	$2.30	$2.50
8		$2.19	$2.39	$2.53	$2.73
9		$2.39	$2.61	$2.76	$2.96
15		$3.59	$3.93	$4.14	$4.34
20		$4.14	$5.13	$5.39	$5.54
0		7.3%	7.3%	7.4%	7.5%
3		5.9%	6.1%	6.1%	6.3%
7		5.2%	5.3%	5.4%	5.6%
8		5.0%	5.2%	5.3%	5.4%
9		4.9%	5.1%	5.2%	5.3%
15		4.6%	4.8%	4.8%	4.8%
20		3.3%	4.0%	4.0%	4.0%
Potable Avg Inc. (No CAP)		***5.5%***	***5.5%***	***5.5%***	***5.5%***
Total Utility Bill = Potable Fixed +Volume +CAP +Conservation					
Projected CAP	$1.00	$1.00	$1.00	$1.00	$1.00
Projected Conservati	$0.10	$0.10	$0.10	$0.10	$0.10

Detailed proposed rates for each customer class can be found in the attached Rate Schedule Options (Attachment B and C).

Attachments:

- Attachment A: Tucson Water FY 2023-27 Financial Plan
- Attachment B: Tucson Water FY 2023 to FY 2027 Proposed Rates
- Attachment C: Tucson Water FY 2023 to FY 2027 Proposed Differential Rates
- CWAC letter to Mayor and Council dated 9/19/22

Tucson Water
Financial Planning & Rate Model
Financial Summary

	Diff?	FY 2023 Budget	FY 2024 Projected	FY 2025 Projected	FY 2026 Projected	FY 2027 Projected
Annual Water System Results	Yes					
Revenue						
Potable Water Sales [1]		$ 220,642,258	$ 237,813,835	$ 249,642,671	$ 261,949,594	$ 274,959,585
Reclaimed Water [2]		10,079,179	10,544,418	11,035,245	11,553,067	12,099,370
Misc. Revenue [3]		19,088,170	19,128,970	19,200,370	19,241,170	19,256,470
Subtotal: Revenue		$ 249,809,607	$ 267,487,223	$ 279,878,286	$ 292,743,831	$ 306,315,425
Expenses						
O&M (Excludes Units 7402 & 7500)						
100-Personnel		$ 49,121,137	$ 50,594,772	$ 52,112,615	$ 53,675,993	$ 55,286,273
200-Services		91,143,629	97,363,457	103,949,367	107,786,888	110,303,566
300-Commodities		8,516,630	8,601,796	8,687,814	8,774,692	8,862,439
400-Capital Outlay		750,000	757,500	765,075	772,726	780,453
500-Fiscal Agent Fees		354,840	354,840	354,840	354,840	354,840
700-Payments to Outside Organizations		99,000	99,990	100,990	102,000	103,020
900-Interactivity Transfers		(6,500,000)	(6,500,000)	(6,500,000)	(6,500,000)	(6,500,000)
Subtotal: O&M (Excludes Units 7402 & 7500)		$ 143,485,237	$ 151,272,355	$ 159,470,701	$ 164,967,139	$ 169,190,591
		3%	5%	5%	3%	3%
Projected Budget Savings		(2,131,680)	(3,462,414)	(3,283,374)	(3,323,362)	(3,363,455)
Operations & Maintenance [4]		$ 141,353,557	$ 147,809,941	$ 156,187,327	$ 161,643,777	$ 165,827,136
		8%	5%	6%	3%	3%
Debt Service		0	0	0	0	0
Senior		$ 52,756,815	$ 52,386,756	$ 51,229,888	$ 45,647,945	$ 41,135,383
Junior		4,362,522	3,960,007	3,745,593	3,745,941	2,988,511
All-In Debt Service	Debt?:	57,119,337	56,346,763	54,975,482	49,393,886	44,123,894
Cash Financed Capital [5]	YES	65,031,000	67,550,000	70,176,500	92,881,795	95,668,249
Subtotal: System Expenses		$ 263,503,893	$ 271,706,705	$ 281,339,309	$ 303,919,458	$ 305,619,279
Annual Net Revenue		**$ (13,694,287)**	**$ (4,219,482)**	**$ (1,461,023)**	**$ (11,175,628)**	**$ 696,146**
Capital Improvement Projects						
Cash Financed CIP		$ 65,031,000	$ 67,550,000	$ 70,176,500	$ 92,881,795	$ 95,668,249
Debt Financed CIP [5]		20,000,000	20,000,000	20,000,000	-	-
Subtotal: Capital Improvement Projects		$ 85,031,000	$ 87,550,000	$ 90,176,500	$ 92,881,795	$ 95,668,249
Ending Fund Balances						
Operating Fund		$ 79,282,306	$ 75,062,825	$ 73,601,802	$ 62,426,175	$ 63,122,321
Bond Fund		-	-	-	-	-
Infrastructure Fund [5]		20,000,000	20,000,000	20,000,000	20,000,000	20,000,000
Total: Fund Balance		$ 99,282,306	$ 95,062,825	$ 93,601,802	$ 82,426,175	$ 83,122,321
Days of O&M (All Funds)		**256**	**235**	**219**	**186**	**183**
Days of O&M (Excludes Infrastructure)		**205**	**185**	**172**	**141**	**139**
Debt Coverage						
Senior Debt Service Coverage		**2.29**	**2.52**	**2.67**	**3.16**	**3.74**
All-in Debt Service Coverage		**2.12**	**2.35**	**2.48**	**2.92**	**3.49**
Residential Bill 8 CCF		$41.04	$45.35	$47.40	$49.57	$51.85
$ Change		$0.00	$4.31	$2.05	$2.17	$2.29

Tucson Water Proposed Rates FY2023-2027: Smoothing Model with Reclaimed Increase

Rate Component/Class	2023			2024			2025			2026			2027		
	Potable	*Reclaimed*	*Fire Sprinkler*	*Potable*	*Reclaimed*	*Fire Sprinkler*	*Potable*	*Reclaimed*	*Fire Sprinkler*	*Potable*	*Reclaimed*	*Fire Sprinkler*	*Potable*	*Reclaimed*	*Fire Sprinkler*
Service Charge															
Meter Size															
5/8"	$16.33	$10.98		$17.52	$11.78		$18.81	$12.64		$20.19	$13.56		$21.72	$14.55	
3/4"	$22.03	$0.00		$23.89	$0.00		$25.63	$0.00		$27.53	$0.00		$29.60	$0.00	
1"	$33.42	$20.20		$36.61	$21.68		$39.29	$23.26		$42.19	$24.96		$45.37	$26.78	
1.5"	$61.91	$35.58		$68.42	$38.17		$73.43	$40.96		$78.85	$43.95		$84.79	$47.16	
2"	$96.09	$54.03	$15.14	$106.59	$57.97	$16.18	$114.40	$62.20	$17.29	$122.84	$66.74	$18.50	$132.09	$71.62	$19.79
2.5"	$141.67	$78.63	$0.00	$157.49	$84.37	$0.00	$169.02	$90.53	$0.00	$181.49	$97.14	$0.00	$195.16	$104.23	$0.00
3"	$187.24	$103.23	$25.45	$208.39	$110.76	$27.54	$223.64	$118.85	$29.43	$240.14	$127.53	$31.49	$258.23	$136.83	$33.68
4"	$318.27	$173.95	$39.86	$354.71	$186.65	$43.44	$380.68	$200.28	$46.43	$408.76	$214.90	$49.67	$439.56	$230.59	$53.13
6"	$646.43	$351.07	$76.94	$721.17	$376.70	$84.34	$773.96	$404.20	$90.14	$831.06	$433.71	$96.43	$893.66	$465.37	$103.16
8"	$973.44	$527.58	$114.01	$1,086.35	$566.09	$125.24	$1,165.87	$607.42	$133.85	$1,251.89	$651.76	$143.19	$1,346.19	$699.34	$153.18
10"	$1,486.18	$804.33	$172.71	$1,658.94	$863.05	$189.99	$1,780.36	$926.05	$203.05	$1,911.73	$993.65	$217.22	$2,055.74	$1,066.19	$232.38
12"	$2,454.68	$1,327.09	$281.88	$2,740.50	$1,423.96	$310.41	$2,941.08	$1,527.91	$331.74	$3,158.08	$1,639.45	$354.90	$3,395.98	$1,759.13	$379.66
Usage Charge (Per Ccf)															
Residential (Single Family) Block Rates															
1-7 Ccf	$2.07			$2.18			$2.31			$2.44			$2.58		
8-15 Ccf	$3.82			$4.02			$4.24			$4.47			$4.70		
16-30 Ccf	$8.39			$8.50			$8.74			$8.99			$9.23		
Over 30 Ccf	$12.93			$13.10			$13.31			$13.52			$13.65		
Residential (Duplex-Triplex) Block Rates															
1-10 Ccf	$2.07			$2.18			$2.31			$2.44			$2.58		
10-20 Ccf	$3.82			$4.02			$4.24			$4.47			$4.70		
21-35 Ccf	$8.39			$8.50			$8.74			$8.99			$9.23		
Over 35 Ccf	$12.93			$13.10			$13.31			$13.52			$13.65		
Other Classes: Base Rates															
Multifamily *	$3.42			$3.57			$3.74			$3.91			$4.08		
Mobile Home Parks w/sub-meters *	$2.56			$2.68			$2.80			$2.92			$3.05		
Commercial	$3.36			$3.49			$3.65			$3.81			$3.98		
Community Garden	$2.56			$2.67			$2.79			$2.92			$3.04		
Industrial	$3.38			$3.53			$3.69			$3.86			$4.03		
Construction *	$3.70			$4.02			$4.20			$4.39			$4.58		
Tier Rates (Summer Only: May - Oct)**															
Tier 1	$1.08			$1.14			$1.19			$1.25			$1.30		
Tier 2	$0.29			$0.31			$0.32			$0.33			$0.35		
Reclaimed Std Usage Rate *		$2.13			$2.26			$2.38			$2.51			$2.65	
Per Acre-Foot		$815.00			$983.00			$1,037.00			$1,094.00			$1,154.00	
Reclaimed Contract Usage Rate *		$0.82			$0.82			$0.45			$0.48			$0.52	
CAP Charge ***	$1.00			$1.00			$1.00			$1.00			$1.00		
Conservation Charge	$0.10			$0.10			$0.10			$0.10			$0.10		

*** Uniform rate year-round; not subject to summer tier rates**

****Applicable for Commercial and Industrial classes only.**

***** Assessed to potable customers only.**

Tucson Water Proposed Differential Rates FY2023-2027: Smoothing Model with Reclaimed Increase

Rate Component/Class	2023			2024			2025			2026			2027		
	Potable	*Reclaimed*	*Fire Sprinkler*	*Potable*	*Reclaimed*	*Fire Sprinkler*	*Potable*	*Reclaimed*	*Fire Sprinkler*	*Potable*	*Reclaimed*	*Fire Sprinkler*	*Potable*	*Reclaimed*	*Fire Sprinkler*
Service Charge															
Meter Size															
5/8"	$17.96	$10.98		$19.28	$11.78		$20.69	$12.64		$22.21	$13.56		$23.89	$14.55	
3/4"	$24.23	$0.00		$26.27	$0.00		$28.20	$0.00		$30.28	$0.00		$32.56	$0.00	
1"	$36.76	$20.20		$40.27	$21.68		$43.22	$23.26		$46.41	$24.96		$49.90	$26.78	
1.5"	$68.10	$35.58		$75.26	$38.17		$80.77	$40.96		$86.73	$43.95		$93.26	$47.16	
2"	$105.70	$54.03	$15.14	$117.25	$57.97	$16.18	$125.83	$62.20	$17.29	$135.12	$66.74	$18.50	$145.30	$71.62	$19.79
2.5"	$155.84	$78.63	$0.00	$173.24	$84.37	$0.00	$185.92	$90.53	$0.00	$199.64	$97.14	$0.00	$214.68	$104.23	$0.00
3"	$205.96	$103.23	$25.45	$229.23	$110.76	$27.54	$246.00	$118.85	$29.43	$264.15	$127.53	$31.49	$284.05	$136.83	$33.68
4"	$350.10	$173.95	$39.86	$390.19	$186.65	$43.44	$418.74	$200.28	$46.43	$449.64	$214.90	$49.67	$483.51	$230.59	$53.13
6"	$711.07	$351.07	$76.94	$793.29	$376.70	$84.34	$851.35	$404.20	$90.14	$914.17	$433.71	$96.43	$983.03	$465.37	$103.16
8"	$1,070.78	$527.58	$114.01	$1,194.99	$566.09	$125.24	$1,282.45	$607.42	$133.85	$1,377.08	$651.76	$143.19	$1,480.81	$699.34	$153.18
10"	$1,634.80	$804.33	$172.71	$1,824.84	$863.05	$189.99	$1,958.40	$926.05	$203.05	$2,102.90	$993.65	$217.22	$2,261.31	$1,066.19	$232.38
12"	$2,700.15	$1,327.09	$281.88	$3,014.55	$1,423.96	$310.41	$3,235.19	$1,527.91	$331.74	$3,473.89	$1,639.45	$354.90	$3,735.58	$1,759.13	$379.66
Usage Charge (Per Ccf)															
Residential (Single Family) Block Rates															
1-7 Ccf	$2.28			$2.40			$2.54			$2.68			$2.84		
8-15 Ccf	$4.58			$4.82			$5.09			$5.36			$5.64		
16-30 Ccf	$10.91			$11.05			$11.36			$11.69			$12.00		
Over 30 Ccf	$18.10			$18.34			$18.63			$18.93			$19.11		
Residential (Duplex-Triplex) Block Rates															
1-10 Ccf	$2.28			$2.40			$2.54			$2.68			$2.84		
10-20 Ccf	$4.58			$4.82			$5.09			$5.36			$5.64		
21-35 Ccf	$10.91			$11.05			$11.36			$11.69			$12.00		
Over 35 Ccf	$18.10			$18.34			$18.63			$18.93			$19.11		
Other Classes: Base Rates															
Multifamily *	$3.76			$3.93			$4.11			$4.30			$4.49		
Mobile Home Parks w/sub-meters *	$2.82			$2.94			$3.08			$3.22			$3.36		
Commercial	$3.70			$3.84			$4.01			$4.19			$4.38		
Community Garden	$2.82			$2.93			$3.07			$3.21			$3.35		
Industrial	$3.72			$3.89			$4.06			$4.25			$4.43		
Construction *	$4.07			$4.42			$4.62			$4.83			$5.04		
Tier Rates (Summer Only: May - Oct)**															
Tier 1	$1.19			$1.25			$1.31			$1.37			$1.43		
Tier 2	$0.32			$0.34			$0.35			$0.37			$0.38		
Reclaimed Std Usage Rate *		$2.13			$2.26			$2.38			$2.51			$2.65	
Per Acre-Foot		$815.00			$983.00			$1,037.00			$1,094.00			$1,154.00	
Reclaimed Contract Usage Rate *		$2.13			$2.26			$2.38			$2.51			$2.65	
CAP Charge ***	$1.10			$1.10			$1.10			$1.10			$1.10		
Conservation Charge	$0.11			$0.11			$0.11			$0.11			$0.11		

*** Uniform rate year-round; not subject to summer tier rates**

****Applicable for Commercial and Industrial classes only.**

***** Assessed to potable customers only.**

cwac

Citizens' Water Advisory Committee
City of Tucson
P.O.Box 27210
Tucson, AZ 85726-7210

DATE: September 19, 2022

TO: Honorable Mayor and Council Members

FROM: Rory Juneman, Chair
Citizens' Water Advisory Committee

Subject: Tucson Water FY 23-27 Rate Adjustment Proposal

The Citizens' Water Advisory Committee (CWAC) was created in 1977 at the direction of Mayor and Council, and one of CWAC's roles is to act as an advisory body to City Government on matters pertaining to rate structure formulation. Specifically, CWAC is charged with reviewing the annual revenue requirements of the system and recommending to the Governing Body when increases are required, while also promoting the concerns of Tucson Water customers by ensuring the rate increases are kept to the absolute minimum necessary.

The past years have been challenging on many fronts due to the COVID-19 pandemic and its lingering impact that has created economic uncertainty on a national and local level. This has led to increasing inflation that has impacted Tucson Water's operating and capital costs while simultaneously impacting the ability of the most vulnerable in our community to pay their utility bills. This dynamic has been further exacerbated by worsening drought conditions that have moved the basin states into a Tier 2A drought declaration, causing rapidly escalating CAP costs.

Tucson Water is now in the third year without a rate increase. Approval of the 2020 rate increase proposal was put on hold due to the emergence of the pandemic. Due to temporary reductions in expenditures, deferral of projects, the use of remaining bond proceeds, and higher than normal water consumption and related billing revenue in FY20 and FY21, Tucson Water has been able to manage through without significant impacts to the utility's fund balance and financial position. However, these measures cannot be sustained indefinitely. Tucson Water's staff is planning for the utility's financial future through a careful balance of recommended fund balance use, staged rate and fee increases, and a proposed revenue bond. This combination will secure the utility's financial position over the next five years and minimize, to the greatest degree possible, rate shock to rate payers.

CWAC, through both its Finance Committee and full committee, met with staff on several occasions to review and understand the operational and financial realities of the utility. The following report outlines CWAC's recommendations related to the financial plan and rate increases presented by Tucson Water staff to CWAC on September 7, 2022.

Recommendation

CWAC recommends that Mayor and Council approve the Tucson Water Fiscal Years 2023 – 2027 Financial Plan (Plan), as presented in Attachment B of the Mayor and Council Communication. The Plan recommends the following:

1) Increase the CAP Surcharge (CAP and Water Resource Fee) by $0.30/Ccf to $1.00/Ccf effective January 1, 2023
2) Continue a multi-year rate cycle over four years at 5.5% revenue increases each year effective at the start of fiscal year.
    - FY 2024 5.5%
    - FY 2025 5.5%
    - FY 2026 5.5%
    - FY 2027 5.5%
3) Issue a $60M revenue bond to fund planned capital infrastructure investment and temporarily relieve pressure on rates due to annual infrastructure requirements.
4) Use fund balance over the 5-year period in an amount estimated at $30 million to help mitigate the need for more immediate higher rate increases.

A. September 7th CWAC Presentation – Proposed Rate Structure

On September 7, 2022, Tucson Water presented a cost-of-service analysis to the CWAC, discussing the drivers for the revenue requirement increases and adjustments based on policy-based objectives and to meet the overall goals of Tucson Water. Staff evaluated cost-of-service models based on a "traditional" model and a "smoothing" model. The "smoothing" model distributes the allocated costs more equally among the different rate classes, keeping revenue increases no lower than 5.1% for every class. Construction water and fire service rates would increase the most by 9.4% and 9.5% respectively. Residential, Multifamily, Commercial, and Industrial rates would increase by 5.4% and the Community Garden rate would increase by 5.1%. Before specific rate design increases were calculated, the City Manager's Office gave direction to Tucson Water to increase the Reclaimed Water rate to maintain equity across all rate classes. Reclaimed water rates are increasing by 5.5%. Overall, typical residential users will realize about a 5.4% annual average rate increase through FY2027 with the smoothing model that includes a Reclaimed rate increase.

The proposed potable and reclaimed water revenue increase of 5.5% effective July 1, 2023 is projected to generate an additional $11.0 million in FY 2024 water revenues over existing rates. If approved, the additional revenues will enable Tucson Water to:

- Continue capital projects that will allow Tucson Water to recharge, recover, and deliver its CAP allocation;
- Continue important potable distribution projects and other infrastructure replacement

projects ensuring system reliability and stored water supply for the future;

- Continue to go beyond regulations, be proactive, and serve safe quality drinking water;
- Continue efforts in Conservation, Customer Engagement, and Education;
- Invest in additional capital projects while reducing future issuance of new debt and progressing towards Pay-As-You-Go capital financing; and
- Protect the fiscal stability of Tucson Water by meeting required debt service coverage and reserve levels.

Based on the projections, revenue increases are necessary to allow Tucson Water to ensure water system reliability, the long-term health of the utility, and continue the utility's investment in the sustainability and stability of the community and its water future.

B. CWAC believes that the Plan is the minimum necessary to allow Tucson Water to continue to provide safe and reliable water services.

CWAC voted (7-1) to support the proposed FY 2023-FY2027 rate schedule presented to Mayor and Council, with the smoothing model including the Reclaimed rate increase, and the recommendation that any adopted rate schedule be for four years. CWAC believes approving revenue increases less than what staff has recommended will have negative effects on the utility and would force Tucson Water to implement reductions to operating and capital budgets and could potentially impact the utility's financial rating and future stability.

As part of its motion for recommending approval, CWAC included the following:

1. Increasing Base Fee

Some members of CWAC had concerns with this projection given that it shows an expected gradual increase in overall consumption each year of the plan. The concern is that with continued drought related messaging and enhanced conservation efforts given the recent Tier 2A declaration that an overall consumption increase, no matter how minimal, is unlikely to occur. This presents potential revenue uncertainty since the majority of potable revenue sales is still based on the volume of water sales.

One aspect of the current rate proposal that reduces the risk of revenue uncertainty is that the fixed base rate percentage will increase gradually from 27% to 30%. **CWAC supports prioritizing fixed rate revenues by way of gradually increasing the monthly service fee (base rate) to provide more assurances that the utility has the funds it needs, particularly as enhanced conservation efforts will reduce revenues based on volumetric consumption.** Tucson Water will continue to monitor consumption trending, and will escalate awareness and initiate rate adjustments if consumption is shown to deviate significantly from the FY23-FY27 Financial Plan.

2. Increasing Awareness to the Low-Income Assistance Program

Several CWAC members voiced concerns about how the rate increase will affect customers who participate in or are eligible for the Customer Assistance Program. The proposed Plan reflects the continuation of funding for Tucson Water's Customer Assistance Programs including the addition of the newly created emergency/special hardship program to support residential customers who are experiencing a financial hardship due to job loss, serious illness, or family loss. The creation of this new program supplemented action taken by Mayor and Council and processed by Tucson Water staff in FY21 and FY22 to eliminate delinquent amounts accumulated by some low-income customers and those experiencing pandemic specific hardships during the height of the pandemic. Ongoing customer assistance program costs are expected to average $2.2M annually and increase by approximately $90K over the remaining plan years. The total number of customers qualifying for the Low-Income Assistance Program has steadily increased over the life of the program which has also increased the total amount of financial assistance. As of July 2022, over 4800 customers have enrolled in the program. CWAC supports Tucson Water's effort to achieve greater revenue stability by gradually increasing the percentage of revenue collected through the fixed monthly service fee versus volumetric revenue, but also recognizes that this has impact on low-income families who might not be as able to pay these fixed fees. **For this reason, CWAC has requested that Tucson Water do more to target outreach to those who need assistance but might be reluctant based on prior barriers to entry that have since been addressed. CWAC also requests that the Mayor and Council direct the City's Equity Officer to review the proposed rate increase for its affect on low-income water users.**

3. Rename CAP Surcharge Fee

CWAC supports the proposed increase to the CAP surcharge to allow it to purchase the full CAP allotment or pursue the purchase of other water rights in the event the City's CAP allocation is cut. As part of this increase, **CWAC recommends that rather than rename the CAP Surcharge to the Water Resource Fee as staff has requested, that the name be changed to the CAP Surcharge and Water Resource Fee.** CWAC believes it important that the fee continue to be closely correlated to costs that are outside of Tucson Water's control and/or related to securing water resources for the region.

4. Commercial Tier Rates Review

Additionally, **CWAC voted through separate motion (6-3) to support the concept of commercial tiered rates and recommend that Mayor and Council study it and have staff evaluate and determine the feasibility of implementing commercial tiered rates as a means to further incentivize conservation within the commercial class.** Staff is investigating this and will return to CWAC at a later date to discuss feasibility and recommendations for possibly implementing such a rate structure change as part of future rate increases.

*** LATE MATERIAL FOR SCHEDULED REGULAR AGENDA ITEM #8 ***

MAYOR & COUNCIL COMMUNICATION

June 8, 2021

Subject: Public Hearing: Amending Tucson Code to implement a differential rate structure for Tucson Water customers located in unincorporated Pima County (Outside City)

Issue – Public hearing concerning the proposed implementation of a differential rate structure for Tucson Water customers located in unincorporated Pima County.

City Manager's Recommendation – Following the close of today's public hearing the Mayor and Council are respectfully requested to consider the attached schedule of FY 21-22 differential rate options (Attachment A), and to also consider adoption of the attached ordinance. If adopted, differential rates for Tucson Water customers located in unincorporated Pima County will take effect on or after July 12, 2021.

Background – On January 5, 2021, Mayor and Council discussed options for the implementation of a differential rate structure for water customers located outside of the City, and directed staff to gather preliminary stakeholder input regarding a proposal to adjust rates for Tucson Water in unincorporated Pima County. Tucson Water proceeded to conduct multiple meetings with regional stakeholders to gauge community response to the Mayor and Council proposal. During the April 6, 2021, Study Session, Mayor and Council heard a preliminary staff summary of stakeholder outreach efforts, as well as revenue estimates for flat differential rate increases up to 30%.

At the Regular Meeting of Mayor and Council on April 6, 2021, the Mayor and Council adopted a Notice of Intention to implement a differential rate structure for Tucson Water customers located in unincorporated Pima County, and scheduled the proposed differential rate options for public hearing today. Mayor and Council directed staff to file all necessary documents with the City Clerk to allow the consideration of differential rates up to but not exceeding 50%. Mayor and Council further moved to reaffirm that the City's Water Service Area Policy protects the City's water supply and is vital to its future sustainability.

After today's public hearing, the Mayor and Council may enact a differential rate structure that is equal to or less than the 50% maximum recommended with the Notice of Intention, or they may choose not to implement a differential rate structure.

Present Considerations – Historically, all Tucson Water customers have paid the same rates. Implementing a differential rate structure at this time would begin to address various known inequities that exist between city and county customers:

- Infrastructure use: The 29% of Tucson Water customers in unincorporated Pima County utilize 36% of the utility's infrastructure assets.

- Resource use: A significant portion of water used by county customers is lost to septic systems or retained by the county, rather than being returned to the city as a reclaimed water resource
- Water conservation: County customers use 43% more water on average than city customers

Additionally, the Tucson region loses $40M - $50M in State Shared Revenues every year due to the high unincorporated area population. A differential rate structure is one means of encouraging annexation or incorporation.

Stakeholder Outreach and Response – Today's public hearing was advertised on May 1, 2021, in the major local newspaper and on the City's website on May 7, 2021, in conformance with the requirements of State law. Additionally, Tucson Water has conducted community outreach and education via two remote Town Hall meetings, a presentation narrated by Interim Assistant City Manager Tim Thomure, a survey available in English and Spanish, and a fact sheet about the proposed differential rates. All outreach materials are available to the public at www.tucsonaz.gov/water-rates.

In addition to the preliminary stakeholder input provided to Mayor and Council on April 6, staff has continued to receive a robust community response following adoption of the Notice of Intention. This has included:

Citizens' Water Advisory Committee: CWAC responded to Mayor and Council's initial request for stakeholder input by dedicating the majority of two regular meetings (February 3 and March 3, 2021) to review and discussion of the proposed differential rates. Based upon these discussions the general opinion of CWAC's 15 members was against the proposal, with 10 members opposed to differential rates and 5 members expressing support. The perspectives of members who opposed or supported the proposal can be found in CWAC's March 30, 2021, memo to Mayor and Council (Attachment B). Regardless of their position on the proposal, CWAC members expressed the opinion that if such rates are implemented, new funds should remain with the utility for water-related infrastructure. CWAC members generally opposed the use of new differential rate funds for the City's general fund.

On May 5, 2021, Interim ACM Thomure provided CWAC with a full summary of Tucson Water's differential rate proposal (Attachment C), including policy considerations, stakeholder comments, a complete review of the differential rate options being proposed to Mayor and Council today, and a summary of projected bill impacts for customers in the unincorporated County. CWAC has submitted an additional Memo to Council following their most recent meeting held on June 2, 2021 (Attachment I). By way of the Memo, CWAC recommends that a decision on differential rates be deferred until Fall 2021.

At its June 2, 2021, meeting CWAC again reviewed and discussed the differential rates proposals and community feedback to date. The Committee voted to recommend that Mayor and Council defer a decision on differential water rates until at least the Fall of 2021 to allow time for additional public participation, and for further analysis and discussion of the options being considered (see Attachment I).

Pima County: Staff presentations to CWAC have elicited two direct responses in opposition to the proposal from Pima County administration (Attachments D and E).

Online Public Surveys: An online survey was made available to the public on May 7, 2021, and will remain available through today's public hearing.

As of 8 a.m. on May 27, 1,551 complete responses had been received by Tucson Water in English, and two responses in Spanish. Of those respondents, 87.7% indicated that they were "very opposed" (81%) or "somewhat opposed" (6.7%) to the initiation of differential rates for customers in the unincorporated County. A total of 10.8% indicated that they were "very supportive" (7.3%), "somewhat supportive" (2.5%), or "neutral" (1%). An additional 1.5% of respondents indicated a lack of information on which to base a decision. Responses of opposition or support appear to align closely with respondents' geographic location, with 74.0% of respondents indicating residence in "the greater Tucson area" and only 14.6% indicating residence within the City.

Asked to prioritize the use of additional revenues that might be collected under a differential rate structure, respondents' highest preferences were:

1. Fund infrastructure rehabilitation and replacement, and improve service levels in unincorporated areas
2. Fund additional green stormwater infrastructure throughout the Tucson Water service area
3. Pay down utility debt

A summary of survey responses is attached to this Communication (see Attachment F). It should be noted that responses will continue to be accepted through today's public hearing, and final results may differ somewhat from those summarized here.

Public Town Halls: Two Town Hall meetings were conducted online via Zoom by City staff on May 12 and May 25, 2021, with approximately 190 attending the first Town Hall and 140 attending the second. During each Town Hall, Interim ACM Thomure provided attendees with a full summary of Tucson Water's differential rate proposal, including policy considerations, stakeholder comments, a complete review of the differential rate options being proposed to Mayor and Council today, and a summary of projected bill impacts for customers in the unincorporated County. Following the presentation, attendees were invited to ask questions or make statements, and were provided an opportunity to ask follow-up questions via chat box. Participant response during both Town Halls was generally opposed to implementation of a differential rate structure.

Both meetings were recorded and are available for viewing at www.tucsonaz.gov/water-rates, along with the archived chat-box transcripts.

Summary of Differential Rate Options – Eight options were developed for consideration as reflected in Attachment A. Table 1 below shows the options for the single-family residential (SFR) customer class which is Tucson Water's largest class, with approximately 90% of customer accounts across the entire service area. This class represents 95% of the customer base among customers located in unincorporated Pima County.

The SFR rate structure consists of three basic components: a fixed monthly service charge based upon meter size; a volumetric usage charge based on a four-tiered, inclining-block structure; and miscellaneous fees. The SFR volumetric rate blocks established in FY 2016 are as follows, and would not be affected by the proposed differential rate options:

- Tier 1 = 0-7 Ccf
- Tier 2 = 8-15 Ccf
- Tier 3 = 16-30 Ccf
- Tier 4 = >30 Ccf

The first five options are flat percentage increases starting with 10% up to a flat 50% increase across the rates and fees. Options 6, 7 and 8 are comprised of the same increase for the monthly base rate, first volumetric tier (0–7 Ccf), Central Arizona Project (CAP) fee, conservation Fee and includes escalating percentage increases in the inclining block rate structure.

Table 1. Rate options for consideration

		Option 1		Option 2		Option 3		Option 4		Option 5	
Single Family Residential	Current Rate FY 21 & FY 22	*Flat 10%*		*Flat 20%*		*Flat 30%*		*Flat 40%*		*Flat 50%*	
Monthly Base Rate (5/8')	$16.33	10%	$17.96	20%	$19.60	30%	$21.23	40%	$22.86	50%	$24.50
1 – 7 Ccf	$2.07	10%	$2.28	20%	$2.48	30%	$2.69	40%	$2.90	50%	$3.11
8 – 15 Ccf	$3.82	10%	$4.20	20%	$4.58	30%	$4.97	40%	$5.35	50%	$5.73
16 – 30 Ccf	$8.39	10%	$9.23	20%	$10.07	30%	$10.91	40%	$11.75	50%	$12.59
Over 30 Ccf	$12.93	10%	$14.22	20%	$15.52	30%	$16.81	40%	$18.10	50%	$19.40
CAP Fee	$0.70	10%	$0.77	20%	$0.84	30%	$0.91	40%	$0.98	50%	$1.05
Conservation Fee	$0.10	10%	$0.11	20%	$0.12	30%	$0.13	40%	$0.14	50%	$0.15

		Option 6		Option 7		Option 8	
Single Family Residential	Current Rate FY 21 & FY 22	5% Differential Rate on Base plus Escalating Tiers (T1-5%, T2-10%, T3-15%, T4-20%)		10% Differential Rate on Base plus Escalating Tiers (T1-10%, T2-20%, T3-30%, T4-40%)		15% Differential Rate on Base plus Escalating Tiers (T1-15%, T2-30%, T3-40%, T4-50%)	
Monthly Base Rate (5/8')	$16.33	5%	$17.15	10%	$17.96	15%	$18.78
1 – 7 Ccf	$2.07	5%	$2.17	10%	$2.28	15%	$2.38
8 – 15 Ccf	$3.82	10%	$4.20	20%	$4.58	30%	$4.97
16 – 30 Ccf	$8.39	15%	$9.65	30%	$10.91	40%	$11.75
Over 30 Ccf	$12.93	20%	$15.52	40%	$18.10	50%	$19.40
CAP Fee	$0.70	5%	$0.74	10%	$0.77	15%	$0.81
Conservation Fee	$0.10	5%	$0.11	10%	$0.11	15%	$0.12

Highlights of Bill Effects – Each of the eight differential rate options would result in some level of bill increase for all customers in the unincorporated County. Options 1-5 would result in a flat, across-the-board increase of all water bill components. Options 6-8 would shift a greater proportion of the rate increase for any given customer toward the higher volumetric rate blocks, potentially increasing the conservation incentive for customers using more than the in-City average of 7 Ccf per month.

The projected effect of each differential rate option upon a sample of SFR customers is shown in the tables below. Table 2a describes the effects of flat-rate differentials (Options 1-5); Table 2b shows the effects of rate differentials with escalating tiers (Options 6-8).

Table 2a. Residential bill examples (Options 1-5)

			Option 1	Option 2	Option 3	Option 4	Option 5
			Flat 10%	*Flat 20%*	*Flat 30%*	*Flat 40%*	*Flat 50%*
Water Bill	# Ccfs	Current					
Low	4	$27.81	$30.59	$33.37	$36.15	$38.93	$41.72
Inside City Average	7	$36.42	$40.06	$43.70	$47.35	$50.99	$54.63
Outside City Average	10	$50.28	$55.31	$60.34	$65.36	$70.39	$75.42
High	45	$417.48	$458.90	$500.62	$542.33	$584.05	$625.77

Table 2b. Residential bill examples (Options 6-8)

			Option 6		Option 7		Option 8	
Water Bill	# Ccfs	Current	*5% Differential Rate on Base plus Escalating Tiers (T1-5%, T2-10%, T3-15%, T4-20%)*	Percentage Increase	*10% Differential Rate on Base plus Escalating Tiers (T1-10%, T2-20%, T3-30%, T4-40%)*	Percentage Increase	*15% Differential Rate on Base plus Escalating Tiers (T1-15%, T2-30%, T3-40%, T4-50%)*	Percentage Increase
Low	4	$27.81	$29.20	5.0%	$30.59	10.0%	$31.98	15.0%
Inside City Average	7	$36.42	$38.24	5.0%	$40.06	10.0%	$41.88	15.0%
Outside City Average	10	$50.28	$53.37	6.1%	$56.45	12.3%	$59.54	18.4%
High	45	$417.18	$481.24	15.4%	$545.31	30.7%	$609.37	46.1%

Financial Considerations – New annual revenues anticipated from the implementation of differential water rates would depend on the rate adjustment applied to customers located in unincorporated Pima County. A summary of revenue estimates based on the rate options presented today to Mayor and Council appears in Table 3.

Table 3. Revenue estimates

	Option 1	Option 2	Option 3	Option 4	Option 5
	Flat 10%	*Flat 20%*	*Flat 30%*	*Flat 40%*	*Flat 50%*
Est. Revenues:	$6,340,000	$12,690,000	$19,030,000	$26,520,000	$34,010,000

	Option 6	Option 7	Option 8
	5% Differential Rate + Escalating Tiers	*10% Differential Rate + Escalating Tiers*	*15% Differential Rate + Escalating Tiers*
Est. Revenues:	$4,960,000	$9,910,000	$14,030,00

The use of any new funds generated by the implementation of a differential rate structure would be determined by Mayor & Council. Regardless of their position on differential rates, Tucson Water stakeholders have expressed the opinion that if such rates are implemented, the funds should remain with the utility for water-related infrastructure. Based on stakeholder interactions to date, a common theme of interest is to build utility resiliency. Initial staff recommendations for the uses of differential rate revenue include:

- Keep revenues with the utility: This practice is consistent with peer Arizona utilities that charge a differential rate.
- Allocate 50% to **Infrastructure Resiliency**: Fund water system capital projects in the unincorporated areas, where there is sufficient need. This includes infrastructure rehabilitation and replacement and improving service levels.
- Allocate 25% to **Financial Resiliency**: Fund the system-wide low-income and customer assistance programs and/or pay down utility debt.
- Allocate 25% to **Climate Resiliency**: Fund additional Green Stormwater Infrastructure (on top of GSI Fee) and fund a "Tree-bate" program to support Tucson Million Trees. This would support regional equity, as the current GSI Fee is only assessed inside the City.

Rate Change Implementation – Any new rate structure adopted by the Mayor and Council following tonight's public hearing will become effective on or after July 12, 2021.

Legal Considerations – The stakeholder outreach process conducted to date by Tucson Water has elicited questions and concerns about the legal basis for a differential rate structure. Differential water rates are allowed by Arizona law, provided that the rates are based upon a rational relationship to the services provided. The practice is commonplace among Arizona towns and cities that operate water utilities serving customers outside of their jurisdiction.
Tucson Water is not the sole regional water provider, and its water service obligations outside the City's jurisdiction are limited to contracts and infill. In a December 10, 2007, memo to Tucson Water (see Attachment G), the City Attorney's Office indicated that "the City is not a public service corporation, and has no obligation to provide persons in unincorporated areas with water, and need not treat new and existing customers in those areas under the same policies."

Additionally, the City's CAP Subcontract does not obligate Tucson Water to provide service to specific areas outside of the City's jurisdiction. As noted in a December 11, 2007, memo to Tucson Water (see Attachment H), the Department's legal counsel established that the City's CAP Subcontract and the CAP allocation process do not obligate the City to provide water service to any particular area within the City's 50-year service area filed with the Central Arizona Water Conservation District.

Furthermore, the establishment of a differential rate structure would not violate existing Intergovernmental Agreements (IGAs) between the City and County. The 1979 City-County IGA specifically obligates the County to provide wastewater services within the City, but does not require the City to provide water service to all County customers.

The Governing Body has conformed to the requirements of State law in adopting the Notice of Intention to increase rates, filing supporting materials with the City Clerk for public review, posting notice of proposed rates on the City's website, and scheduling and advertising today's public hearing. Rather than attach 8 separate ordinances for each different option, the City Attorney has attached the Ordinance, which includes the amendments to the Tucson Code that would occur if the Mayor and Council choose to implement Option 5, the 50% flat option. In the event that the Mayor and Council choose a different option, the Ordinance will be revised to incorporate the fee tables associated with that option (as provided in Attachment A).

Consistency with Plan Tucson – The proposed differential rate schedules are consistent with the voter approved goals outlined in Plan Tucson related to the Social Environment policies associated with Governance & Participation (G1-12); the Natural Environment policies associated with Energy & Climate Readiness (including EC8-9), Green Infrastructure (including GI1-6), and Water Resources (including WR1-11); and the Built Environment policies associated with Public Infrastructure, Facilities, & Cost of Development (including PI1-2 & 5-6).

Respectfully submitted,

Timothy M. Thomure, PE, ENV SP
Interim Assistant City Manager

TT/kl
John Kmiec, Interim Director, Tucson Water

Attachments:
Attachment A: Schedule of FY 21-22 Differential Rate Options
Attachment B: CWAC Memorandum dated May 30, 2021
Attachment C: FY 21-22 Rates Presentation to CWAC dated May 2021
Attachment D: County Administrator Memorandum to CWAC dated February 22, 2021
Attachment E: County Administrator Memorandum to CWAC dated May 17, 2021
Attachment F: Summary of Public Survey Results
Attachment G: TW Memorandum re: Obligated Service Area dated December 10, 2007
Attachment H: TW Memorandum re: CAP Subcontract Obligations dated December 11, 2007
Attachment I: CWAC Memorandum dated June 2, 2021
Ordinance

JUN08-21-174

cwac

Citizens' Water Advisory Committee
City of Tucson
P.O.Box 27210
Tucson, AZ 85726-7210

DATE: June 2, 2021

TO: Honorable Mayor and Council Members

FROM: Mark Taylor
Citizens' Water Advisory
Committee Chair

FROM: Alison Jones
Citizens' Water Advisory
Committee Chair

SUBJECT: Citizens' Water Advisory Committee (CWAC) Deferment Recommendation

CWAC recommends deferring a decision on differential water rates until at least the Fall of 2021 to allow time for further analysis, discussion, and public participation about the details of any options that are being considered by the Mayor and Council. CWAC takes its responsibility regarding providing advice to Mayor and Council on water rates very seriously. In the past, increasing water rates has been proposed to address a specific need. In this case, it is not clear to CWAC what need Mayor and Council wish to address. Initially, we understood that it was to encourage annexation, thereby increasing state-shared revenues. Later it was stated during a study session that annexation was not the reason for promoting differential rates. All members of CWAC feel strongly that any additional revenues generated by differential rates, if adopted, should stay within the utility. We still do not know how Mayor and Council plan to use the additional revenues. We encourage Mayor and Council to be more definitive for their reason(s) for differential rates and how those additional revenues will be used now and in the future.

CWAC is concerned about the impact of differential rates on low-income families in unincorporated Pima County. CWAC supports investigating potential solutions regarding the impacts to low income users. In addition, whether or not differential rates are imposed, CWAC supports simplifying and reducing the barriers to enrolling in the Low Income Assistance Program which is critical to so many families in the City of Tucson and in Pima County.

Finally, it is worth pointing out that members of CWAC are volunteers who have expertise in hydrogeology, engineering, water rights, finance, real estate, and other disciplines. Some of them have served on the committee for a long period of time. The committee was dismayed that Vice Mayor Cunningham addressed CWAC in a very disrespectful manner during our June 2 meeting. We have always managed to have a civil discourse in our meetings as we discuss the demands and challenges of one of the best water utilities in the State of Arizona. Volunteerism is a noble and unselfish act, worthy of at least a modicum of respect.

Attachment I

The CWAC committee appreciates the opportunity to provide its perspectives regarding these important issues affecting Tucson Water Customers.

Respectfully submitted,

Citizens Water Advisory Committee

Cc:
Timothy Thomure, Interim Assistant City Manager
John Kmiec, Interim Director, City of Tucson Water
Silvia Amparano, Deputy Director, City of Tucson Water
Christopher Avery, City Attorney

MEMORANDUM

TO:	David Modeer, Director Tucson Water
COPY TO:	Dennis Rule Chris Avery
FROM:	Marvin S. Cohen
DATE:	December 11, 2007
CLIENT/MATTER:	TU010 - 00503
SUBJECT:	Whether City of Tucson's CAP Subcontract Creates an Obligation to Serve

The following memorandum analyzes the development of the City of Tucson ("Tucson" or "City") allocation of Central Arizona Project ("CAP") water, Tucson's participation in the allocation process, and the basis for the final CAP allocation to the City. This memorandum also analyzes whether the Secretary's CAP allocation to Tucson and the consequent CAP subcontract ("Subcontract") created any specific obligation to serve specific lands. Also analyzed is whether any landowner, customer or potential customer can claim third party beneficiary rights under the City's CAP subcontract.

City of Tucson CAP Allocation Does Not Create Obligation to Serve

On January 10, 1983, Secretary of the Interior James Watt signed a record of decision that allocated CAP water to Arizona entities. Tucson received an allocation of 151,064 acre-feet. As explained below, this was subsequently reduced to 148,420 acre-feet. Nothing in the record of decision obligates Tucson to serve water to any specific lands. A copy of the record of decision is Exhibit 1 hereto. Tucson's Subcontract was entered into among the City, the Central Arizona Water Conservation District ("CAWCD") and the United States on November 28, 1988. Nothing in the Subcontract obligates Tucson to serve any specific lands. A copy of the Subcontract is Exhibit 2 hereto.

History of CAP Allocation

Throughout much of the 1970's and extending into the early 1980's, the Arizona Interstate Stream Commission and its successor agency, the Arizona Department of Water Resources ("ADWR"), were charged with developing recommendations for the allocation of Central Arizona Project water among various potential water users. In 1977, the Arizona Water Commission made an initial recommendation for an allocation of 97,800 acre-feet to Tucson. After a series of subsequent back-and-forth recommendations by the Department of Interior and the State of Arizona concerning

allocations among the Indian and non-Indian interests, ADWR transmitted its final recommendation for non-Indian M&I allocations to the Secretary of the Interior on January 18, 1982.

The ADWR allocation recommendations were intended to meet Central Arizona's M&I water needs in the year 2034. The projected water demand was predicated on the 1980 Department of Economic Security ("DES") population projections for 2034. The recommendations were generally based on an "equal per capita basis," derived from "anticipated population times a uniform per capita use rate minus all dependable water supplies otherwise available to the applicant." [1]

Tucson had applied for an allocation based on a projected 50 year CAP water service area covering most of eastern Pima County.[2] The 1980 DES population projection for eastern Pima County in 2034 was 1.19 million people with a base water requirement of nearly 240,000 acre-feet.[3] The 1980 projection did not disaggregate the anticipated population by geographic location within eastern Pima County. ADWR's recommended allocation was initially predicated on this population projection. However, the overall water requirement for all M&I applicants was reduced by approximately 21%, due to a lack of sufficient CAP water to meet all M&I requirements within the CAP service area.[4] This reduction resulted in a prorated 2034 water requirement for Tucson of 187,180 acre-feet. However, Tucson's recommended allocation was further reduced by 36,116 acre-feet of "otherwise available supply", resulting in a recommended allocation of 151,064 acre-feet.[5]

Finally, in July of 1984, Tucson's CAP allocation was reduced by another 2,644 acre-feet on the presumption that Ranchlands Water Company would serve approximately 30,000 people originally assumed to be within Tucson's water service area. This reduction was based on a proportionate distribution of Tucson's recommended allocation, but the calculations were based on new projections for a 2034 regional population of 1.59 million people rather than the original projection of 1.19 million.[6]

At the conclusion of these actions over the course of several years, the City of Tucson received a CAP subcontract for 148,420 acre-feet, a volume of water substantially unrelated to Tucson's originally projected 2034 service area population of 1.19 million people with a base water need of 240,000 acre-feet.

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[1] Letter of January 18, 1982 from Wes Steiner to James Watt attached as Exhibit 3.

[2] A copy of the submission of Tucson CAP service area map to the CAWCD by T.J. Harrison, assistant city attorney, on February 6, 1985 is attached hereto as Exhibit 4.

[3] The ADWR projections for 2034 water requirements assumed a use rate of 180 gallons per capita per day, resulting in a calculated annual water requirement for Tucson of 239,938 acre-feet.

[4] Due to previous allocations to Indian tribes, the total amount of CAP water available for all non-Indian M&I applicants was limited to 640,000 acre-feet. The reductions to the calculated base needs were done uniformly by proration except in situations where the application requested less water than the computed base need. Letter of January 18, 1982, at 6.

[5] ADWR has never explained the origin of this "otherwise available supply", but it appears to have been a calculation or methodology used to match the ADWR recommended allocation with Tucson's request for 151,064 acre-feet of allocation.

[6] Letter of July 9, 1984 from Wesley A. Steiner, Director, ADWR to N.W. Bill Plumer, Regional Director, Lower Colorado River Region, Bureau of Reclamation, attached hereto as Exhibit 5.

At this same time, a few water providers within the City's projected 50-year service area applied for and received their own CAP allocations, as follows:

Flowing Wells Irrigation District	4,354 a.f.
Ranch Lands Water Co.	3,037 a.f.
Canada Hills Water Co.*	1,652 a.f.
Midvale Farms Water Co.	1,500 a.f.
Del Lago Water Co.	786 a.f.
New Pueblo Water Co.	237 a.f.
Cortaro Marana Irrigation District	47 a.f.
TOTAL	11,613 a.f.

Tucson's CAP Subcontract

When Tucson entered into the Subcontract for 148,420 acre-feet, it was assumed that those water purveyors within the City's 50-year projected CAP service area which had not received their own CAP allocations would enter into wholesale water delivery agreements with the City. For those purveyors which did receive their own CAP allocations, it was assumed the City would enter into treat-and-wheel agreements.

Beginning in late 1989 as the CAP canal to Tucson was being completed, discussions were held between Tucson Water and other M&I water providers in the region to develop principles for wholesale water delivery and treat-and-wheel agreements. At that time, Tucson Water staff analyzed, by geographic area, the population projections upon which the City's 1982 CAP allocation was established. Since the original 1980 population projections had not been geographically disaggregated across the projected service area, the 1982 PAG projections were utilized as the most relevant available source of disaggregated data. These projections predicted a 2035 Tucson Water service area population of nearly 1.7 million people, as compared to the 1980 projections of only 1.19 million in 2034.

The 1982 PAG projections were disaggregated by staff over the private water company service areas, adjusted to accord with the total 1980 projection, and a portion of the City's CAP allocation attributable to each service area was estimated. According to these estimates, a total of 16,141 acre-feet of the CAP water allocated to the City was based on population projections for the service areas of other water purveyors within the City's projected 50-year service area.

The discussions between Tucson Water and other water providers in the region did not result in any wholesale water delivery or treat-and-wheel agreements. Most of the other water providers viewed Tucson Water's proposed wholesale water rates as excessive, particularly in comparison to their own cost of pumping groundwater. The majority of the private water companies in the Tucson region, including those within the Town boundaries, chose simply to forego the use of renewable water supplies in favor of continuing to pump mined groundwater.

* Canada Hills Water Co. acquired its own CAP allocation after entering into the Northwest Area Agreement. It was assumed the City would provide treatment and delivery capacity for this water.

The only water providers that remained in a wholesale relationship with Tucson Water were the parties to the 1979 Northwest Area Agreements. These were private water companies that were subsequently acquired by the Metropolitan Domestic Water Improvement District ("MDWID") and the town of Oro Valley ("Oro Valley").[8] In the late 1990's, after extensive litigation, settlements were reached between the City and MDWID and between the City and Oro Valley under the Northwest Area Agreements were terminated, MDWID and Oro Valley agreed to pay substantial amounts of money to the City ($12.3 million and $5.4 million respectively), and the City transferred portions of its CAP allocation to MDWID (9,500 acre-feet) and to Oro Valley (4,400 acre-feet).

In 1994, the Arizona Department of Water Resources ("ADWR") invited municipal water users to apply for allocation of the M&I CAP water that had not been contracted after the 1982 Secretarial allocation—65,647 acre-feet. The City applied for 36,116 acre feet, the amount by which its initial allocation was reduced as "otherwise available supply," and received an allocation of 8,206 acre-feet. Tucson also acquired a small CAP allocation from Midvale Farms Water Company, in the amount of 1,500 acre-feet. As a result of these transactions, Tucson's current CAP entitlement is 144,172 acre-feet.

Delineation of a CAP Service Area Did Not Create Any Obligation to Serve

In connection with the CAP allocation process and to comply with the terms of its Subcontract, Tucson delineated a 50 year CAP service area. This area provided the maximum geographic territory that might be served in the future by Tucson during the ensuing 50 year period so that water demand projections could be made based on population projection for that area. The population projection for 2034 on which the CAP allocation was made was 1.19 million people within the 50 year CAP service area. The most recent estimate of the population of eastern Pima County in 2006 is over 900,000. Tucson Water is already serving more than 720,000 people. There is no doubt that the population in 2034 within Tucson Water's current actual service area, 27 years from now, will be substantially in excess of 1.19 million.

The terms of the Subcontract that refer to the City's CAP service area only for the purpose of limiting the City's use of groundwater outside the boundaries of that service area. They do not obligate the City of Tucson to provide water service to any applicant for water service within the City's CAP service area.[9] Section 4.3(c) of the Subcontract refers to the Subcontractor's service area as delineated on a map filed with CAWCD, but this reference is only for purposed of limiting the City's pumping of groundwater within the service area for use outside the service area. Section 4.5(b) refers to construction of the connection facilities required to take and convey water from the CAP turnout to the Subcontractor's service area. There are no other references in the Subcontract to the Subcontractor's service area. Nothing in the Subcontract obligates the City to provide water service to any particular territory.

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[8] Neither the Town of Marana nor any of the private water companies in Marana were parties to the Northwest Area Agreements.

[9] The City's CAP service area is the area shown on the map filed with the CAWCD for purposes of compliance with the Subcontract. It is different from the City's Department of Water Resources service area.

CAP Customers or Potential Customers Are Not Third Party Beneficiaries to the Subcontract

Only parties and third party beneficiaries, if any, may assert rights under the Subcontract. The only parties to the Subcontract are Tucson, the CAWCD and the United States. The courts in the West have grappled with the issue of whether customers of a Bureau of Reclamation contractor or subcontractor have any third party beneficiary rights or standing. The issue has arisen in the context of Reclamation contracts with agricultural districts in California. There farmers in an agricultural district claimed third party beneficiary rights under a Reclamation contract between the district and the United States.

Customers of a reclamation contractor were held by the Ninth Circuit Court of Appeals not to be third-party beneficiaries of the reclamation contract. Parties that benefit from a government contract are generally assumed to be incidental beneficiaries unless the contract evidences a clear intent to the contrary. *Klamath Water Users Protective Ass'n v. Patterson*, 204 F.3d 1206(9th Cir. 2000) (holding that water users were not intended beneficiaries of a reclamation contract); *Orff v. United States*, 358 F.3d 1137, 1145-47 (9thCir.), affirmed on other grounds 125 S. Ct. 2606 (2005). The court held that the reclamation contracts did not evidence a clear intent to create third party beneficiaries.

The thirty page Subcontract between the City, the United States, and CAWCD are almost entirely silent about the customers or landowners who might be served water by the City. Nothing in the Subcontract expressly or implicitly indicates that the landowners, customers or potential customers within the City's service area were to have intended-beneficiary status. In 2005, the Arizona Supreme Court considered whether landowners in agricultural districts with CAP subcontracts were third party beneficiaries of those subcontracts and opined that they were not. *Maricopa-Stanfield Irrigation & Drainage District v. Robertson*, 211 Ariz. 485, 123 P3d 1122 (2005). Customers or potential customers of M&I CAP subcontractors would have even less basis for claiming third party beneficiary status than the landowners in those agricultural districts. Quite clearly, customers or potential customers of Tucson Water would have no third party beneficiary rights or standing under Tucson's Subcontract.

Summary

In sum, the City's CAP Subcontract and the CAP allocation process provide no basis for a claim that the City is obligated to provide water service to any particular territory within the 50 year CAP service area filed with the CAWCD.

Differential Rates Survey Results (as of May 27, 2021)

May 27, 2021, 8:20 AM

Contents

Differential Rates Survey Results (as of May 27, 2021)

What is your position on the proposal to increase water rates to Tucson Water customers in unincorporated Pima County?

Summary Of Responses

As of May 27, 2021, 8:20 AM, this forum had:	
Attendees:	2379
Responses:	1551
Hours of Public Comment:	77.6

Topic Start
April 11, 2021, 9:33 PM

QUESTION 1

How would you rate your level of support or opposition to the proposal to increase water rates to Tucson Water customers in unincorporated Pima County?

	%	Count
Very Opposed	81.0%	1257
Somewhat Opposed	6.7%	104
Neutral	1.0%	15
Somewhat Supportive	2.5%	39
Very Supportive	7.3%	113
I don't have enough information to decide.	1.5%	23

QUESTION 2

If the rates are increased, how would you prioritize the use of additional revenues by Tucson Water? Place the following items in order of priority:

1. Fund infrastructure rehabilitation and replacement, and improve service levels in unincorporated areas.
2. Fund additional green stormwater infrastructure throughout the Tucson Water service area
3. Pay down utility debt .
4. Other
5. Fund low-income assistance program offered to all Tucson Water customers .
6. Fund a "Tree-bate" program to provide rebates to customers who purchase and plant desert-adapted trees

7. Increase funding for Tucson Water's low-income rainwater harvesting program
8. Cancel existing water delinquency debt for families enrolled in Tucson Water's low-income program

QUESTION 3

If you selected "Other" as one of your top 3 priorities please, indicate what you would prioritize with the additional funds.

Answered	405
Skipped	1,146

QUESTION 4

Do you have any additional comments?

Answered	838
Skipped	713

QUESTION 5

Do you (check all that apply)

	%	Count
Live in the greater Tucson area	74.9%	1158
Live in the City of Tucson	14.6%	226
Work in Tucson	37.7%	583
Visit Tucson	18.6%	287
Own property in Tucson	41.3%	639
Own a business in Tucson	9.4%	145
Rent in Tucson	3.3%	51

What is your position on the proposal to increase water rates to Tucson Water customers in unincorporated Pima County?

	%	Count
Go to school in Tucson	5.6%	87
Serve on City Council, Board, Commission, or city staff	1.0%	15
Other	10.1%	157

QUESTION 6

What is your age?

	%	Count
15-19	0.2%	3
20-24	0.5%	7
25-34	6.6%	102
35-44	18.2%	281
45-54	16.5%	255
55-59	10.9%	169
60-64	10.8%	167
65-74	28.0%	433
75-84	7.8%	121
85 and over	0.6%	9

QUESTION 7

With which racial and ethnic group do you identify? (select all that apply)

Differential Rates Survey Results (as of May 27, 2021)

What is your position on the proposal to increase water rates to Tucson Water customers in unincorporated Pima County?

		%	Count
American Indian or Alaska Native		1.2%	19
Asian or Asian American		2.3%	35
Black or African American		1.2%	19
Hispanic, Latino or Spanish origin		8.7%	135
Native Hawaiian or Other Pacific Islander		0.6%	9
White or Caucasian		60.4%	935
Other		6.1%	94
Prefer not to disclose		25.1%	388

QUESTION 8

How do you describe your gender identity?

		%	Count
Female		45.8%	709
Male		35.1%	543
Non-binary		0.6%	9
Genderqueer		0.2%	3
Other		2.8%	43
Prefer not to disclose		15.5%	240

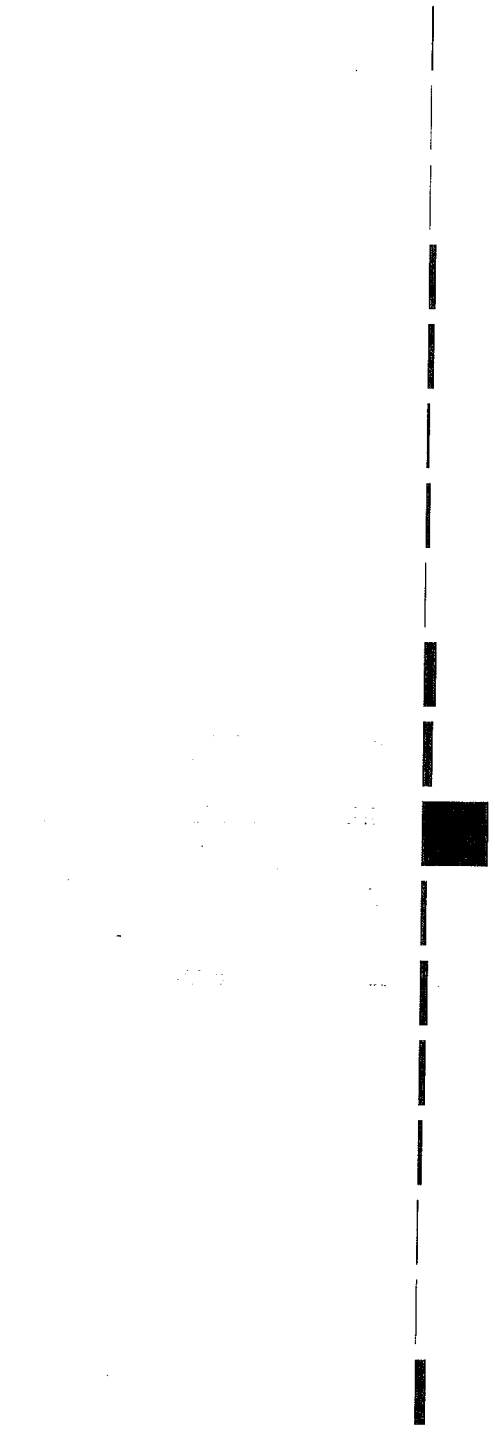
QUESTION 9

What is your zip or postal code?

	%	Count
85321	0.1%	2
85341	0.3%	4
85602	0.1%	1
85611	0.2%	3
85614	0.6%	9
85619	0.1%	2
85622	0.3%	4
85629	0.1%	1
85633	0.1%	1
85637	0.1%	1
85641	6.3%	98
85645	0.2%	3
85653	1.6%	25
85658	0.5%	8
85701	0.8%	13
85704	3.7%	57
85705	1.7%	27

Differential Rates Survey Results (as of May 27, 2021)

What is your position on the proposal to increase water rates to Tucson Water customers in unincorporated Pima County?



	%	Count
85706	0.3%	5
85707	0.1%	1
85708	0.1%	1
85710	1.7%	27
85711	1.6%	24
85712	0.6%	10
85713	1.1%	17
85714	0.1%	2
85715	3.1%	48
85716	2.5%	38
85718	17.2%	266
85719	1.4%	21
85730	2.0%	31
85735	1.6%	25
85736	1.1%	17
85737	0.3%	4
85739	0.1%	2
85741	2.7%	42

Differential Rates Survey Results (as of May 27, 2021)

What is your position on the proposal to increase water rates to Tucson Water customers in unincorporated Pima County?

	%	Count
85742	3.2%	50
85743	2.7%	41
85745	6.1%	94
85746	2.0%	31
85747	1.2%	18
85748	1.7%	27
85749	12.2%	188
85750	13.5%	209
85755	0.3%	4
85756	0.8%	13
85757	1.4%	21
Other	0.8%	12

QUESTION 10

What is the highest degree or level of school that you have completed?

	%	Count
Less than high school	0.2%	3
High school or GED	2.1%	33
Trade School/Certification Program	2.3%	36

Differential Rates Survey Results (as of May 27, 2021)

What is your position on the proposal to increase water rates to Tucson Water customers in unincorporated Pima County?

		%	Count
Some college, no degree		10.9%	169
Associate degree		6.3%	97
Bachelor's degree		30.3%	469
Advanced degree beyond a bachelor's degree		40.2%	622
Prefer not to say		7.6%	118

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(520) 724-8661 FAX (520) 724-8171

C.H. HUCKELBERRY
County Administrator

May 17, 2021

Citizens' Water Advisory Committee
c/o Tucson Water Intergovernmental Coordination
Delivered via Email to: Jessica.Rodriguez@tucsonaz.gov

Re: **Differential Water Rates Proposed by the City of Tucson**

I understand you have received a supplemental presentation from City staff on this issue. The County would like to provide our response for consideration. (Enclosure)

We remain concerned about the proposal as there is no cost of service foundation for charging a differential water rate to the same class of customer. In addition, the proposal raises concerns of equity and will not foster sustainable or conservation practices related to our water supply.

Sincerely,

C.H. Huckelberry
County Administrator

Enclosure

c: Jan Lesher, Chief Deputy County Administrator
Carmine DeBonis, Jr., Deputy County Administrator for Public Works
Yves Khawam, PhD, Assistant County Administrator for Public Works

MEMORANDUM

Date: May 10, 2021

To: The Honorable Chair and Members
Pima County Board of Supervisors

From: C.H. Huckelberry
County Administrator

Re: **City of Tucson Water Policy Related to Differential Water Rates**

As you are aware, the City of Tucson continues to pursue a higher differential water rate for unincorporated County customers despite an overwhelming recommendation not to do so from the City of Tucson Citizen's Water Advisory Committee. I provided information responding to City staff justifications for a differential rate to Supervisor Rex Scott, which he attached to Board of Supervisors Resolution 2021-9 affirming support for jurisdictional rate parity for Tucson Water customers, adopted on April 6, 2021.

In efforts to further justify a differential rate, City of Tucson staff has introduced additional points through a presentation delivered to the Citizen's Water Advisory Committee on May 5, 2021 (Attachment 1). I would like to take the opportunity to further inform the Board on the points raised in that presentation.

1. Differential Infrastructure Use

City staff has indicated that unincorporated County customers comprise 29 percent of Tucson Water customers and that these 29 percent utilize 36 percent of Tucson Water assets based on pipe measurements. It is unclear whether this measure included renewable water assets mostly located in the unincorporated area serving all City residents. Regardless, it is not a substitute for a cost of service study and the City is yet to demonstrate that it is more costly to serve unincorporated areas.

Additionally, Tucson Water states that unincorporated County customers use 43 percent more water than City customers. Since Tucson water has a tiered rate structure based on consumption, the average County customer is generating substantially more revenue than the average City customer (much more than the 43 percent increased consumption), thereby significantly subsidizing City customers at the current rate structure despite geographic distribution of water assets.

Furthermore, the City staff position regarding geographic distribution of infrastructure and customers is disingenuous in that most of the Tucson Water well pumping and recharge facilities are located in the unincorporated areas. The attached Tucson Water exhibit depicts well fields serving Tucson Water customers (Attachment 2). Interestingly, only two of the

six well fields are entirely contained within the City. Tucson Water is acting as though it has exclusive ownership and management of the Tucson Active Management Area by withdrawing water from the unincorporated areas to serve City customers all while proposing to penalize those customers located in the geographic area of water withdrawal through differential rate increases.

2. Differential Resource Use

City staff has indicated that 32 percent of unincorporated County customers are on septic systems compared to 5 percent of City customers. This is primarily due to many rural areas and communities served by Tucson Water not having access to regional wastewater collection infrastructure. However, reclaimed water is not used as a potable source by the City which instead primarily uses it for landscape irrigation and recharge. Septic systems achieve the same goal at much lower cost since effluent from these systems do not need to be reclaimed and redistributed. Instead it infiltrates directly into the ground, either reaching the aquifer (recharge) or is available for tree root irrigation and reduction of heat island effect through evapotranspiration. Due to the large reduction in energy needed for on-site recharge and irrigation, it can be argued that septic systems can be as environmentally sustainable as centralized treatment and redistribution systems. This is substantiated by the U.S. Environmental Protection Agency promotion of benefits on their septic systems overview web page:

- ***Public health benefits*** *- Proper use of decentralized systems reduces the risk of disease transmission and human exposure to pathogens, which can occur through drinking water, surface water, and shellfish bed contamination.*
- ***Environmental benefits*** *- Wastewater treatment removes pollution from surface water, recharges groundwater, and replenishes aquifers.*
- ***Economic benefits*** *- Decentralized wastewater systems help communities reduce large infrastructure and energy costs to collect and treat wastewater.*

No perceived penalty should therefore be directed toward water users with septic systems. Similarly, no penalty should be applied to City regulation and rebates regarding diverting grey water to irrigation.

City staff further points to water resources retained by Pima County produced at the Corona de Tucson and Avra Valley water reclamation facilities. Indeed the County retains this effluent since it is legally entitled to do so as substantiated by the Arizona Supreme Court ruling that the utility treating the wastewater controls the resulting effluent (Arizona Public Service Co. v. Long, 1989). The County bears the entire regulatory burden and financial cost of producing reclaimed water. The fact that the County granted the City rights over 90 percent of the effluent produced by the metropolitan water reclamation facilities via the 1979 City-County Agreement constitutes a gift to the City not borne out by case law, and which would be subject to reconsideration should the 1979 Agreement be placed into question.

3. Differential Conservation Results

City staff has indicated that customers in the unincorporated County use 43 percent more water on average than City customers. As demonstrated above, this additional consumption results in unincorporated customers subsidizing Tucson Water infrastructure and operations for City residents. Additionally, and as noted by the City Citizen's Water Advisory Committee, water use is complex and influenced by a number of factors including multi-family units which have much lower consumption and are more prevalent in the City.

While water conservation is a regional aspiration, utility incentives/disincentives to promote conservation should be applied regardless of geographic distribution. There are environmentally-minded extremely low water users in the unincorporated areas just as there are extreme water users in the City. An equitable sustainable water use policy should target consumption of each user and not geographically discriminate based on geographic location. The Tucson Water tiered rate structure is a good example of one method already in place that supports a sustainable water use policy.

4. Equity and Precedent

City staff continues to claim that differential rates would address alleged inequities, that City is extending a City service to non-City residents with no return-on-investment, and that the region loses $40-$50 million in state-shared revenues due to unincorporated County population.

I believe that I have adequately addressed the latter issue of state-shared revenues and the large cost of annexation in my April 30, 2021 communication to you. As to the former, it has already been noted that unincorporated customers are subsidizing City customers at the current rates and despite Tucson Water groundwater withdrawals occurring primarily in the unincorporated areas. However, even more importantly is that the City selected to provide this large number of unincorporated customers with water service at a time when the City was operating as a regional provider. Had the City not provided water to these areas, property owners would have looked to other providers, such as the Metropolitan Domestic Water Improvement District (Metro Water) to establish service.

It is especially noteworthy that should these unincorporated areas have incorporated into Metro Water service, they would be paying lower water rates than currently paid to Tucson Water. Indeed, the current average Metro monthly bill, inclusive of miscellaneous changes, taxes and fees is $50.94 per month compared to $52.06 per month for Tucson Water users. The City has voluntarily extended service to serve the unincorporated areas and now hold these customers hostage without political recourse, by seemingly punishing them for having accepted water from the City. Had they not been provided City water, they would have secured water at lower cost in addition to not facing what could be construed as extortion under the guise of equity.

5. Obligation to Serve and City-County IGAs

It is agreed that the City has no legal obligation to serve outside City boundaries, has no legal obligation to extend service to those areas included in original Central Arizona Project (CAP) application and that a differential rate would not violate the 1979 City-County Agreement. However, what is at issue is the City's past intentions demonstrated through its actions whereby it extended service far beyond City limits and included representations as a regional water provider in its CAP water allocation application and the 1979 City-County Agreement to justify reclaimed water allocations.

Had the City not presented itself as the principal regional water provider in 1979, it would not have been able to claim control over the Santa Cruz River Basin and adjacent basins. This would have resulted in a City allocation reduction of both CAP and County effluent of at least 29 percent, as these unincorporated areas would have secured water through other providers who would have directly claimed these allocations. Furthermore, the City allocation reduction of both these renewable resources would have been much larger than 29 percent as the City is receiving a disproportionately large share of CAP and effluent allocations based on prior representations made as a regional water provider. The City receives 74 percent of regional effluent and 79 percent of regional CAP allocations to serve only 65 percent of the area population.

The 2000 City-County Agreement forced the City to reassign some of its County effluent allocation to other regional water providers including Metro Water, Marana and Oro Valley, based on the original premise that the water provider controls the effluent as conceded by the County in the 1979 City-County Agreement. However, based on the Arizona Supreme Court decision, we now know that original premise is contrary to law, resulting in County effluent being gifted to the City and other water providers.

In summary, it is unfortunate that the City staff are recommending a differential water rate policy to the Mayor and Council that is not borne out by the facts and that will create large inequities without apparent recourse to affected unincorporated County customers. I suggest the forthcoming City Equity Office could provide some insight into this context.

CHH/anc

Attachments

c: Jan Lesher, Chief Deputy County Administrator
Carmine DeBonis, Jr., Deputy County Administrator for Public Works
Yves Khawam, PhD, Assistant County Administrator for Public Works
Jackson Jenkins, Director, Regional Wastewater Reclamation
Kathy Chavez, Water Policy Manager

ATTACHMENT 1

TUCSON WATER

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Fiscal Year 21-22 Water Rates

Timothy Thomure, PE

Interim Assistant City Manager

AGENDA

- Overview
- Policy Considerations
  - Infrastructure Differential
  - Water Resources Differential
  - Water Conservation Differential
  - Equity and Precedent
- Stakeholder Comments
- Differential Rate Options
- Bill Impacts
- Q&A

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Overview of Water Rates for FY 21-22

- Notice of Intent adopted April 6, 2021
- Public Hearing June 8, 2021
- No general rate increase (second consecutive year)
- No reclaimed rate increase (second consecutive year)
- No rate increase to Tucson Water customers located in other jurisdictions (Marana, Oro Valley, South Tucson, Pascua Yaqui)
- Proposed rate increase for unincorporated areas (aka Differential Rate)

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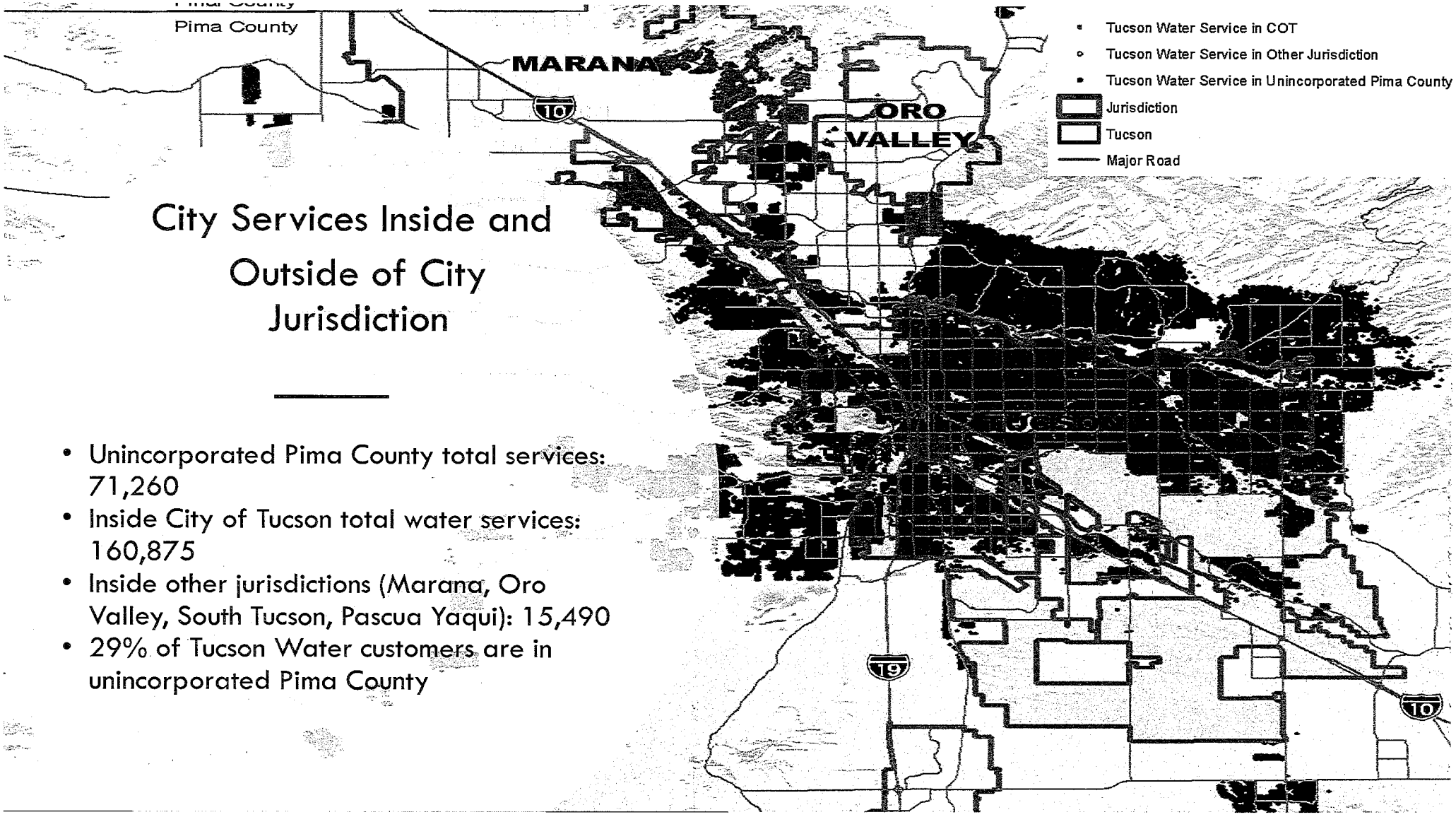
City Services Inside and Outside of City Jurisdiction

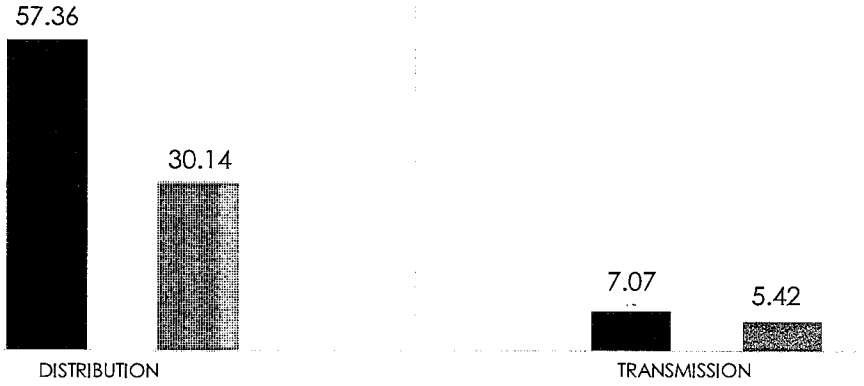
- Unincorporated Pima County total services: 71,260
- Inside City of Tucson total water services: 160,875
- Inside other jurisdictions (Marana, Oro Valley, South Tucson, Pascua Yaqui): 15,490
- 29% of Tucson Water customers are in unincorporated Pima County



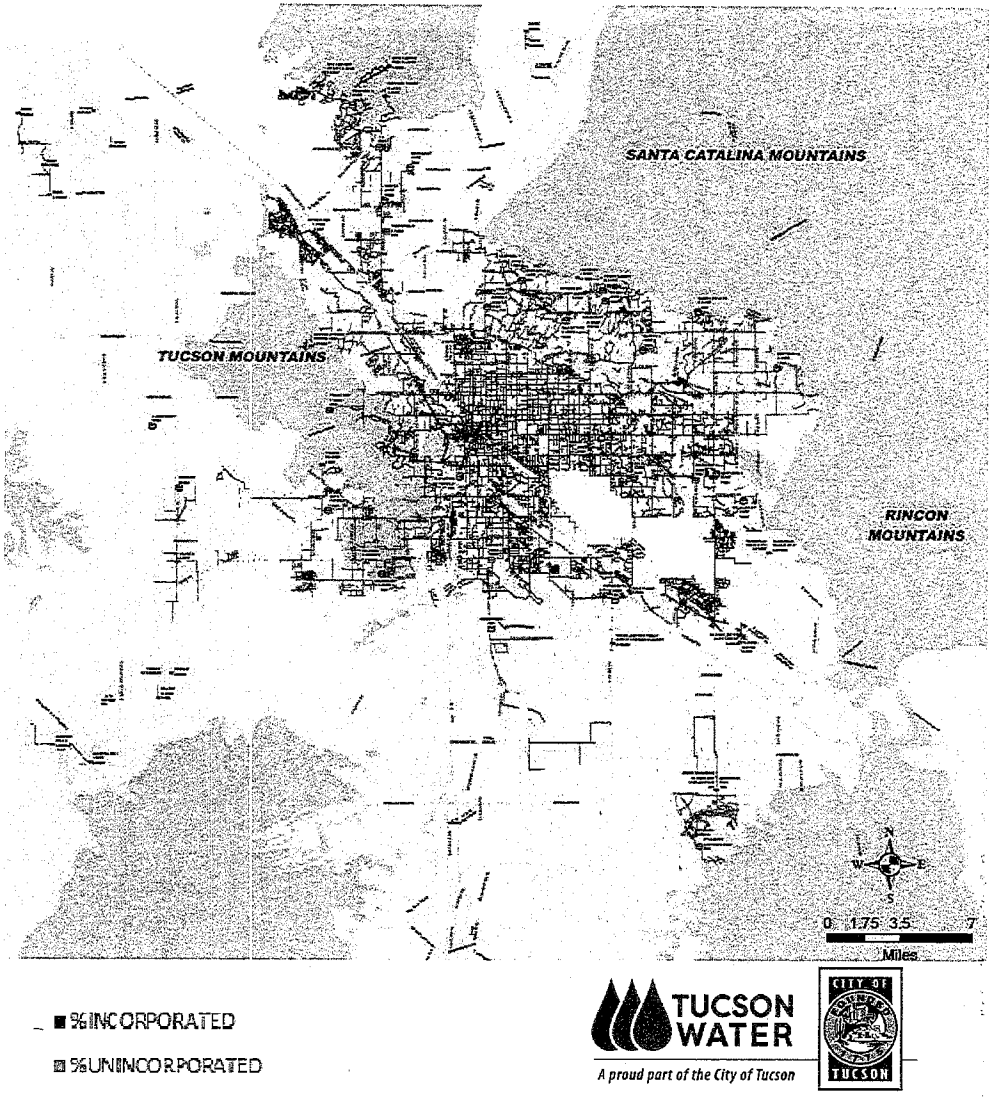
Differential Infrastructure Use

29% of Tucson Water customers (County) utilize 36% of the assets*

Row Labels	%INCORPORATED	%UNINCORPORATED	%COMBINED
DISTRIBUTION	57.36%	30.14%	87.50%
TRANSMISSION	7.07%	5.42%	12.50%
%COMBINED	64.44%	35.56%	100.00%

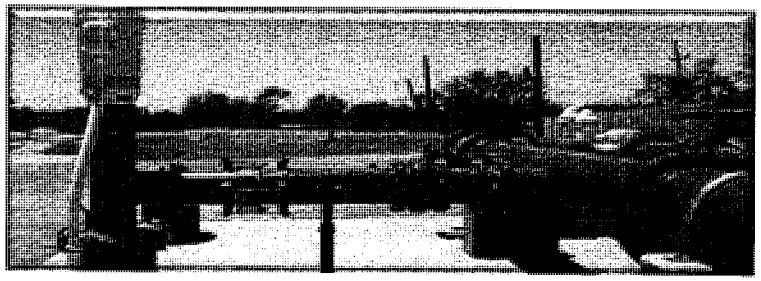


*Measured by pipes, the largest asset. Excludes renewable water assets that serve all customers.



Differential Resource Use

City's water resources are only "one-time use" in County growth areas



Water resources lost to septic systems

- 32% of County customers (5% of City customers) are not connected to a sewer system. The water delivered by the City is used only once.

Water resources retained by Pima County

- Unlike for City customers, the reclaimed water for many County customers is not returned to the City as a resource. It is retained by the County, even though the water was provided by the City.
- Corona de Tucson WWTP produces 400 AF/YR and growing.
- Avra Valley WWTP produces over 1,500 AF/YR and growing.

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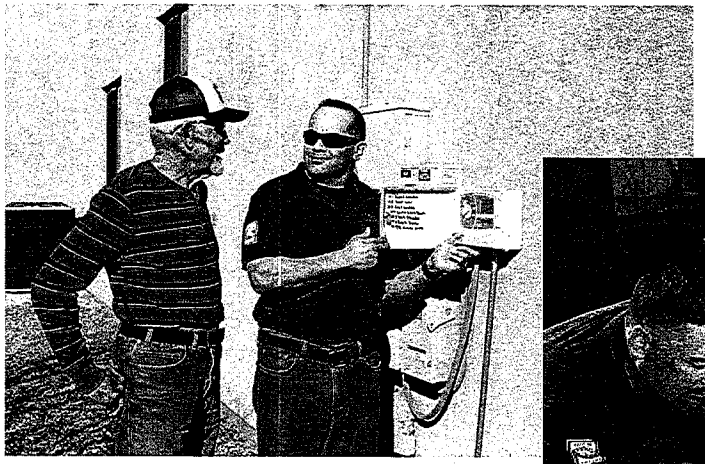
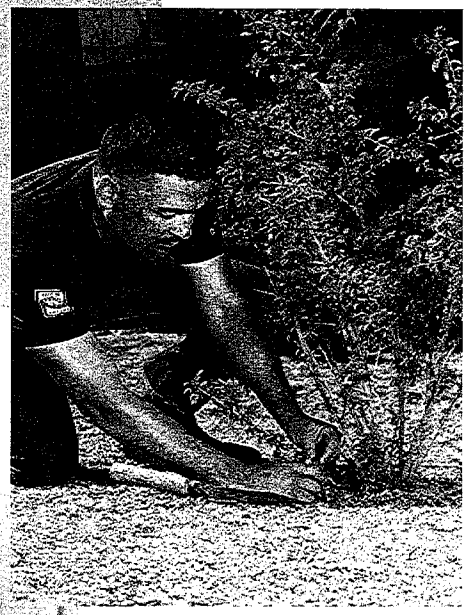
Differential Conservation Results

Customers in unincorporated County use 43% more water on average than City customers





Average monthly residential water use

- System-wide = 8 CCF*
- City customer = 7 CCF
- County customer = 10 CCF

*1 CCF is 100 cubic feet of water or 748 gallons. This is the unit of measurement we use for our water rates and billing.

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Equity and Precedent

Historically, all Tucson Water customers have paid the same rates, despite these inequities

Differential rates for unincorporated area customers address the inequities and acknowledges that:

- City customers bear the utility's financial risks
- City is extending a City service, with its own resources, to non-City residents with no return-on-investment
- The region loses $40M - $50M in State Shared Revenues every year due to high unincorporated area population

Almost all Arizona cities charge differential rates

Utility	Serve customers outside jurisdiction	Percentage of customers outside jurisdiction	Charge a differential rate to customers outside jurisdiction	Differential Rate
Chandler	Yes	1.50%	Yes	40%
Flagstaff	Yes	0.66%	Yes	10%
Glendale	Yes	-	Yes	30%
Peoria	Yes	0.06%	No	N/A
Phoenix	Yes	0.50%	Yes	50%
Scottsdale	Yes	16%	Yes	15%
Tempe	Yes	>2%	Yes	30%
Yuma	Yes	-	Yes	33%

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Answers to Stakeholder Comments

Tucson Water is not the regional water provider

- There are multiple local water providers [See Map – Slide 10]
- City has transferred effluent ownership to other water providers since 2001
- Obligations outside City jurisdiction are limited to contracts and infill [See 12-10-2007 Memorandum]

The City's CAP Subcontract does not obligate service to specific areas

- Delineation of a CAP Service Area did not create an obligation to serve; rather, it was intended to limit the City's use of groundwater outside of that area
- City has since transferred CAP allocations to others [See 12-11-2007 Memorandum]

Charging a differential rate does not violate any of the City-County IGAs

- 1979 IGA obligated County Wastewater to serve inside the City, but not the opposite
- County water customers are outside of the City's jurisdiction, whereas City wastewater customers are inside of the County's

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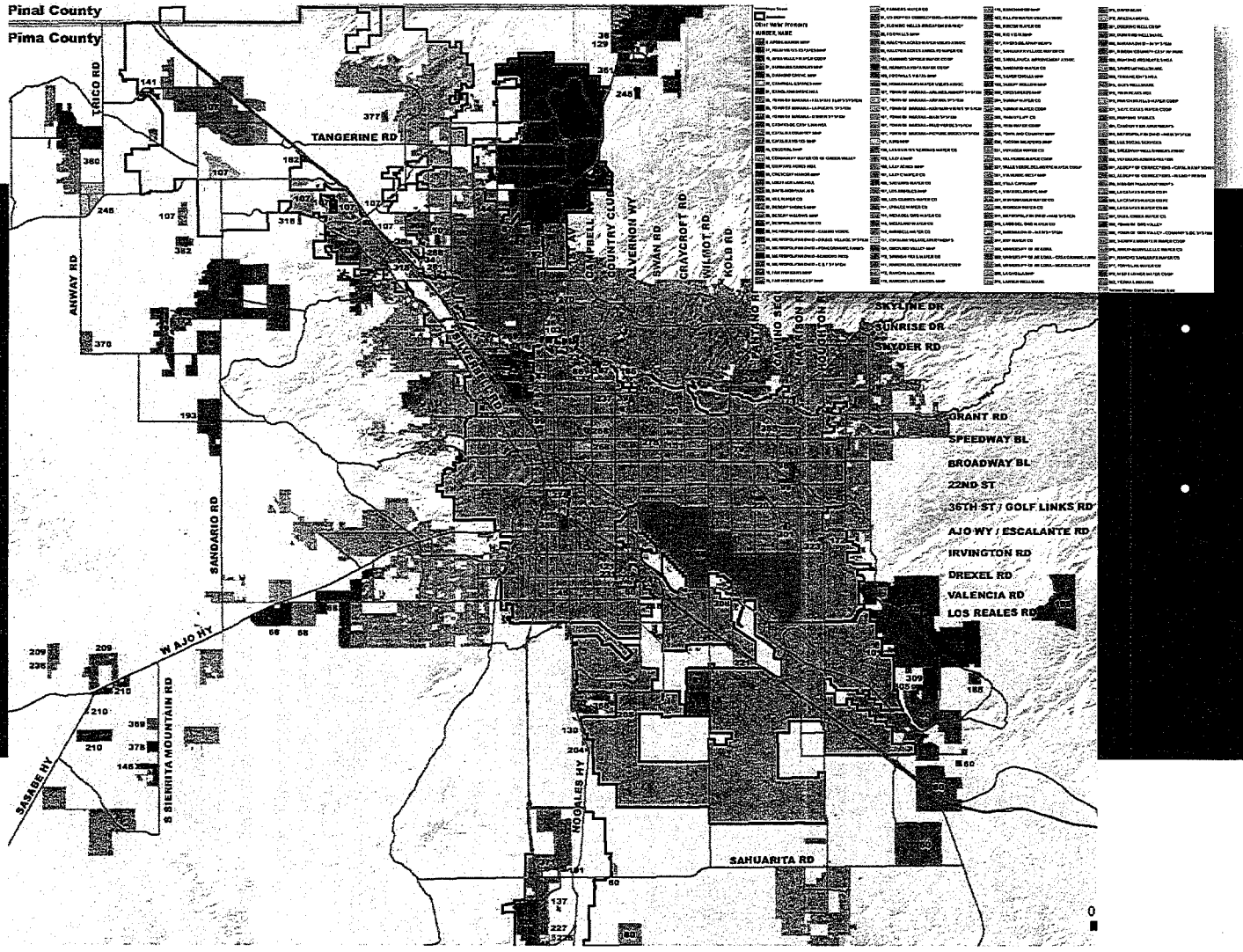

- The 2001 City-County Effluent IGA recognizes the co-equal importance of other regional water providers
- The City is not the "sole regional provider" of potable water service and has transferred effluent to a wide variety of other regional water providers

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Options for Consideration

		Option 1		Option 2		Option 3		Option 4		Option 5		Option 6		Option 7		Option 8	
Single Family Residential	**Current Rate FY 21 & FY 22**	*Flat 10%*		*Flat 20%*		*Flat 30%*		*Flat 40%*		*Flat 50%*		**5% Differential Rate on Base plus Escalating Tiers (T1-5%, T2-10%, T3-15%, T4-20%)**		**10% Differential Rate on Base plus Escalating Tiers (T1-10%, T2-20%, T3-30%, T4-40%)**		**15% Differential Rate on Base plus Escalating Tiers (T1-15%, T2-30%, T3-40%, T4-50%)**	
Monthly Base Rate (5/8')	$16.33	10%	$17.96	20%	$19.60	30%	$21.23	40%	$22.86	50%	$24.50	5%	$17.15	10%	$17.96	15%	$18.78
1 – 7 Ccf	$2.07	10%	$2.28	20%	$2.48	30%	$2.69	40%	$2.90	50%	$3.11	5%	$2.17	10%	$2.28	15%	$2.38
8 – 15 Ccf	$3.82	10%	$4.20	20%	$4.58	30%	$4.97	40%	$5.35	50%	$5.73	10%	$4.20	20%	$4.58	30%	$4.97
16 – 30 Ccf	$8.39	10%	$9.23	20%	$10.07	30%	$10.91	40%	$11.75	50%	$12.59	15%	$9.65	30%	$10.91	40%	$11.75
Over 30 Ccf	$12.93	10%	$14.22	20%	$15.52	30%	$16.81	40%	$18.10	50%	$19.40	20%	$15.52	40%	$18.10	50%	$19.40
CAP Fee	$0.70	10%	$0.77	20%	$0.84	30%	$0.91	40%	$0.98	50%	$1.05	5%	$0.74	10%	$0.77	15%	$0.81
Conservation Fee	$0.10	10%	$0.11	20%	$0.12	30%	$0.13	40%	$0.14	50%	$0.15	5%	$0.11	10%	$0.11	15%	$0.12

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Revenue Estimates

Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8
Flat 10%	*Flat 20%*	*Flat 30%*	*Flat 40%*	*Flat 50%*	*5% Differential Rate plus Escalating Tiers*	*10% Differential Rate plus Escalating Tiers*	*15% Differential Rate plus Escalating Tiers*
$ 6,340,000	$ 12,690,000	$ 19,030,000	$ 26,520,000	$ 34,010,000	$ 4,960,000	$ 9,910,000	$ 14,030,000

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Residential Bill Examples

Water Bill	# Ccfs	Current	Option 1 *Flat 10%*	Option 2 *Flat 20%*	Option 3 *Flat 30%*	Option 4 *Flat 40%*	Option 5 *Flat 50%*	Option 6 *5% Differential Rate on Base plus Escalating Tiers (T1-5%, T2-10%, T3-15%, T4-20%)*	Option 7 *10% Differential Rate on Base plus Escalating Tiers (T1-10%, T2-20%, T3-30%, T4-40%)*	Option 8 *15% Differential Rate on Base plus Escalating Tiers (T1-15%, T2-30%, T3-40%, T4-50%)*
Low	4	$27.81	$30.59	$33.37	$36.15	$38.93	$41.72	$29.20	$30.59	$31.98
Inside City Average	7	$36.42	$40.06	$43.70	$47.35	$50.99	$54.63	$38.24	$40.06	$41.88
Outside City Average	10	$50.28	$55.31	$60.34	$65.36	$70.39	$75.42	$53.37	$56.45	$59.54
High	45	$417.18	$458.90	$500.62	$542.33	$584.05	$625.77	$481.24	$545.81	$583.69

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Potential Uses of Funding

- Infrastructure resiliency
- Water bill assistance programs
- Pay down existing debt
- Climate resiliency investment

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QUESTIONS

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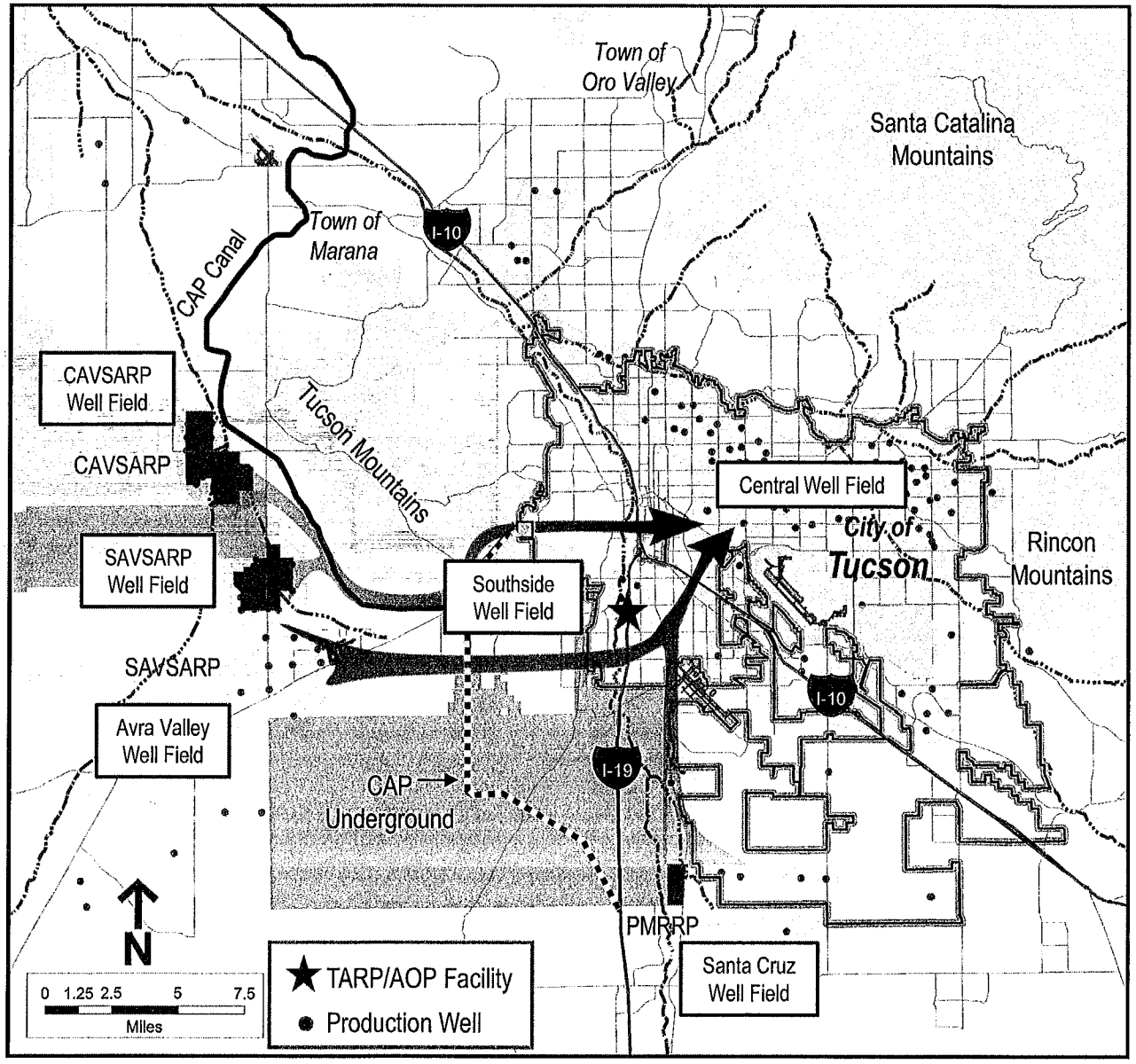
ATTACHMENT 2

Drinking Water Well Fields – Groundwater, Colorado River Water, and Remediated Water

- **Prior to 2001** – The Central Well Field provided most of Tucson Water's water supply (groundwater).
- **Since 2008** – Tucson Water has delivered more blended Colorado River water than groundwater.
- **2018** – The Central and Southside Well Fields are continuously maintained to be able to provide water service on short notice.

MOST WATER DELIVERED TO CUSTOMERS:

- Comes from Tucson Water's CAVSARP, SAVSARP, and Santa Cruz Well Fields
- Is a Colorado River water blend



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(520) 724-8661 FAX (520) 724-8171

C.H. HUCKELBERRY
County Administrator

February 22, 2021

Citizens' Water Advisory Committee
c/o Tucson Water Intergovernmental Coordination
Delivered via Email to: Jessica.Rodriguez@tucsonaz.gov

Re: **Pre-Annexation Development Agreements and Differential Rates Presentation**

I have had an opportunity to review the February 3, 2021 presentation by Interim Assistant City Manager Timothy Thomure and Assistant City Attorney Christopher Avery entitled Pre-Annexation Development Agreements and Differential Rates. (Attachment 1)

First, I would like to preface my remarks with some history associated with regional water and sewer service. Before the Intergovernmental Agreement (IGA) referenced in the document, the City and the County agreed to form an entity called the Metropolitan Utilities Management Agency for the purpose of regionalizing and consolidating water and sewer service for all citizens of Pima County, whether they live in cities, towns or the unincorporated area of Pima County. Unfortunately, that entity did not last and the outgrowth was the 1979 City/County IGA dividing water and sewer service. The original concept was that the City of Tucson would be the regional water provider and Pima County would be the regional sewer provider. Only the latter is viable to date.

Given the presentation and the history of Tucson Water providing what was originally deemed to be a regional service, it is not surprising that 34 percent of Tucson Water customers live outside the City limits. While the decision on differential water rates will rest with the Mayor and Council, I suggest that Article III Paragraph A of the 1979 IGA regarding water service reflects equal footing for both the City and the County when it comes to cost. The phrase, "...minimize costs to water rate payers in City and County." underpins the concept of water service in equal cost as well as benefits to both City and County residents. This concept was the sole basis for allocating County-generated effluent to the City at no cost to "...maintain management of the total water resources of the Santa Cruz and adjacent water basins." This clearly implies a regional benefit, not a city-centric benefit.

Additionally, the cited memorandum on Page 7 of the presentation incorrectly "cherry picks" data from my June 17, 2016 memorandum to the Board of Supervisors; it only quotes the first page. The full version of this memorandum clearly indicates that, while counties are

left out of the distribution of state-shared income taxes, incorporating or annexing is not the financial boon they are purported to be in this slide. In fact, my memorandum goes on to say that this additional revenue would be consumed in one line of business for newly incorporated residents in the form of simply police protection. (Attachment 2)

Justifying differential rates through financial backing of the City's General Fund is no different than the County's General Fund backing the wastewater enterprise. Under no circumstances would we consider differential sewer rates to City customers. Our customers are regional, in fact, in my memorandum that was cited by the City, I conclude that this strategy will lead to increased local taxes, instead of being a tax reduction strategy.

Thank you for allowing me to clarify the recent presentation on this matter before your Committee. Please share this information with all committee members.

Sincerely,

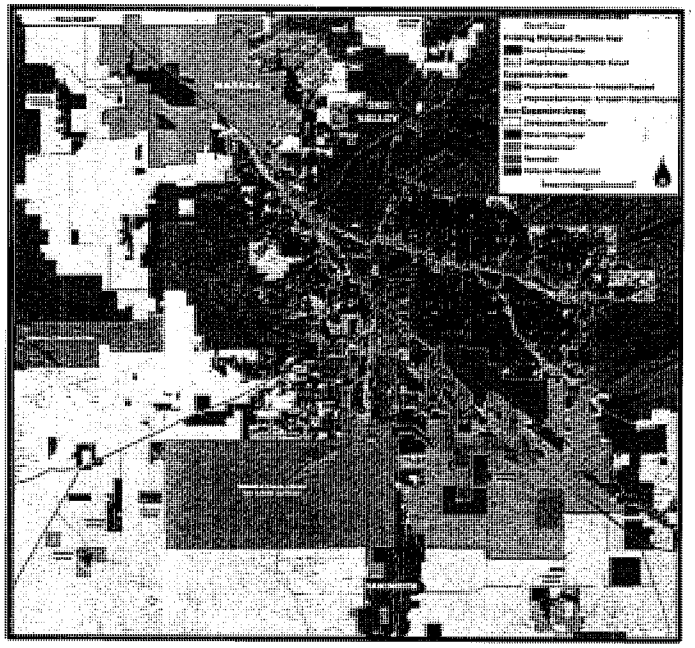
C.H. Huckelberry
County Administrator

Attachments

c: The Honorable Chair and Members, Pima County Board of Supervisors
Pima County Wastewater Reclamation Advisory Committee
Jan Lesher, Chief Deputy County Administrator
Carmine DeBonis, Jr., Deputy County Administrator for Public Works
Yves Khawam, PhD, Assistant County Administrator for Public Works
Jackson Jenkins, Director, Regional Wastewater Reclamation

ATTACHMENT 1

Pre-Annexation Development Agreements and Differential Rates



Citizens' Water Advisory Committee

February 3, 2021

Timothy Thomure, Interim Asst. City Manager

Christopher Avery, Asst. City Attorney

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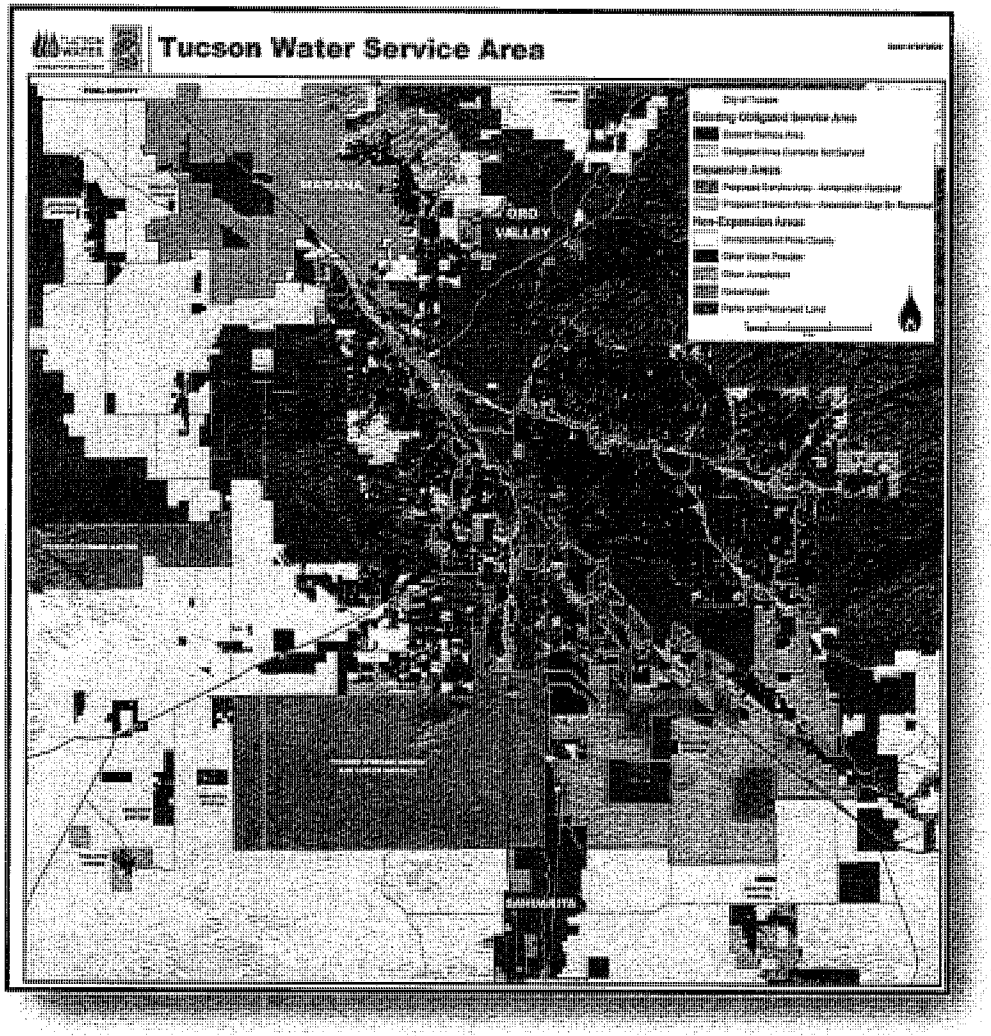
CITY OF TUCSON

CITIZENS' WATER ADVISORY COMMITTEE
Pre-Annexation Development Agreements and Differential Rates

- About 34% of Tucson Water customers are located outside of the city limits
- About 28% are located in unincorporated Pima County
- About 6% are in another jurisdiction: Marana, Oro Valley, South Tucson



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CITIZENS' WATER ADVISORY COMMITTEE
Pre-Annexation Development Agreements and Differential Rates

- **Differential Rates are allowed.** Requires a rational relationship to services provided. This has been tested in Court in AZ
- Legal Context of ARS 9-511

  If a municipality provides water to another municipality, the rates it charges for the water to the public in the other municipality shall be one of the following:

  1. The same or less than the rates it charges its own residents for water.

  2. The same or less than the rates the other municipality charges its residents for water.

  3. If the other municipality does not provide water, the average rates charged for water to the residents in the other municipality by private water companies.

  4. Rates determined by a contract which is approved by both municipalities and in which such rates are justified by a cost-of-service study or by any other method agreed to by both municipalities.

CITIZENS' WATER ADVISORY COMMITTEE
Pre-Annexation Development Agreements and Differential Rates

Differential Rates are commonplace

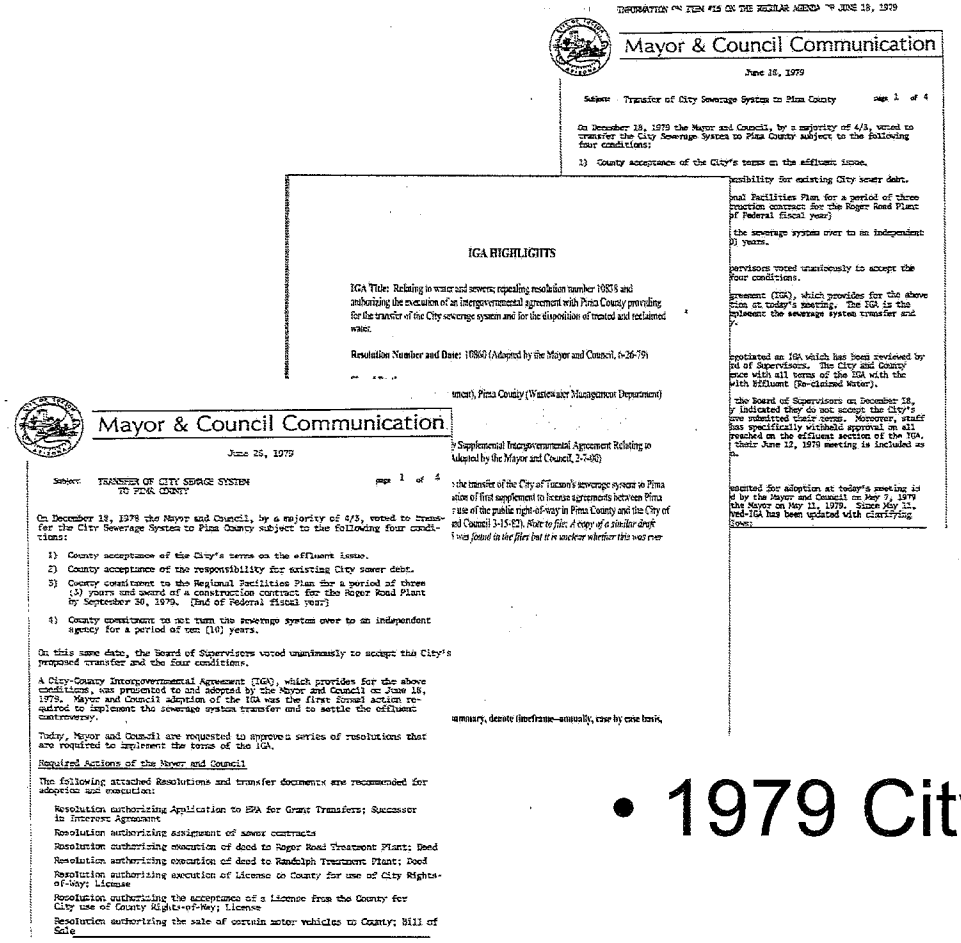
	BASE RATE (typical SFR meter)		VOLUME (1st tier SFR use)		Inside/Outside Adjuster	Notes
	Inside	Outside	Inside	Outside		
Chandler	$9.07/mo	$12.70/mo	$1.60 per 1,000 gal	$2.24 per 1,000 gal	**+40%**	volume rate is for first 10,000 gal
Flagstaff	$15.27/mo	$16.80/mo	$3.98 per 1,000 gal	$4.38 per 1,000 gal	**+10%**	volume rate is for first 3,500 gal
Flowing Wells	$12.00/mo	$16.00/mo	$2.45 per 1,000 gal	$2.52 per 1,000 gal	n/a	volume rate is per 1,000 gal
Glendale	$10.20/mo	$13.26/mo	$2.26 per 1,000 gal	$2.94 per 1,000 gal	**+30%**	volume rate is for first 6,000 gal
Metro Water	$29.50/mo	$31.00/mo	$2.75 per 1,000 gal	$3.00 per 1,000 gal	n/a	Metro's differential rate applies only to its Metro SW-Diablo Village Service Area; up to 3,000 gal included in base rate; volume charge is for 3,001 – 10,000 gal
Phoenix	$5.50/mo	$8.25/mo	$4.08 flat	$6.12 flat	**+50%**	the volume rate is a flat fee for any use over the 10 ccf summer allowance; 6 ccf winter / 10 ccf summer allowance is included in base rate
Scottsdale	$11.90/mo	$13.69/mo	$1.65 per 1,000 gal	$1.90 per 1,000 gal	**+15% ***	volume rate is per 1,000 gal for first 5,000 gal; *also, a 25% surcharge on new meter fees outside of City limits
Tempe	$11.50/mo	$14.95/mo	$1.80 per 1,000 gal	$2.34 per 1,000 gal	**+30%**	volume rate is for first 6,000 gal
Yuma	$17.47/mo	$23.24/mo	$1.53/ccf	$2.03/ccf	**+30%**	

CITIZENS' WATER ADVISORY COMMITTEE
Pre-Annexation Development Agreements and Differential Rates

Updated survey is being conducted:

1. Do you serve any water customers outside of your jurisdiction? If so, what percentage is that of total customer base?
2. Do you charge a differential rates to customers outside your municipality?
3. If you charge a differential rate, what year was it established?
4. If you charge a differential rate, how much is it?
5. If you do charge a differential rate, what is the basis? (e.g. Revenue generation, cost-of-service, or support policy outcomes such as annexation)
6. Where does the revenue from differential rates go? (e.g. Stay in the utility or other city fund?)

CITIZENS' WATER ADVISORY COMMITTEE
Pre-Annexation Development Agreements and Differential Rates



INFORMATION ON ITEM #15 ON THE REGULAR AGENDA OF JUNE 18, 1979

Mayor & Council Communication

June 18, 1979

Subject: Transfer of City Sewerage System to Pima County page 1 of 4

On December 18, 1979 the Mayor and Council, by a majority of 4/5, voted to transfer the City Sewerage System to Pima County subject to the following four conditions:

1) County acceptance of the City's terms on the effluent issue.

...sibility for existing City sewer debt.

...nal Facilities Plan for a period of three ...truction contract for the Roger Road Plant ...of Federal fiscal year)

...the sewerage system over to an independent ...0) years.

...pervisors voted unanimously to accept the ...four conditions.

...greement (IGA), which provides for the above ...tion at today's meeting. The IGA is the ...plement the sewerage system transfer and ...y.

...gotiated an IGA which has been reviewed by ...rd of Supervisors. The City and County ...nce with all terms of the IGA with the ...with Effluent (Re-claimed Water).

...the Board of Supervisors on December 18, ...y indicated they do not accept the City's ...ave submitted their terms. Moreover, staff ...has specifically withheld approval on all ...reached on the effluent section of the IGA. ...their June 12, 1979 meeting is included as ...

...mitted for adoption at today's meeting is ...d by the Mayor and Council on May 7, 1979 ...the Mayor on May 11, 1979. Since May 11, ...ed-IGA has been updated with clarifying ...items:

IGA HIGHLIGHTS

IGA Title: Relating to water and sewers; repealing resolution number 10535 and authorizing the execution of an intergovernmental agreement with Pima County providing for the transfer of the City sewerage system and for the disposition of treated and reclaimed water.

Resolution Number and Date: 10860 (Adopted by the Mayor and Council, 6-26-79)

...ment), Pima County (Wastewater Management Department)

...y Supplemental Intergovernmental Agreement Relating to ...dopted by the Mayor and Council, 2-7-80)

...the transfer of the City of Tucson's sewerage system to Pima ...ation of first supplement to license agreements between Pima ...use of the public right-of-way in Pima County and the City of ...nd Council 3-15-82). *State to file: A copy of a similar draft ...was found in the files but it is unclear whether this was ever*

...ummary, denote timeframe--annually, case by case basis,

Mayor & Council Communication

June 25, 1979

Subject: TRANSFER OF CITY SEWAGE SYSTEM TO PIMA COUNTY page 1 of 4

On December 18, 1978 the Mayor and Council, by a majority of 4/5, voted to transfer the City Sewerage System to Pima County subject to the following four conditions:

1) County acceptance of the City's terms on the effluent issue.
2) County acceptance of the responsibility for existing City sewer debt.
3) County constraint to the Regional Facilities Plan for a period of three (3) years and award of a construction contract for the Roger Road Plant by September 30, 1979. (End of Federal fiscal year)
4) County constraint to not turn the sewerage system over to an independent agency for a period of ten (10) years.

On this same date, the Board of Supervisors voted unanimously to accept the City's proposed transfer and the four conditions.

A City-County Intergovernmental Agreement (IGA), which provides for the above conditions, was presented to and adopted by the Mayor and Council on June 18, 1979. Mayor and Council adoption of the IGA was the first formal action required to implement the sewerage system transfer and to settle the effluent controversy.

Today, Mayor and Council are requested to approve a series of resolutions that are required to implement the terms of the IGA.

Required Actions of the Mayor and Council

The following attached Resolutions and transfer documents are recommended for adoption and execution:

Resolution authorizing Application to EPA for Grant Transfers; Successor in Interest Agreement
Resolution authorizing assignment of sewer contracts
Resolution authorizing execution of deed to Roger Road Treatment Plant; Deed
Resolution authorizing execution of deed to Randolph Treatment Plant; Deed
Resolution authorizing execution of License to County for use of City Rights-of-Way; License
Resolution authorizing the acceptance of a License from the County for City use of County Rights-of-Way; License
Resolution authorizing the sale of certain motor vehicles to County; Bill of Sale

- 1979 City and County IGA
- 1970's Lift Charges

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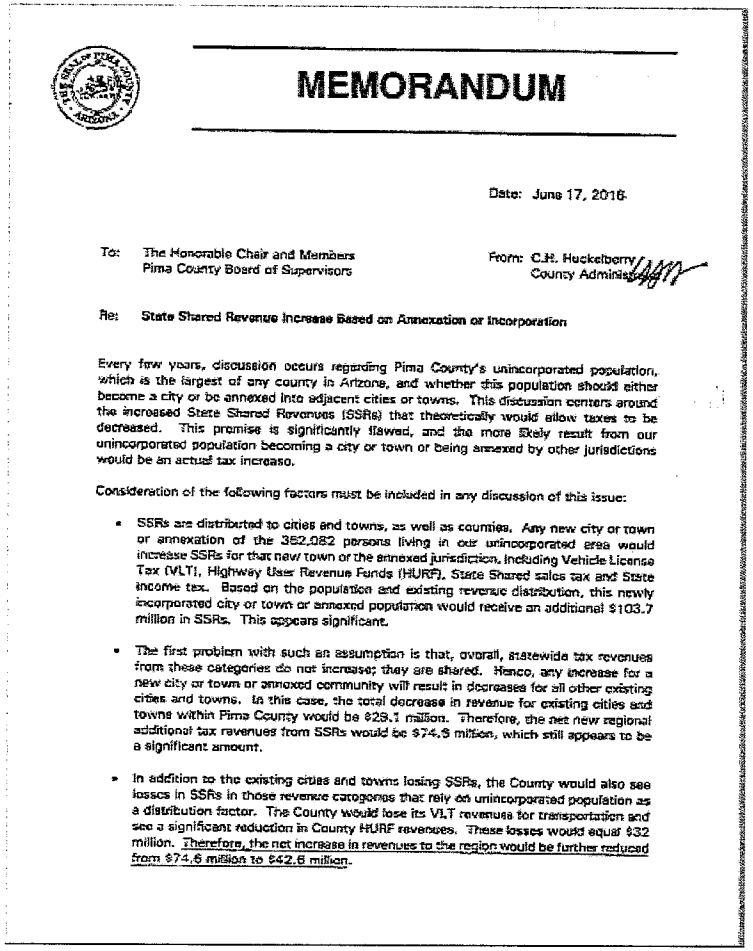
CITIZENS' WATER ADVISORY COMMITTEE
Pre-Annexation Development Agreements and Differential Rates



MEMORANDUM

Date: June 17, 2016

To: The Honorable Chair and Members
Pima County Board of Supervisors

From: C.H. Huckelberry
County Administrator

Re: **State Shared Revenue Increase Based on Annexation or Incorporation**

Every few years, discussion occurs regarding Pima County's unincorporated population, which is the largest of any county in Arizona, and whether this population should either become a city or be annexed into adjacent cities or towns. This discussion centers around the increased State Shared Revenues (SSRs) that theoretically would allow taxes to be decreased. This premise is significantly flawed, and the more likely result from our unincorporated population becoming a city or town or being annexed by other jurisdictions would be an actual tax increase.

Consideration of the following factors must be included in any discussion of this issue:

- SSRs are distributed to cities and towns, as well as counties. Any new city or town or annexation of the 352,082 persons living in our unincorporated area would increase SSRs for that new town or the annexed jurisdiction, including Vehicle License Tax (VLT), Highway User Revenue Funds (HURF), State Shared sales tax and State income tax. Based on the population and existing revenue distribution, this newly incorporated city or town or annexed population would receive an additional $103.7 million in SSRs. This appears significant.

- The first problem with such an assumption is that, overall, statewide tax revenues from these categories do not increase; they are shared. Hence, any increase for a new city or town or annexed community will result in decreases for all other existing cities and towns. In this case, the total decrease in revenue for existing cities and towns within Pima County would be $29.1 million. Therefore, the net new regional additional tax revenues from SSRs would be $74.6 million, which still appears to be a significant amount.

- In addition to the existing cities and towns losing SSRs, the County would also see losses in SSRs in those revenue categories that rely on unincorporated population as a distribution factor. The County would lose its VLT revenues for transportation and see a significant reduction in County HURF revenues. These losses would equal $32 million. Therefore, the net increase in revenues to the region would be further reduced from $74.6 million to $42.6 million.

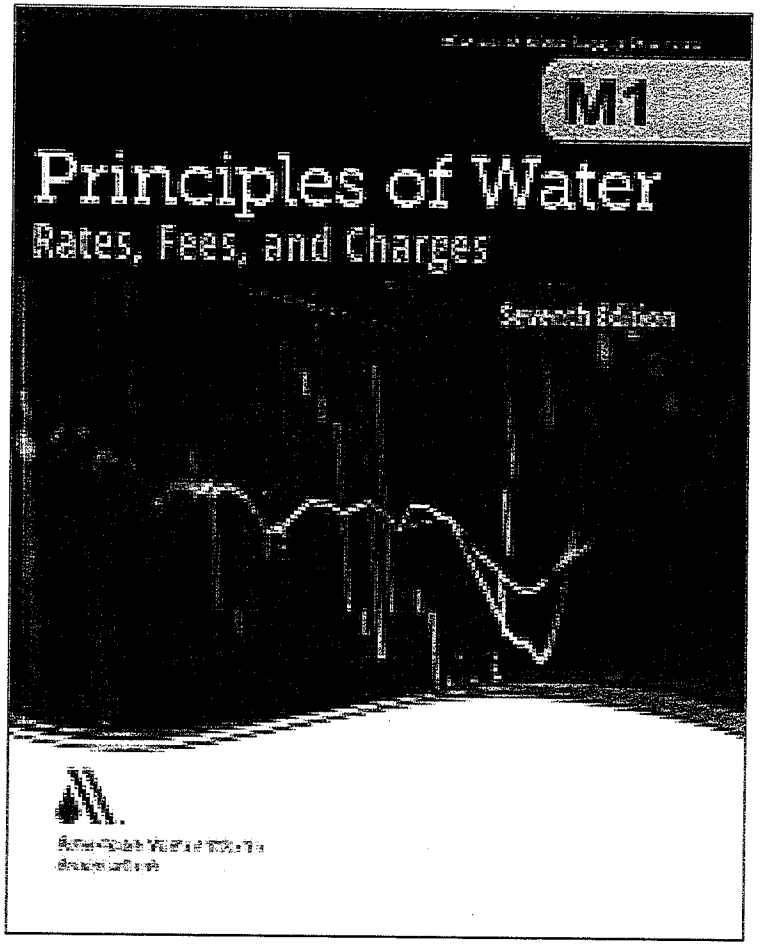
- Policy objectives ("why differential rates?")
  - Unincorporated areas receive lower State Shared Revenues (SSR)
  - For Pima County, this impact to SSR is $42.6M (2016 Memorandum Chuck Huckleberry)
  - Annexation / incorporation is the prime policy objective

CITIZENS' WATER ADVISORY COMMITTEE
Pre-Annexation Development Agreements and Differential Rates

Industry policy norms

- Inside City customer-ownership ROI
- Revenue risk of outside customers
- Financial backing of General Fund

Under this proposal, rates in unincorporated areas would approximately match prior financial plan



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CITIZENS' WATER ADVISORY COMMITTEE
Pre-Annexation Development Agreements and Differential Rates

- Utilization of funds
  - Use in General Fund is legal
  - Use within TW is legal and could offset general rate increases
  - Use within TW is legal and could be directed to assistance programs, etc that benefits all customers

CITIZENS' WATER ADVISORY COMMITTEE
Pre-Annexation Development Agreements and Differential Rates

Next Steps

- Stakeholder Outreach now through April 6, 2021
- Return to Mayor and Council with summary of public outreach and Notice of Intent (NOI) for consideration on April 6, 2021
- Public Hearing June 8, 2021
- Effective Date July 5, 2021

CITIZENS' WATER ADVISORY COMMITTEE
Pre-Annexation Development Agreements and Differential Rates

Stakeholders

- Community Water Coalition
- Watershed Management Group
- Tucson Metro Chamber of Commerce
- Southern Arizona Housing Builder Association
- Metropolitan Pima Alliance
- Tucson Real Estate Advisory Council
- Tucson Association Realtors
- SERI
- Coalition for Sonoran Desert Protection
- Sierra Club
- LUCHA
- CHiSPA

Questions?

ATTACHMENT 2

MEMORANDUM

Date: June 17, 2016

To: The Honorable Chair and Members
Pima County Board of Supervisors

From: C.H. Huckelberry
County Administrator

Re: **State Shared Revenue Increase Based on Annexation or Incorporation**

Every few years, discussion occurs regarding Pima County's unincorporated population, which is the largest of any county in Arizona, and whether this population should either become a city or be annexed into adjacent cities or towns. This discussion centers around the increased State Shared Revenues (SSRs) that theoretically would allow taxes to be decreased. This premise is significantly flawed, and the more likely result from our unincorporated population becoming a city or town or being annexed by other jurisdictions would be an actual tax increase.

Consideration of the following factors must be included in any discussion of this issue:

- SSRs are distributed to cities and towns, as well as counties. Any new city or town or annexation of the 362,082 persons living in our unincorporated area would increase SSRs for that new town or the annexed jurisdiction, including Vehicle License Tax (VLT), Highway User Revenue Funds (HURF), State Shared sales tax and State income tax. Based on the population and existing revenue distribution, this newly incorporated city or town or annexed population would receive an additional $103.7 million in SSRs. This appears significant.

- The first problem with such an assumption is that, overall, statewide tax revenues from these categories do not increase; they are shared. Hence, any increase for a new city or town or annexed community will result in decreases for all other existing cities and towns. In this case, the total decrease in revenue for existing cities and towns within Pima County would be $29.1 million. Therefore, the net new regional additional tax revenues from SSRs would be $74.6 million, which still appears to be a significant amount.

- In addition to the existing cities and towns losing SSRs, the County would also see losses in SSRs in those revenue categories that rely on unincorporated population as a distribution factor. The County would lose its VLT revenues for transportation and see a significant reduction in County HURF revenues. These losses would equal $32 million. Therefore, the net increase in revenues to the region would be further reduced from $74.6 million to $42.6 million.

- The next significant questions are whether the region would be better off with this new or annexed community with a net increase of $42.6 million, and could this increase in revenue offset expected service costs for a new city, town, or annexed community? To answer this question, the best model would be to examine aggregate budgets of cities and towns in Arizona where the population ranges from as high 261,000 to as low as 171,000. The table below shows a list of the six Arizona communities that fall within this population threshold, as well as their respective annual and per capita budgets for last year. As can be seen, the annual budgets of even the least populated community of Peoria has an annual budget that exceeds by a factor of 12 the additional regional revenues that would be derived from such a strategy. Even with discounting the water and wastewater enterprise funds run by the community of Peoria, this factor would still exceed the additional revenue by 9.5 times. Clearly, a new community would need to rely on increased taxes. Hence, rather than being a tax reduction strategy, it is a strategy that will actually lead to increased local taxes.

Expenditures

City/Town	Population[1]	FY2015/16 General Fund Expenditures	FY2015/16 Total Funds Expenditures	Total Budget, Net of Enterprise Funds
Chandler	260,828	$244,595,922	$ 910,614,017	$ 810,734,843
Gilbert	247,542	169,904,050	615,009,220	518,437,420
Glendale	240,126	206,154,495	632,000,000	535,418,169
Peoria	171,237	168,566,321	511,000,000	403,422,981
Scottsdale	236,839	273,234,364	1,201,690,332	1,016,311,698
Tempe	175,826	187,647,884	607,527,884	516,329,698

Expenditures Per Capita

City/Town	Population[1]	FY2015/16 General Fund Expenditures	FY2015/16 Total Funds Expenditures	Total Budget, Net of Enterprise Funds
Chandler	260,828	$ 937.77	$3,491.24	$3,108.31
Gilbert	247,542	686.36	2,484.46	2,094.34
Glendale	240,126	858.53	2,631.95	2,229.74
Peoria	171,237	984.40	2,984.17	2,355.93
Scottsdale	236,839	1,153.67	5,073.87	4,291.15
Tempe	175,826	1,067.24	3,455.28	2,936.59

[1]US Census Bureau population estimate for July 1, 2015 https://www.census.gov/popest/data/

Assuming the highest annual per capita budget expenditure of the City of Scottsdale for our unincorporated population, the new community would result in a budget expenditure of $1.55 billon. Utilizing even the lowest per capita annual budget expenditure, the Town of Gilbert at $2,094.34, still results in an annual expenditure of $758.3 million.

Believing that incorporating our unincorporated population in either a new city or annexing it into existing cities and towns will result in a tax decrease is a fallacy. The exact opposite would occur.

CHH/mjk

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Fiscal Year 21-22 Water Rates

Timothy Thomure, PE

Interim Assistant City Manager

Attachment C

AGENDA

- Overview
- Policy Considerations
  - Infrastructure Differential
  - Water Resources Differential
  - Water Conservation Differential
  - Equity and Precedent
- Stakeholder Comments
- Differential Rate Options
- Bill Impacts
- Q&A

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Overview of Water Rates for FY 21-22

- Notice of Intent adopted April 6, 2021
- Public Hearing June 8, 2021
- No general rate increase (second consecutive year)
- No reclaimed rate increase (second consecutive year)
- No rate increase to Tucson Water customers located in other jurisdictions (Marana, Oro Valley, South Tucson, Pascua Yaqui)
- Proposed rate increase for unincorporated areas (aka Differential Rate)

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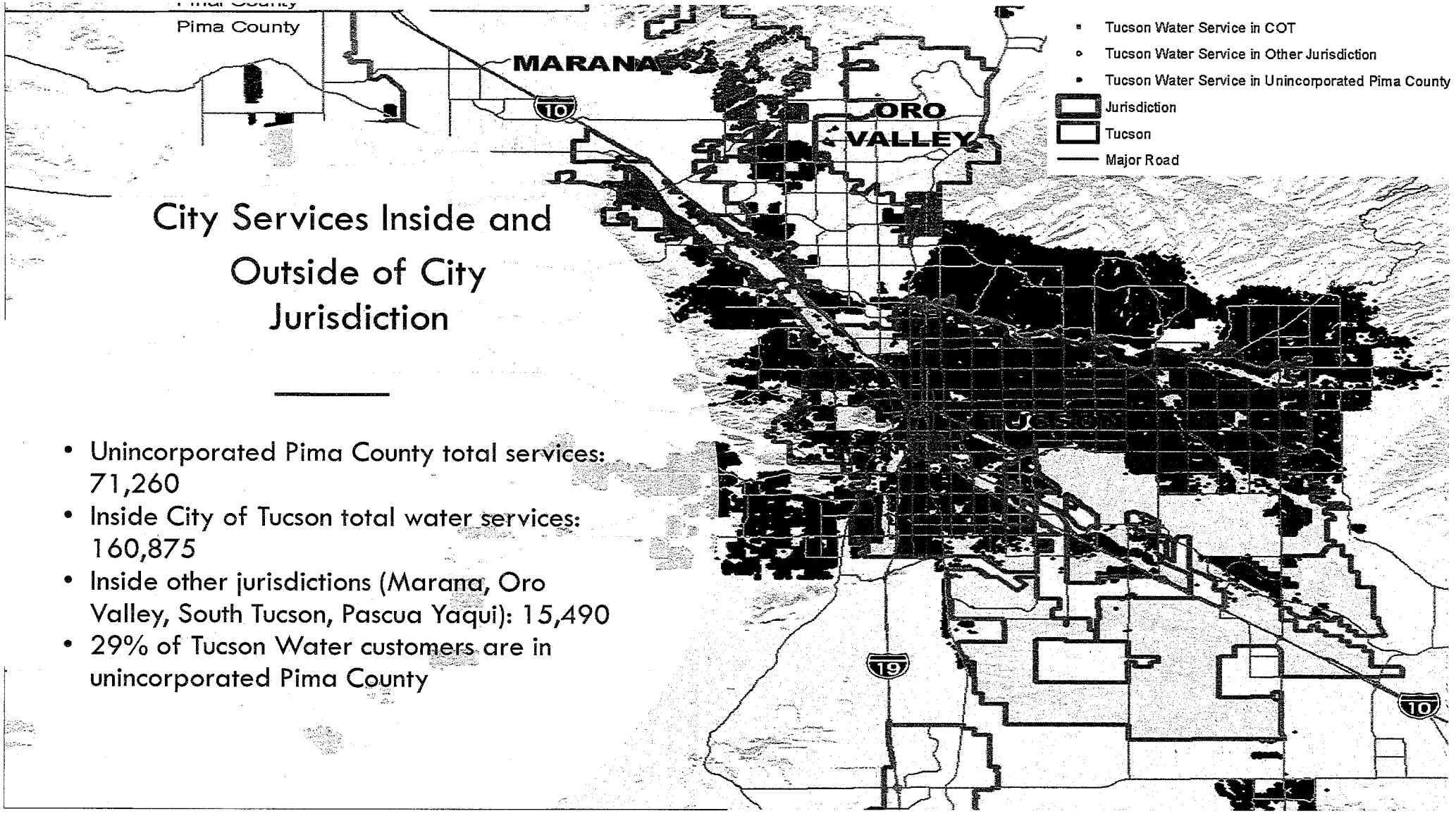
City Services Inside and Outside of City Jurisdiction

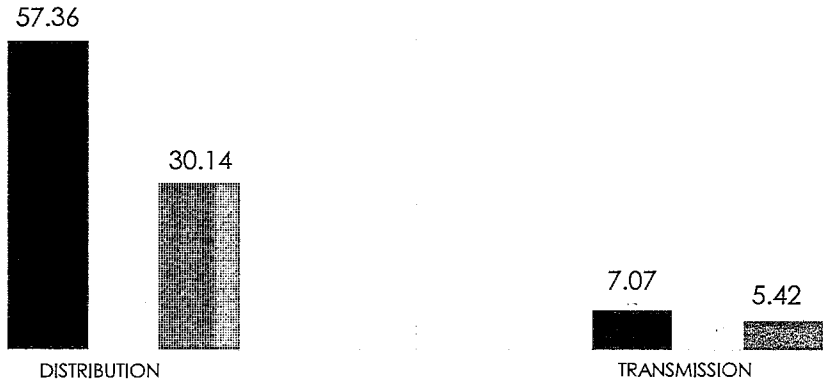
- Unincorporated Pima County total services: 71,260
- Inside City of Tucson total water services: 160,875
- Inside other jurisdictions (Marana, Oro Valley, South Tucson, Pascua Yaqui): 15,490
- 29% of Tucson Water customers are in unincorporated Pima County



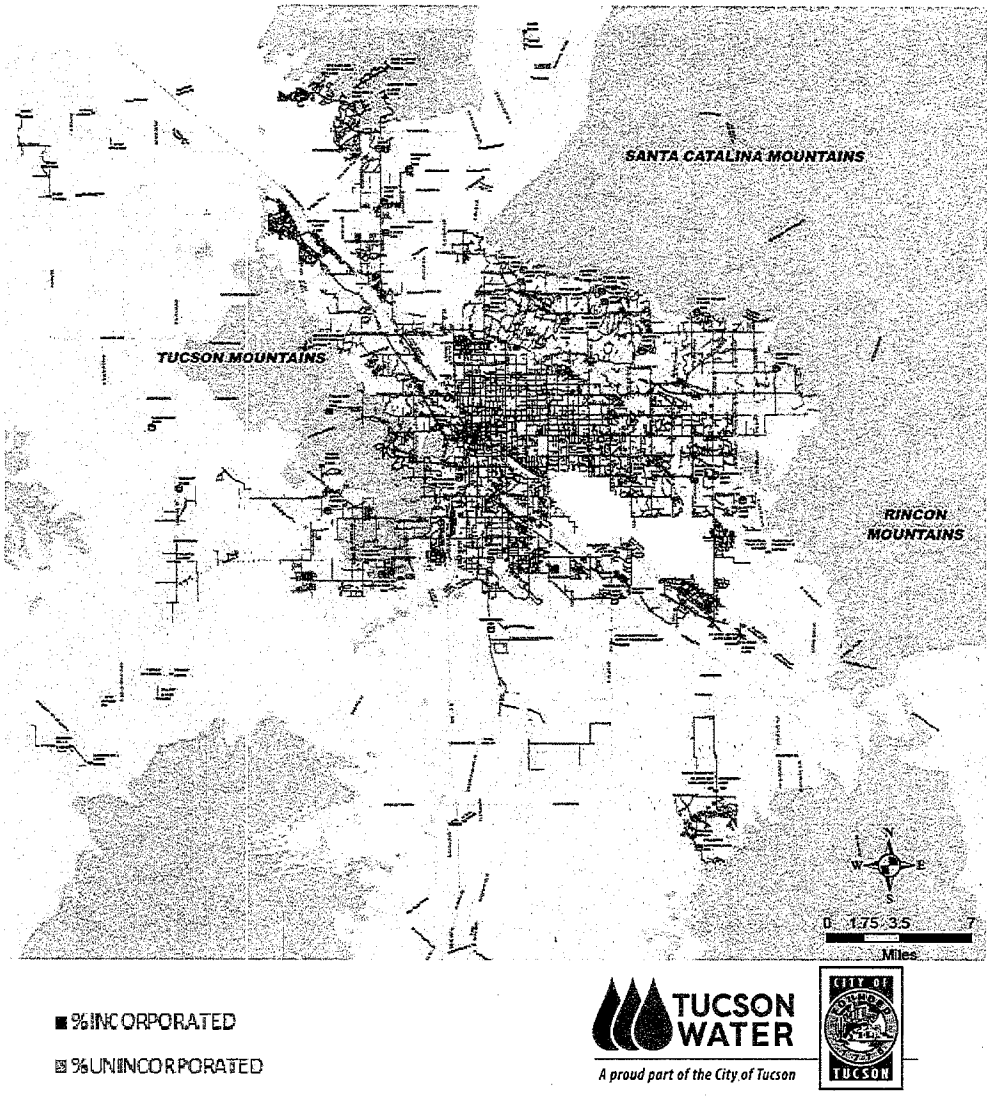
Differential Infrastructure Use

29% of Tucson Water customers (County) utilize 36% of the assets*

Row Labels	%INCORPORATED	%UNINCORPORATED	%COMBINED
DISTRIBUTION	57.36%	30.14%	87.50%
TRANSMISSION	7.07%	5.42%	12.50%
%COMBINED	64.44%	35.56%	100.00%

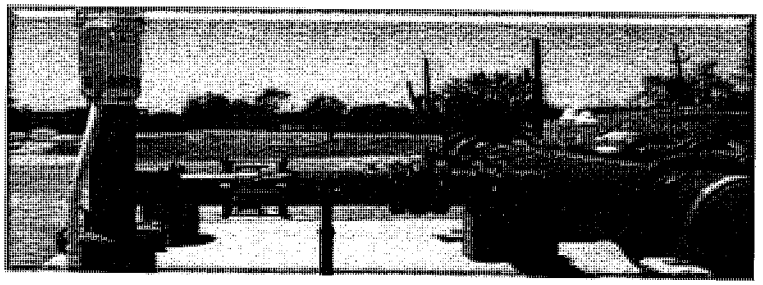


*Measured by pipes, the largest asset. Excludes renewable water assets that serve all customers.



Differential Resource Use

City's water resources are only "one-time use" in County growth areas



Water resources lost to septic systems

- 32% of County customers (5% of City customers) are not connected to a sewer system. The water delivered by the City is used only once.

Water resources retained by Pima County

- Unlike for City customers, the reclaimed water for many County customers is not returned to the City as a resource. It is retained by the County, even though the water was provided by the City.
- Corona de Tucson WWTP produces 400 AF/YR and growing.
- Avra Valley WWTP produces over 1,500 AF/YR and growing.

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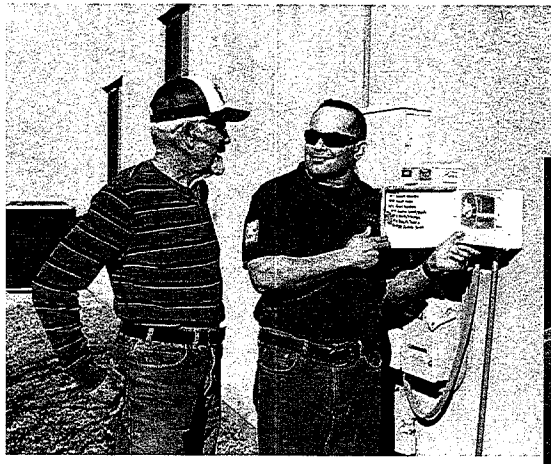
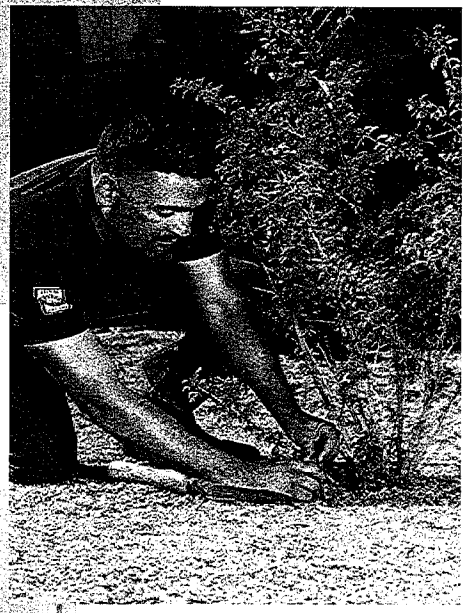
Differential Conservation Results

Customers in unincorporated County use 43% more water on average than City customers





Average monthly residential water use

- System-wide = 8 CCF*
- City customer = 7 CCF
- County customer = 10 CCF

*1 CCF is 100 cubic feet of water or 748 gallons. This is the unit of measurement we use for our water rates and billing.

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Equity and Precedent

Historically, all Tucson Water customers have paid the same rates, despite these inequities

Differential rates for unincorporated area customers address the inequities and acknowledges that:

- City customers bear the utility's financial risks
- City is extending a City service, with its own resources, to non-City residents with no return-on-investment
- The region loses $40M - $50M in State Shared Revenues every year due to high unincorporated area population

Almost all Arizona cities charge differential rates

Utility	Serve customers outside jurisdiction	Percentage of customers outside jurisdiction	Charge a differential rate to customers outside jurisdiction	Differential Ra...
Chandler	Yes	1.50%	Yes	40%
Flagstaff	Yes	0.66%	Yes	10%
Glendale	Yes	-	Yes	30%
Peoria	Yes	0.06%	No	N/A
Phoenix	Yes	0.50%	Yes	50%
Scottsdale	Yes	16%	Yes	15%
Tempe	Yes	>2%	Yes	30%
Yuma	Yes	-	Yes	33%

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Answers to Stakeholder Comments

Tucson Water is not the regional water provider

- There are multiple local water providers [See Map – Slide 10]
- City has transferred effluent ownership to other water providers since 2001
- Obligations outside City jurisdiction are limited to contracts and infill [See 12-10-2007 Memorandum]

The City's CAP Subcontract does not obligate service to specific areas

- Delineation of a CAP Service Area did not create an obligation to serve; rather, it was intended to limit the City's use of groundwater outside of that area
- City has since transferred CAP allocations to others [See 12-11-2007 Memorandum]

Charging a differential rate does not violate any of the City-County IGAs

- 1979 IGA obligated County Wastewater to serve inside the City, but not the opposite
- County water customers are outside of the City's jurisdiction, whereas City wastewater customers are inside of the County's

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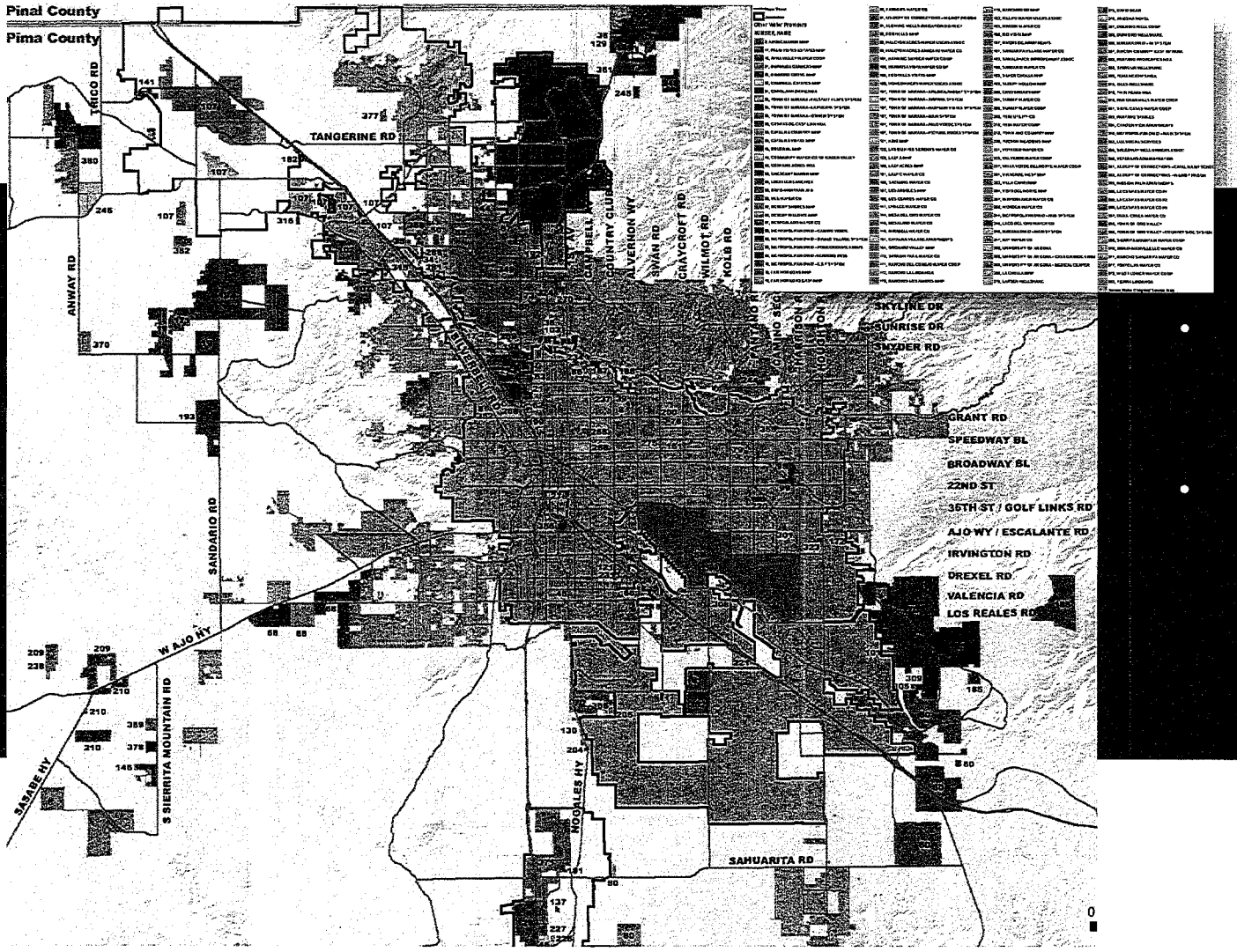

- The 2001 City-County Effluent IGA recognizes the co-equal importance of other regional water providers
- The City is not the "sole regional provider" of potable water service and has transferred effluent to a wide variety of other regional water providers

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Options for Consideration

		Option 1		Option 2		Option 3		Option 4		Option 5		Option 6		Option 7		Option 8	
Single Family Residential	**Current Rate FY 21 & FY 22**	*Flat 10%*		*Flat 20%*		*Flat 30%*		*Flat 40%*		*Flat 50%*		**5% Differential Rate on Base plus Escalating Tiers (T1-5%, T2-10%, T3-15%, T4-20%)**		**10% Differential Rate on Base plus Escalating Tiers (T1-10%, T2-20%, T3-30%, T4-40%)**		**15% Differential Rate on Base plus Escalating Tiers (T1-15%, T2-30%, T3-40%, T4-50%)**	
Monthly Base Rate (5/8')	$16.33	10%	$17.96	20%	$19.60	30%	$21.23	40%	$22.86	50%	$24.50	5%	$17.15	10%	$17.96	15%	$18.78
1 – 7 Ccf	$2.07	10%	$2.28	20%	$2.48	30%	$2.69	40%	$2.90	50%	$3.11	5%	$2.17	10%	$2.28	15%	$2.38
8 – 15 Ccf	$3.82	10%	$4.20	20%	$4.58	30%	$4.97	40%	$5.35	50%	$5.73	10%	$4.20	20%	$4.58	30%	$4.97
16 – 30 Ccf	$8.39	10%	$9.23	20%	$10.07	30%	$10.91	40%	$11.75	50%	$12.59	15%	$9.65	30%	$10.91	40%	$11.75
Over 30 Ccf	$12.93	10%	$14.22	20%	$15.52	30%	$16.81	40%	$18.10	50%	$19.40	20%	$15.52	40%	$18.10	50%	$19.40
CAP Fee	$0.70	10%	$0.77	20%	$0.84	30%	$0.91	40%	$0.98	50%	$1.05	5%	$0.74	10%	$0.77	15%	$0.81
Conservation Fee	$0.10	10%	$0.11	20%	$0.12	30%	$0.13	40%	$0.14	50%	$0.15	5%	$0.11	10%	$0.11	15%	$0.12

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Revenue Estimates

Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8
Flat 10%	*Flat 20%*	*Flat 30%*	*Flat 40%*	*Flat 50%*	*5% Differential Rate plus Escalating Tiers*	*10% Differential Rate plus Escalating Tiers*	*15% Differential Rate plus Escalating Tiers*
$ 6,340,000	$ 12,690,000	$ 19,030,000	$ 26,520,000	$ 34,010,000	$ 4,960,000	$ 9,910,000	$ 14,030,000

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Residential Bill Examples

Water Bill	# Ccfs	Current	Option 1 *Flat 10%*	Option 2 *Flat 20%*	Option 3 *Flat 30%*	Option 4 *Flat 40%*	Option 5 *Flat 50%*	Option 6 *5% Differential Rate on Base plus Escalating Tiers (T1-5%, T2-10%, T3-15%, T4-20%)*	Option 7 *10% Differential Rate on Base plus Escalating Tiers (T1-10%, T2-20%, T3-30%, T4-40%)*	Option 8 *15% Differential Rate on Base plus Escalating Tiers (T1-15%, T2-30%, T3-40%, T4-50%)*
Low	4	$27.81	$30.59	$33.37	$36.15	$38.93	$41.72	$29.20	$30.59	$31.98
Inside City Average	7	$36.42	$40.06	$43.70	$47.35	$50.99	$54.63	$38.24	$40.06	$41.88
Outside City Average	10	$50.28	$55.31	$60.34	$65.36	$70.39	$75.42	$53.37	$56.45	$59.54
High	45	$417.18	$458.90	$500.62	$542.33	$584.05	$625.77	$481.24	$545.31	$583.69

TUCSON WATER
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Potential Uses of Funding

- Infrastructure resiliency
- Water bill assistance programs
- Pay down existing debt
- Climate resiliency investment

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QUESTIONS

TUCSON WATER

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cwac

Citizens' Water Advisory Committee
City of Tucson
P.O.Box 27210
Tucson, AZ 85726-7210

DATE: March 30, 2021

TO: Honorable Mayor and Council members

FROM: Mark Taylor
CWAC Chair

Alison Jones
CWAC Vice Chair

SUBJECT: Differential Rates

On January 5th, the Mayor and Council requested that the Citizen Water Advisory Committee (CWAC) provide comments regarding the proposal for Differential Water Rates that might be imposed solely on Tucson Water customers located in unincorporated Pima County.
CWAC members were given a 90-day period to get up to speed regarding the various aspects of the M&C Differential Water Rate proposal. The Members used the entire CWAC committee meeting on February 3, 2021 to be briefed by staff on the history and legal framework of differential rates. The following March 3, 2021 meeting was committed to discussion by CWAC members to help more fully develop informed discussion of these matters, as reflected in this document. During this latter discussion, the Committee Chair asked each Committee member to address the following questions in an effort to understand what members perspectives were at this stage of our research and discussion:

1) Do you think there should be different water rates between the City of Tucson and unincorporated Pima County?
2) If yes, what percentage increase should be imposed on unincorporated Pima County?
3) If yes, where should the additional fund go? City of Tucson General Fund? Tucson Water, and for what purpose in TW?
4) Do you believe differential rates will provide the desired outcome of being an incentive for annexation?

Based upon these discussions and the follow up responses provided on March 3, 2021, the general opinion of the 15 CWAC members were divided where 10 members were "not" in favor of adoption of differential rates and 5 members were supportive of differential rates. After the discussion, the committee voted to develop a letter to M&C stating that the CWAC committee voted "against adoption of differential rates and to provide in a memo the issues and arguments on both sides of the discussion". The following initial perspectives were cited by the *majority* of CWAC members:

- It was generally believed that differential rates would not incentivize annexation. CWAC members have not been able to acquire information suggesting that differential rates had resulted in additional annexations in other municipalities. It was also felt that many areas seeking

annexation in Pima County would not be able to annex based upon their location, or if they were eligible to annex, would not be incentivized by higher water rates to do so.

- The proposed differential rates are not linked to cost of service. It was stated that some areas inside Tucson have a higher cost of service than some areas in unincorporated Pima County. This is due to many areas within the City limits having elevations as high as those outside. It was stated that de-linking rates from cost of service, and thereby charging an arbitrary higher rate for those customers in unincorporated Pima County, would not only be divisive, but would establish a dangerous precedent as well.
- CWAC members generally agreed that differential rates would create a breach of trust between the utility and a large percentage of its customers. Given the City of Tucson's and Tucson Water's history with customers located in unincorporated Pima County, it was considered too late to impose such rates solely on those long-term customers and would likely result in angry customers. This could potentially lead to long-term trust issues with the utility and other possible unintended consequences. Several committee members noted that the proposal appears to be an issue of "taxation without representation", expressing this differential rate may be considered a new revenue source for the City from solely (unincorporated) County residents.
- Water is an emotional issue in Pima County. The fact that other cities impose differential rates is not likely to convince Tucson Water customers that differential rates are a good idea. This is especially true since such a large portion of Tucson Water customers live outside the City limits as compared to other cities with existing differential rates.
- The importance of an increased proportion of State Shared Revenues may be self-evident, but those revenues might well be offset by their uses in annexed areas. It may not be a valid approach to address municipal budget gaps for Tucson. In fact, it is possible that annexed properties will need more City investment than can be obtained with State Shared Revenues.
- If one believes that water is a human right, differential rates are inconsistent with the concept of water as a revenue source. Differential rates could be construed as a regressive tax.

Although the CWAC committee voted to "not support" the Differential Rates Proposal, the committee also voted to provide Mayor and Council with a summary of the minority dissenting voters' perspectives so that Mayor and Council can consider both sides of the discussion. The following are some of the reasons that five of the committee members supported differential rates.

- Many other cities in Arizona that serve water outside of their incorporated areas use differential rates in some form.
- Water rates are already too low in the desert southwest, and CAP water is expected to become scarce in the era of climate change. Differential rates could encourage conservation. Added benefits include reducing sprawl and protecting habitat.
- Revenues generated by differential rates could be used for subsidizing water for low-income households throughout the service area, especially those that are also affected by the increased rates; paying off the existing water delinquency debt; and/or other Tucson Water programs.
- The CWAC members that expressed support for differential rates opined that any revenues generated by differential water rates should stay with the water utility, and not go to the city's general fund. One member who was against differential rates, suggested that if differential rates are implemented, that they be dedicated to those areas where the additional revenues would be generated, specifically to areas outside the Tucson city limits.

- The members who supported differential rates did not agree on the amount of the rate, suggesting amounts ranging from 10%-30%.

In conclusion, based on these initial discussions, the majority of CWAC members do not believe that differential rates would encourage annexation, the primary reason that has been presented for its possible implementation. The CWAC members who supported differential rates supported it for reasons other than annexation.

Many CWAC members did express the opinion that if such rates are implemented, members believe the funds should be used for water-related infrastructure. CWAC members did not in any manner support the idea of funds generated through differential rates going into the City's general fund.

CWAC appreciates the opportunity to provide this initial input to Mayor and Council on differential rates. Please know that CWAC recognizes the complexity and importance of this matter and plan to continue to gather more information and potentially expand its discussion to include additional aspects of the proposed polices.

Respectfully submitted,
Citizens Water Advisory Committee

Cc: Tim Thomure, Interim Assistant City Manager
John Kmiec Interim Director, Tucson Water
Silvia Amparano, Deputy Director, Tucson Water
Chris Avery, City Attorney's Office

Tucson Water Proposed Differential Rates for Unincorporated Pima County Customers

Rate Component/Class	FY 2021 *Current Rates*	Option 1 *Flat 10%*	Option 2 *Flat 20%*	Option 3 *Flat 30%*	Option 4 *Flat 40%*	Option 5 *Flat 50%*	Option 6 *5% Differential Rate on Base plus Escalating Tiers (T1-5%, T2-10%, T3-15%, T4-20%)*	Option 7 *10% Differential Rate on Base plus Escalating Tiers (T1-10%, T2-20%, T3-30%, T4-40%)*	Option 8 *15% Differential Rate on Base plus Escalating Tiers (T1-15%, T2-30%, T3-40%, T4-50%)*
Service Charge									
Meter Size									
5/8"	$16.33	$17.96	$19.60	$21.23	$22.86	$24.49	$17.15	$17.96	$18.78
3/4"	$22.03	$24.23	$26.43	$28.63	$30.84	$33.04	$23.13	$24.23	$25.33
1"	$33.42	$36.76	$40.10	$43.45	$46.79	$50.13	$35.09	$36.76	$38.43
1.5"	$61.91	$68.10	$74.29	$80.48	$86.67	$92.86	$65.00	$68.10	$71.19
2"	$96.09	$105.70	$115.31	$124.92	$134.52	$144.13	$100.89	$105.70	$110.50
2.5"	$141.67	$155.83	$170.00	$184.16	$198.33	$212.50	$148.75	$155.83	$162.92
3"	$187.24	$205.97	$224.69	$243.41	$262.14	$280.86	$196.60	$205.97	$215.33
4"	$318.27	$350.10	$381.93	$413.76	$445.58	$477.41	$334.19	$350.10	$366.02
6"	$646.43	$711.07	$775.71	$840.36	$905.00	$969.64	$678.75	$711.07	$743.39
8"	$973.44	$1,070.78	$1,168.13	$1,265.47	$1,362.82	$1,460.16	$1,022.11	$1,070.78	$1,119.46
10"	$1,486.18	$1,634.80	$1,783.41	$1,932.03	$2,080.65	$2,229.27	$1,560.49	$1,634.80	$1,709.10
12"	$2,454.68	$2,700.15	$2,945.62	$3,191.09	$3,436.56	$3,682.02	$2,577.42	$2,700.15	$2,822.88
Usage Charge (Per Ccf)									
Residential (Single Family) Block Rates									
1-7 Ccf	$2.07	$2.28	$2.48	$2.69	$2.90	$3.11	$2.17	$2.28	$2.38
8-15 Ccf	$3.82	$4.20	$4.58	$4.97	$5.35	$5.73	$4.20	$4.58	$4.97
16-30 Ccf	$8.39	$9.23	$10.07	$10.91	$11.75	$12.59	$9.65	$10.91	$11.75
Over 30 Ccf	$12.93	$14.22	$15.52	$16.81	$18.10	$19.40	$15.52	$18.10	$19.40
Residential (Duplex-Triplex) Block									
1-10 Ccf	$2.07	$2.28	$2.48	$2.69	$2.90	$3.11	$2.17	$2.28	$2.38
10-20 Ccf	$3.82	$4.20	$4.58	$4.97	$5.35	$5.73	$4.20	$4.58	$4.97
21-35 Ccf	$8.39	$9.23	$10.07	$10.91	$11.75	$12.59	$9.65	$10.91	$11.75
Over 35 Ccf	$12.93	$14.22	$15.52	$16.81	$18.10	$19.40	$15.52	$18.10	$19.40
Other Classes: Base Rates									
Multifamily *	$3.42	$3.76	$4.10	$4.45	$4.79	$5.13	$3.59	$3.76	$3.93
Mobile Home Parks w/sub-meters *	$2.56	$2.81	$3.07	$3.32	$3.58	$3.84	$2.68	$2.81	$2.94
Community Garden *	$2.56	$2.81	$3.07	$3.32	$3.58	$3.84	$2.68	$2.81	$2.94
Commercial	$3.36	$3.69	$4.03	$4.36	$4.70	$5.03	$3.52	$3.69	$3.86
Industrial	$3.38	$3.71	$4.05	$4.39	$4.73	$5.07	$3.55	$3.71	$3.88
Construction *	$3.70	$4.07	$4.44	$4.81	$5.18	$5.55	$3.89	$4.07	$4.26
Tier Rates (Summer Only: May - Oct)**									
Tier 1	$1.08	$1.19	$1.30	$1.40	$1.51	$1.62	$1.13	$1.19	$1.24
Tier 2	$0.29	$0.32	$0.35	$0.38	$0.41	$0.44	$0.30	$0.32	$0.33
CAP Charge *	$0.70	$0.77	$0.84	$0.91	$0.98	$1.05	$0.74	$0.77	$0.81
Conservation Charge	$0.10	$0.11	$0.12	$0.13	$0.14	$0.15	$0.11	$0.11	$0.12

*** Uniform rate year-round; not subject to summer tier rates**
****Applicable for Commercial and Industrial classes only**
***** Assessed to potable customers only**

*** LATE MATERIAL FOR SCHEDULED REGULAR AGENDA ITEM #8 ***

MAYOR & COUNCIL COMMUNICATION

June 22, 2021

Subject: Public Hearing: Amending Tucson Code to Implement a Differential Rate Structure for Tucson Water customers Located in Unincorporated Pima County (Outside City) (Continued from June 8, 2021 Meeting)

Issue – Continuation of the June 8, 2021, public hearing concerning the proposed implementation of a differential rate structure for Tucson Water customers located in unincorporated Pima County.

City Manager's Recommendation – Following the close of today's public hearing the Mayor and Council are respectfully requested to consider the attached revised schedule of FY 21-22 differential rate options (Attachment A), and to also consider adoption of the attached ordinance. If adopted, differential rates for Tucson Water customers located in unincorporated Pima County will take effect on or after August 1, 2021.

Background – This item is the continuation of a public hearing held on June 8. The Communication and materials for the June 8 meeting are available on the Mayor and Council meeting notice and agenda website (tinyurl.com/COT-MC-060821, Item #8).

Mayor and Council directed staff to return today with additional analysis of rate options #1, #4, #6, and #7, to include projected revenues, impacts to typical water bills, and a comparison of the rate options to differential rates charged by other water providers. Additionally, Mayor and Council directed staff to describe how differential rate revenues could be used by Tucson Water to support and/or expand its current programs in the following areas:

- Expanding the Low-Income and other Customer Assistance Programs
- Enhancing water resources management
- Improving infrastructure reliability

After today's public hearing, the Mayor and Council may enact a differential rate structure that is equal to or less than the 50% maximum recommended with the Notice of Intention, or they may choose not to implement a differential rate structure.

Summary of Differential Rate Options – As requested by Mayor and Council, Table 1 below shows differential rate options #1, #4, #6, and #7 for the single-family residential (SFR) customer class, which is Tucson Water's largest class with approximately 90% of customer accounts across the entire service area. This class represents 95% of the customer base among customers located in unincorporated Pima County.

The SFR rate structure consists of three basic components: a fixed monthly service charge based upon meter size; a volumetric usage charge based on a four-tiered, inclining-block structure; and miscellaneous fees. The SFR volumetric rate blocks established in FY 2016 are as follows, and would not be affected by the proposed differential rate options:

- Tier 1 = 0-7 Ccf
- Tier 2 = 8-15 Ccf
- Tier 3 = 16-30 Ccf
- Tier 4 = >30 Ccf

Options #1 and #4 are flat percentage increases of 10% and 40%, respectively, across all rates and fees. Options #6 and #7 each feature a base percentage increase for the monthly base rate, first volumetric tier (0–7 Ccf), Central Arizona Project (CAP) Fee, and Conservation Fee, in addition to escalating percentage increases in the inclining block rate structure.

Table 1. Focused rate options for consideration

Single Family Residential	Current Rate FY 21 & FY 22	Option 1 *Flat 10%*		Option 4 *Flat 40%*		Option 6 5% Differential Rate on Base plus Escalating Tiers (T1-5%, T2-10%, T3-15%, T4-20%)		Option 7 10% Differential Rate on Base plus Escalating Tiers (T1-10%, T2-20%, T3-30%, T4-40%)	
Monthly Base Rate (5/8')	$16.33	10%	$17.96	40%	$22.86	5%	$17.15	10%	$17.96
1 – 7 Ccf	$2.07	10%	$2.28	40%	$2.90	5%	$2.17	10%	$2.28
8 – 15 Ccf	$3.82	10%	$4.20	40%	$5.35	10%	$4.20	20%	$4.58
16 – 30 Ccf	$8.39	10%	$9.23	40%	$11.75	15%	$9.65	30%	$10.91
Over 30 Ccf	$12.93	10%	$14.22	40%	$18.10	20%	$15.52	40%	$18.10
CAP Fee	$0.70	10%	$0.77	40%	$0.98	5%	$0.74	10%	$0.77
Conservation Fee	$0.10	10%	$0.11	40%	$0.14	5%	$0.11	10%	$0.11

Highlights of Bill Effects – Each of the differential rate options would result in some level of bill increase for all customers in the unincorporated County. Options #1 and #4 would result in a flat, across-the-board increase of all water bill components. Options #6 and #7 would shift a greater proportion of the rate increase for any given customer toward the higher volumetric rate blocks, potentially increasing the conservation incentive for customers using more than the in-City average of 7 Ccf per month.

The projected effect of each differential rate option upon a sample of SFR customers is shown in Table 2.

Table 2. Residential bill examples (Options #1, #4, #6, and #7)

			Option 1	Option 4	Option 6	Option 7
			Flat 10%	*Flat 40%*	*5% Differential Rate on Base plus Escalating Tiers (T1-5%, T2-10%, T3-15%, T4-20%)*	*10% Differential Rate on Base plus Escalating Tiers (T1-10%, T2-20%, T3-30%, T4-40%)*
Water Bill	**# Ccfs**	**Current**				
Low	4	$27.81	$30.59	$38.93	$29.20	$30.59
Inside City Average	7	$36.42	$40.06	$50.99	$38.24	$40.06
Outside City Average	10	$50.28	$55.31	$70.39	$53.37	$56.45
High	45	$417.18	$458.90	$584.05	$481.24	$545.31

Financial Considerations – New annual revenues anticipated from the implementation of differential water rates would depend on the rate adjustment applied to customers located in unincorporated Pima County. A summary of revenue estimates based on the rate options presented today to Mayor and Council appears in Table 3.

Table 3. Focused revenue estimates

Revenue Projections			
Option 1	**Option 4**	**Option 6**	**Option 7**
Flat 10%	*Flat 40%*	*5% Differential Rate on Base plus Escalating Tiers (T1-5%, T2-10%, T3-15%, T4-20%)*	*10% Differential Rate on Base plus Escalating Tiers (T1-10%, T2-20%, T3-30%, T4-40%)*
$ 6,340,000	**$ 26,520,000**	**$ 4,960,000**	**$ 9,910,000**

Mayor and Council directed staff to describe how differential rate revenues could be used by Tucson Water to support and/or expand specific current programs. Staff proposals for potential uses of additional revenues include:

1. Expand the Low-Income and other Customer Assistance Programs, including:
   - One-time debt forgiveness for those financially impacted by COVID-19
   - Expansion of the low-income program
   - Development of an Emergency / Special Hardship Relief Program

2. Enhance water resources management by:
   - Expanding recharge capabilities
   - Providing additional funding for GSI/Stormwater capture
   - Acquiring and developing additional renewable water supplies

3. Improve infrastructure reliability through investments in:
   - Addressing system-wide leakage and water loss
   - Rehabilitating aging infrastructure
   - Improving system reliability

Additional Information as Requested: In response to stakeholder input gathered prior to and during the June 8 public hearing, Mayor and Council have requested that staff provide additional information related to the proposed implementation of a differential rate structure:

Cost-of-Service analysis: The process of determining which portion of water sales revenues will be borne by each rate class is known as a cost-of-service (COS) allocation. During a full rate-setting process, Tucson Water develops COS models in conjunction with its rate consultants, which are then reviewed by CWAC and the City Manager's Office before being presented to Mayor and Council.

In prior rate-setting processes, CWAC and Tucson Water staff have agreed that the COS allocation approach endorsed by the American Water Works Association should be the "baseline" for setting customer-class revenue targets. In previous years, CWAC has also recommended two adjustments to the baseline COS: a pro-rata redistribution of Tucson Unified School District peak demand costs, and a reallocation of reclaimed water costs.

Previous COS analyses have been done on the entire Tucson Water system, accounting for systemwide components such as customer-class data and peak-demand expectations. The utility does not break down COS allocations by Ward or by ZIP Code, and a typical COS analysis does not provide the granularity to examine specific geographical areas or elevation zones.

Mayor and Council directed Tucson Water staff to explore differential rate options and to go through the procedural process to enact a differential rate structure, but Council has not yet directed Tucson Water to justify such rates by any specific method or process. Further, the Arizona

Supreme Court has held that a cost-of-service analysis is not required to support a differential rate – a City is entitled to a return-on-investment from service to outsiders.

If the Mayor and Council desire that a specific COS analysis be performed to compare customers inside the City to those in unincorporated Pima County, the utility will work with its rate consultants to produce such an analysis. Staff expects this process would take at least six months to complete.

Analysis of delinquent Tucson Water accounts: Mayor and Council previously requested a breakdown of Tucson Water accounts in delinquent status or on a payment plan, in relation to location inside or outside of the City. This analysis is included with this Communication as Attachment B.

Additional legal considerations: Specific challenges to the legality of the proposed differential rate structure were raised during the June 8 public hearing. These are addressed in the attached memorandum from the City Attorney's Office (Attachment C).

COVID-related debt cancellation: There are approximately 3,000 accounts on payment plans that were established by customers that self-reported being negatively affected by the COVID-19 pandemic. The amount outstanding is around $2.5 million and represents water, wastewater, and garbage/recycling services.

Tucson is not the regional water provider: Tucson Water is not the sole regional water provider, and its water service obligations outside the City's jurisdiction are limited to contracts and infill. In a December 10, 2007, memo to Tucson Water (refer to Attachment G in the June 8 public meeting materials), the City Attorney's Office indicated that "the City is not a public service corporation and has no obligation to provide persons in unincorporated areas with water, and need not treat new and existing customers in those areas under the same policies."

CAP allocation does not constitute an agreement to serve outside jurisdiction: The City's CAP Subcontract does not obligate Tucson Water to provide service to specific areas outside of the City's jurisdiction. As noted in a December 11, 2007, memo to Tucson Water (refer to Attachment H in the June 8 public meeting materials), the Department's legal counsel established that the City's CAP Subcontract and the CAP allocation process do not obligate the City to provide water service to any particular area within the City's 50-year service area filed with the Central Arizona Water Conservation District.

Additional staff responses: Throughout the public hearing process, Mayor and Council have provided staff with questions and requests for additional information about the proposed implementation of a differential rate structure. Collected staff responses are included here for Mayor and Council reference as Attachment D.

Legal Consideration – Adoption of the attached ordinance by the Mayor and Council following tonight's public hearing is required to establish a new rate structure effective on or after August 1, 2021.

Consistency with Plan Tucson – The proposed differential rate schedules are consistent with the voter approved goals outlined in Plan Tucson related to the Social Environment policies associated with Governance & Participation (G1-12); the Natural Environment policies associated with Energy & Climate Readiness (including EC8-9), Green Infrastructure (including GI1-6), and Water Resources (including WR1-11); and the Built Environment policies associated with Public Infrastructure, Facilities, & Cost of Development (including PI1-2 & 5-6).

Respectfully submitted,

Timothy M. Thomure, PE, ENV SP
Interim Assistant City Manager

TT/kl
John Kmiec, Interim Director, Tucson Water

Attachments: Attachment A - Tucson Water Proposed Differential Rates for Unincorporated Pima County Customers
Attachment B - Status Report on Utility Billing
Attachment C - Memorandum to Water Department Dated June 15, 2021
Attachment D - Staff Responses to Mayor & Council Inquiries Re: Differential Rate Proposal, June 8 and June 22, 2021
Ordinance

Tucson Water Proposed Differential Rates for Unincorporated Pima County Customers

Rate Component/Class	FY 2021 *Current Rates*	Option 1 *Flat 10%*	Option 4 *Flat 40%*	Option 6 *5% Differential Rate on Base plus Escalating Tiers (T1-5%, T2-10%, T3-15%, T4-20%)*	Option 7 *10% Differential Rate on Base plus Escalating Tiers (T1-10%, T2-20%, T3-30%, T4-40%)*
Service Charge					
Meter Size					
5/8"	$16.33	$17.96	$22.86	$17.15	$17.96
3/4"	$22.03	$24.23	$30.84	$23.13	$24.23
1"	$33.42	$36.76	$46.79	$35.09	$36.76
1.5"	$61.91	$68.10	$86.67	$65.00	$68.10
2"	$96.09	$105.70	$134.52	$100.89	$105.70
2.5"	$141.67	$155.83	$198.33	$148.75	$155.83
3"	$187.24	$205.97	$262.14	$196.60	$205.97
4"	$318.27	$350.10	$445.58	$334.19	$350.10
6"	$646.43	$711.07	$905.00	$678.75	$711.07
8"	$973.44	$1,070.78	$1,362.82	$1,022.11	$1,070.78
10"	$1,486.18	$1,634.80	$2,080.65	$1,560.49	$1,634.80
12"	$2,454.68	$2,700.15	$3,436.56	$2,577.42	$2,700.15
Usage Charge (Per Ccf)					
Residential (Single Family) Block Rates					
1-7 Ccf	$2.07	$2.28	$2.90	$2.17	$2.28
8-15 Ccf	$3.82	$4.20	$5.35	$4.20	$4.58
16-30 Ccf	$8.39	$9.23	$11.75	$9.65	$10.91
Over 30 Ccf	$12.93	$14.22	$18.10	$15.52	$18.10
Residential (Duplex-Triplex) Block Rates					
1-10 Ccf	$2.07	$2.28	$2.90	$2.17	$2.28
10-20 Ccf	$3.82	$4.20	$5.35	$4.20	$4.58
21-35 Ccf	$8.39	$9.23	$11.75	$9.65	$10.91
Over 35 Ccf	$12.93	$14.22	$18.10	$15.52	$18.10
Other Classes: Base Rates					
Multifamily *	$3.42	$3.76	$4.79	$3.59	$3.76
Mobile Home Parks w/sub-meters *	$2.56	$2.81	$3.58	$2.68	$2.81
Community Garden *	$2.56	$2.81	$3.58	$2.68	$2.81
Commercial	$3.36	$3.69	$4.70	$3.52	$3.69
Industrial	$3.38	$3.71	$4.73	$3.55	$3.71
Construction *	$3.70	$4.07	$5.18	$3.89	$4.07
Tier Rates (Summer Only: May - Oct)**					
Tier 1	$1.08	$1.19	$1.51	$1.13	$1.19
Tier 2	$0.29	$0.32	$0.41	$0.30	$0.32
CAP Charge ***	$0.70	$0.77	$0.98	$0.74	$0.77
Conservation Charge	$0.10	$0.11	$0.14	$0.11	$0.11

*** Uniform rate year-round; not subject to summer tier rates**
****Applicable for Commercial and Industrial classes only**
***** Assessed to potable customers only**

6/9/2021

Attachment A

MEMORANDUM

DATE: June 15, 2021

TO: John Kmiec
Interim Director
Tucson Water

FROM: Chris Avery
Principal Assistant City Attorney

SUBJECT: WHETHER A.R.S. § 9-511.01 OR TUCSON CODE § 27-32 PRECLUDE THE CITY FROM ADOPTING A DIFFERENTIAL RATE FOR CUSTOMERS OUTSIDE OF MUNICIPAL BOUNDARIES.

During the Mayor and Council meeting of June 8, 2021, a member of the Mayor and Council requested the City Attorney's Office to respond to allegations that the proposed differential rate considered at Item Number 8, Public Hearing: Amending the Tucson City Code (Chapter 27) Relating to the Implementation of a Differential Rate Structure, was illegal under two separate statutes: A.R.S. § 9-511 and Tucson Code § 27-32. This Memorandum is a response to that inquiry.

As a preliminary matter, the Arizona Supreme Court in *Jung v. City of Phoenix,* 160 Ariz. 38 (1989), expressly held that as "a general rule a municipally owned waterworks system supplying water outside its corporate limits may charge more for that service than it charges the users who reside within the corporate limits." 160 Ariz. at 40. Because the municipality is providing a public utility service, it must charge a "reasonable rate." *Id.* at 41. The *Jung* Court held that "proof that service of nonresidents involves greater expenses is sufficient to show a city acted reasonably in charging higher rates for nonresidents," but that a cost of service analysis is provided only as an illustration and not a limitation. *Id.*

The statutory analysis is simple. Like *Jung*, A.R.S. § 9-511.01(D) and -511.01(E) require that any proposed water rate be "just and reasonable" and declare that "unjust and unreasonable" rates or charges are illegal. A.R.S. § 9-511.01(A) also establishes the procedures for adopting a new rate or revenue increase. Tucson Code § 27-32 provides that Tucson Water rates "shall, to the extent possible, be consistent with the policy of charging for water in direct proportion to the cost of securing, developing, and delivering the water to the customers of the city water system."

Under *Jung*, a differential rate would be legal if the Mayor and Council were to accomplish the following steps: (1) provide appropriate direction to staff about the amount of a differential water rate, so that the rate differential is reasonable, (2) provide direction regarding the purposes for which the differential rate will be used, and the policy considerations underpinning that decision (again, so that the rate being charged is reasonable, and not arbitrary or punitive), and, (3) allow for sufficient time for all of the procedural requirements to be accomplished before the rate is actually assessed to customers, including the furnishing of a "cost of service" or rate study.

On June 8, when the Mayor and Council directed Tucson Water to return to the Mayor and Council with four proposed revenue increases, it also directed that Tucson Water provide an analysis of how any increased revenues could be used for (1) expanding the Low-Income Program, (2) water resources management, and (3) infrastructure reliability. This direction ensures that all of the funds from any differential rate will be used for programs within Tucson Water, and any increased spending to support those programs will increase the total costs that Tucson Water will spend in future years, all of which will be paid by Tucson Water ratepayers. Thus, to the extent that revenues from a differential rate increase stay within Tucson Water and are spent to accomplish the policy goals of the Mayor and Council, Tucson Water's rates, in the aggregate, are "cost of service" rates.

Nonetheless, in light of this direction by the Mayor and Council on June 8, as summarized in the Legal Action Report, it is the recommendation of this office that any proposed differential rate adopted by the Mayor and Council during the continuation of the Public Hearing be analyzed by a cost of service study before final adoption. First, such a study—as recognized by *Jung*—could form the basis for a showing that the adopted rates are reasonable. Second, to the extent that the rates are entirely or "to the extent possible" based on proportional costs of service, the rates would be reasonable under *Jung* and A.R.S. § 9-511.01, and would also be consistent with Tucson Code § 27-32. If some portions of the differential rates were found not to be based on "cost of service," the extent of that discrepancy would be an important consideration in any subsequent legal analysis of whether the rates are "reasonable." While the *Jung* Court expressly held that a city may "glean a [reasonable] profit from outsiders," a cost of service study showing that even some of the rate is supported by increased costs is an important component of determining whether the "profit" is reasonable. 160 Ariz. at 40-41 (insertion mine). Following the results of such a study, if the Mayor and Council were to obtain a reasonable "profit" from non-resident customers, the Mayor and Council should amend Tucson Code § 27-32 alongside any such rate or revenue increase to reflect that policy decision; to expressly hold that rates for customers within the unincorporated area will be set in proportion to costs, plus a reasonable differential.

CA/dg
cc:

ADOPTED BY THE
MAYOR AND COUNCIL

June 22, 2021

ORDINANCE NO. 11846

RELATING TO WATER; AMENDING THE TUCSON CODE, CHAPTER 27, WATER, ARTICLE II, RATES AND CHARGES; SECTION 27-33, MONTHLY POTABLE WATER SERVICE CHARGES BY ADDING RATES FOR TUCSON WATER CUSTOMERS IN UNINCORPORATED PIMA COUNTY BEGINNING IN FISCAL YEAR (FY) 2022; AND SETTING AN EFFECTIVE DATE.

BE IT ORDAINED BY THE MAYOR AND COUNCIL OF THE CITY OF TUCSON ARIZONA, AS FOLLOWS:

SECTION 1. The Tucson Code, Chapter 27, Article II, Section 27-33 is hereby amended to read as follows:

ARTICLE II. RATES AND CHARGES

* * *

Sec. 27-33. Monthly potable water service charges.

For the purposes of computing monthly water charges:

(1) The monthly service charge shown in the following table applies to all customer classes. The fee shall be charged whether or not any water is provided.

Service Size (inches)	*MONTHLY SERVICE CHARGE FOR UNINCORPORATED PIMA COUNTY*
	FY 2022
5/8	$24.49
3/4	$33.04
1	$50.13
1 1/2	$92.86
2	$144.13
2 1/2	$212.50
3	$280.86
4	$477.41
6	$969.64
8	$1,460.16
10	$2,229.27
12	$3,682.02

(2) Monthly water use charges in addition to the service charge shall be applicable to each service connection and shall be per Ccf and vary with customer classification and volumes used according to the following table:

RATE SCHEDULES BY CUSTOMER CLASSES FOR UNINCORPORATED PIMA COUNTY

Residential Single-Family	*$/Ccf*
	FY 2022
1–7 Ccf	$3.11
8-15 Ccf	$5.73
16–30 Ccf	$12.59
Over 30 Ccf	$19.40

Residential Duplex-Triplex	*$/Ccf*
	FY 2022
1 – 10 Ccf	$3.11
11 – 20 Ccf	$5.73
21 – 35 Ccf	$12.59
Over 35 Ccf	$19.40

Multi-Family	*$/Ccf*
	FY 2022
Basic Volume Charge	$5.13

Mobile Home Park with Sub-Meters	*$/Ccf*
	FY 2022
Basic Volume Charge	$3.84
Community Garden	$3.84
Commercial	*$/Ccf*
	FY 2022
Basic Volume Charge	$5.03
Tier 1 Summer Surcharge: for usage during May-October above 100% of winter (November-April) average	$1.62
Tier 2 Summer Surcharge: for usage during May-October above 145% of winter (November-April)	$0.44

average, added to Tier 1 Surcharge	
Industrial (more than 5 Mg per month & Tucson Unified School District by contract)	*$/Ccf*
	FY 2022
Basic Volume Charge	$5.07
Tier 1 Summer Surcharge: for usage during May-October above 100% of winter (November-April) average	$1.62
Tier 2 Summer Surcharge: for usage during May-October above 145% of winter (November-April) average, added to Tier 1 Surcharge	$0.44

Construction Water	*$/Ccf*
	FY 2022
Basic Volume Charge	$5.55

(3) The Central Arizona Project surcharge shall be in addition to the service charge and water use charges for all customer classes and apply to all monthly water use at the rate of sixty-nine cents ($1.05) per Ccf beginning in FY 2022.

(4) The conservation charge shall be in addition to the service charge and water use charges for all potable water customer classes and apply to all monthly water use at the rate of ten cents ($0.15) per Ccf beginning in FY 2022.

SECTION 2. The rate changes approved by this Ordinance for customers in unincorporated Pima County shall take effect on July 12, 2021.

SECTION 3. The various City officers and employees are authorized and directed to perform all acts necessary or desirable to give effect to this Ordinance.

SECTION 4. If any provisions of this Ordinance, or the application thereof to any person or circumstance is invalid, the invalidity shall not affect other provisions or applications of this Ordinance which can be given effect without the invalid provision or circumstance, and to this end, the provisions of this Ordinance are severable.

PASSED, ADOPTED AND APPROVED by the Mayor and Council of the City of Tucson, Arizona, June 22, 2021.

_____
MAYOR

ATTEST:

_____
CITY CLERK

APPROVED AS TO FORM:

_____
CITY ATTORNEY

REVIEWED BY:

_____
CITY MANAGER

CA/dg
6/15/21

MAYOR & COUNCIL COMMUNICATION

October 19, 2021

Subject: Public Hearing: Amending Tucson Code to implement a differential rate structure for Tucson Water customers located in unincorporated Pima County and adoption of proposed changes to the Tucson City Code Sections 27-32 and 27-33 relating to charges for water service; Adoption of Ordinance. (Outside City)

Issue – Public hearing concerning the proposed implementation of a differential rate structure for Tucson Water customers located in unincorporated Pima County.

City Manager's Recommendation – Following the close of today's public hearing the Mayor and Council are respectfully requested to consider adoption of the attached ordinance (Attachment A), which will cause the attached differential rate schedule (Attachment B) for Tucson Water customers located in unincorporated Pima County to take effect on or after December 1, 2021.

Background – On June 22, 2021, Mayor and Council unanimously adopted Ordinance 11846 directing staff to establish a differential water rate for customers in unincorporated Pima County, to take effect on December 1, 2021.

By adopting Ordinance 11846, Mayor and Council found that implementing this rate structure would result in reasonable differential rates and would advance policy considerations that are critical to the City, including:

- The rate structure supports and rewards annexation and incorporation, providing economic benefit and increased state shared revenues for the City and the region;
- The rate structure recognizes that the City, as owner of Tucson Water, bears financial risks and liabilities that are not shared by the unincorporated County, including the City's financial backstopping of the utility;
- The rate structure promotes environmental sustainability and water conservation, particularly in areas outside the City limits where the City has limited powers to promote those interests.

Mayor and Council further found that implementation of a differential water rate structure is permissible under Arizona law and commonplace among Arizona municipalities that own and operate water utilities.

Mayor and Council moved to direct staff to complete a broad cost-of-service (COS) analysis to demonstrate that a rational relationship exists between the adopted differential rate structure and the services provided to customers residing in unincorporated Pima County. Staff have engaged with the utility's financial consultants to produce the differential rate COS study as directed. Results of the COS study have been provided to Mayor and Council and made available for public review, and the COS study is included here as Attachments C and D (Phase 1 Preliminary Outside Differential Rate Analysis; Phase 2 Outside Differential Rate Analysis).

At the Regular Meeting of Mayor and Council on August 10, 2021, the Mayor and Council adopted a Notice of Intention to implement the previously adopted differential water rate structure. Implementation of the adopted differential rate structure was scheduled for public hearing today. At the conclusion of today's public hearing, the Mayor and Council will have completed the necessary steps to adopt the proposed Attachment A Ordinance, which will entirely supplant Ordinance 11846.

Present Considerations – Tucson Water engaged Galardi Rothstein Group and Raftelis (GRG/Raftelis) to perform a COS analysis to assess various options for calculating rate differentials to be applied to outside-City customers. The results of the COS analysis are supplemental to the policy basis already used to approve the differential rate. In making this decision to assess a higher rate, Mayor and Council made a policy decision that outside-City customers would be considered "non-owners" of the Tucson Water system from a rate-setting perspective and should be assessed rates consistent with that status.

The Phase 1 analysis performed by GRG/Raftelis used readily available data to develop revenue requirements for the Tucson Water system. Revenue requirements were allocated between inside-City customers and outside-City customers based solely on annual water use. The outside-City customer revenue requirements were compared to the revenue generated by outside-City customers under Tucson Water's existing rates. The difference between the calculated revenue requirements and revenue at existing rates serves as an approximation of a cost-based rate differential. The results of the Phase 1 analysis indicated outside-City rate differentials ranging between 6.1% and 25.7%, depending on the cost of equity applied to outside-City customers for determining a return on investment for inside-City customers.

Upon completion of the Phase 1 analysis, Tucson Water tasked GRG/Raftelis with performing a Phase 2 analysis. Phase 2 involved exploring potential differences in the costs to serve outside-City customers in more detail, and to narrow the range of returns on investment that could be used to calculate a differential rate. The Phase 2 analysis determined that cost-based rate differentials range between 9% and 26% depending on the differential in the rate of return between inside-City and outside-City customers. The choice of an appropriate rate-of-return differential between inside-City and outside-City customers is a policy decision. However, even if no rate-of-return differential is applied, the Phase 2 analysis determined that a cost-based differential of approximately 5% exists between inside-City and outside-City customers. This 5% differential is driven by the higher peak demands of the outside-City customers as well as the greater relative cost of constructing, operating, and maintaining the distribution system that serves the outside-City customers.

In summary, the Phase 1 and Phase 2 COS analyses performed by GRG/Raftelis demonstrate that a reasonable relationship exists between the adopted differential rate structure and the services provided to customers residing in unincorporated Pima County.

Summary of Adopted Differential Rate Structure – The differential rate structure adopted by Mayor and Council on June 22, and which remains completely intact in the attached Ordinance for consideration with this matter, is presented in Attachment A. Table 1 below compares inside- and outside-City water rates for the single-family residential (SFR) customer class, which is Tucson Water's largest class with approximately 90% of customer accounts across the entire service area. This class represents 95% of the customer base among customers located in unincorporated Pima County.

The SFR rate structure consists of three basic components: a fixed monthly service charge based upon meter size; a volumetric usage charge based on a four-tiered, inclining-block structure (measured in hundreds of cubic feet, or Ccf); and miscellaneous fees. The SFR volumetric rate blocks established in FY 2016 are as follows, and would not be affected by the adopted differential rate structure:

- Tier 1 = 0-7 Ccf
- Tier 2 = 8-15 Ccf
- Tier 3 = 16-30 Ccf
- Tier 4 = >30 Ccf

For Tucson Water customers in unincorporated Pima County, the adopted differential rate structure would result in a 10% increase for the monthly base rate, the first volumetric tier (0–7 Ccf), the Central Arizona Project (CAP) fee, and the conservation Fee; escalating percentage increases would apply to the inclining block rate structure.

Table 1. Inside/Outside-City SFR Rate Comparison

Single Family Residential	Current Rate FY 21 & FY 22	10% Differential Rate on Base plus Escalating Tiers (T1-10%, T2-20%, T3-30%, T4-40%)	
Monthly Base Rate (5/8")	$16.33	10%	$17.96
1-7 Ccf	$2.07	10%	$2.28
8-15 Ccf	$3.82	20%	$4.58
16-30 Ccf	$8.39	30%	$10.91
Over 30 Ccf	$12.93	40%	$18.10
CAP Fee	$0.70	10%	$0.77
Conservation Fee	$0.10	10%	$0.11

Highlights of Bill Effects – The projected effect of the adopted differential rate structure upon a sample of SFR customers is shown in Table 2 below. The differential rate structure would shift a

greater proportion of the rate increase toward the higher volumetric rate blocks, potentially increasing the conservation incentive for customers using more than the in-City average of 7 Ccf per month.

Table 2. Sample Residential Bill Impact

Water Bill	# Ccfs	Current	10% Differential Rate on Base plus Escalating Tiers (T1-10%, T2-20% T3-30%, T4-40%	Percentage Increa
Low Usage	4	$27.81	$30.59	10.0%
Inside-City Average	7	$36.42	$40.06	10.0%
Outside-City Average	10	$50.28	$56.45	12.3%
High Usage	45	$417.18	$545.31	30.7%

Financial Considerations – New annual revenues from the implementation of the adopted differential water rate structure are estimated to be about $9.9M. As directed by Mayor and Council at the June 22 public hearing, all additional revenues generated by differential rates will be retained entirely within the utility and will be used for the following three purposes:

- Infrastructure maintenance and upgrades to enhance water delivery from the City limits to outside the City limits;
- Climate Resiliency and Water Sustainability for recharge, retention and reclamation projects (primarily outside the City limits) and enhancing the tree canopy throughout the entire Tucson water system; and
- Financial resiliency in the form of expansion of the low-income program and a one-time pay down of eligible delinquent accounts that have been negatively impacted by COVID-19.

Stakeholder Outreach and Response – Tucson Water conducted extensive community outreach and education about the differential rate proposal prior to the June 22, 2021, public hearing that resulted in the adoption of the attached rate schedule. Today's public hearing was advertised on the City's website on September 17, 2021, and in the major local newspaper on September 26, 2021, in conformance with the requirements of State law.

An open and public process was conducted for review and discussion of the differential rate COS study produced by Tucson Water's financial consultants. The Finance Subcommittee of the Citizens' Water Advisory Committee (CWAC) met on July 28 and again on September 16, 2021, to consider

the COS study. The full CWAC reviewed and discussed the topic at its regular meetings on September 1 and October 6, 2021. Pima County remained actively engaged throughout this process, with County representatives attending CWAC meetings and the County providing input via memoranda to CWAC (Attachment E).

CWAC has prepared a statement to Mayor and Council regarding its engagement in this process. The document is attached as Attachment G.

Legal Considerations – Analysis by Tucson Water's financial consultants demonstrates that a reasonable relationship exists between the adopted differential rate structure and the services provided to customers residing in unincorporated Pima County. Differential water rates are allowed by Arizona law, provided that the rates are based upon a reasonable relationship to the services provided. The practice is commonplace among Arizona towns and cities that operate water utilities serving customers outside of their jurisdiction.

Additional legal considerations were fully addressed by Mayor and Council during the June 22 public hearing that resulted in the adoption of the attached rate schedule. Notably, in *Jung v. City of Phoenix*, 160 Ariz. 38 (1989), the Arizona Supreme Court expressly held that as "a general rule a municipally owned waterworks system supplying water outside its corporate limits may charge more for that service than it charges the users who reside within the corporate limits." 160 Ariz. at 40. Because the municipality is providing a public utility service, it must charge a "reasonable rate." *Id.* at 41. The *Jung* Court held that "proof that service of nonresidents involves greater expenses is sufficient to show a city acted reasonably in charging higher rates for nonresidents." *Id.* One notable difference between the present day and June 22 is the Mayor and Council's direction to proceed with a COS study; the COS study shows that service of nonresidents involves greater expenses than service of Tucson residents.

On September 22, 2021, Pima County Administrator Chuck Huckleberry addressed a memo to the County Board of Supervisors (Attachment F) stating disagreement with the conclusions of Tucson Water's differential rate COS study. Mr. Huckleberry contends that the study is based upon invalid criteria and therefore does not provide a legitimate basis for a differential fee to be applied to unincorporated County residents. The County Administrator advises the Board that a July 28, 2021, County Attorney analysis found "standing and capacity" for the County to pursue legal action against the City if a differential water rate is implemented. It is worth noting that the County Attorney's analysis was made before the completion of Phase 2 of Tucson Water's COS study.

The Governing Body has conformed to the requirements of State law in adopting the Notice of Intention to increase rates, filing supporting materials with the City Clerk for public review, posting notice of proposed rates on the City's website, and scheduling and advertising today's public hearing. Adoption of the Attachment A ordinance will replace the June 22 Ordinance with the attached

ordinance. This ordinance is supported by a COS analysis, and any assorted policy considerations to be added to its legislative history, including, but not limited to, the policy considerations established in the draft ordinance attached to this Communication as Attachment A. The draft ordinance also amends Tucson Code Section 27-32, to provide that rates for customers within the unincorporated area, outside lands placed into trust for Native American tribes, will be set in proportion to costs, plus a reasonable differential.

Consistency with Plan Tucson – The proposed differential rate schedules are consistent with the voter approved goals outlined in Plan Tucson related to the Social Environment policies associated with Governance & Participation (G1-12); the Natural Environment policies associated with Energy & Climate Readiness (including EC8-9), Green Infrastructure (including GI1-6), and Water Resources (including WR1-11); and the Built Environment policies associated with Public Infrastructure, Facilities, & Cost of Development (including PI1-2 & 5-6).

Rate Change Implementation – If so directed by the Mayor and Council following tonight's public hearing, the differential rate structure will become effective on or after December 1, 2021.

Respectfully submitted,

Timothy M. Thomure, PE, ENV SP
Assistant City Manager

TT/kl
John Kmiec, Interim Director, Tucson Water

Attachments:
- Attachment A: Ordinance
- Attachment B: Adopted schedule of differential rates
- Attachment C: Raftelis Phase 1 Preliminary Outside Differential Rate Analysis
- Attachment D: Raftelis Phase 2 Outside Differential Rate Analysis
- Attachment E: Pima County correspondence with CWAC
- Attachment F: Pima County response to differential rate COS study
- Attachment G: Final CWAC Response on Review of Differential Water Rates Cost of Service Analysis

Tucson Water Proposed Differential Rates for Unincorporated Pima County Customers

Rate Component/Class	FY 2022 *Current Rates*	New Rates *10% Differential Rate on Base plus Escalating Tiers (T1-10%, T2-20%, T3-30%, T4-40%)*
Service Charge		
Meter Size		
5/8"	$16.33	$17.96
3/4"	$22.03	$24.23
1"	$33.42	$36.76
1.5"	$61.91	$68.10
2"	$96.09	$105.70
2.5"	$141.67	$155.83
3"	$187.24	$205.97
4"	$318.27	$350.10
6"	$646.43	$711.07
8"	$973.44	$1,070.78
10"	$1,486.18	$1,634.80
12"	$2,454.68	$2,700.15
Usage Charge (Per Ccf)		
Rates		
1-7 Ccf	$2.07	$2.28
8-15 Ccf	$3.82	$4.58
16-30 Ccf	$8.39	$10.91
Over 30 Ccf	$12.93	$18.10
Residential (Duplex-Triplex) Block Rates		
1-10 Ccf	$2.07	$2.28
10-20 Ccf	$3.82	$4.58
21-35 Ccf	$8.39	$10.91
Over 35 Ccf	$12.93	$18.10
Other Classes: Base Rates		
Multifamily *	$3.42	$3.76
Mobile Home Parks w/sub-meters *	$2.56	$2.81
Community Garden *	$2.56	$2.81
Commercial	$3.36	$3.69
Industrial	$3.38	$3.71
Construction *	$3.70	$4.07
Tier Rates (Summer Only: May -		
Tier 1	$1.08	$1.19
Tier 2	$0.29	$0.32
CAP Charge *	$0.70	$0.77
Conservation Charge	$0.10	$0.11

*** Uniform rate year-round; not subject to summer tier rates**
****Applicable for Commercial and Industrial classes only**
***** Assessed to potable customers only**

7/22/2021

ADOPTED BY THE
MAYOR AND COUNCIL

June 22, 2021

ORDINANCE NO. 11846

RELATING TO WATER; AMENDING THE TUCSON CODE, CHAPTER 27, WATER, ARTICLE II, RATES AND CHARGES; SECTION 27-33, MONTHLY POTABLE WATER SERVICE CHARGES BY ADDING RATES FOR TUCSON WATER CUSTOMERS IN UNINCORPORATED PIMA COUNTY BEGINNING IN FISCAL YEAR (FY) 2022; MAKING LEGISLATIVE FINDINGS; AND SETTING AN EFFECTIVE DATE.

BE IT ORDAINED BY THE MAYOR AND COUNCIL OF THE CITY OF TUCSON ARIZONA, AS FOLLOWS:

SECTION 1. The Tucson Code, Chapter 27, Article II, Section 27-33 is hereby amended to read as follows:

ARTICLE II. RATES AND CHARGES

* * *

Sec. 27-33. Monthly potable water service charges.

For the purposes of computing monthly water charges:

(1) The monthly service charge shown in the following table applies to all customer classes. The fee shall be charged whether or not any water is provided.

Service Size (inches)	*MONTHLY SERVICE CHARGE FOR UNINCORPORATED PIMA COUNTY*
	FY 2022
5/8	$17.96
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1	$36.76
1 1/2	$68.10
2	$105.70
2 1/2	$155.83
3	$205.97
4	$350.10
6	$711.07
8	$1,070.78
10	$1,634.80
12	$2,700.15

(2) Monthly water use charges in addition to the service charge shall be applicable to each service connection and shall be per Ccf and vary with customer classification and volumes used according to the following table:

RATE SCHEDULES BY CUSTOMER CLASSES FOR UNINCORPORATED PIMA COUNTY

Residential Single-Family	*$/Ccf*
	FY 2022
1–7 Ccf	$2.28
8-15 Ccf	$4.58
16–30 Ccf	$10.91
Over 30 Ccf	$18.10

Residential Duplex-Triplex	*$/Ccf*
	FY 2022
1 – 10 Ccf	$2.28
11 – 20 Ccf	$4.58
21 – 35 Ccf	$10.91
Over 35 Ccf	$18.10

Multi-Family	*$/Ccf*
	FY 2022
Basic Volume Charge	$3.76

Mobile Home Park with Sub-Meters	*$/Ccf*
	FY 2022
Basic Volume Charge	$2.81
Community Garden	$2.81
Commercial	*$/Ccf*
	FY 2022
Basic Volume Charge	$3.69
Tier 1 Summer Surcharge: for usage during May-October above 100% of winter (November-April) average	$1.19
Tier 2 Summer Surcharge: for usage during May-October above 145% of winter (November-April)	$0.32

average, added to Tier 1 Surcharge	
Industrial (more than 5 Mg per month & Tucson Unified School District by contract)	*$/Ccf*
	FY 2022
Basic Volume Charge	$3.71
Tier 1 Summer Surcharge: for usage during May-October above 100% of winter (November-April) average	$1.19
Tier 2 Summer Surcharge: for usage during May-October above 145% of winter (November-April) average, added to Tier 1 Surcharge	$0.32

Construction Water	*$/Ccf*
	FY 2022
Basic Volume Charge	$4.07

(3) The Central Arizona Project surcharge shall be in addition to the service charge and water use charges for all customer classes and apply to all monthly water use at the rate of seventy-seven cents ($0.77) per Ccf beginning in FY 2022.

(4) The conservation charge shall be in addition to the service charge and water use charges for all potable water customer classes and apply to all monthly water use at the rate of eleven cents ($0.11) per Ccf beginning in FY 2022.

SECTION 2. The rate changes approved by this Ordinance for customers in unincorporated Pima County shall take effect on December 1, 2021.

SECTION 3. The Mayor and Council find that implementing the differential rate structure as provided in this Ordinance results in reasonable differential rates and advances critical policy considerations including:

1. the rate structure supports and rewards annexation and incorporation, providing economic benefit and increased state shared revenues for the City and the region;

2. the rate structure recognizes that the City, as owner of Tucson Water, bears financial risks and liabilities that are not shared by the unincorporated county, including the City's financial backstopping of the utility;

3. the rate structure promotes environmental sustainability and water conservation, particularly in areas outside the city limits where the City has limited powers to promote those interests; and

4. the rate structure is common among other Arizona municipal water providers for similar policy reasons.

SECTION 4. The various City officers and employees are authorized and directed to perform all acts necessary or desirable to give effect to this Ordinance.

SECTION 5. If any provisions of this Ordinance, or the application thereof to any person or circumstance is invalid, the invalidity shall not affect other provisions or applications of this Ordinance which can be given effect without the invalid provision or circumstance, and to this end, the provisions of this Ordinance are severable.

PASSED, ADOPTED AND APPROVED by the Mayor and Council of the City of Tucson, Arizona, June 22, 2021.

MAYOR

ATTEST:

CITY CLERK

APPROVED AS TO FORM:

CITY ATTORNEY

REVIEWED BY:

CITY MANAGER

CA/dg
6/1/21

COUNTY ADMINISTRATOR'S OFFICE

PIMA COUNTY GOVERNMENTAL CENTER
130 W. CONGRESS, FLOOR 10, TUCSON, AZ 85701-1317
(520) 724-8661 FAX (520) 724-8171

C.H. HUCKELBERRY
County Administrator

September 8, 2021

Citizens' Water Advisory Committee
c/o Tucson Water Intergovernmental Coordination
Delivered via Email to: Jessica.Rodriguez@tucsonaz.gov

Re: **Tucson Water Cost-of-service Study—Response to Raftelis Memorandum**

Dear Chair and Members, Citizens' Water Advisory Committee:

You received the attached technical memorandum on August 30, 2021 drafted by Raftelis Financial Consultants, Inc., primarily addressing two items raised in my July 30, 2021 letter to you. These relate to appropriateness of applying the utility and return on equity approaches to Tucson Water customers residing in the unincorporated areas of the County.

While I do not dispute that the methodologies discussed in that memorandum are generally correct, they are, however offered devoid of context. In lieu of addressing the validity of the reasons I provided as to why the utility approach is problematic to the Tucson Water context, the Raftelis memorandum instead lists examples of other utilities using this approach as well as citing the American Water Works Association (AWWA) *Water Rates Fees and Charges (M1)* manual which lists this option to supplement other methods in determining rates. The Raftelis justification assumes all public utilities structure ownership, debt and risk in the same manner. However, clearly that is not the case. Some public utilities generate profit to shareholders; others may structure debt through the municipality general fund, thereby placing liability squarely within the municipal corporate boundaries.

None of these is the case with Tucson Water where the entire utility debt and risk is held by ratepayers and not residents of the municipality. In the event of a force majeure, the City of Tucson would secure mitigating debt against future revenues generated by ratepayers, thereby leaving Tucson Water residents in the unincorporated areas as exposed as Tucson resident ratepayers. City of Tucson residents receiving water from other utilities such as Metro Water, however, would not be exposed to this additional liability since they are not ratepayers. Clearly and based on historical City practice, the criteria of residency within the Tucson Corporate limits has no bearing on assets, risk and debt held by the Tucson Water utility.

The same context applies to the return on equity approach. While the City of Tucson ownership of water infrastructure assets is not in dispute, the manner in which the City has structured the Tucson Water enterprise results in risk borne by Tucson Water ratepayers and not City

residents. This fact is further evidenced by subsidies for reclaimed water, contaminated City water wells and green infrastructure, all of which are subsidized by all Tucson Water ratepayers to benefit projects within City limits. The reclaimed water system revenue shortfall, contamination mitigation costs, and the Green Stormwater Infrastructure Fee could have been borne by the City General Fund. Instead, Mayor and Council has selected to apply these City liabilities to all Tucson Water ratepayers. This demonstrates an additional burden placed on unincorporated residents in lieu of the converse since they draw no benefit from these liabilities.

Furthermore, the Raftelis memorandum indicates that "...outside City customers could not own such assets due to the lack of enabling legislation for the County to operate a water utility." While it is correct that counties in Arizona do not have authority to operate a water utility, outside customers could own assets by forming a Domestic Water Improvement District or by requesting service from another water utility. However, Arizona Department of Water Resources and Arizona Corporation Commission rules preclude utilities from enabling service in existing service areas without the approval of the serving utility. Thus, outside City customers cannot own water service assets, not due to lack of county enabling authority but due to control held by the City of Tucson.

Finally and since the Raftelis justifications rely heavily on the AWWA M1 manual, it is appropriate to note two introductory paragraphs in the manual related to rates, fees and charges objectives:

As a manual of standard practice, AWWA advocates the use of the generally accepted cost-based principles and methodologies for establishing rates, charges, and fees contained and discussed within this manual. ***Establishing cost-based and equitable rates is technically challenging and requires, at some level, knowledge and understanding of finance, accounting, budgeting, engineering, system design and operations, customer service, public outreach and communication, and the legal environment as it may relate to setting rates, fees, and charges.***

Water rates developed using the methodologies discussed in this manual, when appropriately applied, are generally considered to be fair and equitable because these rate-setting methodologies result in cost-based rates that generate revenue from each class of customer in proportion to the cost to serve each class of customer. Water rates are considered fair and equitable when each customer class pays the costs allocated to the class and, consequently, cross-class subsidies are avoided. *While recovery of the full revenue requirement in a fair and equitable manner is a key objective of a utility using a cost-of-service rate-making process, it is often not the only objective. The following list contains the typical objectives in establishing cost-based rates (Bonbright, Danielsen, and Kamerschen 1988):*

- *Effectiveness in yielding total revenue requirements (full cost recovery)*
- *Revenue stability and predictability*
- *Stability and predictability of the rates themselves from unexpected or adverse changes*
- *Promotion of efficient resource use (conservation and efficient use)*
- *Fairness in the apportionment of total costs of service among the different ratepayers*
- *Avoidance of undue discrimination (subsidies) within the rates*
- *Dynamic efficiency in responding to changing supply-and-demand patterns*

- *Freedom from controversies as to proper interpretation of the rates*
- *Simple and easy to understand*
- *Simple to administer*
- *Legal and defendable*

Clearly, the AWWA advocates applying not all available methodologies but appropriate methodologies grounded in a thorough understanding of context and equity as I have outlined in my previous letter to you.

Sincerely,

Yves Khawam, PhD
Assistant County Administrator for Public Works

Attachment

c: C.H. Huckelberry, County Administrator
Jan Lesher, Chief Deputy County Administrator
Carmine DeBonis, Jr., Deputy County Administrator for Public Works
Jackson Jenkins, Director, Regional Wastewater Reclamation Department
Kathy Chavez, Water Policy Manager

TECHNICAL MEMORANDUM

To: John Kmiec, Interim Utility Director, Tucson Water

From: Harold Smith, Raftelis Financial Consultants, Inc.

Subject: Response to County Letter to Citizens' Water Advisory Committee

CC: Deborah Galardi, Galardi Rothstein Group

The purpose of this memorandum is to address certain technical issues raised by Pima County in its letter to the Citizens' Water Advisory Committee (CWAC) dated July 30, 2021. Specifically, the following items are addressed:

- The appropriateness of the use of the utility approach to determine the revenue requirements to be recovered from the Outside Customers
- Return on Equity issues, and
- Cost-of-service factors to be considered in the Phase 2 outside city differential analysis that is currently being conducted.

Appropriateness of Utility Basis for Municipal Utilities

The County states that the utility basis is designed for use by private utilities such that they can earn a return on their investment and generate a profit. While it is true that the utility approach is commonly used by investor owned utilities as the basis for determining rates, this is only one use of the methodology. For example, municipal utilities regulated by the Wisconsin Public Utility Commission are required to use the utility basis in the determination of rates. Additionally, municipal utilities across the country utilize the utility approach when calculating rates for outside-city and wholesale customers. Some examples include the utilities that serve Milwaukee, Wisconsin; Salt Lake City, Utah; Portland, Oregon and Oklahoma City, Oklahoma.

The County letter states that there is no basis for a municipal utility to use the utility approach when determining rates. In fact, it is not uncommon for municipal utilities to use the utility approach when determining rates, especially when setting rates for customers located outside the municipality's corporate boundaries. The American Water Works Association (AWWA), delineates the use of the utility approach by municipal utilities when calculating rates for outside city customers in its Manual of Water Supply Practices, M-1, *Principles of Water Rates, Fees and Charges*:

> *"Municipal or government-owned utilities may also use the utility-basis approach for purposes of cost allocation. It is considered an appropriate method for calculating the costs of service applicable to all classes of customers, but it is particularly applicable to those customers located outside the geographical limits of a government-owned utility. (Page 14, AWWA Manual M-1, Seventh Edition)*

Return on Equity

The County's letter states that the only basis for establishing a differential rate for a municipal utility, aside from differential infrastructure and operational costs, is if one class of customers incurs risk beyond that of another class. While it is true that differential rates of return may reflect differences in risks, they may be imposed to secure ownership benefits (irrespective of differential risks).

Again, from AWWA:

> *When a government-owned utility provides service to customers outside its geographical limits or corporate boundary, the situation is similar to the relationship of an investor-owned utility to its customers because the owner (political subdivision) provides services to nonowner customers (customers outside its geographical limits).* ***In this situation, the government-owned utility, like an investor-owned utility, is entitled to earn a reasonable return from nonowner customers based on the value of its plant investment required to serve those customers.*** *(Page 14, AWWA Manual M-1, Seventh Edition, emphasis added)*

Furthermore, the County questions application of ROE ranges to "outside City customers" on the basis that outside customers are being required to pay dividends to inside customers who "somehow hold a greater risk-based ownership stake in the utility". Yet, the fact is that as the serving municipal utility, the City of Tucson does own the assets – as reflected in financial statements, bond offering documents, etc. And, importantly, per the historical review, the outside City customers could not own such assets "due to the lack of enabling legislation for the County to operate a water utility." (p. 4.)

Phase 2 Analysis

The County letter provides a number of recommendations related to issues that should be addressed as part of the Phase 2 Outside City Differential Analysis that is currently being performed. The Phase 2 analysis will expand on the analysis conducted in Phase 1 to include customer service characteristics beyond annual water use (e.g., peak demands, number of accounts and meter equivalents, etc.) that formed the basis of the Phase 1 analysis. Furthermore, data available to support other operating and capital cost differences will be considered.

COUNTY ADMINISTRATOR'S OFFICE

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C.H. HUCKELBERRY
County Administrator

July 30, 2021

Citizens' Water Advisory Committee
c/o Tucson Water Intergovernmental Coordination
Delivered via Email to: Jessica.Rodriguez@tucsonaz.gov

Re: **Analysis of Tucson Water Cost-of-service Study**

Dear Chair and Members, Citizens' Water Advisory Committee:

I have reviewed the attached materials prepared by Raftelis Financial Consultants for your July 28, 2021 Citizens' Water Advisory Committee (CWAC) Finance Subcommittee meeting and am providing the following comments for your consideration.

As you are aware, the attached Raftelis technical memorandum comprises the first phase of determining a basis for a differential rate in the unincorporated County based on a cost-of-service analysis independent of any policy considerations by the Mayor and Council. This phase employs an equity-based investment approach calculating a rate of return on utility investment. The methodology is designed to evaluate rates for private utilities predicated on a return paid to owners of the utility to recover costs from ratepayers and generate profits to owners.

However, there is no basis to apply this private utility profit model to a municipal utility. A municipal utility has no identified owners as it is organized as an enterprise within a municipal corporation bound by Governmental Accounting Standards Board rules. In the case of Tucson Water, all customer ratepayers have contributed equally to investments made and secured against the enterprise, either directly or through developer funded expansions. The only exception that may warrant a differential rate for a municipal utility, aside from differential infrastructure and operational costs, is if one class of customers incurs risk beyond that of another class. This context has been raised in prior CWAC meetings where it was stated that the City of Tucson General Fund acts to "backstop" the enterprise fund in the event of a force majeure default. However, even if this eventually were to occur, an emergency expenditure exceeding the reserve capacity of the Tucson Water Enterprise Fund would result in a loan secured by the enterprise to cover the default amount. That loan, however, would be repaid to the City General Fund or other loaning entity with principal and interest by all Tucson Water ratepayers, regardless of jurisdictional location. As such, the risk to the enterprise is borne by all ratepayers of the enterprise since City residents contributing to the City General Fund though property taxes are no more owners of the system than international visitors contributing to the City General Fund through sales tax payment for goods and services.

Additionally, the equity-based utility investment approach requires inferring a rate of return based on cost of equity values. Since municipal utilities cannot be evaluated on the basis of cost of equity, the phase 1 analysis arbitrarily selects values ranging between 5 and 10 percent based on Arizona Corporation Commission rate cases for private utilities. However, these values include imbedded profit margins and applying these ranges to "outside City customers" assumes outside customers pay dividends to inside customers who somehow hold a greater risk-based ownership stake in the utility.

Furthermore, while "outside customers" is not defined in the memorandum, I understand from clarification provided at the July 28 CWAC Finance Subcommittee meeting that "outside" refers to the unincorporated area customers, defined as "non-owners" and that the other municipalities served by Tucson Water are considered "inside" or "owners" of the Tucson Water Utility. This means that Tucson Water customers within municipalities other than the City of Tucson are somehow also considered owners of the enterprise. While this distinction does not stand up to scrutiny, it should be moot since the entire equity ownership approach does not apply to a municipal utility.

It is recognized that the phase 1 Raftelis analysis was conducted with limited time and so employed a simplified approach which did not provide the level of detail expected of a full cost-of-service study. Missing elements that warrant pursuing in phase 2, some of which were raised at the July 28 meeting, include:

- Providing the calculations showing how inside/outside consumption splits are determined.
- Comparison of inside/outside revenue since outside customers are paying proportionally more based on consumption than inside customers due to the current volumetric tiered rate structure.
- Including payments made for procuring CAP water under Central Arizona Water Conservation District property tax levies, where unincorporated County residents are currently subsidizing City of Tucson CAP water costs (see Table 2 in Historical Perspective Regarding Regional Water and Sewer Rates Established by Pima County and City of Tucson's Mayor and Council).
- Including PFAS and other contaminant treatment costs relegated to Tucson Water rate payers based on contamination within vs outside City limits.
- Consumption was used as basis of cost split but certain costs, such as director's office, billing and metering, financial and engineering are fixed costs not tied to consumption. These would more equitably be distributed using a metric such as number of connections.
- Inclusion of the reclaimed system since it is subsidized by potable system rates.
- Comparison of inside/outside pumping and distribution infrastructure requires adjustments recognizing that the majority of City well fields and recharge/recovery facilities are located in the unincorporated area and that distribution infrastructure serving other municipalities transit through the unincorporated area.

In summary, I recommend that you reject phase 1 of the Raftelis cost-of-service analysis, as artificially assigning return on investment based on utility cost of equity bears no relationship to

municipal utility value where cost of capital is limited to cost of debt and where dividends are not paid out to "owners." Additionally, I hope you will request that phase 2 of the cost-of-service study evaluates costs having a legitimate basis for differential potential, including those itemized in the above bullets in addition to those identified within the Raftelis presentation for phase 2 evaluation such as peaking characteristics, fire service, non-revenue water, distance and elevation.

Finally, it is important that water considerations are applied equitably across the region and that differential rates be based on legitimate cost-of-service in lieu of retaliation for perceived taxation inequities unrelated to water that should be resolved by other means. Doing so will allow us to concentrate on better regional management of our limited water resources that impact all residents across the Santa Cruz basin. To this end, the County Administrator has provided an overview of opportunities regarding water resources management of the lower Santa Cruz basin that are candidates for future City of Tucson partnerships and CWAC discussion.

Sincerely,

Yves Khawam, PhD
Assistant County Administrator for Public Works

Attachment

c: C.H. Huckelberry, County Administrator
Jan Lesher, Chief Deputy County Administrator
Carmine DeBonis, Jr., Deputy County Administrator for Public Works
Jackson Jenkins, Director, Regional Wastewater Reclamation Department
Kathy Chavez, Water Policy Manager

TECHNICAL MEMORANDUM

To: John Kmiec, Interim Utility Director, Tucson Water

From: Harold Smith, Raftelis Financial Consultants, Inc.

Subject: Outside Differential Analysis

CC: Deborah Galardi, Galardi Rothstein Group

On June 22, 2021, the City of Tucson Mayor and Council approved a rate differential for Tucson Water customers located within unincorporated Pima County (Outside City Customers). This decision was policy based and goes into effect on December 1, 2021. Mayor and Council further directed Tucson Water to conduct a cost-of-service analysis using standard industry practices to determine the cost basis for differential rates. The results of the cost-of-service analysis are supplemental to the policy basis already used to approve the differential rate.

Tucson Water engaged Raftelis to develop a range of possible cost-based differentials as the first step in this cost-of-service analysis. The analysis performed by Raftelis involved using readily available data to develop revenue requirements for the entire Tucson Water system using the utility basis, allocating those revenue requirements between inside city customers and Outside City Customers and then comparing the revenue requirements for Outside City Customers to the revenue generated by Outside City Customers under Tucson Water's existing rates. The difference between the calculated revenue requirements and revenue at existing rates serves as an approximation of a cost-based rate differential. The second phase of the cost-of-service analysis will refine the differential rate range presented in this Memorandum and will address the detailed information now decided by Mayor and Council, namely the differential rate schedule to be implemented (Option 7 from the original Notice of Intent), the projected differential rate revenues, and the projects and programs within the utility where Mayor & Council directed that the revenues be used.

Overview of the Utility Approach

The utility approach for determining revenue requirements is typically utilized by investor-owned utilities, and also for governmental utilities that are regulated by state public service agencies. The utility approach provides for a utility to recover operating and capital costs as determined by generally accepted accounting principles. In addition, the utility is provided a return on its investment in utility plant-in-service and other capital facilities. O&M costs are typically based on the utility's operating budget and capital costs are estimated based on actual or projected depreciation and adjusted for additions, retirements, "contributions in aid of construction," and "customer capital advances."

Under the utility approach, a return is calculated by applying a rate of return on the investment by the owner of the utility (typically the original cost of assets less accumulated depreciation and adjustments). The utility's investment is defined as a "rate base." In situations where outside-city service is provided, two separate rate base values can be determined, the rate base for inside-city service and the rate-base for outside city service. The utility's return should provide for the payment of interest on outstanding

debt, the funding of certain capital items, and a payback (dividend) to the investors of the utility. In situations where a municipal utility is the service provider, this dividend is sometimes used to offset the revenue requirement to be recovered from inside-city rates, thereby lowering the rates paid by inside-city customers. Tucson Water has been directed to use the differential rate revenues within the utility to fund programs in the areas of financial resilience, water resources resilience, and infrastructure resilience.

The most widely recognized method for selecting an appropriate rate of return is the weighted average cost of capital (WACC) approach. This approach can be used by both public and private utilities and represents the weighted average of the utility's cost of debt (outstanding bonds) and cost of equity. A utility's average cost of debt is the average interest rate that it pays on all its outstanding bonds and loans. Since a utility is often required to issue debt at various times to meet capital needs, the average cost of debt reflects both the utility's financial strength and the prevailing market interest rates at the time each bond series is issued. Therefore, the average cost of a utility's debt should be weighted based on the duration of payments and the amount of funds outstanding for each bond series. The cost of equity for an investor-owned utility represents its average cost of debt, as well as a risk premium and return on investment, or dividend for its investors. For a government utility, the cost of equity generally represents its average cost of debt and a risk premium. Once the average cost of debt and average cost of equity are determined for a utility, the WACC is determined by weighting the cost of debt and equity by the proportion of debt to equity as presented in the utility's balance sheet.

As mentioned previously, If the utility is governmental, the return is still appropriate, although the utility is "nonprofit." As with investor-owned utilities, the return is used to pay interest, and possibly, along with depreciation, retire principal on debt and fund certain capital items. In some instances, however, the dividend component for government utilities may be eliminated because a return or profit component may be excluded from revenue requirements. However, if the government utility has customers who are "non-owners" of the system, a return to the utility (such as the treasury bill rate or the municipality's current investment rate) may be appropriate to be charged to the non-owner customers.

The major advantage of the utility approach is that there is typically less interpretation when establishing revenue requirements than under the cash-needs approach. In other words, the utility approach provides for a less subjective methodology for identifying revenue requirements. A major disadvantage of the utility approach is that in a governmental environment, revenue requirements that would be recovered under the utility approach could be significantly more or less than is required for cash flow purposes.

When setting outside-city rates, use of the utility approach is most appropriate when there is a clear distinction between owner customers and non-owner customers because the utility approach allows for the development of rates that recover a return on the owner's investment in the system thereby compensating them for the risk incurred to construct the utility system. In cases where the distinction between owner and non-owner customers is not clear, for instance when the utility's legal or policy driven service area extends beyond the parent municipality's corporate limits, justification of a return on investment may be complicated by a number of factors.

Data Used In the Analysis

Data used for the analysis was derived from a variety of sources and brief descriptions of each data set are provided below:

- *Customer Demand Data* – Customer demand data for FY2019 was used for this analysis. However, detailed demand data regarding consumption within each of Tucson Water's rate tiers was not available for FY2019 so the FY2019 data was calibrated based on actual revenue generated by water sales to the Outside City Customers in FY2019. This calibration involved determining the percentage of consumption for customer classes with tiered rates that fell within each rate tier. These percentages were then applied to FY2019 demand to develop an approximation of consumption within each tier for FY2019.
- *Operation & Maintenance (O&M) Expenses* – O&M expenses were derived from Tucson Water's FY2019 budget. FY2019 was chosen as the test year because it was the rate year for cost of service analysis used to develop the rates currently in effect.
- *Rate Base and Depreciation* – Rate base and depreciation was determined using asset data from FY2019. Similar to the customer demand and O&M expense data, FY2019 was chosen as the test year because existing rates are based on FY2019 data. Additionally, asset data that excluded contributed capital was readily available for FY2019.
- *Cost of Capital*- Tucson Water's weighted average cost of debt was based on outstanding water debt as of July 1, 2020 included in "City of Tucson, Arizona; 2020-21 Summary of Outstanding Debt" prepared by Piper/Sandler.

Revenue Requirements

For this analysis, revenue requirements for the entire Tucson Water system were determined using the utility approach and then a portion of the system revenue requirements were allocated to the Outside City Customers. Under the utility approach, a utility's revenue requirements are comprised of O&M expenses, depreciation, and a return on rate base.

Operation & Maintenance Expenses

As mentioned previously, for this analysis Tucson Water's O&M expense are based on the FY2019 budget. Costs associated with operating and maintaining the reclaimed water system were excluded from the analysis. A portion of the FY2019 budgeted O&M expenses are allocated to the Outside City Customers based on their proportionate share of consumption.

Schedule 1 shows the system O&M expenses and the allocation to Outside City Customers.

Rate Base

The rate base, or the value of the assets used to provide service to the Outside City Customers, was determined by first excluding the value of contributed assets from Tucson Water's net plant in service. Additionally, the value of all reclaimed water assets was excluded from rate base. The value of the remaining assets was then allocated between inside city customers and Outside City Customers based on each group's proportionate share of consumption.

Schedule 2 shows the development of rate base and the allocation to Outside City Customers.

Rate of Return

Given time constraints for the analysis, Raftelis did not perform a cost of capital study. As mentioned previously, the rate of return is typically set equal to the utility's WACC. As discussed previously, s utility's WACC is comprised of its weighted average cost of debt (WACD) and the cost of equity. The determination of Tucson Water's WACD is demonstrated in Schedule 3. As shown, Tucson Water's WACD is 4.57%.

Since Tucson Water is a municipally owned water system, it is difficult to determine a cost of equity. AWWA's M-1 manual suggests four different options for determining an appropriate cost of equity for municipally owned systems. These options include:

1. Base the cost of equity on the return allowed by regional regulatory bodies in recent rate cases for similar utilities.
2. Perform a discounted cash-flow analysis.
3. Use a risk-free rate with an appropriate risk premium.
4. Use a multiplier on top of the WACD.

Given the time constraints for performing the analysis the only feasible option was to use recently allowed costs of equity for water utilities regulated by the Arizona Corporation Commission as a proxy for Tucson Water's cost of equity. However, review of recent rate cases did not reveal any decisions for utilities that would be considered similar to Tucson Water. Therefore, it was decided to calculate cost justified outside differentials using a range of cost of equity values. Research of recent ACC rate cases did reveal a wide range of approved rates of return on rate base. Given this information it was decided to calculate outside city differentials using cost of equity values ranging between 5% and 10%.

In order to recognize that Outside City Customers have contributed to the equity in the system by virtue of paying rates and system equity fees that funded the assets that comprise the system, the calculation of system equity includes a downward adjustment commensurate with the Outside City customer's share of revenue.

Schedule 3 shows the development of the rate of return on rate base.

Depreciation

Depreciation was derived from Tucson Water's asset records and only depreciation on those assets included in rate base was included in the system revenue requirements. Similar to O&M expenses and rate base, depreciation was allocated to Outside City Customers based on consumption.

Table 1 below shows the revenue requirements under five different cost of equity scenarios.

Table 1
Outside City Revenue Requirements Under Various Cost of Equity Assumptions

	Cost of Equity					
	5.0%	6.0%	7.0%	8.0%	9.0%	10.0%
Operation & Maintenance Expenses	$ 35,834,858	$35,834,858	$35,834,858	$35,834,858	$35,834,858	$35,834,858
Depreciation	$ 8,750,060	$ 8,750,060	$ 8,750,060	$ 8,750,060	$ 8,750,060	$ 8,750,060
Return on Rate Base	$ 17,601,576	$19,897,029	$22,192,482	$24,487,935	$26,783,388	$29,078,841
Total Outside City Revenue Requirements	**$ 62,186,494**	**$64,481,947**	**$66,777,400**	**$69,072,853**	**$71,368,307**	**$73,663,760**

Determination of Outside City Differential

To determine the appropriate outside city differential, outside city revenue requirements are compared to the revenue that is generated by Outside City Customers at the existing rates that are assessed to all customers, both inside and outside the city limits. The percent difference between these two values is the percent increase to existing rates that would be required for revenue from Outside City Customers to equal outside city revenue requirements. Table 2 below shows the resulting outside differentials under each cost of equity assumption.

Table 2
Outside City Differential Under Various Cost of Equity Assumptions

	Cost of Equity					
	5.0%	6.0%	7.0%	8.0%	9.0%	10.0%
Outside City Revenue Under Existing Rates	$ 58,607,302	$58,607,302	$58,607,302	$58,607,302	$58,607,302	$58,607,302
Outside City Revenue Requirements	$ 62,186,494	$64,481,947	$66,777,400	$69,072,853	$71,368,307	$73,663,760
Cost Justified Differential	**6.1%**	**10.0%**	**13.9%**	**17.9%**	**21.8%**	**25.7%**

Conclusions

Results of the limited analysis described in this memo indicate that by using standard industry practices for determining rates for outside city customers an outside city differential can be cost based, but that the magnitude of the justified differential is highly dependent upon the assumed value for Tucson Water's cost of equity. Additionally, a more detailed analysis of O&M expenses and rate base could yield different allocations of costs to the Outside City Customers resulting in outside city revenue requirements that are different from those that resulted from this analysis.

Phase 2 of this cost-of-service analysis will be to assess an outside city differential based on cost-of-service principles alone. It should be noted, however, that it is not uncommon for utilities to charge a higher rate to outside city customers on a policy basis and Arizona law allows for the assessment of higher outside city rates as long as the higher rates are "reasonable". That is the basis of the action already taken by the City of Tucson Mayor and Council. Measures of reasonableness may include comparisons of rate differentials in other communities, as well as general considerations of risk, ownership relationship, and cost of service. Recent surveys of other Arizona utilities indicate that many utilities that assess rates to outside city customers have no cost justification for the higher rates, and rate differentials range from 10% to 50%. This cost of service analysis is supplemental to the recently established policy basis for Tucson's differential rate.

Schedule 1 - O&M Expenses

O&M Expenses

			Outside City %	Inside City %	Outside City $	Inside City $
Director's Office						
Customer Outreach Unused	$	1,319,114	27%	73%	$ 352,115	$ 966,999
Security Unit	$	572,197	27%	73%	$ 152,738	$ 419,459
Personnel Services	$	789,206	27%	73%	$ 210,665	$ 578,541
Director's Office Unused	$	3,617,975	27%	73%	$ 965,756	$ 2,652,218
Subtotal: Director's Office	**$**	**6,298,492**			**$ 1,681,275**	**$ 4,617,217**
Customer Service						
Billing Office	$	4,017,919	28%	72%	$ 1,125,017	$ 2,892,902
Westside Metering Services	$	3,862,351	28%	72%	$ 1,081,458	$ 2,780,893
Eastside Metering Services	$	2,703,322	28%	72%	$ 756,930	$ 1,946,392
Subtotal: Customer Service	**$**	**10,583,593**			**$ 2,963,406**	**$ 7,620,187**
Business Services						
Financial & Office Services	$	1,214,304	27%	73%	$ 324,138	$ 890,166
Information Services/Support	$	-	27%	73%	$ -	$ -
Pueblo Billing System Project	$	3,841,780	27%	73%	$ 1,025,498	$ 2,816,283
Subtotal: Business Services	**$**	**5,056,084**			**$ 1,349,635**	**$ 3,706,449**
Water Quality						
Reclaimed Water System	$	4,036,220	0%	100%	$ -	$ 4,036,220
Clearwater Facility Operations (CAVSARP)	$	5,166,500	27%	73%	$ 1,379,109	$ 3,787,391
CAP Water Purchases (CAVSARP) (7200-249)	$	10,965,787	27%	73%	$ 2,927,129	$ 8,038,658
Clearwater Facility 2 Operations (SAVSARP)	$	5,190,085	27%	73%	$ 1,385,404	$ 3,804,681
CAP Water Purchases (SAVSARP) (7210-249)	$	7,554,209	27%	73%	$ 2,016,467	$ 5,537,742
Maintenance Management Program	$	-	27%	73%	$ -	$ -
Technical Support	$	235,556	27%	73%	$ 62,878	$ 172,679
Water Quality Lab	$	2,176,431	27%	73%	$ 580,961	$ 1,595,470
TARP Management	$	1,244,594	27%	73%	$ 332,223	$ 912,371
AOP	$	2,474,367	27%	73%	$ 660,490	$ 1,813,877
Water Production Admin Support	$	863,823	27%	73%	$ 230,583	$ 633,240
Water Production Plant Operation	$	1,133,168	27%	73%	$ 302,480	$ 830,688
Water Treatment Plant Maintenance	$	760,069	27%	73%	$ 202,888	$ 557,182
Water Production Plant Instru/Cntrl	$	5,673,352	27%	73%	$ 1,514,404	$ 4,158,948
Compliance & Regulatory Support	$	604,632	27%	73%	$ 161,396	$ 443,236
Environmental Performance	$	-	27%	73%	$ -	$ -
Subtotal: Water Quality	**$**	**48,078,793**			**$ 11,756,412**	**$ 36,322,381**
Planning & Engineering						
Backflow Prevention	$	-	27%	73%	$ -	$ -
Admin. & Project Support	$	723,400	27%	73%	$ 193,099	$ 530,301
Plant Design	$	1,060,562	27%	73%	$ 283,099	$ 777,463
Distribution Design	$	789,853	27%	73%	$ 210,838	$ 579,015
Construction	$	950,887	27%	73%	$ 253,823	$ 697,064
Mapping/GIS	$	1,222,152	27%	73%	$ 326,233	$ 895,919
Water System Evaluation	$	736,141	27%	73%	$ 196,500	$ 539,641
System Planning	$	939,940	27%	73%	$ 250,901	$ 689,039
Research & Technical Support	$	1,829,749	27%	73%	$ 488,420	$ 1,341,329
Subtotal: Planning & Engineering	**$**	**8,252,683**			**$ 2,202,913**	**$ 6,049,771**

Schedule 1 - O&M Expenses

O&M Expenses

			Outside City %	Inside City %	Outside City $	Inside City $
Water Operations						
Maintenance Management Program (7297)	$	716,660	27%	73%	$ 191,300	$ 525,360
Equipment Maintenance	$	2,607,115	27%	73%	$ 695,925	$ 1,911,190
Control Systems	$	1,997,427	27%	73%	$ 533,179	$ 1,464,248
Property Management	$	2,511,699	27%	73%	$ 670,455	$ 1,841,244
Well Maintenance	$	452,284	27%	73%	$ 120,729	$ 331,554
Quality Control	$	1,754,177	27%	73%	$ 468,248	$ 1,285,929
North Maintenance	$	1,812,325	27%	73%	$ 483,769	$ 1,328,556
System Support	$	7,119,712	27%	73%	$ 1,900,485	$ 5,219,226
Central Maintenance	$	2,599,844	27%	73%	$ 693,984	$ 1,905,860
East Maintenance	$	1,712,822	27%	73%	$ 457,209	$ 1,255,614
System Improvements - Potable	$	2,851,188	27%	73%	$ 761,076	$ 2,090,112
System Improvements - Reclaimed	$	277,805	27%	73%	$ 74,155	$ 203,650
West Maintenance	$	1,964,723	27%	73%	$ 524,449	$ 1,440,274
Subtotal: Water Operations	**$**	**28,377,781**			**$ 7,574,963**	**$ 20,802,817**
Other Budgetary Requirements						
General Expense (7437)	$	4,462,291	27%	73%	$ 1,191,132	$ 3,271,159
Groundwater Withdrawal Tax	$	45,000	27%	73%	$ 12,012	$ 32,988
Superfund Tax (7437-289)	$	540,000	27%	73%	$ 144,144	$ 395,856
SAWARSA Settlement	$	-	27%	73%	$ -	$ -
New Program (see below)	$	-	27%	73%	$ -	$ -
Enhanced Water Quality Treatment Plant	$	-	27%	73%	$ -	$ -
CAGRD Membership	$	-	27%	73%	$ -	$ -
In Lieu of Property Tax (7438-289)	$	2,020,400	27%	73%	$ 539,311	$ 1,481,089
CAP Water Purchases (non Clearwater) (7437-249)	$	5,848,420	27%	73%	$ 1,561,136	$ 4,287,284
CAP Annual Capital Payment (existing alloc.) (7437-250)	$	8,435,174	27%	73%	$ 2,251,625	$ 6,183,549
CAP Annual Capital Payment (add'l 8206 AF allocation)	$	-	27%	73%	$ -	$ -
CAP Purchase - Back Capital 8206 (P)	$	-	27%	73%	$ -	$ -
CAP Purchase - Back Capital 8206 (I)	$	-	27%	73%	$ -	$ -
Admin. Serv. Chg. (Pmt to GF: direct srvcs) (7438)	$	2,671,969	27%	73%	$ 713,236	$ 1,958,732
Admin. Serv. Chg. (Pmt to GF: Indirect srvc) (7438-297)	$	8,009,441	27%	73%	$ 2,137,983	$ 5,871,458
Low Income Program (7400)	$	1,262,750	27%	73%	$ 337,070	$ 925,680
Capitalized O&M Expense (7439)	$	(6,566,300)	27%	73%	$ (1,752,761)	$ (4,813,539)
New Program (7NEW)	$	3,823,166	27%	73%	$ 1,020,529	$ 2,802,637
Mail Services (7247)	$	565,076	27%	73%	$ 150,837	$ 414,238
Subtotal: Other Budgetary Requirements	**$**	**31,117,387**			**$ 8,306,254**	**$ 22,811,133**
Total: O&M Expenses	$	137,764,813			$ 35,834,858	$ 101,929,955

Schedule 2 - Rate Base and Depreciation

RateBase

Asset Type	Depreciated Net Plant Investment [1]	Outside City %	Inside City %	Outside City $	Inside City $
Land - Other	$ 45,661,445	27%	73%	$ 12,188,542	$ 33,472,903
Wells	$ 169,636,454	27%	73%	$ 45,281,550	$ 124,354,904
Treatment Plant	$ 101,023,967	27%	73%	$ 26,966,620	$ 74,057,346
Buildings	$ 42,226,393	27%	73%	$ 11,271,613	$ 30,954,779
Pumping Equip.	$ 27,125,657	27%	73%	$ 7,240,730	$ 19,884,927
Tanks and Reservoirs	$ 190,429,213	27%	73%	$ 50,831,822	$ 139,597,391
Transmission Mains	$ 247,039,617	27%	73%	$ 65,943,001	$ 181,096,616
Distribution Mains	$ 270,167,064	27%	73%	$ 72,116,478	$ 198,050,587
Services and Meters	$ 146,067,747	27%	73%	$ 38,990,287	$ 107,077,460
Hydrants	$ 42,005,780	27%	73%	$ 11,212,725	$ 30,793,055
Reclaimed Water System	$ 156,176,999	0%	100%	$ -	$ 156,176,999
General Plant	$ 80,594,103	27%	73%	$ 21,513,218	$ 59,080,886
	$ 1,518,154,438			$ 363,556,586	$ 1,154,597,852

Depreciation

Asset Type	Depreciation[1]	Outside City %	Inside City %	Outside City $	Inside City $
Land - Other	$ -	27%	73%	$ -	$ -
Wells	$ 4,411,000	27%	73%	$ 1,177,441	$ 3,233,559
Treatment Plant	$ 2,526,000	27%	73%	$ 674,273	$ 1,851,727
Buidlings	$ 1,056,000	27%	73%	$ 281,881	$ 774,119
Pumping Equip.	$ 678,000	27%	73%	$ 180,981	$ 497,019
Tanks and Reservoirs	$ 3,999,000	27%	73%	$ 1,067,465	$ 2,931,535
Transmission Mains	$ 3,891,000	27%	73%	$ 1,038,636	$ 2,852,364
Distribution Mains	$ 5,782,000	27%	73%	$ 1,543,406	$ 4,238,594
Services and Meters	$ 3,798,000	27%	73%	$ 1,013,811	$ 2,784,189
Hydrants	$ 672,000	27%	73%	$ 179,379	$ 492,621
Reclaimed Water System	$ 2,499,000	0%	100%	$ -	$ 2,499,000
General Plant	$ 5,967,000	27%	73%	$ 1,592,789	$ 4,374,211
	$ 35,279,000			$ 8,750,060	$ 26,528,940

Notes:

1 - Data from "Vail Wheeling_1-14-20"

Schedule 3 - Cost of Capital

Rate of Return

Cost of Debt

	Par Amount	Outstanding Principal	% of Total	Interest Rate	Cost of Debt
Series 2010A Obligations	$ 38,510,000	$ 38,510,000	8.46%	5.87%	0.497%
Series 2011 Obligations	$ 30,965,000	$ 1,500,000	0.33%	5.00%	0.016%
Series 2012 Obligations	$ 31,555,000	$ 9,095,000	2.00%	3.78%	0.075%
Refunding Bonds, Series 2013A	$ 34,280,000	$ 21,085,000	4.63%	4.60%	0.213%
Refunding Bonds, Taxable Series 2013	$ 18,825,000	$ 6,005,000	1.32%	2.63%	0.035%
Series 2013 Obligations	$ 21,065,000	$ 18,065,000	3.97%	4.75%	0.189%
Series 2014 Obligations	$ 35,630,000	$ 33,130,000	7.28%	4.09%	0.298%
Series 2015 Obligations	$ 20,570,000	$ 18,470,000	4.06%	4.35%	0.176%
Refunding Bonds, Series 2015	$ 46,640,000	$ 46,640,000	10.25%	4.82%	0.494%
Refunding Bonds, Series 2016-A	$ 71,805,000	$ 44,060,000	9.68%	5.00%	0.484%
Series 2016 Obligations	$ 17,215,000	$ 16,425,000	3.61%	3.67%	0.132%
Series 2017 Obligations & Refunding	$ 106,970,000	$ 88,575,000	19.47%	5.00%	0.973%
Series 2018 Obligations	$ 23,935,000	$ 23,435,000	5.15%	4.04%	0.208%
Series 2019 Obligations	$ 13,195,000	$ 13,195,000	2.90%	4.38%	0.127%
Series 2020 Obligations	$ 45,765,000	$ 45,765,000	10.06%	4.37%	0.439%
Jr. WIFA Series 2012	$ 4,000,000	$ 2,658,662	0.58%	2.80%	0.016%
Series 2012 Refunding Bond	$ 15,245,000	$ 645,000	0.14%	1.90%	0.003%
Series 2011 Obligations	$ 16,000,000	$ 9,633,040	2.12%	2.79%	0.059%
Series 2010 Obligations	$ 2,750,000	$ 1,572,044	0.35%	2.93%	0.010%
Series 2009B	$ 1,000,000	$ 486,015	0.11%	3.60%	0.004%
Series 2009A	$ 2,500,000	$ 1,260,865	0.28%	3.38%	0.009%
Series 2008 Obligations	$ 17,800,000	$ 7,679,214	1.69%	3.55%	0.060%
Series 2007 Obligations	$ 6,500,000	$ 2,396,334	0.53%	3.21%	0.017%
Series 2006 Obligations (Drinking Wat	$ 4,500,000	$ 1,670,514	0.37%	3.32%	0.012%
Series 2005 Obligations	$ 2,997,000	$ 786,393	0.17%	3.11%	0.005%
Series 2004 Obligations	$ 5,500,000	$ 1,112,800	0.24%	3.20%	0.008%
Series 2003 Obligations	$ 8,300,000	$ 1,145,306	0.25%	3.44%	0.009%
	$ 644,017,000	**$ 455,001,187**			**4.570%**

Weighted Average Cost of Debt 4.570%

Cost of Equity

Net Plant Investment	$ 1,518,154,438
Outstanding Debt	$ 455,001,187
Equity in System	$ 1,063,153,251
Less: OC Contributed Equity	$ (283,790,579)
Adjusted System Equity	$ 779,362,672

Cost of Equity 5.00%

Cost of Capital

			% of Total	Cost	
Outstanding Debt	$	455,001,187	37%	4.570%	1.68%
System Equity	$	779,362,672	63%	5.00%	3.16%
	$	1,234,363,859		WACC	4.84%

Rate of Return **4.84%**

Schedule 4 - Units of Service

Meters

Meter Count	Meters				Equiv. Meters			
Meter Size	TU	OC Non-TU	IC		TU	OC Non-TU	IC	
5/8"	59,402	12,795	133,165		59,402	12,795	133,165	
3/4"	1,815	391	4,068		2,449	527	5,488	
1"	5,093	1,097	11,417		10,423	2,245	23,366	
1.5"	492	106	1,104		1,865	402	4,184	
2"	1,035	223	2,320		6,090	1,312	13,651	
2.5"	2	0	5		17	4	39	
3"	12	3	27		138	30	310	
4"	14	3	32		273	59	615	
6"	10	2	23		396	86	892	
8"	1	0	2		60	13	134	
10"	-	-	-		-	-	-	
12"	-	-	-		-	-	-	
				Total Meters				Total Equivalent Meters
Total	67,876	14,620	152,161	234,657	81,112	17,472	181,843	280,427
					29%	6%	65%	

Consumption

	Usage (CCF)	
TU	10,101,253	27%
Non-TU	3,559,386	9%
Inside	24,181,281	64%
Total	37,841,920	

Schedule 5 - Outside City Revenue Requirements and Differential

Outside City Revenue Requirements

Utility Approach Revenue Requirements

Operation & Maintenance Expenses	$	35,834,858
Depreciation	$	8,750,060
Return on Rate Base	$	17,601,576
Total Outside City Revenue Requirements	$	62,186,494

Return on Rate Base

Outside City Rate Base	$	363,556,586
Rate of Return		4.84%
Return on Rate Base	$	17,601,576

Determination of Outside City Differential

Outside City Revenue Under Existing Rates	$	58,607,302
Outside City Revenue Requirements	$	62,186,494
% Difference		6%

TUCSON WATER

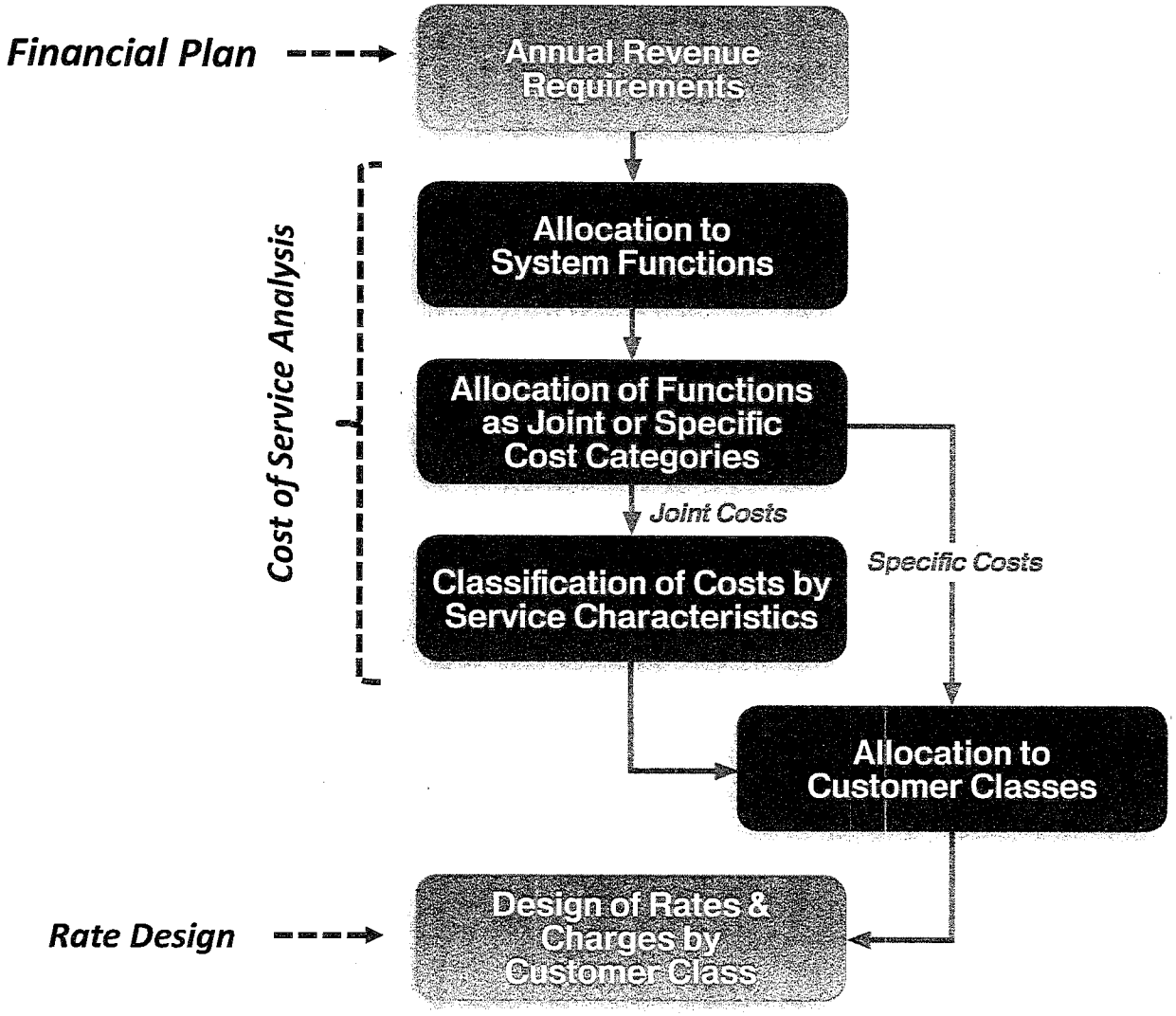
A proud part of the City of Tucson

Outside City Rate Analysis

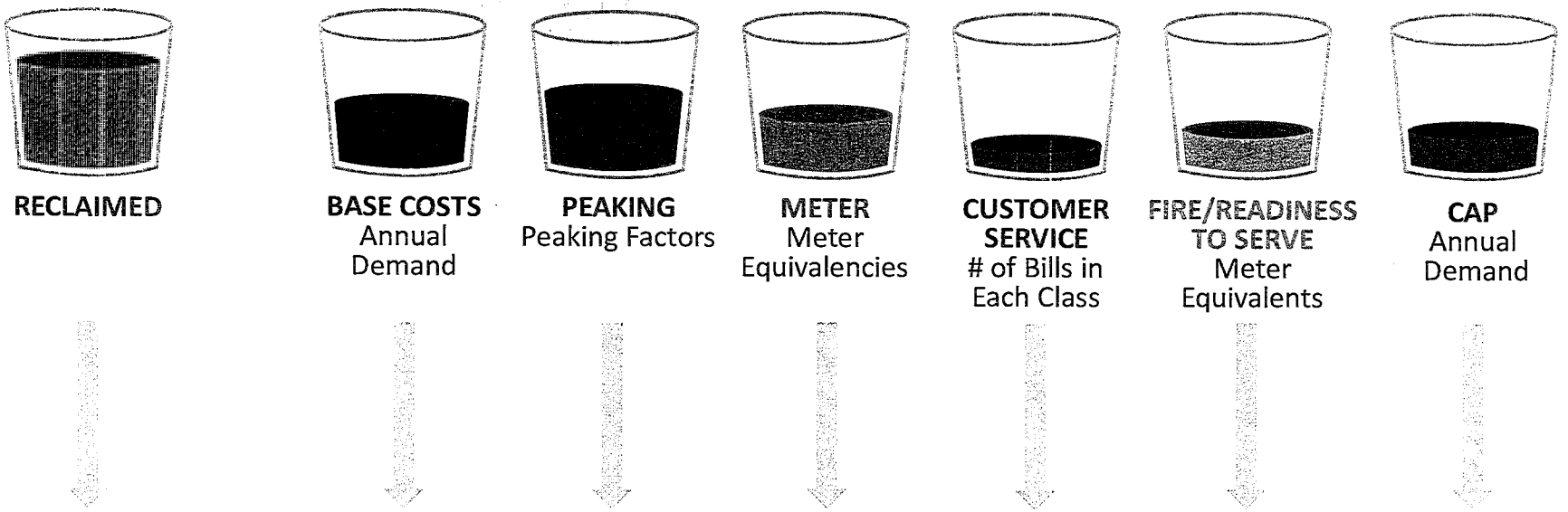
CWAC Finance Subcommittee

July 28, 2021

COST OF SERVICE PROCESS



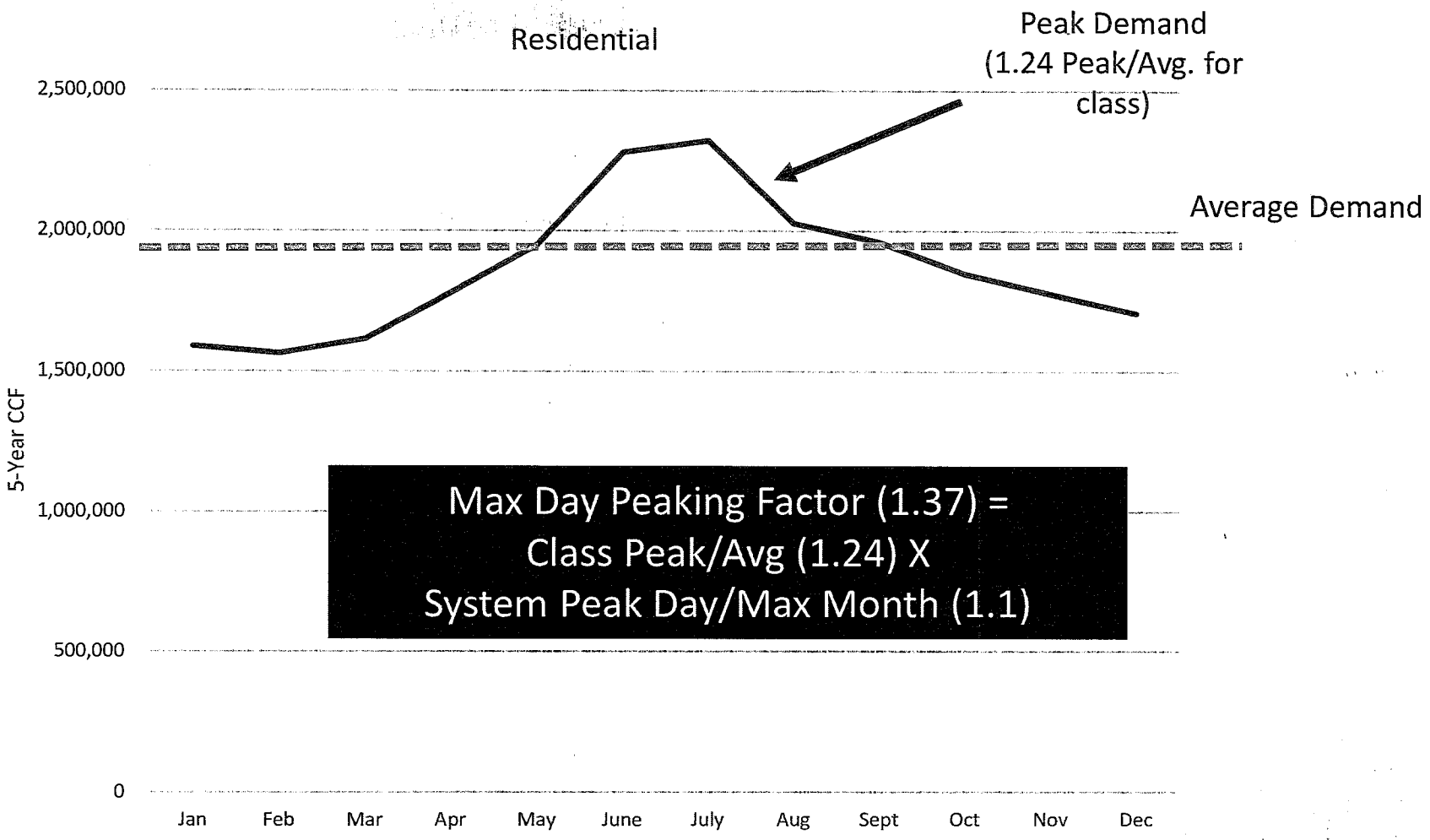
CUSTOMER CLASS SERVICE CHARACTERISTICS



Reclaimed

Potable CUSTOMER CLASSES
(Single Family, Multi-family, Commercial etc.)

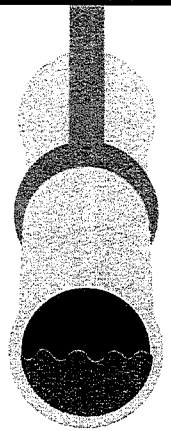
CUSTOMER CLASS PEAKING



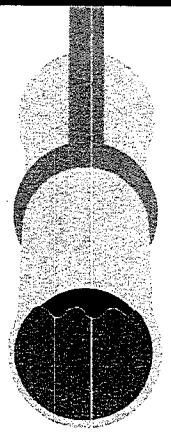
Max Day Peaking Factor (1.37) =
Class Peak/Avg (1.24) X
System Peak Day/Max Month (1.1)

WATER SYSTEM PEAK VS. BASE DEMAND COSTS

Example: Transmission Mains



Transmission main for average day demand



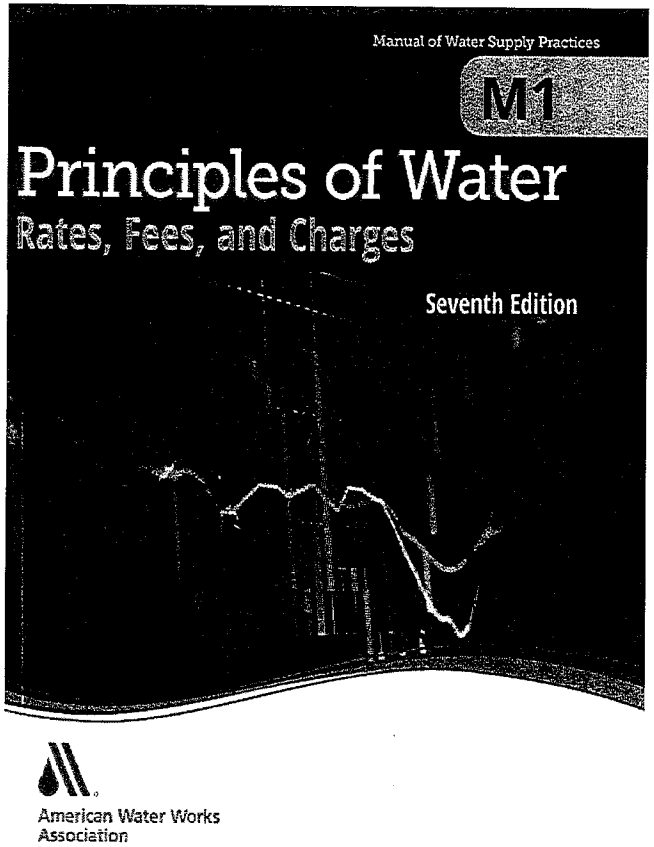
Transmission main for peak summer day demand

POLICY – BASED ADJUSTMENTS

Customer Class	Allocated COS ($1,000)	Allocate TUSD Differential ($1,000)	Allocate Reclaimed Benefit ($1,000)	Class Adjustments ($1,000)	Adjusted COS ($1,000)	% Revenue Increase Required
Residential	133,881	247	3,940	(1,145)	136,923	5.4%
Multifamily	32,789	61	965	850	34,665	5.4%
Commercial	47,136	87	1387	225	48,835	5.5%
Industrial	2,861	5	84	50	3,000	5.4%
Construction Water	2,134	4	63	(180)	2,021	9.4%
Private Fire Protection:				200		
Fire Sprinkler Service	3,853	7	113	200	4,173	9.4%
Sub-Total Potable	222,655	411	6,552	200	229,617	5.5%
Difference in schools peak costs	411	(411)				
Total Potable	**223,066**	**0**	**6,552**		**229,617**	**5.5%**
Reclaimed	**17,295**		**(6,552)**		**10,744**	**5.5%**
Utility Total	**240,361**				**240,361**	**5.5%**

OUTSIDE CITY RATE DEVELOPMENT

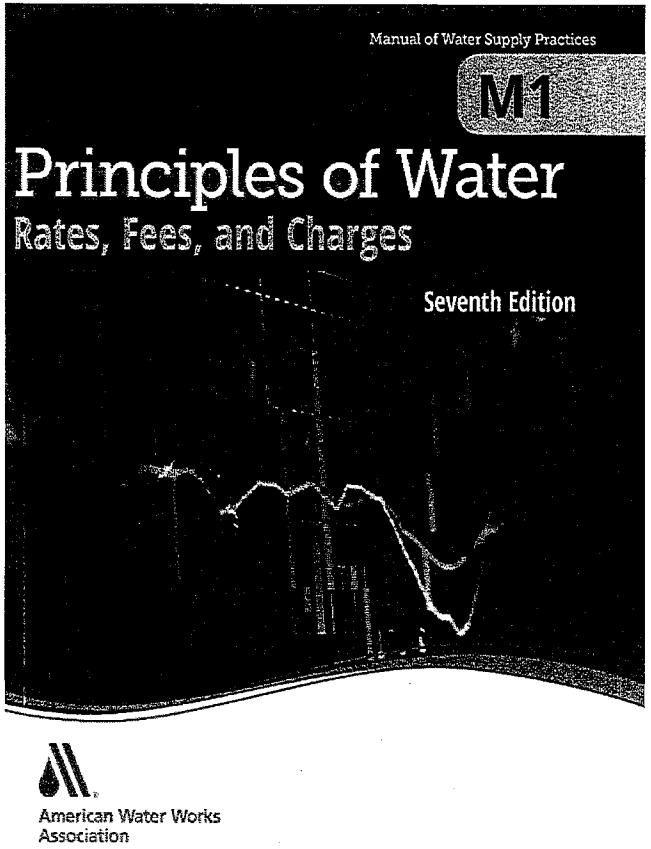
- Follow cost-of-service framework
- Establish outside city customer as separate class(es)
  - Ownership status
  - Service requirements
- Revenue Requirement Structure
  - Cash needs
  - Utility basis (most common approach for outside city)
  - Hybrid: Consistent with overall cash needs, with differential rate of return



2017 American Water Works Association (AWWA)

RATE DIFFERNTIAL ANALYSIS

- Rate Base and Return on Investment
  - Contributions in aid of construction
  - Levels of service
  - Risk considerations
- Other cost factors
  - Class peaking characteristics
  - Service delivery requirements (fire service, non-revenue water, distance & elevation, etc.)



2017 American Water Works Association (AWWA)

Phase 1 Outside Differential Analysis

- Revenue requirements for entire Tucson Water system determined using the Utility Approach
- Revenue requirements allocated between Outside City Customers and the rest of Tucson Water's customers
- Range of differentials determined by comparing allocated revenue requirements to revenue under existing rates

The Utility Approach vs. Cash Needs

Utility Approach

- O&M Expenses
- Depreciation
- Return on Rate Base

Cash Needs Approach

- O&M Expenses
- Capital Expenses
- Contribution to Reserves

Allocation Between Outside and Inside

O&M EXPENSES

	Outside	Inside
Director's Office	$ 1,681,275	$ 4,617,217
Customer Service	$ 2,963,406	$ 7,620,187
Business Services	$ 1,349,635	$ 3,706,449
Water Quality	$ 11,756,412	$ 36,322,381
Planning & Engineering	$ 2,202,913	$ 6,049,771
Water Operations	$ 7,574,963	$ 20,802,817
Other Budgetary Requirements	$ 8,306,254	$ 22,811,133
	$ 35,834,858	$ 101,929,955

RATE BASE

	Outside	Inside
Land - Other	$ 12,188,542	$ 33,472,903
Wells	$ 45,281,550	$ 124,354,904
Treatment Plant	$ 26,966,620	$ 74,057,346
Buildings	$ 11,271,613	$ 30,954,779
Pumping Equip.	$ 7,240,730	$ 19,884,927
Tanks and Reservoirs	$ 50,831,822	$ 139,597,391
Transmission Mains	$ 65,943,001	$ 181,096,616
Distribution Mains	$ 72,116,478	$ 198,050,587
Services and Meters	$ 38,990,287	$ 107,077,460
Hydrants	$ 11,212,725	$ 30,793,055
Reclaimed Water System	$ -	$ 156,176,999
General Plant	$ 21,513,218	$ 59,080,886
	$ 363,556,586	$ 1,154,597,852

Rate of Return

Weighted Average Cost of Debt = 4.570%

Cost of Equity = Between 5%-10%

Weighted Average Cost of Debt	**4.570%**	**4.570%**	**4.570%**	**4.570%**	**4.570%**	**4.570%**
Cost of Equity	**5%**	**6%**	**7%**	**8%**	**9%**	**10%**
Rate of Return	**4.84%**	**5.47%**	**6.10%**	**6.74%**	**7.37%**	**8.00%**

Outside City Revenue Requirements

	Cost of Equity					
	5.0%	6.0%	7.0%	8.0%	9.0%	10.0%
Operation & Maintenance Expenses	$ 35,834,858	$ 35,834,858	$ 35,834,858	$ 35,834,858	$ 35,834,858	$ 35,834,858
Depreciation	$ 8,750,060	$ 8,750,060	$ 8,750,060	$ 8,750,060	$ 8,750,060	$ 8,750,060
Return on Rate Base	$ 17,601,576	$ 19,897,029	$ 22,192,482	$ 24,487,935	$ 26,783,388	$ 29,078,841
Total Outside City Revenue Requirements	**$ 62,186,494**	**$ 64,481,947**	**$ 66,777,400**	**$ 69,072,853**	**$ 71,368,307**	**$ 73,663,760**

Range of Outside City Differentials

	Cost of Equity					
	5.0%	6.0%	7.0%	8.0%	9.0%	10.0%
Outside City Revenue Under Existing Rates	$ 58,607,302	$ 58,607,302	$ 58,607,302	$ 58,607,302	$ 58,607,302	$ 58,607,302
Outside City Revenue Requirements	$ 62,186,494	$ 64,481,947	$ 66,777,400	$ 69,072,853	$ 71,368,307	$ 73,663,760
Cost Justified Differential	**6.1%**	**10.0%**	**13.9%**	**17.9%**	**21.8%**	**25.7%**

Next Steps

- Phase 2 Cost of Service Analysis
  - Utilize prior cost of service framework
    - Hybrid revenue requirement structure
    - Outside class data refinements
  - Evaluate cost differential
    - Peaking factors
    - Service delivery
    - Rate base and return
- Rate differential report

DISCUSSION

MEMORANDUM

Date: September 22, 2021

To: The Honorable Chair and Members
Pima County Board of Supervisors

From: C.H. Huckelberry
County Administrator

Re: **City of Tucson Differential Water Rates Cost-of-Service Study**

As you are aware, the City of Tucson Mayor and Council adopted an ordinance on June 22, 2021 directing staff to establish a differential water rate for Tucson Water customers located in the unincorporated County with an effective date of December 1, 2021. On August 10, 2021 Mayor and Council adopted Resolution 23379 providing a notice of intent to implement a minimum differential rate for customers in the unincorporated County of 10 percent, and up to 40 percent for single-family tiered rate of use over 3,000 cubic feet/month. The resolution also sets a public hearing for the rate increase on October 19, 2021.

On June 15, 2021, Principal Assistant City Attorney Chris Avery generated a legal analysis indicating that the Mayor and Council adoption of a differential water rate for the unincorporated County could only be legitimized by a cost-of-service study in order to comply with the Arizona Supreme Court ruling in Jung v. City of Phoenix, A.R.S. § 9-511.01(D) and -511.01(E), and Tucson Code § 27-32. Additionally, Mr. Avery stated that the study needs to demonstrate that at least a portion of the rate is supported by an increased cost. This statement is consistent with the analyses conducted by the County Attorney's Office, which you have reviewed and publicly released following waiving attorney-client privilege.

The City has since contracted with Raftelis Financial Consultants, Inc. for a cost-of-service study which was provided in two phases, the second of which was sent to the Citizen's Water Advisory Committee on September 15, 2021 (attached).

A review of this study indicates that the City, through their consultant, has failed to demonstrate an increased cost to providing service in the unincorporated County since they have only selected factors in the analysis that support their case and ignored others that do not. Factors included in the cost-of-service analysis are customer meter and class data, system peaking data (maximum usage by hour and month), and distribution lines (inch-miles of 8" diameter and smaller pipes). While these factors could be considered legitimate, assumptions and calculations were not provided for validation, including elements such as isolating distribution and metering infrastructure costs which are paid by property owners through the development process. The same applies to how operations and maintenance costs were allocated to inside City and unincorporated residents. Using self-serving targeted factors and questionable assumptions, the study reports an approximately five percent greater cost-based differential for the unincorporated County.

The cost-of-service study also incorrectly allocates 100 percent of the Utility Tax to inside City customers stating, "...this tax is only assessed to customers living within city limits." However, City tax does appear on unincorporated resident bills.

Additional factors not considered in the cost-of-service analysis include:

- Using consumption as the basis for splitting all costs between inside and outside customers when some of these costs such as director's office, billing, metering, financial and engineering are unit costs not related to volume consumed;
- City sales tax and groundwater protection fee applied to Tucson Water bills, benefiting solely the City of Tucson;
- Disproportionate payment of Central Arizona Water Conservation District taxes by unincorporated residents thereby subsidizing Central Arizona Project water for City customers;
- Costs of treating and conveying water containing contaminants such as PFAS and 1,4 Dioxane within City limits subsidized by unincorporated County customers;
- Reclaimed water use in the City of Tucson subsidized by unincorporated County customers; and
- Evaluation of average customer elevation data due to the significant costs associated with moving water from the Avra Valley, SAVSARP and CAVSARP well fields to the east side of the City of Tucson.

A review of these combined factors would likely demonstrate that unincorporated County water service costs less than City of Tucson and that unincorporated customers are already significantly subsidizing City residents *at existing rates*.

The Raftelis study goes on to calculate a utility-basis with a differential rate of return. However, the consultant acknowledged at the September 16, 2021 Citizen's Water Advisory Committee (CWAC) Financial Subcommittee Meeting that the only real "finding" of the analysis is a five percent differential and that further selection of an outside City differential is strictly a policy decision left to Mayor and Council based on the artificial "returns" they wish to receive.

This rate setting methodology, inferring a rate of return, assumes differences between owners and non-owners. As explained in Assistant County Administrator Yves Khawam's attached letters to the CWAC, this distinction is tenuous at best in terms of how Mayor and Council has selected to allocate Tucson Water's risk and debt and does not meet the criteria set by the American Water Works Association for developing fair and equitable rates.

Additionally, the City has further corrupted the concept of utility-basis and equity ownership by including other municipalities, the Tohono O'odham nation, the Pascua Yaqui Tribe and Tucson Unified School District within the "ownership" group, even though these entities have no more ownership stake in the utility than the remainder of the unincorporated County. This clearly demonstrates the discriminatory approach used by the City, which politically intermingles owners and non-owners thereby invalidating the utility-based approach altogether and rendering any rate of return projections meaningless.

In summary, the City cost-of-service study finds that an artificial five percent differential exists in certain areas of the unincorporated County through solely selecting factors that assist in making this case and ignoring factors that would potentially negate and even reverse this differential. Furthermore, the City proposed utility-basis fee differential cannot legitimately be applied from the standpoint of overall validity based both on the manner that the Tucson Water Enterprise is managed and by having corrupted the concept of ownership through including an array of entities unrelated to the Tucson municipality within the same ownership class.

The City cost-of-service study does not stand up to scrutiny and provides no legitimate basis for a differential fee to be applied to unincorporated County residents. As stated in the July 28, 2021 County Attorney analysis regarding legal options available to challenge the differential rate, the County has standing and capacity to sue the City on its own behalf or it may join a class of unincorporated customers. The City Council did not follow statutory procedures in adopting the differential rate ordinance on June 22, 2021 and has yet to demonstrate a basis for a fee differential through a valid cost-of-service study.

CHH/mp

Attachments

A. Undated phase 2 of 2 Raftelis Consultants cost-of-service study (sent to CWAC on 09/15/21)
B. Correspondence between the County and CWAC related to cost-of-service study

c: Honorable Mayor and Council Members, City of Tucson
Chair and Members, Citizen's Water Advisory Committee
Jan Lesher, Chief Deputy County Administrator
Carmine DeBonis, Jr., Deputy County Administrator for Public Works
Yves Khawam, PhD, Assistant County Administrator for Public Works

ADOPTED BY THE
MAYOR AND COUNCIL

October 19, 2021

ORDINANCE NO. 11881

RELATING TO WATER; AMENDING THE TUCSON CODE, CHAPTER 27, WATER, ARTICLE II, RATES AND CHARGES; SECTION 27-32 AND SECTION 27-33, MONTHLY POTABLE WATER SERVICE CHARGES BY ADDING RATES FOR TUCSON WATER CUSTOMERS IN UNINCORPORATED PIMA COUNTY BEGINNING IN FISCAL YEAR (FY) 2022; MAKING LEGISLATIVE FINDINGS; SETTING AN EFFECTIVE DATE; AND REPLACING THE PROVISIONS OF ORDINANCE NO. 11846 ADOPTED JUNE 22, 2021.

BE IT ORDAINED BY THE MAYOR AND COUNCIL OF THE CITY OF TUCSON ARIZONA, AS FOLLOWS:

SECTION 1. The Tucson Code, Chapter 27, Article II, Sections 27-32 and 27-33 are hereby amended to read as follows:

ARTICLE II. RATES AND CHARGES

* * *

Sec. 27-32. Charges for Water Service.

Charges for water utility service shall be made at monthly intervals and shall, to the extent possible, be consistent with the policy for charging for water in direct proportion to the cost of securing, developing and delivering water to the customers of the city water system. Charges for water utility service for customers within unincorporated Pima County, but not within lands placed into trust for a Native American tribal nation, will be set in proportion to costs, plus a reasonable differential. Water charges will be computed through the summation of service charge, the monthly water use charge, the Central Arizona Project surcharge, the conservation charge and summer surcharges where applicable.

In addition to cost of service considerations, the differential charged to customers within unincorporated Pima County may be established and structured to advance critical policy considerations, including but not limited to supporting annexation and incorporation; and promoting environmental sustainability and water conservation,

particularly in areas outside the city limits where the City has limited powers to promote those interests.

Sec. 27-33. Monthly potable water service charges.

For the purposes of computing monthly water charges:

(1) The monthly service charge shown in the following table applies to all customer classes. The fee shall be charged whether or not any water is provided.

Service Size (inches)	*MONTHLY SERVICE CHARGE FOR UNINCORPORATED PIMA COUNTY*
	FY 2022
5/8	$17.96
¾	$24.23
1	$36.76
1 1/2	$68.10
2	$105.70
2 1/2	$155.83
3	$205.97
4	$350.10
6	$711.07
8	$1,070.78
10	$1,634.80
12	$2,700.15

(2) Monthly water use charges in addition to the service charge shall be applicable to each service connection and shall be per Ccf and vary with customer classification and volumes used according to the following table:

RATE SCHEDULES BY CUSTOMER CLASSES FOR UNINCORPORATED PIMA COUNTY

Residential Single-Family	*$/Ccf*
	FY 2022

1–7 Ccf	$2.28
8-15 Ccf	$4.58
16–30 Ccf	$10.91
Over 30 Ccf	$18.10

Residential Duplex-Triplex	*$/Ccf*
	FY 2022
1 – 10 Ccf	$2.28
11 – 20 Ccf	$4.58
21 – 35 Ccf	$10.91
Over 35 Ccf	$18.10

Multi-Family	*$/Ccf*
	FY 2022
Basic Volume Charge	$3.76

Mobile Home Park with Sub-Meters	*$/Ccf*
	FY 2022
Basic Volume Charge	$2.81
Community Garden	$2.81
Commercial	*$/Ccf*
	FY 2022
Basic Volume Charge	$3.69
Tier 1 Summer Surcharge: for usage during May-October above 100% of winter (November-April) average	$1.19

Tier 2 Summer Surcharge: for usage during May-October above 145% of winter (November-April) average, added to Tier 1 Surcharge	$0.32
Industrial (more than 5 Mg per month & Tucson Unified School District by contract)	*$/Ccf*
	FY 2022
Basic Volume Charge	$3.71
Tier 1 Summer Surcharge: for usage during May-October above 100% of winter (November-April) average	$1.19
Tier 2 Summer Surcharge: for usage during May-October above 145% of winter (November-April) average, added to Tier 1 Surcharge	$0.32

Construction Water	*$/Ccf*
	FY 2022
Basic Volume Charge	$4.07

(3) The Central Arizona Project surcharge shall be in addition to the service charge and water use charges for all customer classes and apply to all monthly water use at the rate of seventy-seven cents ($0.77) per Ccf beginning in FY 2022.

(4) The conservation charge shall be in addition to the service charge and water use charges for all potable water customer classes and apply to all monthly water use at the rate of eleven cents ($0.11) per Ccf beginning in FY 2022.

SECTION 2. The rate changes approved by this Ordinance for customers in unincorporated Pima County shall take effect on December 1, 2021.

SECTION 3. The Mayor and Council find that implementing the differential rate structure as provided in this Ordinance results in reasonable differential rates and advances critical policy considerations including:

1. the rate structure supports and rewards annexation and incorporation, providing economic benefit and increased state shared revenues for the City and the region;

2. the rate structure recognizes that the City, as owner of Tucson Water, bears financial risks and liabilities that are not shared by the unincorporated county, including the City's financial backstopping of the utility; and

3. the rate structure promotes environmental sustainability and water conservation, particularly in areas outside the city limits where the City has limited powers to promote those interests.

The Mayor and Council further find that:

1. the rate structure is common among other Arizona municipal water providers for similar policy reasons; and

2. the rate structure is supported by the Cost of Service Phase 1 and Cost of Service Phase 2 studies authored in recent months by Galardi Rothstein Group and Raftelis.

SECTION 4. The provisions of this Ordinance supplant, supersede and replace the provisions of Ordinance No. 11846, adopted and approved June 22, 2021, which is hereby repealed by this Ordinance.

SECTION 5. The various City officers and employees are authorized and directed to perform all acts necessary or desirable to give effect to this Ordinance.

SECTION 6. If any provisions of this Ordinance, or the application thereof to any person or circumstance is invalid, the invalidity shall not affect other provisions or applications of this Ordinance which can be given effect without the invalid provision or circumstance, and to this end, the provisions of this Ordinance are severable.

PASSED, ADOPTED AND APPROVED by the Mayor and Council of the City of Tucson, Arizona, October 19, 2021.

_____
MAYOR

ATTEST:

_____
CITY CLERK

APPROVED AS TO FORM:

_____
CITY ATTORNEY

REVIEWED BY:

_____
CITY MANAGER

CA/dg
10/5/21

TECHNICAL MEMORANDUM

To: John Kmiec, Interim Utility Director, Tucson Water

From: Harold Smith, Raftelis Financial Consultants, Inc.

Subject: Phase 2 Outside Differential Analysis

CC: Deborah Galardi, Galardi Rothstein Group

On June 22, 2021, the City of Tucson (City) Mayor and Council approved a rate differential for Tucson Water customers located within unincorporated Pima County (Outside City Customers). This differential will be in addition to the rates assessed to all other customers (Inside City Customers). This decision was policy based and goes into effect on December 1, 2021. Mayor and Council further directed Tucson Water to conduct a cost-of-service analysis using standard industry practices to determine a potential cost basis for differential rates. The results of the cost-of-service analysis are supplemental to the policy basis already used to approve the differential rate. In making this decision to assess a higher rate, Mayor and Council made a policy decision that Outside City Customers would be considered "non-owners" of the Tucson Water system from a rate-setting perspective and should be assessed rates consistent with that status.

Tucson Water engaged Galardi Rothstein Group and Raftelis (GRG/Raftelis) to perform a cost-of-service analysis to assess various options for calculating rate differentials to be applied to non-owner customers. The Phase 1 analysis performed by GRG/Raftelis used readily available data to develop revenue requirements for the Tucson Water system. Using a utility basis structure, revenue requirements were allocated between Inside City Customers and Outside City Customers based solely on annual water use. The Outside City Customer revenue requirements were compared to the revenue generated by Outside City Customers under Tucson Water's existing rates. The difference between the calculated revenue requirements and revenue at existing rates serves as an approximation of a cost-based rate differential. The results of the Phase 1 analysis indicated outside city rate differentials ranging between 6.1% and 25.7%, depending on the cost of equity applied to Outside City Customers for determining a return on investment for Inside City Customers.

Upon completion of the Phase 1 analysis, Tucson Water tasked GRG/Raftelis with performing a Phase 2 analysis. Phase 2 involved exploring potential differences in the costs to serve Outside City Customers in more detail, and to narrow the range of returns on investment that could be used to calculate a differential rate. The results of the Phase 2 analysis are presented in this memo.

Overview of the Utility Basis with Differential Rates of Return Approach

As discussed in Chapter IV.1 of the American Water Works Association (AWWA) Manual of Water Supply Practices M-1 "Principle of Water Rates, Fees and Charges" (M-1 Manual), the utility basis with differential rates of return approach is an industry standard method of determining rates to be assessed to non-owner customers of a utility. This approach involves first determining the revenue requirements of the entire system using the cash-needs approach. The cash-needs revenue requirements include all costs necessary to provide utility service during the rate year and in the future. Cash-needs revenue requirements include O&M expenses, taxes, and capital costs (debt service and annual rate funded capital).

The next step is to recast the cash-needs capital requirements as utility basis revenue requirements (depreciation and a return on investment), and then determine the return on rate base that would be required to generate a return on investment equal to the cash-needs capital costs. The required return on investment is calculated by subtracting the annual O&M expenses and depreciation from the cash-needs revenue requirements. An imputed rate of return on rate base is then calculated by dividing the required return by the rate base.[1]

Next, in order to recognize the owner/non-owner relationship, differential rates of return are developed for Inside City and Outside City Customers to generate an equivalent overall return on investment sufficient to meet the annual cash-needs revenue requirements.

Finally, the utility basis O&M and capital components are allocated between Inside City Customers and Outside City Customers based on the different usage characteristics and ownership status of the two groups of customers. The allocated costs of both groups of customers are divided by their respective annual water usage to determine an overall unit cost of service for each group. The difference between the Inside City unit cost of service and the Outside City unit cost of service represents the cost-based rate differential for Outside City Customers.

Data Used in the Analysis

Data used for the analysis were derived from a variety of sources. Brief descriptions of each data set are provided below. It should be noted that data used in the Phase 1 analysis was further refined in Phase 2 to represent Outside City Customer characteristics more precisely. New data were developed in Phase 2 to allow for consideration of additional usage characteristics as outlined below.

- *Customer Data* – Customer data, including monthly consumption by customer class and meter counts by meter size and customer class, was available for FY2021 and prior years. The data was coded according to whether it was in an incorporated or unincorporated area of Pima County. With a few exceptions, all customers located in unincorporated areas within Tucson Water's service area are considered Outside City Customers. Policy-based exceptions include customers located in Tribal areas (e.g., Pascua Yaqui, Tohono O'odham) and Tucson Unified School District (TUSD) customers, both of which are considered Inside City customers for the purposes of this analysis.

- *System and Customer Peaking Data* – Average day, max day, max hour, and max month system production data was used to determine three-year averages of max day to max month (MD:MM) and max hour to max month (MH:MM) ratios. These system ratios were then applied to the maximum month to average month use ratio for each customer class to determine Inside City and Outside City Customer class peaking factors, consistent with Tucson Water's typical rate-setting process. The peaking factors are used to allocate peak-related operating expenses and net plant revenue requirements between Inside City and Outside City Customers.[2]

[1] Rate base equals the original cost of the assets less contributions and accumulated depreciation.

[2] The allocations of individual line-item O&M cost and net plant investment categories to service characteristics (average demand, peak demand, etc.) is based on the most recent Tucson Water rate process conducted in FY2019-20.

- *Distribution Lines* – Data on inch-miles of distribution pipeline for Inside City and Outside City Customers were provided by Tucson Water based on GIS data. For the purposes of this analysis, distribution lines for Outside City customers are defined as 8-inch diameter and smaller pipes located in the unincorporated service area. The respective inch-miles of Inside and Outside pipeline are used to allocate distribution-related maintenance expenses and net plant revenue requirements between Inside City and Outside City customers.

- *Cash Basis Revenue Requirements*– O&M and capital expenses (debt service and cash funded capital) net of non-rate revenues reflect a FY2020-21 test year, as it was the most recent year a cost-of-service analysis was conducted, and customer data was available.

- *Rate Base and Depreciation* – Rate base and annual depreciation was determined using asset data from FY2019-20, as it was the most recent fixed asset dataset available. The FY2019-20 fixed asset data was used to determine total Net Plant (the value of assets less contributed capital and accumulated depreciation). Revenues generated from system equity fees were also deducted from the Net Plant value, yielding total rate base which was then allocated between Inside City and Outside City Customers based on relevant service characteristics for each type of asset. System equity fee revenues were also attributed to Inside City and Outside City Customers as reported by Tucson Water's financial system.

Cash-Needs Revenue Requirements

Each component of the FY2020-21 Test Year (Test Year) revenue requirements is summarized below.

Operation & Maintenance Expenses

Tucson Water's budget includes projected expenses associated with operating, maintaining, and repairing the infrastructure used to provide water service. For the purposes of this analysis, O&M expenses related to the Reclaimed system have been excluded since a portion of Reclaimed expenses are recovered through Reclaimed rates, and this analysis is focused only on rates for potable water. In addition, a portion of Tucson Water's O&M expenses are offset by revenue from other sources. After exclusion of the Reclaimed expenses and adjusting for non-rate revenue, net O&M expenses to be included in revenue requirements are $112,539,677.

Table 1 on the following page provides a summary of net O&M expenses.

Table 1 – Net Operation & Maintenance Expenses

Director's Office	$ 6,523,190
Customer Services	10,154,100
Business Services	6,294,550
Water Quality and Operations	48,617,890
Planning & Engineering	9,034,690
Maintenance	30,712,260
Other Budgetary Requirements	23,963,040
Total O&M	$135,299,720
Less: Reclaimed Costs	(5,917,643)
Less: Non-Rate Revenue	(16,842,400)
Net O&M Expenses	$112,539,677

Taxes

Also included in Tucson Water's budget are two tax expenses: a Utility Tax expense and a Payment in Lieu of Taxes (PILOT) expense. The Utility Tax is a payment to the City equal to 4.5% of revenue generated from water sales from customers located inside the city limits. The PILOT, as the name implies, is a payment to the City in lieu of property taxes. The PILOT is based on the value of the assets located within the City. These two tax expenses total $8,489,736.

Table 2 provides a summary of tax expenses.

Table 2 – Tax Expenses

Utility Tax	$ 6,489,736
PILOT	2,000,000
Total Taxes	$ 8,489,736

Capital Expenses

Capital expenses included in revenue requirements consist of Tucson Water's debt service payments (both principal and interest) plus budgeted annual costs associated with projects funded with rate revenues. Capital expenses related to Reclaimed projects were excluded for the reason discussed above. Capital expenses included in revenue requirements are $101,562,771.

Table 3 on the following page provides a summary of net capital expenses.

Table 3 – Net Capital Expenses

Bond Debt Service Payments	$ 58,908,186
Capital Improvements from Annual Revenues	63,750,000
Capitalizable Equipment	2,250,000
Additions to Working Capital	(7,996,433)
Total Capital Costs	$ 116,911,752
Less: Reclaimed Capital Costs	$ (10,973,981)
Less: Non-Rate Revenue	$ (4,375,000)
	$ 101,562,771

As shown below in Table 4, Tucson Water's Test Year cash-needs potable water revenue requirements are $222,592,184.

Table 4 – Cash-Needs Revenue Requirements

Operation & Maintenance Expenses	$112,539,677
Utility Tax	6,489,736
Pilot/In Lieu of Property Tax	2,000,000
Capital Requirements	101,562,771
Total Revenue Requirements	$ 222,592,184

Imputed Rate of Return

The first step in determining the imputed rate of return is to recast Tucson Water's cash-needs revenue requirements as utility basis revenue requirements, as described previously. Annual depreciation is derived from Tucson Water's fixed asset records and the required return on rate base is determined by subtracting O&M expenses and depreciation from the cash-needs revenue requirements. The remainder is the required return on rate base necessary to ensure that Tucson Water can meet its annual cash needs.

Tucson Water's Test Year utility basis revenue requirements related to potable water are shown below.

Table 5 – Utility Basis Revenue Requirements

Operation & Maintenance Expenses	$ 112,539,677
Utility Tax	6,489,736
Pilot/In Lieu of Property Tax	2,000,000
Depreciation	29,691,941
Required Return on Investment	71,870,830
	$ 222,592,184

Imputed Rate of Return

As discussed earlier, the potable water rates that Tucson Water assesses to its customers must generate $222,592,184 in revenue, which under the utility basis includes a $71,870,830 return on rate base. By dividing the required return on rate base by Tucson Water's rate base, an imputed rate of return can be determined. This imputed rate of return is the rate of return that would need to be used to calculate

rates for all of Tucson Water's customers if Tucson Water's rates were determined using the utility basis. Calculation of the imputed system-wide rate of return is show below.

Calculation of Imputed Rate of Return

Required Return on Rate Base	$	71,870,830
Divided by Rate Base	$	810,386,764
		8.87%

Allocation of Utility Basis Revenue Requirements

The next step in the process is the allocation of the utility basis revenue requirements between the Inside City Customers and Outside City Customers. For this analysis, total O&M expenses, depreciation, and rate base were allocated to each customer group based on service characteristics, following the Base/Extra Capacity allocation approach used in prior Tucson Water cost-of-service analyses. The costs by service characteristic are then allocated to the Outside City Customers and Inside City Customers based on their service requirements. Schedules summarizing the allocation of O&M expenses, depreciation and rate base can be found in Appendix A to this memo.

Allocation to Base/Extra Capacity Cost Categories

O&M and capital costs are allocated to service characteristic categories in a manner consistent with the way in which they are allocated during Tucson Water's regular rate setting process. It should be noted that costs allocated to the "Readiness-To-Serve" category are primarily costs associated with Tucson Water's distribution system. Both readiness-to-serve O&M and capital costs associated with distribution assets are allocated between the Inside City and Outside City customer groups based on inch-miles of mains.

Schedule 1 shows the allocation of O&M costs to Base/Extra Capacity cost categories.

Schedules 2 and 3 show the allocation of depreciation and rate base to service characteristic categories.

Allocation to Inside City and Outside City Customers

Once O&M costs, depreciation and rate base have been allocated to service characteristic categories, they are then allocated between Inside City Customers and Outside City Customers using the allocation factors shown in Table 6 on the following page.

Table 6 – Inside City and Outside City Allocation Factors

Allocation Factors	Inside	Outside
Usage	73.07%	26.93%
Max Day	70.43%	29.57%
Max Hour	72.27%	27.73%
Customer Accounts	71.62%	28.38%
Meter Equivalents	73.44%	26.56%
Inch-Miles	63.65%	36.35%
All Inside	100.00%	0.00%
Neither	0.00%	0.00%
O&M	71.70%	28.30%
Assets	70.70%	29.30%
Depreciation	71.13%	28.87%

Base O&M Costs, Depreciation and Rate Base – Allocated based on total annual consumption using the Usage allocation factor.

Max Day O&M Costs, Depreciation and Rate Base – Allocated based on the Max Day demands of each customer group using the Max Day allocation factor.

Max Hour O&M Costs, Depreciation and Rate Base – Allocated based on the Max Hour demands of each customer group using the Max Hour allocation factor.

Meters and Services O&M Costs, Depreciation and Rate Base – Allocated based on the number of 5/8" meter equivalents using the Meter Equivalents allocation factor.

Billing O&M Costs, Depreciation and Rate Base – Allocated based on the number of customer accounts using the Customer Accounts allocation factor.

Readiness-To-Serve O&M Costs, Distribution Depreciation and Distribution Rate Base – Allocated based on inch-miles of distribution pipe 8" inches or less in diameter using the Inch-Miles allocation factor. This allocation factor recognizes that more distribution system piping per customer is required to serve Outside City Customers, based on data provided by Tucson Water.

Fire Protection O&M Costs, Depreciation and Rate Base – Since Tucson Water recovers its fire protection costs through its fixed monthly service charge (consistent with industry practice), these costs are allocated based on the number of 5/8" meter equivalents using the Meter Equivalents allocation factor.

CAP O&M Costs, Depreciation and Rate Base – Allocated based on the total annual consumption using the Usage allocation factor.

Reclaimed O&M Costs, Depreciation and Rate Base – As discussed previously, costs associated with the reclaimed system are excluded from this analysis and are not allocated to either customer group.

After rate base has been allocated between the Inside City and Outside City customer groups, rate base is adjusted to recognize the investment in the system made by both groups through the payment of System Equity Fees.

The results of the process to allocate O&M costs, depreciation and rate base between the Inside City and Outside City Customer groups are shown in Schedules 4, 5, and 6. Rate base is adjusted to recognize contributions made through the payment of System Equity Fees is shown in Schedule 7.

The detailed allocation of O&M expenses indicates that 71.70% of the O&M component of the utility basis revenue requirements should be allocated to Inside City Customers and 28.30% should be allocated to Outside City Customers.

The detailed allocation of depreciation indicates that 71.13% of depreciation should be allocated to Inside City Customers and 28.87% should be allocated to Outside City Customers.

The Utility Tax expense is allocated 100% to Inside City Customers since this tax is only assessed to customers living within the city limits.

The PILOT is allocated between Inside City Customers and Outside City Customers based on the allocation of assets to each group. While the amount of the PILOT is based on the value of Tucson Water assets located within the City, these assets are used to serve all customers and therefore both customer groups contribute to the recovery of this expense. 70.07% of the PILOT is allocated to Inside City Customers and 29.30% is allocated to Outside City Customers.

Once O&M costs, depreciation and taxes have been allocated between the Inside City Customers and the Outside City Customers, the next step in the process is to determine the allocation of the required return on investment. As discussed previously, the total return on rate base that must be recovered from rates is $71,870,830. The rate of return required to generate this return from the system as a whole is 8.87%.

The use of the “utility basis with differential rates of return” approach allows for the recognition of the risks borne by the Inside City owners by applying a higher rate of return to the rate base allocated to Outside City Customers. Given that Tucson Water’s Outside City differentials were established based on policy, a range of rate of return differentials were analyzed. Each rate of return scenario involved applying a rate of return to the rate base allocated to each customer group such that the combined return on rate base was equal to the required return for the system as a whole.

Finally, the respective rate of return values for Inside and Outside City were added to the other allocated revenue requirements to determine the total requirements for each group under the various rate of return scenarios. The total requirements of each group were then divided by the annual consumption for that group to arrive at a unit cost of service for each group. The difference between the calculated unit cost for each group under each rate of return scenario is the calculated rate differential based on the cost-of-service analysis. Table 7 on the following page shows the unit costs and cost-of-service based differentials resulting from rate of return (ROR) differentials ranging from 1% to 5% in 0.5% increments.

Table 7 – Range of Rate Differentials

ROR Differential	1.00%	1.50%	2.00%	2.50%	3.00%	3.50%	4.00%	4.50%	5.00%
Inside City ROR	8.57%	8.43%	8.28%	8.13%	7.98%	7.83%	7.69%	7.54%	7.39%
Outside City ROR	9.57%	9.93%	10.28%	10.63%	10.98%	11.33%	11.69%	12.04%	12.39%
Inside City Unit Cost	$5.33	$5.30	$5.28	$5.25	$5.22	$5.19	$5.16	$5.13	$5.11
Outside City Unit Cost	$5.82	$5.90	$5.98	$6.05	$6.13	$6.21	$6.28	$6.36	$6.44
Outside City Differential	9%	11%	13%	15%	17%	20%	22%	24%	26%

As shown in Table 7, depending on the differential in the rate of return between Inside City and Outside City Customers, cost-based rate differentials range between 9% and 26%. The choice of an appropriate rate of return differential is a policy decision; however, it should be noted that even if there is no rate of return differential, there is still a cost-based differential of approximately 5%. This 5% differential is driven by the higher peak demands of the Outside City Customers as well as the greater relative cost of constructing, operating, and maintaining the distribution system that serves the Outside City Customers.

Appendix A to Phase 2 Outside City Differential Analysis

Appendix A – Cost Allocation Schedules

Schedule 1 – Allocation of O&M Expenses to Base/Extra Capacity Cost Categories

Operating and Maintenance Expenses - Total

	Total	Base	Max Day	Max Hour	Meters/Services	Billing	Readiness-to-Serve	Fire Protection	CAP
Director's Office	$ 6,295,797	$ 2,077,307	$ 645,282	$ 40,778	$ 196,454	$ 2,645,059	$ 511,732	$ 179,185	$ -
Customer Services	10,154,100	-	-	-	-	10,154,100	-	-	-
Business Services	6,240,915	380,835	86,719	9,618	46,337	5,554,438	120,702	42,264	-
Water Quality and Operations	44,480,047	22,924,267	3,682,713	452	14,675	-	18,788	853,452	16,985,700
Planning & Engineering	7,942,589	3,332,881	1,693,350	1,485,387	680,328	-	440,417	310,226	-
Maintenance	30,424,437	9,372,266	3,217,096	403,888	4,070,775	-	10,549,885	2,810,527	-
Other Budgetary Requirements	23,844,191	5,730,095	233,558	(878,914)	103,916	2,014,335	1,664,195	467,445	14,509,560
Total O&M	$ 129,382,077	$ 43,817,652	$ 9,558,718	$ 1,061,210	$ 5,112,485	$ 20,367,932	$ 13,305,719	$ 4,663,100	$ 31,495,260

Schedule 2 - Allocation of Depreciation to Service Characteristic Categories

	Total	Base	Max Day	Max Hour	Meters/Services	Billing	Distribution	Direct Fire Protection
Depreciation - Total								
Land	$ 46,021	$ 28,763	$ 17,258	$ -	$ -	$ -	$ -	$ -
Wells	$ 3,827,681	2,392,301	1,435,380	-	-	-	-	-
CAP/Hayden Udall WTP	$ 2,387,329	1,492,081	895,248	-	-	-	-	-
Reclaimed Water System	$ -	-	-	-	-	-	-	-
Buildings	$ 1,115,886	697,429	418,457	-	-	-	-	-
Pumping Equip. - Well Related	$ 454,894	284,309	170,585	-	-	-	-	-
Pumping Equip. - Other	$ 450,869	281,793	169,076	-	-	-	-	-
Tanks and Reservoirs	$ 4,042,908	1,443,896	-	2,599,012	-	-	-	-
Transmission Mains	$ 4,499,905	2,812,441	1,687,464	-	-	-	-	-
Distribution Mains	$ 4,570,911	-	-	-	-	-	4,570,911	-
Services and Meters	$ 4,529,616	-	-	-	4,529,616	-	-	-
Hydrants	$ 770,281	-	-	-	-	-	-	770,281
General Plant	$ 2,995,640	1,214,774	617,195	541,396	503,770	-	-	118,505
Total Depreciation	$ 29,691,941	$ 10,647,785	$ 5,410,664	$ 3,140,408	$ 5,033,386	$ -	$ 4,570,911	$ 888,786

Appendix A – Cost Allocation Schedules

Schedule 3 - Allocation of Rate Base to Service Characteristic Categories

	Total	Base	Max Day	Max Hour	Meters/Services	Billing	Distribution	Direct Fire Protection
Rate Base -Total								
Land	$ 45,540,395	$ 28,462,747	$ 17,077,648	$ -	$ -	$ -	$ -	$ -
Wells	90,582,823	56,614,264	33,968,559	-	-	-	-	-
CAP/Hayden Udall WTP	47,251,680	29,532,300	17,719,380	-	-	-	-	-
Reclaimed Water System	-	-	-	-	-	-	-	-
Buildings	21,354,533	13,346,583	8,007,950	-	-	-	-	-
Pumping Equip. - Well Related	12,806,625	8,004,141	4,802,485	-	-	-	-	-
Pumping Equip. - Other	7,452,824	4,658,015	2,794,809	-	-	-	-	-
Tanks and Reservoirs	133,677,709	47,742,039	-	85,935,670	-	-	-	-
Transmission Mains	172,152,798	107,595,499	64,557,299	-	-	-	-	-
Distribution Mains	164,709,257	-	-	-	-	-	164,709,257	-
Services and Meters	88,048,688	-	-	-	88,048,688	-	-	-
Hydrants	30,398,590	-	-	-	-	-	-	30,398,590
General Plant	23,027,385	9,337,928	4,744,357	4,161,697	3,872,461	-	-	910,942
Total Rate Base	$ 837,003,306	$ 305,293,515	$ 153,672,486	$ 90,097,367	$ 91,921,149	$ -	$ 164,709,257	$ 31,309,531

Appendix A – Cost Allocation Schedules

Schedule 4 – Allocation of O&M Costs Between Inside City and Outside City Customer Groups

Operating and Maintenance Expenses - Allocated to Inside-City

	Total	Base	Max Day	Max Hour	Meters/Services	Billing	Readiness-to-Serve	Fire Protection	CAP
Director's Office	$ 4,497,740	$ 1,517,838	$ 454,484	$ 29,471	$ 144,274	$ 1,894,373	$ 325,708	$ 131,592	$ -
Customer Services	7,272,297	-	-	-	-	7,272,297	-	-	-
Business Services	$ 4,466,240	278,267	61,078	6,951	34,030	3,978,050	76,825	31,039	-
Water Quality and Operations	$ 32,404,867	16,750,202	2,593,799	327	10,777	-	11,958	626,768	12,411,036
Planning & Engineering	$ 5,709,201	2,435,254	1,192,656	1,073,518	499,627	-	280,318	227,827	-
Maintenance	$ 21,174,226	6,848,086	2,265,857	291,898	2,989,542	-	6,714,816	2,064,027	-
Other Budgetary Requirements	$ 17,239,399	4,186,841	164,499	(635,208)	76,315	1,442,653	1,059,231	343,288	10,601,781
Total Inside-City O&M	$ 92,763,970	$ 32,016,487	$ 6,732,373	$ 766,957	$ 3,754,565	$ 14,587,374	$ 8,468,856	$ 3,424,540	$ 23,012,817

Operating and Maintenance Expenses - Allocated to Outside-City

	Total	Base	Max Day	Max Hour	Meters/Services	Billing	Readiness-to-Serve	Fire Protection	CAP
Director's Office	$ 1,798,057	$ 559,470	$ 190,799	$ 11,307	$ 52,180	$ 750,686	$ 186,023	$ 47,593	$ -
Customer Services	$ 2,881,803	-	-	-	-	2,881,803	-	-	-
Business Services	$ 1,774,675	102,568	25,641	2,667	12,308	1,576,388	43,877	11,226	-
Water Quality and Operations	$ 12,075,180	6,174,065	1,088,914	125	3,898	-	6,830	226,684	4,574,664
Planning & Engineering	$ 2,233,388	897,626	500,694	411,869	180,701	-	160,099	82,399	-
Maintenance	$ 9,250,211	2,524,180	951,239	111,990	1,081,233	-	3,835,069	746,500	-
Other Budgetary Requirements	$ 6,604,792	1,543,255	69,059	(243,706)	27,601	571,682	604,964	124,157	3,907,779
Total Outside-City O&M	$ 36,618,107	$ 11,801,164	$ 2,826,345	$ 294,253	$ 1,357,920	$ 5,780,559	$ 4,836,863	$ 1,238,560	$ 8,482,443

Schedule 5 – Allocation of Depreciation Between Inside City and Outside City Customer Groups

	Total	Base	Max Day	Max Hour	Meters/Services	Billing	Distribution	Direct Fire Protection
Depreciation - Inside-City	$ 21,119,033	$ 7,780,076	$ 3,810,826	$ 2,269,635	$ 3,696,475	$ -	$ 2,909,305	$ 652,717
Depreciation - Outside-City	8,572,908	2,867,709	1,599,838	870,774	1,336,911	-	1,661,607	236,069
Total Depreciation	$ 29,691,941	$ 10,647,785	$ 5,410,664	$ 3,140,408	$ 5,033,386	$ -	$ 4,570,911	$ 888,786

Schedule 6 – Allocation of Rate Base Between Inside City and Outside City Customer Groups

	Total	Base	Max Day	Max Hour	Meters/Services	Billing	Distribution	Direct Fire Protection
Rate Base - Inside-City	$ 591,753,962	$ 223,070,513	$ 108,234,229	$ 65,115,131	$ 67,506,094	$ -	$ 104,834,546	$ 22,993,448
Rate Base - Outside-City	245,249,344	82,223,002	45,438,257	24,982,235	24,415,055	-	59,874,711	8,316,083
Total Rate Base	$ 837,003,306	$ 305,293,515	$ 153,672,486	$ 90,097,367	$ 91,921,149	$ -	$ 164,709,257	$ 31,309,531

Appendix A – Cost Allocation Schedules

Schedule 7 – Allocation of Rate Base Between Inside City and Outside City Customer Groups Adjusted for System Equity Fees

Rate Base Net of System Equity Fee Revenues:	
Net Plant - Inside-City	$ 570,943,150
Net Plant - Outside-City	239,443,614
Bate Base - Adjusted	$ 810,386,764

City of Tucson Differential Analysis

Second SME Meeting

May 6, 2024

Attendees:

Tucson Water Representatives:

Silvia Amparano, Tucson Water Deputy Director
Chris Avery, Assistant City Attorney
Amber Kerwin, Rates and Revenue Manager

Tucson Water Contracted Rate Consultants:

Deb Galardi, Principal, Galardi Rothstein Group
Harold Smith, Vice President, Raftelis

Subject Matter Experts:

Michael Matichich, Economic and Financial Consulting Team Lead, Jacobs
Shawn Koorn, Associate Vice President/Senior Professional Associate, HDR
Bart Foster, President, Foster Group
Dan Jackson, Vice President, Willdan Financial Services

Agenda

1.) Questions from last meeting's materials and/or discussion?

2.) Follow up Action Items from Last Meeting
   a. Inclusion of contributed assets in allocation of distribution assets between incorporated and unincorporated?
   b. Testimony of H.Smith as part of current litigation in response to challenges on methodology.

3.) Review of Phase II Analysis Workbook (data inputs and calculations) – Harold Smith

4.) Current Data and Usage Characteristics – Amber Kerwin

5.) Final Thoughts/Recommendations:
   a. Sufficient data?
   b. Methodology?
   c. Groups subject to differential?
   d. Other considerations?

6.) Next Steps:
   a. Draft summary report sent out to panel for review – May 15th.
   b. Panel feedback comments due – May 22nd
   c. Present findings to Mayor and Council – August 7th or 20th
      i. Direction to proceed with differential rate development?

Pima County

v.

City of Tucson et al.

Statement of Expert Opinion

For

The City of Tucson

February 10, 2022

Prepared by

Harold J. Smith

Introduction

This report is being prepared at the request of the City of Tucson in connection with the lawsuit Pima County vs. City of Tucson, et al.

My name is Harold J. Smith, and my business address is 383 North Corona Street, #204, Denver, Colorado, 80218.

I am a Vice President of Raftelis Financial Consultants, Inc. (Raftelis), a consulting firm specializing in water and wastewater finance and pricing. Raftelis was established in 1993 in Charlotte, North Carolina, by George A. Raftelis to provide environmental and management consulting services to public and private sector clients. Raftelis is a national leader in the development of water and wastewater rates that satisfy local government objectives.

I obtained a Master of Business Administration from Wake Forest University in 1997, and a Bachelor of Science in Natural Resources from the University of the South in 1987. I have been employed at Raftelis since 1997 and am a Registered Municipal Advisor. As an employee of Raftelis, I have been involved in numerous projects for public utilities, including a number of studies involving the transition to new rate structures designed to address specific pricing objectives. I have also served on engagements involving a wide range of technical specialties, including:

- Utility Cost of Service and Rate Structure Studies
- Privatization Feasibility Studies
- Privatization Procurements
- Utility Financial Planning Studies
- Municipal Financial Planning Studies

During the past four years, I have provided testimony for the City of Newport, Utilities Department, Water Division ("Newport Water" or "Newport") in its most recent rate filing before the Rhode Island Public Utilities Commission ("Commission") in Docket No. 4933. I also provided testimony in the Providence Water Supply Board's most recent rate filings (Docket Nos. 4618 and 4994). I have also provided testimony for the Pittsburgh Water and Sewer Authority's (PWSA) first three water (Docket Nos. R-2018-3002645, R-2020-3017951 and R-2021-3024773) and wastewater conveyance (Docket

Nos. R-2018-3002647, R-2020-3017970 and R-2021-3024774) and PWSA's first stormwater (Docket Nos. R-2021-3024779) rate filings before the PAPUC.

I was a contributing author of "Water and Wastewater Finance and Pricing, The Changing Landscape", Fourth Edition, Taylor and Francis Group, 2015

I was the primary author of the Phase 1 and Phase 2 Cost of Service Analysis memorandums and led the preparation of those analyses. Memoranda summarizing the Phase 1 and Phase 2 analyses are attached to this report.

I am being compensated for my expert testimony at my standard billing rate of $310 per hour.

Overview of Phase 1 and Phase 2 Cost of Service Analyses

On June 22, 2021, the City of Tucson (City) Mayor and Council approved a rate differential for Tucson Water customers located within unincorporated Pima County (Outside City Customers). This differential is in addition to the rates assessed to all other customers (Inside City Customers). This decision was policy based and went into effect on July 12, 2021. However, Mayor and Council further directed Tucson Water to conduct a cost-of-service analysis using standard industry practices to determine a potential cost basis for differential rates. The results of the cost-of-service analysis are supplemental to the policy basis used to approve the differential rate. In making this decision to assess a higher rate, Mayor and Council made a policy decision that from a rate-setting perspective, Outside City Customers would be considered "non-owners" of the Tucson Water system and should be assessed rates consistent with that status.

Tucson Water engaged Galardi Rothstein Group and Raftelis (GRG/Raftelis) to perform a cost-of-service analysis to assess various options for calculating rate differentials to be applied to non-owner customers. The Phase 1 analysis performed by GRG/Raftelis used readily available data to develop revenue requirements for the Tucson Water system. Using a utility basis structure, revenue requirements were allocated between Inside City Customers and Outside City Customers based solely on annual water use. The Outside City Customer revenue requirements were compared to the revenue generated by Outside City Customers under Tucson Water's existing rates. The difference between the calculated revenue requirements and revenue at existing rates serves as an approximation of a cost-based rate differential. The results of the Phase 1 analysis indicated outside city rate differentials ranging between 6.1% and 25.7%, depending on the cost of equity applied to Outside City Customers for determining a return on investment for Inside City Customers. As mentioned in the technical memorandum summarizing the Phase 1 analysis and results (Phase 1 memorandum), this was a high-

level analysis, performed in a short amount of time, using limited available data, and was never intended to be used to calculate rates to be assessed to Outside City Customers and was not used for that purpose.

Upon completion of the Phase 1 analysis, Tucson Water tasked GRG/Raftelis with performing a Phase 2 analysis. For the Phase 2 analysis, the utility basis with differential rates of return approach was used to identify differences in the costs to serve Inside City and Outside City Customers and to calculate the rate differential resulting from the application of a variety of differential rates of return for Outside City Customers. As discussed in Chapter IV.1 of the American Water Works Association (AWWA) Manual of Water Supply Practices M-1 "Principle of Water Rates, Fees and Charges" (M-1 Manual), the utility basis with differential rates of return is an industry standard method of determining rates to be assessed to non-owner customers of a utility. This approach involves first determining the revenue requirements of the entire system using the cash-needs approach, recasting the cash-needs revenue requirements as utility basis revenue requirements, and then determining the return on rate base that would be required to generate a return on investment that, when added to the utility's annual depreciation expense is equal to the utility's cash-needs capital costs. The required return on investment is calculated by subtracting the annual O&M expenses and depreciation from the cash-needs revenue requirements. An imputed rate of return on rate base is then calculated by dividing the required return by the rate base. Next, in order to recognize the owner/non-owner relationship, differential rates of return are developed for Inside City and Outside City Customers to generate an equivalent overall return on investment sufficient to meet the annual cash-needs revenue requirements. Finally, the utility basis O&M and capital components are allocated between Inside City Customers and Outside City Customers based on the different usage characteristics of the two groups of customers. The first step in the allocation process, the assignment of costs to Base/Extra Capacity cost categories, uses the same allocations as the cost of service analysis that was the basis for the Tucson Water rates that were proposed for fiscal year 2021 (FY 2021). The allocated costs of both groups of customers are then divided by their respective annual water usage to determine an overall unit cost of service for each group. The difference between the Inside City unit cost of service and the Outside City unit cost of service represents the cost-based rate differential for Outside City Customers. A memorandum detailing the analysis and summarizing the results (Phase 2 memorandum) was delivered to Tucson Water management.

After the analyses, in October the Mayor and Council replaced the Ordinance adopted in June with an Ordinance adopting rate differentials to become effective on December 1, 2021.

Purpose and Use of Phase 1 and Phase 2 Cost of Service Analyses

It is important to note that the water rates assessed to Outside City Customers were not determined based on the results of the Phase 1 or Phase 2 cost of service analyses. Neither of these analyses was prepared for the purpose of calculating differential rates, and neither the Phase 1 nor Phase 2 analysis was used to determine the set of differential rates approved by the Council. The rates assessed to Outside City Customers were determined by applying the Council approved set of multipliers to the rates assessed to Inside City Customers, which are determined using industry accepted rate-setting practices. The purpose of these two analyses was to provide information to the Council as to whether there was a justifiable difference in the cost of serving customers located in unincorporated Pima County. The Council had already determined the magnitude of the differential and how it was to be applied to the different components of Tucson Water's rates.

Much has been said, both in correspondence from Pima County and in the reports prepared by the County's experts, about whether it is appropriate for a municipal utility to determine rates using the utility basis. While it is perfectly acceptable for municipal utilities to set rates using the utility basis, and even required in some jurisdictions, neither Tucson Water's rates nor the rates assessed to Outside City Customers were developed using the utility basis. The utility basis was used for the Phase 2 cost of service analysis to demonstrate that there is a cost justifiable differential between the cost to serve Inside City Customers and Outside City Customers. This differential is due in part to different demands placed on the system by the Outside City Customers as well as a higher rate of return on investment due from the non-owner Outside City Customers.

It seems that much of the criticism of the use of the utility basis in the Phase 2 analysis stems from the misunderstanding that the return on rate base component of the utility basis revenue requirements represents a "profit" to the utility. While profit can be a component of the return on rate base, there is no profit included in the utility basis revenue requirements used in the Phase 2 analysis. The primary reason for the use of the utility basis for the Phase 1 and Phase 2 analyses was to allow for the recognition of the risks the City bears as a result of serving customers outside its jurisdiction. Neither the Phase 1 nor Phase 2 analysis attempted to put a discrete value on these risks, but

the use of the utility basis allowed for it to be considered when deciding whether the Council approved differential between Inside City rates and Outside City rates was justifiable.

The Phase 2 analysis demonstrated that even without taking risk into account there is a difference in the cost to serve Inside City and Outside City Customers. The higher cost of service for Outside City Customers is due to higher peak demands on the part of Outside City Customers and the fact that it requires more pipe to serve customers in the generally less densely developed area outside Tucson's city limits. The Phase 2 analysis also demonstrated that the relatively low rate of return differential required to achieve the rate differential imposed by Tucson City Council is reasonable.

The reports submitted by Khawam and Bourassa both question whether the City, in serving customers located outside the City's corporate limits, incurs risks in addition to the risks it incurs serving customers inside the City limits. As mentioned previously, the Phase 1 and Phase 2 analyses did not attempt to identify or specifically quantify the risks the City bears by serving customers outside its jurisdiction; however, the use of the utility approach with a differential rate of return for the Phase 2 analysis allowed for that risk to be recognized. The practice of recognizing the risks associated with serving non-owner customers is addressed in detail in Chapter VI.1 of the M-1 Manual. Of the risks borne by the City, the most significant is the risk of not recovering sufficient revenue if customers located outside the City decide to cease being customers of Tucson Water and obtain their water from one of the other water service providers located within Pima County. Such action on the part of the Outside City Customers would force Tucson Water to raise rates for its remaining customers such that it could generate revenue sufficient to meet the revenue requirements associated with a system designed, constructed and operated to serve a larger customer base. If a large enough group of Outside City Customers left Tucson Water, the utility could be in jeopardy of being unable to meet the debt service coverage requirements of its bond covenants and the City would need to step in to avoid a default on Tucson Water's debt. The City also bears the regulatory risk associated with treating and delivering safe, clean drinking water to customers as well as the risk that the City will be sued as a result of its operating and rate-setting practices.

As discussed previously, neither the Phase 1 or Phase 2 analysis attempted to quantify the risks borne by the City, but both analyses used utility basis revenue requirements such that this risk could be recognized.

It is my opinion that the Phase 1 and Phase 2 analyses demonstrate that the differential rates approved by City Council are just and reasonable and appropriately recognize the difference in the cost to serve Outside City Customers

Reports Prepared by Pima County Experts

Pima County engaged experts in various fields to perform analysis and prepare reports in support of Pima County's position with respect to the implementation of differential rates for Outside City Customers. The reports prepared by Mr. Yves Khawam and Mr. Thomas Bourassa provide criticism of the City's decision to implement differential rates for Outside City Customers and the Phase 1 and Phase 2 analysis prepared by GRG/Raftelis. The report prepared by Messrs. Hopkins and Hansen provided a great deal of interesting information regarding evapotranspiration and the effectiveness of conservation rate structures, but that information, in my opinion, is irrelevant in a dispute over the appropriateness of charging higher rates to customers located outside the City's corporate limits.

In his expert report, Mr. Khawam attacks the use of differential rates and the Phase 1 and Phase 2 analysis on a number of fronts. He begins by identifying what he considers to be a number of errors in the Phase 1 and Phase 2 analyses. He states that the cost of service studies "ignored many elements tending to show that the cost of service is actually higher for inside city customers[1]. Specifically, Mr. Khawam incorrectly asserts that "Perhaps the most significant element ignored by Raftelis is the cost associated with Capital Improvement Projects (CIP)."[2] He then goes on to describe an analysis that he performed that is based on a cost allocation approach that is inconsistent with industry-standard rate-setting practices. Mr. Khawam also takes issue with the way in which certain costs were allocated and asserts that certain costs, specifically costs associated with the treatment of certain contaminants and the value of reclaimed water were not properly considered in the Phase 2 analysis. Mr. Khawam also opines that the Phase 2 analysis should have taken into consideration the relative magnitude of tax payments paid to the Central Arizona Conservation District by Inside City Customers and Outside City Customers.

Finally, Mr. Khawam opines at length that the Phase 2 analysis' use of the utility basis is inappropriate because Tucson Water is not a for profit utility regulated by the Arizona Corporation Commission and because the City and the Inside City Customers do not bear more risk that the Outside City Customers.

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[1] PIMA001513
[2] PIMA001514

Phase 1 and Phase 2 Analyses

Capital Costs

The development of cash-needs and utility basis revenue requirements was clearly described in the Phase 2 memorandum, and Table 3 from that memo clearly shows that contrary to Mr. Khawam's assertions, $63,750,000 in cost associated with capital improvements was included in the cash-needs revenue requirements. Additionally, these costs were first allocated to cost categories and then to customer classes, in this case, Inside City Customers, and Outside City Customers, in a manner consistent with standard rate-setting practice.

The development of cash-needs capital requirements presented in Mr. Khwam's report has a number of flaws. First, Mr. Khawam arbitrarily divides Tucson Water's cash needs capital requirements into two components, Capital Requirements (distributed) and Capital Requirements (specifically allocated) apparently ignoring the information presented in Table 3 of the Phase 2 memorandum that shows a detailed build-up of the annual cash needs capital requirements. This table shows that $58,908,186 of the capital requirements is for actual debt service payments on existing debt, that $63,750,000 in actual cash is planned to be used to fund specific capital projects from the CIP, and that $2,250,000 will be used to fund actual capitalizable equipment needed to be purchased in the rate year. Table 3 also shows a series of adjustments to remove working capital, the cost to fund reclaimed projects, and to account for funds provided from sources other than rates. Mr. Khawam replaces these numbers, which were developed using a careful financial planning process, with fabricated values derived from a poorly informed attempt to directly assign responsibility for all of the projects in Tucson Water's five-year CIP to Inside City Customers and Outside City Customers. His analysis bypasses the standard industry practice of first identifying the actual annual capital expenses that are projected to be incurred and then allocating these costs to cost categories and then to customer classes using an approach described in the M-1 Manual.

As stated in the M-1 Manual:

"Because the annual costs of debt service or cash-financed capital outlays can vary significantly from year to year, revenue requirements under the cash-needs approach can also vary significantly. To conform to the objective of rate continuity, those capital costs can be allocated to base and extra capacity components, or to commodity and demand cost components, in the same overall proportion or ratio as the allocation of

total net plant investment or rate base. It is assumed that future capital projects (whether debt or cash financed) will be in rough proportion to the past investments in the system or the net plant value, and the use of the cumulative net plant-value allocation basis for annual capital costs will tend to "dampen out" the variations in the annual additions to the net plant value and will provide for rate continuity."[3]

This was the process used for the allocation of capital costs in the Phase 2 analysis, as demonstrated in Schedule 3 in Appendix A of the Phase 2 memo.[4]

In addition to being inconsistent with standard industry practice and rate-setting practices used for decades by Tucson Water, Mr. Khawam's attempt at allocating capital costs directly to customer classes is flawed in many ways. First, the project costs he uses are estimated project costs over a period of five years and do not represent actual annual costs for the rate year. Second, his analysis includes costs for both reclaimed and green infrastructure projects, which should not be recovered through potable water rates. Third, Mr. Khawam's analysis ignores the fact that twenty of the projects in the CIP with total project costs of approximately $59.4 million will be funded with debt, thereby spreading the cost of those projects over the term of the debt, which could be as long as thirty years.

Perhaps the biggest flaw with Mr. Khawam's analysis is that it is based on an erroneous determination of which customer classes planned capital improvements will benefit. Conversations with Mr. Scott Schladweiler, Deputy Director and former Chief Engineer of Tucson Water, revealed that many of the capital projects that Mr. Khawam assigned to Inside City Customers only will, in fact, be used to provide service to all of Tucson Water's customers. Examples include:

- New Building and Plant 1 Complex ($15.5 million)– This is a facility that houses maintenance crews and equipment as well as a meter shop and warehouse space used to store materials and supplies used throughout the system and therefore benefits both Inside City and Outside City Customers.
- Craycroft Road D-E Booster Station ($10.3 million) – This project will provide additional pumping and storage capacity in a portion of the system used to serve both Inside City and Outside City Customers.
- Pantano Road E-F Booster Station ($10.76 million) - This project will provide additional pumping and storage capacity in a portion of the system used to serve both Inside City and Outside City Customers.

[3] M-1 p80
[4] Phase 2 memo Appendix A

- Advanced Treatment for New Contaminants ($9.08 million) – These facilities will remove emerging contaminants detected in water from wells located throughout the system, thereby ensuring that all customers receive safe healthy water regardless of their location.
- Old Vail Road 36-inch Transmission Main Projects (3 projects - $14.8 million) – These projects involve the installation of new transmission piping that will improve operating efficiency, public water pressure, and fire flow, and also will improve reliability during peak demand and outages.

Mr. Schladweiler reviewed the table included with Mr. Khawam's report at PIMA001540-1541 and provided comments regarding the purpose of each project and the way in which they benefit Tucson Water's customers. A review of Mr. Schladweiler's comments reveals that many of the projects that Mr. Khawam assigned to the Inside City Customer class in fact benefit both Inside City Customers and Outside City Customers. Mr. Schladweiler's comments are included in Appendix C to this report.

Allocation of Costs

On page 5 of his report, Mr. Khawam asserts that:

"The Raftelis cost model also allocates several fixed Operations and Maintenance (O&M) expenses to inside and outside customers based on consumption or usage rates. Allocating fixed costs to inside/outside customers based on usage or consumption is a significant error because fixed costs are incurred regardless of the amount of water consumed by customers."[5]

This statement demonstrates a misunderstanding of the Base/Extra Capacity method of cost allocation as well as the cost structure of a water utility. When using the Base/Extra Capacity approach to cost allocation, revenue requirements are first allocated from functional cost centers (Director's Office, Water Quality and Operations, etc.) to Base/Extra Capacity cost categories (Base, Max Day, Max Hour, etc.) in a manner that reflects that the costs incurred in each functional cost center are incurred to meet the specific demands that a utility's customers place on the system. For example, costs incurred by the Water Quality and Operations cost center include the operations costs associated with wells, treatment facilities, pump stations, and storage tanks, and each of these facilities are used to meet average day demands, maximum day demands, and maximum hour demands. As such, costs incurred by the Water Quality and Operations cost center are allocated to the Base, Max Day, and Max Hour cost categories. The

[5] PIMA001515

allocation of these costs is not based on usage as Mr. Khawam asserts but on system demand characteristics.

Once costs from each functional cost center are assigned to cost categories, they are then allocated to customer classes based on the way in which each class demands service. If one class has a higher average day or Base demand, it will be allocated a larger share of the costs incurred to meet Base demand. Similarly, a customer class that has higher peak demands relative to their average day demands will be allocated a larger share of the costs incurred to meet peak demands. This approach to cost allocation helps ensure adherence to the principle of cost causation. Cost causation or the concept that revenue should be recovered from those that cause the costs to be incurred is one of the guiding principles of water rate-setting. The Base/Extra Capacity approach was developed to allocate costs in a way that adheres to the principle of cost causation. This was the approach used for the Phase 2 analysis as shown in Schedules 1, 2 and 3 in the Appendix to the Phase 2 memorandum, and is the approach that Tucson Water has used to set rates for decades. In fact, the allocation results shown in Schedules 1, 2 and 3 are the results of the cost allocation process used to develop the rates that were initially proposed to be implemented in July of 2020, but were not put in place in response to the COVID-19 pandemic.

It should be noted that the fixed or variable nature of the costs being allocated typically has no bearing on the assignment to cost categories, and it is important to understand that the majority of water utility costs are fixed or semi-fixed, with energy, chemicals, and purchased water costs being the only truly variable costs at most utilities. The costs to construct the facilities needed to provide service are fixed, and the salaries and wages of employees are generally fixed over the course of a year since employees are not hired and fired on a daily basis as water demands fluctuate. As such it is inevitable that some fixed costs will be allocated based on consumption and recovered through variable charges.

Contamination Mitigation Costs

Mr. Khawam opines that costs associated with treating contaminant plumes located inside the city limits should not be allocated to the Outside City Customers, however, that position fails to recognize that Tucson's efforts to protect the central aquifer from contamination benefits all customers (except those located in so-called "isolated systems") because the central aquifer allows Tucson to supply water throughout its system during maintenance, outages, shortages, and infrastructure disruptions to Tucson's Colorado River supplies and pipelines. As such, these treatment facilities are no different from other wells, and the costs are allocated in the same

manner. Moreover, should Tucson's central aquifer become so contaminated that it could no longer perform this function, Tucson would need to make significant water resources and infrastructure investments to be able to duplicate this capacity, almost all of it within areas outside of the Tucson City limits.

Reclaimed Water Costs and Subsidy

On page 6 of his report, Mr. Khawam acknowledges that the Phase 2 analysis did not take costs associated with the reclaimed water system into account and later mentions that the analysis fails to recognize that the water rates paid by all customers subsidize the reclaimed water system. These statements are true. The Phase 2 analysis purposely excluded all O&M and capital costs associated with the reclaimed system because the Outside City differentials are only applied to potable water rates.

Mr. Khawam also states that the Phase 2 analysis fails to recognize the benefits accruing to Tucson Water as a result of County treatment facilities producing water at no cost to Tucson Water that is suitable for indirect and direct reuse[6]. This statement is untrue in that the Inside City rates, which are the basis for the Outside City rates, do recognize that Tucson Water does not incur a cost for the reclaimed water provided by Pima County. If it did incur a cost for this water both Inside City and Outside City rates would need to be higher in order to recover these costs.

Report of Thomas Bourassa, CPA

In his report prepared on behalf of Pima County, Mr. Bourassa asserts that the unit cost to serve Outside City Customers is actually less than the cost to serve Inside City Customers and supports this assertion with two separate analyses.

Mr. Bourassa first presents an analysis that purports to demonstrate that the cost to serve Outside City Customers is lower than the cost to serve Inside City Customers. His analysis, as presented in Exhibit 1[7] of his report, starts out with the utility basis revenue requirements presented in the Phase 2 memorandum. Mr. Bourassa then reduces the Return on Investment component of the revenue requirements by $36,218,000. Exhibit 1 also shows a $34,034,000 adjustment to Return on Investment allocated to Inside City Customers and a $2,184,000 adjustment to the Return on Investment allocated to Outside customers. After making these adjustments, Mr. Bourassa then calculates the

[6] PIMA001516-001518
[7] PIMA001359

unit cost to serve both Inside City Customers and Outside City Customers by dividing each class's revenue requirements by their respective annual consumption.

In a footnote on Exhibit A Mr. Bourassa characterizes these adjustments with the following statement:

"[A] Remove 5-year average CIP for projects specifically identified for Inside City and Outside City. Remainder is the amount of capital projects benefiting both Inside City and Outside City Customers and is allocated based upon the Assets allocation factor.

[B] Add back 5-year average of CIP projects that are specifically identified as Inside City projects.

[C] Add back 5-year average CIP projects that are specifically identified as Outside City projects."[8]

In his report, Mr.Bourassa states:

"Exhibit 1 shows that there are approximately $34 million of annual expected future capital projects that only benefit the Outside-City(sic) customers and approximately $2.2 million of annual expected future capital projects that only benefit Outside-City customers for a total of $36.2 million."[9]

However, Mr. Bourassa fails to explain how he arrived at the amounts of $34 million and $2.2 million and Exhibit 1 does not "show" that there are $34 million of annual expected future capital projects that only benefit the Inside City Customers. Exhibit 1 only shows that Mr. Bourassa entered that value into an Excel spreadsheet. A reader of Mr. Bourassa's report is left guessing at the origin of the values for the adjustments that Mr. Bourassa made to the Return on Investment component of the revenue requirements. It is not until one reads the previously discussed report prepared by Mr. Khawam that the origin of these values becomes apparent. Given that the values used by Mr. Bourassa are exactly the same as the values that Mr. Khawam arrived at when he attempted to allocate capital costs directly to customer classes, one can only assume that Mr. Khawam's report is the source for Mr. Bourassa's adjustments. However, as discussed previously, Mr. Khawam's use of Tucson Water's CIP as the basis for allocating capital costs is not only inconsistent with industry practice but is inherently flawed thereby rendering Mr. Bourassa's analysis suspect at best. If one prepares a similar analysis to that performed by Mr. Bourassa but omits the adjustments made based on the analysis of Mr. Khawam, the results are the same as those of the Phase 2 analysis if it is assumed

[8] PIMA001359
[9] PIMA001350

that there should be no rate of return differential between Inside City and Outside City Customers.

The remainder of Mr. Bourassa's report focuses on the determination of what he considers to be an appropriate rate of return on Tucson Water's investment in assets used to serve Outside City Customers. Mr.Bourassa uses Tucson Water's weighted cost of debt and a range of assumed costs of equity to calculate returns on investment from the Outside City Customers ranging between 5.42% and 6.08%. While his calculations appear to be correct, the resulting rates of return are well below the rate of return that would be required to generate revenue sufficient to meet Tucson Water's cash needs revenue requirements. As demonstrated in the Phase 2 analysis, the rates that Tucson Water assesses to all of its customers must generate enough revenue to cover its annual O&M and depreciation expenses and generate a return on rate base of 8.87%. Figure 1 below shows the calculation of return on investment using Mr. Bourassa's highest calculated rate of return.

Figure 1

Calculation of ROI	
Total Rate Base	$ 810,386,764
Bourassa's Highest Rate of Return	6.08%
Return on Investment	$ 49,271,515

Figure 2 then shows that the utility basis revenue requirements resulting from the use of Mr. Bourassa's highest calculated rate of return are approximately $22 million less than Tucson Water's cash needs revenue requirements.

Figure 2

Utility Basis Using Bourassa's ROR	
Operation & Maintenance Expenses	$ 112,539,677
Utility Tax	$ 6,489,736
Pilot/In Lieu of Property Tax	$ 2,000,000
Depreciation	$ 29,691,941
Return on Investment	$ 49,271,515
Total	**$ 199,992,869**
Total Cash Basis Revenue Requirements	**$ 222,592,184**
Resulting Shortfall	**$ 22,599,315**

If Tucson Water were to set rates that recovered the utility basis revenue requirements that result from using Mr. Bourassa's highest rate of return, its rate revenue would fall approximately $22.6 million short of meeting its annual cash expenditures, which could

easily place it in jeopardy of failing to meet its debt service coverage requirements imposed by its lenders.

Conclusions

GRG/Raftelis prepared the Phase 1 and Phase 2 cost of service analyses to provide the Tucson City Council with information related to whether there was a difference in the cost to serve Inside City Customers and Outside City Customers. Both analyses, and particularly the Phase 2 analysis demonstrated that when standard industry practice cost allocation approaches are used, the cost to serve Outside City Customers is greater than the cost to serve Inside City Customers. While neither the Phase 1 or Phase 2 analyses were performed for the purpose of calculating rates for Outside City Customers, both were prepared using methodologies endorsed by the most respected source of guidance for water rate-setting. As such, they demonstrate that the differential rates approved by City Council are just and reasonable.

In an expert report prepared on behalf of Pima County, Mr. Yves Khawam argued that the cost to serve Outside City Customers was less than the cost to serve Inside City Customers and used a number of novel cost allocation approaches in an attempt to prove his point. His approach to allocating capital costs between the two customer groups involved looking at future capital costs that may or may not actually be incurred instead of an actual annual capital budget developed by the water professionals that operate and manage the Tucson Water system. The results of his non-standard approach were that Outside City Customers should only be allocated only 20% of Tucson Waters annual capital costs despite the fact that Outside City Customers represent 28% of Tucson Waters customers and account for 27% of its annual demand for water.

Mr. Khawam also argues that it is inappropriate to use the utility basis for determining Tucson Water's revenue requirements because as a municipal utility, it should not earn a return on its investment.[10] The Phase 2 analyses proves otherwise by showing that if Tucson Water did develop its rates using the utility basis it would need to earn a return on investment of approximately 9% from all of its customer in order to cover its annual costs and meet its debt service coverage requirements.

In the report that he prepared on behalf of Pima County, Mr. Thomas Bourassa first presents an analysis that purports to demonstrate that it actually costs less to serve Outside City Customers; however, his analysis is entirely dependent upon an inherently

[10] PIMA001520-1521

flawed allocation of capital costs between Inside City Customer and Outside City Customers prepared by Mr. Khawam and therefore cannot be relied on.

Mr. Bourassa also calculates what he considers to be a range of acceptable rates of return on Tucson Water's rate base using a range of costs of equity and determines that the appropriate rate of return is somewhere between 5.42% and 6.08%, but fails to recognize that if Tucson Water were to determine its rates using the utility basis it would need to earn a return on rate base of almost 9% in order to meet its cash needs revenue requirements.

Submitted by

Harold J. Smith

Pima County

v.

City of Tucson et al.

Statement of Expert Opinion

For

Pima County

December 9, 2022

Prepared by

Thomas Bourassa, CPA

ANALYSIS OF THE PHASE 1 AND PHASE 2 COST OF SERVICE STUDIES

Submitted by Thomas J. Bourassa.

I. Introduction and Summary of Findings

This expert report is prepared at the request of the law firm Snell & Wilmer of Phoenix, Arizona, in connection with the lawsuit *Pima County v. City of Tucson, et al.*

My name is Thomas J. Bourassa. I am a self-employed certified public accountant licensed in the State of Arizona. My business address in 139 W. Wood Drive, Phoenix, Arizona 85029. My practice primarily focuses on assisting regulated utilities in preparing and supporting rate applications and other regulatory filings before regulatory bodies as an expert witness in the areas of cost of service, cost of capital, rates and rates design, as well as regulatory accounting. I have testified before the Arizona Corporation Commission, the California Public Utilities Commission, the Regulatory Commission of Alaska, the Arkansas Public Service Commission, the Montana Public Utilities Commission, and the Texas Public Utilities Commission. A copy of my work history is attached in Attachment A. I have not authored any publications within the last 10 years. I am being compensated at a rate of $275 per hour.

My work as an expert in this case consisted of reviewing and analyzing the Phase 1 and Phase 2 cost of service studies and differential return analysis (the "Raftelis Study") prepared by Raftelis Financial Consultants, Inc. and the Galardi Rothstein Group (collectively, "Raftelis") for the Tucson Water Department. The overall purpose of my study was to assess whether the Raftelis Study accurately evaluated the actual cost of service to provide water to Tucson Water customers living in unincorporated Pima County. A summary of my expert opinions is below.

1. The Raftelis Study misstates the cost of service for both Inside City and Outside City customers because it fails to properly allocate expected annual capital improvements between those that benefit both Inside City customer and Outside City customers (shared benefits), those that benefit only Inside City customers, and those the benefit only Outside City Customers. When expected annual capital improvements to be recovered from revenues (rates) are properly allocated, the per unit cost of service for Outside City customers is less than Inside City customers under the Raftelis Study.
2. The Raftelis Study uses a Utility Basis Approach to calculate the costs of service for Outside City customers. Raftelis's justification for using this approach is that Tucson Water customers living within incorporated areas face financial "risks" that customers living in unincorporated areas do not—and that therefore these "inside" customers can be considered quasi-

"owners" of Tucson Water. While I generally agree that a Utility Basis approach is an acceptable method to calculate the cost of service, the specific version of the Utility Basis Approach actually used by Raftelis to determine the cost of service for Outside City customers in this instance is inappropriate. Specifically, the version of the Utility Basis Approach used by Raftelis determines the utility's required return on investment ("ROI") by subtracting depreciation from the utility's capital requirements. This method results in an *imputed*, backed-into, ROI and imputed rate of return that does not reflect the actual risks of owning or operating a utility. As such, the Raftelis Study and the differential analysis contained therein is merely a cost-shifting mechanism essentially done to arbitrarily attribute higher costs of service to a select scope of users, in this case the Outside City customers.

3. Assuming that "Inside City" customers can truly be labeled "owners" of Tucson Water (which is a questionable claim, at best)[1], the most appropriate and generally accepted method to determine the actual cost of service to Outside City customers is to establish a "fair" rate of return using Tucson Water's Weighted Average Cost of Capital ("WACC") and then apply that return to the rate base to determine the ROI component in the cost of service.

4. I calculated a range of "fair" rates of returns based on Tucson Water's WACC. Using these fair rates of return, rather than Raftelis's backed-into figures, the per unit cost of service for Outside City customers using the Utility Basis Approach is actually less than the per unit cost of service of Inside City customers. Charging a differential rate to Outside City customers is, therefore, unsupported by any fair and reasonable cost of service analysis that reflects ownership interests, and the cost of service based upon the Raftelis Study's differential analysis should not serve as a basis for charging differential rates.

5. The Raftelis Study's differential analysis in essence adds a premium on top of the calculated "cost of service" based on the supposed financial risks faced by Inside City customers. But an equity return developed from an appropriate methodology and used to calculate a rate of return (or weighted average cost of capital) that is applied to the rate base already accounts for ownership risk. There was no legitimate basis to add an additional premium to the return here, even if Inside City customers do "backstop" the Utility. So-called "backstopping" does not justify a risk premium over an equity return developed from an appropriate method under the circumstances. That said, Inside City Customers *do not* actually face additional risks that are not also faced by Outside City Customers.

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1 Utility customers do gain ownership interests in utility property by merely paying for utility service. See *Pacific Gas & Electric Co. v. Public Util. Comm'n of California*, 475 U.S. 1 (1986)

II. Raftelis Study Misstates the Cost of Service for Inside City and Outside City Customers.

The Raftelis Study fails to properly allocate expected annual capital improvements between those that benefit both Inside City customer and Outside city customers (shared benefits), those that benefit only Inside City customers, and those the benefit only Outside City Customers. Annual expected future capital improvements are included in the capital requirements component in the Cash Needs Approach[2] and in the ROI component in the Utility Basis Approach.[3]

I have prepared Exhibit 1 which shows a restated Cash Needs Approach cost of service and Utility Basis Approach cost of service based upon the Raftelis Study. Exhibit 1 shows that there are approximately $34 million of annual expected future capital projects that only benefit the Outside-City customers and approximately $2.2 million of annual expected future capital projects that only benefit Outside-City customers for a total of $36.2 million. Exhibit 1 also shows that under the Utility Basis Approach employed by Raftelis, the indicated unit cost for Outside-City customers is lower than the unit cost for Inside-City customers by 13.36 percent. The lower indicated unit cost contradicts the conclusion of the Raftelis Study that the unit cost for Outside City customers is 5 percent above the Inside City customers with no return differential. Thus, once the proper inputs are considered, even under Raftelis' flawed methodology discussed in the next section, implementing differential rates for Outside City customers that are higher than the Inside City customer rates is unsupported and unreasonable.

III. The Methodology Used by Raftelis Did Not Result in a Legitimate Cost of Service for Outside City Customers

There are two generally accepted methods for determining revenue requirements to establish rates: the "Utility Basis" Approach and the "Cash Needs" Approach.[4] The objective of the Cash-Needs Approach is to recover the utility's total "cash needs"—which are defined to include total revenues required by the utility to meet its annual cash expenditures. Thus, the cost of service (aka, the "revenue requirement") under the Cash Needs Approach is equal to annual operation and maintenance expenses ("O&M) plus taxes or transfer payments plus debt-service payments plus rate-funded capital expenditures to be paid during the relevant time frame.[5] The Cash-Needs Approach is typically used by government-owned utilities.[6]

2 *See* American Water Works Association M-1 Manual - Principles of Water Rates, Fees, and Charges, Seventh Edition, p. 278 ("AWWA M-1 Manual")

3 *See id.* at 16-17

4 *Id.* at 12, 278.

5 *Id.* at 12-14.

6 *Id.* at 12.

The Utility Basis Approach, on the other hand, is designed to recoup costs *plus* receive a "fair" ROI.[7] As such, the Utility Basis Approach is generally used for investor-owned utilities or municipal-owned utilities subject to government regulation.[8] Under the Utility Basis Approach, the cost of service is equal to O&M expenses plus taxes or transfer payments plus depreciation plus a fair return on the rate base investment.9 The fair return on investment is determined by applying a fair rate of return to the rate base investment. The fair rate of return is typically established using the weighted average cost of capital ("WACC"), which weighs the cost of debt and the cost of equity relative to the proportion of each in the total capitalization (capital structure).[10] The cost of debt is generally not disputed because it is simply the weighted cost of the debt instruments that comprises total debt. On the other hand, the cost of equity, which reflects business risk, interest rate risk, financial risk, and liquidity risk, is often disputed because it requires some analysis justifying the cost. Typically, the cost of equity is quantified by financial models such as the discounted cash flow model and/or the capital asset pricing model or other risk premium models using a proxy group of publicly traded utilities and market data. Utilities may also estimate the cost of equity by reviewing recent cost of equity percentages adopted by the state regional public utilities commission.11

A Utility Basis Approach using a "fair" rate of return calculated using WACC recognizes business and other risks, protects non-owner customers against potentially inefficient capital financing choices or inequitable practices of the owner, and provides justification for differential rates charged to customers located inside and outside the jurisdictional limits of local government.12 For these reasons, assuming that Tucson Water customers can actually be considered "owners" of Tucson Water,[13] the Utility Basis Approach employing a return that reflects the risk of ownership is the most appropriate approach for determining the cost of service for Outside City customers. That is not the methodology that Raftelis used here.

Instead, the Raftelis Study employs a Cash Needs Approach, under which Raftelis determined Tucson Water's "cash needs", and then "recast[ed]" those cash needs as a utility basis revenue requirement.[14] Under this approach, Raftelis "determine[ed] the return on rate base" or ROI component of the utility basis revenue requirement by "subtracting the annual O&M expenses, taxes, and

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7 *Id.* at 14.

8 *Id.* at 14.

9 *Id.*

10 The WACC is expressed by the formula Wd x Kd + We x Ke, where Wd is the percentage of debt in the capital structure, Kd is the cost of debt, We is the percentage of equity capital in the capital structure, and Ke is the cost of equity.

11 AWWA M-1 Manual, page 285.

12 AWWA M-1 Manual. page 279.

13 Although I did not review Dr. Khawam's report in preparing this Report, I understand that he criticizes the Raftelis Study on the grounds that in-city customers should not be considered "owners." I do not take any opinion, one way or another, on this issue in my Report.

14 PIMA000353.

depreciation from the cash-needs revenue requirement."[15] By Raftelis's own admission, this results in an "*imputed* rate of return on rate base…"[16] An imputed rate of return has no relation to a fair and reasonable return that reflects the actual risks of utility ownership with respect to utility service to Outside City customers. Further, there is no analysis based upon an accepted methodology justifying a 3.5 percent return differential. Consequently, the Raftelis study should not serve as a basis for any differential analysis and should not be used to set differential rates between Inside City customers and Outside City customers.

Moreover, it is important to note that the actual differential rates adopted by the City are not the "cost of service" that was calculated by the Raftelis Study. Putting aside my concerns about the Raftelis Study's results, the Raftelis Study determined that there is "a cost-based differential of approximately 5%" between Inside and Outside Customers.[17] But the rates ultimately adopted by the City actually add a 3.5% differential to the rate of return for Outside City customers *on top of* imputed return, increasing the cost of service calculated by Raftelis for Outside City customers —resulting in base water rates to Outside City customers that are 10% more than the base rate paid by inside city customers and are 10%-40% more than the escalating usage tiers charged to inside city customers.[18] This ultimately results in a 20% overall increase in rates.

IV. USING THE WACC IN THE UTILITY BASIS APPROACH, THE COST TO SERVICE OUTSIDE CITY CUSTOMERS IS LESS THAN INSIDE-CITY CUSTOMERS.

I have prepared an exhibit (Exhibit 2) calculating the unit cost of service for Outside City customers under a Utility Basis Approach using the WACC to determine a fair rate of return. I first calculated a range of WACC's using fair equity returns ("ROE") ranging from 9.0 percent to 10.5 percent in 50 basis point increments; a weighted cost of debt of 2.6068 percent19; an imputed capital structure consisting of 56 percent debt and 44 percent equity20; and a rate base of $239,443,614 for Outside City customers.[21] The range of "fair" rate of equity returns used to compute the WACCs in Exhibit 2 is similar to the range of equity returns adopted by the Arizona Corporation Commission (ACC) for similarly sized utilities[22] in the past few years, which have ranged from 8.9 percent to 10.00 percent

15 *Id.*

16 *Id.*

17 PIMA000560.

18 *E.g.,* PIMA000594.

19 Based upon Tucson Water debt founding in the City of Tucson's 2020-2021 Debt Outstanding Summary.

20 The imputed capital structure is based upon the total debt outstanding of about $255 million relative to the total rate base of about $810.4 million. Debt comprises about 56 percent of the capital structure based upon these metrics. The remaining 44% is the percentage of equity investment funding rate base.

21 PIMA000365.

22 The Outside-City utility service to customers, as a stand-alone water utility, would be considered a Class A utility under the rules governing the ACC. With over 67,000 customers, revenues of over $50 million, and a rate base of nearly $240 million, the Outside-City as a stand-alone utility would be among the largest in Arizona.

with a mid-point of 9.45 percent.[23] Using the WACCs developed by these numbers, I then calculated a range of required rates of return ("ROR"):

Table 1

ROE	9%	9.5%	10%	10.5%
ROR	5.42%	5.640%	5.860%	6.080%

I then applied these ROR's to determine the total "Return on Investment" ("ROI") required for Outside City customers:

Table 2

ROE	9%	9.5%	10%	10.5%
ROR	5.42%	5.640%	5.860%	6.080%
ROI	$12,977,844	$13,504,620	$14,031,396	$14,558,172

I then calculated the "Total Operating Expenses" attributable to Outside City customers using the O&M, Utility Tax, PILOT tax, and depreciation expenses identified in the Raftelis Study, and allocating those expenses to Outside City customer's based on Raftelis' allocation factors. In total, using Raftelis' numbers and allocation factors, I calculated $40,881,798 in Total Operating Expenses attributable to Outside City customers. I then added the Total Operating Costs ($40,881,798) to the ranges of ROI's calculated using WACC, to develop a "Total Cost of Service" for Outside City customers:

Table 3

ROE	9%	9.5%	10%	10.5%
ROR	5.42%	5.640%	5.860%	6.080%
ROI	$12,977,844	$13,504,620	$14,031,396	$14,558,172
Total Cost of Service	$53,859,642	$54,386,418;	$54,913,194	$55,439,970

I then divided these total costs of service by 10,970,256, which reflects the total annual water usage for Outside City customers,[24] and used to determine the Unit Cost for Outside City Customers:

Table 4

23 EPCOR Water Arizona ACC Decision 78658 (April 22, 2022) adopting a 10.0% equity return, EPCOR Water Arizona ACC Decision 78439 (February 1, 2022) adopting an 8.93% equity return, Liberty Utilities (Black Mountain Sewer) Corp. ACC Decision 78017 (May 18, 2021) adopting a 9.1% equity return, and Liberty Utilities (Litchfield Park Water and Sewer) Corp. ACC Decision 76799 (August 15, 2018) adopting a 9.7% equity return.

24 *See* "Copy of OC Differential Model for CWAC Presentation at "Differential" Tab and "Peaking_Summary" Tab.

ROE	9%	9.5%	10%	10.5%
ROR	5.42%	5.640%	5.860%	6.080%
Total Cost of Service	$53,859,642	$54,386,418;	$54,913,194	$55,439,970
Unit Cost (Outside City)	$4.91	$4.96	$5.01	$5.05

Using these Unit Costs, I compared the Unit Costs for Outside Customers to: (1) the Unit Cost for Inside City Customers per the Raftelis Study, without adding any rate of return differential; (2) the Unit Cost for Outside City Customers plus a 3.5% rate of return differential (the return differential ultimately adopted by the City) calculated in the Raftelis Study[25] ; and (3) the Unit Cost for Inside City Customers in the Restated Raftelis Study with no rate of return differential that I calculated in Section II and in Exhibit 1 of this Report :

Table 5

ROE	9%	9.5%	10%	10.5%
ROR	5.42%	5.640%	5.860%	6.080%
Unit Cost (Outside City)	$4.91	$4.96	$5.01	$5.05
Unit Cost (Raftelis Study - Inside City with No Differential)	$5.39	$5.39	$5.39	$5.39
Difference	-8.91%	-8.02%	-7.13%	-6.24%

Table 6

Unit Cost (Outside City)	$4.91	$4.96	$5.01	$5.05
Unit Cost (Raftelis Study - Outside City Cost + 3.5% Return Differential)	$6.21	$6.21	$6.21	$6.21
Difference	-20.94%	-20.17%	-19.39%	-18.62%

Table 7

Unit Cost (Outside City)	$4.91	$4.96	$5.01	$5.05
Unit Cost (Inside City per Restated Raftelis Study)	$5.68	$5.68	$5.68	$5.68

25 PIMA000360

Difference	-13.56%	-12.72%	-11.87%	-11.03%

As Table 5 illustrates, the unit costs for Outside-City customers under the Utility Basis Approach using the WACC are 6 percent to 9 percent below the unit cost $5.39 Unit Cost of Inside City customers with no return differential under the Raftelis Study. These results contradict the Raftelis Study's claim that the unit cost for Outside-City customers is 5 percent above the Inside-City customers even with no return differential.[26] Further, as Table 6 shows, the unit costs for Outside-City customers under the Utility Basis Approach using the WACC are 18.5 percent to 21 percent below the Outside City Unit Cost plus a 3.5% return differential in the rate of return under the Raftelis Study, which was the return differential ultimately adopted by the City. In other words, when using the correct methodology that reflects risks of utility ownership, the actual cost of service to Outside City customers is *lower* than Inside City Customers.

Moreover, these tables highlight how outrageous the City's added 3.5% return differential really is. The 3.5 percent differential in the return equates to an 11.33 percent return on the Outside City customer rate base. To put this in perspective, an 11.33 percent return is 1.9 to 2.1 times more than the rate of return's calculated using a WACC (from Table 1) of 5.42 percent, 5.64 percent, 5.86 percent, and 6.08 percent. Even if one were to assume an equity return of 11.33 percent were appropriate in this case, a WACC using a cost of equity of 11.33 percent is only 6.445 percent. The 11.33 percent return is nearly 1.8 times the WACC of 6.445 percent and is not even close to being reflective of the cost of capital of Tucson Water. These results show that Outside-City customer rates adopting providing a 3.5 percent differential in the return are not fair and reasonable – they are excessive and provide an unjustified windfall to the Inside City customers and Tucson Water.

Finally, Table 7 shows that the unit cost of service for Inside City customers under the restated Raftelis Study which properly allocates annual capital improvements and discussed in Section II, is 11 percent to 14 percent higher than the unit cost for Outside City customers under a Utility Basis Approach using the WACC.

V. Back-Stopping by the City of Tucson Does Not Justify adding a Differential to the Calculated Cost of Service.

Finally, as I discussed above, the rates adopted by the City do not actually reflect the costs of service for Outside City customers determined by the Raftelis Study—rather, the City added an additional 3.5% return differential on top of the calculated cost of service. The only cost-based[27] justification for this is that the City supposedly "back-stops" Tucson Water and that therefore the City is entitled to recoup a profit on Outside City customers to cover its alleged "financial risks." But even assuming that the City does actually

26 See Raftelis Financial Consultants Memorandum from Mr. Harold Smith, Subject: Phase 2 Outside Differential Analysis, Table 7.

27 I understand that the City has also asserted a variety of non-cost "policy" justifications for charging higher rates to Outside City Customers.

backstop Tucson Water, the returns adopted by the ACC already reflect the risk of ownership and can therefore serve as a basis for what are adequate returns that should be earned on Outside-City customers' rate base. In other words, the "cost of service" calculated under the Utilities Basis approach using WACC to determine the ROR already covers financial risks, among other risks, faced by the owner—this is the entire point of using the WACC to begin with. What the City has done in adding a differential above the cost of service is essentially "double dipping" on Outside City customers creating an unjustified windfall—this is why the City's return on Outside City customers is so disproportionately high in comparison to other approved rates.

In fact, Raftelis admits that the final adopted rates do not reflect the true cost of service, but were instead adopted based on "policy" considerations. 28 Policy is established by politicians to achieve political goals, it has nothing to do with the actual cost of service. The differential rates adopted by the City therefor have no reasonable cost-based support and I can only conclude that the differential rate analysis in the Raftelis Study is merely a cost shifting exercise for unjustly and unreasonably attributing higher costs of service to Outside City customers. Preventing this kind of abuse is one of the advantages of using a Utility Basis approach which reflects the cost of capital as measured by the WACC.[29]

Even if it were reasonable to add an additional differential on top of the cost of service due to "ownership risks," the City does not actually face additional "ownership risks" with respect to Outside City customers. Tucson Water is a self-sustaining enterprise fund that is solely responsible for its own debt through bonds secured by utility revenues and/or property owned by the City of Tucson Water. Further, Tucson Water essentially operates as a monopoly within its service area with captive customers who as a practical matter do not have the ability to seek water service from another water provider and therefore there is little additional risk of revenue instability or uncertainty with respect to Outside City Customers as compared to Inside City customers. Because all customers are responsible for all costs regardless of citizenship, there are no differences in risks and responsibilities between Inside City customers and Outside City customers. This circumstance is much like a stand-alone, for-profit utility regulated by the Arizona Corporation Commission in which the utility acts as a monopoly. If costs rise, the City of Tucson can increase rates to recover the shortfall without having to go through a protracted ACC regulatory proceeding. Under the circumstances I do not believe there is an additional risk (risk premium) from so called back-stopping for Inside City, owner customers or the City of Tucson that isn't already reflected in the adopted ACC equity returns

28 See Raftelis Memorandum, Subject: Phase 2 Outside Differential Analysis, Table 7.

29 AWWA M-1, page 279.

VI. Conclusions

The Raftelis Study and its differential analysis are flawed in two important ways and should not serve as a basis determining whether a cost differential exists between Inside City and Outside City customers. First, the Raftelis Study does not properly allocate annual capital improvements projects between Inside City and Outside City. When annual capital improvements are allocated properly the Outside City unit cost of service is less than the Inside City unit cost of service. Second, a Utility Basis Approach using a cost of capital derived from the WACC should be used for determining the cost of service and the unit cost of service for Outside City customers. A correct Utility Basis approach reflecting ownership by Inside City customers (or the City) shows the unit cost of service for Outside City customers is less than the unit cost for Inside City customers over a range of reasonable equity returns. The 3.5 percent return differential in the Raftelis Study is unsupported by any credible cost of capital analysis and this renders the Raftelis Study's differential analysis merely a cost shifting mechanism which creates an unjustifiable windfall to Tucson Water and Inside City customers. Finally, there is no ownership risk differential between Inside City and Outside City customers based upon Tucson Water monopoly status and the fact that Tucson Water itself (and all its customers) is solely responsible for the cost of service.

DocuSigned by:
Thomas J. Bourassa
FE8923CC55F1481...

EXHIBIT 1

Restated Tucson Water - Utility Basis with Adjusted Return on Invesment

EXHIBIT 1

Rev. Req. Component	Total	Label	Adjmt	Adjusted Total	Allocation	Inside City %	Outside City %	Allocd Inside City	Label	Adjmt	Adjd Inside City	Allocd Outside City	Label	Adjmt	Adjd Outside City
O&M[1]	$ 112,539,677			$ 112,539,677	O&M	71.70%	28.30%	$ 80,688,357			$ 80,688,357	$ 31,851,320			$ 31,851,320
Utility Tax[1]	6,489,736			6,489,736	All Inside	100.00%	0.00%	6,489,736			6,489,736	0			0
Pilot/In Lieu of Property Tax[1]	2,000,000			2,000,000	Assets	70.70%	29.30%	1,413,982			1,413,982	586,018			586,018
Depreciation[1]	29,691,941			29,691,941	Depreciatior	71.13%	28.87%	21,119,033			21,119,033	8,572,908			8,572,908
Return on Investment[2]	71,870,830	[A]	(36,218,000)	35,652,830	Assets	70.70%	29.30%	25,206,237	[B]	34,034,000	59,240,237	10,446,593	[C]	2,184,000	12,630,593
Total Potable Costs	**$ 222,592,184**		**$ (36,218,000)**	**$ 186,374,184**		**72.39%**	**27.61%**	**$ 134,917,345**		**$ 34,034,000**	**$ 168,951,345**	**$ 51,456,839**		**$ 2,184,000**	**$ 53,640,839**
Current Usage											29,762,239				10,970,256
Unit Cost											$ 5.68				$ 4.89

Water Rate Differential (based on average) **-14.90%**

% Difference between Inside City and Outside City Unit costs **-13.86%**

	Total
Rate Base	$ 810,386,764
Return On Investment	$ 71,870,830
Return On Investment %	8.87%

[1] From Raftelis Utility Basis COSS Approach.

2 From Raftelis Utility Basis COSS Approach. This is a figure which represents the shortfall in cash needed to fund capital requirements net of depreciation in the Raftelis Cash Basis COSS Approach.

Depreciation	$ 29,691,941
Return on Investment	71,870,830
Capital Requirements from Cash Approach	$ 101,562,771

Adjustment

[A] Remove 5-year average CIP for projects specifically identified for Inside City and Outside City. Remainder is the amount of capital projects benefiting both Inside City and Outside City customers and is allocated based upon the Assets allocation factor.

[B] Add back 5-year average of CIP projects that are specifically identified as Inside City projects.

[C] Add back 5-year average CIP projects that are specifically identified as Outside City projects.

EXHIBIT 2

Outside City Cost of Service using Utility Basis - Investor Owned Approach

EXHIBIT 2

Cost of Service Component	Total	Allocation	Allocation Factor % Outside City	9.0% ROE Investor-Owned Utility Basis Outside City	9.5% ROE Investor-Owned Utility Basis Outside City	10.0% ROE Investor-Owned Utility Basis Outside City	10.5% ROE Investor-Owned Utility Basis Outside City	11.33% ROE Investor-Owned Utility Basis Outside City
O&M[1]	$ 112,085,837	O&M	28.30%	$ 31,722,873	$ 31,722,873	$ 31,722,873	$ 31,722,873	$ 31,722,873
Utility Tax[1]	6,489,736	All Inside	0.00%	-	-	-	-	-
Pilot/In Lieu of Property Tax[1]	2,000,000	Assets	29.30%	586,018	586,018	586,018	586,018	586,018
Depreciation[1]	29,691,941	Depreciation	28.87%	8,572,908	8,572,908	8,572,908	8,572,908	8,572,908
Total Operating Expenses	$ 150,267,513			$ 40,881,798	$ 40,881,798	$ 40,881,798	$ 40,881,798	$ 40,881,798
Return on Investment [2]				12,977,844	13,504,620	14,031,396	14,558,172	15,432,141
Total Cost of Service				$ 53,859,642	$ 54,386,418	$ 54,913,194	$ 55,439,970	$ 56,313,939
Current Usage				10,970,256	10,970,256	10,970,256	10,970,256	10,970,256
Unit Cost for Outside City Customers				$ 4.91	$ 4.96	$ 5.01	$ 5.05	$ 5.13
Unit Cost for Inside City Customers Per Ratelis Study - Utility Basis with no ROR differential				$ 5.39	$ 5.39	$ 5.39	$ 5.39	$ 5.39
Difference				-8.91%	-8.02%	-7.13%	-6.24%	-4.76%
Unit Cost for Outside City Customers				$ 4.91	$ 4.96	$ 5.01	$ 5.05	$ 5.13
Unit Cost for Outside City Customers Per Raftelis Study - Utility Basis with 3.5% ROR differential				$ 6.21	$ 6.21	$ 6.21	$ 6.21	$ 6.21
Difference				-20.94%	-20.17%	-19.39%	-18.62%	-17.34%
Unit Cost for Outside City Customers				$ 4.91	$ 4.96	$ 5.01	$ 5.05	$ 5.13
Unit Cost for Inside City Customers Per Restated Ratelis Study - Utility Basis with no ROR diferential				$ 5.68	$ 5.68	$ 5.68	$ 5.68	$ 5.68
Difference				-13.56%	-12.72%	-11.87%	-11.03%	-9.62%

[1] Obtained from Raftelis Study

[2] Computation of Required Return on Investment	9.0% ROE	9.5% ROE	10.0% ROE	10.5% ROE	10.5% ROE
Rate Base	$ 239,443,614	$ 239,443,614	$ 239,443,614	$ 239,443,614	$ 239,443,614
x Required ROR based upon the WACC	5.420%	5.640%	5.860%	6.080%	6.445%
Return on Investment	$ 12,977,844	$ 13,504,620	$ 14,031,396	$ 14,558,172	$ 15,432,141

EXHIBIT 3

RESUME OF THOMAS J. BOURASSA, CPA

EDUCATIONAL BACKGROUND

B.S. Northern Arizona University Chemistry/Accounting (1980)
M.B.A. University of Phoenix with Emphasis in Finance (1991)
C.P.A. State of Arizona (1995)
Continuing Professional Education – In areas of tax, accounting, management, economics, finance, business valuation, consulting, and ethics (80 hrs every two years)

MEMBERSHIPS

Arizona Society of CPAs
Water Utilities Association of Arizona
American Water Works Association

EMPLOYMENT EXPERIENCE

1995 – Present	CPA - Self Employed Consultant to utilities on regulatory matters including all aspects of rate applications (rate base, income statement, cost of capital, cost of service, and rate design), rate reviews, certificates of convenience and necessity (CC&N), CC&N extensions, financing applications, accounting order applications, and off-site facilities hook-up fee applications. Provide expert testimony as required. Consult on various aspects of business, financial and accounting matters including best business practices, generally accepted accounting principles, generally accepted ratemaking principles, project analysis, cash flow analysis, regulatory treatment of certain expenditures and investments, business valuations, and rate reviews. Litigation support services.
1992-1995	Employed by High-Tech Institute, Phoenix, Arizona as Controller and C.F.O.
1989-1992	Employed by Alta Technical School, a division of University of Phoenix as Division Controller.
1985-1989	Employed by M.L.R. Builders, Tampa and Pensacola, Florida as Operations/Accounting Manager
1982-1985	Employed by and part owner in Area Sand and Clay Company, Pensacola, Florida.

1981-1982	Employed by Purdue University, West Lafayette, Indiana as Teaching Assistant.

SUMMARY OF REGULATORY WORK EXPERIENCE AS SELF-EMPLOYED CONSULTANT

COMPANY/CLIENT	FUNCTION
Truxton Canyon Water Company ACC Docket No. W-02168A-22-0302	Permanent Rate Application –Water. Prepared short-form schedules on Rate Base, Plant, Income Statement, Revenue Requirement, and Rate Design
Tonto Basin Water Company ACC Docket No. W-03515A-22-0266	Permanent Rate Application –Water. Prepared short-form schedules on Rate Base, Plant, Income Statement, Revenue Requirement, and Rate Design
East Slope Water Company ACC Docket No. W-01906A-22-0289	Permanent Rate Application –Water. Prepared short-form schedules on Rate Base, Plant, Income Statement, Revenue Requirement, and Rate Design
Sunrise Vistas Utilities ACC Docket No. WS-03586A-22-0068	Permanent Rate Application –Water and Wastewater. Prepared short-form schedules on Rate Base, Plant, Income Statement, Revenue Requirement, and Rate Design.
Liberty Utilities (Gold Canyon Sewer) Corp. Liberty Utilities (Entrada Del Oro Sewer) Corp. ACC Docket No. SW-02519A-21-0361 ACC Docket No. SW-04316A-21-0359	Permanent Rate Application –Wastewater. Prepared financing application. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, Cost of Service Study, Rate Design, and Cost of Capital.
Navajo Water Company ACC Docket No. W-03511A-21-0124	Permanent Rate Application – Water. Prepared short-form schedules for Rate Base, Income Statement, Plant, Bill Counts, and Rate Design.
Bensch Ranch Utilities, LLC. ACC Docket No. SW-04026A-21-0225	Permanent Rate Application –Water Prepared short-form schedules on Rate Base, Plant, Income Statement, Revenue Requirement, and Rate Design.
Cerbat Water Company ACC Docket No. W-02391A-21-0290	Permanent Rate Application –Water Prepared short-form schedules on Rate Base, Plant, Income Statement, Revenue

COMPANY/CLIENT	FUNCTION
	Requirement, and Rate Design.
Liberty Utilities (Calpeco Electric, LLC) Corp. CPUC Docket A.21-05-017	Cost of Capital. Prepared Cost of Capital analysis and testimony. Assisted in tax depreciation projections and determination of projected accumulated deferred income taxes.
Double R Water Distributors, Inc. ACC Docket No. W-02821A-21-0047	Permanent Rate Application –Water Prepared short-form schedules on Rate Base, Plant, Income Statement, Revenue Requirement, and Rate Design.
Pine Meadows Utilities, LLC. ACC Docket No. SW-03962A-20-0079	Permanent Rate Application –Water Prepared short-form schedules on Rate Base, Plant, Income Statement, Revenue Requirement, and Rate Design.
Coronado Utilities, Inc. ACC Docket No. SW-04305A-20-0346	Permanent Rate Application – Wastewater Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, and Rate Design.
SaddleBrooke Utility Company ACC Docket No. SW-02849A-20-0262	Permanent Rate Application – Wastewater Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, Rate Design, and Cost of Capital.
Pine Meadows Utilities ACC Docket No. SW-03926A-20-0079	Permanent Rate Application –Wastewater Prepared short-form schedules on Rate Base, Plant, Income Statement, Revenue Requirement, and Rate Design.
EPCOR Arizona (Johnson Utilities) ACC Docket No. WS-02987A-20-0025	Permanent Rate Application. Water and Wastewater. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, Rate Design and Cost of Service.
Beardsley Water Company ACC Docket No. W-02074A-19-0312	Permanent Rate Application –Water Prepared short-form schedules on Rate Base, Plant, Income Statement, Revenue Requirement, and Rate Design.

COMPANY/CLIENT	FUNCTION
Oak Creek Water Company No. 1 ACC Docket No. W-01392A-19-0216	Permanent Rate Application –Water Prepared short-form schedules on Rate Base, Plant, Income Statement, Revenue Requirement, and Rate Design.
Alliant Gas ACC Docket No. G-20889A-19-0200	Permanent Rate Application – Gas Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, Cost of Service Study, Rate Design, and Cost of Capital.
Utility Source, LLC. ACC Docket No. WS-04235A-19-0232 ACC Docket No. WS-04235A-19-0233	Permanent Rate Application – Water and Wastewater. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, Rate Design, and Cost of Capital.
Liberty Utilities (Black Mountain Sewer) Corp. ACC Docket No. SW-02361A-19-0139	Permanent Rate Application –Wastewater. Prepared financing application. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, Cost of Service Study, Rate Design, and Cost of Capital.
Pueblo Del Sol Water Company ACC Docket No. SW-02208A- 19-0140	Permanent Rate Application –Water. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, and Rate Design.
DS Water Company ACC Docket No. W-04049A-18-0142	Permanent Rate Application –Water Prepared short-form schedules on Rate Base, Plant, Income Statement, Revenue Requirement, and Rate Design.
Liberty Utilities (CalPeco Electric) LLC CPUC Application 18-12-001.	Cost of Capital. Prepared Cost of Capital analysis and testimony.
Liberty Utilities (Park Water) Corp. and Liberty Utilities (Apple Valley Ranchos Water) Corp. CPUC Applications 18-05-001, et al.	Cost of Capital. Prepared Cost of Capital analysis and testimony.
Truxton Water Company ACC W-02168A-18-308	Permanent Rate Application –Water. Prepared schedules and testified on Rate

COMPANY/CLIENT	FUNCTION
	Base, Plant, Income Statement, Revenue Requirement, and Rate Design.
Payson Water Company ACC W-03514A-18-0230	Permanent Rate Application – Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, Rate Design, and Cost of Capital.
Farmers Water Company ACC W-01654A-18-0083	Permanent Rate Application – Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, Rate Design, and Cost of Capital.
Liberty Utilities (Silverleaf Water) Corp. SOAH DOCKET NO. 473-18-3006.WS Texas P.U.C. DOCKET NO. 47976	Permanent Rate Application – Water and Wastewater. Prepared financing application. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, Rate Design, and Cost of Capital.
Generic Proceeding - Income Tax "Savings" from reduction in Federal Income Tax Rate ACC AU-0000A-17-0379 ACC various dockets	Prepared computations of tax "savings" from the reduction in federal income tax rates and proposal for passing savings to rate payers through bill credits.
Liberty Utilities (Woodmark Sewer) Corp. Liberty Utilities (Tall Timbers Sewer) Corp. SOAH DOCKET NO. 473-17-1641.WS Texas P.U.C. DOCKET NO. 46256	Develop wastewater rates based upon water usage.
Cerbat Water Company ACC W-02391A-18-0018	Permanent Rate Application –Water. Prepared financing application. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, and Rate Design.
Ajo Improvement Company ACC Docket No. WS-01025A-17-0361	Permanent Rate Application – Water, Wastewater, and Electric. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, and Rate Design,

COMPANY/CLIENT	FUNCTION
East Slope Water Company ACC Docket No. W-02031A-17-317	Permanent Rate Application –Water Prepared short-form schedules on Rate Base, Plant, Income Statement, Revenue Requirement, and Rate Design.
Kachina Village Improvement District Flagstaff, Arizona	Prepared rate studies and rate designs. Participated in Board work sessions, customer work sessions, and open houses.
Liberty Utilities (Litchfield Park Water & Sewer) Corp. ACC Docket No. W-01428AA-17-0059 ACC Docket No. SW-01428AA-17-0058	Permanent Rate Application – Water and Wastewater. Prepared financing application. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, Cost of Service, Rate Design, and Cost of Capital.
Pima Utility Company ACC Docket No. W-02199A-16-0421 ACC Docket No. SW-02199A-16-0422	Permanent Rate Application – Water and Wastewater. Prepared financing application. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, Rate Design, and Cost of Capital.
Valley Pioneers Water Company ACC Docket No. W-02033-16-0412	Permanent Rate Application –Water. Prepared financing application. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, and Rate Design.
Yarnell Water Co-Op ACC Docket No. W-02255A-16-0153	Permanent Rate Application –Water Prepared short-form schedules on Rate Base, Plant, Income Statement, Revenue Requirement, and Rate Design.
Oak Creek Water Company No. 1 ACC Docket No. W-01392A-16-0161	Permanent Rate Application –Water Prepared short-form schedules on Rate Base, Plant, Income Statement, Revenue Requirement, and Rate Design.
Epcor Water Arizona ACC Docket No. W-01303A-16-0145	Permanent Rate Application – Wastewater. Prepared Reconstruction Cost New Less Depreciation Plant for use in determining fair value rate base.
Mountain Water Company	Testified in the matter investigating

COMPANY/CLIENT	FUNCTION
Montana PUC Docket No. D2016.2.15	whether Mountain Water Company's rates are just and reasonable.
Turner Ranches Water and Sanitation Company ACC Docket No. W-01677A-16-0076	Permanent Rate Application –Water Prepared short-form schedules on Rate Base, Plant, Income Statement, Revenue Requirement, and Rate Design.
Liberty Utilities (Entrada Del Oro Sewer) Corp. ACC Docket No. W-04316A-16-0078 ACC Docket No. W-04316A-16-0085	Permanent Rate Application –Wastewater. Prepared financing application. Prepared schedules and testified on Rate Base, Original Cost Less Depreciation Plant, Reconstruction Cost New less Depreciation Plant, Income Statement, Revenue Requirement, Rate Design, and Cost of Capital.
Liberty Utilities (Rio Rico Water and Sewer) Corp. ACC Docket No. WS-02676A-15-0368 ACC Docket No. WS-02676A-15-0371	Permanent Rate Application – Water and Wastewater. Prepared financing application. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, Rate Design, and Cost of Capital.
Liberty Utilities (Bella Vista Water) Corp. ACC Docket No. W-02465A-15-0367 ACC Docket No. W-02465A-15-0370	Permanent Rate Application – Water. Prepared financing application. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, Rate Design, and Cost of Capital.
Community Water of Green Valley ACC Docket No. W-02304A-15-0263	Permanent Rate Application – Water. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, and Rate Design.
Sahuarita Water Company ACC Docket No. W-03718A-15-0213	Permanent Rate Application –Water. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, Rate Design, and Cost of Capital.
Liberty Utilities (Black Mountain Sewer) Corp.	Permanent Rate Application –Wastewater. Prepared financing application. Prepared

COMPANY/CLIENT	FUNCTION
ACC Docket No. SW-0236 1A- 15-0206 ACC Docket No. SW-0236 1A- 15-0207	schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, Cost of Service Study, Rate Design, and Cost of Capital.
Tierra Buena Water Company ACC Docket No. W-02076A-15-013	Permanent Rate Application – Water. Assisted in preparation of short-form schedules.
Red Rock Utilities, LLC ACC Docket No. W-04245A-14-0295	Permanent Rate Application – Water and Wastewater. Prepared short-form schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, Rate Design, and Cost of Capital.
Quail Creek Water Company ACC Docket No. W-02514A-14-0370	Permanent Rate Application – Water. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, Rate Design, and Cost of Capital.
Tonto Basin Water Company ACC Docket No. W-03515A-14-0310	Permanent Rate Application – Water. Prepared short-form schedules for Rate Base, Income Statement, Plant, Bill Counts, and Rate Design.
Navajo Water Company ACC Docket No. W-03511A-14-304	Permanent Rate Application – Water. Prepared short-form schedules for Rate Base, Income Statement, Plant, Bill Counts, and Rate Design.
Alaska Power Company Regulatory Commission of Alaska Docket No. U-14-002	Prepared schedules and testified on cost of capital.
Anchorage Municipal Light & Power Regulatory Commission of Alaska Docket No. U-13-184	Prepared schedules and testified on cost of capital.
Liberty Utilities (Pine Bluff) Inc. Arkansas Public Service Commission Docket No. 14-020-U	Permanent Rate Application – Water. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, Cost of Service, Rate

COMPANY/CLIENT	FUNCTION
	Design, and Cost of Capital.
Abra Water Company ACC Docket No. W-01782A-14-0084	Permanent Rate Application – Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, Rate Design, and Cost of Capital.
EPCOR Water Arizona, Inc. ACC Docket No. W-01303A-14-0010	Permanent Rate Application – Prepared rate designs and cost of Service studies for Mohave Water District, Mohave Wastewater District, Paradise Valley Water District, Tubac Water District, and Sun City Water District.
Liberty Utilities (Midstates Natural Gas), Inc. Missouri Public Service Commission Case No. GR-2014-0152	Permanent Rate Application – Assist in preparing required rate application schedules for Rate Base, Plant, Income Statement, Revenue Requirement, and Rate Design.
Hydro Resources, LLC. ACC Docket No. W-20770A-13-0313	Certificate of Convenience and Necessity – Water. Prepared pro-forma balance sheets, income statements, plant schedules, rate base, and initial rates.
Little Park Water Company ACC Docket No. W-02192A-13-0336	Permanent Rate Application – Water. Prepared short-form schedules for Rate Base, Income Statement, Plant, Bill Counts, and Rate Design.
Utility Source, LLC. ACC Docket No. WS-04235A-13-0331	Permanent Rate Application – Water and Sewer. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, Rate Design, and Cost of Capital.
Payson Water Company ACC Docket No. W-03514A-13-0111 ACC Docket No. W-03514A-13-0142	Permanent Rate Application – Water. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, Rate Design, and Cost of Capital. Financing Application. Prepared financial ratios and debt surcharge mechanism.

COMPANY/CLIENT	FUNCTION
Goodman Water Company	Valuation
Verde Santa Fe Wastewater ACC Docket No. SW-03437A-13-0292	Permanent Rate Application – Wastewater. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, Rate Design, and Cost of Capital.
Lago Del Oro Water Company ACC Docket No. W-01944A-13-0215	Permanent Rate Application – Water. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, Cost of Service, Rate Design, and Cost of Capital.
Chaparral City Water Company ACC Docket No. W-02113A-13-0118	Permanent Rate Application – Prepared and testified on cost of service study.
Las Quintas Serenas Water Company ACC Docket No. W-01583A-13-0117	Permanent Rate Application – Water. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, Rate Design, and Cost of Capital.
Southwest Environmental Utilities. Inc. ACC Docket No. WS-20878A-13-0065	Certificate of Convenience and Necessity – Water and Wastewater. Prepared pro-forma balance sheets, income statements, plant schedules, rate base, and initial rates.
Litchfield park Service Company ACC Docket No. SW-01428A-13-0043 ACC Docket No. W-01428A-13-0042	Permanent Rate Application – Water and Wastewater. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, Rate Design, Cost of Service, and Cost of Capital.
Beaver Dam Water Company ACC Docket No. WS-03067A-12-0232	Permanent Rate Application. Prepared schedules on Plant, Income Statement, Revenue Requirement, and Rate Design.
Rio Rico Utilities ACC Docket No. WS-02676A-12-0196	Permanent Rate Application – Water and Wastewater. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, Cost of Service, Rate Design, and Cost of Capital.

COMPANY/CLIENT	FUNCTION
Vail Water Company ACC Docket No. W-01651B-12-0339	Permanent Rate Application. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, Cost of Service, Rate Design, and Cost of Capital.
Avra Water Co-Op. ACC Docket No. W-02126A-11-0480	Permanent Rate Application. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, Cost of Service, Rate Design, and Cost of Capital.
Pima Utility Company ACC Docket No. W-02199A-11-0329 ACC Docket No. SW-02199A-11-0330	Permanent Rate Application – Water and Wastewater. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, Cost of Service, Rate Design, and Cost of Capital. Work on financing application.
Liberty Utilities (CALPECO Electric), LLC) Docket No. 11202020	Work on preparation of permanent rate application. Prepared schedules on Rate Base, Plant, Income Statement, Revenue Requirement.
Livco Water Company ACC Docket No. SW-02563A-11-0213	Permanent Rate Application – Water and Wastewater. Prepared short-form schedules for Rate Base, Income Statement, Plant, Bill Counts, and Rate Design.
Orange Grove Water Company ACC Docket No. W-02237A-11-0180	Permanent Rate Application. Prepared schedules on Plant, Income Statement, Revenue Requirement, and Rate Design.
Goodman Water Company ACC Docket No. W-02500A-10-0382	Permanent Rate Application – Water. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, Rate Design, and Cost of Capital.
Doney Park Water ACC Docket No. W-01416A-10-0450	Permanent Rate Application – Water. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, and Rate Design.

COMPANY/CLIENT	**FUNCTION**
Grimmelmann, et. al. v. Pulte Home Corporation, et. al., case no. CV-08-1878-PHX-FJM, the United States District Court for the District of Arizona.	Consultant to defendant and expert witness for defendant on rates and ratemaking.
Southern Arizona Home Builders Association	Consultant on ratemaking aspects to line extension policies (electric).
H2O Water Company	Valuation
Tierra Linda HOA Water Company	Valuation
Las Quintas Serenas Water Company ACC Docket No. W-01583A-09-0589	Permanent Rate Application – Water. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, Rate Design, and Cost of Capital.
Coronado Utilities ACC Docket No. SW-04305A-09-0291	Permanent Rate Application – Wastewater. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, Rate Design, and Cost of Capital.
Little Park Water Company ACC Docket No. W-02192A-09-0531	Permanent Rate Application. Prepared schedules on Plant, Income Statement, Revenue Requirement, and Rate Design.
Sahuarita Water Company ACC Docket No. W-03718A-09-0359	Permanent Rate Application – Water. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, Rate Design, Cost of Service, and Cost of Capital.
Bella Vista Water Company Southern Sunrise Water Company Northern Sunrise Water Company ACC Docket No. W-02465A-09-0414 ACC Docket No. W-02453A-09-0414 ACC Docket No. W-02454A-09-0414	Permanent Rate Application – Water. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, Rate Design, Cost of Service, and Cost of Capital.
Rio Rico Utilities, Inc ACC Docket No. WS-02676A-09-0257	Permanent Rate Application – Water and Wastewater. Prepared schedules and

COMPANY/CLIENT	FUNCTION
	testified on Rate Base, Plant, Income Statement, Revenue Requirement, Rate Design, and Cost of Capital.
Litchfield park Service Company ACC Docket No. SW-01428A-09-0103 ACC Docket No. W-01428A-09-0104	Permanent Rate Application – Water and Wastewater. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, Rate Design, Cost of Service, and Cost of Capital.
Town of Thatcher v. City of Safford, CV 2007-240, Superior Court of Arizona	Consultant to plaintiff on ratemaking and cost of service.
Valencia Water Company California Public Utility Commission Case No. 09-05-002	Cost of Capital
Valley Utilities ACC Docket No. W-01412A-08-0586	Permanent Rate Application. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, and Rate Design.
Black Mountain Sewer Company ACC Docket No. SW-02361A-08-0609	Permanent Rate Application – Sewer. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, Rate Design, and Cost of Capital.
Far West Water and Sewer Company ACC Docket No. WS-03478A-08-0608	Interim Rate Application (Emergency Rates)
Farmers Water Company ACC Docket No. W-01654A-08-0502	Permanent Rate Application. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, and Rate Design.
Far West Water and Sewer Company ACC Docket No. WS-03478A-08-0454	Permanent Rate Application. Sewer. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, Rate Design and Cost of Capital.
Ridgeline Water Company, LLC	Certificate of Convenience and Necessity

COMPANY/CLIENT	FUNCTION
ACC Docket No. W-20589A-08-0173	– Water. Prepared pro-forma balance sheets, income statements, plant schedules, rate base, financing, and intitial rates.
Sacramento Utilities, Inc. ACC Docket No. SW-20576A-08-0067	Certificate of Convenience and Necessity – Wastewater. Prepared pro-forma balance sheets, income statements, plant schedules, rate base, and financing.
Johnson Utilities ACC Docket No. WS-02987A-08-0180	Permanent Rate Application. Water and Sewer. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, Rate Design and Cost of Capital. Participate in 40-252 proceeding.
Orange Grove Water Company ACC Docket No. W-02237A-08-0455	Permanent Rate Application. Prepared schedules on Plant, Income Statement, Revenue Requirement, and Rate Design.
Far West Water and Sewer Company ACC Docket No. WS-03478A-07-0442	Financing Application. Prepare schedules to support application.
Oak Creek Water No.1 ACC Docket No. W-01392A-07-0679	Permanent Rate Application. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, and Rate Design.
ICR Water Users Association Docket W-02824-07-0388	Permanent Rate Application. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, and Rate Design.
Johnson Utilities	Valuation consultant in the matter of the sale of Johnson Utilities assets to the Town of Florence.
H2O, Inc ACC Docket No. W-02234A-07-0550	Permanent Rate Application. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, Rate Design, and Cost of Capital.

COMPANY/CLIENT	FUNCTION
Chaparral City Water Company ACC Docket No. W-02113A-07-0551	Permanent Rate Application. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, Rate Design, and Cost of Capital.
Valley Utilities ACC Docket No. W-01412A-07-0561	Financing Application. Prepare schedules to support application.
Valley Utilities ACC Docket No. W-01412A-07-280	Emergency Rate Application. Prepare schedules to support application.
Valley Utilities ACC Docket No. W-01412A-07-0278	Accounting Order. Assist in preparing definition and scope of costs for deferral for future regulatory consideration and treatment.
Litchfield Park Service Company ACC Docket No. W-01427A-06-0807	Accounting Order. Assist in preparing definition and scope of costs for deferral for future regulatory consideration and treatment.
Golden Shores Water Company ACC Docket No. W-01815A-07-0117	Permanent Rate Application. Water. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, Rate Design, and Cost of Capital.
Diablo Village Water Company ACC Docket No. W-02309A-07-0140	Off-site facilities hook-up fee application. Prepare schedules to support application.
Diablo Village Water Company ACC Docket No. W-02309A-07-0399	Permanent Rate Application (Class C). Water. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, Rate Design, and Cost of Capital.
Sahuarita Water Company (Rancho Sahuarita Water Co.) ACC Docket No. W-03718A-07-0687	Extension Certificate of Convenience and Necessity – Water. Prepared pro-forma balance sheets, income statements, plant schedules, rate base, and financing.
Utility Source, L.L.C.	Permanent Rate Application- Water and

COMPANY/CLIENT	FUNCTION
ACC Docket No. WS-04235A-06-0303	Wastewater. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, Rate Design, and Cost of Capital.
Tierra Buena Water Company	Valuation of Tierra Buena Water Company for estate purposes.
Goodman Water Company ACC Docket No. W-02500A-06-0281	Permanent Rate Application (Class C). Water. Prepared schedules and testified on Rate Base, Plant, Income Statement, and Cost of Capital.
Links at Coyote Wash Utilities ACC Docket No. SW-04210A-06-0220	Certificate of Convenience and Necessity – Sewer. Prepared pro-forma balance sheets, income statements, plant schedules, rate base, financing, and initial rate design.
New River Utilities ACC Docket No. W-0173A-06-0171	Extension Certificate of Convenience and Necessity – Water. Prepared pro-forma balance sheets, income statements, plant schedules, rate base, and financing.
Johnson Utilities ACC Docket No. WS-02987A-04-0501 Docket WS-02987A-04-0177	Extension of Certificate of Convenience and Necessity – Sewer. Prepared pro-forma balance sheets, income statements, plant schedules, rate base, financing, and initial rate design.
Bachmann Springs Utility ACC Docket No. WS-03953A-07-0073	Permanent Rate Application – Water and Sewer. Prepared short-form schedules for Rate Base, Income Statement, Plant, Bill Counts, and Rate Design.
Avra Water Cooperative ACC Docket No. W-02126A-06-0234	Permanent Rate Application – Water. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, and Rate Design.
Gold Canyon Sewer Company ACC Docket No. SW-025191A-06-0015	Permanent Rate Application – Sewer. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, Rate Design, and Cost of Capital.

COMPANY/CLIENT	FUNCTION
State of Arizona v. Far West Water and Sewer, No. 1 CA-CR 06-0160	Expert witness on behalf of defendant in penalty phase of case.
Far West Water and Sewer Company ACC Docket No. WS-03478A-05-0801	Permanent Rate Application – Sewer. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, Rate Design, and Cost of Capital.
Black Mountain Sewer Company ACC Docket No. SW-02361A-05-0657	Permanent Rate Application – Sewer. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, Rate Design, and Cost of Capital.
Balterra Sewer Company ACC Docket No. SW-02304A-05-0586	Certificate of Convenience and Necessity – Sewer. Prepared pro-forma balance sheets, income statements, plant schedules, rate base, financing, and initial rate design.
Community Water Company of Green Valley ACC Docket No. W-02304A-05-0830	Permanent Rate Application – Water. Prepared schedules and testified on Rate Base, Plant, Income Statement, Revenue Requirement, and Rate Design.
McClain Water Systems Northern Sunrise Water Southern Sunrise Water ACC Docket No. W-020453A-06-0251	Certificate of Convenience and Necessity – Water. Prepared pro-forma balance sheets, income statements, plant schedules, rate base, financing, and initial rate design.
Valley Utilities Water Company ACC Docket No. W-01412A-04-0376	Off-site facilities hook-up fee application. Prepare schedules to support application.
Valley Utilities Water Company ACC Docket No. W-01412A-04-0376	Permanent Rate Application – Water. Prepared schedules and testified on Rate Base, Plant, Income Statement, and Revenue Requirement. Assisted in preparation of Rate Design.
Beardsley Water Company ACC Docket No. W-02074A-04-0358	Permanent Rate Application – Water. Prepared short-form schedules for Rate Base, Income Statement, Plant, Bill

COMPANY/CLIENT	FUNCTION
	Counts, and Rate Design.
Pine Water Company, Inc. ACC Docket No. W-03512A-03-0279	Interim and Permanent Rate Application, Financing Application - Water. Prepared schedules and testified on Rate Base, Plant, Income Statement, Cost of Capital, and Rate Design.
Chaparral City Water Company ACC Docket No. W-02113A-04-0616	Permanent Rate Application. Prepared schedules and testified on Rate Base, Plant, and Income Statement. Assisted in preparation Rate Design.
Tierra Linda Home Owners Association ACC Docket No. W-0423A-04-0075	Certificate of Convenience and Necessity – Water. Prepared pro-forma balance sheets, income statements, plant schedules, rate base, financing, and initial rate design.
Diamond Ventures - Red Rock Utilities ACC Docket No. WS-04245A-04-0184	Certificate of Convenience and Necessity – Water and Sewer. Prepared pro-forma balance sheets, income statements, plant schedules, rate base, financing, and initial rate design.
Arizona-American Water Company, Inc. ACC Docket No. WS-01303A-02-0867 ACC Docket No. WS-01303A-02-0868 ACC Docket No. WS-01303A-02-0869 ACC Docket No. WS-01303A-02-0870 ACC Docket No. WS-01303A-02-0908	Permanent Rate Application Water and Sewer (10 divisions). Prepared schedules and testimony on Rate Base, Plant, Income Statement, and Revenue Requirement. Assisted in preparation of Rate Design.
Bella Vista Water Company, Inc. ACC Docket No. W-02465A-01-0776	Permanent Rate Application - Water. Prepared schedules and testimony on Rate Base, Plant, Income Statement, and Revenue Requirement. Assisted in preparation of Cost of Capital and Rate Design.
Green Valley Water Company Docket (2000 Not Filed)	Permanent Rate Application. Prepared schedules and testimony on Rate Base, Plant, Income Statement, and Revenue

COMPANY/CLIENT	FUNCTION
	Requirement. Assisted in preparation of Cost of Capital and Rate Design.
Gold Canyon Sewer Company ACC Docket No. SW-02519A-00-0638	Permanent Rate Application - Sewer. Prepared schedules and testimony on Rate Base, Plant, Revenue Requirement, and Income Statement. Assisted in preparation of Cost of Capital and Rate Design.
Rio Verde Utilities, Inc. ACC Docket No. WS-02156A-00-0321	Permanent Rate Application – Water and Sewer. Prepared schedules and testimony on Rate Base, Plant, Revenue Requirement, and Income Statement. Assisted in preparation of Cost of Capital and Rate Design.
Livco Water Company Livco Sewer Company ACC Docket No. SW-02563A-05-0820	Permanent Rate Application – Water. Prepared short-form schedules for Rate Base, Income Statement, Plant, Bill Counts, and Rate Design.
Livco Water Company ACC Docket No. SW-02563A-07-0506	Permanent Rate Application – Water and Sewer. Prepared short-form schedules for Rate Base, Income Statement, Plant, Bill Counts, and Rate Design.
Cave Creek Sewer Company	Revenue Requirement, Rate Adjustment and Rate Design - Sewer.
Avra Water Cooperative ACC Docket No. W-02126A-00-0269	Permanent Rate Application – Water. Assisted in preparation of Rate Base, Plant, Income Statement, Revenue Requirement, and Rate Design.
Town of Oro Valley	Revenue Requirements, Water Rate Adjustments and Rate Design.
Far West Water Company ACC Docket No. WS-03478A-99-0144	Permanent Rate Application – Water. Assisted in preparation of schedules for Rate Base, Income Statement, Revenue Requirement, Lead-Lag Study, Cost of Capital, and Rate Design.
MHC Operating Limited Partnership	Permanent Rate Application – Sewer.

COMPANY/CLIENT	FUNCTION
Sedona Venture Wastewater ACC Docket No. W-	Assisted in preparation of schedules for Rate Base, Plant, Income Statement, and Rate Design.
Vail Water Company ACC Docket No. W-01651B-99-0406	Permanent Rate Application. Assisted in preparation of schedules for Rate Base, Plant, Income Statement, and Rate Design.
E&T Water Company ACC Docket No. W-01409A-95-0440	Permanent Rate Application - Water. Assisted in preparation of schedules for Rate Base, Plant, Income Statement, and Rate Design.
New River Utility ACC Docket No. W-01737A-99-0633	Permanent Rate Application - Water. Assisted in preparation of schedules for Rate Base, Plant, Income Statement, and Rate Design.
Golden Shores Water ACC Docket No. W-01815A-98-0645	Permanent Rate Application – Water. Assisted in preparation of schedules for Rate Base, Plant, Income Statement, and Rate Design.
Ponderosa Utility Company ACC Docket No. W-01717A-99-0572	Permanent Rate Application – Water. Assisted in preparation of schedules for Rate Base, Plant, Income Statement, and Rate Design.

Expert Witness Report

Pima County vs City of Tucson et al.

Case Number: No. CV2022-001141

Submitted by:
Bryan G. Hopkins, Ph.D., CPSS
Neil Hansen, Ph.D.
8 December 2022

Table of Contents

I. Background and Assignment

The City of Tucson in Pima County, Arizona, imposed differential water rates for customers and is charging higher rates for those located in unincorporated areas compared to those in the incorporated areas of the City. This is in addition to the tiered rate system already being charged, with higher rates for higher water use, which is aimed at promoting conservation. Water conservation is a significant issue, particularly in the Southwest region of the United States. Based on the documents we were provided; we understand that the justifications the City of Tucson uses for charging differential rates are:

1. Unincorporated customers (29% of their customers) require more assets (36%, which is mainly pipe) than incorporated customers,
2. Unincorporated customer water is "one-time use" because some (32%) are not connected to the sewer system and the water is "lost",
3. Unincorporated customers use 43% more water than incorporated customers,
4. City bears the financial risk for the system that includes assets located outside of the City,
5. City resources are being provided to non-City residents with no "return-on-investment",
6. City wants access to the 40-50 million dollars annually for shared revenues from the state for the unincorporated areas,
7. City cites precedent for differential water rates used by other cities.

We were retained by the Snell & Wilmer law firm to primarily opine about the validity of points 2 and 3 above, as well as items peripherally related to the others. Our assignment is to specifically opine on the merits of the City of Tucson's claims and provide expert testimony regarding scientific principles related to the water cycle and if, indeed, these facts support or deny the position taken by the City of Tucson in this policy matter. We opine regarding:

⇒ Evapotranspiration Analysis of the Incorporated vs. Unincorporated areas relating to better understanding the range of water use by City customers in this case,

⇒ Effectiveness of Tiered Rates on water conservation efforts, and

⇒ Water Balance of areas with a sewer management system with waste transported via pipe to a central waste treatment plant(s) vs. onsite septic tank based water treatment systems.

Because we are issuing this report before many depositions have occurred and before discovery is completed, we explicitly reserve the right to supplement this report as necessary as new information becomes available. In particular, the following categories of information were not available to us at the time of this report and may ultimately impact our analysis:

- Statistics in a presentation apparently authored by Timothy Thomure related to the City's decision to adopt differential rates (bates labeled PIMA000317-331). This specifically includes the presentation's claims (at PIMA000323) that unincorporated customers use "43%" more water than incorporated customers. Particularly, what data was collected to

create the average monthly residential water use? What experts were utilized to help determine these values?

- More explicit data showing CCF consumption in residential and non-residential areas.

II. Qualifications Summary

Dr. Bryan G. Hopkins

As a Certified Professional Soil Scientist (CPSS), Dr. Hopkins is an expert in soil and water science. He is employed as a Full Professor in the Plant and Wildlife Sciences Dept. at Brigham Young University. His prior employment includes working with Utah Power and Light, Kansas State University, Servi-Tech, Inc., Stukenholtz Laboratory, and University of Idaho.

He earned an A.A.S. degree in Horticulture from Brigham Young University—Idaho (formerly Ricks College) in 1986, a B.S. degree in Agronomy and Horticulture from Brigham Young University in 1990, a M.S. degree in Agronomy and Horticulture from Brigham Young University in 1991, and a Ph.D. in Agronomy from Kansas State University in 1995. Horticulture and Agronomy involve the science of soil and crop management, including water relations.

At present, the focus of his teaching is environmental chemistry and plant, soil, and water science and management. He maintains an active research program focused on soil-plant-water issues in urban, agricultural, and native environments with nearly 100 peer reviewed refereed journal publications, 10 invited book chapters, and hundreds of invited presentations and other publications. He has been cited nearly 5,000 times by other scientists and has an active graduate program—with 17 graduate students successfully completing degrees under his leadership as the major professor with many millions in funding to support his research. He has published and presented extensively on a wide variety of topics related to soil and water science.

He has consulted with several past clients, including many government agencies, farms, collegiate and professional sports teams, golf courses, and large multi-national companies, such as John Deere and Nutrien. He has been asked to serve as an expert witness on about a dozen cases. See curriculum vitae (CV) for details on these and other qualifications.

Dr. Neil C. Hansen

Dr. Hansen is a soil scientist and specializes in soil-water-plant systems. He is employed as a Full Professor and Department Chair in the Plant and Wildlife Sciences Department at Brigham Young University. Previous employment includes working as an Assistant Professor at the University of Minnesota and as an Associate Professor at Colorado State University.

He earned a B.S. degree in Agronomy and Horticulture from Brigham Young University in 1992, a M.S. degree in Agronomy and Horticulture from Brigham Young University in 1994, and a Ph.D. in Soil Science from University of Minnesota in 1998.

The focus of his teaching is soil and environmental sciences and international agricultural development. He maintains an active research program focused on water use and water conservation in irrigated urban and agricultural environments. He has over 100 peer reviewed refereed journal publications that have been cited more than 2,500 times. His research has been widely supported by competitive research grants, with the majority of funding from the U.S. Department of Agriculture. He has an active graduate program—with 14 graduate students that have completed their training under his leadership. See curriculum vitae (CV) for details on these and other qualifications. Dr. Hansen has not served as an expert witness in the prior ten years.

III. Compensation

Compensation is strictly on an hourly basis and is not in any way dependent on the outcome of our research, the contents of our report, or the outcome of this case. We are being compensated/reimbursed based on the following agreement:

Expert Witness Fee Schedule

Research, Review, Writing, Preparation, Consultation, Correspondence, & Travel - All services rendered will be billed at one consistent rate of $300 per hour. The client is responsible for portal-to-portal travel expenses including: time, air fare, rental car, personal vehicle mileage, hotel, meals, etc. Airfares at business class rate. Mileage and per diem (or actual costs for meals) at the U.S. federal rate.

Deposition & Trial - All services rendered at trial will be billed at $350 per hour with a minimum of 3 hours. If the deposition or trial services are canceled within 7 days of the date set, a $600 fee will be charged per expert that is set to testify.

Scientific Aides and Assistants - Some preparatory work may be delegated to one of our Scientific Aides billed at $40 per hour. Administrative Assistant and unskilled labor will be billed at $28 per hour.

Supplies, Facilities, Mileage - The client will be charged for all costs incurred in preparing and carrying out research, demonstrations, report writing etc. requested by the client.

Agreement & Billing - A written retention agreement is required after initial consultation. Estimated fees will be provided in advance to Retaining Counsel. Services are billed at the end of every calendar month. Payment is due upon receipt of the invoice. A 1.5% interest per month charge for unpaid invoice balances will be charged after 30 days. Retaining Counsel is responsible for payments if the client or opposing counsel fails to pay, as well as attorney's fees in the event of a dispute.

IV. Terminology

Aquifer: A body of permeable rock which can contain or transmit groundwater.

Average: A value that is computed by dividing the sum of a set of terms by the number of term.

Climatic Data: A measured parameter which helps to specify the climate of a specific location or region, such as precipitation, temperature, wind speed and humidity.

Conservation: Planned management of a natural resource to prevent or minimize exploitation, destruction, or neglect.

Correlate: A relation existing between phenomena or things or between mathematical or statistical variables which tend to vary, be associated, or occur together in a way not expected on the basis of chance alone.

Differential: Making a distinction between individuals or classes.

Effective: Producing a decided, decisive, or desired effect.

Equity: The quality of being fair and impartial.

Evapotranspiration: The combined loss of water from a given area, and during a specified period of time, by evaporation from the soil surface and by transpiration from plants.

Environmental: The complex of physical, chemical, and biotic factors (such as climate, soil, and living things) that act upon an organism or an ecological community and ultimately determine its form and survival.

Imagery: In remote sensing, imagery is the acquisition of information about an object or phenomenon without making physical contact with the object. Which contrasts with in situ or on-site observation. The term is applied especially to acquiring information about the Earth and other planets.

Landscaped: To modify or ornament (a natural landscape) by altering the plant cover.

Metered: To supply in a measured or regulated amount.

Per Capita: Per unit of population by or for each person.

Shapefile(shp): Simple, nontopological format for storing the geometric location and attribute information of geographic features. Geographic features in a shapefile can be represented by points, lines, or polygons (areas).

Significant: Relative to the field of statistics, significant is a term applied to differences, correlation, etc., to indicate that they are probably not due to chance alone; usually indicates a probability of not less than 95 percent.

Soil: The layer(s) of generally loose mineral and/or organic material that are affected by physical, chemical, and/or biological processes at or near the planetary surface, and usually hold liquids, gases and biota and support plants.

Spatial Autocorrelation: Term used to describe the presence of systematic spatial variation in a variable and is the tendency for areas or sites that are close together to have similar values.

Statistically Significant ($P < 0.001$): A p-value less than 0.05 is typically considered to be statistically significant, in which case the null hypothesis should be rejected. A p-value greater than 0.05 means that deviation from the null hypothesis is not statistically significant, and the null hypothesis is not rejected.

Tiered: The rate you pay is determined by the amount of water you use. As water use increases, so does the cost per thousand gallons.

Transpired: To give off or exude watery vapor especially from the surfaces of leaves.

Water Conservation: Includes all the policies, strategies and activities to sustainably manage the natural resource of fresh water, to protect the hydrosphere, and to meet the current and future human demands.

V. Summary of Opinions

The City of Tucson, located within Pima county in the state of Arizona, has imposed differential water rates for customers, with the net effect of charging higher rates for those geographically located in unincorporated areas compared to those located in the incorporated areas of the City. This is in addition to the tiered rate system already being charged, with higher rates charged for higher water use for each customer, which is aimed at promoting conservation. Water conservation is a significant issue, particularly in the Southwest region of the United States. The justifications the City of Tucson uses for charging differential rates are:

1. Unincorporated customers (29% of their customers) require more assets (36%, which is mainly pipe) than incorporated customers,

2. Unincorporated customer water is "one-time use" because some (32%) are not connected to the sewer system and the water is "lost",

3. Unincorporated customers use 43% more water than incorporated customers,

4. City bears the financial risk for the system that includes assets located outside of the City,

5. City resources are being provided to non-City residents with no "return-on-investment",

6. City wants access to the 40-50 million dollars annually for shared revenues from the state for the unincorporated areas,

7. City cites precedent for differential water rates used by other cities.

It is apparent that the City's justifications are broadly invalid and we were specifically asked our expert opinions upon points 2 and 3.

With regard to point #2, there are a number of problems with this justification. First, the large majority (68%) of customers located in the unincorporated area do not have a septic tank and utilizing this as a primary justification is disingenuous . Secondly, and most importantly, water flows in a cycle and, thus, is not "lost" as claimed by the City. Much of the reclaimed water that the City treats in their sewer system is used for groundwater recharge. Similarly, water that is treated in a septic tank and drainage field is largely contributing to groundwater recharge, as well as to provide moisture for deep rooted trees and shrubs that might be in close proximity to the drain field. Thirdly, treating this water has no cost to the City as the cost of installing and maintaining the onsite systems is carried by the property owner. The treated water eventually makes its way to groundwater and is once again brought into use by the City as potable water (once treated). Thus, it is not "one-time-use".

With regard to point #3, we do not disagree with the City's assertion that customers in unincorporated areas use, on average, more water than those located in the City. However, we do disagree with their premise of using this as justification to charge every customer outside of the City higher rates based strictly on geographical location. The City provides only an average water use and did not provide a range of water consumption. We have demonstrated, using estimated water loss to the atmosphere through evapotranspiration (ET) that, while unincorporated properties do have greater water consumption in the landscape on average, there is a wide range for both incorporated and unincorporated customers. Some of the properties we evaluated had high water loss to ET in both the incorporated and the unincorporated areas. Similarly, some of the properties we evaluated had low water loss to ET in both the incorporated and unincorporated areas. It is disingenuous to make a blanket statement that unincorporated customers use more water and apply it to all regardless of actual use.

A tiered pricing structure for water, which was already in place prior to the double dipping of using differential water rates, is known to provide incentives for customers to conserve water. Those who use more water pay more and those who use less pay less, which seems to be a fair standard and not one meant to charge an additional cost to some based on whether they are in incorporated or unincorporated areas rather than basing cost on actual water use.

We opine that the arguments we were provided lack logic and specifics. The information we evaluated does not accurately reflect the complexities of the water cycle and water/sewer distribution and costs, including the fact that much of the water the City uses is pumped from unincorporated areas. Our initial opinion is that the justification for differential rates are invalid and that there is not a reasonable basis to charge different rates based on the incorporation or unincorporation location of their residences. We resonate with Mr. Huckelberry's statement in his Memorandum cited herein that this is "extortion under the guise of equity" and "there are environmentally-minded extremely low water users in the unincorporated areas just as there are extreme water users in the City". We also find the differing rates to be inequitable, particularly for those customers who are motivated to conserve water but live in unincorporated areas.

In summary, it is our expert opinion that the City's approach to using Differential Rates for their customers is not based on reasonable scientific facts and, as such, is not equitable.

Bryan G. Hopkins, Ph.D., CPSS

Neil C. Hansen, Ph.D.

VI. Evapotranspiration Analysis

Evapotranspiration (ET) encompasses both the water evaporated from the soil surface and the water transpired from plants (Trout & Ross, 2006). Rates of evapotranspiration are controlled climate and weather conditions, surface conditions and management, and water availability. Climate and weather factors include solar radiation, temperature, humidity, and wind. Surface conditions include type and amounts of vegetation, surface material (pavement, soil, etc). Water availability includes such factors as precipitation, irrigation, free water, and soil water. It is time and labor intensive to physically measure ET across a citywide scale and local climate and microclimate factors can lead to differences in ET.

Within a local urban environment, however, differences in water use practices/management typically have a larger impact on ET than variation in microclimates. There are reliable resources to estimate ET using satellite imagery, local precipitation, and climatic data for an area (Trout & Ross, 2006; Vulova et al., 2021). One of these resources is www.OpenETdata.org.

We chose to use data from OpenET as a way to demonstrate that a mean is not a fair way to represent water use data. The data we obtain from OpenET are only approximations of ET to make this point and are not proposed to be precise quantitative values for the sampled properties. We believe that data from OpenET is useful in this case. The developers of OpenET state that among valid uses of the data are to "develop more effective management plans and incentive programs, evaluate water demand and use patterns and inform planning to meet future water needs, and co-develop solutions with local communities and water users and take the steps needed to sustainably manage the water supplies for their basin or region" (https://openetdata.org/how-to-use-data-from-openet/openet-for-water-managers/).

The provided shapefiles of Tucson incorporated and unincorporated City were used as boundaries (Figure 1).[1] Each shapefile was imported into the ArcGIS Pro software as polygons. The random point generator tool in ArcGIS was used to create 50 random sample points in each of the two categories, incorporated and unincorporated. The parameters were set to 50 random points in each boundary type, minimum distance between points was 300 feet to ensure that we did not have spatial autocorrelation between points (Figure 2).

Once a random sample was created, the nearest developed property to the random point was assigned. If a random point was not within 300 feet of a developed property it was deemed as not a useful point and a new random sample point was created. There were 15 random points in the incorporated and 5 in the unincorporated areas that had to be resampled following the same parameters. At each of the developed properties, a boundary was drawn around the property structure(s) and landscaped vegetation areas. The landscaped area, for example, would include the yard and pool if applicable. The property boundaries varied in size for the

[1] Assumptions made in our analysis: The first assumption is that the land area selected to estimate ET for each randomly selected property encompassed the full area where potable water is used in the landscape. We evaluated various methods to define property boundaries, and area for each property. We also assume that precipitation and background evapotranspiration (the ET that would occur without addition of potable water) is essentially uniform across the entire study area. These are reasonable assumptions that allow for reliable estimates of the data shown.

incorporated zone from 0.03 to 0.50 acres (Table 1), and for the unincorporated zone from 0.05 to 0.43 acres (Table 1).

Data from OpenETdata.org was used to estimate the amount of ET at each of the 100 randomly selected property boundary areas. The ET was estimated on an annual basis for 2017-2021. The ET for the sampled property boundaries in the incorporated zone varied from 2.8 to 31.7 inches with an average 12.9 inches per year (Figure 3). The ET for the sampled property boundaries in the unincorporated zone varied from 6.4 to 30.7 inches per year with an average 16.1 inches per year (Figure 3). Once ET was recorded for each property boundary, the product of estimated ET and parcel size was calculated to represent an estimate of the amount of water each property lost to ET each year (Figure 4).

The estimated total water use by ET data was compiled for each sampled property boundary and independent-sample T-tests were performed in R Studio statistical software to assess whether the incorporated and unincorporated zones have statistically different volumes of water lost due to ET. Each of the 5 years were used as replicates. For all five years there was a difference in ET between the incorporated and unincorporated zones ($p < 0.05$) (Table 2). The unincorporated zone had an average of 84.4 CCF of annual water loss to ET, which was 44% greater than the average of 58.6 CCF annual water loss to ET in the incorporated zone. Thus, on average, the unincorporated areas have higher water loss due to ET. However, the range of ET values for individual properties in both incorporated and unincorporated shows that both have properties with low and high ET (Figure 4), confirming that a mean is not a good way to represent water use data. The full ranges of data for water lost by ET do not align with boundaries between incorporated and unincorporated areas.

In reference to the City's justifications listed in Section I. (point #3), we are not opining about the City's assertion that unincorporated customers use more water on average. However, we do point out a flaw in this justification that the average use is not indicative of all customers. In fact, when there is a wide range of values in a dataset, such as is expected with water use data, an average is not representative of <u>most</u> customers. In the presentation provided to us by Mr. Timothy Thomure, it states that customers in the unincorporated area of Tucson use 43% more water than customers within the incorporated area of Tucson. This justification is a comparison of the average water use between the incorporated and unincorporated customers. We were not provided with detailed water meter data to evaluate how the averages in each area represent the actual ranges of water use by customers. As an alternative, we chose to evaluate water lost to evapotranspiration from a sampling of properties from incorporated and unincorporated areas. We did find that water loss due to evapotranspiration was higher on average for unincorporated areas. However, there is a wide range in evapotranspiration values for the areas we sampled in both incorporated and unincorporated areas. The observed range in the evapotranspiration (ET) data shows that statistical means are not a good way to represent the data. In this case water losses due to evapotranspiration are not controlled by whether the customer is or is not in an incorporated area. It would be expected that water use data would have a similar wide range around the mean. The City relying upon an average value and not acknowledging a wide range in water use is not appropriate as there is a wide range of values in the data set.

In short, it is disingenuous to state that water use increases based on whether a user is inside the City's jurisdiction or outside the jurisdiction—that one customer not in the City uses 43% more water than another across the street in the City. The size of the property and the number of residents comes into play in water use per property. There are undoubtedly residents

with large families, some of whom are economically disadvantaged, who are effective at water conservation. There are others with one or two residents per property who are water wasteful—and surely every other condition between these extremes. The City states that "29% of Tucson Water customers (County) utilize 36% of the assets" but this statement only defines 'assets' as transmission and distribution pipes. There are more complexities to "assets" than just pipes. This would also include a complex bevy of assets related to water pumping, distribution, and wastewater treatment as is outlined in Mr. Huckelberry's well-reasoned Memorandum (PIMA000312-315).

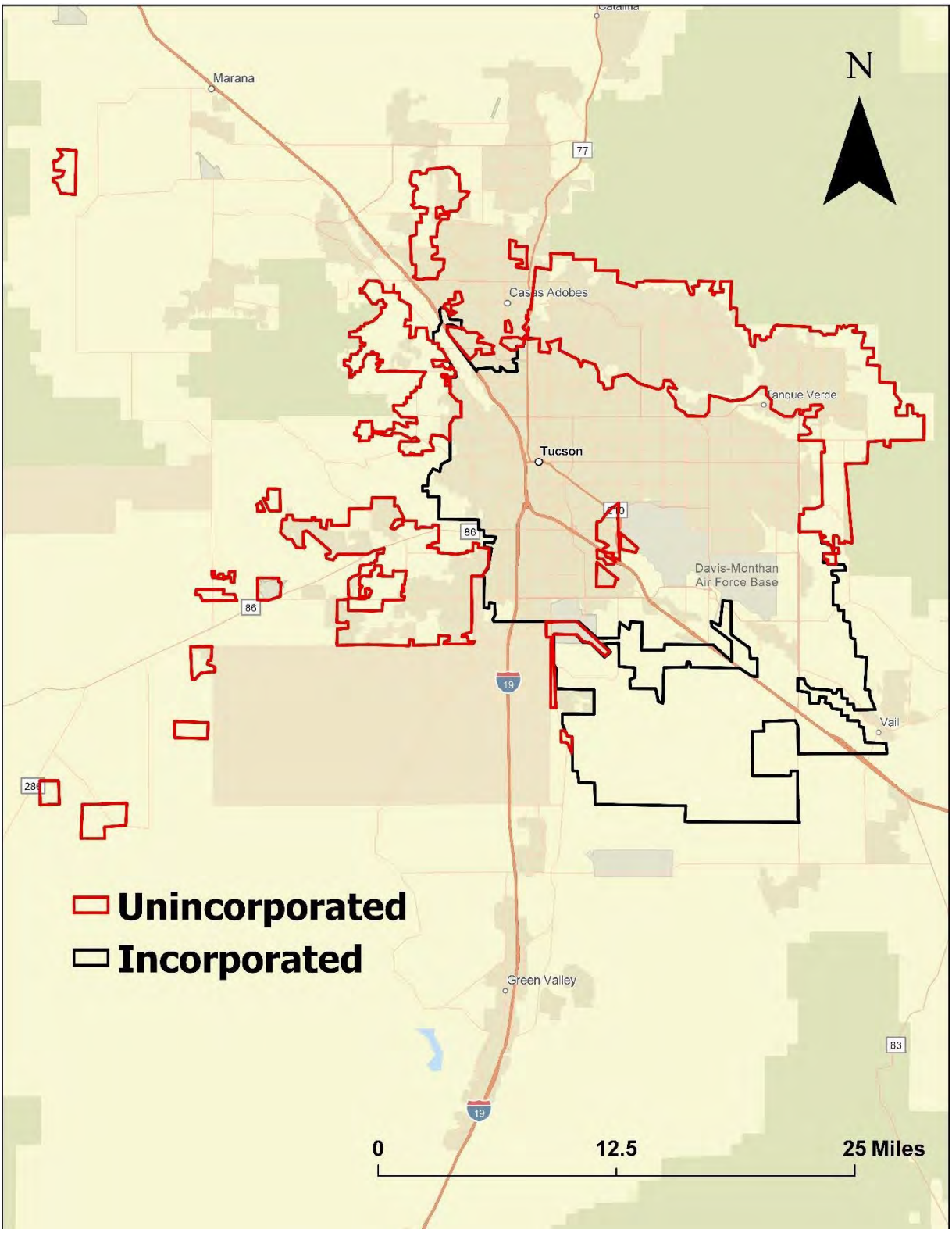

Figure 1. Tucson, Arizona, incorporated and unincorporated areas.

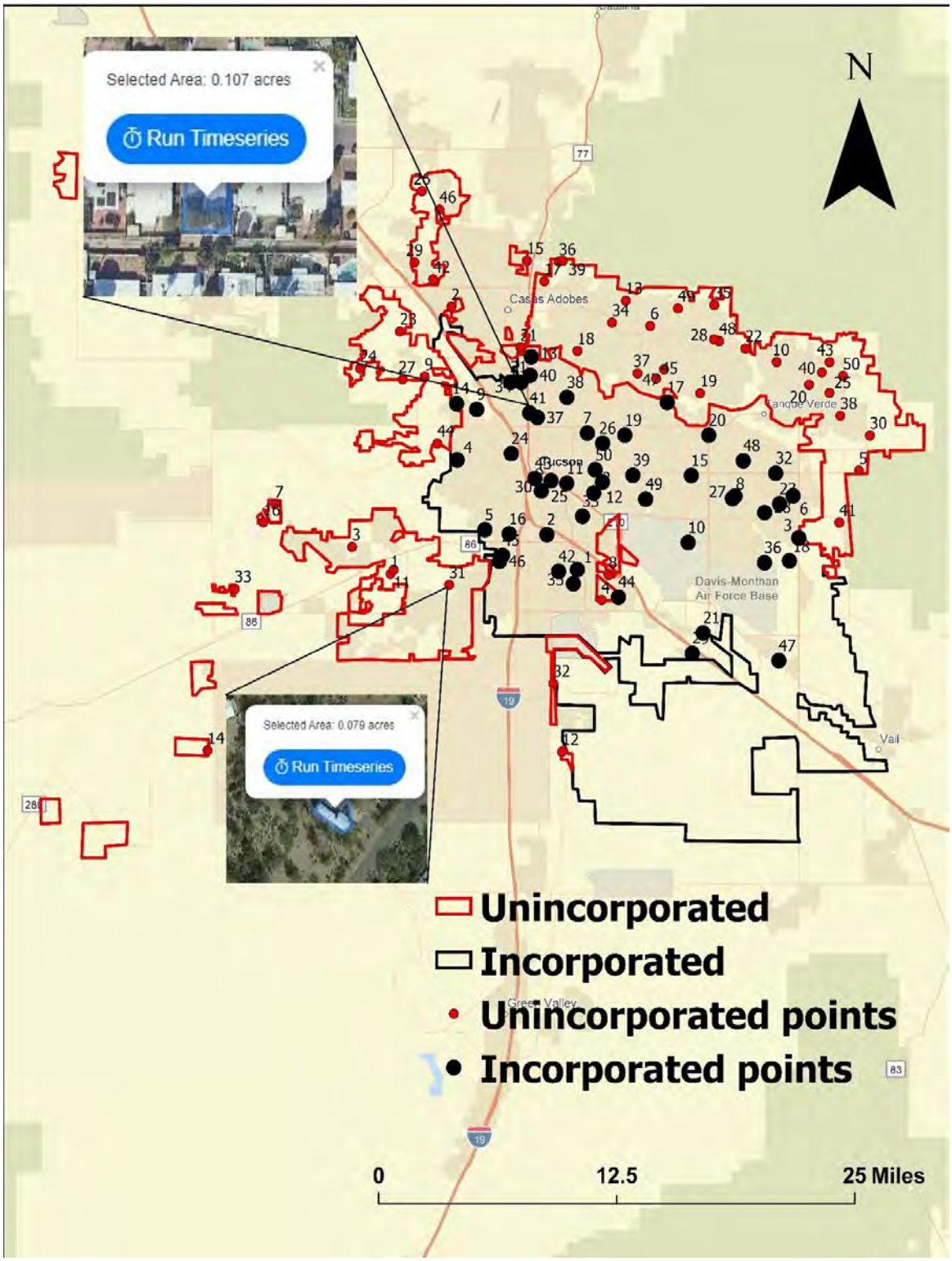

Figure 2. Tucson, Arizona, random sampling design of 50 points in incorporated and unincorporated categories. The random points were created in ArcGIS Pro with at least 300 feet between points. The inset figures show examples of how boundaries were created around landscaped areas for the determination of water lost to evapotranspiration.

Place	Min	Max	Mean	Standard deviation
	----------Acres----------			
Incorporated	0.03	0.50	0.11	0.09
Unincorporated	0.05	0.43	0.14	0.08

Table 1. The minimum, maximum, average, and standard deviation of individual property sizes for randomly sampled properties in incorporated and unincorporated areas (landscaped areas only).

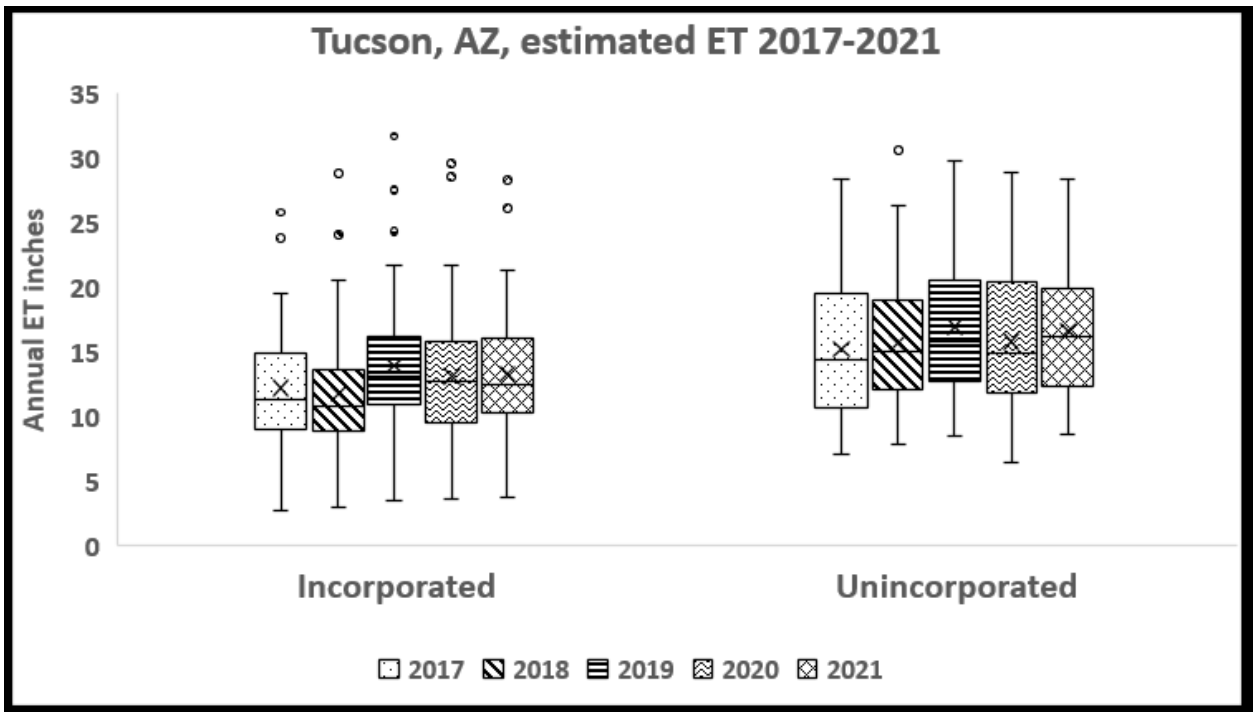

Figure 3. Box plots show the mean (shows as an x) median (shown as the line inside the box), the inner quartile range of data (upper and low boundaries of boxes), and 1.5 times the interquartile range of data (the whiskers) and outlier observations (circles). These plots show estimated annual evapotranspiration rate for 50 randomly selected properties in both incorporated and unincorporated zones for 2017 to 2021. Incorporated had lower average ET than unincorporated areas ($p < 0.05$), but both areas had individual properties with high ET.

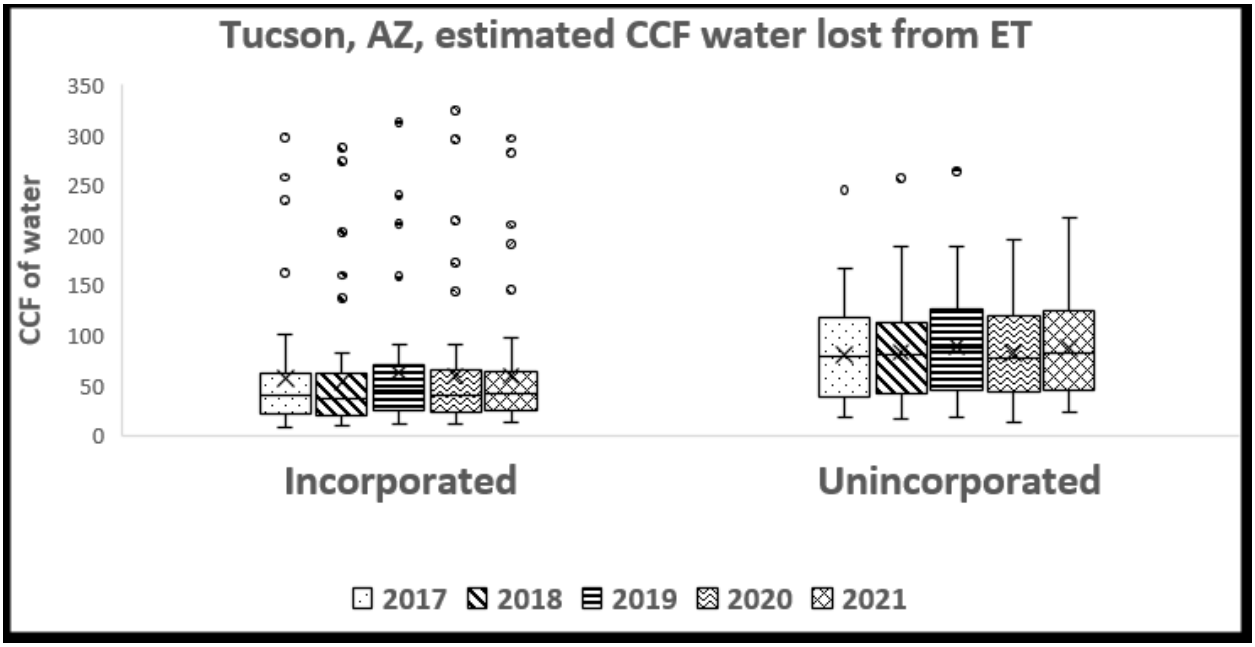

Figure 4. Box plots show the mean (shows as an x) median (shown as the line inside the box), the inner quartile range of data (upper and low boundaries of boxes), and 1.5 times the interquartile range of data (the whiskers) and outlier observations (circles). These plots show the mean and ranges of annual water loss due to estimated evapotranspiration for 50 randomly selected properties in both incorporated and unincorporated zones for 2017 to 2021. On average water loss due to evapotranspiration is higher in unincorporated areas. There are, however, relatively high and low property boundary areas in both incorporated and unincorporated zones.

Year	p-value	Estimated Average Water Loss Due to Evapotranspiration	
		Incorporated	Unincorporated
2017	0.02	56.6	80.5
2018	< 0.01	53.9	82.8
2019	0.02	63.1	89.2
2020	0.02	59.6	82.5
2021	< 0.01	59.7	87.2
Average	< 0.01	58.6	84.4

Table 2. Statistical comparison of average water loss due to evapotranspiration from 50 randomly selected properties in both incorporated and unincorporated areas. Each year (2017-2021) is a replicate. In all five years the unincorporated area had higher amounts of average water lost to evapotranspiration ($p < 0.05$).

VII. Tiered Rate vs Differential Rate Effectiveness for Water Conservation

In reference to the City's overall approach of charging more for water use by customers living in unincorporated areas, the approach is not effective for their stated reason of water conservation and is redundant with their existing tiered rate approach.

Generally speaking, uniform block pricing (paying for the volume of water used, with cost per unit being constant) has a built-in incentive for conservation and has been shown to be tied to water conservation.[2] (Zerraner and Rambarran, 2017; *but see* Arbués et al., 2003 (showing a poor relationship between tiered payment structure and conservation)). Before it adopted a differential rate for unincorporated customers, Tucson Water *already* utilized this type of pricing structure, by charging a service charge to all users plus an additional charge based on water consumption. The City continues to use this type of structure today (*See* PIMA001343-1346). In other words, the pricing structure used by Tucson Water before adopting differential rates already sufficiently promotes conservation.

We are not aware of any study showing that simply adding a differential rate, on top of a tiered water structure, has any impact on conservation. Although price is a factor in conservation, there are many other factors that impact water use, including: whether the user is able to understand how their water use affects their water price (a factor which is itself contingent on educational campaigns and whether the user is being metered); household characteristics (type and age of dwelling, house size, lot size, landscape type, pool, income, etc.); climate (precipitation, temperature, ET); and urban structure (building density, parks, industrial areas, etc.). (Zerraner and Rambarran, 2017; Carter and Milon, 2005; Kenney et al., 2008). Water use is also driven by economic factors: behavior response to water pricing is greatest by low-income water users and least for high-income users (Grafton et al., 2011). These key, measurable, factors that have been shown to affect household water use do not include whether the user is located in an unincorporated area or might want to annex to an incorporated area. Thus, it cannot be said for certain that simply adding a differential on top of a tiered structure would increase conservation above the amount already seen with a tiered water structure.

Moreover, the best water use policies combine some version of a tiered water structure with other measures to promote conservation. For instance, the City of Phoenix has utilized tiered pricing structures over the past 40 years, including several policy adjustments made to increase conservation and equity goals (Zerraner and Rambarran, 2017). Water use per capita declined 25 percent (2002-2017) with factors contributing to this reduction, including: plumbing fixture standards, smaller residential lots, fewer new pools, low water use landscaping, and education about the water rate system. Of note, it does not appear that the water use decline was tied to the City of Phoenix's differential rates for outside-City customers. Here, in contrast, it

[2] Studies suggest that there are more effective pricing structures at promoting conservation. One specialized form of tiered water pricing is known as increasing block rate water budgets (IBR). IBR is different than tiered rates because it allows individualized assessment of customers water blocks based on such factors as household size, the irrigated area on the property, and localized environmental conditions. A study evaluating IBR for the Eastern Municipal Water District of Southern California found it to be highly effective at achieving water conservation goals (Baerenklau et al., 2013).

appears that Tucson has simply adopted a differential for non-City customers without concurrently adopting any other measures to promote conservation in the City or unincorporated areas.[3]

[3] The City has stated that revenues from the differential rates should be used in part for "climate resiliency" and "water sustainability" projects. CITY000663. However, Assistant City Manager Timothy Thomure did not know the amount (if any) of differential revenues that had ad been budgeted towards conservation projects at his December 1, 2022 deposition. [Thomure Dep. at 104:5-9.] To the extent that the City is not actually using differential revenues for water conservation projects, this further suggests that the differential rate does not actually promote conservation.

VIII. Septic System Imbalance

We reviewed a presentation apparently authored by Mr. Timothy Thomure regarding the City's decision to implement differential rates (See PIMA000317-333). The presentation includes the following statement justifying differential rates: "City's water resources are only one time use in County growth areas" (See PIMA000322). It further argues that "32% of County customers (5% of City customers) are not connected to a sewer system." (*Id).* In addition to the fact that this justification is being applied to all unincorporated customers despite a large majority (68%) not using septic systems, it is our opinion that the argument for one-time use of water delivered to county areas that are not connected to a sewer system is incorrect.

Water customers who are not connected to a sewer system are required by the Arizona Department of Environmental Quality to have a permitted onsite wastewater treatment system (septic system; see https://www.azdeq.gov/onsitewastewater). The basic function of a septic system is to treat wastewater through separation in a septic tank, breakdown, filtration, and water discharge through a leach field. Soil in the leach field further naturally remediates the wastes and wastewater as these migrate through the soil. In general, soil has a natural decontamination ability as beneficial microbes consume the pathogens and the waste products. This similar process is performed artificially in wastewater treatment plants as part of a sewage system. Any waste that is not treated in the sewer system but is, instead, treated by a septic system saves the City wastewater reclamation costs.

Water reclaimed though an onsite septic system is not "lost" as is incorrectly stated by the City. Instead, and as the City failed to consider, the water discharged from the septic system recharges the aquifer or is used by deep rooted trees and shrubs, which contribute greatly to the urban ecosystem in many positive ecosystem services. Studies around the world, including arid areas, have documented that wastewater streams in urbanized areas are responsible for an increase in groundwater recharge compared to background conditions (Lerner, 2002; Wakode et al., 2018). Recharge of water treated through an onsite wastewater treatment system constitutes a beneficial use beyond the initial use by the customer. Unlike the City's sewer system, the burden of cost for septic tank maintenance are on the property owner, while the benefits of water recharge are regional. Our understanding is that the County actually pays for the reclamation process and redistributes reclaimed water, at no charge, back to the City (*See* PIMA000313; Thomure Dep. 77:17-78:9). As such, allowing the water cycle to process and reclaim unincorporated wastewater saves the City a significant amount of taxpayer money.

IX. Materials Reviewed

- Abbott, B.W., Bishop, K., Zarnetske, J.P. et al. Human domination of the global water cycle absent from depictions and perceptions. Nat. Geosci. 12, 533–540 (2019). (*available at: https://doi.org/10.1038/s41561-019-0374-y*)
- Anonymous. Spreadsheet showing Inside City vs. Unincorporated Water Use over time. (*Tucson Water Data Combined January 2020 Through July 2022 9.7.22.xlsx*)
- Data Set: Set of Pima County shp files, etc.zip
- Czechokski, Michael. Deposition 1 Dec. 2022 (*2022 1201CZECHOWSKI-rough*)
- Exhibit A: Ordinance No. 11881 adopted by Tucson City Mayor and Council (*Ex. A ORDINANCE_11881.pdf*)
- Huckelberry, C.H., Pima County Administrator, Memorandum to The Honorable Chair and Members of the Pima County Board of Supervisors (*PIMA000312-333 Ex G May 10, 2021 City of Tucson Water Policy Related to Differential Water Rates.pdf*)
- OpenET Data – www.openETdata.org
- Open Net Data - https://openetdata.org/how-to-use-data-from-openet/openet-for-water-managers/
- Thomure, T., Interim Assistant City Manager, Fiscal Year 21-22 Water Rates presentation (*210507 REVISED TW CWAC Differential Rate Presentation.pdf*)
- Thomure, Timothy Deposition 1 Dec. 2022 (*2022 1201THOMURE-rough*)

X. References

Arbue´s, F., Garcı´a-Valin˜as, M.A., and Martı´nez-Espin˜eira, R., 2003. Estimation of residential water demand: a stateof-the-art review. Journal of Socio-Economics, 32, 81 –102.

Baerenklau, K. A., Schwabe, K. A., and Dinar, A. 2013. Do Increasing Block Rate Water Budgets Reduce Residential Water Demand? A Case Study in Southern California. University of California, Riverside Water Science and Policy Center. Working Paper 01-0913, September 2013. Available at: https://www.financingsustainablewater.org/sites/www.financingsustainablewater.org/files/resource_pdfs/WSPC-%282013%29-Do-Increasing-Block-Rate-Water-Budgets-Reduce-Water-Use.pdf

Carter, D.W. and J.W. Milon, 2005. Price Knowledge in Household Demand for Utility Services. Land Economics 81: 265- 283.

Grafton, R.Q., Ward, M.B., To, H. and Kompas, T. 2011. Determinants of residential water consumption: Evidence and analysis from a 10-country household survey. Water Resources Research 47: available at: https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2010WR009685

Kenney, D.S., C. Goemans, R. Klein, J. Lowrey, and K. Reidy, 2008. Residential Water Demand Management: Lessons from Aurora, Colorado. Journal of the American Water Resources Association 44: 192- 207.

Lerner, D. 2002. Identifying and quantifying urban recharge: a review . Hydrogeology Journal (2002) 10:143–152.

Trout, K., Ross, M. (2006). Estimating Evapotranspiration In Urban Environments. In: Tellam, J.H., Rivett, M.O., Israfilov, R.G., Herringshaw, L.G. (eds) Urban Groundwater Management and Sustainability. NATO Science Series, vol 74. Springer, Dordrecht. https://doi.org/10.1007/1-4020-5175-1_12

Vulova, S., Meier, F., Rocha, A., Quanz, J., Nouri, H., & Kleinschmit, B. (2021). Modeling urban evapotranspiration using remote sensing, flux footprints, and artificial intelligence. *Science of The Total Environment, 786*. https://www.sciencedirect.com/science/article/pii/S0048969721023640

Wakode, H.B., Baier, K. Jha, R., and Azzam, R. 2018. Impact of Urbanization on Groundwater Recharge and Urban Water Balance for the city of Hyderabad, India. International Soil and Water Conservation Research 6:51-62.

https://doi.org/10.1016/j.iswcr.2017.10.003

Zerrenner, K., and Rambarran, J. 2017. Examining Conservation-Oriented Water Pricing and Programs through an Energy Lens: An Analysis of the Energy Savings Associated with Water Demand Reductions; Environmental Defense Fund: New York, NY, USA, 2017; Available online: http://blogs.edf.org/energyexchange/files/2017/12/conservation-rates-white-paper-Final.pdf.

XI. Appendix 1 – Dr. Hopkins CV

BRYAN GENE HOPKINS
CURRICULUM VITAE

RANK: Professor, Brigham Young University

DEPARTMENT: Plant and Wildlife Sciences

OFFICE LOCATION: 5117 LSB
Provo, UT 84602

OFFICE PHONE: 801-422-2185

EMAIL: hopkins@byu.edu
WEB: http://lifesciences.byu.edu/home/FacStaff/default.aspx?ID=293

EDUCATION:

Degrees:

1995	Ph.D.	Agronomy	Kansas State University, Manhattan, KS
1991	M.S.	Agronomy and Horticulture	Brigham Young University, Provo, UT
1990	B.S.	Agronomy and Horticulture	Brigham Young University, Provo, UT
1988	A.A.	Horticulture	Ricks College, Rexburg, ID

Certificates:

1991-present	Certified Professional Soil Scientist (CPSSc),	Soil Science Society of America

EXPERIENCE:

Academic Appointments:

Environment Science of Managed Landscapes, Professor, Brigham Young University, Provo, UT, 50% teaching/45% research/5% citizenship, 10 month appointment
*2019-present BYU Professor and Soil Science Society of America—North American Proficiency Testing (NAPT) Coordinator
*2012-2019 Professor and Director of BYU Environmental Analytical Lab
*2007-2012 Associate Professor

Soil Scientist and Cropping Systems Specialist, University of Idaho, Idaho Falls, ID, 80% extension/20% research and citizenship, 2001-2007

Research Assistant/Lab Manager, Kansas State University, Manhattan, KS, 1991-1995

Research/Teaching Assistant, BYU, Provo, UT, 1990-1991

Non-Academic Employment:

Director of Education Division & Lab Consultant, Servi-Tech, Inc., Blackfoot, ID, 1998-2001

Laboratory Director/Agronomist, Stukenholtz Laboratories, Twin Falls, ID, 1997-1998

Laboratory Director/Agronomist, Servi-Tech, Inc., Hastings, NE, 1995-1997

Foreman and Research Assistant, Utah Power & Light Wastewater Research Farm, Castle Dale and Huntington, UT, 1989

Consulting:

1994-present, partial list of clients includes:
Progressive Plants, Brigham Young University, Democratic Republic of the Congo, John Deere, Floratine, Aquatrols, Bayer CropScience, Wilbur Ellis, BASF, DuPont, Research and Business Development Center, Ostara, Mosaic, Pizza Hut, Honeywell, Pioneer Hi-Bred International, DOW Chemical, Nutrien (formerly Agrium), Georgia Pacific, Helena Chemical, Scotts Miracle-Gro Company, Manitoba Potato Growers, Alberta Potato Growers, RD Offutt and many other farm corporations, Nutrient-Soil-Water Management Continuing Education, as well as a variety of other corporations and municipalities, golf courses, sports field facilities, etc.

TEACHING:

Traditional Courses (BYU)

Semester	Course	Course Name	Cr	Enrollment
F07	PWS 319	Turfgrass Science	2.0	43
F07	PWS 402	Urban Soil & Water Management	4.0	35
W08	PWS 100	Living with Plants (Botany)	3.0	41
F08	PWS 319	Turfgrass Science	2.0	46
W09	PWS 150	Environmental Biology	3.0	114
W09	PWS 402	Urban Soil & Water Management	4.0	38
F09	PWS 319	Turfgrass Science	2.0	40
F09	PWS 511	Environmental Biophysics (Soil & Plant Water Relations)	3.0	15
W10	PWS 150	Environmental Biology	3.0	108
W10	PWS 402	Urban Soil & Water Management	4.0	42
SU10	PWS 150	Environmental Biology	3.0	43
F10	PWS 318	Sports Turfgrass Science	2.0	21
F10	PWS 319	Turfgrass Science	2.0	46
W11	PWS 150	Environmental Biology	3.0	59
W11	PWS 402	Urban Soil & Water Management	4.0	36
F11	PWS 318	Sports Turfgrass Science	2.0	18
F11	PWS 319	Turfgrass Science	2.0	31
F11	PWS 511	Environmental Biophysics (Soil & Plant Water Relations)	4.0	7
W12	PWS 150	Environmental Biology (sec 001)	3.0	122
W12	PWS 150	Environmental Biology (sec 002)	3.0	143
W12	PWS 402	Urban Soil & Water Management	4.0	59
F12	PWS 318	Sports Turfgrass Science	2.0	7
F12	PWS 319	Turfgrass Science	2.0	24
F12	PWS 283	Soil Science Laboratory	1.0	20
F12	PWS 283	Soil Science Laboratory	1.0	20
F12	PWS 283	Soil Science Laboratory	1.0	19
W13	PWS 402	Urban Soil & Water Management	4.0	22
W13	PWS 283	Soil Science Laboratory	1.0	18
W13	PWS 283	Soil Science Laboratory	1.0	15

W13	PWS 283	Soil Science Laboratory	1.0	14
F13	PWS 283	Soil Science Laboratory	1.0	26
F13	PWS 283	Soil Science Laboratory	1.0	26
F13	PWS 319	Turfgrass Science	3.0	27
F13	PWS 405	Environmental Chemistry Lab 1	1.0	6
F13	PWS 560	Quantitative Environmental Chemistry	2.0	10
W14	PWS 283	Soil Science Laboratory	1.0	19
W14	PWS 283	Soil Science Laboratory	1.0	14
W14	PWS 402	Urban Soil & Water	3.0	28
W14	PWS 406	Environmental Chemistry Lab 2	1.0	6

Traditional Courses (BYU) - continued

Semester	Course	Course Name	Cr	Enrollment
F14	PWS 283	Soil Science Laboratory	1.0	30
F14	PWS 283	Soil Science Laboratory	1.0	24
F14	PWS 319	Turfgrass Science	3.0	19
F14	PWS 405	Environmental Chemistry Lab 1	1.0	3
F14	PWS 560	Quantitative Environmental Chemistry	2.0	3
W15	PWS 283	Soil Science Laboratory	1.0	22
W15	PWS 283	Soil Science Laboratory	1.0	9
W15	PWS 402	Urban Soil & Water	3.0	21
W15	PWS 406	Environmental Chemistry Lab 2	1.0	9
W15	PWS 660	Environmental Site Evaluation	2.0	5
F15	PWS 282	Introduction to Soil Science	3.0	46
F15	PWS 283	Soil Science Laboratory	1.0	20
F15	PWS 283	Soil Science Laboratory	1.0	14
F15	PWS 319	Turfgrass Science	3.0	31
F15	PWS 405	Environmental Chemistry Lab 1	1.0	4
F15	PWS 560	Quantitative Environmental Chemistry	2.0	5
W16	PWS 283	Soil Science Laboratory	1.0	26
W16	PWS 283	Soil Science Laboratory	1.0	8
W16	PWS 402	Urban Soil & Water	3.0	25
W16	PWS 406	Environmental Chemistry Lab 2	1.0	4
W16	PWS 660	Environmental Site Evaluation	2.0	5
F16	PWS 282	Introduction to Soil Science	3.0	82
F16	PWS 283	Soil Science Laboratory	1.0	31
F16	PWS 283	Soil Science Laboratory	1.0	31
F16	PWS 319	Turfgrass Science	3.0	23
F16	REL A 121	The Book of Mormon	2.0	53
W17	PWS 283	Soil Science Laboratory	1.0	1
W17	PWS 283	Soil Science Laboratory	1.0	24
W17	PWS 402	Urban Soil & Water	3.0	32
W17	PWS 406	Environmental Chemistry Lab 2	1.0	7
F17	PWS 283	Soil Science Laboratory-1	1.0	27
F17	PWS 283	Soil Science Laboratory-2	1.0	22
F17	PWS 319	Turfgrass Science	3.0	27

F17	REL A 121	The Book of Mormon	2.0	42
W18	PWS 283	Soil Science Laboratory-1	1.0	26
W18	PWS 283	Soil Science Laboratory-2	1.0	12
W18	PWS 402	Urban Soil & Water -1	3.0	27
W18	PWS 402	Urban Soil & Water -2	3.0	7
W18	PWS 560	Quantitative Environmental Chemistry	2.0	10
F18	PWS 283	Soil Science Laboratory-1	1.0	30
F18	PWS 283	Soil Science Laboratory-2	1.0	24
F18	PWS 319	Turfgrass Science	3.0	22
W19	PWS 283	Soil Science Laboratory-1	1.0	28
W19	PWS 283	Soil Science Laboratory-2	1.0	12

Traditional Courses (BYU) - continued

Semester	Course	Course Name	Cr	Enrollment
W19	PWS 402	Urban Soil & Water -1	3.0	23
W19	PWS 402	Urban Soil & Water -2	3.0	2
W19	PWS 405	Quantitative Environmental Chemistry	2.0	8
F19	PWS 283	Soil Science Laboratory-1	1.0	32
F19	PWS 283	Soil Science Laboratory-2	1.0	29
F19	PWS 319	Turfgrass Science	3.0	24
W20	PWS 283	Soil Science Laboratory-1	1.0	27
W20	PWS 283	Soil Science Laboratory-2	1.0	12
W20	PWS 402	Urban Soil & Water -1	3.0	18
W20	PWS 402	Urban Soil & Water -2	3.0	1
W20	PWS 405	Quantitative Environmental Chemistry	2.0	8
W20	PWS 560	Quantitative Environmental Chemistry	2.0	6
F20	PWS 283	Soil Science Laboratory-1	1.0	31
F20	PWS 283	Soil Science Laboratory-2	1.0	31
F20	PWS 319	Turfgrass Science -1	3.0	23
W21	PWS 283	Soil Science Laboratory-1	1.0	31
W21	PWS 283	Soil Science Laboratory-2	1.0	27
W21	PWS 402	Urban Soil & Water	3.0	18
W21	PWS 560	Quantitative Environmental Chemistry	2.0	4

R Course - Lecture

Semester	Course	Course Name	Cr	Enrollment
F08	PWS 198R	Sports Turfgrass Science interns	0.5	8
F08	PWS 390R	Sports Turfgrass Science course	1.0	4 (5 audit)
F08	PWS 494R	Special Topics: Soil & Water	3.0	6
F09	PWS 198R/390R	Sports Turfgrass Science	0.5/1.0	3/16
F10	PWS 390R	Leadership Principles/PWS Clubs	1.0	22
W11	PWS 390R	Leadership Principles/PWS Clubs	1.0	19
F12	PWS 390R	Analytical Laboratory Principles	1.0	8

W13	PWS 390R	Soil Plant & Water Science Lab	1.0	1
W13	PWS 494R	Soil Plant & Water Science Lab	1.0	1
F16	PWS 494R	Soil Plant & Water Science Lab	6.0	5
W17	PWS 494R	Special Topics: Soil & Water	3.0	4
SP17	PWS 390R	Urban Agriculture	0.5/1.0	7
SU17	PWS 390R	Urban Agriculture	1.0/2.0	3
W18	PWS 390R	Sports Turfgrass Science	1.0/3.0	2
W18	PWS 494R	Soil Plant & Water Science Lab	2.0/3.0	2
F18	PWS 390R	Urban Agriculture	1.0/3.0	10
W19	PWS 390R	Urban Agriculture	1.0/3.0	5

R Course Lecture – continued

Sp21	PWS 598R	Advanced Topics	3.0	1

R Courses - Research

Semester	Course	Course Name	Cr	Enrollment
W11	PWS 697R	Research	2.0	1
W14	PWS 598R	Advanced Topics	3.0	1
F14	PWS 598R	Advanced Topics	3.0	1
F15	PWS 598R	Advanced Topics	3.0	1
W16	PWS 598R	Advanced Topics	3.0	2
F16	PWS 598R	Advanced Topics	3.0	5
W17	PWS 598R	Advanced Topics	3.0	2
W18	PWS 598R	Advanced Topics	1.0	1
W19	PWS 697R	Research	3.0	1
F07-W21	BIOL/PWS/ LFSCI 494R	Mentored Research	1-6	97
F07-W21	PWS 699R	Master's Thesis	1-6	92
W21	PWS 799R	Doctoral Discertation	1-6	2

University Courses: Previous Positions

Directed Studies: Potato Cropping Systems, PLSC 502, UI, Idaho Falls, ID, 2005
Special Topics: Nutrient Interactions, PLSC 404, UI, Idaho Falls, ID, 2004
Soil Fertility Lab, AGHORT 306, BYU, Provo, UT, 1990-91
Saline-Sodic Soils Lab, AGHORT 520, BYU, Provo, UT, 1991
Agricultural Computing Lab, AGHORT 240, BYU, Provo, UT, 1988-89

Undergraduate Students Mentored as Research Assistants:

Surname	First	Years	Surname	First	Years
Callahan	Ryan	2007 - 2007	Relf	Brandon	2010 - 2010
Chariton	Nicholas	2007 - 2007	Hamilton	Matthew	2010 - 2011
Clarke	Richard	2007 - 2007	Katseanes	Chelsea	2010 - 2011
Gerber	Perrin	2007 - 2007	LeMonte	Sarah	2010 - 2011
Glenn	Brian	2007 - 2007	Ransom	Curtis	2010 - 2011
Greenwood	Brian	2007 - 2007	Story	Tobin	2010 - 2012
Roueche	Megan	2007 - 2007	Wankier	Preston	2010 - 2012
Banfield	John	2007 - 2008	Hopkins	Tyler	2010 - 2018
Marcroft	Kelly	2007 - 2008	Bergsten	Steve	2011 - 2011
Warner	Devin	2007 - 2008	Dix	Wray	2011 - 2011
Beckett	Travis	2007 - 2009	Hales	Michael	2011 - 2011
Christensen	Ryan	2007 - 2009	Rankin	Adriana	2011 - 2011
LeMonte	Joshua	2007 - 2009	Ransom	Heather	2011 - 2011
Nichols	Brandt	2007 - 2009	Schrieber	Charles	2011 - 2011
Gish	James	2007 - 2012	Smith	Kileen	2011 - 2011
Bulkley	Kate	2008 - 2008	Spratling	Trenton	2011 - 2011
Buck	Joshua	2008 - 2009	Cartozian	Alyssa	2011 - 2012
Reese	David	2008 - 2009	Hill	Jeremy	2011 - 2012
Summerhays	Jeffrey Sean	2008 - 2009	Hoki	Glenna	2011 - 2012
Babbel	Lee	2008 - 2010	Mason	Greg	2011 - 2012
Padilla	Heather	2008 - 2010	Packer	Katie	2011 - 2012
Buxton	Emily	2008 - 2011	Sleight	Rachel	2011 - 2012
Blaylock	Austin	2009 - 2009	Winchester	Adam	2011 - 2013
Bond	Jason	2009 - 2009	Sutton	Lloyd	2011 - 2014
Bradshaw	Eric	2009 - 2009	Blair	Trenton	2011 - 2015
Coleman	Ashley	2009 - 2009	Hosford	Paul	2012 - 2012
Niedfedt	Emily	2009 - 2009	Kirk	Aaron	2012 - 2012
Patrick	Ashton	2009 - 2009	Lyon	Chris	2012 - 2012
Schloemer	Steven	2009 - 2009	Olson	Brigg	2012 - 2012
Tulley	Nikki	2009 - 2009	Peaden	Steven	2012 - 2012
Wade	Joshua	2009 - 2009	Bradshaw	Derek	2012 - 2013
Washburn	Jacob	2009 - 2009	Carroll	David	2012 - 2013
Winegar	Allie	2009 - 2009	Hofheins	Amy	2012 - 2013
Bond	Daniel	2009 - 2010	Manning	Karen	2012 - 2013
Haskell	Christopher	2009 - 2010	McLane	Kathryn	2012 - 2013
Fernelius	Kaitlynn	2009 - 2011	Moody	Justin	2012 - 2013
Hill	Michael	2009 - 2011	Nelson	Spencer	2012 - 2013
Brown	Tabitha	2009 - 2012	Black	Beth	2012 - 2015
Babbel	Justin	2010 - 2010	Smith	Melissa	2012 - 2015
Barrett	John	2010 - 2010	Arnold	Casey	2013 - 2013
Hardy	Grant	2010 - 2010	Carroll	Alex	2013 - 2013
Kemmer	Ben	2010 - 2010	Freddy	Brett	2013 - 2013
King	James	2010 - 2010	Fredericksen	Brett	2013 - 2013

Perry	Devin	2010	-	2010	Houston	Kayla	2013	- 2013

Undergraduate Students Mentored as Research Assistants- continued:

Surname	First	Years			Surname	First	Years		
Mariana	Valerie	2013	-	2013	Crosland	Marco	2017	-	2017
Swainston	Sarah	2013	-	2013	Crump	Wesley	2017	-	2017
Taylor	Brett	2013	-	2013	Douglas	Carson D.	2017	-	2017
Taylor	Samuel	2013	-	2013	Erikson	Alexander	2017	-	2017
Wear	Ben	2013	-	2013	Eyler	Raquel	2017	-	2017
Randell	Sam	2013	-	2014	Franchino	Rebecca	2017	-	2017
Selman	Jacob	2013	-	2014	Frei	Rebecca	2017	-	2017
Yancey	Katherine	2013	-	2014	Gruwel	Trevor	2017	-	2017
Pumphrey	Blake	2013	-	2014	Haddock	Tandra L.	2017	-	2017
Albright	John	2013	-	2015	Jensen	Kurt	2017	-	2017
Buss	Jessica	2013	-	2015	Leavitt	Paul	2017	-	2017
Williams	Staci	2013	-	2015	Marion	Rachel	2017	-	2017
Sion	Marta	2013	-	2016	Neeley	Ruthe	2017	-	2017
Svedin	Jeff	2013	-	2016	Rose	Emma	2017	-	2017
Baker	Jenna	2014	-	2014	Silvester	Shannon	2017	-	2017
Cates	Lakin	2014	-	2015	Stratton	Marie	2017	-	2017
Pearce	Austin	2014	-	2015	Thacker	Mitch	2017	-	2017
Pryor	Mowava	2014	-	2015	Walker	Joe	2017	-	2017
Lambert	Cameron	2014	-	2016	Whitmore	Edward	2017	-	2017
Russell	Kerri	2014	-	2016	Valentine	Giselle	2017	-	2017
Ruth	Miranda	2014	-	2016	Billin	Tansy	2017	-	2018
Nelson	Shannon	2015	-	2016	Malmfeldt	Madeleine	2017	-	2018
Davidson	Jorgen	2015	-	2017	Nistler	Bridget	2017	-	2018
Hopkins	Austin	2015	-	2017	Phillips	Sierra	2017	-	2018
Neville	Bretton	2015	-	2017	Porter	Carlysle	2017	-	2018
Nielson	Landon	2015	-	2017	Porter	Warren	2017	-	2018
Parkinson	Morgan	2015	-	2017	Zeyer	Spencer	2017	-	2018
Patch	Leika	2015	-	2017	DiNuzzo	Eleanor	2017	-	2019
Petersen	Wyatt	2015		2017	Norris	Adam	2017	-	2019
Phelan	Samuel	2015	-	2017	Pedigo	Ashley	2017	-	2019
Rosell	Jordan	2015	-	2017	Summerhays	Sara	2017	-	2019
(Lowe) Tyler	Andrea	2015	-	2017	Cole	David	2017	-	2020
Lallatin	Madison	2015	-	2018	Ball	Lindsay	2018	-	2018
Luymes	Andrew	2015	-	2018	Barney	Tate	2018	-	2018
Sudweeks	Ivy	2015	-	2018	Binns	Mikayla	2018	-	2018
Beck	Colton	2016	-	2017	Errigo	Isabella Marie	2018	-	2018
Black	Holly	2016	-	2017	Hoyt	Rieley Davis	2018	-	2018
Geary	Nelson	2016	-	2017	Jorgensen	Emily L.	2018	-	2018
Ricks	Warren	2016	-	2017	Keightley	Michael	2018	-	2018
Shipp	Eric	2016	-	2017	Lambert	Austen	2018	-	2018
Sorensen	Peter	2016	-	2017	Meadows	Emily	2018	-	2018
Hastriter	Adam	2016	-	2018	Newman	Jessica Ann	2018	-	2018

Hopkins	Tyler	2016	-	2019	Nistler	Bridget	2018	- 2018
Valencia	Maria	2016	-	2019	Perryman	Katie	2018	- 2018

Undergraduate Students Mentored as Research Assistants- continued:

Surname	First	Years			Surname	First	Years		
Peo	Alley	2018	-	2018	Nolan	Emily	2019	-	2019
Phipps	John	2018	-	2018	Perryman	Katie	2019	-	2019
Schaerr	Elisabeth	2018	-	2018	Sundberg	McKayla	2019	-	2019
Selfaison	Kyle	2018	-	2018	Thompson	Megan	2019	-	2019
Tanner	Kaylee	2018	-	2018	Vera	Saida	2019	-	2019
Thompson	Megan	2018	-	2018	Bonsra	Dicken	2019	-	2020
Woo	Yee Ki	2018	-	2018	DeFord	Mallory	2019	-	2020
Blackwelder	Jake	2018	-	2019	Herbst	Dereck	2019	-	2020
Broadhead	Cameron	2018	-	2019	Milam	Sierra	2019	-	2020
Bruce	Anna	2018	-	2019	Outhenthapanya	Aaron	2019	-	2020
Crandall	Sara	2018	-	2019	White	Karaline	2019	-	2020
Dzubeck	Emily	2018	-	2019	Carlock	Eva	2019	-	2020
Eves	Jordan	2018	-	2019	Fahning	Savannah	2019	-	2020
Morris	Angel	2018	-	2019	Graff	James	2019	-	2021
Scheuller	Jordynn	2018	-	2019	Kobza	Savannah	2019	-	2021
Vargas	Camila	2018	-	2019	Moore	Jacob	2020	-	2020
Wood	Emily	2018	-	2019	Chattin	Taylor	2020	-	2021
Woolley	Roger	2018	-	2019	Heidenreich	David Taylor	2020	-	2021
Cass	Kristina	2018	-	2020	Jones	Nathan	2020	-	2021
Christensen	Whitney	2018	-	2020	Mecate	Kylee	2020	-	2021
Adams	Andrew	2019	-	2019	Anderson	Sophie	2021	-	2021
Chandler	Jackson	2019	-	2019	Binns	Nathan	2021	-	2021
Fisher	Jasive	2019	-	2019	Chattin	Taylor	2021	-	2021
Heller	Megan	2019	-	2019	Climes	Lexanne	2021	-	2021
Keightly	Michael	2019	-	2019	Harris	Dru	2021	-	2021
Lawson	Gabriella	2019	-	2019					

Undergraduate Students Mentored as Research Assistants - Present:

Surname	First	Years			Surname	First	Years		
Geary	Benjamin	2020	-	Present	Olson	Kimberlee	2021	-	Present
Lambert	Austen	2020	-	Present	Brown	Grace	2021	-	Present
Seely	Caden	2020	-	Present	Evans	Natalie	2021	-	Present
Ioannou	James	2021	-	Present	Martini	Madison	2021	-	Present
Svedin	Faith	2021	-	Present	McClellan	Collette	2021	-	Present
Sannar	Lauren	2021	-	Present	Geilman	Joseph	2021	-	Present
Vanderbark	Andrea	2021	-	Present	Norris	Adam	2021	-	Present
Despain	Rachel	2021	-	Present	Jones	Erin	2021	-	Present
Chen	Mei	2021	-	Present	Barnes	Miria	2021	-	Present

Graduate Students—Major Advisor:					
Surname	First	Degree	Years		
Bowen	Tom	M.S. (UI)	2003	-	2011‡
Cook	Aaron	M.S. (UI)	2004	-	2011‡
Barben	Steve	M.S.(co-advise)	2007	-	2009
McNulty	Patrice	M.S.	2007	-	2010
LeMonte	Joshua	M.S.	2009	-	2011
Blaser	Greg	Ph.D.(co-advise)	2003	-	2012
Summerhays	Jeffrey Sean	M.S.	2009	-	2012
Hill	Micheal	M.S.(co-advise)	2011	-	2012
Buck	Rachel	M.S.	2012	-	2013
Katseanes	Chelsea	M.S.	2012	-	2014
Ransom	Curtis	M.S.	2012	-	2014
Gervais	Emily	M.S.	2013	-	2015
Taysom	Trent	M.S. (UI)	2005	-	2015
Buss	Jessica	M.S.	2014	-	2016
Svedin	Jeffrey	M.S.	2016	-	2018
Woolley	Elisa Anne	M.S.	2018	-	2020
Burgin	Hannah	M.S.	2019	-	2021
Nelson	Shannon	Ph.D	2016	-	present
Stapley	Samuel	M.S.	2021	-	present
Barns	Miria	M.S.	2022	-	present
			‡inactive, did not graduate		

Graduate Students—Committee Member:

Surname	First	Degree	University	Years
Watt	Dan	M.S.	UI	2003 - 2004
Myer	Penny	M.S.	UI	2003 - 2005
Taberna	John	Ph.D.	UI	2003 - 2006‡
Jackson	Chad	M.S.	UI	2006 - 2007
Sweetwood	Ryan	M.S.	BYU	2007 - 2008
Madsen	Matthew	Ph.D.	BYU	2007 - 2010
Young	Kert	Ph.D.	BYU	2007 - 2012
Jones	Covy	M.S.	BYU	2008 - 2011
Rogers	Maile	Ph.D. (eng.)	BYU	2008 - 2013
Pletsch-Jones	Mary	M.S.	BYU	2009 - 2011
Buck	Joshua	M.S.	BYU	2010 - 2012
Cline	Nathan	Ph.D.	BYU	2010 - 2014
Bergsten	Steve	M.S.	BYU	2011 - 2013
Fernelius	Kaitlynn	M.S.	BYU	2011 - 2013
Jacobson	Doug	M.S.	BYU	2011 - 2016
Carroll	Alex	M.S.	BYU	2013 - 2015
Ulmer	Austin	M.S.	BYU	2013 - 2015
Pearce	Austin	M.S.	BYU	2014 - 2017
Brown	Bryce	M.S.	BYU	2016 - 2016
Priebe	Brian	Ph.D. (eng.)	BYU	2016 - 2020
Evans	Shane	M.S.	USU	2017 - 2020
Parkinson	Morgan	M.S.	BYU	2018 - 2020
Larson	Isak	M.S.	BYU	2019 - 2021
Norris	Adam	M.S.	BYU	2020 - present
Zenger	Verna	M.S.	BYU	2021 - present
Shumate	Samantha	M.S.	BYU	2021 - present

‡inactive, did not graduate

SCHOLARSHIP:

Publications and Presentations Summary for Bryan Hopkins

	Hopkins' Graduate Student First Author	Hopkins' Undergraduate Student First Author	Other Graduate Student First Author	Other Undergraduate Student First Author	Hopkins First Author	Co-author	**Total**
Refereed Journal	15	4	14		14	7	**54**
Editor Reviewed Journal		2			4	3	**9**
Book Chapters					6	4	**10**
Bulletins					12	8	**20**
Conference Proceedings Published Abstracts							
Presentations							
Other Reports							

PUBLICATIONS IN PREPARATION:

In Preparation (Draft Completed):

Blaser, G.E., J.C. Stark, J.M. Marshall, D.L. Eggett, and **B.G. Hopkins**. 202x. Yield response of potato to N following alfalfa, alfalfa-maize or alfalfa-wheat rotations. *Agron. J.*

Blaser, G.E., J.C. Stark, and **B.G. Hopkins**. 202x. Nitrogen use efficiency of potato to N following alfalfa, alfalfa-maize or alfalfa-wheat rotations. *Agron. J.*

Buss, J.C., J.H. Gish, and **B.G. Hopkins**. 202x. Polymer coated urea in Kentucky bluegrass: Rate. *Crop Sci.*

Buss, J.C., J.H. Gish, and **B.G. Hopkins**. 202x. Polymer coated urea in Kentucky bluegrass: Timing. *Crop Sci.*

Nielson, P.A., **B.G. Hopkins**, V.D. Jolley, and D.L. Eggett. 202x. Variable palatability of aspen for large ungulates: Mineral nutrition. *J. Wildlife Manage*.

Nielson, P.A., S.B. St. Clair, and **B.G. Hopkins**. 202x. Digestibility factors and variable palatability of quaking aspen for large ungulates. *J. Wildlife Manage*.

Ransom, C.J. and **B.G. Hopkins**. 202x. Evaluating the nitrogen release of slow and controlled-release fertilizers in field and laboratory conditions at different placements. *J. Environ. Qual.*

Ransom, C.J. and **B.G. Hopkins**. 202x. Turfgrass response to reduced rates of polymer-coated urea. *J. Environ. Qual.*

Taysom, T.T., J.C. Stark, and **B.G. Hopkins**. 202x. Polymer-coated urea in potato production. *Agron. J.*

Carroll, A., K.C. DeJonge, **B.G. Hopkins**, and N.C. Hansen. 202x. Water stress indices of maize with controlled deficit irrigation and variable nitrogen supply. *Field Crops Res.*

In Review:

Hopkins, B.G., A.P. Hopkins, and T.J. Hopkins. 202x. Nutrient and water interactions for reducing environmental impacts in lawn grass: A review. *Crop Science. (submitted June 2020)*

Zamora Re, M., A. Tomasek, **B.G. Hopkins**, D.M. Sullivan, and L. Brewer. 2022. Managing salt-affected soils for crop production. PNW 601. Corvallis, OR: Oregon State University.

Thompson, C., E. Guertal, P. McGroary, D. Soldat, and **B.G. Hopkins.** 202x. Considerations with soil testing in turfgrass. *In* M. Fidanza (*ed.*) *Achieving Sustainable Turfgrass Management.* Ch. 22: xx-xx. Cambridge, UK: Burleigh Dodds Science Publishing. DOI: https://doi.org.xx (*accepted*).

REFEREED JOURNAL PUBLICATIONS - IN PRESS:

Evans, S. R., K. Kopp, P.G. Johnson, B.G. Hopkins, X. Dai, & C. Schaible. (2022). Comparing Smart Irrigation Controllers for Turfgrass Landscapes, *HortTechnology*, *32*(5), 415-424. Retrieved Dec 8, 2022, from https://journals.ashs.org/horttech/view/journals/horttech/32/5/article-p415.xml

Burgin, H.R., G.A. Wear, N.C. Hansen, B.G. Hopkins. 2021. Variable impacts on growth of deficit irrigation on *Cynodon dactylon* (L.) Pers. × *Cynodon transvaalensis* Burtt Davy and *Poa pratensis* L *Int Turfgrass Soc Res J*. 2022; 14: 152– 156. https://doi.org/10.1002/its2.71

Shane, R.E., K. Kopp, P.G. Johnson, **B.G. Hopkins**, X. Dai, and C. Schaible. 20xx. A Comparison of Smart Irrigation Controllers in the Urban Landscape. *Hortech* (accepted).

Burgin, H.R., G.A. Wear, N.C. Hansen, and **B.G. Hopkins**. 2021. Variable impacts on growth of deficit irrigation on Cynodon dactylon (L.) Pers. × C. Transvaalensis Burt Davy and Poa pratensis L. *International Turfgrass Society Research Journal.* (accepted Apr. 2021). https://onlinelibrary.wiley.com/doi/10.1002/its2.71

Cole, D.L., Kobza, S.J., Fahning, S.R., Stapley, S.H., Bonsrah, D.K.A., Buck, R.L. and **B.G. Hopkins**. 2021. Soybean nutrition in a single-nutrient source hydroponic solution. *Agronomy* 11(3): 523. https://doi.org/10.3390/agronomy11030523

Svedin, J.D., R. Kerry, N.C. Hansen, and **B.G. Hopkins**. 2021. Identifying within-field spatial and temporal crop water stress to conserve irrigation resources with variable-rate irrigation. *Agronomy* 11(7): 1377. https://doi.org/10.3390/agronomy11071377

Smith, R., L. Oyler, C. Campbell, E.A. Woolley, **B.G. Hopkins**, R. Kerry, and N.C. Hansen. 2021. A new approach for estimating and delineating within-field crop water stress zones with satellite imagery. *International Journal of Remote Sensing.* 42(16): 6005-024. https://doi:10.1080/01431161.2021.1931536.

Cole, D.L., R.K. Woolley, R.L. Buck, A. Tyler, and **B.G. Hopkins**. 2020. Mineral nutrient deficiencies in quinoa grown in hydroponics with single nutrient salt/acid/chelate sources. *J. Plant Nutr.* 43(11): 1661-1673. https://doi:10.1080/01904167.2020.1739304

Ransom, C.J., V.D. Jolley, T.A. Blair, L.E. Sutton, and **B.G. Hopkins.** 2020. Nitrogen release rates from slow- and controlled-release fertilizers influenced by placement and temperature. *PLOS ONE.* 15(6): e0234544. https://doi.org/10.1371/journal.pone.0234544

Hopkins, B.G. and N.C. Hansen. 2019. Phosphorus management in high-yield systems. *J. Environ. Qual.* 48:1265–1280. https://doi:10.2134/jeq2019.03.0130.

Hopkins, B.G., K.J. Fernelius, N.C. Hansen, and D.L. Eggett. 2018. A response to the letter to the editor from Chien et al. (Comments on "AVAIL phosphorus fertilizer enhancer: Meta-analysis of

503 field evaluations" by B.G. Hopkins et al.) *Agron. J.* 110(4):1627-1630. https://doi:10.2134/agronj2018.03.0161

Hopkins, B.G., K.J. Fernelius, N.C. Hansen, and D.L. Eggett. 2018. AVAIL phosphorus fertilizer enhancer: Meta-analysis of 503 field evaluations. *Agron. J.* 110: 389-398. https://doi:10.2134/agronj2017.07.0385

Jones, C.D., J.M. Stetler, V.D. Jolley, **B.G. Hopkins,** S.L. Jensen, D. Turner, and M.R. Stevens. 2018. Comparisons of cultivation methods for *Lupinus sericeus, L. argenteus, L. prunophilus, and L. arbustus*. *Native Plants J.* 19: 90-99. https://doi:10.3368/npj.19.2.90

LeMonte, J.J., V.D. Jolley, T.M. Story, and **B.G. Hopkins**. 2018. Assessing atmospheric nitrogen losses with photoacoustic infrared spectroscopy: Polymer coated urea. *PLOS ONE* 13(9): e0204090. https://doi:org/10.1371/journal.pone.0204090

Smith, T.S., **B.G. Hopkins**, J. Gookin, and S. Thompson. 2018. Portable electric fencing for bear deterrence and conservation. *Hum-Wildl Interact.* 12(3): 309–321. https://doi:https://doi.org/10.26077/H9SW-QG28

Carroll, D.A., N.C. Hansen, **B.G. Hopkins**, and K.C. DeJonge. 2017. Leaf temperature of maize and Crop Water Stress Index with variable irrigation and nitrogen supply. *Irrig. Sci.* 35(6): 549-560. https://doi:10.1007/s00271-017-0558-4

Fernelius, K.J., M.D. Madsen, **B.G. Hopkins**, S. Bansal, V.J. Anderson, D.L. Eggett, and B.A. Roundy. 2017. Post-fire interactions between soil water repellency, soil fertility and plant growth in soil collected from a burned piñon-juniper woodland. *J. Arid Env.* 144: 98-109. https://doi:org/10.1016/j.jaridenv.2017.04.005.

Katseanes, C.K., M.A. Chappell, **B.G. Hopkins**, B.D. Durham, C.L. Price, B.E. Porter, and L.F. Miller. 2017. Multivariate soil fertility relationships for predicting the environmental persistence of 2, 4, 6-trinitrotoluene (TNT) and 1, 3, 5-trinitro-1,3,5-tricyclohexane (RDX) among taxonomically distinct soils. *J. Environ. Manage.* 203: 383-390. https://doi: https://doi.org/10.1016/j.jenvman.2017.08.005

Summerhays, J.S., V.D. Jolley, M.W. Hill, and **B.G. Hopkins**. 2017. Enhanced phosphorus fertilizers (Carbond P® and AVAIL®) supplied to maize in hydroponics. *J. Plant Nutr.* 40: 2889-2897. https://doi:10.1080/01904167.2017.1384007.

Buck, R.L**., B.G. Hopkins**, B.L. Webb, and V.D. Jolley. 2016. Depth of ion exchange resin capsule placement impacts on estimation of nitrogen and phosphorus bioavailability in semi-arid, low fertility soils. *Soil Sci.* 181: 216–221. https://doi:10.1097/SS.0000000000000165

Buck, R.L., B.L. Webb, V.D. Jolley, B.A. Roundy, and **B.G. Hopkins**. 2016. Comparing traditional soil extraction with ion exchange resin capsules for determining sulfur bioavailability in semiarid, low-fertility soils. *Soil Sci.* 181: 39-43. https://doi:10.1097/SS.0000000000000137

Jones, C.D., M.R. Stevens, V.D. Jolley, **B.G. Hopkins**, S.L. Jensen, D. Turner, and J.M. Stettler. 2016. Evaluation of thermal, chemical, and mechanical seed scarification methods for four Great Basin lupine species. *Native Plants J.* 1: 5-18. https://doi:10.3368/npj.17.1.5

Katseanes, C.K., M.A. Chappell, **B.G. Hopkins**, B.D. Durham, C.L. Price, B.E. Porter, and L.F. Miller. 2016. Multivariate functions for predicting the sorption of 2, 4, 6-trinitrotoluene (TNT) and 1,3,5-trinitro-1,3,5-tricyclohexane (RDX) among taxonomically distinct soils. *J. Environ. Manage.* 182: 101–110. https://doi:org/10.1016/j.jenvman.2016.07.043

LeMonte, J.J., V.D. Jolley, J.S.C. Summerhays, R.E. Terry, and **B.G. Hopkins**. 2016. Polymer coated urea in turfgrass maintains vigor and mitigates nitrogen's environmental impacts. *PLOS ONE* 11: e0146761. https://doi:10.1371/journal.pone.0146761

Geary, B.D., J. Clark, **B.G. Hopkins**, and V.D. Jolley. 2015. Deficient, adequate and excess nitrogen levels established in hydroponics for biotic and abiotic stress-interaction studies in potato. *J. Plant Nutr*. 38: 41–50. https://doi:10.1080/01904167.2014.912323

Hill, M.W., **B.G. Hopkins**, and V.D. Jolley. 2015. Maize in-season growth response to organic acid-bonded phosphorus fertilizer (Carbond P®). *J. Plant Nutr.* 38:1398-1415. (*Online first*). https://doi:10.1080/01904167.2014.973040.

Hill, M.W., **B.G. Hopkins**, V.D. Jolley, and B.L. Webb. 2015. Phosphorus mobility through soil increased with organic acid-bonded phosphorus fertilizer (Carbond® P). *J. Plant Nutr.* 38: 1416-1426. https://doi:10.1080/01904167.2014.973041.

Madsen, M.D., D.L. Zvirzdin, S.L. Petersen, **B.G. Hopkins**, and B.A. Roundy. 2015. Anchor chaining's influence on soil hydrology and seeding success in burned piñon-juniper woodlands. *Rangeland Ecol. Manage.* 68: 231-240. https://doi:10.1016/j.rama.2015.03.010

Stark, J.C. and **B.G. Hopkins**. 2015. Fall and spring phosphorus fertilization of potato using a dicarboxylic acid polymer (AVAIL®). *J. Plant Nutr.* 38: 1595-1610. (*Online first*). https://doi:10.1080/01904167.2014.983124.

Summerhays, J.S.C., **B.G. Hopkins**, V.D. Jolley, M.W. Hill, C.J. Ransom, and T.R. Brown. 2015. Enhanced phosphorus fertilizer (Carbond P®) supplied to maize in moderate and high organic matter soils. *J. Plant Nutr.* 38: 1359-1371. https://doi:10.1080/01904167.2014.973039.

Hopkins, B.G., D.A. Horneck, and A.E. MacGuidwin. 2014. Improving phosphorus use efficiency through potato rhizosphere modification and extension. *Am. J. Potato Res.* 91: 161-174. https://doi:10.1007/s12230-014-9370-3.

Hopkins, B.G. 2013. Russet Burbank potato phosphorus fertilization with dicarboxylic acid copolymer additive (AVAIL®). *J. Plant Nutr.* 36: 1287-1306. https://doi:10.1080/01904167.2013.785565

Jones, M.P., B.L. Webb, V.D. Jolley, **B.G. Hopkins**, and D.A. Cook. 2013. Evaluating nutrient availability in semi-arid soils with resin capsules and conventional soil tests, I. Native plant bioavailability under glasshouse conditions. *Commun. Soil Sci. Plant Anal.* 44: 971-986. https://doi:10.1080/00103624.2012.747609

Jones, M.P., B.L. Webb, V.D. Jolley, M.D. Vickory, R.L. Buck, and **B.G. Hopkins**. 2013. Evaluating nutrient availability in semi-arid soils with resin capsules and conventional soil tests. II. Field studies. *Commun. Soil Sci. Plant Anal.* 44: 1764-1775. https://doi:10.1080/00103624.2013.769564

Madsen, M.D., E.G. Coronel, and **B.G. Hopkins**. 2013. Soil surfactant products for improving hydrologic function in post-fire water-repellent soil. *Soil Sci. Soc. Am. J.* 77: 1825-1830. https://doi:10.2136/sssaj2012.0305

Buxton, E.A., **B.G. Hopkins**, V.D. Jolley, B.L. Webb, and R.C. Christensen. 2012. Iron efficiency in Kentucky bluegrass not related to phytosiderophore release. *J. Plant Nutr.* 35: 311-329. https://doi:10.1080/01904167.2012.636133

Christensen, R.C., **B.G. Hopkins**, V.D. Jolley, K.M. Olson, C.M. Haskell, N.J. Chariton, and B.L. Webb. 2012. Elemental sulfur impregnated with iron as a fertilizer source for Kentucky bluegrass. *J. Plant Nutr.* 35: 1878-1895. https://doi:10.1080/01904167.2012.706684

Madsen, M.D., S.L. Petersen, K.J. Fernelius, B.A. Roundy, A.G. Taylor, and **B.G. Hopkins**. 2012. Influence of soil water repellency on seedling emergence and plant survival in a burned semi-arid woodland. *Arid Land Res. Manag.* 26: 236-249. https://doi:10.1080/15324982.2012.680655

Madsen, M.D., S.L. Petersen, B.A. Roundy, A.G. Taylor, and **B.G. Hopkins**. 2012. Comparison of postfire soil water repellency amelioration strategies on bluebunch wheatgrass and cheatgrass survival. *Rangeland Ecol. Manage.* 65: 182-188. https://doi:10.2111/REM-D-10-00152.1

Nichols, B.A., **B.G. Hopkins**, V.D. Jolley, B.L. Webb, B.G. Greenwood, and J.R. Buck. 2012. Phosphorus and zinc interactions and their relationships with other nutrients in maize grown in chelator-buffered nutrient solution. *J. Plant Nutr.* 35: 123-141. https://doi:10.1080/01904167.2012.631672

Barben, S.A., **B.G. Hopkins**, V.D. Jolley, B.L. Webb, B.A. Nichols, and E.A. Buxton. 2011. Zinc, manganese and phosphorus interrelationships and their effects on iron and copper in chelator-buffered solution grown Russet Burbank potato. *J. Plant Nutr.* 34: 1144-1163. https://doi:10.1080/01904167.2011.558158

Madsen, M.D., D.L. Zvirzdin, S.L. Petersen, **B.G. Hopkins**, B.A. Roundy, and D.G. Chandler. 2011. Soil water repellency within a burned piñon-juniper woodland: Spatial distribution, severity, and ecohydrologic implications. *Soil Sci. Soc. Am. J.* 75: 1543-1553. https://doi:10.2136/sssaj2010.0320.

Barben, S.A., **B.G. Hopkins**, V.D. Jolley, B.L. Webb, and B.A. Nichols. 2010. Optimizing phosphorus and zinc concentrations in hydroponic chelator-buffered nutrient solution for Russet Burbank potato. *J. Plant Nutr.* 33: 557-570. https://doi:10.1080/01904160903506282

Barben, S.A., **B.G. Hopkins**, V.D. Jolley, B.L. Webb, and B.A. Nichols. 2010. Phosphorus and manganese interactions and their relationships with zinc in chelator-buffered solution grown Russet Burbank potato. *J. Plant Nutr.* 33: 752-769. https://doi:10.1080/01904160903575964

Barben, S.A., **B.G. Hopkins**, V.D. Jolley, B.L. Webb, and B.A. Nichols. 2010. Phosphorus and zinc interactions in chelator-buffered solution grown Russet Burbank potato. *J. Plant Nutr.* 33: 587-601. https://doi:10.1080/01904160903506308

Hopkins, B.G., J.W. Ellsworth, T.R. Bowen, A.G. Cook, S.C. Stephens, V.D. Jolley, A.K. Shiffler, and D.L. Eggett. 2010. Phosphorus fertilizer timing for Russet Burbank potato grown in calcareous soil. *J. Plant Nutr.* 33: 529-540. https://doi:10.1080/01904160903506266

Hopkins, B.G., J.W. Ellsworth, A.K. Shiffler, T.R. Bowen, and A.G. Cook. 2010. Pre-plant versus in-season application of phosphorus fertilizer for Russet Burbank potato grown in calcareous soil. *J. Plant Nutr.* 33: 1026-1039. https://doi:10.1080/01904161003728693

Hopkins, B.G., J.W. Ellsworth, A.K. Shiffler, A.G. Cook, and T.R. Bowen. 2010. Monopotassium phosphate as an in-season fertigation option for potato. *J. Plant Nutr.* 33: 1422-1434. https://doi:10.1080/01904167.2010.489981

Hopkins, B.G., V.D. Jolley, B.L. Webb, and R.K. Callahan. 2010. Boron fertilization and evaluation of four soil extractants: Russet Burbank potato. *Commun. Soil Sci. Plant Anal.* 41: 527-539. https://doi:10.1080/00103620903527928

Benson, J.H., B.D. Geary, J.S. Miller, **B.G. Hopkins**, V.D. Jolley, and M.R. Stevens. 2009. *Phytophthora erythroseptica* (Pink Rot) development in Russet Norkotah potato grown in buffered hydroponic solutions II. pH effects. *Am. J. Potato Res.* 86: 472-475. https://doi:10.1007/s12230-009-9102-2

Benson, J.H., B.D. Geary, J.S. Miller, V.D. Jolley, **B.G. Hopkins**, and M.R. Stevens. 2009. *Phytophthora erythroseptica* (pink rot) development in Russet Norkotah potato grown in buffered hydroponic solutions I. Calcium nutrition effects. *Am. J. Potato Res.* 86: 466-471. https://doi:10.1007/s12230-009-9101-3

Hopkins, B.G., C.J. Rosen, A.K. Shiffler, and T.W. Taysom. 2008. Enhanced efficiency fertilizers for improved nutrient management: potato (*Solanum tuberosum*). *Crop Manag.* http://www.plantmanagementnetwork.org/cm/element/cmsum2.asp?id=6920 https://doi:10.1094/CM-2008-0317-01-RV. *(Invited)*

Myers, P., C.S. McIntosh, P.E. Patterson, R.G. Taylor, and **B.G. Hopkins**. 2008. Optimal crop rotation of Idaho potatoes. *Am. J. Potato Res.*, 85: 183-197. https://doi:10.1007/s12230-008-9026-2

Hopkins, B.G., D.A. Horneck, M.J. Pavek, B.D. Geary, N.L. Olsen, J.W. Ellsworth, G.D. Newberry, J.S. Miller, R.E. Thornton, and G.W. Harding. 2007. Evaluation of potato production best management practices. *Am. J. Potato Res.* 84: 19-27.

Neufeld, J.D., S.J. Reddy, J.S. Miller, C.A. Shock, L. Jensen, N.L. Olsen, W.H. Bohl, **B.G. Hopkins,** and C.C. Shock. 2007. Rapid delivery of regional pest alerts using an interactive internet site. *J. Ext.* 45: 5IAW5. Available at: http://www.joe.org/joe/2007october/iw5.shtml

Stevens, W.B., A.D. Blaylock, J.M. Krall, **B.G. Hopkins**, and J.W. Ellsworth. 2007. Sugarbeet yield and nitrogen use efficiency with preplant broadcast, banded, or point-injected nitrogen application. *Agron. J.* 99: 1252-1259. https://doi:10.2134/agronj2006.0357

Hopkins, B.G., D.A. Whitney, R.E. Lamond, and V.D. Jolley. 1998. Phytosiderophore release by sorghum, wheat, and corn under zinc deficiency. *J. Plant Nutr*. 21: 2623-2637. https://doi:10.1080/01904169809365593

Hopkins, B.G., V.D. Jolley, and J.C. Brown. 1992. Differential response of Fe-inefficient muskmelon, tomato, and soybean to phytosiderophore released by Coker 227 oat. *J. Plant Nutr*. 15: 35-48. https://doi:10.1080/01904169209364300

Hopkins, B.G., V.D. Jolley, and J.C. Brown. 1992. Plant utilization of iron solubilized by oat phytosiderophore. *J. Plant Nutr*. 15: 1599-1612. https://doi:10.1080/01904169209364425

Hopkins, B.G., V.D. Jolley, and J.C. Brown. 1992. Variable inhibition of iron uptake by oat phytosiderophore in five soybean cultivars. *J. Plant Nutr*. 15: 125-135. https://doi:10.1080/01904169209364305

Brown, J.C., R.E. Terry, V.D. Jolley, and **B.G. Hopkins**. 1990. Reduction of iron (Fe^{3+} to Fe^{2+}) by tumorous crown gall cells of sunflower. *J. Plant Nutr*. 13:1513-1521. https://doi:10.1080/01904169009364172

EDITOR REVIEWED JOURNAL PUBLICATIONS- IN PRESS (*ALL INVITED*):

Hopkins, B.G., J.R. Lawley, and G.E. Cardon, (2022), Soil Testing: How Precise Is My Lab Data?. Crops & Soils Mag., 55: 46-49. https://doi.org/10.1002/crso.20224

Hopkins B.G. 2019. Phosphorus use in high yield cropping systems. *Better Crops* 103(1): 46-49. https://doi: doi.org/10.24047/BC103146.

Stark, J.C. and **B.G. Hopkins**. 2014. Potato response to phosphorous fertilizer using dicarboxylic acid polymer. *Better Crops* 97(3):7-10. Available at: www.ipni.net/publication/bettercrops.nsf/0/51EDF923029E733285257BD500550B8D/$FILE/BC%202013-3%20p7.pdf

Stark, J.C. and **B.G. Hopkins.** 2013. Potato response to phosphorus fertilizer using a dicarboxylic acid polymer. *Better Crops* 97:7-10.

Hopkins, B.G. and S.C. Stephens. 2008. Band placement critical to potato yield. *Fluid J.* 16(3):1-3. Available at: https://fluidfertilizer.org/wp-content/uploads/2016/05/ls08-a5.pdf

Ellsworth J.W. and **B.G. Hopkins**. 2006. Banded P increases sugarbeet yields. *Fluid J.* 14(1):14-16. Available at: https://fluidfertilizer.org/wp-content/uploads/2016/05/51P14-16.pdf

Hopkins, B.G. and J.W. Ellsworth. 2005. Starter applications of APP show positive response in sugarbeet trials. *Fluid J.* 13(2):20-23. Available at: https://fluidfertilizer.org/wp-content/uploads/2016/05/48P20-23.pdf

Stark, J.C. and **B.G. Hopkins**, 2004. Optimal nutrient levels required for high-yielding potatoes. *Fluid J.* 12(3):1-2. Available at: https://fluidfertilizer.org/wp-content/uploads/2016/05/46P20-22.pdf

BOOK CHAPTERS:

Wallace, V., M. Anderson, J. Bowers, J. Brosnan, J. Churchill, P. Coakley, L. DiVito, J. Driscoll, J. Gill, M. Goatley, N. Harryman, Z. S. Holm, **B.G. Hopkins**, J. Kruse, T. Leonard, B. Polimer, T. Van Loo, and K. Althouse. 2021. *In* S. Kingsbury and N. Weinstein *(ed.) Best Management Practices for the Sports Field Manager: A Professional Guide for Environmental Sports Field*

Management. Sports Turf Managers Association, Lawrence, KS. Available at: https://11luuvtufne6f2y33i1nvedi-wpengine.netdna-ssl.com/wp-content/uploads/2021/04/FINAL-National-BMPs.pdf

Woolley, E.A., R. Kerry, N.C. Hansen, and **B.G. Hopkins.** 2021. Variable rate irrigation: Investigating within zone variability. *Precision Agriculture '21 (*presented at the *13th European Conference on Precision Agriculture*; 19-22. July 2021; Budapest, Hungary.)

Hopkins B.G., Stark J.C., and Kelling K.A. 2020. Nutrient Management. *In* Stark J., Thornton M., Nolte P. *(ed) Potato Production Systems*. Ch. 8:155-202. New York, New York: Springer, Cham. DOI: https://doi.org/10.1007/978-3-030-39157-7_8 (ISBN978-3-030-39157-7)

Hopkins, B.G. 2020. Developments in the use of fertilizers. *In* Rengel, Z. *(ed.) Achieving Sustainable Crop Nutrition.* Ch. 19: 555-588. Cambridge, UK: Burleigh Dodds Science Publishing. *(ISBN: 978 1 78676 312 9; www.bdspublishing.com)*

Svedin, J.D., N.C. Hansen, R. Kerry, and **B.G. Hopkins.** 2019. A new approach for estimating and delineating within-field crop water stress zones with satellite imagery. *Precision Agriculture '19* (presented at the *12th European Conference on Precision Agriculture*; 8-11 July 2019; Montpellier,France.) pp. 687–693. https://doi.org/10.3920/978-90-8686-888-9_85

Hopkins, B.G. 2015. Phosphorus in plant nutrition. *In* D.J. Pilbeam and A.V. Barker (*ed.*) *Plant Nutrition Handbook.* 2nd ed., Ch. 3: 65-126. Boca Raton, FL: CRC Press, Taylor & Francis Group.

Hopkins, B.G. 2010. Rotations. *In* W.H. Bohl and S.B. Johnson (*ed.*) *Commercial Potato Production in North America*. Second Revision of American Potato Journal Supplement Volume 57 and USDA Handbook 267. Orono, ME: Potato Association of America. p. 34-35.

Hopkins, B.G. and J.C. Stark. 2010. Potato nutrition. *In* W.H. Bohl and S.B. Johnson (*ed.*) *Commercial Potato Production in North America*. Second Revision of American Potato Journal Supplement Volume 57 and USDA Handbook 267. Orono, ME: Potato Association of America. p. 57-62.

Hopkins, B.G. and R.E. Hirnyck. 2007. Organic potato production. *In* D.A. Johnson (*ed.*) *Potato Health Management*. Minneapolis, MN: American Phytopathological Society. Ch. 11: 101-108.

Miller, J.S. and **B.G. Hopkins**. 2007. Checklist for a holistic potato health management plan. *In* D.A. Johnson (*ed.*) *Potato Health Management*. Minneapolis, MN: American Phytopathological Society. Ch. 2: 7-10.

Thornton, M.K., J.C. Stark, **B.G. Hopkins**, and R.E. Thornton. 2007. Selecting and preparing the planting site. *In* D.A. Johnson (*ed.*) *Potato Health Management*. Minneapolis, MN: American Phytopathological Society. Ch. 5: 23-30.

Hansen, N.C., **B.G. Hopkins**, J.W. Ellsworth, and V.D. Jolley. 2006. Iron nutrition in field crops. *In* L.L. Barton and J. Abadia *(ed.) Iron Nutrition in Plants and Rhizospheric Microorganisms*. New York, NY: Springer Publishing. p. 21-53.

Schulte, E.E. and **B.G. Hopkins**. 1996. Estimation of soil organic matter by weight loss-on-ignition. *In* Magdoff et al. *(ed.) Soil Organic Matter: Analysis and Interpretation*. Madison, WI: SSSA Special Publication no. 46. p. 21-31.

THESIS AND DISSERTATION:

Wooley, E.A. 2020. Soil water dynamics within variable rate irrigation zones of winter wheat. M.S. thesis. Provo, UT: Brigham Young Univ.

Crosland, M.S. 2018. Landscape foundations: A practical & technical guide to landscape maintenance. Honors thesis. Provo, UT. Brigham Young Univ.

Svedin, J.D. 2018. Characterizing the spatial variation of crop water productivity for variable-rate irrigation management. M.S. thesis. Provo, UT: Brigham Young Univ.

Buss, J.C. 2016. Polymer coated urea in Kentucky bluegrass. M.S. thesis. Provo, UT. Brigham Young Univ.

Gervais, E.L. 2015. Evaluation of a combination approach to pedagogy in a soil science laboratory classroom and an environmental site assessment sample. M.S. thesis. Provo, UT. Brigham Young Univ.

Peacock, B.B. 2015. Nitrogen nutrition impact on incidence of *Rhizoctonia* infection on *Agrostis stolonifera*. Honors thesis. Provo, UT. Brigham Young Univ.

Taysom, T.W. 2015. Polymer coated urea in Russet Burbank potato production. M.S. thesis. Moscow, ID. Univ. Idaho.

Katseanes, C.K. 2014. Soil fertility status and degradation of 2, 4, 6-trinitrotoluene contaminated soils. M.S. thesis. Provo, UT. Brigham Young Univ.

Ransom, C.J. 2014. Nitrogen use efficiency of polymer-coated urea. M.S. thesis. Provo, UT. Brigham Young Univ.

Buck, R.L. 2013. Importance of placement depth in evaluating soil nitrogen, phosphorus, and sulfur using ion exchange resin capsules in semi-arid, low fertility soils. M.S. thesis. Provo, UT. Brigham Young Univ.

Blaser, G.E. 2012. Yield response and nitrogen use efficiency of potato following alfalfa and alfalfa-cereal rotation. Ph.D. dissertation. Moscow, ID. University of Idaho.

Hill, M.W. 2012. Improving phosphorus use efficiency through organically bonded phosphorus. M.S. thesis. Provo, UT. Brigham Young Univ.

Summerhays, J.S.C. 2012. Effectiveness of phosphorus fertilizers in hydroponics and glasshouse settings with moderate and high organic matter soils. M.S. thesis. Provo, UT. Brigham Young Univ.

LeMonte, J.J. 2011. Environmental implications of polymer coated urea. M.S. thesis. Provo, UT. Brigham Young Univ.

Nielson, P.A. 2010. Variable palatability of quaking aspen for large ungulate herbivores. M.S. thesis. Provo, UT. Brigham Young Univ.

Beckett, T. 2009. Reducing pesticide use with crop rotation. Honors thesis. Provo, UT. Brigham Young Univ.

Barben, S.A. 2008. Using a chelator-buffered nutrient system to study phosphorus, manganese and zinc interactions in Russet Burbank potato. M.S. thesis. Provo, UT. Brigham Young Univ.

Nichols, B.A. 2008. Phosphorus, zinc, and manganese interactions in hydroponically grown maize. Honors thesis. Provo, UT. Brigham Young Univ.

Hopkins, B.G. 1995. Zinc nutrition of sorghum in Kansas. Ph.D. dissertation. Manhattan, KS. Kansas State Univ.

Hopkins, B.G. 1991. Differential response of Fe-inefficient muskmelon, tomato, and soybean to phytosiderophore released by Coker 227 oat. M.S. thesis. Provo, UT. Brigham Young Univ.

PEER-REVIEWED BULLETINS:

Mikkelsen, R. and **B.G. Hopkins.** 2009. Fertilizer BMPs - fertilizer management practices for potato production in the Pacific Northwest. *International Plant Nutrition Institute (IPNI) Special Publication* as a series of Fertilizer BMP NRCS sponsored publications. Available at: http://www.ipni.net/bmp. *(Invited)*

Moore, A., J.C. Stark, B. Brown, and **B.G. Hopkins**. 2009. Southern Idaho fertilizer guide: Sugarbeets. CIS 1174. Moscow, ID: University of Idaho. Available at: http://www.cals.uidaho.edu/edComm/pdf/CIS/CIS1174.pdf.

Patterson, P.E., J.C. Stark, **B.G. Hopkins**, and W.H. Bohl. 2009. Maximum economic yield vs. maximum yield. *Spudvine*. Blackfoot, ID: University of Idaho. Available at: http://www.if.uidaho.edu/~bingham/spudvine.htm.

Hopkins, B.G., D.A. Horneck, R.G. Stevens, J.W. Ellsworth, and D.M. Sullivan. 2007. Managing irrigation water quality for crop production in the Pacific Northwest. PNW 597-E. Corvallis, OR: Oregon State University.

Horneck, D.A., J.W. Ellsworth, **B.G. Hopkins**, D.M. Sullivan, and R.G. Stevens. 2007. Managing salt affected soils for crop production. PNW 601-E. Corvallis, OR: Oregon State University.

Horneck, D.A., D. Wysocki, **B.G. Hopkins**, J. Hart, and R.G. Stevens. 2007. Acidifying soil for crop production: Inland Pacific Northwest. PNW 599-E. Corvallis, OR: Oregon State University.

Windes, J., P.E. Patterson, **B.G. Hopkins**, J.W. Ellsworth, B. Brown, K.M. Olson, and P. Dailey. 2007. Saving energy and fertilizer costs. CIS 1127. Moscow, ID: CALS UI.

Hopkins, B.G. 2005. Production efficiency - Cropping sequence and rotation: Impact on potato production and soil condition. *In* Craven et. al. (*eds*.) *Trade Adjustment Assistance for Idaho Fresh Potatoes – Technical Assistance Curriculum.* Moscow, ID: UI. p. 47-56. *(Invited)*

Patterson, P.E., B. Smathers, **B.G. Hopkins**, and K. Esplin. 2005. Trade adjustment assistance for Idaho fresh potatoes. Technical Assistance Curriculum. USDA Agreement No. 2001-49200-01259. Moscow, ID: UI. *(Invited)*

Stark, J.C., D.T. Westermann, and **B.G. Hopkins**. 2004. Nutrient management guidelines for Russet Burbank potatoes. BUL 840. CALS Moscow, ID: UI.

Hopkins, B.G., J.W. Ellsworth, and P.E. Patterson. 2003. Skyrocketing nitrogen prices and potato production. UI Agricultural Economics Extension Series no. 03-04. Moscow, ID. *(Invited)*

Hopkins, B.G. 2002. Early season plant nutrition. Self-Study ceu's. Certified Crop Advisor Program. Madison, WI: ASA-CSSA-SSSA. *(Invited)*

Hopkins, B.G. 2002. Plant analysis. Self-Study ceu's. Certified Crop Advisor Program. Madison, WI: ASA-CSSA-SSSA. *(Invited)*

Hopkins, B.G. 2002. Soil and yield variability: A primer. Self-Study ceu's. Certified Crop Advisor Program. Madison, WI: ASA-CSSA-SSSA. *(Invited)*

Hopkins, B.G. 2002. Yield mapping. Self-Study ceu's. Certified Crop Advisor Program. Madison, WI: ASA-CSSA-SSSA. *(Invited)*

Hopkins, B.G. 2001. Phosphorus and zinc interaction. From the Ground Up Agronomy News. Fort Collins, CO: Colorado State University Cooperative Extension. 21(6):15. *(Invited)*

Hopkins, B.G., D.A. Whitney, R.E. Lamond, V.L. Martin, and L.D. Maddux. 1994. Zinc fertilization of grain sorghum. *In* Kansas Fertilizer Research 1994, Agricultural Experiment Station Report of Progress 719. Manhattan, KS: Kansas State University. p. 107-109.

Hopkins, B.G., D.A. Whitney, and R.E. Lamond. 1993. Evaluation of grain sorghum and corn hybrids for zinc stress. *In* Kansas Fertilizer Research 1993, Agricultural Experiment Station Report of Progress 697. Manhattan, KS: Kansas State University. p. 114-116.

Hopkins, B.G., D.A. Whitney, and R.E. Lamond. 1993. Zinc fertilization of grain sorghum. *In* Kansas Fertilizer Research 1993, Agricultural Experiment Station Report of Progress 697. Manhattan, KS: Kansas State University. p. 112-113.

Hopkins, B.G., D.A. Whitney, and R.E. Lamond. 1992. Zinc fertilization of grain sorghum. *In* Kansas Fertilizer Research 1992, Agricultural Experiment Station Report of Progress 670. Manhattan, KS: Kansas State University. p. 121-123.

CONFERENCE PROCEEDINGS:

Kerry R., B.R. Ingram, K. Hammond, S. Shumate, D. Gunther, R. Jensen, S. Schill, N.C. Hansen, and **B.G. Hopkins.** 2022. Variable rate irrigation: Investigating within zone variability. *In Proceedings of the 15th International Conference on Precision Agriculture (ICPA)*; 26-29. June 2022; Minneapolis, MN.

Stapley, S.H., N.C. Hansen, M.A. Yost, E.A. Woolley, and **B.G. Hopkins.** 2022. Stacking nutrient 4Rs on potato and wheat. (poster presentation.) *In Proceedings of the Great Plains Soil Fertility Conference (GPSFC)*; 8-9 Mar. 2022; Denver, CO. Great Soil Fertility Conference. Available at: https://greatplainssoilfertility.org/proceedings/?action=abstract&id=8485&title=Stacking+Nutrient+4Rs+on+Potato+and+Wheat

Seely, C.J., B.T. Geary, and **B.G. Hopkins.** 2022. Microplastics: polymer coated fertilizers in urban landscapes. (poster presentation.) *In Proceedings of the Great Plains Soil Fertility Conference (GPSFC)*; 8-9 Mar. 2022; Denver, CO. Great Plains Soil Fertility Conference. Available at: https://greatplainssoilfertility.org/proceedings/?action=abstract&id=8483&title=Microplastics+in+Urban+Landscapes%3A+Polymer+Coated+Fertilizers

Lambert, A.M., D.L. Cole, S.M. Anderson, A. Haderlie, C.J. Seely, and **B.G. Hopkins**. 2022. A new hydroponic system for testing mineral nutrient deficiencies and its application to soybeans. (poster presentation.) *In Proceedings of the Great Plains Soil Fertility Conference (GPSFC)*; 8-9 Mar. 2022; Denver, CO. Great Soil Fertility Conference. Available at: https://greatplainssoilfertility.org/proceedings/?action=abstract&id=8486&title=A+New+Hydroponic+System+for+Testing+Mineral+Nutrient+Deficiencies+and+It%27s+Application+to+Soybeans

Ioannou, J.D., E.A. Woolley, and **B.G. Hopkins.** 2022. Homogenous boron-potassium fertilizer: Plant uptake. (poster presentation.) *In Proceedings of the Great Plains Soil Fertility Conference (GPSFC)*; 8-9 Mar. 2022; Denver, CO. Great Soil Fertility Conference. Available at: https://greatplainssoilfertility.org/proceedings/?action=abstract&id=8484&title=Nutrient+Distribution+and+Uptake%3A+Homogeneous+Vs.+Heterogeneous+Fertilizer+Blends

Hopkins, B.G., J.R. Lawley, and G.E. Cardon. 2022. Soil test methods accuracy and precision comparison: Historical north American proficiency testing (NAPT) program results. (poster presentation.) *In Proceedings of the Great Plains Soil Fertility Conference (GPSFC)*; 8-9 Mar. 2022; Denver, CO. Great Plains Soil Fertility Conference. Available at: https://greatplainssoilfertility.org/proceedings/?action=abstract&id=8477&title=Soil+Analysis+Methods+Accuracy+and+Precision+Comparison%3A+Historical+North+American+Proficiency+Testing+%28NAPT%29+Program+Results

Geary, B.T., C.J. Seely, and **B.G. Hopkins**. 2022. Microplastics in sweet corn: Polymer coated fertilizers. (poster presentation.) *In Proceedings of the Great Plains Soil Fertility Conference (GPSFC)*; 8-9 Mar. 2022; Denver, CO. Great Soil Fertility Conference. Available at: https://greatplainssoilfertility.org/proceedings/?action=abstract&id=8482&title=Microplastics+in+Sweet+Corn%3A+Polymer+Coated+Fertilizers

Woolley, E.A., R. Kerry, N.C. Hansen, and **B.G. Hopkins.** 2021. Variable rate irrigation: Investigating within zone variability. *In Proceedings of the 13th European Conference on Precision Agriculture (ECPA)*; 19-22. July 2021; Budapest, Hungary.

Fahning, S.R. and **B.G. Hopkins.** 2020. Enhanced efficiency nitrogen fertilizer: Coated urea. (Poster presentation.) *In Proceedings of the Great Plains Soil Fertility Conference (GPSFC)*; 10-11 Mar. 2020; Denver, CO. Great Soil Fertility Conference. 18:147-152. Available at: https://greatplainssoilfertility.org/files/FINAL2020GPSFCProceedings.pdf

Kobza, S.J. and **B.G. Hopkins.** 2020. Enhanced efficiency phosphorus fertilizers. (Poster presentation.) *In Proceedings of the Great Plains Soil Fertility Conference (GPSFC);* 10-11 Mar. 2020; Denver, CO. Great Soil Fertility Conference. 18:190-195. Available at: https://greatplainssoilfertility.org/files/FINAL2020GPSFCProceedings.pdf

Carlock, E.T., A.M. Weigel, T.G. Searle, T.J. Hopkins, J.D. Williams, and **B.G. Hopkins**. 2019. Polymer coated urea and urea blends on potato. (Poster and oral presentation.) *In Proceedings of the Western Nutrient Management Conference (WNMC);* 7-8 Mar. 2019; Reno, NV. Peachtree Corners, GA: International Plant Nutrition Institute (IPNI). 13:63-71.

Cole, D.L., R.K. Woolley, R.L. Buck, and **B.G. Hopkins.** 2019. New hydroponic system for testing mineral nutrient deficiencies and its application to quinoa. (Poster and oral presentation.) *In Proceedings of the Western Nutrient Management Conference (WNMC);* 7-8 Mar. 2019; Reno, NV. Peachtree Corners, GA: International Plant Nutrition Institute (IPNI).

Fahning, S.R., T.G. Searle, A.M. Weigel, R.L. Buck, T.J. Hopkins, and **B.G. Hopkins.** 2019. Polymer coated urea impact on barley yield and protein. (Poster and oral presentation.) *In Proceedings of the Western Nutrient Management Conference (WNMC);* 7-8 Mar. 2019; Reno, NV. Peachtree Corners, GA: International Plant Nutrition Institute (IPNI). 13:72-77. Available at: https://scisoc.confex.com/scisoc/2019am/meetingapp.cgi/Paper/118749

Fisher, J., E.A. Woolley, J.D. Svedin, and **B.G. Hopkins.** 2019. Struvite phosphorous fertilizer on sugar beet. (Poster and oral presentation.) *In Proceedings of the Western Nutrient Management Conference (WNMC);* 7-8 Mar. 2019; Reno, NV. Peachtree Corners, GA: International Plant Nutrition Institute (IPNI). 13:78-85

Hopkins, A.P., C.S. Campbell, **B.G. Hopkins,** and N.C. Hansen. 2019. Water and nitrogen interactions in Kentucky bluegrass. (Poster and oral presentation.) *In Proceedings of the Western Nutrient Management Conference (WNMC);* 7-8 Mar. 2019; Reno, NV. Peachtree Corners, GA: International Plant Nutrition Institute (IPNI). 13:87-95.

Norris, A.J. and **B.G. Hopkins.** 2019. Source and rate interactions for enhanced efficiency phosphorus fertilizers. (Poster and oral presentation.) *In Proceedings of the Western Nutrient Management Conference (WNMC);* 7-8 Mar. 2019; Reno, NV. Peachtree Corners, GA: International Plant Nutrition Institute (IPNI). 13:97-102.

Stapley, S.H., J.C. Buss, and **B.G. Hopkins.** 2019. Polymer coated urea in Kentucky bluegrass. (Poster and oral presentation.) *In Proceedings of the Western Nutrient Management Conference (WNMC);* 7-8 Mar. 2019; Reno, NV. Peachtree Corners, GA: International Plant Nutrition Institute (IPNI). 13:104-113.

Valencia, M.C., S.V. Nelson, and **B.G. Hopkins.** 2019. Phosphorus fertilizer and hydrogel for rangeland seeding. (Poster and oral presentation.) *In Proceedings of the Western Nutrient Management Conference (WNMC);* 7-8 Mar. 2019; Reno, NV. Peachtree Corners, GA: International Plant Nutrition Institute (IPNI). 13:114-117.

Woolley, E.A., T.G. Searle, T.J. Hopkins, J.D. Williams, and **B.G. Hopkins.** 2019. Boron fertilization with Aspire® in alfalfa and potato. (Poster and oral presentation.) *In Proceedings of the Western Nutrient Management Conference (WNMC);* 7-8 Mar. 2019; Reno, NV. Peachtree Corners, GA: International Plant Nutrition Institute (IPNI). 13:118-126

Woolley, R.K., J.D. Svedin, E.A. Woolley, and **B.G. Hopkins.** 2019. Struvite phosphorus fertilizer on potato. (Poster and oral presentation.) *In Proceedings of the Western Nutrient Management Conference (WNMC);* 7-8 Mar. 2019; Reno, NV. Peachtree Corners, GA: International Plant Nutrition Institute (IPNI). 13:127-137.

Campbell C.S., A. Campbell, N.C. Hansen, **B.G. Hopkins,** S.R. Evans, E. Campbell, and D.R. Cobos. 2017. Comparing in situ soil water characteristic curves to those generated in the lab. (Oral presentation.) *Second Pan-American Conference on Unsaturated Soils*; 12-15 Nov. 2017; Dallas, TX. Reston, VA; ASCE Publishing.

Bartholomew S., T.J. Hopkins, and **B.G. Hopkins.** 2017. Polymer coated urea: Meeting plant needs while mitigating environmental impacts – research summary. (Poster presentation.) *In Proceedings*

of the Western Nutrient Management Conference (WNMC); 2-3 Mar. 2017; Reno, NV. 12:181-190. Peachtree Corners, GA: International Plant Nutrition Institute (IPNI). Available at: http://www.ipni.net/ipniweb/conference/wnmc.nsf/e0f085ed5f091b1b852579000057902e/ccbc3bfdb684ebee852580e400519374/$FILE/17WNMC%20Bartholomew%20pg181.pdf

Hopkins, B.G. and J.D. Svedin. 2017. Soil fertility and plant nutrition 101. (Oral presentation.) *49th Annual Idaho Potato Conference and 38th Ag Expo*; 18 - 19 Jan. *2017;* Pocatello, ID. Pocatello, ID*:* University of Idaho Extension Program.

Hopkins, B.G., J.D. Svedin, and R.C. Christensen. 2017. On farm fertilizer management: Case studies. (Oral presentation.) *49th Annual Idaho Potato Conference and 38th Ag Expo*; 18 - 19 Jan. *2017;* Pocatello, ID. Pocatello, ID*:* University of Idaho Extension Program.

Hopkins, B.G. and N.C. Hansen. 2017. Nitrogen and water interactions: Crop production systems case studies. (Poster and oral presentation.) *In Proceedings of the Western Nutrient Management Conference (WNMC);* 2-3 Mar. 2017; Reno, NV. 12:22-27. WERA-103; USDA-NIFA; Peachtree Corners, GA: International Plant Nutrition Institute (IPNI). Available at: http://www.ipni.net/ipniweb/conference/wnmc.nsf/e0f085ed5f091b1b852579000057902e/ccbc3bfdb684ebee852580e400519374/$FILE/17WNMC%20Hopkins%20pg22.pdf)

Russell K.A., A.P. Hopkins, N.C. Hansen, and **B.G. Hopkins**. 2017. Nitrogen and irrigation water interactions in drought stressed Kentucky bluegrass. (Oral presentation.) *In Proceedings of the Western Nutrient Management Conference (WNMC);* 2-3 Mar. 2017; Reno, NV. 12:172-180. Peachtree Corners, GA: International Plant Nutrition Institute (IPNI). Available at: http://www.ipni.net/ipniweb/conference/wnmc.nsf/e0f085ed5f091b1b852579000057902e/ccbc3bfdb684ebee852580e400519374/$FILE/17WNMC%20Hopkins%20pg172.pdf

Shipp E., T.J. Hopkins, and **B.G. Hopkins.** 2017. Improving phosphorus use efficiency: Right rate, timing, and placement and enhanced efficiency fertilizer sources: Research summary. (Poster presentation.) *In Proceedings of the Western Nutrient Management Conference (WNMC);* 2-3 Mar. 2017; Reno, NV. 12:164-171. Peachtree Corners, GA: International Plant Nutrition Institute (IPNI). Available at: http://www.ipni.net/ipniweb/conference/wnmc.nsf/e0f085ed5f091b1b852579000057902e/ccbc3bfdb684ebee852580e400519374/$FILE/17WNMC%20Shipp%20pg164.pdf

Svedin J.D., N.C. Hansen, R. Kerry, R.C. Christensen, and **B.G. Hopkins.** 2017. Creating prescription variable rate irrigation and fertilization zones: Water and nutrient management interactions. (Poster presentation.) *In Proceedings of the Western Nutrient Management Conference (WNMC);* 2-3 Mar. 2017; Reno, NV. 12:156-163. Peachtree Corners, GA: International Plant Nutrition Institute (IPNI). Available at: http://www.ipni.net/ipniweb/conference/wnmc.nsf/e0f085ed5f091b1b852579000057902e/ccbc3bfdb684ebee852580e400519374/$FILE/17WNMC%20Svedin%20pg156.pdf

Hopkins, B.G. 2016. Polymer coated urea: Mitigating nitrogen loss to the environment. (Poster and oral presentation.) *International Nitrogen Initiative Conference*; 4 Dec. 2016; Melbourne, Australia. Available at: www.ini2016.com/pdf-papers/INI2016_Hopkins_Bryan.pdf

Black, B., B. Neville, C. Ewell, B.D. Geary, and **B.G. Hopkins.** 2015. Nitrogen nutrition impact on incidence of *Rhizoctonia* infection of *Agrostis stolonifera.* (Poster presentation.) *In Proceedings of the Western Nutrient Management Conference (WNMC);* 5-6 Mar. 2015; Reno, NV. 11:112-116. Peachtree Corners, GA: International Plant Nutrition Institute (IPNI). Available at: http://www.ipni.net/ipniweb/conference/wnmc.nsf/e0f085ed5f091b1b852579000057902e/4be3031d1d87927a85257e37004fa7a8/$FILE/WNMC2015%20Neville%20pg112.pdf

Blair, T.A., C.J. Ransom, P. Hosford, J.D. Svedin, L.E. Sutton, A.M. Winchester, K. Manning, T.J. Hopkins, and **B.G. Hopkins**. 2015. Phosphorus and organic acid bonding impacts at varying soil pH.

(Poster presentation.) *In Proceedings of the Western Nutrient Management Conference (WNMC);* 5-6 Mar. 2015; Reno, NV. 11:90-93. Peachtree Corners, GA: International Plant Nutrition Institute (IPNI). Available at: http://www.ipni.net/ipniweb/conference/wnmc.nsf/e0f085ed5f091b1b852579000057902e/4be3031d1d87927a85257e37004fa7a8/$FILE/WNMC2015%20Blair%20pg90.pdf

Blair, T.A., J.D. Selman, C.J. Ransom, T.J. Hopkins, and **B.G. Hopkins.** 2015. Phosphorus and organic acid bonding enhances uptake efficiency and yield response in crop plants. (Poster presentation.) *In Proceedings of the Western Nutrient Management Conference (WNMC);* 5-6 Mar. 2015; Reno, NV. 11:142-145. Peachtree Corners, GA: International Plant Nutrition Institute (IPNI). Available at: http://www.ipni.net/ipniweb/conference/wnmc.nsf/e0f085ed5f091b1b852579000057902e/4be3031d1d87927a85257e37004fa7a8/$FILE/WNMC2015%20Selman%20pg142.pdf

Buss, J.C., J.H. Gish, and **B.G. Hopkins.** 2015. Minimizing nitrogen inputs while optimizing verdure and growth of Kentucky bluegrass with polymer coated urea. (Poster presentation.) *In Proceedings of the Western Nutrient Management Conference (WNMC);* 5-6 Mar. 2015; Reno, NV. 11:94-99. Peachtree Corners, GA: International Plant Nutrition Institute (IPNI). Available at: http://www.ipni.net/ipniweb/conference/wnmc.nsf/e0f085ed5f091b1b852579000057902e/4be3031d1d87927a85257e37004fa7a8/$FILE/WNMC2015%20Buss%20pg94.pdf

Carroll, A., C. Lindsey, J. Baker, and **B.G. Hopkins.** 2015. Drought and nitrogen stress effects on maize canopy temperature. *In Proc. of the Western Nutrient Management Conf.;* 5-6 March 2015; Reno, NV. 11:84-89. Available at: http://www.ipni.net/ipniweb/conference/wnmc.nsf/e0f085ed5f091b1b852579000057902e/4be3031d1d87927a85257e37004fa7a8/$FILE/WNMC2015%20Baker%20pg84.pdf

Fernelius, K.J., M.D. Madsen, K.A. Russell, B.A. Roundy, and **B.G. Hopkins.** 2015. Effects of post-fire soil hydrophobicity on inorganic soil nitrogen and sulfur cycling. (Poster presentation.) *In Proceedings of the Western Nutrient Management Conference (WNMC);* 5-6 Mar. 2015; Reno, NV. 11:129-135. Peachtree Corners, GA: International Plant Nutrition Institute (IPNI). Available at: http://www.ipni.net/ipniweb/conference/wnmc.nsf/e0f085ed5f091b1b852579000057902e/4be3031d1d87927a85257e37004fa7a8/$FILE/WNMC2015%20Russell%20pg129.pdf

Fernelius, K.J., M.M.E. Pryor, and **B.G. Hopkins.** 2015. Summarization of 471 field comparisons of AVAIL. (Poster presentation.) *In Proceedings of the Western Nutrient Management Conference (WNMC);* 5-6 Mar. 2015; Reno, NV. 11:123-128. Peachtree Corners, GA: International Plant Nutrition Institute (IPNI). Available at: http://www.ipni.net/ipniweb/conference/wnmc.nsf/e0f085ed5f091b1b852579000057902e/4be3031d1d87927a85257e37004fa7a8/$FILE/WNMC2015%20Pryor%20pg123.pdf

Hopkins, B.G. and J.C. Stark. 2015. Nitrogen cycling and fertilization in legume inclusive cropping systems. (Oral presentation.) *In Proceedings of the Western Nutrient Management Conference (WNMC);* 5-6 Mar. 2015; Reno, NV. 11:50-55. Peachtree Corners, GA: International Plant Nutrition Institute (IPNI). Available at: http://www.ipni.net/ipniweb/conference/wnmc.nsf/e0f085ed5f091b1b852579000057902e/4be3031d1d87927a85257e37004fa7a8/$FILE/WNMC2015%20Hopkins%20pg50.pdf

Ransom, C.J., M.J. Ruth, T. Blair, L.E. Sutton, D. Bradshaw, K. Campbell, and **B.G. Hopkins**. 2015. Turf response to reduced rates of polymer-coated urea. (Poster presentation.) *In Proceedings of the Western Nutrient Management Conference (WNMC);* 5-6 Mar. 2015; Reno, NV. 11:136-141. Peachtree Corners, GA: International Plant Nutrition Institute (IPNI). Available at: http://www.ipni.net/ipniweb/conference/wnmc.nsf/e0f085ed5f091b1b852579000057902e/4be3031d1d87927a85257e37004fa7a8/$FILE/WNMC2015%20Ruth%20pg136.pdf

Svedin J.D., C.J. Ransom, J.C. Buss, T.A. Blair, and **B.G. Hopkins**. 2015. Evaluation of nitrogen gas loss from polymer coated and polymer sulfur coated urea. (Poster presentation.) *In Proceedings of the Western Nutrient Management Conference (WNMC);* 5-6 Mar. 2015; Reno, NV. 11:157-162. Peachtree Corners, GA: International Plant Nutrition Institute (IPNI). Available at: http://www.ipni.net/ipniweb/conference/wnmc.nsf/e0f085ed5f091b1b852579000057902e/4be3031d1d87927a85257e37004fa7a8/$FILE/WNMC2015%20Svedin%20pg157.pdf

Blair, T.A., M.W. Hill, **B.G. Hopkins,** and C.J. Ransom. 2013. Phosphorus and organic acid bonding enhances uptake efficiency in crop plants. (Poster presentation.) *In Proceedings of the Western Nutrient Management Conference (WNMC);* 7-8 Mar. 2013; Reno, NV. Brookings, SD: International Plant Nutrition Institute (IPNI).10:149.

Ransom, C.J., **B.G. Hopkins,** T.W. Taysom, and J.J. LeMonte. 2013. Polymer coated urea (ESN): Impacts on potato crop and N losses. (Poster presentation.) *In Proceedings of the Western Nutrient Management Conference (WNMC);* 7-8 Mar. 2013; Reno, NV. Brookings, SD: International Plant Nutrition Institute (IPNI).10:150.

Sutton, L.E., C.J. Ransom, **B.G. Hopkins,** T.A. Blair, J.J. Moody, K.E. Manning, and S.J. Bergsten. 2013. Polymer coated urea (Duration) in turfgrass: Impacts on mowing, visual, and loss to environment. (Poster presentation.) *In Proceedings of the Western Nutrient Management Conference (WNMC);* 7-8 Mar. 2013; Reno, NV. Brookings, SD: International Plant Nutrition Institute (IPNI). 10:151.

Ransom, C.J., M.W. Hill, and **B.G. Hopkins.** 2011. Improving phosphorus use efficiency with Carbond® P and dicarboxylic acid polymer (AVAIL®) fertilizer additives. (Poster presentation.) *In Proceedings of the Winter Commodity Schools. Idaho Potato Conference*; 18-20 Jan. 2011; Pocatello, ID. Moscow, ID: University of Idaho. 43:149-154. *(Invited)*

Hill, M.W., **B.G. Hopkins.** C.J. Ransom, and B.L. Webb. 2011. Improving phosphorus use efficiency with Carbond P. (Poster presentation.) *In Proceedings of the Western Nutrient Management Conference (WNMC);* 3-4 Mar. 2011; Reno, NV. Norcross, GA: International Plant Nutrition Institute (IPNI). 9:129-134.

Hopkins, B.G. 2011. Advances in nutrient use efficiency. (Oral presentation.) *In Proceedings of the Western Nutrient Management Conference (WNMC);* 3-4 Mar. 2011; Reno, NV. Norcross, GA: International Plant Nutrition Institute (IPNI).9:83-88.

LeMonte, J.J., **B.G. Hopkins,** J.S.C. Summerhays, and V.D. Jolley. 2011. Polymer coated urea: Impacts on air/water quality with surface application to permanent sod. (Poster presentation.) *In Proceedings of the Western Nutrient Management Conference (WNMC);* 3-4 Mar. 2011; Reno, NV. Norcross, GA: International Plant Nutrition Institute (IPNI).9:122-128.

Ransom, C.J. and **B.G. Hopkins.** 2011. Dicarboxylic acid polymer (AVAIL®) phosphorus fertilizer additive: Review. (Poster presentation.) *In Proceedings of the Western Nutrient Management Conference (WNMC);* 3-4 Mar. 2011; Reno, NV. Norcross, GA: International Plant Nutrition Institute (IPNI).9:135-140.

Geary, B.D., J.H. Benson, J. Miller, **B.G. Hopkins,** V.D. Jolley, and M.R. Stevens. 2010. Pink rot of potato, influence of pH and calcium on disease development. (Oral presentation.) *In Proceedings for the 2010 Southern Rocky Mountain Agricultural Conference;* 9-12 Feb. 2010; Monte Vista, CO. p. 18-22. Available at: http://www.colostate.edu/Depts/SLVRC/CROPWATER/proceedingsSRMAC10.pdf. *(Invited)*

Geary, B.D., **B.G. Hopkins,** V.D. Jolley, J.H. Benson, J.S. Miller, and M.R. Stevens. 2010. Nutrient and pathogen interactions in potato: impacts of pH and calcium on pink rot disease development. (Oral presentation.) *In Proceedings of the Winter Commodity Schools. Idaho Potato Conference;* 19-21 Jan. 2010; Pocatello, ID. Moscow, ID: University of Idaho. 42:141-149. *(Invited)*

Buxton, E.A., **B.G. Hopkins,** V.D. Jolley, and R.C. Christensen. 2009. Phytosiderophore exudation from the roots of iron stressed Kentucky bluegrass. (Poster presentation.) *In Proceedings of the Western Nutrient Management Conference (WNMC);* 4-5 Mar. 2009; Salt Lake City, UT. Norcross, GA: International Plant Nutrition Institute, 8:68-71. Available at: http://cropandsoil.oregonstate.edu/sites/default/files/WNMC09_Buxton_pg68.pdf.

Hopkins, B.G. 2009. Variable crop & fertilizer prices result in shifting optimal fertilizer rates: potato. (Oral presentation.) *In Proceedings of the Western Nutrient Management Conference (WNMC);* 4-5 Mar. 2009; Salt Lake City, UT. Norcross, GA: International Plant Nutrition Institute (IPNI).International Plant Nutrition Institute (IPNI).

Hopkins, B.G., J.C. Stark, and T.W. Taysom. 2009. Enhanced efficiency fertilizers for improved nutrient management of potatoes. (Oral presentation.) *In Proceedings of the Winter Commodity Schools. Idaho Potato Conference;* 20-21 Jan. 2009; Pocatello, ID. Moscow, ID: University of Idaho. 41:125-131. *(Invited)*

LeMonte, J.J., T.W. Taysom, **B.G. Hopkins,** V.D. Jolley, and B.L. Webb. 2009. Residual soil nitrate and potato yield with polymer coated urea. (Poster presentation.) *In Proceedings of the Western Nutrient Management Conference (WNMC);* 4-5 Mar. 2009; Salt Lake City, UT. Norcross, GA: International Plant Nutrition Institute (IPNI).8:77-81. Available at: http://cropandsoil.oregonstate.edu/sites/default/files/WNMC09_LeMonte_pg77.pdf. Oregon State University, Corvallis, OR.

Marcroft, K., R.C. Christensen**, B.G. Hopkins,** V.D. Jolley, and B.L. Webb. 2009. Elemental sulfur with iron: Kentucky bluegrass. (Poster presentation.) *In Proceedings of the Western Nutrient Management Conference (WNMC);* 4-5 Mar. 2009; Salt Lake City, UT. Norcross, GA: International Plant Nutrition Institute (IPNI). 8:56-61. Available at: http://cropandsoil.oregonstate.edu/sites/default/files/WNMC09_Mar.croft_pg56.pdf. Oregon State University, Corvallis, OR.

Pletsch, M.C., D.A. Cook, M. Vickery, B.L. Webb, V.D. Jolley, and **B.G. Hopkins.** 2009. Comparing nutrient availability in low fertility soils using ion exchange resin capsules and plant bioavailability under greenhouse conditions. (Poster presentation.) *In Proceedings of the Western Nutrient Management Conference (WNMC);* 4-5 Mar. 2009; Salt Lake City, UT. Brookings, SD: International Plant Nutrition Institute (IPNI). Oregon State University, Corvallis, OR. 8:72-76. Available at: http://cropandsoil.oregonstate.edu/sites/default/files/WNMC09_Pletsch_pg72.pdf.

Shiffler, A.K., **B.G. Hopkins,** P.J.S. Hutchinson, S.L. Hafez, N.L. Olsen, and T.G. Beckett. 2009. Long term impacts of short rotations. (Poster presentation.) *In Proceedings of the Winter Commodity Schools. Idaho Potato Conference;* 20-21 Jan. 2009; Pocatello, ID. Moscow, ID: University of Idaho. 41:81-89. *(Invited)*

Hopkins, B.G. and S.C. Stephens. 2008. Band placement for potatoes in calcareous soil. (Oral presentation.) *In* L. Murphy (*ed.*) *Fluid Forum Symp. Proceedings;* 17-19 Feb. 2008; Scottsdale, AZ. Manhattan, KS: Fluid Fertilizer Foundation. 25: 35-41. *(Invited)* Available at: https://fluidfertilizer.org/wp-content/uploads/2016/05/Bryan-Hopkins-1.pdfBarben, S.A., B.A. Nichols, **B.G. Hopkins,** V.D. Jolley, J.W. Ellsworth, and B.L. Webb. 2007. Phosphorus and zinc interaction in potato. (Poster presentation.) *In* J. Hart (*ed.*) *Western Nutrient Management Conference Proceedings;* 8-9 Mar. 2007; Salt Lake City, UT. WERA-103 subcommittee of CSREES-USDA, Corvallis, OR: Oregon State University Press. 7:219-223.

Hopkins, B.G., V.D. Jolley, B.L. Webb, J.W. Ellsworth, and R.K. Callahan. 2007. Boron fertilization in potato. (Poster presentation.) *In* J. Hart (*ed.*) *Western Nutrient Management Conference Proceedings;* 8-9 Mar. 2007; Salt Lake City, UT. WERA-103 subcommittee of CSREES-USDA, Corvallis, OR: Oregon State University Press. 7:215-218.

Hopkins, B.G. and S.C. Stephens. 2007. Starter band placement for potatoes in calcareous soil. (Oral presentation.) *In* L. Murphy (*ed.*) *Fluid Forum Proceedings;* 18-20 Feb. 2007; Scottsdale, AZ. Manhattan, KS: Fluid Fertilizer Foundation. 24: 47-54. *(Invited)*

Hopkins, B.G., S.C. Stephens, and A.K. Shiffler. 2007. Optical sensing for nitrogen management. (Oral presentation.) *In* J. Hart (*ed.*) *Western Nutrient Management Conference Proceedings;* 8-9 Mar. 2007; Salt Lake City, UT. WERA-103 subcommittee of CSREES-USDA, Corvallis, OR: Oregon State University Press. 7:98-105.

Taysom, T.W., **B.G. Hopkins,** A.K. Shiffler, and S.C. Stephens. 2007. Polymer coated urea in potato production. (Poster presentation.) *In* J. Hart (*ed.*) *Western Nutrient Management Conference Proceedings;* 8-9 Mar. 2007; Salt Lake City, UT. WERA-103 subcommittee of CSREES-USDA, Corvallis, OR: Oregon State University Press. 7:169-175.

Ellsworth, J.W. and **B.G. Hopkins.** 2006. Management of nitrogen with high fertilizer prices. (Oral presentation.) *In* J.W. Ellsworth *(ed.) Nutrient and Waste Management Conference Proceedings;* Twin Falls, ID. Moscow, ID: University of Idaho. *(Invited)*

Hopkins, B.G. 2006. Cutting edge fertilization technologies. (Oral presentation.) *Manitoba Potato Conference;* 25 Jan. 2006; Brandon, MB, Canada. *(Invited)*

Hopkins, B.G. 2006. Evaluation of "alternative products" in potato production. (Oral presentation.) *Manitoba Potato Conference;* 25 Jan. 2006; Brandon, MB, Canada. *(Invited)*

Hopkins, B.G. and J.W. Ellsworth. 2006. Starter band placement for potatoes in calcareous soil. (Oral presentation.) *In* L. Murphy *(ed.) Fluid Forum Proceedings*, 13 Feb. 2006; Scottsdale, AZ. Manhattan, KS: Fluid Fertilizer Foundation. 23:88-95. *(Invited)*

Hopkins, B.G. and J.W. Ellsworth. 2006. Cropping systems considerations in nutrient management. (Oral presentation.) *In* J.W. Ellsworth *(ed.) Nutrient and Waste Management Conference Proceedings;* Twin Falls, ID. Moscow, ID: University of Idaho. *(Invited)*

Bowen, T.R., **B.G. Hopkins**, J.W. Ellsworth, A.G. Cook, and S.A. Funk. 2005. In-season variable rate N in potato and barley production using optical sensing instrumentation. (Poster presentation.) *In* W.B. Stevens *(ed.) Western Nutrient Management Conference Proceedings;* 3 Mar. 2005; Salt Lake City, UT. Norcross, GA: Potash and Phosphate Institute. 6:141-148.

Cook, A.G., **B.G. Hopkins,** J.W. Ellsworth, T.R. Bowen, and S.A. Funk. 2005. Pre-season variable rate nitrogen in potatoes. (Poster presentation.) *In* W.B. Stevens *(ed.) Western Nutrient Management Conference Proceedings;* 3 Mar. 2005; Salt Lake City, UT. Norcross, GA: Potash and Phosphate Institute. 6:149-158.

Ellsworth, J.W. and **B.G. Hopkins.** 2005. The power of precision agriculture. (Oral presentation.) *In* K. Copeland et. al. *(eds.) Proceedings of the Winter Commodity Schools, Idaho Potato Conference;* Pocatello, ID. Moscow, ID: UI-Cooperative Extension System. 37:19-24.

Hopkins, B.G. and J.W. Ellsworth. 2005. Phosphorus availability with alkaline/calcareous soil. (Oral presentation.) *In* K. Copeland et. al. *(eds.) Proceedings of the Winter Commodity Schools, Idaho Potato Conference;* Pocatello, ID. Moscow, ID: UI-Cooperative Extension System. 37:9-18.

Hopkins, B.G. and J.W. Ellsworth. 2005. Phosphorus availability with alkaline/calcareous soil. (Oral presentation.) *In* W.B. Stevens *(ed.) Western Nutrient Management Conference Proceedings;* 4 Mar. 2005; Salt Lake City, UT. Salt Lake City, UT: Potash and Phosphate Institute. 6:88-93. *(Invited)*

Hopkins, B.G. and J.W. Ellsworth. 2005. Phosphorus placement for sugarbeets in calcareous soil. (Oral presentation.) *In* L. Murphy *(ed.) Fluid Forum Proceedings;* 15 Feb. 2005; Scottsdale, AZ. Manhattan, KS: Fluid Fertilizer Foundation. 22:22-28. (*Invited)*

Hopkins, B.G. and J.W. Ellsworth. 2005. Trace metal toxicity from manure in Idaho: emphasis on copper. (Oral presentation.) *In* K. Copeland et. al. *(eds.) Proceedings of the Winter Commodity*

Schools, Idaho Potato Conference; Pocatello, ID. Moscow, ID: UI-Cooperative Extension System. 37:25-36.

Hopkins, B.G., B.D. Geary, J.W. Ellsworth, N.L. Olsen, D.A. Horneck, M.J. Pavek, G.D. Newberry, and R.E. Thornton. 2005. Best management practices for potato production. (Oral presentation.) *In* A. Jensen *(ed.) Proceedings of the 44th Annual Washington State Potato Conference*, Washington State Potato Commission; 1-3 Feb. 2005; Moses Lake, WA. p. 31-34. *(Invited)*

Hopkins, B.G. and J.W. Ellsworth. 2004. Banded P placement for sugarbeets in calcareous soils. (Oral presentation.) *In* L. Murphy *(ed.) Fluid Forum Proceeding;* 24 Feb. 2004; Scottsdale, AZ. Manhattan, KS: Fluid Fertilizer Foundation. 21:101-106. *(Invited)*

Hopkins, B.G. and J.W. Ellsworth. 2004. Banded P placement for sugarbeets in calcareous soil. (Oral presentation.) *In* A. Schlegel *(ed.) 2004 Great Plains Soil Fertility Conference Proceedings;* 2 Mar. 2004; Denver, CO. Manhattan, KS: Kansas State University. p. 138-144. *(Invited)*

Hopkins, B.G. and J.W. Ellsworth. 2004. Banded P placement for sugarbeets in calcareous soil. (Oral presentation.) *In* K. Copeland et. al. *(eds.) Proceedings of the Winter Commodity Schools. Idaho Sugarbeet Conference;* Meridian, ID. Moscow, ID: UI-Cooperative Extension System. 36:215-222.

Hopkins, B.G., P.J.S. Hutchinson, P.E. Patterson, J.S. Miller, M.K. Thornton, S.L. Hafez, and J.M. Alvarez. 2004. Cropping sequence and rotation: impact on potato production and soil condition. (Oral presentation.) *In* K. Copeland et. al. *(eds.) Proceedings of the Winter Commodity Schools. Idaho Potato Conference;* Pocatello, ID. Moscow, ID: UI-Cooperative Extension System. 36:97-109.

Stark, J. C. and **B.G. Hopkins.** 2004. Meeting nutrient requirements of high yielding potato crops. (Oral presentation.) *In* L. Murphy *(ed.) Fluid Forum Proceedings;* 24 Feb. 2004; Scottsdale, AZ. Manhattan, KS: Fluid Fertilizer Foundations. 21:59-66. *(Invited)*

Thornton, M., B.G. Hopkins, and J. Stark. 2004. Influence of soil compaction and tillage on potato production. *Winter Commodity School Proceedings: Idaho Potato Conference.* 36: 79—81.

Hopkins, B.G. and J.W. Ellsworth. 2003. Phosphorus management in potato production. (Oral presentation.) *Potato Growers of Alberta Annual Conference;* 14 Nov. 2003; Banff Springs, AB, Canada. *(Invited)*

Hopkins, B.G. and J.W. Ellsworth. 2003. Phosphorus nutrition in potato production. (Oral presentation.) *In* L.D. Robertson et. al. *(eds.) Proceedings of the Winter Commodity Schools. Idaho Potato Conference;* Pocatello, ID. Moscow, ID: UI-Cooperative Extension System. 35:75-86.

Hopkins, B.G. and J.W. Ellsworth. 2003. Starter and deep banded P on sugarbeets in alkaline soil. (Oral presentation.) *In* L. Murphy *(ed.) Fluid Forum Proceedings;* 18 Feb. 2003; Scottsdale, AZ. Manhattan, KS: Fluid Fertilizer Foundation. 20:219-225. *(Invited)*

Hopkins, B.G. and J.C. Stark. 2003. Humic acid effects on potato response to phosphorus. (Oral presentation.) *In* L.D. Robertson et al.*(eds.) Proceedings of the Winter Commodity Schools. Idaho Potato Conference;* Pocatello, ID. Moscow, ID: UI-Cooperative Extension System. 35:87-92.

Hopkins, B.G., V.D. Jolley, D.A. Whitney, and R.E. Lamond. 2002. Zinc deficiency response of sorghum, wheat, and corn. (Poster presentation.) *North-Central Extension Industry Soil Fertility Conference;* 20-21 Nov. 2002; Des Moines, IA.

Hopkins, B.G. and H. Niebling. 2002. Irrigation scheduling tools. (Oral presentation.) *In* L.D. Robertson et al. *(eds.) Proceedings of the Winter Commodity Schools. Idaho Potato Conference;* Pocatello, ID. Moscow, ID: UI-Cooperative Extension System. 34:127-131.

Hopkins, B.G. 1998. Regulatory trends of concern for agronomists: keynote address. (Oral presentation.) *California Department of Agriculture Annual Fertilizer Conference;* 17 Nov. 1998; Fresno, CA. *(Invited)*

Hopkins, B.G. 1996. Agricultural waste analysis: art or science. (Oral presentation.) *Agricultural Testing Workshop*; 17-18 Oct. 1996; Denver, CO. Denver, CO: Colorado State University. *(Invited)*

Hopkins, B.G. and D.A. Whitney. 1995. Soil organic matter analysis. (Oral presentation.) *In* S.M. Combs *(ed.) Proc: Fourteenth Soil-Plant Analyst's Workshop. NCR-13 Soil and Plant Analysis Committee;* St. Louis, MO. *(Invited)*

Hopkins, B.G. 1994. Zinc fertilization of grain sorghum. (Oral presentation.) *Fertilizer and Ag-Chemical Conference;* 11-12 Jan. 1994; Salina, KS. *(Invited)*

Hopkins, B.G. and D.A. Whitney. 1993. Implementing loss-on-ignition for soil organic matter determination in a routine soil testing lab. (Oral presentation.) *In* S.M. Combs *(ed.) Proceedings: Thirteenth Soil-Plant Analyst's Workshop. NCR-13 Soil and Plant Analysis Committee;* St. Louis, MO.

Hopkins, B.G., V.D. Jolley, and J.C. Brown. 1991. Plant utilization of iron solubilized by oat phytosiderophore. (Oral presentation.) *In* G.W. Miller *(ed.) 6th International Iron Symposium*; 14-19 Jul. 1991; Utah State University; Logan, UT. p. 57.

PROFESSIONAL MEETING PRESENTATIONS WITH PUBLISHED ABSTRACTS:

Hopkins, B.G., G.E. Cardon, J.R. Lawley. 2021. Soil analysis methods accuracy and precision comparison: historical North American proficiency testing (NAPT) Program Results. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 7-10 Nov. 2021; Salt Lake City, UT. Madison, WI: ASA-CSSA-SSSA. Avaliable at: https://scisoc.confex.com/scisoc/2021am/meetingapp.cgi/Paper/134465

Stapley, S.H., N.C. Hansen, M. Yost, E.A. Woolley, and **B.G. Hopkins**, 2021. Stacking nutrient 4Rs on potato and wheat. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 7-10 Nov. 2021; Salt Lake City, UT. Madison, WI: ASA-CSSA-SSSA. Avaliable at: https://scisoc.confex.com/scisoc/2021am/meetingapp.cgi/Paper/135280

Kerry, R., B. Ingram, K. Hammond, S. Schill, D. Gunther, R. Jensen, L.Y. Lee, C.Y. Golden, **B.G. Hopkins**, and N.C. Hansen. 2021. Spatial analysis of soil moisture and turfgrass health to determine zones for spatially variable irrigation management. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 7-10 Nov. 2021; Salt Lake City, UT. Madison, WI: ASA-CSSA-SSSA. Avaliable at: https://scisoc.confex.com/scisoc/2021am/meetingapp.cgi/Paper/134769

Binns, N., and **B.G. Hopkins**, 2021. Potato phosphorus fertilizer calibration: First project. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 7-10 Nov. 2021; Salt Lake City, UT. Madison, WI: ASA-CSSA-SSSA. Avaliable at: https://scisoc.confex.com/scisoc/2021am/meetingapp.cgi/Paper/135675

Loannou, J., T.J. Hopkins, and **B.G. Hopkins**. 2021. Homogeneous boron-potassium fertilizer: Plant uptake. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 7-10 Nov. 2021; Salt Lake City, UT. Madison, WI: ASA-CSSA-SSSA. Avaliable at: https://scisoc.confex.com/scisoc/2021am/meetingapp.cgi/Paper/134813

Seely, C., B. Geary, and **B.G. Hopkins**. 2021. Microplastics: Polymer coated fertilizers in urban landscapes. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 7-10 Nov. 2021; Salt Lake City, UT. Madison, WI: ASA-CSSA-SSSA. Avaliable at: https://scisoc.confex.com/scisoc/2021am/meetingapp.cgi/Paper/135230

Geary, B., C. Seely, and **B.G. Hopkins**. 2021. Microplastics from Polymer Coated Urea in Sweet Corn. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 7-10 Nov. 2021; Salt Lake City, UT. Madison, WI: ASA-CSSA-SSSA. Avaliable at: https://scisoc.confex.com/scisoc/2021am/meetingapp.cgi/Paper/134838

Shumate, S., A. Campbell, A.P. Hopkins, **B.G. Hopkins**, and N.C. Hansen. 2021. Effects of Nitrogen Fertilizer Treatments on Turfgrass Water Usage in Varying Stages of Drought. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 7-10 Nov. 2021; Salt Lake City, UT. Madison, WI: ASA-CSSA-SSSA. Avaliable at: https://scisoc.confex.com/scisoc/2021am/meetingapp.cgi/Paper/137258

Lambert, A.M., S. Anderson, D.L. Cole, A. Haderlie, C. Seely, and **B.G. Hopkins.** 2021. A New Hydroponic System for Testing Mineral Nutrient Deficiencies and It's Application to Soybeans. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 7-10 Nov. 2021; Salt Lake City, UT. Madison, WI: ASA-CSSA-SSSA. Avaliable at: https://scisoc.confex.com/scisoc/2021am/meetingapp.cgi/Paper/134808

Nelson, S.V., M.D. Madsen, N.C. Hansen, V.J. Anderson, and **B.G. Hopkins.** 2021. Super Absorbent Polymer Banding to Inprove Seedling Establishment in Rangeland Restoration. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 7-10 Nov. 2021; Salt Lake City, UT. Madison, WI: ASA-CSSA-SSSA. Avaliable at: https://scisoc.confex.com/scisoc/2021am/meetingapp.cgi/Paper/133845

Burgin, H.R., G.A. Wear, N.C. Hansen, and **B.G. Hopkins.** 2021. Cold and Traffic Tolerance of Eight Hybrid Bermudagrass Cultivars in a Cool, Arid Region. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 7-10 Nov. 2021; Salt Lake City, UT. Madison, WI: ASA-CSSA-SSSA. Avaliable at: https://scisoc.confex.com/scisoc/2021am/meetingapp.cgi/Paper/134971

Woolley, E.A., M. Yost, N.C. Hansen, and **B.G. Hopkins.** 2021. Optimal Number of Sensors and Sensor Placement for Sensor-Based Irrigation Scheduling for a Variable Rate Irrigation System. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 7-10 Nov. 2021; Salt Lake City, UT. Madison, WI: ASA-CSSA-SSSA. Avaliable at: https://scisoc.confex.com/scisoc/2021am/meetingapp.cgi/Paper/134657

Hopkins, B.G. 2021. Nutrient and water input interactions for reducing environmental impacts in turfgrass: A review. *14th International Turfgrass Society Conference (ITC)*; 10-15 July 2022; Copenhagen, Denmark.

Blackwelder, J.S., A.M. Bruce, W.H. Porter, J.E. Eves, and **B.G. Hopkins.** 2019. Aquaponics nutrition studies with Pacu grown with lettuce and tomato: Methodology. (Poster presentation.) *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 10-13 Nov. 2019; San Antonio, TX. Madison, WI: ASA-CSSA-SSSA. Avaliable at: https://scisoc.confex.com/scisoc/2019am/meetingapp.cgi/Paper/120457

Campbell, C.S., R.G. Smith, R.C. Christensen, N.C. Hansen, and **B.G. Hopkins.** 2019. Improving irrigation recommendations by combining high resolution temporal soil moisture with satellite synthetic aperture radar. (Poster presentation.) *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 10-13 Nov. 2019; San Antonio, TX. Madison, WI: ASA-CSSA-SSSA. Avaliable at: https://scisoc.confex.com/scisoc/2019am/meetingapp.cgi/Paper/119990

Carlock, E.T., T.J. Hopkins, and **B.G. Hopkins.** 2019. Polymer coated urea and urea blends on potato. (Poster presentation.) *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 10-13 Nov. 2019; San Antonio, TX. Madison, WI: ASA-CSSA-SSSA. Avaliable at: https://scisoc.confex.com/scisoc/2019am/meetingapp.cgi/Paper/118801

Cole, D.L., S.H. Stapley, R.L. Buck, and **B.G. Hopkins.** 2019. New hydroponics system for testing mineral nutrient deficiencies and its application to Quinoa. (Poster presentation.) *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 10-13 Nov. 2019; San Antonio, TX. Madison, WI: ASA-CSSA-SSSA. Avaliable at: https://scisoc.confex.com/scisoc/2019am/meetingapp.cgi/Paper/118667

Evans, S.R., K.L. Kopp, P.G. Johnson, and **B.G. Hopkins.** 2019. Can smart irrigation controllers improve water use efficiency in urban landscapes? (Oral presentation.) *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 10-13 Nov. 2019; San Antonio, TX. Madison, WI: ASA-CSSA-SSSA. Avaliable at: https://scisoc.confex.com/scisoc/2019am/meetingapp.cgi/Paper/120100

Fahning, S.R., T.G. Searle, A.M. Weigel, R.L. Buck, and **B.G. Hopkins.** 2019. Polymer coated urea impact on barley protein and yield. (Poster presentation.) *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 10-13 Nov. 2019; San Antonio, TX. Madison, WI: ASA-CSSA-SSSA. Avaliable at: https://scisoc.confex.com/scisoc/2019am/meetingapp.cgi/Paper/118749

Hansen, N.C., R. Kerry, **B.G. Hopkins,** M. Heaton, R. Jensen, and R.G. Smith. 2019. Informing variable rate irrigation with in-situ soil water sensors and remote sensing. (Oral presentation.) *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 10-13 Nov. 2019; San Antonio, TX. Madison, WI: ASA-CSSA-SSSA. Avaliable at: https://scisoc.confex.com/scisoc/2019am/meetingapp.cgi/Paper/118816

Hopkins, A.P., N.C. Hansen, **B.G. Hopkins,** E.A. Woolley, R. Kerry, and R. Jensen. 2019. Remote sensing approaches for maximizing productivity of variable-rate irrigation systems. (Poster presentation.) *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 10-13 Nov. 2019; San Antonio, TX. Madison, WI: ASA-CSSA-SSSA Avaliable at: https://scisoc.confex.com/scisoc/2019am/meetingapp.cgi/Paper/118802

Hopkins, B.G. 2019. Overview of Biostimulants Efficacy. (Oral presentation.) *In Proceedings of the Western Nutrient Management Conference (WNMC);* 7-8 Mar. 2019; Reno, NV. 13:5. *(invited)*

Hopkins, B.G. 2019. Biostimulants: Meta analysis and overview. (Oral presentation.) 2019. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 10-13 Nov. 2019; San Antonio, TX. Madison, WI: ASA-CSSA-SSSA. *(invited)* Avaliable at: https://scisoc.confex.com/scisoc/2019am/meetingapp.cgi/Paper/119669

Nelson, S.V., M.D. Madsen N.C. Hansen, V.J. Anderson, and **B.G. Hopkins.** 2019. Hydrogel banding for increased soil moisture and range seeding establishment. (Poster presentation.) *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 10-13 Nov. 2019; San Antonio, TX. Madison, WI: ASA-CSSA-SSSA. *(invited)* Avaliable at: https://scisoc.confex.com/scisoc/2019am/meetingapp.cgi/Paper/118505

Nelson, S.V., R. Lawrence, M.D. Madsen, N.C. Hansen, V.J. Anderson, and **B.G. Hopkins**. 2019. Hydrogel rate and depth: Impact on soil water and seedling establishment. *In* Abstracts, *Proceedings of the 72nd Society for Range Management (SRM) Annual Meeting*; 10-14 Feb. 2019; Minneapolis, MN.

Nolan, E.A., E.A. Woolley, T.G. Searle, T.J. Hopkins, J.D. Williams, and **B.G. Hopkins.** 2019. Boron uptake efficiency with a homogeneous potassium granule as a function of root system diameter. (Poster presentation.) *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 10-13 Nov. 2019; San Antonio, TX. Madison, WI: ASA-CSSA-SSSA. Avaliable at: https://scisoc.confex.com/scisoc/2019am/meetingapp.cgi/Paper/118435

Shumate, S., E. Lowe, N.C. Hansen, and **B.G. Hopkins.** 2019. Drought and recovery responses of Kentucky Bluegrass with varying nitrogen fertility status. (Poster presentation.) *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 10-13 Nov. 2019; San Antonio, TX. Madison, WI: ASA-CSSA-SSSA. Avaliable at: https://scisoc.confex.com/scisoc/2019am/meetingapp.cgi/Paper/120395

Svedin, J.D., N.C. Hansen, R. Kerry, and **B.G. Hopkins.** 2019. Modeling spatio-temporal variations in crop water stress for variable rate irrigation. (Oral presentation.) *12th European Conference on Precision Agriculture Conference Proceedings*; 8-11 Jul. 2019; Montpellier France. *(invited)*

Woolley, E.A., J.D. Svedin, R. Kerry, N.C. Hansen, R. Jensen, A.P. Hopkins, and **B.G. Hopkins**. 2019. Comparing spatial variation of crop water productivity and moisture relations in potato and wheat. (Poster presentation.) *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 10-13 Nov. 2019; San Antonio, TX. Madison, WI: ASA-CSSA-SSSA. Avaliable at: https://scisoc.confex.com/scisoc/2019am/meetingapp.cgi/Paper/120245

Campbell, C.S., **B.G. Hopkins,** N.C. Hansen, J.D. Svedin, and R. Smith. 2018. Integrating remote sensing and spatiotemporal data to improve variable rate irrigation systems. (Oral presentation.) *In* Abstracts, *ASA•CSSA International Annual Meeting;* 4-7 Nov. 2018; Baltimore, MD. Madison, WI: ASA-CSSA.

Cole, D.L., A. Tyler, A. Lambert, S.V. Nelson, T. Billin, and **B.G. Hopkins.** 2018. A new hydroponic system for testing mineral nutrient deficiencies in plants. *In* Abstracts, *ASA•CSSA International Annual Meeting;* 4-7 Nov. 2018; Baltimore, MD. Madison, WI: ASA•CSSA.

Evans, S.R., K.L. Kopp, P.G. Johnson, and **B.G. Hopkins.** 2018. A comparison of smart controllers in the urban landscape. *In* Abstracts, *ASA•CSSA International Annual Meeting;* 4-7 Nov. 2018; Baltimore, MD. Madison, WI: ASA•CSSA.

Hopkins, B.G. and T.J. Hopkins. 2018. Enhanced efficiency fertilizers in turfgrass: A review. (Oral presentation.) *In* Abstracts, *ASA•CSSA International Annual Meeting;* 4-7 Nov. 2018; Baltimore, MD. Madison, WI: ASA•CSSA.

Hopkins, B.G. and T.J. Hopkins. 2018. Enhanced efficiency nitrogen fertilizers: Review. (Oral presentation.) *In* Abstracts, *ASA•CSSA International Annual Meeting;* 4-7 Nov. 2018; Baltimore, MD. Madison, WI: ASA•CSSA.

Hopkins, B.G. and T.J. Hopkins. 2018. Enhanced efficiency phosphorus fertilizers: Review. (Oral presentation.) *In* Abstracts, *ASA•CSSA International Annual Meeting;* 4-7 Nov. 2018; Baltimore, MD. Madison, WI: ASA•CSSA.

Hopkins, A.P., N.C. Hansen, **B.G. Hopkins,** and C.S. Campbell. 2018. Remote sensing approaches to improve water and nitrogen management of Kentucky bluegrass. *In* Abstracts, *ASA•CSSA International Annual Meeting;* 4-7 Nov. 2018; Baltimore, MD. Madison, WI: ASA•CSSA.

Nelson, S.V., M.C. Valencia, H. Black, W. Petersen, J.D. Svedin, N.C. Hansen, M.D. Madsen, V.J. Anderson, and **B.G. Hopkins.** 2018. The effect of polyacrylamide rate and depth on soil water storage and seedling establishment. *In* Abstracts, *Proceedings of the 71st Society for Range Management (SRM) Annual Meeting*; 28 Jan. - 2 Feb. 2018; Sparks, NV. Littleton, CO: Society for Range Management.

Parkinson, M.E., M.D. Madsen, and **B.G. Hopkins**. 2018. Use of phosphorus fertilizer as a seed coating enhance seedling growth of bluebunch wheatgrass. *In* Abstracts, *Proceedings of the 71st Society for Range Management (SRM) Annual Meeting*; 28 Jan. - 2 Feb. 2018; Sparks, NV. Littleton, CO: Society for Range Management.

Svedin, J.D., E.A. Woolley, N.C. Hansen, R. Kerry, and **B.G. Hopkins.** 2018. Spatio-temporal soil water and crop stress modeling for variable rate irrigation. (Oral presentation.) *In* Abstracts, *ASA•CSSA International Annual Meeting;* 4-7 Nov. 2018; Baltimore, MD. Madison, WI: ASA•CSSA.

Svedin, J.D., N.C. Hansen, R. Kerry, and **B.G. Hopkins.** 2018. Spatial variation in winter wheat crop water productivity to inform variable-rate irrigation *In* Abstracts, *ASA•CSSA International Annual Meeting;* 4-7 Nov. 2018; Baltimore, MD. Madison, WI: ASA•CSSA.

Valencia, M.C., S.V. Nelson, R. Lawrence, N.C. Hansen, M.D. Madsen, V.J. Anderson, S.L. Petersen, and **B.G. Hopkins.** 2018. Phosphorus fertilizer and hydrogel for rangeland seedling success. *In* Abstracts, *ASA•CSSA International Annual Meeting;* 4-7 Nov. 2018; Baltimore, MD. Madison, WI: ASA•CSSA.

Weigel, A.M., **B.G. Hopkins,** and T.G. Searle. 2018. Granulated homogenous potassium and boron fertilizer: Impact on alfalfa quality and yield. *In* Abstracts, *ASA•CSSA International Annual Meeting;* 4-7 Nov. 2018; Baltimore, MD. Madison, WI: ASA- ASA•CSSA.

Wilcox, M., C. Hollist, **B.G. Hopkins,** T.G. Searle, and J.D. Williams. 2018. Granulated homogeneous micronutrient fertilizers: Impact on potato yield and quality. *In* Abstracts, *ASA•CSSA International Annual Meeting;* 4-7 Nov. 2018; Baltimore, MD. Madison, WI: ASA•CSSA.

Wilcox, M., T. Rawlins, T.G. Searle, **B.G. Hopkins,** and J.D. Williams. 2018. Polymer coated and uncoated urea blends: Impact on Russet Burbank potato yield and quality. *In* Abstracts, *ASA•CSSA International Annual Meeting;* 4-7 Nov. 2018; Baltimore, MD. Madison, WI: ASA•CSSA.

Wilcox, M., **B.G. Hopkins,** T.G. Searle and J.D. Williams. 2018. Polymer coated urea impact on barley yield, flag leaf nitrogen, and protein. *In* Abstracts, *ASA•CSSA International Annual Meeting;* 4-7 Nov. 2018; Baltimore, MD. Madison, WI: ASA•CSSA.

Zeyer, S.M., J.D. Svedin, C.H. Porter, D.C. Cole, T.J. Hopkins, and **B.G. Hopkins.** 2018. Struvite as an enhanced efficiency phosphorus fertilizer for sugarbeet and potato. *In* Abstracts, *ASA•CSSA International Annual Meeting;* 4-7 Nov. 2018; Baltimore, MD. Madison, WI: ASA•CSSA.

Nelson, S., W. Petersen, J.D. Svedin, M.D. Madsen, V.J. Anderson, N.C. Hansen, and B.G. Hopkins. 2017. Mulch and polyacrylamide for increasing soil moisture and seeding success," *In* Abstracts, *Proceedings of the 70th Society for Range Management (SRM) Annual Meeting*; 29 Jan. – 2 Feb., 2017; Saint George, UT. Littleton, CO: Society for Range Management.

Campbell, C.S., N.C Hansen, B.G Hopkins, S. Evans, E. Campbell, A. Campbell, L. Rivera, and D. Cobos . 2017. Soil water and plant canopy sensor technologies to optimize water and nutrient use. *In* Abstracts, *ASA•CSSA International Annual Meeting;* 22-25 Oct. 2017; Tampa, FL. Madison, WI: ASA-CSA-SSSA. 361-5. Available at: https://scisoc.confex.com/scisoc/2017am/webprogram/Paper109041.html

Hopkins, A.P., N.C. Hansen, **B.G. Hopkins**, and K. Russell. 2017. Nitrogen and irrigation interactions in water-stressed turfgrass species. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 22-25 Oct. 2017; Tampa, FL. Madison, WI: ASA-CSA-SSSA. Poster No. 301.

Nelson, S.V., W. Petersen, J.D. Svedin, M.D. Madsen, V.J. Anderson, N.C. Hansen, and **B.G. Hopkins**. 2017. Polyacrylamide for increasing soil moisture and seeding success. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 22-25 Oct. 2017; Tampa, FL. Madison, WI: ASA-CSA-SSSA. Poster No. 910.

Porter, W.H., J.D. Svedin, T.J. Hopkins, and **B.G. Hopkins.** 2017. Polymer coated urea research summary: Meeting plant requirements while mitigating environmental impacts. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 22-25 Oct. 2017; Tampa, FL. Madison, WI: ASA-CSA-SSSA.

Svedin, J.D., R. Kerry, N.C. Hansen, and **B.G. Hopkins**. 2017. Developing irrigation zones from a field scale crop water productivity map. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 22-25 Oct. 2017; Tampa, FL. Madison, WI: ASA-CSA-SSSA.

Thurgood, G.W. and **B.G. Hopkins**. 2017. Potato yield response to select phosphorus and potassium sources. *In* Abstracts, *ASA•CSSA International Annual Meeting;* 22-25 Oct. 2017; Tampa, FL. Madison, WI: ASA-CSA-SSSA. 107523; Poster No. 215.

Valencia, M.C., J.D. Svedin, T.J. Hopkins, and **B.G. Hopkins**. 2017. Rate, Timing, Placement and Enhanced Fertilizer Sources for Improving Phosphorus Use Efficiency. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 22-25 Oct. 2017; Tampa, FL. Madison, WI: ASA-CSA-SSSA. 106055; poster No. 211.

Hopkins, B.G. 2017. Mode of action, effectiveness, and value of enhanced efficiency macro- and micronutrient fertilizer products. (Oral presentation.) *4R Nutrient Stewardship Summit;* 12-13 Jun. 2017; Minneapolis, MN. Washington, DC: The Fertilizer Institute.

Svedin, J.D., R. Kerry, N.C. Hansen, and **B.G. Hopkins.** 2017. Using a field scale crop water productivity layer to develop variable rate irrigation zones. *11th European Conference on Precision Agriculture;* 16-20 Jul. 2017; Edinburgh, UK.

Bartholomew, S., J.C. Buss, N.C. Hansen, and **B.G. Hopkins.** 2016. Polymer coated urea in Kentucky bluegrass. *In* Abstracts, *14th AnnualNitrogen Use Efficiency (NUE) Conference*; 8-10 Aug. 2016; Boise, ID. Moscow, ID: University of Idaho.

Bartholomew, S., K. Russell, N.C. Hansen, and **B.G. Hopkins.** 2016. Syringing Kentucky bluegrass: frequency impacts canopy temperature and growth. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 6-9 Nov. 2016; Phoenix, AZ. Madison, WI: ASA-CSA-SSSA.

Campbell, C.S., N.C. Hansen, **B.G. Hopkins**, S.R Evans, L.D. Rivera, D.R. Cobos, and G.S. Campbell. 2016. In situ moisture release curves to determine soil water characteristics. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 6-9 Nov. 2016; Phoenix, AZ. Madison, WI: ASA-CSA-SSSA.

Cooper, R.L., J.D. Williams, and **B.G. Hopkins**. 2016. Effects of Mosaic Aspire compared with MOP and boron blended fertilizer on alfalfa yield and quality. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 6-9 Nov. 2016; Phoenix, AZ. Madison, WI: ASA-CSA-SSSA.

Evans, S.R., C.S. Campbell, **B.G. Hopkins**, and N.C. Hansen. 2016. The effects of water use in turfgrass using sensor-driven decisions. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 6-9 Nov. 2016; Phoenix, AZ. Madison, WI: ASA-CSA-SSSA.

Harding, C., J.D. Williams, and **B.G. Hopkins**. 2016. Comparison of ESN and urea on potato petiole nitrate and yield in southeast Idaho. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 6-9 Nov. 2016; Phoenix, AZ. Madison, WI: ASA-CSA-SSSA.

Hopkins, A.P., K.J. Fernelius, and **B.G. Hopkins.** 2016. AVAIL Phosphorus fertilizer enhancer: analysis of 503 field evaluations. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 6-9 Nov. 2016; Phoenix, AZ. Madison, WI: ASA-CSA-SSSA.

Hopkins, A.P., C.J. Ransom, W. Peterson, J.C. Buss, and **B.G. Hopkins.** 2016. Polymer coated urea release rates under varying conditions. *In* Abstracts, *14th Annual Nitrogen Use Efficiency (NUE) Conference*; 8-10 Aug. 2016; Boise, ID. Moscow, ID: University of Idaho.

Hopkins, B.G. 2016. Aerial assessment strategies: potato/grain NUE. (Oral presentation.) *In* Abstracts, *14th Annual Nitrogen Use Efficiency (NUE) Conference*; 8-10 Aug. 2016; Boise, ID. Moscow, ID: University of Idaho.

Hopkins, B.G. and N.C. Hansen. 2016. Nutrient and water management tools in a water-short world. (Oral presentation.) *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 6-9 Nov. 2016; Phoenix, AZ. Madison, WI: ASA-CSA-SSSA. *(Invited)*

Hopkins, T.J., D.A. Carroll II, **B.G. Hopkins**, and N.C. Hansen. 2016. Drought and nitrogen effects on maize canopy temperature and stress indices. *In* Abstracts, *14th Annual Nitrogen Use Efficiency (NUE) Conference;* 8-10 Aug. 2016; Boise, ID. Moscow, ID: University of Idaho.

Nielsen, N., J.D. Williams, and **B.G. Hopkins.** 2016. Boron and manganese fertilization on Russet Burbank potato. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 6-9 Nov. 2016; Phoenix, AZ. Madison, WI: ASA-CSA-SSSA.

Petersen, W., J.D. Svedin, and **B.G. Hopkins.** 2016. Polyacrylamide use in reestablishing arid rangeland species. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 6-9 Nov. 2016; Phoenix, AZ. Madison, WI: ASA-CSA-SSSA.

Russell, K. A., N. C. Hansen, and **B.G. Hopkins.** 2016. Nitrogen and irrigation water interactions in drought-stressed Kentucky bluegrass. *In* Abstracts, *14th Annual Nitrogen Use Efficiency (NUE) Conference;* 8-10 Aug. 2016; Boise, ID. Moscow, ID: University of Idaho.

Ruth, M.J. and **B.G. Hopkins.** 2016. Combating anemia and other iron related deficiencies through iron-efficiency in soybeans. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 6-9 Nov. 2016; Phoenix, AZ. Madison, WI: ASA-CSA-SSSA.

Searle, T.G., J.D. Williams, and **B.G. Hopkins.** 2016. Polymer coated urea management. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 6-9 Nov. 2016; Phoenix, AZ. Madison, WI: ASA-CSA-SSSA.

Svedin, J.D., N.C. Hansen, R. Kerry, and **B.G. Hopkins.** 2016. Variable rate irrigation and water use efficiency. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 6-9 Nov. 2016; Phoenix, AZ. Madison, WI: ASA-CSA-SSSA.

Svedin, J.D., C.J. Ransom, and **B.G. Hopkins.** 2016. Evaluation of nitrogen gas loss from polymer coated and polymer sulfur coated urea. *In* Abstracts, *14th Annual Nitrogen Use Efficiency (NUE) Conference;* 8-10 Aug. 2016; Boise, ID. Moscow, ID: University of Idaho.

Thurgood, G.W., J.D. Williams, and **B.G Hopkins.** 2016. Comparison of Agrium ESN and urea fertilizers on barley in southeast Idaho. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 6-9 Nov. 2016; Phoenix, AZ. Madison, WI: ASA-CSA-SSSA.

Thurgood, G.W., J.D. Williams, and **B.G. Hopkins.** 2016. Comparison of FUSN and urea fertilizers on potato yield and tuber quality in SE Idaho. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 6-9 Nov. 2016; Phoenix, AZ. Madison, WI: ASA-CSA-SSSA.

Tyler, A., J.C. Buss, J.H. Gish, J.D. Svedin, and **B.G. Hopkins**. 2016. Polymer coated urea in Kentucky bluegrass: optimal timing and rate of application. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 6-9 Nov. 2016; Phoenix, AZ. Madison, WI: ASA-CSA-SSSA.

Ruth, M.J., T.J. Hopkins, and **B.G**. **Hopkins.** 2015. The mode of action for a citrate soluble phosphorus fertilizer product. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 21-24 Oct. 2012; Cincinnati, OH. Madison, WI: ASA-CSSA-SSSA.

Bartholomew, S., K. Russell, N.C. Hansen, and **B.G. Hopkins**. 2015. Syringing Kentucky bluegrass: frequency impacts canopy temperature and growth. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 15-18 Nov. 2015; Minneapolis, MN. Madison, WI: ASA-CSA-SSSA.

Black, B., B.D. Geary, and **B.G. Hopkins**. 2015. Nitrogen nutrition impact on incidence of Rhizoctonia infection of *Agrostis stolinifera*. *In* Abstracts, *Annual Meeting, American Phytopathological Society*; 1-5 Aug. 2015; Pasadena, CA. St. Paul, MN: American Phytopathological Society.

Buss. J.C., **B.G. Hopkins,** and J.H. Gish. 2015. Optimizing polymer coated urea applications for Kentucky bluegrass. (Oral presentation.) *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 15-18 Nov. 2015; Minneapolis, MN. Madison, WI: ASA-CSA-SSSA.

Cardon, G.E., **B.G. Hopkins,** J.R. Lawley, and T.L. Provin. 2015. Historical data structure and laboratory performance in the North American proficiency testing (NAPT) program. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 15-18 Nov. 2015; Minneapolis, MN. Madison, WI: ASA-CSA-SSSA.

Carroll II, D.A., **B.G. Hopkins,** and N.C. Hansen. 2015. Drought and nitrogen stress effects on maize canopy temperature. (Oral presentation.) *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 15-18 Nov. 2015; Minneapolis, MN. Madison, WI: ASA-CSA-SSSA.

Hansen, N.C., **B.G. Hopkins**, and J. Altenhofen. 2015. Interaction of irrigation, nitrogen management, and crop genetics on water productivity of maize and Kentucky bluegrass. (Oral presentation.) *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 15-18 Nov. 2015; Minneapolis, MN. Madison, WI: ASA-CSA-SSSA.

Hopkins, B.G. 2015. Field evaluation of "enhanced" phosphorus fertilizers. (Oral presentation.) *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 15-18 Nov. 2015; Minneapolis, MN. Madison, WI: ASA-CSA-SSSA. *(Invited)*

Johnson, N., J.D. Williams, **B.G. Hopkins**, and R.L. Cooper. 2015. Comparison of asn-26 and urea fertilizers in potato production in southeast Idaho. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 15-18 Nov. 2015; Minneapolis, MN. Madison, WI: ASA-CSA-SSSA.

Molina, M., **B.G. Hopkins**, and J.D. Williams. 2015. Polymer coated urea impact on petiole nitrate-N concentrations. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 15-18 Nov. 2015; Minneapolis, MN. Madison, WI: ASA-CSA-SSSA.

Russell, K., **B.G. Hopkins**, and N.C. Hansen. 2015. Nitrogen and irrigation water interactions in drought-stressed Kentucky bluegrass. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 15-18 Nov. 2015; Minneapolis, MN. Madison, WI: ASA-CSA-SSSA.

Scadden, I.P., J.D. Williams, and **B.G. Hopkins.** 2015. Response of Russet Burbank potatoes to manganese fertilizer on silt-loam, calcareous soils. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 15-18 Nov. 2015; Minneapolis, MN. Madison, WI: ASA-CSA-SSSA.

Svedin, J.D., **B.G. Hopkins,** and C.J. Ransom. 2015. Nitrogen gas loss from polymer coated and polymer sulfur coated urea. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 15-18 Nov. 2015; Minneapolis, MN. Madison, WI: ASA-CSA-SSSA.

Black, B., **B.G. Hopkins,** and B.D. Geary. 2014. Creeping bentgrass nitrogen and brown patch interactions. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 2-5 Nov. 2014; Long Beach, CA. Madison, WI: ASA-CSA-SSSA.

Buss, J.C., C.J. Ransom, L.E. Sutton, and **B.G. Hopkins**. 2014. Reducing mowing and fertilizing with polymer coated urea in Kentucky bluegrass. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 2-5 Nov. 2014; Long Beach, CA. Madison, WI: ASA-CSA-SSSA.

Carroll II, D.A., N.C. Hansen, **B.G. Hopkins**, and R.E. Terry. 2014. Nitrogen Management and Water Productivity of Limited Irrigation Corn. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 2-5 Nov. 2014; Long Beach, CA. Madison, WI: ASA-CSA-SSSA.

Svedin, J.D., C.J. Ransom, and **B.G. Hopkins**. 2014. Evaluation of nitrogen gas loss from polymer coated and polymer sulfur coated urea. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 2-5 Nov. 2014; Long Beach, CA. Madison, WI: ASA-CSA-SSSA.

Blair, T., M.W. Hill, **B.G. Hopkins**, and C.J. Ransom. 2013. Phosphorus and organic acid bonding enhances uptake efficiency in crop plants. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 3-6 Nov. 2013; Tampa, FL. Madison, WI: ASA-CSA-SSSA.

Buck, R.L., E.L. Gervais, V.D. Jolley, B.L. Webb, and **B.G. Hopkins**. 2013. Depth of placement impacts efficiency of estimating plant nutrient availability in semi-arid, low fertility soils with ion exchange resin capsules. (Oral presentation.) *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 3-6 Nov. 2013; Tampa, FL. Madison, WI: ASA-CSA-SSSA.

Campbell, K., M.D. Madsen, and **B.G. Hopkins**. 2013. Kentucky bluegrass seed coating with an organic acid based fertilizer. (Oral presentation.) *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 3-6 Nov. 2013; Tampa, FL. Madison, WI: ASA-CSA-SSSA.

Gervais, E.L., C.J. Ransom, J. Banfield, R.L. Buck, **B.G. Hopkins**, V.D. Jolley, J. Moody, A. Cartozian, J. Hill, C. Lyon, D. Bradshaw, R. Sleight, and T. Hopkins. 2013. Evaluating release rates of controlled and slow release nitrogen fertilizer. (Oral presentation.) *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 3-6 Nov. 2013; Tampa, FL. Madison, WI: ASA-CSA-SSSA.

Hill, M.W., **B.G. Hopkins**, C.J. Ransom, and V.D. Jolley. 2013. Phosphorus use efficiency: organic acid bonding. (Oral presentation.) *In* Abstracts, *Annual Meeting, Potato Association of America*; 12-16 Aug. 2012; Denver, CO. Orono, ME: Potato Association of America. *Am. J. Potato Res.* 90: 134.

Hopkins, B.G., M.W. Hill, D.A. Horneck, G.H. Clough, and A.E. MacGuidwin. 2013. Phosphorus use efficiency: Rhizosphere modification. (Oral presentation.) *In* Abstracts, *Annual Meeting, Potato Association of America*; 12-16 Aug. 2012; Denver, CO. Orono, ME: Potato Association of America. *Am. J. Potato Res.* 90:134. *(Invited)*

Katseanes, C.K., **B.G. Hopkins**, M.A. Chappell, and C.L. Price. 2013. Soil fertility status and degradation of munitions constituent contaminated soil. (Oral presentation.) *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 3-6 Nov. 2013; Tampa, FL. Madison, WI: ASA-CSA-SSSA.

Ransom, C.J., L.E. Sutton, T. Blair, K. Campbell, A.M. Winchester, V.D. Jolley, **B.G. Hopkins**, and R.L. Buck. 2013. Turf response to polymer coated urea. (Oral presentation.) *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 3-6 Nov. 2013; Tampa, FL. Madison, WI: ASA-CSA-SSSA.

Sutton, L.E., C.J. Ransom, T. Blair, **B.G. Hopkins**, V.D. Jolley, and R.L. Buck. 2013. Turf response to polymer – sulfur coated urea. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 3-6 Nov. 2013; Tampa, FL. Madison, WI: ASA-CSA-SSSA.

Hopkins, B.G. and M.W. Hill. 2012. Phosphorus and organic acid bonding enhances uptake efficiency in crop plants. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 21 – 24 Oct. 2012; Cincinnati, OH. Madison, WI: ASA-CSA-SSSA. *(Invited)*

Hopkins, B.G. and M.W. Hill. 2012. Phosphorus use efficiency: improvement with organic acids. (Oral presentation.) *In* Abstracts, *Annual Meeting, Potato Association of America;* 14-18 Aug. 2011; Wilmington, NC. Orono, ME: Potato Association of America. *Am. J. Potato Res.* 89: 38.

Hopkins, B.G. and J.J. LeMonte. 2012. Nitrogen fertilizer use efficiency and greenhouse/reactive N gas losses in potato production. (Oral presentation.) *In* Abstracts, *Annual Meeting, Potato Association of America;* 14-18 Aug. 2011; Wilmington, NC. Orono, ME: Potato Association of America. *Am. J. Potato Res.* 89: 38.

Hopkins, B.G., A. Nordin, B.D. Geary, D.A. Johnson, J.J. Gneck, V.D. Jolley, M. Merrell, and A. Baron. 2012. Influence of pH, sulfur, chloride, and potassium on infection severity of *Verticillium dahliae* in Russet Burbank potato roots. (Oral presentation.) *In* Abstracts, *Annual Meeting, Potato Association of America;* 14-18 Aug. 2011; Wilmington, NC. Orono, ME: Potato Association of America. *Am. J. Potato Res.* 89: 38.

Katseanes, C.K., M.A. Chappell, **B.G. Hopkins,** and C.L. Price. 2012. Soil fertility status and degradation of munitions constituent contaminated soil. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 21-24 Oct. 2012; Cincinnati, OH. Madison, WI: ASA-CSSA-SSSA.

Ransom, C.J., J.J. LeMonte, L.E. Sutton, **B.G. Hopkins**, V.D. Jolley, and B.L. Webb. 2012. Turf response to reduced rates of polymer coated urea. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 21-24 Oct. 2012; Cincinnati, OH. Madison, WI: ASA-CSSA-SSSA.

Brown, T.R., **B.G. Hopkins**, M.W. Hill, V.D. Jolley, and B.L. Webb. 2011. Increasing phosphorus use efficiency with organic acids: Movement of P through soil. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 16-19 Oct. 2011; San Antonio, TX. Madison, WI: ASA-CSSA-SSSA.

Buck, R.L., B.L. Webb, V.D. Jolley, and **B.G. Hopkins**. 2011. Field studies evaluating placement of ion exchange resins to assess nutrient availability in desert soils. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 2011 Oct. 16-19; San Antonio, TX. Madison, WI: ASA-CSSA-SSSA.

Hill, M.W., **B.G. Hopkins**, C.J. Ransom, B.L. Webb, and V.D. Jolley. 2011. Increasing phosphorus solubility and uptake efficiency with organic acids. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 16-19 Oct. 2011; San Antonio, TX. Madison, WI: ASA-CSSA-SSSA.

Hopkins, B.G. 2011. New nitrogen and phosphorus fertilizer technology to increase nutrient use efficiency: A review. (Oral presentation.) *In* Abstracts, *ASA•CSSA•SSSA International Annual Meetings;* 16-19 Oct. 2011;San Antonio, TX. Madison, WI: ASA-CSSA-SSSA.

Hopkins, B.G. and J.J. LeMonte. 2011. Global importance and progress of reducing anthropogenic emissions of nitrous oxide. (Oral presentation.) *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 16-19 Oct. 2011;San Antonio, TX. Madison, WI: ASA-CSSA-SSSA. (*Invited)*

Hopkins, T.J., **B.G. Hopkins,** R.C. Christensen, V.D. Jolley, and B.L. Webb. 2011. Nutrient uptake by *Poa pratensis* from oxidation of elemental sulfur impregnated with micronutrients. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 16-19 Oct. 2011; San Antonio, TX. Madison, WI: ASA-CSSA-SSSA.

Katseanes, C.K. and **B.G. Hopkins**. 2011. Soil fertility status and degradation of munitions constituent contaminated soil. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 16-19 Oct. 2011; San Antonio, TX. Madison, WI: ASA-CSSA-SSSA.

LeMonte, J.J., **B.G. Hopkins**, and V.D. Jolley. 2011. Polymer coated urea (ESN): Increase in nitrogen use efficiency and potato tuber size and quality. (Oral presentation.) *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 16-19 Oct. 2011; San Antonio, TX. Madison, WI: ASA-CSSA-SSSA. *(Invited)*

Nordin, A., B.D. Geary, J. Gneck, V. D. Jolley, **B.G. Hopkins,** M. Merrell, A. Baron, and D. Johnson. 2011. Influence of pH, sulfur, chloride, and potassium on infection severity of *Verticillium dahliae* in Russet Burbank potato roots. *Hortscience* 46(9): S94-S94. https://journals.ashs.org/hortsci/view/journals/hortsci/46/9S/article-pS1.xml

Ransom, C.J., J.J. LeMonte, **B.G. Hopkins**, T.M. Story, V.D. Jolley, and R.E. Terry. 2011. Photoacoustic infrared spectroscopy to continuously measure nitrous oxide and ammonia emissions from soil. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 16-19 Oct. 2011; San Antonio, TX. Madison, WI: ASA-CSSA-SSSA.

Smith, N.T., R.L. Buck, B.L. Webb, V.D. Jolley, and **B.G. Hopkins**. 2011. Field studies evaluating sulfur availability using ion exchange resin capsules. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 16-19 Oct. 2011; San Antonio, TX. Madison, WI: ASA-CSSA-SSSA.

Story, T.M., **B.G. Hopkins**, and J.J. LeMonte. 2011. Polymer coated urea in grass systems: reduction of ammonia volatilization. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 16-19 Oct. 2011; San Antonio, TX. Madison, WI: ASA-CSSA-SSSA.

Summerhays, J.S.C., **B.G. Hopkins,** M.W. Hill, V.D. Jolley, and B.L. Webb. 2011. Increasing phosphorus use efficiency with organic acids: Crop yield. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 16-19 Oct. 2011; San Antonio, TX. Madison, WI: ASA-CSSA-SSSA.

Vocasek, F.F. and **B.G. Hopkins.** 2011. Case study: Developing field-scale nitrogen budgets for wastewater irrigation. (Oral presentation.) *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 16-19 Oct. 2011; San Antonio, TX. Madison, WI: ASA-CSSA-SSSA.

Vocasek, F.F. and **B.G. Hopkins.** 2011. Case study: Implementing an index system to prioritize soil impacts following wastewater irrigation. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 16-19 Oct. 2011; San Antonio, TX. Madison, WI: ASA-CSSA-SSSA.

Wankier, P.T., A.L. Patrick, C.A. Schreiber, and **B.G. Hopkins.** 2011. Mowing system and overseeding rates on Kentucky bluegrass American football fields. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 16-19 Oct. 2011; San Antonio, TX. Madison, WI: ASA-CSSA-SSSA.

Bernards, M.L., V.D. Jolley, E.A. Buxton, and **B.G. Hopkins**. 2010. Maize hybrids differ in their 24-hour patterns of phytosiderophore release. (Oral presentation.) *In* Abstracts, *15th International*

Symposium on Iron Nutrition and Interactions in Plants; 26-30 Jun. 2010; Budapest, Hungary. p. 94.

Brown, J.C., Williams, B. Willis, and **B.G. Hopkins**. 2010. Composting, tillage, and rotation effects on micronutrients and soil carbon. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 31 Oct.- 4 Nov. 2010; Long Beach, CA. Madison, WI: ASA-CSSA-SSSA.

Buxton, E.A., **B.G. Hopkins**, V.D. Jolley, B.L. Webb, and R.C. Christensen. 2010. Iron efficiency in Kentucky bluegrass not related to phytosiderophore release. *In* Abstracts, *15th International Symposium on Iron Nutrition and Interactions in Plants;* 26-30 Jun. 2010; Budapest, Hungary. *35*(2), 311–329

Geary, B.D., J. Morton, B. Blaisdell, D.A. Johnson, **B.G. Hopkins**, and V.D. Jolley. 2010. Adequate and high nitrogen represses infection severity of *Colletotrichum coccodes* in Russet Burbank potato roots. (Oral presentation.) *In* Abstracts, *93nd Annual Meeting of the Potato Association of America, Fredericton*; 9-13 Aug. 2009; NB, Canada. Orono, ME: Potato Association of America. *Am. J. Potato Res.* 87:123.

Geary, B.D., J.H. Benson, **B.G. Hopkins**, V.D. Jolley, J.S. Miller, and M.R. Stevens. 2010. Low pH and calcium levels increase infection severity of *Phytophthora erythroseptica* in Russet Norkotah potato roots. (Oral presentation.) *In* Abstracts, *93nd Annual Meeting of the Potato Association of America, Fredericton*; 9-13 Aug. 2009; NB, Canada. Orono, ME: Potato Association of America. *Am. J. Potato Res.* 87:123.

Gneck, J.J., B.D. Geary, D.A. Johnson, **B.G. Hopkins**, and V.D. Jolley. 2010. Influence of differing phosphorus levels on infection severity of *Colletotrichum coccodes* in Russet Burbank potato roots. *In* Abstracts, *Annual Meeting, Potato Association of America;* 15-19 Aug. 2010; Corvallis, OR. Orono, ME: Potato Association of America. *Am. J. Potato Res.* 88:39-40.

Gneck, J.J., B.D. Geary, D.A. Johnson, **B.G. Hopkins**, and V.D. Jolley. 2010. Influence of differing phosphorus levels on infection severity of *Colletotrichum coccodes* in Russet Burbank potato roots. *In* Abstracts, *Annual Meeting, American Phytopathological Society;* 7-11 Aug. 2010; Charlotte, NC. St. Paul, MN: American Phytopathological Society.

Hill, M.W., **B.G. Hopkins**, J.J. LeMonte, T.J. Hopkins, V.D. Jolley, and B.L. Webb. 2010. Phosphorus flux in soil increased with organic acid complexation. . *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 31 Oct.- 4 Nov. 2010; Long Beach, CA. Madison, WI: ASA-CSSA-SSSA.

Hill, M.W., C.J. Ransom, L.A. Babbel, J.J. LeMonte, and **B.G. Hopkins**. 2010. Phosphorus use efficiency improvement with organic acid ligand exchange. (Oral presentation.) *In* Abstracts, *Annual Meeting, Potato Association of America;* 15-19 Aug. 2010; Corvallis, OR. Orono, ME: Potato Association of America. *Am. J. Potato Res.* 88:44.

Hopkins, B.G., R.C. Christensen, V.D. Jolley, and B.L. Webb. 2010. Elemental sulfur impregnated with iron as a fertilizer source for Kentucky bluegrass. *In* Abstracts, *15th International Symposium on Iron Nutrition and Interactions in Plants;* 26-30 Jun. 2010; Budapest, Hungary. p. 83.

Hopkins, B.G., J.J. LeMonte, J.S.C. Summerhays, V.D. Jolley, and B.L. Webb. 2010. Nitrogen use efficiency in Kentucky bluegrass. (Oral presentation.) *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 31 Oct.- 4 Nov. 2010; Long Beach, CA. Madison, WI: ASA-CSSA-SSSA.

Bernards, M.L., V.D. Jolley, E.A. Buxton, and **B.G. Hopkins**. 2010. Maize hybrids differ in their 24-hour patterns of phytosiderophore release. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 31 Oct.- 4 Nov. 2010; Long Beach, CA. Madison, WI: ASA-CSSA-SSSA.

Jolley, V.D. and **B.G. Hopkins.** 2010. Building on the legacy of Arthur Wallace: Practical aspects of iron nutrition in plants and soils. (Oral presentation.) *In* Abstracts, *15th International Symposium on Iron Nutrition and Interactions in Plants*; 26-30 Jun. 2010; Budapest, Hungary. p. 28. *(Invited)*

LeMonte, J.J., T.W. Taysom, and **B.G. Hopkins.** 2010. Polymer coated urea in potato. (Oral presentation.) *In* Abstracts, *Annual Meeting, Potato Association of America;* 15-19 Aug. 2010; Corvallis, OR. Orono, ME: Potato Association of America. *Am. J. Potato Res.* 88:51.

LeMonte, J.J., **B.G. Hopkins,** J.S.C. Summerhays, V.D. Jolley, and R.E. Terry. 2010. Nitrous oxide and ammonia emissions from turfgrass: Urea vs. polymer coated urea. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 31 Oct.- 4 Nov. 2010; ASA-CSSA-SSSA, Madison, WI.

Pletsch, M.C., V.D. Jolley, B.L. Webb, M.D. Vickery, R.L. Buck, and **B.G. Hopkins**, 2010. Field studies comparing nutrient availability in low fertility soils using ion exchange resin capsules and conventional soil tests. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 31 Oct. - 4 Nov. 2010; Long Beach, CA. Madison, WI: ASA-CSSA-SSSA.

Ransom, C.J., **B.G. Hopkins,** J.J. LeMonte, V.D. Jolley, B.L. Webb, and L.A. Babbel. 2010. Improving phosphorus use efficiency with organic acid complexation: Corn. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meetings;* 31 Oct. - 4 Nov. 2010; Long Beach, CA. Madison, WI: ASA-CSSA-SSSA.

Summerhays, J.S.C., J.J. LeMonte, **B.G. Hopkins**, V.D. Jolley, and B.L. Webb. 2010. Nitrogen use efficiency and potato yield with polymer coated urea. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 31 Oct. - 4 Nov. 2010; Long Beach, CA. Madison, WI: ASA-CSSA-SSSA.

Beckett, T.J., M.C. Pletsch, **B.G. Hopkins,** A.K. Shiffler, P.J.S. Hutchinson, B.D. Geary, D.A. Horneck, N.O. Olsen, S.L. Hafez, M.K. Thornton, and J. Washburn. 2009. Reducing pesticides and increasing potato yields by increasing time between potato crops. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 1-5 Nov. 2009; Pittsburgh, PA. Madison, WI: ASA-CSSA-SSSA.

Benson, J.H., B.D. Geary, **B.G. Hopkins,** and V.D. Jolley. 2009. Effect of Ca on pink rot infection in potato. *In* Abstracts, *Annual Meeting, American Phytopathological Society*; 1-5 Aug. 2009; Portland, OR. St. Paul, MN: American Phytopathological Society. 99(6): S180. WOS:000266213301061.

Blaisdell, B., B.D. Geary, J. Morton, M.J. Kearns, D.A. Johnson, **B.G. Hopkins,** and V.D. Jolley. 2009. Available nitrogen levels influence *Colletotrichum coccodes* infection severity of Russet Burbank potato roots. (Oral presentation.) *In* Abstracts, *Annual Meeting, American Phytopathological Society*; 1-5 Aug. 2009; Portland, OR. St. Paul, MN: American Phytopathological Society. Available at: http://apsjournals.apsnet.org/doi/pdf/10.1094/PHYTO.2009.99.6.S1

Buxton, E.A., V.D. Jolley, **B.G. Hopkins,** R.C. Christensen, C.M. Haskell, and B.L. Webb. 2009. Phytosiderophore production in response to Fe deficiency in Kentucky bluegrass. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 1-5 Nov.2009 ; Pittsburgh, PA. Madison, WI: ASA-CSSA-SSSA.

Geary, B.D., M.J. Kearns, E. Song, B. Blaisdell, D.A. Johnson, **B.G. Hopkins,** and V.D. Jolley. 2009. Infection severity of *Colletotrichum coccodes* in Russet Burbank potatoes with respect to environmental potassium. (Oral presentation.) *In* Abstracts, *Annual Meeting, American Phytopathological Society*; 1-5 Aug. 2009; Portland, OR. St. Paul, MN: American Phytopathological Society. 99(6): S41. WOS:000266213300245. Available at: http://apsjournals.apsnet.org/doi/pdf/10.1094/PHYTO.2009.99.6.S1

Haskell, C.M., **B.G. Hopkins,** V.D. Jolley, and E.A. Buxton. 2009. Sports field management: *Poa pratensis* L. phytosiderophore exudation at high iron availability. *In* Abstracts, *Utah Conference on Undergraduate Research*; 20 Feb. 2009; Salt Lake City, UT.

Hopkins, B.G. 2009. Increased production and reduced environmental risk with new potato fertilizers. (Oral presentation.) *In* Abstracts, *Potato Growers of Alberta Annual Conference*; Banff, AB, Canada. *(Invited)*

Hopkins, B.G. 2009. Review of nitrogen and phosphorus fertilizer efficiency research. (Oral presentation.) *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 1-5 Nov. 2009; Pittsburgh, PA. Madison, WI: ASA-CSSA-SSSA. *(Invited)*

Hopkins, B.G. 2009. Polymer coated urea for improved aesthetics, functionality, and reduction of nutrient pollution. (Oral presentation.) *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 1-5 Nov. 2009; Pittsburgh, PA. Madison, WI: ASA-CSSA-SSSA.

Hopkins, B.G. 2009. Potato production with drastically rising fertilizer prices: A review of nitrogen management options. (Oral presentation.) *In* Abstracts, *92nd Annual Meeting of the Potato Association of America*; 10-14 Aug. 2008; Buffalo, NY. *Am. J. Potato Res.* 86:147. *(Invited)*

Hopkins, B.G., R.E. Terry, V.D. Jolley, B.L. Webb, and J.R. Buck. 2009. Nitrous oxide and ammonia emission reductions with polymer coated urea. (Oral presentation.) *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 1-5 Nov. 2009; Pittsburgh, PA. Madison, WI: ASA-CSSA-SSSA.

LeMonte, J.J., **B.G. Hopkins,** R.E. Terry, V.D. Jolley, B.L. Webb, and J.R. Buck. 2009. Nitrous oxide and ammonia emission reduction with polymer coated urea. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 1-5 Nov. 2009; Pittsburgh, PA. Madison, WI: ASA-CSSA-SSSA.

Madsen, M.D., S.L. Petersen, **B.G. Hopkins,** and B.A. Roundy. 2009. Influence of water repellency on post-fire revegetation success. (Oral presentation.) *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 1-5 Nov. 2009; Pittsburgh, PA. Madison, WI: ASA-CSSA-SSSA.

Madsen, M.D., S.L. Petersen, B.A. Roundy, A.G. Taylor, and B**.G. Hopkins.** 2009. Innovative use of seed coating technologies for the restoration of soil wettability and perennial grasses on burned semi-arid rangelands. (Oral presentation.) *In* Abstracts, *Annual Meeting for the Society for Range Management;* 8-12 Feb. 2009; Albuquerque, NM. Littleton, CO: Society for Range Management.

Stark, J.C., G.E. Blaser, and **B.G. Hopkins.** 2009. Crop rotation effects on potato response to nitrogen. (Oral presentation.) *In* Abstracts, *92nd Annual Meeting of the Potato Association of America;* 10-14 Aug. 2008; Buffalo, NY. *Am. J. Potato Res.* 86:158-159.

Thornton, M.K., J.C. Stark, and **B.G. Hopkins.** 2009. Potato variety response to phosphorus fertilizer. (Oral presentation.) *In* Abstracts, *92nd Annual Meeting of the Potato Association of America;* 10-14 Aug. 2008; Buffalo, NY. *Am. J. Potato Res.* 86:160.

Woodward, G.E., J.D. Williams, B.D. Willis, and **B.G. Hopkins.** 2009. Composting, tillage, and rotation effects on soil fertility and physical properties of cultivated soils. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 1-5 Nov. 2009; Pittsburgh, PA. Madison, WI: ASA-CSSA-SSSA.

Barben, S.A., **B.G. Hopkins,** V.D. Jolley, B.L. Webb, and B.A. Nichols. 2008. Phosphorus and zinc relationships in chelator-buffer grown Russet Burbank potato. (Oral presentation.) *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 5-9 Oct. 2008; Houston, TX. Madison, WI: ASA-CSSA-SSSA.

Barben, S.A., B.A. Nichols, **B.G. Hopkins,** V.D. Jolley, and B.L. Webb. 2008. Phosphorus-zinc-manganese interaction. *In* Abstracts, *91st Annual Meeting of the Potato Association of America*: 12-16 Aug. 2007; Idaho Falls, ID. *Am. J. Potato Res.* 85:2-3.

Becket, T.J. and **Hopkins, B. G.** 2008. Cropping frequency to reduce pesticide use. *Utah Conference on Undergraduate Research Proceedings*, Vol 2: 108.

Buxton, E.A., **B.G. Hopkins,** V.D. Jolley, and R.C. Christensen. 2008. Phytosiderophore exudation from the roots of iron stressed Kentucky bluegrass. *In* Abstracts *ASA•CSSA•SSSA International Annual Meeting;* 5-9 Oct. 2008; Houston, TX. Madison, WI: ASA-CSSA-SSSA.

Christensen, R.C., **B.G. Hopkins,** N.J. Chariton, V.D. Jolley, C.M. Haskell, and B.L. Webb. 2008. Iron impregnated elemental sulfur application to Kentucky bluegrass turf: Comparison with standard

fertilizer methods. *In* Abstracts *ASA•CSSA•SSSA International Annual Meeting;* 5-9 Oct. 2008; Houston, TX. Madison, WI: ASA-CSSA-SSSA.

Hopkins, B.G. 2008. Official methods of soil analysis in an increasingly litigious and regulated world. (Oral presentation.) *In* Abstracts *ASA•CSSA•SSSA International Annual Meeting;* 5-9 Oct. 2008; Houston, TX. Madison, WI: ASA-CSSA-SSSA. *(Invited)*

Hopkins, B.G., V.D. Jolley, B.L. Webb, and R.K. Callahan. 2008. Boron fertilization. (Oral presentation.) *In* Abstracts, *91st Annual Meeting of the Potato Association of America*: 12-16 Aug. 2007; Idaho Falls, ID. *Am. J. Potato Res.* 85:14-15.

LeMonte, J.J., T.W. Taysom, **B.G. Hopkins,** V.D. Jolley, and B.L. Webb. 2008. Residual soil nitrate and potato yield with polymer coated urea (ESN). *In* Abstracts *ASA•CSSA•SSSA International Annual Meeting;* 5-9 Oct. 2008; Houston, TX. Madison, WI: ASA-CSSA-SSSA.

Marcroft, K., **B.G. Hopkins,** N.J. Chariton, C.M. Haskell, V.D. Jolley, and B.L. Webb. 2008. Iron impregnated elemental sulfur application to Kentucky bluegrass turf: Rates and application method. *In* Abstracts *ASA•CSSA•SSSA International Annual Meeting;* 5-9 Oct. 2008; Houston, TX. Madison, WI: ASA-CSSA-SSSA.

Nichols, B.A., **B.G. Hopkins,** V.D. Jolley, B.L. Webb, and B.G. Greenwood. 2008. Phosphorus, zinc, and manganese interactions in hydroponically grown maize. *In* Abstracts *ASA•CSSA•SSSA International Annual Meeting;* 5-9 Oct. 2008; Houston, TX. Madison, WI: ASA-CSSA-SSSA.

Pletsch, M.C., D.A. Cook, B.L. Webb, V.D. Jolley, and **B.G. Hopkins.** 2008. Comparing nutrient availability in low fertility soils using ion exchange resin capsules and plant bioavailability under greenhouse conditions. *In* Abstracts *ASA•CSSA•SSSA International Annual Meeting;* 5-9 Oct. 2008; Houston, TX. Madison, WI: ASA-CSSA-SSSA.

Taysom, T.W., **B.G. Hopkins,** A.K. Shiffler, and S.C. Stephens. 2008. Polymer coated urea: Impacts on nitrogen use efficiency and yield parameters. (Oral presentation.) *In* Abstracts, *91st Annual Meeting of the Potato Association of America;* 12-16 Aug. 2007; Idaho Falls, ID. Orono, ME: Potato Association of America. *Am. J. Potato Res.* 85:31-32.

Thornton, M.K., D. Beck, J.C. Stark, and **B.G. Hopkins.** 2008. Potato variety response to phosphorus fertilizer. (Oral presentation.) *In Proceedings of the University of Idaho Winter Commodity Schools;* 4 Mar. 2008; Jerome, ID. Moscow, ID: University of Idaho 40:19-23.

Woodward, G.E., J.D. Williams, B.D. Willis, and **B.G. Hopkins.** 2008. Composting effects on soil fertility and physical properties of low organic matter soils in southeastern ID. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 5-9 Oct. 2008; Houston, TX. Madison, WI: ASA-CSSA-SSSA.

Barben, S.A., **B.G. Hopkins,** B.A. Nichols, V.D. Jolley, and B.L. Webb. 2007. Phosphorus and zinc interactions in hydroponically grown Russet Burbank potato. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* LA. 4-8 Nov. 2007; New Orleans. Madison, WI: ASA-CSSA-SSSA.

Cook, D.A., A. Lyon, B.L. Webb, V.D. Jolley, **B.G. Hopkins,** M.C. Pletsch, and S. Allen. 2007. Assessing the nutrient status of low fertility soils using ion exchange resin capsules. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* LA. 4-8 Nov. 2007; New Orleans. Madison, WI: ASA-CSSA-SSSA.

Hopkins, B.G. and A.G. Cook. 2007. Water repellent soils in potato production. (Oral presentation.) *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* LA. 4-8 Nov. 2007; New Orleans. Madison, WI: ASA-CSSA-SSSA.

Jolley, V.D., **B.G. Hopkins,** B.L. Webb, and R.K. Callahan. 2007. Boron fertilization of potato in southeastern ID. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* LA. 4-8 Nov. 2007; New Orleans. Madison, WI: ASA-CSSA-SSSA.

Nichols, B.A., S.A. Barben, V.D. Jolley, **B.G. Hopkins,** and B.L. Webb. 2007. Phosphorus-manganese interactions in hydroponically grown potato. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* LA. 4-8 Nov. 2007; New Orleans. Madison, WI: ASA-CSSA-SSSA.

Shock, C., J.D. Neufeld, S.J. Reddy, C. Shock, L. Jensen, W.H. Bohl, **B.G. Hopkins,** and J. Miller. 2007. The Pacific Northwest pest alert network, an interactive site promoting stewardship. (Oral presentation.) *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* LA. 4-8 Nov. 2007; New Orleans. Madison, WI: ASA-CSSA-SSSA.

Taysom, T.W., **B.G. Hopkins,** A.K. Shiffler, and S.C. Stephens. 2007. Polymer coated urea in potato. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* LA. 4-8 Nov. 2007; New Orleans. Madison, WI: ASA-CSSA-SSSA.

Woodward, G.E., J.D. Williams, B.D. Willis, and **B.G. Hopkins.** 2007. Composting effects of intensive cultivated low organic matter soils in southeast ID. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* LA. 4-8 Nov. 2007; New Orleans. Madison, WI: ASA-CSSA-SSSA.

Ellsworth, J.W. and **B.G. Hopkins.** 2006. Management of nitrogen with high prices. (Oral presentation.) *In* Abstracts, *Nutrient and Waste Management Conference;* 7 Mar. 2006; Twin Falls, ID. *(Invited)*

Hopkins, B.G. and J.W. Ellsworth. 2006. Cropping systems considerations in nutrient management. (Oral presentation.) *In* Abstracts, *Nutrient and Waste Management Conference;* 7 Mar. 2006; Twin Falls, ID. *(Invited)*

Hopkins, B.G., J.W. Ellsworth, T.R. Bowen, A.G. Cook, and R.A. Oborn. 2006. Variable rate nitrogen fertilization in potatoes. (Oral presentation.) *In* Abstracts, *Annual Meeting, Potato Association of America;* 23-27 Jul. 2006; Madison, WI. Orono, ME: Potato Association of America.

Hopkins, B.G., J.W. Ellsworth, A.G. Cook, and T.R. Bowen. 2006. Drip irrigated potatoes in uniform grid bed planting. (Oral presentation.) *In* Abstracts, *Annual Meeting, Potato Association of America;* 23-27 Jul. 2006; Madison, WI. Orono, ME: Potato Association of America.

Kostka, S.J., B. Lowry, **B.G. Hopkins,** and A.G. Cook. 2006. Synergistic surfactants for improved irrigation efficiency, rootzone water, and productivity in potatoes growing in water repellent soils. (Oral presentation.) *In* Abstracts, *Australian Vegetable Conference;* 11 May 2006; Brisbane, Australia.

Atkinson, D., W.H. Bohl**, B.G. Hopkins,** and B.D. Geary. 2005. The effect of production area on tuber bulking rates and dry matter accumulation. (Oral presentation.). *In* Abstracts, *Annual Meeting, Potato Association of America, Calgary*; 17-21 Jul. 2005; AB. Orono, ME: Potato Association of America.

Bowen, T.R. and **B.G. Hopkins.** 2005. In-season nitrogen management using optical sensing in barley. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 6-10 Nov. 2005; Salt Lake City, UT. Madison, WI: ASA-CSSA-SSSA.

Bowen, T.R., **B.G. Hopkins**, J.W. Ellsworth, A.G. Cook, and. R. Oborn. 2005. In-season variable rate nitrogen fertilization in potatoes. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 6-10 Nov. 2005; Salt Lake City, UT. Madison, WI: ASA-CSSA-SSSA.

Cook, A.G. and **B.G. Hopkins**. 2005. Use of a non-ionic surfactant to overcome hydrophobicity in potato production. (Oral presentation.) *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 6-10 Nov. 2005; Salt Lake City, UT. Madison, WI: ASA-CSSA-SSSA.

Cook, A.G., **B.G. Hopkins**, J.W. Ellsworth, and T.R. Bowen. 2005. Surfactant application effects on soil water repellency and potato yield and quality. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 6-10 Nov. 2005; Salt Lake City, UT. Madison, WI: ASA-CSSA-SSSA.

Hopkins, B.G. 2005. Sustainable potato cropping systems. (Oral presentation.) *UI Sustainable Ag Retreat. (Invited)*

Hopkins, B.G. and J.W. Ellsworth. 2005. Phosphorus fertilizer timing in Russet Burbank. (Oral presentation.) *In* Abstracts, *Annual Meeting, Potato Association of America*; 18 Jul. 2005; Calgary, AB. Orono, ME: Potato Association of America.

Hopkins, B.G., J.W. Ellsworth, T.R. Bowen, and A.G. Cook. 2005. Pre-season nitrogen management in potato. (Oral presentation.) *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 6-10 Nov. 2005; Salt Lake City, UT. Madison, WI: ASA-CSSA-SSSA.

Hopkins, B.G., J.W. Ellsworth, and J.C. Stark. 2005. How to improve fertilizer P recovery: Fertigation. (Oral presentation.) *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 6-10 Nov. 2005; Salt Lake City, UT. Madison, WI: ASA-CSSA-SSSA. *(Invited)*

Hopkins, B.G., J.W. Ellsworth, J.C. Stark, T.R. Bowen, and A.G. Cook. 2005. How to improve fertilizer phosphorus recovery: Fertigation. (Oral presentation.) *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 6-10 Nov. 2005; Salt Lake City, UT. Madison, WI: ASA-CSSA-SSSA.

Hopkins, B.G., D.A. Horneck, M.J. Pavek, R.E. Thornton, G.D. Newberry, B.D. Geary, N.L. Olsen, and J.W. Ellsworth. 2005. Evaluation of university best management practices (BMPs) in potato production. Best Management Practices for Nutrients and Irrigation: Research, Regulations and Future Directions Keynote Symposia. (Oral presentation.) *In* Abstracts, *Annual Meeting, Potato Association of America*; 18 Jul. 2005; Calgary, AB. Orono, ME: Potato Association of America. *(Invited)*

Hopkins, B.G., D.A. Horneck, M.J. Pavek, R.E. Thornton, B.D. Geary, J.W. Ellsworth, and N.L. Olsen. 2005. Best management practices (BMPs) for sustainable potato production: Putting university recommendations to the test. (Oral presentation.) *Washington Potato Conference;* Feb. 2005; Kennewick, WA.

Jolley, V.D., **B.G. Hopkins,** J.W. Ellsworth, B.L. Webb, A.G. Cook, and T. Bowen. 2005. Soil tests and yield response of potato to soil and foliar applications of boron. (Oral presentation.) *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 6-10 Nov. 2005; Salt Lake City, UT. Madison, WI: ASA-CSSA-SSSA.

Neufeld, J.D., S.J. Reddy, J. Miller, N.L. Olsen, W.H. Bohl, **B.G. Hopkins,** J. Windes, L. Jensen, and C. Shock. 2005. Pest alert network. (Oral presentation.) *UI Annual Extension Conference;* 4 Apr. 2005; Moscow, ID.

Taysom, T.W., **B.G. Hopkins,** and J.W. Ellsworth. 2005. Using polymer coated urea in potato production. *In* Abstracts, UI PSES Seminar Series; Moscow, ID.

Bowen, T.R., **B.G. Hopkins,** and J.W. Ellsworth. 2004. Evaluation of geospatial technologies for variable rate nitrogen management in potatoes. *In* Abstracts, *Annual Meeting, Western Society of Soil Science;* 14 Jun. 2004; Logan, UT.

Bowen, T.R., **B.G. Hopkins,** J.W. Ellsworth, and A.G. Cook. 2004. Evaluation of geospatial technologies for variable rate nitrogen management in potatoes. *In* Abstracts, *Annual Meeting, Potato Association of America*; 9 Aug. 2004; Scottsbluff, NE. Orono, ME: Potato Association of America.

Bowen, T.R., **B.G. Hopkins,** J.W. Ellsworth, A.G. Cook, R.A. Oborn, and S.A. Funk. 2004. Optical sensing technologies in potatoes and malting barley. *Optical Sensing Technologies for Nitrogen Management Workshop*; 6 Aug. 2004; Lincoln, NE. *(Invited)*

Cook, A.G. **B.G. Hopkins,** V.D. Jolley, J.W. Ellsworth, B.L. Webb, T.R. Bowen, L. Ewing, and C.I. Mills. 2004. Unraveling the mystery of phosphorus-zinc interaction in potatoes using buffered nutrient solution. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 31 Oct.-4 Nov. 2004; Seattle WA. Madison, WI: ASA-CSSA-SSSA.

Geary, B.D., **B.G. Hopkins,** W.H. Bohl, J.W. Ellsworth, and D.A. Atkinson. 2004. Effect of production area on tuber bulking rates and dry matter accumulation of Russet Burbank, Alturas, Ranger Russet, and Shepody Potato (5497). . (Oral presentation.) *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 31 Oct.-4 Nov. 2004; Seattle WA. Madison, WI: ASA-CSSA-SSSA.

Hobson, J.E., J.W. Ellsworth, A.B. Leytem, and **B.G. Hopkins.** 2004. Variable-rate nitrogen recommendations based on remote sensing technology for nitrogen in sugarbeet (6084). . (Oral presentation.) *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 31 Oct.-4 Nov. 2004; Seattle WA. Madison, WI: ASA-CSSA-SSSA.

Hopkins, B.G. and J.W. Ellsworth. 2004. Variable rate nitrogen fertilization in potatoes. . (Oral presentation.) *In* Abstracts, *Annual Meeting, Potato Association of America*; 9 Aug. 2004; Scottsbluff, NE. Orono, ME: Potato Association of America. *(Invited)*

Hopkins, B.G., J.W. Ellsworth, K. Kelling, and R. Norell. 2004 Trace metal toxicity from manure in Idaho: Emphasis on copper. . (Oral presentation.) *In* Abstracts, *Second Biennial Idaho Nutrient Management Conference;* 11 Mar. 2004; Twin Falls, ID. *(Invited)*

Stark, J.C. and **B.G. Hopkins**. 2004. Deficit irrigation: Managing a potato crop with less water. . (Oral presentation.) *National Potato Council Seed Seminar;* 10 Dec. 2004; Colorado Springs, Colorado. *(Invited)*

Funk, S.A. and **B.G. Hopkins.** 2003. Elemental sulfur use in potato production. *In* Abstracts, *Annual Meeting, Potato Association of America;* 11-14 Aug. 2003. Orono, ME: Potato Association of America.

Geary, B.D., J.C. Stark, S.L. Love, **B.G. Hopkins,** J.W. Ellsworth, D. Atkinson, and J. Windes. 2003. Potato varietal responses to nitrogen rate and timing. . (Oral presentation.) *In* Abstracts, *Annual Meeting, Potato Association of America;* 11-14 Aug. 2003. Orono, ME: Potato Association of America.

Hopkins, B.G. 2003. Best management practices for potato production: Putting university recommendations to the test. . (Oral presentation.) *In* Abstracts, *Annual Meeting, Potato Association of America;* 11-14 Aug. 2003. Orono, ME: Potato Association of America.

Hopkins, B.G. 2003. Variable rate nitrogen fertilization in potato production. . (Oral presentation.) *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 2-6 Nov. 2003; Denver, CO. TSN: A08-hopkins-899959-oral. Madison, WI: ASA-CSSA-SSSA.

Hopkins, B.G. and J.W. Ellsworth. 2003. Phosphorus management in potato production. . (Oral presentation.) *In* Abstracts, *Annual Meeting, Potato Association of America;* 12 Aug. 2003; Spokane, WA. Orono, ME: Potato Association of America.

Hopkins, B.G. and J.W. Ellsworth. Variable rate nitrogen fertilization in potatoes. . (Oral presentation.) *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 2-6 Nov. 2003; Denver, CO. TSN: A08-hopkins-899959-oral. Madison, WI: ASA-CSSA-SSSA. *(Invited)*

Hopkins, B.G., J.W. Ellsworth, and S.A. Funk. 2003. Phosphorus and zinc interactions in potato nutrition. . (Oral presentation.) *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 2-6 Nov. 2003; Denver, CO. TSN: A08-hopkins-899959-oral. Madison, WI: ASA-CSSA-SSSA.

Hopkins, B.G., J.W. Ellsworth, and S.A. Funk. 2003. Phosphorus-zinc interactions in potato production. . (Oral presentation.) *In* Abstracts, *Annual Meeting, Potato Association of America;* 12 Aug. 2003; Spokane, WA. Orono, ME: Potato Association of America.

Hopkins, B.G., V.D. Jolley, D.A. Whitney, and R.E. Lamond. 2003. Zinc deficiency response of sorghum, wheat, and corn. (Oral presentation.) *In* Abstracts, *Annual Meeting, Western Society of Soil Scientists*; 17 Jun. 2003; San Francisco, CA.

Hopkins, B.G. 2002. Relationship of N and water management to water quality. (Oral presentation.) *UI Nutrient Management Conference;* 28 Mar. 2002; Nampa, ID. *(Invited)*

Hopkins, B.G. 2002. Quality assurance in soil and plant testing laboratories. (Oral presentation.) Keynote Address, *Soil Testing and Plant Analysis Breakfast, ASA•CSSA•SSSA International Annual Meeting;* 12 Nov. 2002 Indianapolis, IN. Madison, WI: ASA-CSSA-SSSA. *(Invited)*

Hopkins, B.G., F.F. Vocasek, R.E. Lamond, G.M. Pierzynski, G.L. Keeler, and B. Davis. 2001. Nutrient management plan: Kansas example. (Oral presentation.) *In* Abstracts, *Annual Meeting; ASA-CSSA-SSSA*; 21-25 Oct. 2001; Charlotte, NC. ASA-CSSA-SSSA, Madison, WI. *(Invited)*

Hopkins, B.G. 2000. NMP regulations: State-by-state comparison. (Oral presentation.) *Nutrient Management Symposium, ASA•CSSA•SSSA International Annual Meeting;* 6 Nov. 2000; Minneapolis, MN. Madison, WI: ASA-CSSA-SSSA. *(Invited)*

Hopkins, B.G. 2000. Soil management: Common sense and science. (Oral presentation.) A9 CCA Symposium, *ASA•CSSA•SSSA International Annual Meeting;* 8 Nov. 2000; Minneapolis, MN. Madison, WI: ASA-CSSA-SSSA. *(Invited)*

Hopkins, B.G. 2000. The roles of private and public labs in soil testing. (Oral presentation.) Keynote Address, *Soil Testing and Plant Analysis Breakfast, ASA•CSSA•SSSA International Annual Meeting;* 7 Nov. 2000; Minneapolis, MN. Madison, WI: ASA-CSSA-SSSA. *(Invited)*

Hopkins, B.G. 1999. The role of private sector sponsored continuing education in agriculture. (Oral presentation.) *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 2 Nov. 1999; Salt Lake City, UT. p. 25. Madison, WI: ASA-CSSA-SSSA. *(Invited)*

Hopkins, B.G., D.A. Whitney, and R.E. Lamond. 1994. Zinc fertility of grain sorghum. (Oral presentation.) *In Agronomy* Abstracts. p. 395. Madison, WI: ASA-CSSA-SSSA.

Schulte, E.E. and **B.G. Hopkins.** 1994. Organic matter analysis by weight loss-on-ignition. (Oral presentation.) *In Agronomy* Abstracts. p. 392. Madison, WI: ASA-CSSA-SSSA.

Hopkins, B.G., D.A. Whitney, and R.E. Lamond. 1993. Zinc deficiency stress of grain sorghum and field corn hybrids. (Oral presentation.) *In Agronomy* Abstracts. p. 274. Madison, WI: ASA-CSSA-SSSA.

Hopkins, B.G., V.D. Jolley, and N.C. Hansen. 1991. Phytosiderophore mediated iron uptake in soybean. (Oral presentation.) *In Agronomy* Abstracts. p. 290. Madison, WI: ASA-CSSA-SSSA.

TRADE JOURNALS/POPULAR PRESS (*ALL INVITED*):

Campbell, C.S., **B.G. Hopkins**, and N.C. Hansen. 2021. Soil water tension: Cutting-edge measurement for perfecting turfgrass performance. *SportsField Management* 37(4): 18-21. Available at: https://read.epgmediallc.com/i/1355281-april-2021/18

Evans, S.R., K.Kopp, P.G. Johnson, N.C. Hansen, and **B.G. Hopkins.** 2020. More "pop" per drop: Smart irrigation. *SportsField Management.* 36(6): 20-25. Available at: https://sportsfieldmanagementonline.com/2020/06/30/more-pop-per-drop-smart-irrigation/11694/?oly_enc_id=5568C0145245D2Y

Evans, S.R., K.Kopp, P.G. Johnson, N.C. Hansen, and **B.G. Hopkins.** 2020. More "pop" per drop: Smart irrigation. *OPE Business: Landscape Business*; 63(4)77-82. Available at: https://read.epgmediallc.com/t/190239-outdoor-power-equipment

Hopkins, B.G. 2020. A murder of crows. *Provo Kindness.* 21 Oct 2020. Available at: http://www.provokindness.org/blog

Hopkins, B.G. 2020. Recommendations: Are yours defensible? *Crops & Soils* 53(4): 46-52. Available at: https://doi:10.1002/crso.20048

Hopkins, B.G. 2020. Nitrogen fertilizer: Choose wisely. *SportsField Management* 36(1): 30-32. Available at: https://sportsfieldmanagementonline.com/2020/01/28/nitrogen-fertilizer-choose-wisely/11053/

Hopkins, B.G., J.S. Miller, E. Nielson, and B.D. Geary. 2019. Chemicals, courts and cancer: The glyphosate conundrum. S*portsTurf* 35(10): 14-19. Available at: https://read.epgmediallc.com/i/1169904-october-2019

Hopkins, B.G. and E.A. Woolley. 2019. Biostimulants - Boom or bull? *SportsTurf* 35(6): 26-29. Available at: https://sportsturfonline.com/2019/06/11/biostimulants-boom-or-bull/

Hopkins, B.G. and N.C. Hansen. 2018. University turf researchers are working for you: Brigham Young University research update. *SportsTurf* 34(6): 27-29. Available at: http://read.epgmediallc.com/i/987581-Jun.-2018

Hopkins, B.G. and T.J. Hopkins. 2018. Carbon: The next frontier in fertilization? *Crop Soil* 51(3) 36-38. Available at: https://dl.sciencesocieties.org/publications/cns/articles/51/3/36.

Hopkins A.P., **B.G. Hopkins**, N.C. Hansen, and T.J. Hopkins. 2017. Interacting Water & Nitrogen. *Turf Trends* 3(3): 10-17.

Hopkins, B.G., A.P. Hopkins, and N.C. Hansen. 2017. Water-wise turf is good even without drought. *SportsTurf* 3:32-34. Plymouth, MN: Sports Turf Managers Association via Green Media Online. Available at: https://sportsturfonline.com/2017/05/09/water-wise-turf-good-even-when-without-drought/

D.A. Carroll II and **B. G. Hopkins.** 2014. Using agricultural byproducts in the effort to restore Haiti's forests: Composted sugarcane bagasse as a soil amendment in Haitian silviculture. *BYU J. Undergrad. Res.* Available at: http://jur.byu.edu/?p=15426.

Hopkins, B.G., S.A. Randall, T.M. Story, C.J. Ransom, and L.E. Sutton. 2013. "Fertilizer Bans" coming to a city near you? *Western Turf* 12:18-21. Idaho Falls, ID: Harris Publishing.

Hopkins, B.G. 2012. 11 steps to proper soil management: A fundamental soil test interpretation guide. *Western Turf* 11:18-21. Idaho Falls, ID: Harris Publishing.

Hopkins, B.G. 2011. Increasing tuber yield and quality with Carbond P. *Potato Grower* 40:36-37. Idaho Falls, ID: Harris Publishing.

Hopkins, B.G. 2010. Testing Carbond technology: A solution to the phosphorus availability problem. *Potato Grower* 39:36-37. Idaho Falls, ID: Harris Publishing.

Hopkins, B.G. and J.J. LeMonte. 2010. Growth spurts: Impacting hormones in sugarbeets. *Sugar Producer*. 36:22-25. Idaho Falls, ID: Harris Publishing. *Mountain West Turf* 9:22-25. Idaho Falls, ID: Harris Publishing.

Spratling, T.L., D.L. Perry, W.M. Dix, G.H. Hardy, **B.G. Hopkins** and B.D. Geary. 2010. An ounce of prevention: Take-all disease and soil pH. *Western Turf* 9:18-19. Idaho Falls, ID: Harris Publishing.

Hopkins, B. G. 2009. Nitrogen balancing act: Aesthetics, functionality, and environment. *Mountain West Turf* 8: 20–22.

Hopkins, B. G. and R.C. Christensen. 2009. The forgotten half: Discussing root zone health. *Mountain West Turf* 7: 22–24.

Hopkins, B.G. 2009. Nitrogen: Balancing aesthetics, functionality, and environment. *Mountain West Turf* 8:20-22. Idaho Falls, ID: Harris Publishing.

Hopkins, B.G. 2008. Crop consulting: Importance of irrigation knowledge. *Potato Grower* 37(11):24-25. Idaho Falls, ID: Harris Publishing.

Hopkins, B.G., J.W. Ellsworth, and J.D. Henningsen. 2008. Reducing the fertilizer bill. *Sugar Producer* 34(5):19-20. Idaho Falls, ID: Harris Publishing.

Hopkins, B.G., J.W. Ellsworth, and J.D. Henningsen. 2008. Specially formulated fertilizer: Green doesn't always equal green. *Sugar Producer* 34(6):17-18. Idaho Falls, ID: Harris Publishing.

Shiffler, A.K., T.J. Beckett, and **B.G. Hopkins.** 2008. Delayed senescence through crop rotation. *Potato Grower* 37(9):18-19. Idaho Falls, ID: Harris Publishing.

Shiffler, A.K., **B.G. Hopkins,** S.L. Hafez, and P.J.S. Hutchinson. 2008. Taking on nematodes: Why crop rotation counts. *Potato Grower* 37(12):22-23. Idaho Falls, ID: Harris Publishing.

Hopkins, B.G. 2007. Fertilization – Low petiole phosphate or potassium? Another option. *Potato Grower* 36(7):38. Idaho Falls, ID: Harris Publishing.
Hopkins, B.G. and J.W. Ellsworth. 2007. Remote Sensing: The view from above. *Sugar Producer* 34(3):29-30. Idaho Falls, ID: Harris Publishing.
Butler-Price, N. and **B.G. Hopkins.** 2006. Budget analysis workshop. Interview article. *Potato Grower* 35(4):34-35. Idaho Falls, ID: Harris Publishing.
Butler-Price, N. 2006. Water management programs increase yield, quality. Interview article. *Potato Grower* 34(11):14-19. Idaho Falls, ID: Harris Publishing.
Ellsworth, J.W. and **B.G. Hopkins.** 2006. Establishing on-farm research plots. *Potato Grower* 34(11):36-39. Idaho Falls, ID: Harris Publishing.
Fairborn, D. 2006. What are best management practices telling growers?: Famous potatoes field day participants learn from U of I field trials. Interview article. *Potato Grower* 34(11):30-35. Idaho Falls, ID: Harris Publishing.
Hopkins, B.G. and J.W. Ellsworth. 2006. Sugarbeet nutrition research. *Sugar Producer* 32:15-18. Idaho Falls, ID: Harris Publishing.
Hopkins, B.G., J.W. Ellsworth, and W.H. Bohl. 2006. Adapt or face extinction. *Potato Grower* 35(3):44-47. Idaho Falls, ID: Harris Publishing.
Hopkins, B.G., J.W. Ellsworth, and H. Neibling. 2006. Drip irrigation in beds. *Potato Grower* 35(2):22-26. Idaho Falls, ID: Harris Publishing.
Neibling, H. and **B.G. Hopkins.** 2006. Pre-season irrigation system maintenance. *Potato Grower* 35(2):69-70. Idaho Falls, ID: Harris Publishing.
Warren, K. 2006. Potatoes on drip. Interview article. *Spudman* 44(5):20-23. Sparta, MI: Great American Publishing.
Anonymous. 2005. Move water to the rootzone – improve potato quality and yield . . . Increase profits. Interview article. *Badger Common'Tater* 57(4):16-17. Antigo, WI: Wisconsin Potato and Vegetable Growers Association.
Hopkins, B.G., E. Cook, and R. Neff. 2005. Famous potatoes field day. *Potato Grower* 34(7):29-31, 37. Idaho Falls, ID: Harris Publishing.
Hopkins, B.G. and J.W. Ellsworth. 2005. Water run phosphorus: Help or hinder? Phosphorus nutrition and chemistry. *Potato Grower* 34(7):3. Idaho Falls, ID: Harris Publishing.
McMullin, E. 2005. GPS steering pays off in potato operations. Interview article. *Potato Grower* 34(5):24-25. Idaho Falls, ID: Harris Publishing.
Rawlins, G. 2005. Are you watching your Zn, Mn, Cu, Fe, B, Cl, and Mo? Interview article. *Potato Grower* 34(3):23-24. Idaho Falls, ID: Harris Publishing.
Butler, N. 2004. Instituting better water efficiency. Interview article. *Potato Grower* 33(4):38-39. Idaho Falls, ID: Harris Publishing.
Butler, N. 2004. Phosphorus fertilizer: Consider whole management system. Interview article. *Potato Grower* 33(4):44-45. Idaho Falls, ID: Harris Publishing.
Ellsworth, J.W. and **B.G. Hopkins.** 2004. Precision agriculture may be just a notebook, pencil. *Potato Grower* 33(11):32-33, 38. Idaho Falls, ID: Harris Publishing.
Fairbourn, D. 2004. U of I researchers compare management practices. Interview article. *Potato Grower* 33(11):24-27. Idaho Falls, ID: Harris Publishing.
Greenfield-Becker, S. 2004. Band placement nutrient report. Interview article. *Sugar* 31(5): 10-11. Idaho Falls, ID: Harris Publishing.
Hopkins, B.G., J.S. Miller, and S. Albrecht. 2004. Biological aspects of soil, crop management. *Potato Grower* 33(6):24-29. Idaho Falls, ID: Harris Publishing.

Morris, C. 2004. Vine killing. Interview article. *Spudman* 42(7): 24-25. Sparta, MI: Great American Publishing.

Northcut, G. 2004. Avoiding sand traps and other magnesium pitfalls. Interview article. Port Orchard, WA: IMC Global and Northcut Communications.

Thornton, M.K., **B.G. Hopkins,** and J.C. Stark. 2004. Impact of tillage on compaction. *Potato Grower* 33(5):28-30. Idaho Falls, ID: Harris Publishing.

Burnham, T.J. 2003. BMPs spark spuds. *Western Farmer-Stockman* 126(7):14-15. Cleveland, Ohio: Penton Agriculture.

Ellsworth, J.W. and **B.G. Hopkins.** 2003. Micronutrients: Are they needed in your soils? *Potato Grower* Idaho Falls, ID: Harris Publishing.

Hopkins, B.G. 2003. Best management practices. *Spudman* Sparta, MI: Great American Publishing.

Hopkins, B.G., J.W. Ellsworth, and P.E. Patterson. 2003. Skyrocketing nitrogen prices and potato production. *Potato Grower* 32(5):34-36. Idaho Falls, ID: Harris Publishing.

Hopkins, B.G. and G.W. Harding. 2003. Why best management practices?: Putting UI recommendations to the test. *In Potato Grower* 31(2). Idaho Falls, ID: Harris Publishing.

Hopkins, B.G. and J.C. Stark. 2003. Humic acid effects on potato response to phosphorus. *Potato Grower* Idaho Falls, ID: Harris Publishing.

Peacock, R. 2003. Best management practices. *Potato Grower* p. 34-36. Idaho Falls, ID: Harris Publishing.

Peacock, R. 2003. It's Time to get on the 'Band'wagon. Interview article. *Sugarbeet Grower* p. 16-17. Idaho Falls, ID: Harris Publishing.

Greenfield, S. 2002. Spraying foliars with micronutrients. Interview article. *Potato Grower* 31(11):22-23. Idaho Falls, ID: Harris Publishing.

Hopkins, B.G. 2002. What can you get from the previous crop? *Potato Grower* 31(5): 24-26. Idaho Falls, ID: Harris Publishing.

Hopkins, B.G. 2002. Why waste water, nitrogen? *Potato Grower* 31(5):44-46. Idaho Falls, ID: Harris Publishing.

Hopkins, B.G., P.J.S. Hutchinson, and J.M. Alvarez. 2002. Previous crop impacts weed, insect management. *Potato Grower* 31(8):12-13. Idaho Falls, ID: Harris Publishing.

Miller, J., T. Miller, **B.G. Hopkins**, P. Nolte, and B.D. Geary. 2002. Previous crop and disease management. *Potato Grower* Idaho Falls, ID: Harris Publishing.

Hopkins, B.G. 2001. Irrigation uniformity: Ten ways to increase 40-60 cwt. *Potato Grower* 30(11):28-30. Idaho Falls, ID: Harris Publishing.

WEBCASTS AND DIGITAL EDUCATION*:*

Hopkins, B.G., C. Hull. 2022. Caring for your grounds with smart irrigation. *American public works association (APWA) facilities and grounds committee*; 28 April 2022. Virtual. *(invited.)*

Hopkins, B.G., N.C. Hansen, C.S. Campbell, and Kerry, R. 2022. Water management: Cutting-edge precision tools you may be missing. *Sports Turf Managers Association (STMA) Annual Meet*; 9 Feb. 2022. Virtual. *(invited.)*

Hopkins, B.G. 2022. Phophorus on potato in the pacific northwest. *Fertilizer Recommendation Support Tool (FRST) National Committee*; 8 Feb. 2022. Virtual. *(invited.)*

Hopkins, B.G. 2022. Phosphorus best practices. *Panelist for Trimming the Fertilizer Fat for Forages: Strategies for Dealing with Doubling of Prices;* 11 Jan. 2022; Utah State University, Logan, UT.Virtual. *(invited.)* https://extension.usu.edu/crops/events/twenty-twenty-two-crop-school

Burgin, H.R., G.A. Wear, N.C. Hansen, and **B.G. Hopkins.** 2021. Hybrid bermudagrass in cool, arid climates. (Poster presentation.) *Intermountain Sustainability Summit*; 18 Mar. 2021. Virtual.

Geary, B.T., S.R. Fahning, and **B.G. Hopkins.** 2021. Environmentally friendly fertilizers. *BYU Library/Life Sciences Undergraduate Poster Competition;* Mar 2021; Brigham Young University, Provo, UT. Virtual. https://scholarsarchive.byu.edu/library_studentposters_2021/24

Geary, B.T., S.R. Fahning, and **B.G. Hopkins.** 2021. Enhanced efficiency nitrogen fertilizers: Coated urea. (Poster presentation.) *In Proceedings of the Western Nutrient Management Conference (WNMC);* 2-4 Mar. 2021. WERA103. Virtual.

Hopkins, B.G. 2021. Enhanced efficiency phosphorus fertilizers. *Servi-Tech Annual Professional Development Conference*; 21 Jan. 2021. Virtual.

Hopkins, B.G. 2021. Biostimulants overview. Integrating soil biogeochemistry and fertilizer sciences to improve ecosystem services across agricultural landscapes; 15 Jan. 2021. *Foundation for Food & Agriculture Research (FFAR).*Virtual. *(invited)*

Hopkins, B.G., N.C. Hansen, and C.S. Campbell. 2021. Irrigation: Grass health, surface quality, and sustainability. *Sports Turf Managers Association (STMA) Annual Meet*; 29 Jan. 2021. Virtual. *(invited.)* Avalable at: https://www.youtube.com/watch?v=NwRTDBFspMc&feature=youtu.be

Lambert, A.M., D.L. Cole, T.T. Heidenreich, S.H. Stapley, R.L. Buck, and **B.G. Hopkins.** 2021. A new hydroponic system for testing mineral nutrient deficiencies and its application to quinoa. *BYU Library/Life Sciences Undergraduate Poster Competition;* Mar 2021; Brigham Young University, Provo, UT. Virtual.

Lambert, A.M., D.L. Cole, D.T. Heidenreich, S.H. Stapley, R.L. Buck, and **B.G. Hopkins.** 2021. New hydroponic system for testing mineral nutrient deficiencies and its application to quinoa. (Poster presentation.) *Intermountain Sustainability Summit*; 18 Mar. 2021. Virtual.

Lambert, A.M., D.L. Cole, D.T. Heidenreich, S.H. Stapley, R.L. Buck, and **B.G. Hopkins.** 2021. New hydroponic system for testing mineral nutrient deficiencies: Quinoa. *In Proceedings of the Western Nutrient Management Conference (WNMC);* 2-4 Mar. 2021. WERA103. Virtual.

Seely, C.J., S.J. Kobza, and **B.G. Hopkins.** 2021. Enhanced efficiency phosphorus fertilizers. *In Proceedings of the Western Nutrient Management Conference (WNMC);* 2-4 Mar. 2021. WERA103. Virtual.

Stapley, S.H., N.C. Hansen, M.A. Yost, and **B.G. Hopkins**. 2021. Stacking nutrient 4Rs on potato: An analysis of best management practices. *BYU Library/Life Sciences Undergraduate Poster Competition;* Mar 2021; Brigham Young University, Provo, UT. Virtual.

Stapley, S.H., and **B.G. Hopkins.** 2021. Stacking and intersecting nutrient 4Rs and using in-season canopy health and petiole nitrate analysis on russet burbank potatoes. (Poster presentation.) *In Proceedings of the Western Nutrient Management Conference (WNMC)*; 2-4 Mar. 2021. WERA103. Virtual.

Burgin, H.R., G. Wear, N.C. Hansen, and **B.G. Hopkins.** 2020. Mowing height and irrigation rate comparisons of *Cynodon Dactylon* (L.) Pers. x *C. Transvaalensis* and *Poa Pratensis* L. *Western Crop Science Society Meeting;* 7 July 2020. Virtual.

Bonsrah, D.K.A., E.A. Woolley, S.J. Kobza, T.G. Searle, J.D. Williams, and **B.G. Hopkins.** 2020. Homogeneous boron-potassium fertilizer granules: Potato and alfalfa. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 9-13 Nov. 2020. Virtual.

Burgin, H.R., G.A. Wear, N.C. Hansen, B.D. Geary, and **B.G. Hopkins.** 2020. Bermudagrass vs. Kentucky bluegrass under varying irrigation rates. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 9-13 Nov. 2020. Virtual.

Campbell, A., C.Thompson, M.Chen, C.S. Campbell, **B.G. Hopkins**, and N.C. Hansen. 2020. A better look at real-time soil conditions under turf: Paired root-zone water content and potential sensors. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 9-13 Nov. 2020. Virtual.

Cole, D.L., D.T. Heidenreich, S.H. Stapley, A.M. Lambert, R.L. Buck, and **B,G. Hopkins.** 2020. New hydroponic system for testing mineral nutrient deficiencies: Quinoa. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 9-13 Nov. 2020. Virtual.

Cole, D.L. and **B.G. Hopkins.** 2020. A new hydroponic system for testing mineral nutrition deficiencies and its application to quinoa. *BYU College Undergraduate Research Awards Virtual Conference.* Prerecorded; 2020 Provo, UT: Brigham Young University. Virtual.

Fahning, S. R. and **B.G. Hopkins.** 2020. Overview of enhanced efficiency nitrogen fertilizers: Coated urea. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 9-13 Nov. 2020. Virtual.

Hopkins, B.G. 2020. Overview of the Biostimulant World. *InfoAg Conference;* 15 Dec. 2020; Virtual.

Hopkins, B.G. 2020. Review of EEFs: Some Meet the Claim and Others Don't. *Washington State University Soil Fertility Webinar;* 14 Dec. 2020. Virtual.

Hopkins, B.G., G.E. Cardon, and J.R. Lawley. 2020. Plant tissue methods accuracy and precision comparison: Historical North American Proficiency Testing (NAPT) program results. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 9-13 Nov. 2020. Virtual. *(Invited)*

Hopkins, B.G. 2020. Late summer management and pandemic impacts on the sports turf industry. *Sports Turf Managers Association (STMA) Town Hall Meeting (Panelist);* 11 Aug 2020. Virtual. Available at: https://www.youtube.com/watch?v=pJBhO6Fymn8

Hopkins, B.G., S. Stapley, N.C. Hansen, and M.A. Yost. 2020. Potato 4R tour and updates. *USU Extension Crops Virtual Field Day*; 29 July 2020. Virtual.

Kobza, S.J. and **B.G. Hopkins.** 2020. Enhanced efficiency phosphorus fertilizers. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 9-13 Nov. 2020. Virtual.

Larsen, I., N.C. Hansen, **B.G. Hopkins,** and R. Kerry. 2020. Variable rate irrigation management zone delineation using spatial statistics. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 9-13 Nov. 2020. Virtual.

Stapley, S.H., N.C. Hansen, M.A.Yost, and **B.G. Hopkins.** 2020. Stacking and intersecting nutrient 4R's and using in-season canopy health and petiole nitrate analysis on Russet Burbank potatoes . *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 9-13 Nov. 2020. Virtual.

Woolley, E.A., J.D. Svedin, A.P. Hopkins, R.Kerry, R. Jensen, N.C. Hansen, and **B.G. Hopkins**. 2020. Soil moisture variability by zone represented through soil sampling and soil sensor data. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 9-13 Nov. 2020. Virtual.

Yost, M.A., N.C. Hansen, B.G. Hopkins, J.D. Williams, O.S. Walsh, G.E. Cardon, E.Creech, and B. Black. 2020. Trends and opportunities in 4R nitrogen management of field and fruit crops in the intermountain west. *In* Abstracts, *ASA•CSSA•SSSA International Annual Meeting;* 9-13 Nov. 2020. Virtual.

Hopkins, B.G. 2019. Chemical (eg. glyphosate) exposure for employees and players: Health concern? *Sports Turf Managers Association (STMA) Annual Meet, (Pre-conference Webinar);* 11 Dec. 2019. Available at: https://zoom.us/recording/play/sT3SbDLYCrHoix-zikcooyeAsltAa5tCvmYOksszxXehu6ylff-LSskVjjWIMkqA?continueMode=true

Hopkins, B.G. 2019. Phosphorus in soil. *NUE University (Nutrient Use Efficacy), Verdesian Life Sciences;* 29 Jul 2019; Provo, UT. Available at: https://www.vlsci.com/nue-university

Hopkins, B.G. 2019. Phosphorus in plants. *NUE University (Nutrient Use Efficacy), Verdesian Life Sciences;* 30 Jul 2019; Provo, UT. Available at: https://www.vlsci.com/nue-university

Hopkins, B.G. 2019. Carbon fertilization: Snake oil or the next big thing? *Sports Turf Managers Association (STMA) Annual Meet. (Pre-conference Webinar);* 10 Jan. 2019; Phoenix, AZ.

Hopkins, B.G. 2018. Enhanced efficiency nitrogen and phosphorus fertilizers. *Western Region Nutrient Management Coordinating Committee/WERA-103*; 19 Jul. 2018.

Hopkins, B.G. 2017. Advanced soil science for the sports turfgrass professional. *Sports Turf Managers Association (STMA) Annual Meet. (Pre-conference Webinar);* 29 Nov. 2017. Available at: http://penxy.com/suki

Hopkins, B.G. 2017. Enhanced efficiency fertilizers. *Federated Co-operatives Limited*; 7 Nov. 2017; Saskatoon, Canada SK S7K 0H2,

Hopkins, B.G. 2017. ESN research on potatoes review– Dr. Bryan Hopkins, Ph.D. Brigham Young University. *Agrium ESN Field Day*; 20 Jul. 2017; Aberdeen, ID. Available at: https://youtu.be/myWFOtHcwGg

Hopkins, B.G. 2017. Dr. Bryan Hopkins, Ph.D. Brigham Young University discusses the merits of ESN. *Agrium ESN Field Day*; 20 Jul. 2017; Aberdeen, ID. Available at: https://youtu.be/Za1E_2gOZB8

Hopkins, B.G., N.C. Hansen, and K.L. Kopp. 2017. Don't let water restriction strike you out. *Sports Turf Managers Association.* 19-22 12 Jan. 2017.

Hopkins, B.G. 2015. Phosphorus fertilization in potato. *Spudman.* 18 Feb. 2015.

Hopkins, B.G. 2015. Drought in the urban landscape. *LDS FM Training Conference.* 13 Aug. 2015.

Miller, J. **B.G. Hopkins,** and B.D. Geary. 2015. "It's significant to me": The purpose of using statistics in agriculture. Plant Management Network: APS Crop Protection and Management Collection. Available at: http://www.plantmanagementnetwork.org/edcenter/seminars/Potato/Statistics/presentation.html

Hopkins, B.G. 2014. Turfgrass fertilization. Sports Turf Managers Association; 19 Nov. 2014.

Hopkins, B.G. 2013. Biophysical chemistry 101: Wetting front impacts the turfgrass, environment, pests, and profits. Water Week Conference Aquatrols; 18 Oct. 2013.

Shock, C., J.D. Neufeld, S.J. Reddy, L. Jensen, W.H. Bohl, **B.G. Hopkins,** and J. Miller. 2007. *Pacific Northwest Pest Alert Network interactive web site promoting environmental stewardship*. http://www.tvpestalert.net/index.php3: Oregon State University; University of Idaho; various commodity commissions in the PNW.

PRESENTATIONS AT PROFESSIONAL MEETINGS

Geary, Benjamin T., Seely, C. J., and **Hopkins, B. G.** 2022 Polymer Coated Urea Microplastics: Sweet Corn. Polymer Coated Urea Microplastics: Urban Landscape. *Library/Life Sciences Undergraduate Poster Competition 2022*; Mar. 2022; Provo, UT: Brigham Young University. Available at: https://scholarsarchive.byu.edu/library_studentposters_2022/4

Seely, C. J., Geary, B. T., and **Hopkins, B. G.** 2022. Polymer Coated Urea Microplastics: Urban Landscape. *Library/Life Sciences Undergraduate Poster Competition 2022*; Mar. 2022; Provo, UT: Brigham Young University. Available at: https://scholarsarchive.byu.edu/library_studentposters_2022/31

Flint, E. A., Yost, M., Kerry, R., Hansen, N. C., and **Hopkins, B. G.** 2022. Optimal sensor placement for sensor-based irrigation scheduling in a variable rate irrigation system. (Poster presentation) *USU Interdisciplinary Water Science & Education*; 20 Mar. 2022; Logan, UT: Utah State University

Hopkins, B.G. 2022. Saline sodic soil and water. *Idaho Independent Crop Consultants.* 16 March 2022; virtual (*invited*).

AHopkins, B.G. 2022. How to optimize phosporus fertilizer management. *Trimming the Fertilizer Fat for Forages: Strategies for Dealing with Doubling of Prices;* 11 Jan. 2022; virtual (*invited*) https://www.youtube.com/watch?v=w3FNTIlc248&list=PLMnDQoXFVBEZXfoSqJSNf_daMgMLi_-cM&index=114

Hopkins, B.G. 2022. Smart irrigation. *April click listen learn webinar*; 28 Apr. 2022; virtual (*invited*).

Hopkins, B.G. 2022. Healthy grass & environment: New technologies for smart water & nutrition. *Golf Course Superintendents Association of America* (*GCSAA) conference and trade show;* 7-10 Feb. 2022; San Diego, CA. *(invited)*

Miller, J.S. and **B.G. Hopkins.** 2022. It's Significant to Me! Making sense of agricultural variability, statistics, and on-farm research. *Washington and Oregon Potato Conference*; 27 Jan. 2022; Kennewick, WA. https://millerresearch.com/wp-content/uploads/2022/02/ItsSignificantToMe_StatsInAg.pdf. *(invited)*

Hopkins, B.G. 2022. Biostimulants: What are they and how to use them? *Sports Turf Managers Association (STMA) Annual Meet*; 17-20 Jan. 2022; Savannah, GA. *(invited)*

Hopkins, B.G. 2022. Chemicals (eg. glyphosate) exposure for employees and players: Health concern? *Sports Turf Managers Association (STMA) Annual Meet*; 17-20 Jan. 2022; Savannah, GA. *(invited)*

Fahning, S.R. and **B.G. Hopkins.** 2020. Enhanced efficiency nitrogen fertilizer: Coated urea. *Library/Life Sciences Undergraduate Poster Competition 2020*; Mar. 2020; Provo, UT: Brigham Young University. Available at: https://scholarsarchive.byu.edu/library_studentposters_2020/30/

Hopkins, B.G. 2020. Chemicals (eg. glyphosate) exposure for employees and players: Health concern? *Intermountain Sports Turf Managers Association (IMSTMA) Annual Meet*; 21 Feb. 2020; Salt Lake City, UT. *(invited)*

Hopkins, B.G. 2020. Soil health indicators. *USU – NRCS Soil Health Conference*; 19 Feb. 2020; Brigham City, UT. *(invited)*

Hopkins, B.G. 2020. Phosphorus management in high yielding environments – Do data support existing critical levels? *Mid-Atlantic Soil Testing and Plant Analysis Work Group, CIG-P Meeting;* 11-12 Feb. 2020; Raleigh, NC. *(invited)*

Hopkins, B.G. 2020. North American Proficiency Testing (NAPT) – Update. *Mid-Atlantic Soil Testing and Plant Analysis Work Group, CIG-P Meeting;* 11-12 Feb. 2020; Raleigh, NC. *(invited)*

Hopkins, B.G. 2020. Enhanced Efficiency Fertilizers: Yield and environmental considerations. *Southwest Hay & Forage Conference;* 29-31 Jan. 2020; Ruidoso, NM.

Hopkins, B.G. 2020. More pop per drop: Smart irrigation. *Sports Turf Managers Association (STMA) Annual Meet*; 13-16 Jan. 2020; West Palm Beach, FL. *(invited)*

Hopkins, B.G. 2020. Chemical (glyphosate, fertilizer, etc.) exposure: Health concern? *Sports Turf Managers Association (STMA) Annual Meet*; FL, 13-16 Jan. 2020; West Palm Beach, FL. *(invited)*

Kobza, S.J. and **B.G. Hopkins.** 2020. Enhanced efficiency phosphorus fertilizers. *Library/Life Sciences Undergraduate Poster Competition 2020*; Mar. 2020; Provo, UT: Brigham Young University. Available at: https://scholarsarchive.byu.edu/library_studentposters_2020/23/

Buck R.L. and **B.G. Hopkins.** 2019. Soils mini-course for landscape architects. *Utah Chapter of the American Society of Landscape Architects Annual Meeting;* 17 May 2019; Pleasant Grove, UT. (invited)

Burgin, H.R., G. Wear, N.C. Hansen, and **B.G. Hopkins.** 2019. Drought, cold, and traffic tolerance of bermudagrass cultivars in arid regions. *BYU PWS Graduate Research Conclave*; 21 Nov. 2019; Provo, UT: Brigham Young University. *(invited)*

Hansen N.C., R. Kerry, M. Heaton, R. Jensen, R. Spackman, E.A. Woolley, J.D. Svedin, and **B.G. Hopkins.** 2019. Update on variable rate irrigation (VRI) research at BYU. *Field day presentation*; July 2019; Logan, UT.

Hopkins, A.P., **B.G. Hopkins,** and N.C. Hansen. 2019. Remote sensing. *BYU PWS Graduate Research Conclave*; 21 Nov. 2019; Provo, UT: Brigham Young University. *(invited)*

Hopkins, B.G. 2019. Fall turfgrass care is vital for year long success. *Utah Facilities Operation & Maintenance Association (UFOMA);* 8 Oct. 2019; St. George, UT.

Hopkins, B.G. 2019. Carbon Fertilization: Boom or bull? *CBIGG Golf Course Superintendent, Fall Summit*; 10-11 Sept. 2019; Katy, TX.

Hopkins, B.G. 2019. Irrigation Water Quality: You can't manage effectively what you don't measure. *CBIGG Golf Course Superintendent, Fall Summit;* 10-11 Sept. 2019; Katy, TX

Hopkins, B.G. 2019. Biostimulants: Boom or bull. *Association of American Plant Food Control Officials (AAPFCO) Annual Summer Meeting;* 8 Aug. 2019; Louisville, KY. *(invited keynote address)*

Hopkins, B.G. 2019. Overview of biostimulants efficacy. *The Fertilzer Institute 4R Nutrient Stewardship Summit;* 10-11 June 2019; Cleveland, OH. *(invited)*

Hopkins, B.G. 2019. Turf selection and cultural practices. *Spring School IPM Meeting: Turf & Turf Pests;* 2 May 2019; American Fork, UT *(invited)*

Hopkins, B.G. 2019. Carbon fertilization: Snake oil or the next big thing? *Sports Turf Managers Association (STMA) Annual Meet*; 22-25 Jan. 2019; Phoenix, AZ. *(invited)*

Hopkins, B.G. 2019. University research update panel: Report on our research on nitrogen and water management. *Sports Turf Managers Association (STMA) Annual Meet*; 25 Jan. 2019; Phoenix, AZ. *(invited)*

Larsen, I.L., E.A. Woolley, J.D. Svedin, N.C. Hansen, R.Kerry, and **B.G. Hopkins.** 2019. Soil water modeling for variable rate irrigation. *BYU PWS Graduate Research Conclave*; 21 Nov. 2019; Provo, UT: Brigham Young University. *(invited)*

Nelson, S.V., M.D. Madsen, N.C. Hansen, V.J. Anderson, and **B.G. Hopkins.** 2019. Hydrogel to improve seedling establishment in rangeland restoration. *BYU PWS Graduate Research Conclave*; 21 Nov. 2019; Provo, UT: Brigham Young University. *(invited)*

Svedin, J.D., N.C Hansen, R. Kerry, and **B.G. Hopkins.** 2019. Modeling spatio-temporal variations in crop water stress for variable-rate irrigation. *Precision agriculture'19;* 2019

Woolley, E.A., J.D. Svedin, N.C. Hansen, R. Kerry, and **B.G. Hopkins.** 2019. Spatio-temporal soil water and crop stress modeling for variable rate irrigation. *BYU PWS Graduate Research Conclave*; 21 Nov. 2019; Provo, UT: Brigham Young University. *(invited)*

Crosland, M.S., B.B. Peacock, B.D. Geary, and **B.G. Hopkins.** 2018. Nitrogen and *Rhizoctonia solani* interactions in creeping bentgrass (*Agronstis stolonifera L.). Sports Turf Managers Association (STMA) Annual Meet*; 16-19 Jan. 2018; Fort Worth, TX. *(invited)*

Douglas, C. and **B.G. Hopkins**. 2018. Enhanced efficiency fertilizers in sports turf. *Sports Turf Managers Association (STMA) Annual Meet*; 16-19 Jan. 2018; Fort Worth, TX. *(invited)*

Hastriter A., K. Russell, and **B.G. Hopkins.** 2018. Nitrogen and water interactions in Kentucky bluegrass (Poa pratensis L.). *Sports Turf Managers Association (STMA) Annual Meet*; 16-19 Jan. 2018; Fort Worth, TX. *(invited)*

Hopkins, B.G. 2018. Nitrogen management innovations. *Shoshone Bannock Tribe Grower's Meeting;* 16 Mar. 2018; Fort Hall, ID. *(invited)*

Hopkins, B.G. 2018. Potato rotations and soil fertility/plant nutrition. *Lamb Weston meeting*; 22 Feb. 2018; Twin Falls, ID. *(invited)*

Hopkins, B.G. 2018. Heavy Traffic: Successes and failures. *Intermountain Sports Turf Managers Association (IMSTMA) Annual Meet*; 16 Feb. 2018; Salt Lake City, UT. *(invited)*

Hopkins, B.G. 2018. Advanced soil science for the sports turf Professional. *Sports Turf Managers Association (STMA) Annual Meet*; 16-19 Jan. 2018; Fort Worth, TX. *(invited)*

Nelson, S.V., R. Lawrence, M.D. Madsen, N.C. Hansen, V.J. Anderson, and **B.G. Hopkins**. 2018. Hydrogel rate and depth: Impact on soil water and seedling establishment. *BYU PWS Graduate Research Conclave*; 15 Nov. 2018; Provo, UT: Brigham Young University. *(invited)*

Pedigo, A., J.D. Svedin, and **B.G. Hopkins**. 2018. Polymer coated urea in Kentucky bluegrass (Poa pratensis L.). *Sports Turf Managers Association (STMA) Annual Meet*; 16-19 Jan. 2018; Fort Worth, TX. *(invited)*

Woolley, E.A., J.D. Svedin, N.C. Hansen, R. Kerry, and **B.G. Hopkins.** 2018. Spatio-temporal soil water and crop stress modeling for variable rate irrigation. *BYU PWS Graduate Research Conclave*; 15 Nov. 2018; Provo, UT: Brigham Young University. *(invited)*

Hopkins, B.G. 2017. Potato rotations and soil fertility/plant nutrition. *Montana Seed Potato Seminar*; 15-16, Nov. 2017; Missoula, MT. *(invited)*

Hopkins, B.G. 2017. ESN research on potatoes review– Dr. Bryan Hopkins, Ph.D. Brigham Young University. *Agrium ESN Field Day*; 20 Jul. 2017; Aberdeen, ID. Available at: https://youtu.be/myWFOtHcwGg

Hopkins, B.G. 2017. Dr. Bryan Hopkins, Ph.D. Brigham Young University discusses the merits of ESN. *Agrium ESN Field Day*; 20 Jul. 2017; Aberdeen, ID. Available at: https://youtu.be/Za1E_2gOZB8

Hopkins, B.G., and J.D. Svedin. 2017. Polymer coated urea in potato. *Agrium ESN Field Day*; 20 Jul. 2017; Aberdeen, ID. *(invited)*

Hopkins, B.G. 2017. Research update. *BYU-Idaho AG Field Day Experience;* 7 Jul. 2017; Rexburg, ID. *(invited)*

Hopkins, B.G. 2017. Nutrient sources: How to choose them to meet plant nutrient need in traditional, organic, or mixed management settings? *5th Annual Urban and Small Farms Conference*; 22 Feb. 2017; Salt Lake City, UT. *(invited)*

Hopkins, B.G. 2017. Are sports field managers at risk legally? Water, Soil, Plant, and Pest BMPs for Success. *Sports Turf Managers Association Annual Meeting;* 24-27 Jan. 2017; Orlando, FL. (*Invited*)

Kopp, K. and **B.G. Hopkins.** 2017. Let it breathe. Optimizing turfgrass water use. *Sports Turf Managers Association Annual Meeting;* 24-27 Jan. 2017; Orlando, FL. (*Invited*)

Nelson, S.V., W. Petersen, J.D. Svedin, M.D. Madsen, V.J. Anderson, N.C. Hansen, and **B.G. Hopkins.** 2017. Polyacrylamide for increasing soil moisture and seeding success. *BYU PWS Graduate Student Conclave*; 16 Nov. 2017; Provo, UT: Brigham Young University. *(invited)*

Svedin, J.D., R. Kerry, N.C. Hansen, and **B.G. Hopkins.** 2017. Informing irrigation management from spatial variation in 'Crop per Drop'. *BYU PWS Graduate Student Conclave;* 16 Nov. 2017; Provo, UT: Brigham Young University. *(invited)*

Bartholomew, S. and **B.G. Hopkins.** 2016. Polymer coated urea in Kentucky bluegrass. Nitrogen Use Efficiency (NUE) Conference; 8-10 2016 Aug.; Boise, ID. *(invited)*

Hopkins, A. and **B.G. Hopkins.** 2016. Polymer coated urea release rates under varying conditions. Nitrogen Use Efficiency (NUE) Conference; 8-10 2016 Aug.; Boise, ID. *(invited)*

Hopkins, B.G. 2016. Research update. . *BYU-Idaho AG Field Day Experience;* 8 Jul. 2016; Rexburg, ID.

Hopkins, B.G. 2016. Aerial assessment strategies: Potato/grain NUE. Nitrogen Use Efficiency (NUE) Conference; 8-10 2016 Aug.; Boise, ID. *(invited)*

Hopkins, B.G. 2016. Turfgrass fertilization. *Utah Nursery and Landscape Association*. 25-27 2016 Jan.; Salt Lake City, UT. (*Invited*)

Hopkins, B.G. 2016. Turfgrass products for cutting-edge water and nutrient management. *Utah Nursery and Landscape Association.* 25-27 2016 Jan.; Salt Lake City, UT. (*Invited*)

Hopkins, B.G. 2016. University research update panel: Water and nutrient management in cool season turfgrass. *Sports Turf Managers Association Annual Meeting;* 19-22 2016 Jan.; San Diego, CA. (*Invited Speaker and Session Moderator*)

Hopkins, T. and **B.G. Hopkins.** 2016. Nitrogen by water interactions in corn. *Nitrogen Use Efficiency (NUE) Conference;* 8-10 2016 Aug.; Boise, ID

Russell, K. and **B.G. Hopkins.** 2016. Nitrogen and irrigation water interactions in drought stressed Kentucky bluegrass*. Nitrogen Use Efficiency (NUE) Conference;* 8-10 2016 Aug.; Boise, ID

Svedin, J.D. and **B.G. Hopkins.** 2016. Evaluation of nitrogen gas loss from polymer coated and polymer sulfur coated urea. *Nitrogen Use Efficiency (NUE) Conference;* 8-10 2016 Aug.; Boise, ID

Svedin, J.D., R. Kerry, N.C. Hansen, and **B.G. Hopkins.** 2016. Variable Rate Irrigation and Water Use Efficiency. *BYU PWS Graduate Research Conclave*; Nov. 2016; Provo, UT: Brigham Young University.

Hopkins, B.G. 2015. Research update. . *BYU-Idaho AG Field Day Experience;* 9 Jul. 2015; Rexburg, ID.

Hopkins, B.G. 2015. Turfgrass fertilization. *Utah Nursery and Landscape Association.* 26-28 2015 Jan.; Salt Lake City, UT. (*Invited*)

Hopkins, B.G. 2015. Turfgrass products for cutting-edge water and nutrient management. *Utah Nursery and Landscape Association.* 26-28 2015 Jan.; Salt Lake City, UT. (*Invited*)

Hopkins, B.G., J.H. Gish, and J.C. Buss. 2015. The nuts and bolts of applied nutrient management. *Sports Turf Managers Association Annual Meeting;* 2015 Jan. 13-16; Denver, CO. (*Invited*)

Hopkins, B. G., M.A. Chappell, and C.K. Katseanes. 2014. EQ/I basic research program close out project 11-008, nutrient quality-intensity relationships for determining the environmental fate of munition constituents in the soil vadose zone. *Department of Defense*; 2014 Mar.; Vicksburg, MS.

Hopkins, B. G., T.S. Smith, S. Henrie, and J. Gookin. 2014. Portable electric fencing for bear deterrence and conservation. *Utah Chapter of the Wildlife Society Annual Meeting*; 2014 Mar.; St. George, UT.

Hopkins, B.G. 2014. Turfgrass nutrition. *Utah Nursery and Landscape Association;* 24-26 2011 Jan.; Salt Lake City, UT. (*Invited*)

Hopkins, B.G. 2014. Keeping it green while being green. Cutting-edge environmental fertilization. *Sports Turf Managers Association Annual Meeting;* 21-24 2014 Jan.; Orlando, FL. (*Invited*)

Hopkins, B.G. 2014. The fact and fiction of turfgrass fertilization. *Sports Turf Managers Association Annual Meeting;* 21-24 2014 Jan.; Orlando, FL. (*Invited*)

Hopkins, B.G. 2013. Organic acids impact water and nutrition in turfgrass. *Floratine Dealer Conference;* 16-17 2013 Oct.; Orlando, FL. (*Invited*)

Hopkins, B. G. 2013. "Polymer Coated Urea in Field Crops," *Polymer Coated Urea Symposia;* 2013 Nov.; Tampa, FL.

Hopkins, B. G. and C.J. Ransom. 2013. Polymer coated urea in turfgrass. *Polymer Coated Urea Symposia;* 2013 Nov.; Tampa, FL.

Hopkins, B. G. 2013. Site-assessment writing. *BYU Writing Across the Curriculum Conference;* 2013 Jun.; BYU, Provo, UT.

Hopkins, B.G. 2013. Organic acids. *Idaho Potato Conference*; 16-18 Jan. 2013; Pocatello, ID.

Hopkins, B.G. 2013. Phosphorus use efficiency. *Idaho Potato Conference*; 16-18 Jan. 2013; Pocatello, ID.

Hopkins, B.G. 2013. Soil and petiole analysis. *Idaho Potato Conference*; 16-18 Jan. 2013; Pocatello, ID.

Hopkins, B.G., C.K. Katseanes, M.A. Chappell, and C.L. Price. 2013. Soil fertility status and degradation of 2,4,6 trinitrotoluene in contaminated soils. *Department of Defense*; 2013 Mar.; Vicksburg, MS.

Hopkins, B.G. 2012. Turfgrass nutrition. *Utah Nursery and Landscape Association*; 23-25 2012 Jan.; Salt Lake City, UT. (*Invited*)

Hopkins, B.G. 2011. Turfgrass nutrition. *Utah Nursery and Landscape Association*; 24-26 2011 Jan.; Salt Lake City, UT. (*Invited*)

Hill, M.W., J.J. LeMonte, and **B.G. Hopkins.** 2010. Reducing phosphorus use in the environment: Increasing phosphorus flux in soil with humic/fulvic acid ligand exchange. *Life Sciences Poster Competition;* 2010 Mar.; BYU College of Life Sciences, Provo, UT.

Hopkins, B.G., B.D. Geary, V.D. Jolley, and J.S. Miller, 2010. Nutrient and nutrition interactions in potato. *Idaho Potato Conference;* 2010 Jan.; University of Idaho, Pocatello, ID.

Hopkins, B.G. 2010. Advanced turfgrass nutrition. *Utah Nursery and Landscape Association*; 25-27 2010 Jan.; Salt Lake City, UT. (*Invited*)

Hopkins, B.G. 2010. Biophysical chemistry in soil-plant systems: spatial variability. *Decagon Soil Water Conference;* 13 2010 May; Provo, UT. (*Invited*)

LeMonte, J.J. and **B.G. Hopkins.** 2010. Soil fertility as it relates to degradation of munition constituents. *Department of Defense Seminar*; 2010 Aug.; DOD, MS.

Ransom, C.J., L.A. Babbel, T.R. Brown, and **B.G. Hopkins.** 2010. Reducing phosphorus use in the environment: optimizing rate and surfactant with genetically engineered crops. *Life Sciences Poster Competition;* 2010 Mar.; BYU College of Life Sciences, Provo, UT.

Hopkins, B.G. 2009. Economic optimum for potato fertilization. *Idaho Potato Commission Research Committee*; Twin Falls, ID.

Hopkins, B.G. 2009. Soil chemistry. *LandView Systems CCA Training;* Rupert, ID.

Hopkins, B.G. 2009. Comparison of potato production practices: Humid vs. arid regions of North America. *Long Island New York Agricultural Forum;* Riverhead, NY.

Hopkins, B.G. 2009. N & P fertilizer efficiency, crop yields, and environmental quality. *Agronomy - Crop - Soil Science Societies International annual meeting;* 2009 Nov.; Pittsburg, PA.

Hopkins, B.G., R. Peterman, and R.C. Christensen. 2009. Soil mechanics of water conservation. *Utah Green Industry Conference - Sport Turf;* Salt Lake City, UT.

Hopkins, B.G., T. W. Taysom, and J.J. LeMonte. 2009. Fertilizer economics and environmental quality issues. *Long Island New York Agricultural Forum;* Riverhead, NY.

Hopkins, B.G., T.W. Taysom, and J.J. LeMonte. 2009. Nutrient management: Reducing air and water quality impacts. *BYU Plant & Wildlife Sciences Department Seminar;* Provo, UT.

Hopkins, B.G., T.W. Taysom, and J.J. LeMonte. 2009. Maximizing fertilizer dollars and minimizing environmental impacts. *Idaho Potato Conference;* Pocatello, ID.

Hopkins, B.G., T.W. Taysom, and J.J. LeMonte. 2009. Methods of improving nutrient use efficiency: Reducing fertilizer costs and environmental impacts. *Long Island New York Agricultural Forum;* Riverhead, NY.

Hopkins, B.G., T.W. Taysom, and J.J. LeMonte. 2009. Hooked on high fertilizer rates? Time to break the habit: farm-environment benefits. *Idaho Potato Conference;* Pocatello, ID.

Webb, B.L., M.C. Pletsch, D.A. Cook, V.D. Jolley, and **B.G. Hopkins.** 2009. Assessing the nutrient status of low fertility soils using ion exchange resin. *11th International Symposium on Soil and Plant Analysis;* 20-24 Jul. 2009; at Santa Rosa, CA.

Webb, B.L., M.C. Pletsch, D.A. Cook, V.D. Jolley, and **B.G. Hopkins.** 2009. Comparing nutrient availability using ion exchange resin capsules and plant bioavailability under greenhouse conditions. *11th International Symposium on Soil and Plant Analysis;* 20-24 Jul. 2009; at Santa Rosa, CA.

Beckett, T.J. and **B.G. Hopkins**. 2008. Cropping frequency to reduce pesticide use. *Utah Conference on Undergraduate Research;* Orem, UT.

Benson, J.H., B.D. Geary, **B.G. Hopkins,** V.D. Jolley, and J. Miller. 2008. Effect of calcium levels on *Phytophthora erythroseptica* infection in potato roots. *Pacific Division American Phytopathological Society*; Jackson Hole, WY.

Hopkins, B.G. 2008. Phosphorus use efficiency in potato: Improving yields and crop quality while minimizing water quality impacts. *Fluid Forum*; Scottsdale, AZ. Available at: https://fluidfertilizer.org/wp-content/uploads/2016/05/Bryan-Hopkins.pdf

Hopkins, B.G. 2008. Potato production with drastically rising fertilizer prices: A review of phosphorus management options. *Potato Association of America;* Buffalo, NY.

Hopkins, B.G. 2008. Fertilizer Economics. *Potato Conference of Alberta;* Red Deer, AB, Canada.

Hopkins, B.G. 2008. Increasing nutrient use efficiency and reducing impacts on air and water quality. *Potato Conference of Alberta;* Red Deer, AB, Canada.

Hopkins, B.G., E.A. Buxton, C.M. Haskell, R.C. Christensen, N.J. Chariton, and K. Marcroft. 2008. Research and consulting with BYU football fields. *BYU College of Life Sciences Volunteer Research Council*; Provo, UT.

Hopkins, B.G., J.J. LeMonte, C.J. Rosen, D.A. Horneck, S. Menasha, C. Hutchinson, and M. Konschuh. 2008. Review of polymer coated urea research on potato: Yield, tuber quality, and impacts on air and water environmental parameters. *Agrium Researcher Roundtable;* Houston, TX.

Hopkins, B.G. and T.J. Beckett. 2008. Organic potato production. *Idaho Potato Conference;* Pocatello, ID.

Hopkins, B.G. and T.W. Taysom. 2008. Polymer coated fertilizers for enhanced nutrient uptake efficiency and water quality. *Idaho Potato Conference;* Pocatello, ID.

Hopkins, B.G. and T.J. Beckett. 2008. Reducing pest/pathogen pressure with cultural, soil & water management. *Idaho Potato Conference;* Pocatello, ID.

Hopkins, B.G. and T.J. Beckett. 2008. Cropping systems: Soil sustainability vs. dollars. *Beckett, Sustainable Agriculture Research and Education Conference;* Kansas City, MO.

Barben, S.A., B.A. Nichols, **B.G. Hopkins,** V.D. Jolley, and B.L. Webb. 2007. Phosphorus, zinc and manganese interactions. *National Meeting of the Potato Association of America*; Idaho Falls, ID.

Benson, J.H., B.D. Geary, **B.G. Hopkins**, V.D. Jolley, and J.R. Miller. 2007. Influence of pH on infection of *Phytophthora erythroseptica* on *Solanum tuberosum*. *American Phytopathological Society*; 28 Jul. – Aug. 1 2007; San Diego CA.

Benson, J.H., B.D. Geary, **B.G. Hopkins,** V.D. Jolley, and J.R. Miller. 2007., "Visualization of *Peronospora farinosa* infection and growth in quinoa using scanning electron microscopy," *American Phytopathological Society*; 28 Jul. – Aug. 1 2007; San Diego CA.

Bowen, T.R., **B.G. Hopkins,** J.W. Ellsworth, and A.G. Cook. 2007. Variable rate application of nitrogen to barley. *Info Ag Northwest 2007 Conference;* 10 – 12 Jul. 200; Springfield, IL.

Hopkins, B.G. 2007. Best management practices for potato production. *Manitoba Potato Conference.*

Hopkins, B.G. 2007. Precision Fertilization. *Manitoba Potato Conference.*

Hopkins, B.G. and J.W. Ellsworth. 2007. Variable rate nitrogen application to potato. *Info Ag Northwest 2007 Conference;* 10 – 12 Jul. 200; Springfiled, IL.

Hopkins, B.G. and J.W. Ellsworth. 2007. Zonal fertilization: step-by-step case study for potatoes. *Info Ag Northwest 2007 Conference;* 10 – 12 Jul. 200; Springfiled, IL.

Hopkins, B.G. and S.C. Stephens. 2007. Organic potato production. *Idaho Potato Conference - Crop Consultants and Farmers;* Pocatello, ID.

Hopkins, B.G., S.C. Stephens, and J.W. Ellsworth. 2007. Remote optical sensing. *Idaho Potato Conference - Crop Consultants and Farmer;* Pocatello, ID.

Hopkins, B.G. and S.C. Stephens. 2007. Fertilizer band placement in potato. Fluid Forum; Scottsdale, AZ.

Stephens, S.C. and **B.G. Hopkins.** 2007. Organic potato production. *Far West Agribusiness Fertilizer and Chemical Conference;* Jackpot, NV.

Hopkins, B.G. and T. W. Taysom. 2007. New technologies in nutrient management. *Idaho Potato Conference - Crop Consultants and Farmers;* Pocatello, ID.

Hopkins, B. G. and T.W. Taysom. 2007. Polymer coated urea fertilizer. *Potato Conference of Alberta;* Lethbridge AB, Canada.

Hopkins, B.G., T.W. Taysom, and S. C. Stephens. 2007. Polymer coated urea fertilizer in potato production. *PAA Annual Meetings scientific- society conference participants*; Idaho Falls, ID.

Hopkins, B.G., V.D. Jolley, B.L. Webb, J.W. Ellsworth, and R.K. Callahan. 2007. Boron fertilization. *National Meeting of the Potato Association of America;* Idaho Falls, ID.

Stephens, S.C. and **B.G Hopkins.** 2007. Remote sensing for identifying management zones. *Info Ag Northwest 2007 Conference;* 10 – 12 Jul. 2007; Springfield, IL.

Hopkins, B.G., V.D. Jolley, B.L. Webb, J.W. Ellsworth, and S.A. Redd. 2006. Potato responses to soil and foliar boron applied a different stages of development. *Annual meetings ASA*; 12-16 Nov. 2006; Indianapolis, IN.

Jolley, V.D., **B.G. Hopkins,** J.W. Ellsworth, B.L. Webb, A.G. Cook, and T.R. Bowen. 2005. Soil tests and yield response of potato to soil and foliar applications of boron. *American Society of Agronomy national meetings*; 6-10 Nov 2005; Salt Lake City, UT.

OTHER – TECHNICAL REPORTS:

Hopkins, B.G. 2018. Summary of field research progress reports. Submitted to various industry partners who provide funding for research.

Morris, A.M., P.J., Maughan, **B.G., Hopkins,** and N.C. Hansen. 2018. The effect of *Chenopodium quinoa* on salinization levels in soil. Brigham Young University, ORCA Final Report.

Hopkins, B.G. 2017. Summary of field research progress reports. Submitted to various industry partners who provide funding for research.

Hopkins, B.G. 2016. Summary of field research progress reports. Submitted to various industry partners who provide funding for research.

Hopkins, B.G. 2015. Summary of field research progress reports. Submitted to various industry partners who provide funding for research.

Hopkins, B.G. 2014. Summary of field research progress reports. Submitted to various industry partners who provide funding for research.

Hopkins, B.G. 2013. Summary of field research progress reports. Submitted to various industry partners who provide funding for research.

Hopkins, B.G. 2012. Summary of field research progress reports. Submitted to various industry partners who provide funding for research.

Hopkins, B.G. 2011. Summary of field research progress reports. Submitted to various industry partners who provide funding for research.

Hopkins, B.G. 2010. Summary of field research progress reports. Submitted to various industry partners who provide funding for research.

Beckett, T.J., A.K. Shiffler, **B.G. Hopkins**, P.J.S. Hutchinson, S.L. Hafez, and N.L. Olsen. 2009. Long term impacts of short rotations. Library Research Grants. 18. Available at: https://scholarsarchive.byu.edu/cgi/viewcontent.cgi?article=1010&context=libraryrg_studentpub

Hopkins, B.G. 2009. Summary of field research progress reports. Submitted to various industry partners who provide funding for research.

Hopkins, B. G. 2008. Product testing field reports. Submitted to research partners.

Hopkins, B.G. 2008. Summary of field research progress reports. Submitted to various industry partners who provide funding for research.

Hopkins, B.G. 2007. Summary of field research progress reports. Submitted to various industry partners who provide funding for research.

Hopkins, B.G. and J.W. Ellsworth. 2006. Potato nutrition (BJKA55) progress report – 3rd Quarter. Idaho Potato Commission.

Hopkins, B.G. and J.W. Ellsworth. 2006. Potato nutrition (BJKA55) progress report – 4th Quarter. Idaho Potato Commission.

Hopkins, B.G. and J.W. Ellsworth. 2006. Starter band placement for potatoes in calcareous soil. Fluid Fertilizer Foundation Research Report of Progress.

Hopkins, B.G., D.A. Horneck, M.J. Pavek, B.D. Geary, N.L. Olsen, J.W. Ellsworth, G.D. Newberry, J.S. Miller, R.E. Thornton, and G.W. Harding. 2006. Best management practices for sustainable potato production – Final Report (SW02-037). WSARE-USDA. Logan, UT.

Hopkins, B.G., J.S. Miller, P.J.S. Hutchinson, J.M. Alvarez, S.L. Hafez, N.L. Olsen, and P.E. Patterson. 2006. Potato rotations (BJKA56) progress report – 3rd Quarter. Idaho Potato Commission.

Hopkins, B.G., J.S. Miller, P.J.S. Hutchinson, J.M. Alvarez, S.L. Hafez, N.L. Olsen, and P.E. Patterson. 2006. Potato Rotations (BJKA56) Progress Report – 4th Quarter. Idaho Potato Commission.

Nolte, P., N.L. Olsen, and **B.G. Hopkins.** 2006. Extension specialist progress report – 3rd Quarter. Idaho Potato Commission.

Nolte, P., N.L. Olsen, and **B.G. Hopkins.** 2006. Extension specialist progress report – 4th Quarter. Idaho Potato Commission.

Ellsworth, J.W. and **B.G. Hopkins.** 2005. Polymer coated urea in sugarbeets and field corn – Research Report of Progress. Agrium.

Hopkins, B.G. 2005. Assessment and demonstration of the sustainability of long vs. short potato rotations. Report of Progress – WSARE Project No. SW05-067.

Hopkins, B.G. 2005. Avail blending with APP use in potatoes – Report of research progress. Simplot.

Hopkins, B.G. 2005. BioFlora product evaluation in potatoes – Report of research progress. BioFlora.

Hopkins, B.G. 2005. Boron use in potatoes – Report of research progress. US Borax.

Hopkins, B.G. 2005. Field evaluation of drip irrigated potatoes planted in beds – Research report of progress. ClearWater Supply and T-Tape International.

Hopkins, B.G. 2005. Foliar fertilizer in potatoes – Report of research progress. Baicor.

Hopkins, B.G. 2005. Hormone use in corn – Report of research progress. Stoller Agronomics.

Hopkins, B.G. 2005. Hormone use in potatoes – Report of research progress. Stoller Agronomics.

Hopkins, B.G. 2005. Hormone Use in sugarbeets – Report of research progress. Stoller Agronomics.

Hopkins, B.G. 2005. Monopotassium phosphate fertilizer use in potatoes – Report of research progress. Rotem BKG.

Hopkins, B.G. 2005. Monopotassium phosphate fertilizer use in sugarbeets – Report of research progress. Rotem BKG.

Hopkins, B.G. 2005. Non-ionic surfactant use for potatoes grown in water repellent soils – Report of research progress. Aquatrols.

Hopkins, B.G. 2005. Phosphite use in potatoes – Report of research progress. Biagro Western.

Hopkins, B.G. 2005. Sulphone use in potatoes – Report of research progress. Biagro Western.

Hopkins, B.G. 2005. Phosphorus-micronutrient interactions (AD-421) Report of progress. HATCH.

Hopkins, B.G. 2005. Potassium sulfate use in potatoes – Report of research progress. Great Salt Lake Mineral Corporation.

Hopkins, B.G., T.R. Bowen, and J.W. Ellsworth. 2005. Barley nitrogen management – Research report of progress. Far West Agribusiness Association Idaho R & E Committee.

Hopkins, B.G. and J.W. Ellsworth. 2005. Banded nitrogen and phosphorus fertilizer (BJKD08) Final research report. Idaho Sugarbeet Growers Association.

Hopkins, B.G. and J.W. Ellsworth. 2005. Potato nutrition (BJKA55) annual report. Idaho Potato Commission.

Hopkins, B.G. and J.W. Ellsworth. 2005. Potato nutrition (BJKA55) progress report – 1st Quarter. Idaho Potato Commission.

Hopkins, B.G. and J.W. Ellsworth. 2005. Potato nutrition (BJKA55) progress report – 2nd Quarter. Idaho Potato Commission.

Hopkins, B.G., J.W. Ellsworth, T.R. Bowen, and A.G. Cook. 2005. Variable rate nitrogen in potatoes – Report of research progress. Valley Wide Cooperative.

Hopkins, B.G., J.W. Ellsworth, B. Brown, J. Windes. T.R. Bowen, and A.G. Cook. 2005. Improving barley yields while maintaining protein: N Management Innovations (BJKA50) annual report of research progress. Idaho Barley Commission.

Hopkins, B.G., J.W. Ellsworth, and T.W. Taysom. 2005. Polymer coated urea in potatoes – Research report of progress. Agrium.

Hopkins, B.G., D.A. Horneck, M.J. Pavek, R.E. Thornton, G.D. Newberry, B.D. Geary, N.L. Olsen, and J.W. Ellsworth. 2005. Promoting sustainable potato cropping systems. Report of progress – WSARE Project No. SW02-037.

Hopkins, B.G., J.S. Miller, P.J.S. Hutchinson, J.M. Alvarez, S.L. Hafez, N.L. Olsen, and P.E. Patterson. 2005. Potato rotations (BJKA56) annual report. Idaho Potato Commission.

Hopkins, B.G., J.S. Miller, P.J.S. Hutchinson, J.M. Alvarez, S.L. Hafez, N.L. Olsen, and P.E. Patterson. 2005. Potato rotations (BJKA56) progress report – 1st Quarter. Idaho Potato Commission.

Hopkins, B.G., J.S. Miller, P.J.S. Hutchinson, J.M. Alvarez, S.L. Hafez, N.L. Olsen, and P.E. Patterson. 2005. Potato rotations (BJKA56) progress report – 2nd Quarter. Idaho Potato Commission.

Nolte, P., N.L. Olsen, and **B.G. Hopkins.** 2005. Extension specialist annual report. Idaho Potato Commission.

Nolte, P., N.L. Olsen, and **B.G. Hopkins.** 2005. Extension specialist progress report – 2nd Quarter. Idaho Potato Commission.

Nolte, P., N.L. Olsen, and **B.G. Hopkins.** 2005. Extension specialist progress report – 1st Quarter. Idaho Potato Commission.

Ellsworth, J.W. and **B.G. Hopkins.** 2004. Nutrient uptake rates of *Alturas, Norkotah, Shepody, Summit, Burbank, and Ranger* varieties (BJKB47). Idaho Potato Commission Report of Progress.

Ellsworth, J.W., **B.G. Hopkins,** B. Brown, and H. Neibling. 2004. Wheat N requirements with reduced irrigation (BJKA30). Idaho Wheat Commission Report of Progress.

Geary, B.D., **B.G. Hopkins,** W.H. Bohl, and J.W. Ellsworth. Phosphorus and potassium fertility in Alturas nutrition and bulking rates of newer potato varieties-BJ-KA41. p. 20-26 *In* Potato Research and Extension Progress Reports. UI, Moscow, ID.

Hopkins, B.G. 2004. Agri-trend bio soil start field evaluation. Technical Report.

Hopkins, B.G. 2004. Agri-trend phosphite field evaluation. Technical Report.

Hopkins, B.G. 2004. Aquatrols IrrigAid surfactant for hydrophobic sands field evaluation. Technical Report.

Hopkins, B.G. 2004. Biagro phosphite and sulphone field evaluation. Technical Report.

Hopkins, B.G. 2004. BioFlora mark out fertilizer field evaluation. Technical Report.

Hopkins, B.G. 2004. Clearwater and T-systems drip bed project. Technical Report.

Hopkins, B.G. 2004. Equity field evaluation. Technical Report.

Hopkins, B.G. 2004. Hormones and fertility trial with Stoller products on potatoes field evaluation. Technical Report.

Hopkins, B.G. 2004. Hormones and fertility trial with Stoller products on sugarbeets field evaluation. Technical Report.

Hopkins, B.G. 2004. Landview acid fertilizer banding below sugarbeets field trial. Technical Report.

Hopkins, B.G. 2004. Landview slow release N in potatoes field trial. Technical Report.

Hopkins, B.G. 2004. MKP Rotem field trial potatoes. Technical Report.

Hopkins, B.G. 2004. MKP Rotem field trial potatoes. Technical Report.

Hopkins, B.G. 2004. MNB field trial sugarbeets. Technical Report.

Hopkins, B.G. 2004. Phosphorus-micronutrient interactions. AD-421 Report of Progress. USDA-CSREES.

Hopkins, B.G., J.W. Ellsworth, J. Gallian, S.A. Funk, A. Pool, and D. Vargas. 2004. Banded nitrogen and phosphorus fertilizer. BJ-KD08. p. 10-12 *In* Sugar Beet Research and Extension Proposals for Cooperative Action. UI, Moscow, ID.

Hopkins, B.G., J.W. Ellsworth, and J.C. Stark. 2004. Potato nutrition-BJ-KA35. p. 27-29 20 *In* Potato Research and Extension Progress Reports. UI, Moscow, ID.

Hopkins, B.G., J.W. Ellsworth, T.R. Bowen, A.G. Cook, R. Oborn, and S.A. Funk. 2004. Variable rate nitrogen in potatoes. Technical Report.

Hopkins, B.G., J.W. Ellsworth, T.R. Bowen, and S.A. Funk. 2004. Improving barley yields while maintaining protein (BJKB50). Idaho Barley Commission Report of Progress.

Hopkins, B.G., J.W. Ellsworth, S.A. Funk, and A. Pool. 2004. Banded nitrogen and phosphorus fertilizer in sugarbeets (BJKD08). Idaho Sugarbeet Growers Report of Progress.

Hopkins, B.G., D.A. Horneck, M.J. Pavek, R.E. Thornton, G.D. Newberry, B.D. Geary, N.L. Olsen, and J.W. Ellsworth. 2004. Promoting sustainable potato cropping systems. Report of Progress – WSARE Project No. SW02-037.

Nolte, P., N.L. Olsen, and **B.G. Hopkins.** 2004. Extension potato specialists-BJK809. p. 13-14 *In* Potato Research and Extension Progress Reports. UI, Moscow, ID.

Ellsworth, J.W., **B.G. Hopkins**, B. Brown, and H. Neibling. 2003. Wheat N requirements with reduced irrigation. p. 12-14 *In* Idaho Wheat Commission Reports of Progress 2003.

Geary, B.D., B. Brown, **B.G. Hopkins,** and J.W. Ellsworth. 2003. Nutrient requirements and effects on new and potential release cultivars in the treasure valley - BJ-KB26. p. 60-62 20 *In* Potato Research and Extension Progress Reports. UI, Moscow, ID.

Hopkins, B.G. 2003. Field evaluation of Biagro phosphite and sulfone products. Technical Report.

Hopkins, B.G. 2003. Field evaluation of BioFlora's mark out product. Technical Report.

Hopkins, B.G. 2003. Field evaluation of equity product. Technical Report.

Hopkins, B.G. 2003. Field evaluation of Landview fertilizer products. Technical Report.

Hopkins, B.G. 2003. Field evaluation of Stoller hormone and calcium products. Technical Report.

Hopkins, B.G. 2003. Phosphorus-micronutrient interactions. AD-421 Report of Progress. USDA-CSREES.

Hopkins, B.G., J.W. Ellsworth, T.R. Bowen, and R.A. Oborn. 2003. Variable rate nitrogen research. Technical Report for 2003.

Hopkins, B.G., J.W. Ellsworth, J.C. Stark, and B.D. Geary. 2003. Potato Nutrition – BJ-KB35. p. 18-20 *In* Potato research and extension progress reports. UI, Moscow, ID.

Hopkins, B.G. and S.A. Funk. 2003. Potato cropping systems: summary of projects. Report to Potato Cropping Systems Advisory Group. UI, Idaho Falls, ID.

Hopkins, B.G., B.D. Geary, D.A. Horneck, and R.E. Thornton. 2003. Promoting sustainable potato cropping systems. Report of Progress – WSARE Project No. SW02-037.

Hopkins, B.G., G.W. Harding, and P. Nolte. 2003. Potato cropping systems: BMPs in action – BJ-KB34. p. 15-17 *In* Potato Research and Extension Progress Reports. UI, Moscow, ID.

Nolte, P., N.L. Olsen, B.D. Geary, and **B.G. Hopkins.** 2003. Extension potato program – BJ-K909. p. 2-4 *In* Potato Research and Extension Progress Reports. UI, Moscow, ID.

Hopkins, B.G. 2002. Elemental sulfur mineralization: Bench test product evaluation of panterra minerals' powdered sulfur. Technical Report: Preliminary Evaluation.

Hopkins, B.G. 2002. Field evaluation of BioFlora mark out product with chipeta, Frito Lay 1533, Frito Lay 1833, Ranger Russet, and Russet Burbank varieties. Technical report: Final evaluation.

Hopkins, B.G. 2002. Field evaluation of BioFlora mark out product with chipeta, Frito Lay 1533, Frito Lay 1833, Ranger Russet, and Russet Burbank varieties. Technical report: Preliminary evaluation.

Hopkins, B.G. 2002. Promoting sustainable potato cropping systems. Report of Progress – WSARE Project No. SW02-037.

Hopkins, B.G., G.W. Harding, and P. Nolte. Mar., 2002. Potato cropping systems: Best management practices in action. Idaho Potato Commission Invited Research and Extension Proposal Presentations.

Hopkins, B.G., J.W. Ellsworth, J.C. Stark, and B.D. Geary. Mar. 7, 2002. Potato nutrition. Idaho Potato Commission Invited Research and Extension Proposal Presentations.

Hopkins, B.G., J.C. Stark, B. Brown, and J.W. Ellsworth. Feb. 8, 2002. Nitrogen management. Idaho Barley Commission Research Proposals/Updates.

MANUALS AND CURRICULUM:

Cardon, G.E., **B.G., Hopkins**, B.C. Joern, and C.F. Drury. (*eds.*) 2022. Quality Assurance and Quality Control (QA/QC) Manual Recommendations. Developed by the Soil Science Society of America for Soil, Plant, and Water Testing Laboratories. Madison, WI: Soil Science Society of America.

Hopkins, B.G. 2006. Best management practices for potato production checklist. Risk Management Education Curriculum. Moscow, ID: UI.

Neufeld, J.D., S.J. Reddy, J. Miller, N.L. Olsen, W.H. Bohl, **B.G. Hopkins,** J. Windes, L. Jensen, and C. Shock. 2005. Treasure Valley/Pacific Northwest pest alert: Network alerts growers to pest outbreaks. Impact Statement. UI Extension Reporting.

Hopkins, B.G., G.W. Harding, and P. Nolte. 2003. Potato cropping systems: BMPs in action. Field Day Report. Idaho Falls, ID: UI.

Hopkins, B.G. and J.C. Stark. 2003. Humic acid effects on potato response to phosphorus. Field Day Report.

Hopkins, B.G., S. Harrold, and C. Vallombroso. Jun. 13, 2001. Laboratory Safety Procedures Manual. Dodge City, KS: Servi-Tech, Inc.

Hopkins, B.G. and S. Harrold. Jun. 1, 2001. Quality assurance/quality control protocols. Dodge City, KS: Servi-Tech, Inc.

Harrold, S. and **B.G. Hopkins.** Apr.7, 2000. Standard operating procedures manual. Dodge City, KS: Servi-Tech, Inc.

NEWS RELEASES:

Fritz, M. and **B.G. Hopkins.** Jun. 2006. Field day Jul. 18. Moscow, ID: UI Press Release.

Fritz, M. and **B.G. Hopkins.** Jun., 2006. UI rotation research includes organic. Moscow, ID: UI Press Release.

Fritz, M. and **B.G. Hopkins.** Feb. 2006. UI offers potato BMP workshops. Moscow, ID: UI Press Release.

Fritz, M. and **B.G. Hopkins.** Dec. 2005. Good for the environment, Variable Rate Nitrogen Good for Potato Profits Tool. Moscow, ID: UI Press Release.

Fritz, M. and **B.G. Hopkins**. Aug., 2005. Test drip irrigation on a small scale. Moscow, ID: UI Press Release.

Fritz, M. and **B.G. Hopkins**. Jun. 30, 2005. Mini potato conference under the sun. Moscow, ID: UI Press Release.

Fritz, M. and **B.G. Hopkins.** May 2005. UI leads regional SARE study on impacts of potato rotations. Moscow, ID: UI Press Release.

Fritz, M. and **B.G. Hopkins.** Aug. 2004. UI on-line publication helps *Potato Grower*s manage nitrogen costs. Moscow, ID: UI Press Release.

Fritz, M. and **B.G. Hopkins.** Jul. 2004. UI displays best management practices at Jul. 28 potato field day in Blackfoot. Moscow, ID: UI Press Release.

Fritz, M. and **B.G. Hopkins.** Jan. 2004. Idaho potato conference Jan. 21-22 emphasizes crop management in a challenging environment. Moscow, ID: UI Press Release.

Fritz, M. and **B.G. Hopkins.** Nov. 2003. BMP-produced potatoes score tops again in bottom-line analyses. Moscow, ID: UI Press Release.

Hopkins, B.G. and J.W. Ellsworth. Sep. 2004. Space age technology aides agriculture in preventing nitrate contamination. Press Release. Spokane, WA: Far West Agribusiness Association.

Loftus, B. and **B.G. Hopkins.** 2003. UI extension plans potato field day Jul. 1 in Shelley. Moscow, ID: UI Press Release.

Fritz, M. and **B.G. Hopkins.** 2002. UI's best management practices worked best in Rexburg potato trial this year. Moscow, ID: UI Press Release.

NEWSPAPER ARTICLES, RADIO/TV INTERVIEWS:

Meiners, J. 30 Nov. 2021. The Fierce Politics of Dust. *The Washington Post.* Washington, DC: https://www.washingtonpost.com/magazine/2021/11/30/dust-control-utah/

Meiners, J. 2 Dec. 2021. Dust in Duck Creek kicks up controversy over trees, wildfire and tourism. *The Spectrum.* St. George, UT: https://www.thespectrum.com/story/news/2021/12/02/duck-creek-dust-control-environment-utah-controversy/8799212002/

Mintz, M. 2017. Every drop; more crop per drop with variable rate irrigation. *The Furrow.* Olathe, KS: 122(8): 4-5.

Crossingham, R. 4 Aug. 2017. ESN smart nitrogen helps farmers minimize N loss in potatoes. *Farm & Ranch Guide - Producer Progress Reports.* Bismarck, ND. 38(7):10A-11A.

Henriksen, M. 2017. Making the most of your campus landscape. *Athletics Admin.* Westlake, OH: NACDA. p. 34-38.

Scott, B. 1 Feb. 2006. Best management practices for sustainable potato production. Phone interview for radio based news program – 64 stations. *Today's Idaho Ag News.* Boise, ID: Northwest Ag Network.

Scott, B. 1 Feb. 2006. Drip irrigating potatoes. Phone interview for radio based news program – 64 stations. *Today's Idaho Ag News.* Boise, ID: Northwest Ag Network.

Scott, B. Feb. 1, 2006. Banding fertilizer for improved sugarbeet nutrition. Phone interview for radio based news program – 64 stations. *Today's Idaho Ag News.* Boise, ID: Northwest Ag Network.

Sumner, C. 25 Jan. 2006. Innovations in potato nutrition. Branden, MB, Canada: Golden West Radio.

Sumner, C. 25 Jan. 2006. Beware of snake oils, but don't ignore them either. Branden, MB, Canada: Golden West Radio.

Fischbach, S. 5 Aug. 2005. Wanted: Research growers can use. Interview Article. Intermountain Farm and Ranch: Idaho Falls, ID. 679:3,10

Scott, B. 5 Aug. 2005. Drip irrigating potatoes. Phone interview for radio based news program – 64 stations. *Today's Idaho Ag News.* Boise, ID: Northwest Ag Network.

Scott, B. 5 Aug. 2005. Planting potatoes in beds. Phone interview for radio based news program – 64 stations. *Today's Idaho Ag News.* Boise, ID: Northwest Ag Network.

Scott, B. 27 Jul. 2005. Spud growers BMP field day. Phone interview for radio based news program – 64 stations. *Today's Idaho Ag News.* Boise, ID: Northwest Ag Network.

Scott, B. 23 Jul. 2005. Pest alert website now statewide. Phone interview for radio based news program – 64 stations. *Today's Idaho Ag News.* Boise, ID: Northwest Ag Network.

Anonymous. 22 Jul. 2005. 'Famous Potatoes Day' to yield new data. Interview Article. Intermountain Farm and Ranch; Idaho Falls, ID. 677:5.

Anonymous. Jul. 2005. 'Famous Potatoes' Field Day. KIDK 590 News Radio Interview: Blackfoot, ID.

Anonymous. Jul. 2005. 'Famous Potatoes' Field Day. KIDK Channel 3 News TV Interview: Blackfoot, ID.

Anonymous. Jul. 2005. 'Famous Potatoes' Field Day. KIFI Channel 8 News TV Interview: Blackfoot, ID.

Anonymous. Jul. 2005. 'Famous Potatoes' Field Day. KPVI Channel 6 News TV Interview: Blackfoot, ID.

Bohl, W.H. 4 Jun. 2005. Little change in nitrogen management needed for current potato crop. Interview article for Potato Pointers. Educational article published for release to: Morning News,

Idaho State Journal, Shoban News, Shelley Pioneer, Power County Press, and Aberdeen Times newspapers.
Bohl, W.H. 28 May 2005. Soil compaction adversely affects potato quality. Interview article for Potato Pointers. Educational article published for release to: Morning News, Idaho State Journal, Shoban News, Shelley Pioneer, Power County Press, and Aberdeen Times newspapers.
Scott, B. 20 May 2005. Potato rotations. Interview quotes broadcasted on 64 radio stations. *Today's Idaho Ag News.* Boise, ID: Northwest Ag Network.
Anonymous. Jul. 2004. 'Famous Potatoes' Field Day. KIDK 590 News Radio Interview: Blackfoot, ID.
Anonymous. Jul. 2004. 'Famous Potatoes' Field Day. KIDK Channel 3 News TV Interview: Blackfoot, ID.
Anonymous. Jul. 2004. 'Famous Potatoes' Field Day. KIFI Channel 8 News TV Interview: Blackfoot, ID.
Anonymous. Jul. 2004. 'Famous Potatoes' Field Day. KPVI Channel 6 News TV Interview: Blackfoot, ID.
Scott, B. Jan. 2004. Best management practices. Phone interview for radio based news program – 64 stations. *Today's Idaho Ag News.* Boise, ID; Northwest Ag Network.
Scott, B. Jan. 2004. Idaho Potato Conference. Phone interview for radio based news program – 64 stations. *Today's Idaho Ag News.* Boise, ID: Northwest Ag Network.
Lies, M. Dec. 2003. BMPs vs. MYMs: the results may surprise you. Interview article. Hermiston, OR: Capital Press.
Fischbach, S. 26 Sep. 2003. Tests show spuds can grow with less chemicals. Cover Story – BuMPer Crop: A better way to grow spuds. Intermountain Farm and Ranch; Idaho Falls, ID. Issue 583,
Strickler, K. Aug. 7, 2003. UI potato field day in wilder. Interview Article. Parma, ID: Western Canyon Chronicle. Vol. 2 No. 1.
Cook, B. 25 Jul. 2003. Potato test plots surprise researcher. Interview Article. Intermountain Farm and Ranch; Idaho Falls, ID.
Anonymous. Jul. 2003. 'Famous Potatoes' Field Day. KIDK 590 News Radio Interview: Blackfoot, ID.
Anonymous. Jul. 2003. 'Famous Potatoes' Field Day. KIDK Channel 3 News TV Interview: Blackfoot, ID.
Anonymous. Jul. 2003. 'Famous Potatoes' Field Day. KIFI Channel 8 News TV Interview: Blackfoot, ID.
Anonymous. Jul. 2003. 'Famous Potatoes' Field Day. KPVI Channel 6 News TV Interview: Blackfoot, ID.
Bohl, W.H. and **B.G. Hopkins.** 19 Apr. 2003. Potato pointers: Banding phosphorus improves uptake efficiency. Educational article prepared for: the Morning News, Idaho State Journal, Shoban News, Shelley Pioneer, Power County Press, Aberdeen Times, and Idaho Farmer.
Scott, B. 20 Mar. 2003. Phone interview for radio based news program. *Today's Idaho Ag News.* Boise, ID; Northwest Ag Network.
Hopkins, B.G. Nov. 18-19, 2002. Best management practices for potato production. Farm and Ranch Web Report www.aginfo.net.
Burnham, T.J. 7, 8, 18 -19 Nov. 2002. Best management practices for potato production. Radio interview – 54 stations. *Today's Idaho Ag News.* Boise, ID; Northwest Ag Network.
Burnham, T.J. 7 Nov. 2002. Best management practices for potato production. Web based news story at www.aginfo.net. *Today's Idaho Ag News.* Boise, ID; Northwest Ag Network.
Fischbach, S. 11 Oct. 2002. UI experiment shows less is more. Interview Article. Intermountain Farm and Ranch; Idaho Falls, ID. Issue 533.
Anonymous. Jul. 2002. 'Famous Potatoes' Field Day. KIDK 590 News Radio Interview; Blackfoot, ID.

Anonymous. Jul. 2002. 'Famous Potatoes' Field Day. KIDK Channel 3 News TV Interview; Blackfoot, ID.

Anonymous. Jul. 2002. 'Famous Potatoes' Field Day. KIFI Channel 8 News TV Interview; Blackfoot, ID.

NEWSLETTERS:

Fritz, M. and **B.G. Hopkins.** 2006. Model *Potato Grower*s maximize profits through best management. AgKnowledge #204/2006.

Hopkins, B.G. Jan. 2006. Best management practices for managing energy and fertilizer costs. Grower Information Sheet. Idaho Barley Commission.

Fritz, M. 2005. Variable rate nitrogen impacts on potatoes and the environment. p. 6 In M.A. Reese (ed.) UI Extension Trends: 2005, Faces of Extension.

Hopkins, B.G., J.W. Ellsworth, and W.H. Bohl. 29 Dec. 2005. Managing potatoes in the future. Potato Progress Newsletter. Washington State Potato Commission. Vol. 18.

Hopkins, B.G., J.W. Ellsworth, and W.H. Bohl. Nov. 2005. Managing potatoes in the future. William H. Bohl (ed.). Spudvine, UI Extension; Blackfoot, ID.

Hopkins, B.G. and J.W. Ellsworth. Oct. 2005. Fall fertilization – Questioning the way we do things. William H. Bohl (ed.). Spudvine, UI Extension; Blackfoot, ID.

Fritz, M. and **B.G. Hopkins.** Mar. 2005. Best management practices for potato production. Extension Trends. UI; Moscow, ID.

Hopkins, B.G. and J.W. Ellsworth. Mar. 2005. Phosphorus availability in alkaline/calcareous soil. William H. Bohl (ed.). Spudvine, UI Extension; Blackfoot, ID.

Hopkins, B.G. and J.W. Ellsworth. Oct. 2004. Potash vs. potassium sulfate: A salt issue? William H. Bohl (ed.). Spudvine, UI Extension, Blackfoot, ID.

Fritz, M. Jul. 2004. Humic acid can increase potato yields, quality, and value. UI Programs and People Highlight; Moscow, ID.

Bohl, W.H. and **B.G. Hopkins.** Jan. 2004. There's not a best management practices recipe. William H. Bohl (ed.). Spudvine, UI Extension; Blackfoot, ID.

Bohl, W.H. and **B.G. Hopkins.** 1 Apr. 2003. Improving phosphorus efficiency. William H. Bohl (ed.). Spudvine, Bingham County Extension; Blackfoot, ID.

Cossey, D. and **B.G. Hopkins.** 2002. Phosphorus soil testing. Agro Newsletter.

Bohl, W.H. and **B.G. Hopkins.** Jun. 2002. Maintain adequate phosphorus through the season. William H. Bohl (ed.). Spudvine. UI-CES Cooperative Extension System; Blackfoot, ID.

Technical Writer. 1995-2001. Servi-tech review - Monthly Newsletter.

EXTENSION/INDUSTRY EDUCATION PRESENTATIONS:

Bryan Hopkins Extension/Industry Education Presentations Summary: 1998-2006
(Individual Titles, Dates, and Locations Available Upon Request)

	Presenter	Co-Presenter	**Total**
Classroom Lectures	12	5	**17**
Grant Proposal/Progress Report	24	8	**32**
Extension: State/Local	36	4	**40**
Extension: Regional/National	7	5	**12**

Workshops: State/Local	34	6	**40**
Workshops: Regional/National	405	15	**420**
International CCA Workshops Organized	111	0	**111**
Conference: Volunteered	46	22	**68**
Conference: Invited	12	10	**22**
Field Days Organized	9	0	**9**
Field Day Presentations	21	14	**35**
TOTAL	**597**	**89**	**806**

Bryan Hopkins grantsmanship summary					
	Grants		Grants-In-Aid		**Total**
	as PI	as Co-PI	as PI	as Co-PI	
TOTAL Spending Authority	$ 1,812,028	$ 464,181	$ 3,404,543	$ 17,500	$ 5,698,252
TOTAL Grants	$ 1,980,918	$ 4,850,693	$ 3,414,513	$ 37,000	$ 10,269,124

Pending *(currently under review):*

Federal, State, and University:

Yost, M., E. Creech, N.C. Hansen, and **Hopkins, B.G.** Identifying Stacked Conservation Practices that Optimize Water Use in Agriculture: Phase II. *Western Sustainable Agriculture Research and Extension (WSARE).* Jul. 1, 2022- June 30, 2025. $350,000. ($50,000. spending authority)

Hopkins, B.G. Reduction of nutrient and microplastics impacts on water quality. *Roger and Victoria Sant Educational Endowment.* Jan. 2021 – Aug. 1, 2022. $14,000

Hopkins, B.G. USGS Soil Analysis. *United States Geological Survey (USGS).* Sep. 2020 – Sep. 2025. $150,000

Hopkins, B.G. Distinguished mentoring fellowship award: Skaggs award for excellence in mentoring. 2020. *Brigham Young University.* April 2020. $20,000

Petersen, S.L, **B.G. Hopkins**, R.T. Larsen, M.D. Madsen, , T.S. Smith. Natural Resources Support for Natural Resources Program, UTTR, Utah and Nevada. *FWS and 2 - Federal Pass-through.* Jan. 2020 – Dec. 2020. $132,540.00 ($10,000 spending authority)

Hansen, N.C., R. Kerry, M. Heaton, R. Jensen, and **B.G. Hopkins**. Spatiotemporal decision support systems for recognizing variability and managing precision irrigation. *The US-Israel Binational agricultural research and development fund (BARD).* Apr. 2019 – Mar. 2022. $310.000 ($15,000. spending authority)

Hopkins, B.G. North American Proficiency Testing Program Coordinator. *SSSA.* 2019-2021. $103,201.00

Yost, M., N.C. Hansen, G. Cardon, **B.G. Hopkins,** O. Walsh, J. Williams, H. Neibling, and B. Black. Stacking and intersecting nutrient and irrigation 4R's. *International plant nutrition institute (IPNI)/Fertilizer Institute(TFI).*2019 – 2023. $612,805. ($150,000. spending authority)

Yost, M., N.C. Hansen, H. Neibling, R. Spackman, E. Creech, L.N. Allen, **B.G. Hopkins**, M. Heaton, R. Christenson, B. Hunter, and S. Hanberg. Identifying stacked conservation practices that optimize water use in agriculture. *Western Sustainable Agricultural Research and Education* (*WSARE).* Mar. 2019 – Feb. 2022. $350,000. ($50,000. spending authority)

Hopkins, B.G. College Mentoring Supplement Award (CEMENT). *Brigham Young University: College of Life Sciences.* Nov. 2018-Nov. 2019. $5,000.

Hopkins, B.G, and N.C. Hansen. Teaching Enhancement Grant (TEG): PWS 282/283 (with N.C. Hansen) - experiential appreciation of soils through development of lab activities. *Brigham Young University-College of Life Sciences.* Nov. 2018 – Aug. 2019. $8,700.00 ($4,350. spending authority)

Hansen, N.C., R. Kerry, R. Jensen, M. Heaton, **B.G. Hopkins,** and C. Campbell. Integrating Remote Sensing and Spatiotemporal Statistics to Develop Prescription Maps for Variable Rate Irrigation Systems. *BYU.* Jan. 2018 – Dec. 2019. $120,000. ($35,200. spending authority)

Petersen, S.L., V.J. Anderson, N.C. Hansen, **B.G. Hopkins,** R.T. Larson, M.D. Madsen, B.R. McMillian, and T.S. Smith. Natural resources support for Utah test and training range. *U.S. Air Force UT Training Range (UTTR) via Army Corps of Engineers.* Sep. 30, 2018 – Sep. 29, 2019. $419,604 ($3,300. spending authority)

Hopkins, B.G. USGS Soil Analysis. *United States Geological Survey (USGS).* Sep. 2018– Sep. 2020. $34,000.

Hopkins, B.G. USGS Canyonlands soil analysis contract. *United States Geological Survey (USGS).* Sep. 2015 – Sep. 2019. $380,000.

Petersen, S.L., V.J. Anderson, N.C. Hansen, **B.G. Hopkins,** R.T. Larson, M.D. Madsen, B.R. McMillian, and T.S. Smith. Increasing establishment of bottlebrush squirreltail and siberian wheatgrass with in-soil hydrogel water reservoirs natural resources program support for Utah test and training range. *U.S. Air Force UT Training Range (UTTR) via Army Corps of Engineers.* US Air Force (Hill AFB) (sponsor), DOD Army Corps of Engineers (USACE) (Contract Coordinator). Aug. 28, 2017 to Dec. 31, 2018. $382,269. ($13,660.26 spending authority)

Hopkins, B.G. Nutrient deficiencies. *International plant nutrition institute (IPNI) Grant-In-Aid.* Jan. 2017 – Dec. 2017. $5000.

Petersen, S.L., V.J. Anderson, N.C. Hansen, **B.G. Hopkins,** R.T. Larson, M.D. Madsen, B.R. McMillian, and T.S. Smith. Natural resources support- Hill AFB and UTTR, (DOD) Army USACE. *U.S. Air Force UT Training Range (UTTR) via Army Corps of Engineers.* Sep. 22, 2014- Sep. 21, 2017. $1,155,251. (21,000spending authority)

Hopkins, B.G. and N.C. Hansen. Annaley Naegle Redd Assistantship. Redd center grant. *The Charles Redd center for western studies*. Mar. 2016 - Oct. 2017. $63,000. ($63,000. spending authority)

Hopkins, B.G. Collaborative BYU and BYU-Idaho research. *Research and Business Development Council*. Rexburg, ID 2015-2016. $500,000.

Hopkins, B.G. Soil samples. *United States geological survey (USGS).* Jul. 2013 – Sep. 2014 $41,885.

Hopkins, B.G. Sci-Scapes. 2013-2014. $370,000.

Hopkins, B.G. Athletic field management and research. *BYU Athletic Department.* Apr. 30, 2008-2014. $65,000.

Chappell, M.A., **B.G. Hopkins,** D. Hancock, and A. Bednar. Nutrient quantity-intensity relationships for determining environmental fate of munitions constituents in the soil vadose zone. *US Army Engineer Research and Development Center.* Sep. 2011- Sept. 2013. $670,000. ($63,150. spending authority)

Hopkins, B.G. Soil samples testing. *United States geological survey (USGS).* Sep. 2012 – Sep. 2013 $19,946.

Various Students. Various Projects. *BYU ORCA Student Grants.* 2011-2013. $ 6,000. ($6,000. spending authority)

Hopkins, B.G. Mentored Environment Grant (MEG): Reduction of nutrient pollution of air and water bodies- Polymerized coating of Urea Fertilizer. *BYU ORCA Student Grants.* Jan. 2011 – Jan. 2013. $20,000.

Hopkins, B.G. Soil and plant analysis. *United States geological survey (USGS).* Sep. 2010 – Sep. 2013. $92,286.

Hopkins, B.G. and C.K. Katseanes. Nutrient quantity-intensity relationships for determining environmental fate of munitions constituents in the soil vadose zone. *U.S. Department of Defense (DOD).* Jan. 1, 2011-Dec. 31, 2012. $78,000. ($78,000. spending authority)

Hopkins, B.G. Polymer chemistry to reduce nutrient pollution. *BYU John A. Widtsoe Scholarly and Creative Work Grant.* Jan. 1, 2011-Dec. 31, 2011. $25,000.

Geary, B.D., **B.G. Hopkins,** V.D. Jolley, and D.A. Johnson. Potassium nutrition influencing *Verticillium* (Early Dying) disease of Russet Burbank potatoes. *Washington Potato Commission.* Jul. 1, 2010-Jun. 30, 2011. $19,500. ($1,500. spending authority)

Various Students (J.J. LeMonte, E.A. Buxton, B.A. Nichols, C.J. Ransom, R.C. Christensen, C.K. Katseanes, and T.J. Beckett). Various Projects. *BYU ORCA Student Grants.* 2008-2011. $10,500. (spending authority)

Geary, B.D., **B.G. Hopkins,** and V.D. Jolley. Mentored Environment Grant (MEG): Influence of phosphorus on *Colletotrichum coccodes* infections of *Solanum tuberosum* roots. *BYU ORCA Student Grants.* Jan. 2010-Dec. 2010. $20,000. ($1000. spending authority)

Hopkins, B.G. Mentored Environment Grant (MEG): Water and nutrient management for improved athletic field safety/aesthetics and reduced environmental impact. *BYU ORCA Student Grants.* Jan. 2008 – Jan. 2010. $20,000

Hopkins, B.G. Research/creative work award: Nutrient, soil, & water management of sports fields. *BYU- Athletic department- Football*. Jan. 2009 - Dec. 2009. $12,000.

Hopkins, B.G. Research/creative work award: Field gas analyzer auto sampler. *BYU- Dept. of Plant & Wildlife Sciences*. Jan. 2009 - Jun. 2009. $24,000.

Hopkins, B.G. Assessment and Demonstration of the sustainability of long vs. short potato rotations. *United States Department of Agriculture (USDA)*. Jun. 2007- Jun. 2009. $135,756.

Hopkins, B.G., D.A. Horneck, M.J. Pavek, P. Patterson, J. Miller, P.J.S. Hutchinson, J.M. Alvarez, M.K. Thornton, S.L. Hafez, and N.L. Olsen. Potato rotations. *WSARE-USDA.* Jul. 1, 2007-Jun. 30, 2009. $135,756 ($35,373 spending authority).

Hopkins, B.G. and J.C. Stark. Potato nutrition and environmental quality. *Idaho Potato Commission*. Jul. 1, 2007- Jun. 30, 2009. $36,000. ($36,000. spending authority)

Hopkins, B.G. Research/creative work award: BYU sports field research. *BYU- Athletic department-Football.* Apr. 2008 - Dec. 2008. $18,000.

Hopkins, B.G. Research/creative work award: Writing across the curriculum grant. *Brigham Young University.* Dec. 2007 - Dec. 2008. $1,000.

Petersen, S.L., M.D. Madsen, B.A. Roundy, **B.G. Hopkins,** and R.F. Miller. Management techniques to improve establishment of desired species in the presence of hydrophobic soil. *NRCS Conservation Innovation Grant.* Jan. 2008 - Dec. 2008. $56,583. ($1,000. spending authority)

Jolley, V.D., B.L. Webb, and **B.G. Hopkins.** Mentored Environment Grant (MEG): Phosphorus, zinc, iron, manganese, and copper interactions in potato cropping systems. *BYU ORCA Student Grants.* Jan. 2006 – Jan. 2008. $18,000. ($6,000. spending authority)

Hopkins, B.G. *BYU Internal Grant. Brigham Young University.* Jan 2007. 120,000.00

Hopkins, B.G. Research/creative work award: Faculty development grant. *Brigham Young University.* May 2007 - Dec. 2007. $300.

Hopkins, B.G. and J.C. Stark. Potassium Chloride Application to Reduce Specific Gravity. *Idaho Potato Commission.* Jul. 1, 2006-Jun. 30, 2007. $12,000. ($12,000. spending authority)

Hopkins, B.G., J.W. Ellsworth, and J. Windes. Demonstration of best management practices for traditional and organic barley production. *USDA-Barley for Rural Development.* Jul. 1, 2006-Jun. 30, 2007. $6,100. ($6,100. spending authority)

Hopkins, B.G., J.W. Ellsworth, and J. Windes. Evaluation of new fertilizer and fertilization technologies to enhance barley production. *USDA-Barley for Rural Development*. Jul. 1, 2006-Jun. 30, 2007. $5,500. ($5,000. spending authority)

Jolley, V.D. and **B.G. Hopkins.** Potato nutrition. *BYU ORCA.* Jul. 2006-Jun. 2007. $18,000. ($6,000. spending authority)

Miller, J., K. Esplin, **B.G. Hopkins,** J. Guenther, and N.L. Olsen. Assessing markets and managing risks for organic potato production in Idaho (RME-B5B01899). *USDA-Western Risk Management Education.* Jul. 2006-Jun. 2007. $38,800. ($5,000. spending authority)

Hopkins, B.G., P. Patterson, J. Miller, P.J.S. Hutchinson, J.M. Alvarez, M.K. Thornton, S.L. Hafez, and N.L. Olsen. Potato rotations. *Idaho Potato Commission.* Jul. 1, 2005-Jun. 30, 2007. $50,000. ($42,000. spending authority)

Hopkins, B.G., J.W. Ellsworth, and T.R. Bowen. Variable rate nitrogen in malting barley. *Idaho Barley Commission.* Jul. 2004-Jun. 2007. $13,000.

Hopkins, B.G., J.W. Ellsworth, and J. Gallion. Banded N and P in sugarbeet production. *Idaho Sugarbeet Growers Association.* Apr. 1, 2003-Mar. 30, 2007. $29,500. ($26,580. spending authority)

Hopkins, B.G. and J.W. Ellsworth. Potato nutrition. *Idaho Potato Commission.* Jul. 1, 2002-Jun. 30, 2007. $103,913. ($98,300. spending authority)

Nolte, P., N.L. Olsen, B.D. Geary, and **B.G. Hopkins.** Potato specialist. *Idaho Potato Commission.* Jul. 1, 2002-Jun. 30, 2007. $200,000. ($50,000. spending authority)

Hopkins, B.G. Phosphorus, Zinc, Iron, manganese, and copper interactions in East-Idaho potato cropping systems. *USDA-CSREES Hatch Project*. Jul. 16, 2001-Jan. 1, 2007. $20,500.

Hopkins, B.G., D.A. Horneck, M.J. Pavek, P. Patterson, J. Miller, P.J.S. Hutchinson, J.M. Alvarez, M.K. Thornton, S.L. Hafez, and N.L. Olsen. Potato rotations. *WSARE-USDA*. Jul. 1, 2005-Jun. 30, 2006. $43,647. ($40,000. spending authority)

Hopkins, B.G. and P. Patterson. Potato rotation economics. *USDA-Western Risk Management Education.* Jul. 1, 2005-Jun. 30, 2006. $24,402.

Hopkins, B.G. Variable rate nitrogen. *UI Seed Grant.* Jul. 1, 2005-Jun. 30, 2006. $9,000.

Ellsworth, J.W., **B.G. Hopkins,** B. Brown, and H. Neibling. Wheat N requirements with reduced irrigation. *Idaho Wheat Commission*. Jul. 1, 2003-Jun. 30, 2006. $41,310. ($5,021. spending authority)

Thornton, M.K., B. Brown, **B.G. Hopkins**, B.D. Geary, and J.W. Ellsworth. Nutrient requirements and effects on new and potential release cultivars in the treasure valley. *Idaho Potato Commission*. Jul. 1, 2003-Jun. 30, 2006. $75,000. ($21,050. spending authority)

Ellsworth, J.W. and **B.G. Hopkins.** Nutrient uptake in potatoes. *Idaho Potato Commission*. Jul. 2004-Jun. 2005. $3,150. ($1,000. spending authority)

Hopkins, B.G., B.D. Geary, D.A. Horneck, and R.E. Thornton. Promoting sustainable potato cropping systems. *Western Sustainable Agriculture Research and Extension (WSARE)*. Jul. 1, 2002-Dec. 31, 2005. $158,477. ($130,000. spending authority)

Ellsworth, J.W., J.C. Stark, **B.G. Hopkins,** and B. King. Variable rate nitrogen impacts on improving water quality. *Idaho State Department of Agriculture Topic Team Grant.* Apr.1, 2003-Mar. 30, 2004. $10,000. ($3,000. spending authority)

Hopkins, B.G. Travel grant to pursue collaborative *USDA-WSARE* Grant Proposal-BJX200. UI. Aug. 2004. $750.

Ellsworth, J.W., B. Brown, and **B.G. Hopkins.** Remote sensing and nitrogen management in winter wheat production. *Idaho Wheat Commission.* Jul. 1, 2002-Jun. 30, 2003. $15,770. ($7,000. spending authority)

Ellsworth, J.W. and **B.G. Hopkins.** Soil fertility school. *Idaho Sugarbeet Growers Association.* Jul. 1, 2002-Jun. 30, 2003. $3,000. ($1,000. spending authority)

Hopkins, B.G. and G.W. Harding. Best management practices (BMP's) for potato cropping systms. *Idaho Potato Commission.* Jul. 1, 2002-Jun. 30, 2003. $5,000. ($5,000. spending authority)

Hopkins, B.G. Internal Grant. *University of Idaho (UOI)* Jan. 2000. $6000.

Grants and Contracts Awarded - Industry Support:

Hopkins, B.G. NAPT Coordinator. *North American Proficiency Testing Program (NAPT).* Oct. 2019 – Dec 2021. $102,389

Hopkins, B.G. Soil, Water, and Plant Management. *Consortium of Agri-Chemical Companies via the Research and Business Development Center (RBDC).* Jan. 2018 – Dec. 2018. $260,000

Hopkins, B.G. Soil, Water, and Plant Management. *Consortium of Agri-Chemical Companies via the Research and Business Development Center (RBDC).* Jan. 2017 – Dec. 2017. $248,000

Hopkins, B.G. Soil, Water, and Plant Management. *Consortium of Agri-Chemical Companies via the Research and Business Development Center (RBDC).* Jan. 2016 – Dec. 2016. $242,000

Hopkins, B.G. Soil, water, and plant management. *Consortium of Fertilizer Companies.* Jan. 2007– Dec. 2015. $1,248,000

Hopkins, B.G. Maintaining crop production while reducing nutrient pollution (Air & water quality). *Consortium of Fertilizer Companies***.** Mar. 2009 – Dec. 2010. $140,000

Raymer, D. and **B.G. Hopkins.** Agronomic assistance advising. *Democratic Republic of the Congo*. 2009. $100,000. ($25,000. spending authority)

Hopkins, B.G. Fertilizers and soil amendments: Impacts on crop yield and environmental quality. *Consortium of Agri-Chemical Companies.* Jan. 2007 – Dec. 2007. $102,000

Hopkins, B.G. and J.W. Ellsworth. Boron in potatoes. *US Borax.* Apr. 2005-Mar. 2007. $10,000. ($10,000. spending authority)

Hopkins, B.G. and J.W. Ellsworth. Phosphite and sulfone application to Russet Burbank potatoes. *Biagro, Inc.* Apr. 2003-Mar. 2007. $32,000. ($32,000. spending authority)

Hopkins, B.G. and J.W. Ellsworth. Fertilizer band placement in potatoes in alkaline and calcareous soil. *Fluid Fertilizer Foundation.* Mar. 2002-Feb. 2007. $26,000. ($26,000. spending authority)

Hopkins, B.G. Fused Ammonium Sulfate-Nitrate Fertilizer Product Evaluation in Potatoes. *Honeywell.* Apr. 2006-Oct. 2006. $10,500.

Hopkins, B.G. Monty's plant food product evaluations. *Monty's Plant Food Corp*. Apr. 2006-Oct. 2006. $10,000.

Hopkins, B.G. Humic acid product evaluation in potatoes. *Horizon Ag.* Apr. 2006-Oct. 2006. $4,000.

Hopkins, B.G. Steric chemistry fertilizers. *Northwest Ag Product*s. Apr. 2006-Oct. 2006. $3,000.

Hopkins, B.G. Nu-Earth product evaluation in potatoes. *Nu-Earth LLC.* Apr. 2006-Oct. 2006. $2,000.

Hopkins, B.G. Tierra resources product evaluation. *Tierra Resources.* Apr. 2006-Oct. 2006. $1,500.

Hopkins, B.G. Equipment evaluation in potatoes. *Spudnick.* Apr. 2006-Oct. 2006. $1,400.

Hopkins, B.G. 3Tier Product evaluation in potatoes. *3 Tier Technologies, Inc*. Apr. 2006-Oct. 2006. $1,200.

Hopkins, B.G. Soil conditioner study in potatoes. *MayZee.* Apr. 2006-Oct. 2006. $1,000.

Hopkins, B.G. Nitamin slow release nitrogen fertilizer product evaluation in potatoes. *Georgia Pacific.* Apr. 2006-Oct. 2006. $10,500.

Hopkins, B.G. Field Day support. *Western Farm Service*. Apr. 2006-Oct. 2006. $500.

Hopkins, B.G., J.W. Ellsworth, and T. Taysom. Polymer coated urea evaluation. *Agrium.* Apr. 2005-Oct. 2006. $16,000. ($16,000. spending authority)

Hopkins, B.G. and J.W. Ellsworth. Avail product evaluation. Soil. *Simplot Soilbuilders.* Mar. 2005-Feb. 2006. $6,000. ($6,000. spending authority)

Hopkins, B.G. and J.W. Ellsworth. Chelated nutrients. *Baicor.* Apr. 2005-Oct. 2006. $4,800. ($4,800. spending authority)

Hopkins, B.G. Field Day support. *Western Labs.* Apr. 2005-Oct. 2006. $500.

Hopkins, B.G. Field Day support. *MK Hansen.* Apr. 2005-Oct. 2006. $300.

Hopkins, B.G. ACA Product evaluation. *Aquatrols.* Apr. 2004-Oct. 2006. $72,910.

Hopkins, B.G. Hormone and calcium product evaluations on potatoes and sugarbeets. *Stoller Agronomics.* Apr. 2004-Oct. 2006. $59,700.

Hopkins, B.G. Drip tape irrigation. *T-Systems International, Inc.* Apr. 2004-Oct. 2006. $16,000.

Hopkins, B.G. MKP product evaluation. *Rotem BKG.* Apr. 2004-Oct. 2006. $11,400.

Hopkins, B.G. and J.W. Ellsworth. Variable rate nitrogen fertilizer application in potatoes. *ValleyWide Coop.* Apr. 2003-Mar. 2006. $75,000. ($65,030. spending authority)

Hopkins, B.G., J.W. Ellsworth, J.C. Stark and J. Gallion. Phosphorus and nitrogen banded fertilizer effects on sugarbeets in alkaline and calcareous soil. *Simplot Soilbuilders*. Mar. 2002-Feb. 2006. $9,500. ($9,500. spending authority)

Hopkins, B.G. BioFlora mark out product evaluation in potatoes and sugarbeets. *BioFlora, Inc.* Apr. 2002-Oct. 2006. $25,000.

Hopkins, B.G. BioSoil product evaluation. *Jet Harvest Solutions.* Apr. 2005-Oct. 2005. $1,600.

Hopkins, B.G. Field Day support. *Raven Industries/Lockwood.* Apr. 2005-Oct. 2005. $750.

Hopkins, B.G. Field Day support. *Ag World Support Systems.* Apr. 2005-Oct. 2005. $250.

Hopkins, B.G., J.W. Ellsworth, and T.R. Bowen. Variable rate nitrogen in malting barley. *Far West Agribusiness Association.* Apr. 2004-Oct. 2005. $12,500. ($12,500. spending authority)

Hopkins, B.G. and J.W. Ellsworth. Nutrient uptake rates of Russet Burbank potato in Minidoka, ID. *Landview Systems.* Apr. 2003-Mar. 2005. $12,063. ($12,063. spending authority)

Hopkins, B.G. and J.W. Ellsworth. Equity product evaluation on Russet Burbank potato. *Naturize, Inc*. Apr. 2003-Mar. 2005. $8,200. ($8,200. spending authority)

Ellsworth, J.W. and **B.G. Hopkins.** Banded phosphorus on sugarbeets in alkaline soils. *Potash and Phosphate Institute.* Apr. 2003-Nov. 2005. $9,000. ($4,000. spending authority)

Hopkins, B.G. Drip tape irrigation. *Clearwater Supply.* Apr. 2004-Oct. 2004. $4,000.

Hopkins, B.G. BioSoilStart product evaluation. *Agri-Trend.* Apr. 2004-Oct. 2004. $1,440.

Stark, J.C., **B.G. Hopkins,** and J.W. Ellsworth. Slow release P fertilizer. *Simplot.* Apr. 2004-Oct. 2004. $1,000. ($500. spending authority)

Hopkins, B.G. MNB product evaluation. *Micro Grow LLC.* Apr. 2004-Oct. 2004. $500.

Hopkins, B.G. Penetron product evaluation. *MazZee.* Apr. 2004-Oct. 2004. $500.

Hopkins, B.G. Nitro Plus, Nitrate balancer, satisfy, and force product evaluations on potatoes and sugarbeets. *Stoller agronomics.* Apr. 2002-Oct. 2003. $12,000.

Hopkins, B.G. Mineralization of elemental sulfur and its impacts on soil properties. *Panterra Industries*. Mar. 2002- Mar. 2003. $6,500.

Hopkins, B.G. Organic Gem product evaluation on Russet Burbank potatoes. *Advanced Marine Technologies.* Apr. 2002-Oct. 2003. $6,000.

J.W. Ellsworth and **B.G. Hopkins.** Remote sensing and nitrogen management in Hard Red Spring Wheat. *John Deere Corporation.* Mar. 2002-Sep. 2002. $27,000. ($13,000. spending authority)

FORENSIC EXPERT WITNESS:

- **Allred** v. ?? (2021-Pending) Representing the Plaintiff. Allred claims damages were caused to home because of improper soil conditions. (4th Distrct Court, UT)

- **Pima County** v. Tucson City. (2021--pending) No. CV2022-001141 Representing the plaintiff. Pima county claims Tucson City wrongly assessed additional fees for water rates on unincorporated citizens. (District Court of Arizona)

- Timpanogos Special Service District v. **Bernard Niel Christensen, et. al.** (2021-Pending) No 210401369. Representing the Plaintiff. Christensen claims district caused damages to his field with installation of a sewer line and district was seeking a second easement to increase the size of the sewer line. (4th District Court, UT)

- Utah State v. **Michael Ignatius Kufrin.** (2020-- pending) No. 171402277. Representing the defendant. State claims that defendant Kufrin killed Peggy Sue Case and buried her in a dirt celler. (4th District Court, UT)

- Balchem Corp. & Albion Lab, INC. v. **Daniel Todd Edwards & Mil Agro, Inc.** (2019- pending) No. 7:18-cv-02677-KMK-JCM. Date of deposition: Dec 4, 2019; Salt Lake City, UT. Representing the defendant. Plaintiffs claim that defendants violated their patent (stolen trade secrets and false advertising). (S.D. New York)

- Falls Fertilizer, INC. v. **Mickelsen.** (2018-2019) No. CV-2017-1670. Date of trial testimony: July 17, 2019; Blackfoot, ID. Representing the defendant-countersuing. Claim by plaintiff that defendant failed to pay for services rendered. Counterclaim by defendant that plaintiff improperly sprayed herbicide which caused crop failure. Ruling in favor of the defendant. (District Court of the 7th Judicial District. ID)

- Pinnacle v. Dewsnup and **1-Stop Realty.** (2016- 2018) No. 4:13-cv-00106-EIJ-CWD. Date of deposition: Aug. 11, 2016; Boise ID. Representing the defendant. Claim by the land purchaser that the defendant misrepresented the quality of the water and that it was unsuitable for plant growth. Case was settled. (US D. Idaho)

- Class actions suit v. **Scotts.** (2015-2018) No. 12-cv-4727(VB). Date of deposition: Apr. 15, 2016; New York, NY. Representing the defendant. Class action claim that Scotts EZ seed labeling was inaccurate and product was defective. Case was settled. (S.D. New York)

- **Phillip E. Allred, et al**. v. PacifiCorp. (2017) No. 2:15-cv-00095. Claim was that the Wood Hollow Fire caused ash and groundwater damage to the plaintiff's farm. Case was successfully mediated on Dec. 2, 2017. (US D. UT)

- **Owyhee Farming Company, LLC** v. Agri-Lines Irrigation, INC. (2015-2017) No. CV OC 1423886. Representing the plaintiff. Claim that defendant improperly installed irrigation systems. Settled prior to trial, favorably for the plaintiff. (US D. ID)

- **Fowers Fruit Ranch** v. Bio Tech Nutrients. (2012-2016) No. 2 11-cv-00105; Dates of deposition: Apr. 30/May 1, 2013; Salt Lake City, UT. Date of trial testimony: Feb. 3, 2016, Salt Lake City, UT. Representing the plaintiff. Claim that BTN product was defective and caused catastrophic harm to crops. Ruling in favor of the plaintiff. (US D. Utah)

- Encap, LLC v **Scotts Company, LLC**, et al. (2014-2014) Defendant consulted with me but no written report, deposition, or trial deposition was requested.

- **Bingham** et al v Roosevelt City. (2010-2012) Representing the plaintiff. Claim that city of Roosevelt pumped water and drawing down aquafer causing catastrophic failure of forage legumes and grasses. I submitted a written report without being deposed and the case was settled for an undisclosed amount.

- **LandView, INC** v undisclosed custom fertilizer applicator; Rupert, ID. (2009-2010) Representing the plaintiff. Claim that defendant spread fertilizer unevenly causing significant crop damage to Landview customers. Settled for undisclosed amount after I submitted a written report and I was not deposed nor did I testify at court.

- **Class action suit brought by Idaho farmers** v Bureau of Land Management; Boise, ID (2002-2006) Engaged as an expert for the plaintiff but was not requested for a written report, deposition, or trial testimony. Claim that U.S. Bureau of Land Management applied herbicide (Oust) which drifted or was blown with soil causing damage to crops. Ruled in favor of plaintiff, but later over turned.

- Various confidential cases for soil, nutrient, water, and plant issues (row crop, forages, and turf grass) as a consultant for Servi-Tech (1995-1999).

- **Pizza Hut Corporation** v General Contractor Group; Liberal, Kansas. (1994-1995) Representing the plaintiff. Claim that contractors improperly placed toxic sludge material in the landscape causing catastrophic failure of the turf grass, trees, and shrubs. Plaintiff dropped the matter after my findings showed there was no basis for their claims.

- Rupert Smith v **Joe Kelly**. Junction City, Kansas (1994-1995) Representing the defendant. Claim that the defendant had applied chemicals through irrigation and/or sprayer causing significant damage to neighboring turf grass and landscape plants. Matter was settled for undisclosed amount prior to any court action.

CITIZENSHIP:

University:

Clemson University guest speaker: PES 220- Soils. Proficiency testing for soil science. October 30, 2021.
BYU PWS Rank and Status Committee. 2014-present.
*Chair 2020-present
BYU Environmental Analytical Lab Director. 2012-present.
BYU Annual guest speaker: PWS 191-Introduction to Landscape Management. Biophysical Soil Chemistry Research. 2007- present.
BYU College Undergraduate Research Award (CURA) Poster Judge, April 10, 2019.
BYU Accreditation Committee- Head of facilities sub-committee. 2018-2019.
BYU Judge for Graduate Student Conclave; 25 Nov. 2018.
BYU College Undergraduate Research Awards (CURAs) Grant Reviewer. 2018.
BYU PWS Skaggs Ranch Oversight Committee. 2012-2017.
BYU PWS Safety Officer. 2012-2015.
BYU CLS Safety Committee. 2012-2015.

BYU PWS Environmental Science Club Co-Advisor. 2008-2013.
BYU PWS Environmental Science Focal Chair. 2010-2012.
BYU PWS Awards Committee. 2010-2012.
BYU PWS Environmental Science Seminar Speaker Subcommittee Chair. 2008-2012.
BYU Internal Review Widtsoe Grants. 2010.
BYU ORCA Grant Reviewer. 2010.
BYU CLS Curriculum Committee. 2008-2010.
BYU PWS Curriculum Committee Chair. 2008-2009.
BYU PWS Environmental Science Recruiting Sub-Committee Chair. 2007-2008.
UI-CES and IPC. Pest Alert Network, Pest Verification Representative for Southeast Idaho. 2003-2008.
UI-CES. Idaho Potato Conference Program Chair. 2004 and 2007.
UI-CES College of Agriculture and Life Sciences. Nutrient and Waste Management Conference Committee member. 2002-2006.
UI Plant, Soil, and Entomological Sciences Department. Idaho Center for Potato Research and Education Web Site Development Committee. 2001-2006.
UI-CES. Idaho Potato Conference Planning Committee. 2001-2006.
UI-CES College of Agriculture and Life Sciences. Nutrient Management Leader for Potato Team. 2002-2006.
UI-CES College of Agriculture and Life Sciences. Nutrient and Waste Management Crops Team member. 2001-2006.
UI-CES College of Agriculture and Life Sciences. Sustainable Ag Coordination/Action Team (SACAT) member. 2001-2006.
UI-CES College of Agriculture and Life Sciences. Potato Team member. 2001-2006
UI Internal Reviewer (6 manuscripts and various grant proposals/reports). 2001-2006.
UI-CES. Special Representative for the UI, United Annual Produce Business Conference and Expo, 2003.
UI-CES Ag Pavilion Volunteer. Eastern Idaho State Fair. Blackfoot, ID. Sep. 5-6, 2001.

Professional and Scholarly Organizations:

Golf Course Superintendents Association of America (GCSAA), 2021- present.
Plant and Soil Journal; Editor, 2020- present.
US TAG (Technical Advisory Group); ISO/TC 134 *Fertilizer, Soil Conditioners, and Beneficial Substances (including Biostimulants),* 2020 - present.
* US expert ISO Working Groups of TC 134: WG 3 "Vocabulary and statistics", WG 5 "Microbiology"
Guest Editor: Agronomy; Special Edition on Phosphorus and Micronutrient Interactions. 2020-present
Joint EPA-USDA Challenge on Enhanced Efficiency Fertilizers Committee. 2019-present.
Western Education/Extension and Research Activities - Western Regional Turfgrass Working Group (WERA-011; USDA-CSREES), 2018 – present.
Turfgrass Producers International, 2017- present.
Intermountain Sports Turf Managers Association, 2008- present.
Sports Turf Managers Association, 2007-present.
* Education Committee 2012-present.
* BMP Task Force Committee. 2019-present.
* Environmental Committee. 2021-present.
National Association of Landscape Professionals, 2007- present.
Idaho Academy of Science. Life time member. 2001- present.

Western Education/Extension and Research Activities - Western Regional Nutrient Management Working Group (WERA-103; USDA-CSREES), 2000 – present.

*Session chair for Biostimulants Symposia at the Western Nutrient Management Conference (WNMC). 2018-2019

*Conference planning committee. 2000- present.

Crop Science Society of America (CSSA), 1999-present.

American Society of Agronomy (ASA), 1989-present.

* Panelist for CCA/CPSS Career Accelerator session as part of SASES undergraduate program, 2020

*Board of Directors – Representing the Practicing Professionals Division A9. 2003-2006.

*Student Presentation Contest Committee (A449.6) of ASA, Member, 2002-2004.

Soil Science Society of America (SSSA), 1989-present.

*Judge for the student competition, 2020

*Session moderator, 2020-present.

*North American Proficiency Testing Committee. Ex-officio member. 2010-2015

*Official Methods of Soil Analysis (S889) Committee, of SSSA Member, 2000-2004; Chair, 2005-2015.

*Nitrous Oxide Impact on Environment Symposia Organizer. 2011. *(Invited)*

*Membership, Identity, and Visibility Committee (S236.1) of SSSA, Professional Practitioners Sub- Committee Chair, 1999-2003.

*Soil Testing and Plant Analysis Committee (S877) of SSSA, Incoming, Chair, and Past Chair, 2000-2003.

*Nutrient Management Symposia Coordinator, Oct. 24-25, 2001. *(Invited)*

*Reviewer for International Soil Testing and Plant Analysis Program Proceedings - Validation and Re-Calibration of a Soil Test for Mineralizable Nitrogen. 2005.

Guest Associate Editor: Journal of Environmental Quality; Special Edition on Phosphorus. 2019

Potato Association of America, 2001-2009.

*Local Area Committee for 2007 meetings in ID.

Certified Crop Advisors of the Pacific Northwest, board of directors and chair of exam sub-committee, 2004-2006.

Far West Agribusiness Association, Research and Education Committee, 2003-2006.

Natural Resources Conservation Service (NRCS) State of Idaho Technical Committee, 2002-2006.

Shoshone-Bannock Tribes' Alternative Cropping Demonstration Advisory Board Member, 2002-2006.

Idaho Association of Plant Pathology, 2000-2006.

Association of LDS Crop and Soil Scientists, President, 2002-2003.

North Central Extension-Industry Soil Fertility Conference Planning Committee, 1999-2001.

AOAC International (formerly American Organization of Analytical Chemists, Associate Referee, 1992-2001.

Soil Testing and Plant Analysis Council, 1995-1998.

North Central Region Soil Test Working Group (NCR-13), Organic Matter Determination Sub-Committee Chair, 1992-1995.

AWARDS AND HONORS

PWS 3 MT Competition- 1st place (Stapley, S.); *Brigham Young University (BYU)*. 2022.

SSSA Fellow Award, *Soil Science Society of America (SSSA)*. 2021.

WSCS Student Oral Contest – 2nd place (Burgin, H.); *Western Society of Crop Science (WSCS).* 2021. Virtual.

BYU Inspiring Learning Award for Career Champion, *Brigham Young Universit*y – Nominated by students of the Plant and Wildlife Sciences Department. 2021

BYU Inspiring Learning Award for Experiential Learning, *Brigham Young Universit*y – Nominated by students of the Plant and Wildlife Sciences Department. 2021

BYU College of Life Sciences Virtual Poster Competition: Video Presentation Award- 2nd place (Stapley, S.) *Brigham Young University*. 2021. Virtual.

BYU College of Life Sciences Virtual Poster Design Award- Peer Choice (Geary, B.T.) *Brigham Young University*. 2021. Virtual.

Editor's Citation in Excellence Award - Outstanding Reviewer, *Soil Science Society of America Journal (SSSAJ).* 2021.

Western Nutrient Management Undergraduate Student Presentation Award – 3rd place (Seely, C), 2nd place (Stapley, S), 1st place (Lambert, A.); *Western Nutrient Management Conference (WNMC).* 2021. Virtual.

Western Crop Science Society Graduate Student Presentation Award- 2nd place (Burgin, H.), *Western Crop Science Society Meeting.* 2020. Virtual.

Skaggs BYU Fellowship Award for Excellence in Mentoring, *Brigham Young University*, 2020.

ASA Fellow Award, *American Society of Agronomy (ASA)*. 2019.

Invited and Key Note speaker at over 100 events across several countries

Co-advisor/coach for National Collegiate Landscape Competition (NCLC) with top 5 finishes in all years involved since 2008, including five times as National Champions.

Guest Associate Editor for Special Publication of Phosphorus, *Journal of Environmental Quality*. 2019

Superior instructor rank, *Brigham Young University*, (average rank of 4.5 out of 5.0); 2007-2019

Precision Ag Oral Presentation Award (Svedin, J.D.,), *ASA•CSSA International Annual Meeting;* Baltimore, MD; 2018.

Student Research Award- 2nd place (Evans S.), *Western Nutrient Management Conference (WNMC);* Reno, NV; 2017.

Adult Service Award of Merit, Wood Badge Leadership Certificate, and various other awards, *Boy Scouts of America*; 1992-2016

ASA Cross Cultural Experience Program Scholarship (Miranda Ruth), *American Society of Agronomy (ASA)*. 2016

Student Research Award- 1st place (Russell, K. A.), *Nitrogen Use Efficiency (NUE);* Boise, ID. 2016.

ASA cross cultural experience program scholarship (Ruth, M.), *American Society of Agronomy (ASA).* 2016.

Student Research Award- 1st place (Trent Blair), *Western Nutrient Management Conference (WNMC);* Reno, NV; 2015.

Practical Science Award, *Western Growers Association.* 2015

Keynote Speaker and Award of Research Excellence, *Denmark Potato Growers and Aarhus University*; 2012

Humanitarian Appreciation Award, *Democratic Republic of the Congo*; 2010

Outstanding Educator, *Potato Growers Association.* 2010

Appointed Board of Directors, Certified Crop Advisors-Pacific Northwest; 2004-2006

Elected to Board of Directors, *American Society of Agronomy*. 2003-2006

Highest ranked presenter at over 100 workshops – Nutrient, Soil, and Water Management Workshops, *Servi-Tech, Inc.;* 1998-2000

Outstanding Educator (highest evaluation scores from CCA participants), *Servi-Tech Inc.*1997, 1998, and 1999

J. Fielding Reed Fellowship, *Potash and Phosphate Institute*. 1991

18 fellowships/scholarships and other academic awards as a graduate and undergraduate student; 1986-1991

EXTERNAL MANUSCRIPT REVIEWS: (INDIVIDUAL TITLES AVAILABLE UPON REQUEST)

Archives of Agronomy and Soil Science J.; 2020
Agriculture J.; 2020
Agronomy J.; 2003, 2008, 2010, 2014, 2015(2), 2021
Am. J. of Potato Research(AJPR); 2004, 2004, 2005, 2005, 2007, 2008, 2008, 2009, 2009, 2010, 2010, 2011, 2013(5), 2014, 2016, 2019
Catena; 2019
Canadian J. of Plant Science; 2004
Communications in Soil Science and Plant Analysis J.; 2003, 2005, 2017
Crop Science; 2020
CSREES-USDA Reviewer for Cool Season Food Legume Special Research Grant; 2004.
Environmental Science book by Richard Wright, chapter 19 review; 2011
HortScience; 2019
The J. of Animal and Plant Sciences; 2017
J. of the American Society for Horticultural Science (ASHA); 2019
J. Environmental Quality; 2009, 2011, 2016, 2021
J. Plant Nutrition; 2010
J. Plant Nutrition and Soil Science; 2010, 2018
J. Science of Food and Agriculture; 2011
J. Soil Water Conservation; 2005, 2009
Plant and Soil J.; 2011, 2020
Manuscript Number: PLSO-D-20-00892R1
Plant Biology; 2010
Plant Physiology and Biochemistry; 2020
Plants J. 2020
Soil Research (INI); 2016, 2019
Soil Science J.; 2004, 2004, 2012, 2019
Soil Science Society of America J.; 2001, 2002, 2002, 2007, 2012, 2019, 2020
Sugarbeet Research J.; 2004

EXTERNAL BOOK REVIEWS:

Kent Crookston; Book of Mormon Ecology; 2019
Pearson; Interactive Environmental Science; 2017
Pearson; Environmental Science, Wright and Boorse; 2015
Pearson; Environmental Science, Wright; 2011

EXTERNAL FACULTY REVIEW FOR PROMOTION AND TENURE:

2017. Dr. Kurt Steinke; Associate Professor at Michigan State University.

COMMUNITY SERVICE:

BYU Women's Conference. Guest speaker: Brigham Young University; 3 May 2019: Provo, UT

Church of Jesus Christ of Latter-day Saints: President of the Provo Utah Stake (2017-present), Bishop of local congregation (2010-2015), many previous voluntary positions, full-time missionary 1984-86.

Church of Jesus Christ of Latter-day Saints: Landscape Committee, 2012-present

Church of Jesus Christ of Latter-day Saints: Water Conservation Committee, 2012-present

Guest speaker at Karl G. Maeser Preparatory Academy; 4 Dec. 2018: Lindon, UT. Topic: Woolley, E.A. and **B.G. Hopkins.** 2018. Research and statistics.

Member of the Provo City Agricultural Commission. 2016-2017

Coach of high school and little league football, basketball, soccer, and wrestling teams/clubs, 1998-2011

Agronomic and Environmental Quality Advisor to Democratic Republic of the Congo and Aid Organizations Located in that region, 2008-2010.

Boy Scouts of America (BSA), Scoutmaster/Adult Advisor/Monthly Community Service Project Advisor, 1991-2007.

XII. Appendix 2 – Dr. Hansen CV

NEIL C. HANSEN

Curriculum vitae

Brigham Young University, Department of Plant and Wildlife Sciences

701 East University Parkway Drive, 4105 LSB, Provo, UT 84602

Phone: (801) 422-2760 Email: neil_hansen@byu.edu

PROFESSIONAL GOALS

My professional goal is to advance understanding and adoption of management strategies for sustainable use of soil and water resources. My research evaluates how management of soil and plant systems influences water resources. This theme has led to work in a variety of agroecosystems including dryland, irrigated, and rainfed croplands. The majority of my research is conducted at multiple sites over multiple years at a field scale with an emphasis on improving crop water productivity and surface water quality in agricultural watersheds. I prioritize research synthesis that informs water policy and conservation strategy.

EDUCATION

Ph.D. - Soil Physics - University of Minnesota, St. Paul, MN - 1998
Dissertation Title: Transport of agricultural contaminants in overland flow: Studies at three scales.
M.S. - Agronomy - Brigham Young University, Provo, UT - 1994
Thesis Title: Phytosiderophore release by iron-deficient oat genotypes.
B.S. - Agronomy, Brigham Young University, Provo, UT - 1992

EXPERIENCE

2018 - Present Department Chair, Dept. Plant and Wildlife Sciences, Brigham Young Univ.

2017 - Present	Professor, Dept. Plant and Wildlife Sciences, Brigham Young Univ.
2013 – 2017	Associate Professor, Dept. Plant and Wildlife Sciences, Brigham Young Univ.
	Affiliate Professor, Dept. Soil and Crop Sciences, Colorado State Univ.
2004 - 2013	Associate Professor, Dept. Soil and Crop Sciences, Colorado State Univ.
	Awarded tenure – 2006
1998 - 2004	Assistant Professor, Dept. of Soil, Water, and Climate, Univ. of Minnesota
	Soil Scientist and Water Quality Specialist, West Central Research and Outreach Center, Morris, MN. Awarded tenure – 2004
1994-1998	USDA National Needs Predoctoral Fellow, Soil management and water quality, Dept of Soil, Water, and Climate, Univ. of Minnesota, St. Paul, MN

PUBLICATIONS

Peer Reviewed Journal Articles and Book Chapters:

Graduate and *Undergraduate* student authors advised by Dr. Hansen are underlined and italicized

Anderson, R M, Hoose, B W, Anderson, Val J, Hansen, Neil C, Stringham, T K, Summers, D D, Gunnell, K L, Landeen, M L, Madsen, Matthew D. 2021. The influence of seed conglomeration technology and planting season on Wyoming big sagebrush restoration. Rangeland Ecology and Management 77:126-135.

Burgin, Hanna R, Wear, Glenl A, Hansen, Neil C, Hopkins, Bryan G. 2021. Variable Impacts on Growth of Deficit Irrigation on Cynodon dactylon (L.) Pers. × C. transvaalensis Burt Davy and Poa pratensis L. International Turfgrass Society Research Journal 14:152-156. https://doi.org/10.1002/its2.71

Crandall, Trevor, Jones, Erin, Greenhalgh, Mitchell, Frei, Rebecca J., Griffin, Natasha, Severe, Emilee, Maxwell, Jordan, Patch, Leika, St Clair, S. Isaac, Bratsman, Sam, Merritt, Marina, Norris, Adam J., Carling, Gregory T, Hansen, Neil C, St Clair, Samuel B, Abbott, Benjamin W. 2021. Megafire affects stream sediment flux and dissolved organic matter reactivity, but land use dominates nutrient dynamics in semiarid watersheds. PLOS ONE 16: e0257733. https://doi.org/10.1371/journal.pone.0257733

Smith, R, Oyler, L, Campbell, C, Woolley, E.A., Hopkins, B.G., Kerry, R, and Hansen, N.C. 2021. A new approach for estimating and delineating within-field crop water stress zones with satellite imagery, International Journal of Remote Sensing, 42:16, 6005-6024, DOI: 10.1080/01431161.2021.1931536

Svedin, J.D. Kerry, R. Hansen, N.C., and Hopkins, B.G. 2021. Identifying within-field spatial and temporal crop water stress to conserve irrigation resources with variable-rate irrigation. Agronomy 11: 1377. https://doi.org/10.3390/agronomy11071377

Zhou, Shiwei, Xiaotao Hu, Hui Ran, Wenè Wang, Neil Hansen, and Ningbo Cui. 2020. Optimization of irrigation and nitrogen fertilizer management for spring maize in northwestern China using RZWQM2. Agric. Water Management 240: 106276, DOI: 10.1016/j.agwat.2020.106276

Ortiz-Cano, Hector, Jose Antonio Hernandez-Herrera, Neil C. Hansen, Steven L. Petersen, Michael T. Searcy, Ricardo Mata-Gonzalez, Teodoro Cervantes-Mendívil, Antonio Villanueva-Morales, Pil Man Park,

and J. Ryan Stewart. 2020. Pre-Columbian Rock Mulching as a Strategy for Modern Agave Cultivation in Arid Marginal Lands. Frontiers in Agronomy 2:10. doi: 10.3389/fagro.2020.00010

Hopkins, Bryan G., and Neil C. Hansen. 2019. Phosphorus Management in High-Yield Systems. J. Environ. Qual. 48: 1265-80.

Pugh, Sierra, Matthew J. Heaton, Jeff Svedin, and Neil Hansen. 2019. Spatiotemporal Lagged Models for Variable Rate Irrigation in Agriculture. J. Agric., Bio. and Env. Statistics, 24: 634-50.

Randall, Matthew C., Carling, Gregory T, Dastrup, Dylan B., Miller, Theron, Nelson, Stephen T., Rey, Kevin A, Hansen, Neil C, Bickmore, Barry R, Aanderud, Zachary Thomas. 2019.

Sediment potentially controls in-lake phosphorus cycling and harmful cyanobacteria in shallow, eutrophic Utah Lake. PLOS ONE 14: e0212238 https://doi.org/10.1371/journal.pone.0212238.

Selck, B., G.T. Carling, S. Kirby, S., N.C. Hansen, B.R. Bickmore, D.G. Tingey, K. Rey, J. Wallace, and L.Jordan. 2018. Investigating anthropogenic and geogenic sources of groundwater contamination in a semi-arid alluvial basin, Goshen Valley, Utah, USA. Water, Air, and Soil Pollution, 229, 186.

Hopkins, B. G., K. J. Fernelius, N. C. Hansen, and D. L. Eggett. 2018. AVAIL Phosphorus Fertilizer Enhancer: Meta-Analysis of 503 Field Evaluations. Agron. J. 110:389-398. DOI:10.2134/agronj2017.07.0385

Carroll, D.A., Hansen, N.C., Hopkins, B.G., and DeJonge, K.C. 2017. Leaf temperature of maize and crop water stress index with variable irrigation and nitrogen supply. Irrigation Science 35: 549. DOI:10.1007/s00271-017-0558-4

Payne, C., E. J. Wolfrum, N. Nagle, J. E. Brummer, and N. Hansen. 2017. Evaluation of Fifteen Cultivars of Cool-Season Perennial Grasses as Biofuel Feedstocks Using Near-Infrared. Agronomy Journal 109:1923-1934. DOI:10.2134/agronj2016.09.0510

Messick, R.M., Heaton, M.J., and **Hansen, N.C.** 2017. Multivariate spatial mapping of soil water holding capacity with spatially varying cross-correlations. Annals of Applied Statistics 11:69-92. (IF=1.43).

Wood, M., Taylor, S., Carroll, A., and **Hansen, N.C.** 2017. Surveying Employment Listings to Inform Curricula of Environmental Science Degree Programs. Journal of Environmental Studies and Sciences 7: 346-354. DOI: 10.1007/s13412-016-0401-x.

Hansen, N.C., Allen, B.L., Anapalli, S., Blackshaw R.E., Lyon, D.J., and Machado, S. 2016. Dryland Agriculture in North America. In: Farooq, M. and K.H.M. Siddique (eds). Innovations in Dryland Agriculture. Cham, Springer, pp 415–441.

Foster, E.J., Hansen, N.C., Wallenstein, M., and Cotrufo, M.F. 2016. Biochar and manure amendments impact soil nutrients and microbial enzymatic activities in a semi-arid irrigated maize cropping system. Agriculture, Ecosystems and Environment 233:404-414; DOI: 10.1016/j.agee.2016.09.029) (IF=3.564)

Nielsen, D.C., Vigil, M.F., and **Hansen, N.C.** 2016. Evaluating potential dryland cropping systems adapted to climate change in the central great plains. Agronomy Journal (accepted – in press, First Online: 15 Sept 2016; DOI: 10.2134/agronj2016.07.0406) (IF=1.44)

Hansen, N.C. 2015. Blue water demand for sustainable intensification. Agronomy Journal 107: 1539-1543. (IF=1.44)

Hansen, N.C., Tubbs, S., Fernandez, F., Green, S., Hansen, N.E., and Stevens, W.B. 2015. Conservation agriculture in North America. In: Farooq, M and Sidique, K (eds.) Conservation Agriculture. Springer.

McMaster, G.S., Ascough, J.C., Edmunds, D.A., Wagner, L.E., Fox, F.A., DeJonge, K.C., and **Hansen, N.C.** 2014. Simulating unstressed crop development and growth using the unified plant growth model. Environmental Modeling and Assessment 19:407-424. (IF=0.98)

Pearson, C.H., Brummer, J.E., Beahm, A.T., and **Hansen, N.C**. 2014. Kura clover living mulch for furrow-irrigated corn in the intermountain west. Agronomy Journal 106:1324-1328. (IF=1.44)

Plaza-Bonilla, D., Álvaro-Fuentes, J., **Hansen, N.C.,** Lampurlanés, J., Cantero-Martínez, C. 2014. Winter cereal root growth and aboveground–belowground biomass ratios as affected by site and tillage system in dryland Mediterranean conditions. Plant and Soil 374:925-939. (IF=2.95)

Sherrod, L.A., Ahuja, L.R., **Hansen, N.C.,** Ascough, J.C., Westfall, D.G., and Peterson, G.A. 2014. Soil and rainfall factors influencing yields of a dryland cropping system in Colorado. Agronomy Journal 106: 1179-1192. (IF=1.44)

Lloyd, G., Hansen, N.C.**, Sherrod, L., Inman, D, and Peterson, G.A. 2013. Constraints and capabilities of no-till dryland agroecosystems as bioenergy production systems. Agronomy Journal 105:364-376. (IF=1.44)**

DeJonge, K.C., Ascough, J.C.II, Andales, A.A., **Hansen, N.C.,** Garcia, L.A. and Arabi, M. 2012. Improving evapotranspiration simulations in the CERES-Maize model under limited irrigation. Agricultural Water Management 115:92-103. (IF=2.29)

Barbarick, K.A., Ippolito, J.A., McDaniel, J. Hansen, N.C.**, Peterson, G.A. 2012. Biosolids application to no-till dryland agroecosystems. Agriculture, Ecosystems and Environment 150:72–81. (IF=3.40)**

Hansen, N.C., **Allen, B.L., Baumhardt, R.L., and Lyon, D.J. 2012. Research achievements and adoption of no-till, dryland cropping in the semi-arid US Great Plains. Field Crops Research 132: 196-203. (IF=2.98)**

Peterson,G.A., Westfall, D.G., and Hansen, N.C. **2012. Enhancing precipitation use efficiency in the world's dryland agroecosystems. In: Lal, R. and Steward, B.A. (eds.) Soil Water and Agronomic Productivity. Advances in Soil Science. CRC Press.**

Taghvaeian, S., Chávez, J.L., and Hansen, N.C**. 2012. Infrared Thermometry to Estimate Crop Water Stress Index and Water Use of Irrigated Maize in Northeastern Colorado. Remote Sensing 4:3619-3637. (IF=3.18)**

Shaner, D. Stromberger, M., Khosla, R., Helm, A., Bosley, B., and Hansen, N.C. **2011. Spatial distribution of enhanced atrazine degradation across northeastern Colorado cropping systems. Journal of Environmental Quality 40:46-56. (IF=2.65)**

DeJonge, K.C., Andales, A.A., Ascough II, J.C., and Hansen, N.C. **2011. Modeling of full and limited irrigation scenarios for corn in a semiarid environment. Transactions of the American Society of Agricultural and Biological Engineers 54:481-492. (IF=0.90)**

Lindenmayer, R.B., Hansen, N.C.**, Brummer, J. and Pritchett, J.G. 2011. Deficit irrigation of alfalfa for water-savings in the Great Plains and Intermountain West: A review and analysis of the literature. Agronomy Journal 103:45-50. (IF=1.44)**

Ascough II, J.C., Andales, A.A., Sherrod, L.A., Mcmaster, G.S., Hansen, N.C.**, Dejonge, K.C., Fathelrahman, E.M., Ahuja, L.R., Peterson, G.A., Hoag, D.L. 2010. Simulating**

landscape catena effects in no-till dryland agroecosystems using GPFARM. Agricultural Systems 103: 569-584. (IF=2.91)

Westfall, D.G., Peterson, G.A., and Hansen, N.C. **2010. Conserving and Optimizing Limited Water for Crop Production. In: Kang, M. (ed). Water and Agricultural Sustainability Strategies. CRC Press.**

Westfall, D. G., Peterson, G. A., and Hansen, N. C. **2010. Conserving and optimizing limited water for crop production. Journal of Crop Improvement 24:70-84.**

Shaner, D.L., Wiles, L., and Hansen, N.C. **2009. Behavior of atrazine in limited irrigation cropping systems in Colorado: Prior use is important. Journal of Environmental Quality 38: 1861-1869. (IF=2.65)**

Hansen, N.C.**, Ward, S., Kohsla, R. and Fenwick, J. 2007. What does undergraduate enrollment in soil and crop sciences mean for the future of agronomy?. Agronomy Journal 99:1169-1174. (IF=1.44)**

Ascough, J.C., McMaster, G.S., Andales, A.A., Hansen, N.C. **and Sherrod, L.A. 2007. Evaluating GPFARM crop growth, soil water, and soil nitrogen components for Colorado dryland locations. Transactions of the American Society of Agricultural and Biological Engineers 50:1565-1578. (IF=0.90)**

Chen, S., Kurle, J.E., Stetina, S.R., Miller, D.R., Klossner, L.D., Nelson, G.A., and Hansen, N.C. **2007. Interactions between iron-deficiency chlorosis and soybean cyst nematode in Minnesota soybean fields. Plant and Soil 299:131-139. (IF=2.95)**

Hansen, N.C., Hopkins, B.G., Ellsworth, J.W., and Jolley, V.D. 2006. Iron Nutrition in Field Crops. In: Barton, L.L. and Abadía, J. (eds.). Iron Nutrition in Plants and Rhizospheric Microorganisms. Springer 2005. pgs. 21-53.

Ranaivoson, A.Z.H., **Moncrief, J.F.,** Hansen, N.C.**, and Gupta, S.C. 2005. Effect of fall tillage following soybeans on organic matter losses in snowmelt. Soil and Tillage Research 81:205-216. (IF=2.62)**

Hansen, N.C.**, Jolley, V.D., Naeve, S.L., and Goos, R.J. 2004. Iron deficiency of soybean in the north central U.S. and associated soil properties. Soil Science and Plant Nutrition 50:983-987. (IF=0.73)**

Jolley, V.D., Hansen, N.C. **and Shiffler, A.K. 2004. Nutritional and management related interactions with iron-deficiency stress response mechanisms. Soil Science and Plant Nutrition 50:973-981. (IF=0.73)**

Gessel, P.D., Hansen, N.C.**, Moncrief, J.F. and Schmitt, M.A. 2004. Application rate of liquid swine manure: effects on runoff, sediment and phosphorus transport. Journal of Environmental Quality 33:1839-1844. (IF=2.65)**

Gessel, P.D., Hansen, N.C.**, Goyal, S.M., Johnston, L.J. and Webb, J. 2004. Persistence of zoonotic pathogens in soil treated with different rates of liquid hog manure. Applied Soil Ecology 25:237-243. (IF=2.64)**

Hansen, N.C.**, Schmitt, M.A., Anderson, J.E., and Strock, J.S. 2003. Iron deficiency of soybean in the upper Midwest and associated soil properties. Agronomy Journal 95:1595-1601. (IF=1.44)**

Forcella, F., Poppe, S., Hansen, N.C.**, Hoover, E., Head, W., Propsom, F., and McKensie, J.. 2003. Biological mulches for managing weeds in transplanted strawberry. Weed Technology 17:782–787. (IF=1.06)**

Hansen, N.C.**, Daniel, T.C., and Sharpley, A.N. 2002. Fate and transport of phosphorus in agricultural systems. Journal of Soil and Water Conservation 57:408-417. (IF=1.60)**

Hansen, N.C., Gupta, S.C., and Moncrief, J.F. 2001. Snowmelt runoff, sediment, and phosphorus losses under three different tillage systems. Soil and Tillage Research 57:93-100. (IF=2.62)

Hansen, N.C.**, Moncrief, J.F., Gupta, S.C., Capel, P.D., and Olness, A.E. 2001. Herbicide banding and tillage system interactions on runoff losses of alachlor and cyanazine. Journal of Environmental Quality 30: 2120-2126. (IF=2.65)**

Hansen, N.C., Moncrief, J.F., and Gupta, S.C. 2000. Herbicide banding and tillage system impacts on runoff, sediment, and phosphorus losses in runoff. Journal of Environmental Quality 29:1555-1560. (IF=2.65)

Balogh, S.J., Meyer, M.L., **Hansen, N.C.**, Moncrief, J.F., and Gupta, S.C. 2000. Transport of mercury from a cultivated field during snowmelt. Journal of Environmental Quality 29:871. (IF=2.65)

Hansen, N.C., Jolley, V.D., Berg, W.A., Hodges, M.E., Krenzer, E.G. 1996. Phytosiderophore release related to susceptibility of wheat to iron deficiency. Crop Science 36: 1473-1476. (IF=1.58)

Jolley, V.D., Cook, K.A., **Hansen, N.C.**, and Stevens, W.B. 1996. Plant physiological responses for genotypic evaluation of iron efficiency in strategy I and strategy II plants - a review. Journal Plant Nutrition 19: 1241-1255. (IF=0.49)

Hansen, N.C., Jolley, V.D., and Brown, J.C. 1995. Clipping foliage differentially affects phytosiderophore release by two wheat cultivars. Agronomy Journal 87: 1060-1063. (IF=1.44)

Hansen, N.C. and Jolley, V.D. 1995. Phytosiderophore release as a criterion for genotypic evaluation of iron efficiency in oat. Journal Plant Nutrition 18: 455-465. (IF=0.49)

Stevens, W.B., Jolley, V.D., and **Hansen, N.C.** 1994. Diurnal rhythmicity of root iron reduction in soybean as affected by various light regimes. Journal Plant Nutrition 17: 2193-2202. (IF=0.49)

Stevens, W.B., Jolley, V.D., **Hansen, N.C.**, and Fairbanks, D.J. 1993. Modified procedures for commercial adaptation of root iron-reducing capacity for use as a screening technique. Journal Plant Nutrition 16: 2507-2519. (IF=0.49)

Non-refereed Publications:

Campbell, Colin S, Hopkins, Bryan G, Hansen, Neil C. 2021. Soil water tension: Cutting-edge measurement for perfecting turfgrass performance. SportsField Management 37:18-21. https://read.epgmediallc.com/i/1355281-april-2021/18?

Evans, Shane R, Kopp, Kelly, Johnson, Paul G, Hansen, Neil C, Hopkins, Bryan G. 2020. More “pop” per drop: Smart irrigationSportsField Management 36:20-25. https://read.epgmediallc.com/i/1255040-june-2020/19?m4=

Morris, A. M., Maughan, P. J., Hopkins, B. G., Hansen, N. C. 2018. The effect of Chenopodium quinoa on salinization levels in soil. ORCA Report. Provo, UT: Brigham Young University.

Hopkins, B. G., Hansen, N. C. 2018. University Turf Researchers Are Working For You: Brigham Young University Research Update. SportsTurf, 34:27-29. www.sportsturfonline.com

Hopkins, A. P., Hopkins, B. G., Hansen, N. C., Hopkins, T. J. 2017. Interacting Water and Nitrogen. Turf Trends 3:10-17. read.uberflip.com/i/865341-fall-2017

Hopkins, B. G., *Hopkins, A. P.*, Hansen, N. C. 2017. Water-Wise Turf Good Even When Without Drought. SportTurf.

Barbarick, K.A., Ippolito, J.A., McDaniel, J.P., **Hansen, N.C.** and Peterson, G.A. 2013. Regression Modeling Weather and Biosolids Effects on Dryland Wheat Yields

in Eastern Colorado. Colorado Agricultural Experiment Station Technical Bulletin, TB13-3.

DiNatale, K., Hickman, A, **Hansen, N.C.** and Bauder, T. 2013. Alternatives to Permanent Dry Up of Formerly Irrigated Lands. Alternative Agricultural Water Transfer Methods Program. Colorado Water Conservation Board. Denver, CO.

Hansen, N.C., Sherrod, L., Peterson, G.A., Westfall, D.G., Peairs, F.B., Poss, D., Shaver, T. Larson, K., Thompson, D.L., Ajuha, L.R., Koch, M.D., and Walker, C.B. 2012. Sustainable dryland agroecosystems management; 2006-2007 Results. Colorado Agricultural Experiment Station Technical Bulletin, TB12-02.

Taghvaeian, S., Chávez, J., and **Hansen, N.C.** 2012. Evaluating Crop Water Stress under Limited Irrigation Practices. World Environmental and Water Resources Congress 2012: pp. 2149-2159.

Hansen, N.C., Holtzer,T., Pritchett, J., and Lytle, B. 2010. Water Conserving Cropping Systems

Lower South Platte Irrigation Research and Demonstration Project. Colorado Water 27:7-11.

Hansen, N.C. 2009. Policies for Forest Vegetation Management and Water Supply. US Forest Service, Policy Analysis, 07.2009.

Hazlet, S. and **Hansen, N.C.** 2009. Current State of the Mountain Pine Beetle in the West: A Literature Review. US Forest Service, Policy Analysis, 08.2009.

Hansen, N.C. 2008. Lower South Platte Irrigation Research and Demonstration Project. Colorado Water 25 (2):31-34.

Helm, A. and **Hansen, N.C.** 2008. Crop Rotations That Reduce Fallow Frequency in Dryland Crop Rotations. From the ground up, Agronomy News 27:3-5.

Hansen, N.C. 2007. What does undergraduate enrollment in soil, crop sciences mean for the future of agronomy? CSA News. 52:28-30.

Hansen, N.C., Lindenmayer, R.B., Crookston, M., and Green, J. 2007. Field Study of Limited Irrigation Alfalfa. From the Ground Up: Agronomy News 26:1.

Moncrief, J.F., Ranaivoson, A.Z., **Hansen, N.C.**, Sands, G.R., and Dorsey, E.C. 2004. Managing Surface Inlets: Rock Filter As An Alternative. Minnesota Department of Agriculture, St. Paul, MN.

Hansen, N.C. and Fuchs, D. 2003. Dairy manure application methods and nutrient loss from alfalfa. In: Greenbook 2003; Caring for the Land. pgs 65-67. Minnesota Department of Agriculture. St. Paul, MN.

Hansen, N.C. 2002. Phosphorus and animal manures from a soil scientist perspective. Proceedings of the 63rd Minnesota Nutrition Conference Symposium. University of Minnesota.

Hansen, N.C. 2002. Land application of mortality compost to improve soil and water quality. In: Greenbook 2002; Sustaining people, land, and communities. Pgs. 30-32. Minnesota Department of Agriculture. St. Paul, MN.

Hansen, N.C., and Pazdernik, K. 2001. Iron chlorosis in soybean. In: On-farm cropping trials, Northwest and West Central Minnesota. Pg. 17. University of Minnesota Extension. St. Paul, MN.

Hansen, N.C. 2000. Soybean inoculation for reducing iron chlorosis. In: On-farm cropping trials, Northwest and West Central Minnesota. Pg. 21 University of Minnesota Extension. St. Paul, MN.

Bloom, P.R., Mulla, D., Cheng, H.H., Eash, N., Strock, J., Schmitt, M., Moncrief, J., Lewandowski, A., Chester-Jones, H., Allan, D., **Hansen, N.C.**, Gollany, H.T., Zumwinkle, M. 1999. Generic Environmental Impact Statement on Animal Agriculture: A Summary of the Literature Related to Soils. Minnesota Environmental Quality Board. St. Paul, MN.

Moncrief, J.F., Ginting, D., Mozaffari, M., Russelle, M.P., Bloom, P.R., Richard, T.L., Goodrich, P.R., Chester-Jones, H., Clanton, C.J., Mulla, D.J., Schmitt, M.A., Randall, G.W., Strock, J.S., Eash, N.S., **Hansen, N.C.**, Rosen, C.J., Schaeffer, C.C., DiCostanzo, A., Cheng, H.H. 1999. Generic Environmental Impact Statement on Animal Agriculture: A Summary of the Literature Related to Manure and Crop Nutrients. Minnesota Environmental Quality Board. St. Paul, MN.

Hansen, N.C., Moncrief, J.F. and Gupta, S.C. 1997. The effects of residue management and herbicide application methods on loss of agricultural contaminants in surface water. In: Field Research in Soil Science 1997. Minnesota agric. expt. stn. misc. pub. 91-1997.

Proceedings/Transactions (8 most recent years):

Woolley, Elisa A, Kerry, Ruth, **Hansen, Neil C**, Hopkins, Bryan G. 2021. Variable rate irrigation: Investigating within zone variability. Proceedings of the 13th European Conference on Precision Agriculture 13:635-641.

Svedin, Jeffrey D, Kerry, Ruth, **Hansen, Neil C**, Hopkins, Bryan G. 2020. Modeling spatio-temporal variations in crop water stress for variable-rate irrigation. Precision Agriculture 12:687-693. Wageningen Academic Publishers. John V. Stafford (ed.).
https://www.wageningenacademic.com/doi/epdf/10.3920/978-90-8686-888-9_85

Hopkins, Austin P, Campbell, Collin S, Hopkins, Bryan G, **Hansen, Neil C**. 2019. Water and nitrogen interactions in Kentucky bluegrass. Proceeds of the Western Nutrient Management Conference 13:87-95. International Plant Nutrition Institute.

Campbell, C., Campbell, A., **Hansen, N. C**., Hopkins, B. G., *Evans, S*., *Campbell, E.*, Cobos, D. 2017. Comparing in situ soil water characteristic curves to those generated in the lab. Proceedings of the Second Pan-American Conf. on Unsaturated Soils.

Hopkins, B. G., **Hansen, N. C**. 2017. Nitrogen and water interactions: Crop production systems case studies. Proceedings of the Western Nutrient Management Conference, 12 (22-27). Brookings, SD: International Plant Nutrition Institute, WERA-103 USDA-NIFA.
www.ipni.net/ipniweb/conference/wnmc.nsf/e0f085ed5f091b1b852579000057902e/ccbc3bfdb684ebee852580e400519374/$FILE/17WNMC%20Hopkins%20pg22.pdf

Svedin, J. D., **Hansen, N. C.**, Kerry, R., Christensen, R. C., Hopkins, B. G. 2017. Creating prescription variable rate irrigation and fertilization zones: Water and nutrient management interactions. Proceedings of the Western Nutrient Management Conference, 12 (156-163). Brookings, SD: International Plant Nutrition Institute, WERA-103 USDA-NIFA.
www.ipni.net/ipniweb/conference/wnmc.nsf/e0f085ed5f091b1b852579000057902e/ccbc3bfdb684ebee852580e400519374/$FILE/17WNMC%20Svedin%20pg156.pdf

Russell, K. A., *Hopkins, A. P.*, **Hansen, N. C.**, Hopkins, B. G. 2017. Nitrogen and irrigation water interactions in drought stressed Kentucky bluegrass. Proceedings of the Western Nutrient Management Conference, 12 (172-180). Brookings, SD: International Plant Nutrition Institute, WERA-103 USDA-NIFA. www.ipni.net/ipniweb/conference/wnmc.nsf/e0f085ed5f091b1b852579000057902e/ccbc3bfdb684ebee852580e400519374/$FILE/17WNMC%20Hopkins%20pg172.pdf

Carroll, D.A.**,** *Lindsey, C., Baker, J.*, Hopkins, B.G. and **Hansen, N.C.** 2015. Drought and nitrogen stress effects on maize canopy temperature. Proceedings of the Western Nutrient Management Conference 11:84-89.

Johns, J., Pearce, A., *Robinson, D.***,** and **Hansen, N.C.** 2015. Applying a phosphorus risk index in a mixed-use mountain watershed. Proceedings of the Western Nutrient Management Conference 11:117-122.

Abstracts (8 most recent years):

Flint, Elisa, Yost, Matt, Kerry, Ruth, Hansen, Neil, Hopkins, Bryan. 2022. Optimal Sensor Placement for Sensor-Based Irrigation Scheduling in a Variable Rate Irrigation System. Spring Runoff Conference. Utah State University.

Kerry, Ruth, Ingram, Ben, Hammond, Keegan, Shumate, Samantha, Gunther, David, Jensen, Ryan, Schill, Steven, Hansen, Neil, Hopkins, Bryan. 2022. Spatial Analysis of Soil Moisture and Turfgrass Health to Determine Zones for Spatially Variable Irrigation Management. International Society of Precision Agriculture. Minneapolis, MN.

Shumate, Samantha, Kerry, Ruth, Ingram, Ben, Hammond, Keegan, Gunther, David, Jensen, Ryan Russell, Schill, Steven R, Hansen, Neil C, Hopkins, Bryan G. 2022. Spatial Analysis of Soil Moisture and Turfgrass Health to Determine Zones for Spatially Variable Irrigation Management. American Association of Geographers. New York, NY.

Turner, Ian, Kerry, Ruth, Jensen, Ryan, Woolley, Elisa, Svedin, Jeff, Hansen, Neil, Hopkins, Bryan. 2022. Investigation and Development of Automated Analysis of Snowmelt from Time-series Sentinel 2 Imagery to Determine Variable Rate Irrigation Zones in the American Mountain West. International Society of Precision Agriculture. Minneapolis, MN.

Burgin, H.R., G.A. Wear, N.C. Hansen, and B.G. Hopkins. 2021. Hybrid Bermudagrass in Cool, Arid Climates. (Poster presentation.) Intermountain Sustainability Summit; 18 Mar. 2021; Virtual.

Hammond, Keegan, Jensen, Ryan Russell, Hopkins, Bryan G, ShumTE, Samantha, Kerry, Ruth, Spackman, Ross, Yost, Matt, Hopkins, Austin, Hansen, Neil C. 2021. Detecting Spatiotemporal Changes of Alfalfa Canopy Height. ASA-CSSA-SSSA International Annual Meeting. Salt Lake City, UT.

Hopkins, Bryan G, Hansen, Neil C, Campbell, Colin S. 2021. Irrigation: Grass Health, Surface Quality, and Sustainability. Sports Turf Managers Association Annual Conference. Virtual meeting.

Kerry, Ruth, Ingram, Ben, Hammond, Keegan, Gunther, David, Jensen, Ryan Russell, Schill, Steve, Hansen, Neil C, Hopkins, Bryan G. 2021. Spatial Analysis of Soil Moisture and Turfgrass Health to Determine Zones for Spatially Variable Irrigation Management. ASA-CSSA-SSSA International Annual Meeting. Salt Lake City, UT.

Woolley, Elisa, Kerry, Ruth, Hansen, Neil C, Hopkins, Bryan G. 2021. Variable rate irrigation: investigating within zone variability. European Conference of Precision Agriculture.

Budapest, Hungary

Burgin, Hanna R, Wear, Glenl, Hansen, Neil C, Hopkins, Bryan G. 2020. Mowing height and irrigation rate comparisons of Cynodon Dactylon (L.) Pers. x C. Transvaalensis and Poa Pratensis L. Western Crop Science Society Meeting (virtual).

Burgin, Hanna R, Wear, Glenl A, Hansen, Neil C, Geary, Bradley D, Hopkins, Bryan G. 2020.

Bermudagrass vs. Kentucky bluegrass under varying irrigation rates. ASA•CSSA•SSSA International Annual Meeting. Virtual meeting.

Campbell, Alton, Thompson, Carson, Chen, Meiyu, Campbell, Colin S, Hopkins, Bryan G, Hansen, Neil C. 2020. A better look at real-time soil conditions under turf: Paired root-zone water content and potential sensors. ASA•CSSA•SSSA International Annual Meeting. Virtual meeting.

Larsen, Isak, Kerry, Ruth, Hansen, Neil C, Hopkins, Bryan G. 2020. Spatial Statistics for Variable Rate Irrigation Zone Delineation. ASA•CSSA•SSSA International Annual Meeting. Virtual meeting.

Stapley, Samuel H, Hansen, Neil C, Yost, Matthew A, Hopkins, Bryan G. 2020. Stacking and Intersecting Nutrient 4R's and Using in-Season Canopy Health and Petiole Nitrate Analysis on Russet Burbank Potatoes. ASA•CSSA•SSSA International Annual Meeting. Virtual meeting.

Yost, Matt A, Hansen, Neil C, Hopkins, Bryan G, Williams, Jared D, Walsh, Olga S, Cardon, Grant E, Creech, Earl, Black, Brent. 2020. Trends and Opportunities in 4R Nitrogen Management of Field and Fruit Crops in the Intermountain West. ASA•CSSA•SSSA International Annual Meeting. Virtual meeting.

Collins, Scott, Jones, Erin, Hansen, Neil C, Abbott, Benjamin Walter, Carling, Gregory T, Baker, Michelle, Aanderud, Zachary T. 2019. More biologically available phosphorus, less eukaryotic grazer populations, and warmer temperatures many intensify HABs on Utah Lake. Society for Freshawater Science; Salt Lake City, UT May 2019

Hansen, Neil C, Kerry, Ruth, Hopkins, Bryan G, Heaton, Matthew J, Jensen, Ryan R., Smith, Ryan G. 2019. Informing variable rate irrigation with in-situ soil water sensors and remote sensing. ASA*CSSA*SSSA International Annual Meeting. San Antonio, TX.

Hopkins, Austin P., Hansen, Neil C, Woolley, Woolley, Elisa A, Kerry, Ruth, Jensen, Ryan R. 2019. Remote sensing approaches for maximizing productivity of variable-rate irrigation systems. ASA*CSSA*SSSA International Annual Meeting. San Antonio, TX.

Madsen, Matthew D, Anderson, Val Jo, Anderson, Rhett M, Hansen, Neil C. 2019. Improving seedling success in the sagebrush steppe with seed priming and deep furrow plantings. 72nd Annual Meeting for the Society of Range Management. Minneapolis, Minnesota, USA

Nelson, Shannon V., Madsen, Matthew D, Hansen, Neil C, Anderson, Val Jo, Hopkins, Bryan G. 2019. Hydrogel banding for increased soil moisture and range seeding establishment. ASA*CSSA*SSSA International Annual Meeting. San Antonio, TX

Nelson, Shannon V, Madsen, Matthew D, Hansen, Neil C, Anderson, Val J, Hopkins, Bryan G. 2019. Hydrogel banding to improve seedling establishment in rangeland restoration. Great Basin Chapter of the Society for Ecological Restoration Meeting Abstracts.

Shumate, Samantha, Lowe, Ethan, Hansen, Neil C, Hopkins, Bryan G. 2019. Drought and recovery responses of Kentucky Bluegrass with varying nitrogen fertility status.

ASA*CSSA*SSSA International Annual Meeting. San Antonio, TX

Woolley, Elisa A., Svedin, Jeffrey D., Kerry, Ruth, Hansen, Neil C, Jensen, Ryan R., Hopkins, Austin P., Hopkins, Bryan G. 2019. Comparing spatial variation of crop water productivity and moisture relations in potato and wheat. ASA*CSSA*SSSA International Annual Meeting. San Antonio, TX

Campbell, C. S., Hopkins, B. G., **Hansen, N. C**. 2017. Soil Water and Plant Canopy Sensor Technologies to Optimize Water and Nutrient Use. Annual Meeting Abstracts (361-5). Madison, WI: American Society of Agronomy. https://scisoc.confex.com/scisoc/2017am/webprogram/ Paper109041.html

Hopkins, A. P., **Hansen, N. C.**, Hopkins, B. G., Russell, K. 2017. Nitrogen and Irrigation Interactions in Water-Stressed Turfgrass Species. Annual Meeting Abstracts (106869 - 301). Madison, WI: American Society of Agronomy. https://scisoc.confex.com/scisoc/2017am/ webprogram/Paper106869.html

Nelson, S., *Petersen, W*., Svedin, J. D., **Hansen, N. C.**, Madsen, M. D., Anderson, V. J., Hopkins, B. G. 2017. Polyacrylamide for Increasing Soil Moisture and Seeding Success. Poster Number. Annual Meeting Abstracts (106067 - 910). Madison, WI: American Society of Agronomy. https://scisoc.confex.com/scisoc/2017am/webprogram/Paper106067.html

Svedin, J. D., Kerry, R., **Hansen, N. C.**, Hopkins, B. G. 2017. Developing Irrigation Zones from a Field Scale Crop Water Productivity Map. Annual Meeting Abstracts (269-3). Madison, WI: American Society of Agronomy. https://scisoc.confex.com/scisoc/2017am/webprogram/ Paper106851.html

Pearce, A., Johns, J.,and **Hansen, N.C.** 2017. Repeated Synoptic Sampling and Phosphorus Fractionation: A Strategy for Sourcing Phosphorus at the Watershed Scale. Oct 22-25, Tampa, FL.

Brummer, J. Cabot, P., Gautam, S., Jones, L, Lindenmayer, B, and **Hansen, N**. 2017. Benefits and Impacts of Partial Season Irrigation on Alfalfa Production. Western Alfalfa & Forage Symposium 2017. Nov. 28-30, Reno, NV.

Pearce, A., Johns, J.,and **Hansen, N.C.** 2016. Hunting for nonpoint source in a mixed-use mountain watershed with a synoptic mass balance approach. National Non-Point Source Monitoring Workshop. Aug 22-24, Salt Lake City, UT.

Johns, J., Pearce, A., and **Hansen, N.C.** 2016. Applying a phosphorus risk index in a mixed-use mountain watershed. National Non-Point Source Monitoring Workshop. Aug 22-24, Salt Lake City, UT.

Russell, K., **Hansen, N.C.**, and Hopkins, B.G. 2016. Nitrogen and irrigation water interactions in drought-stressed Kentucky bluegrass. 14th Annual International Nitrogen Use Efficiency Conference. Aug 8-10, 2016. Boise, ID.

Hansen, N.C. 2015. Interaction of irrigation, nitrogen management, and crop genetics on water productivity of maize and kentucky bluegrass. American Society of Agronomy, Crop Science Society of America, Soil Science Society of America. Nov 2-5, Minneapolis, MN. AnMtgsAbsts 196-2.

Carroll II, D.A., Hopkins, B.G., and **Hansen, N.C.** 2015. Drought and nitrogen stress effects on maize canopy temperature. American Society of Agronomy, Crop Science Society of America, Soil Science Society of America. Nov 2-5, Minneapolis, MN. AnMtgsAbsts 314-12.

Pearce, A., *Johns, J., Jones, J.,* and **Hansen, N.C.** 2015. Searching for phosphorus sources in a mixed-use mountain watershed. American Society of Agronomy, Crop Science Society of America, Soil Science Society of America. Nov 2-5, Minneapolis, MN. AnMtgsAbsts 43-7.

Hansen, N.C. and **Evans, S.R.** 2015. Temperature and moisture of biochar amended soils in irrigated maize. American Society of Agronomy, Crop Science Society of America, Soil Science Society of America. Nov 2-5, Minneapolis, MN. AnMtgsAbsts 133-15.

Foster, E., Cotrufo, M.F., and **Hansen, N.C.** 2015. Biochar and manure amendments alter soil extracellular enzymatic activity under limited irrigation agriculture. American Society of Agronomy, Crop Science Society of America, Soil Science Society of America. Nov 2-5, Minneapolis, MN. AnMtgsAbsts 133-12.

Zhang, Y., **Hansen, N.C.,** Trout, T.J., Nielsen, D.C., and Paustian, K. 2015. Modeling deficit irrigation of maize using the daycent model. American Society of Agronomy, Crop Science Society of America, Soil Science Society of America. Nov 2-5, Minneapolis, MN. AnMtgsAbsts 194-11.

Bartholomew, S., Russell, K., **Hansen, N.C.,** and Hopkins, B.G. 2015. Syringing Kentucky bluegrass: frequency impacts canopy temperature and growth. American Society of Agronomy, Crop Science Society of America, Soil Science Society of America. Nov 2-5, Minneapolis, MN. AnMtgsAbsts 145-3.

Russell, K., Hopkins, B.G., and **Hansen, N.C.** 2015. Nitrogen and irrigation water interactions in drought-stressed Kentucky bluegrass. American Society of Agronomy, Crop Science Society of America, Soil Science Society of America. Nov 2-5, Minneapolis, MN. AnMtgsAbsts 119-3.

FUNDED GRANTS

Identifying Stacked Conservation Practices that Optimize Water Use in Agriculture. PI: M. Yost, Utah State University; CoPI N. Hansen, BYU. Western Sustainable Agriculture Research and Education Program, USDA. $118,000 (BYU Portion) 2020-2022.

Stacking and Intersecting Nutrient and Irrigation 4R's, PI: M. Yost, Utah State University; CoPIs B. Hopkins and N. Hansen, BYU. The Fertilizer Institute. $64,940.00 (BYU Portion). 2020-2023.

Spatiotemporal decision support systems for recognizing variability and

managing precision irrigation. PI: A.B. Ben-Gal, Israel Ministry of Agriculture; Co-PI: S.

O'Shaughnessy, USDA-ARS; Collaborators: Y. Cohen, Yafit Israel Ministry of Agriculture; P.D. Colaizzi, USDA-ARS; J.E. Moorhead, USDA-ARS; H. Yasuor, Israel Ministry of Agriculture; N.C. Hansen, BYU; B.G. Hopkins, BYU; M. Heaton, BYU; R. Kerry, BYU; R. Jensen, BYU. Bi-National Agricultural Research and Development Program. $310,000. 2019-2022

Integrating Remote Sensing and Spatiotemporal Statistics to Develop Prescription Maps for Variable Rate Irrigation Systems. PI: N.C. Hansen, Co-leaders: R.Kerry and R.Jensen, BYU Geography: M. Heaton, BYU Statistics; B.G. Hopkins, BYU Plant and Wildlife Sciences. Brigham Young University Office of Creative Research Activities, $120,000. 2018-2020.

Connecting the Biocycling of Watershed Phosphorus with Synoptic Surface Water Sampling in the Upper Strawberry River Watershed. PI: N.C. Hansen. Utah Division of Wildlife Resources. $17,651. 2016.

Decision Support Tools, Drought Tolerance, and Innovative Soil and Water Management Strategies to

Adapt Semi-arid Irrigated Cropping Systems to Drought. Project Director (PD): N.C Hansen, BYU; Co-director: Francesca Cotrufo, CSU; Co-leaders: Keith Paustian, Raj Khosla, Louis Longchamps, Jose Chavez, Allan Andales, Robin Reich. USDA, NRCS Conservation Innovation Grant Program. $882,924. 2014-2017. (Hansen direct spending authority $156,154).

Soil Testing and Phosphorus Risk Indexing in the Wallsburg Watershed. PI: N.C. Hansen. Utah Department of Environmental Quality. $14,000. 2014-2015.

Lower South Platte Irrigation Research and Demonstration Project. PIs: N. Hansen, J. Chavez, and L. Garcia. Colorado Water Conservation Board. $280,000. 2010-2013.

Demonstrating limited irrigation technology as an approach to sustain irrigated agriculture while meeting increased urban water demands in Colorado. PIs: N. Hansen and D. Westfall. US Bureau of Reclamation. $221,419. 2008-2011.

Options for Maintaining Agricultural Productivity on Historically Irrigated Lands that are the Subject of Water Transfers. PIs: N. Hansen and T. Bauder. East Cherry Creek Water and Sanitation District. $61,000. 2011-2012.

Biomass Production Potential in Central Great Plains Cropping Systems. PIs: N. Hansen and J. Brummer. USDOE $79,000. 2009-2012.

Developing a model to sustain irrigated agriculture while meeting increased urban water demands in Colorado. PIs: T. Holtzer, N. Hansen, D. Westfall, J. Pritchett, R. Waskom, J. Schneekloth, G. Buchleiter, James Aschough, T. Bauder. Parker Water and Sanitation District $858,712. 2007-2010.

Developing economically sustainable cropping strategies for small and medium sized farms in an increasingly scarce water environment. PIs: J. Prittchett, N. Hansen, D. Westfall, R. Waskom, J. Schneekloth, G. Buchleiter, James Aschough, T. Bauder. USDA-NRI. $499,117. 2007-2010.

Sustainable cropping systems for transition from full irrigation to limited irrigation and dryland. PI: N.C. Hansen. USDA-Natural Resources Conservation Service - Conservation Innovation Grant. $74,381. 2005-2007.

Lower South Platte Irrigation Research and Demonstration Project. PIs: N. Hansen, J. Chavez, and L. Garcia. Colorado Water Conservation Board. $280,000. 2010-2013.

Demonstrating limited irrigation technology as an approach to sustain irrigated agriculture while meeting increased urban water demands in Colorado. PIs: N. Hansen and D. Westfall. US Bureau of Reclamation. $221,419. 2008-2011.

Options for Maintaining Agricultural Productivity on Historically Irrigated Lands that are the Subject of Water Transfers. PIs: N. Hansen and T. Bauder. East Cherry Creek Water and Sanatation District. $61,000. 2011-2012.

Biomass Production Potential in Central Great Plains Cropping Systems. PIs: N. Hansen and J. Brummer. USDOE $79,000. 2009-2012.

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Developing economically sustainable cropping strategies for small and medium sized farms in an increasingly scarce water environment. PIs: J. Prittchett, N. Hansen, D. Westfall, R. Waskom, J. Schneekloth, G. Buchleiter, James Aschough, T. Bauder. USDA-NRI. $499,117. 2007-2010.

Sustainable cropping systems for transition from full irrigation to limited irrigation and dryland. PI: N.C. Hansen. USDA-Natural Resources Conservation Service - Conservation Innovation Grant. $74,381. 2005-2007.

TEACHING

BYU Teaching (50% teaching appointment)

Semesters F=Fall, W=Winter, SP=Spring, and S=Summer

Note: BYU changed rating systems in 2015. Prior to 2015, ratings were based on a 0-8 scale and separate evaluation scores were given for the course and the instructor. In 2015, a single composite rating is given on a scale of 0-5.

Course ID	Title	Credit Hours	Semester	Enrollment	Student Ratings 2013-14 1-8 scale C:=course I: = instructor 2015 1-5 scale composite rating	
PWS 150	Environmental Biology	3	F 2013	58	C: 6.8/8.0	I: 7.3/8.0
			F 2014	68	C: 6.7/8.0	I: 7.2/8.0
			F 2015	70	4.7/5.0	
	In this course, students apply an ecosystems approach to understanding major global environmental issues such as water scarcity, sustainable agriculture, climate change, biodiversity, and population growth. Course includes readings, discussions, field trips, seminars, videos, and writing assignments.					
PWS 305	Soils and Water Quality	3	W 2014	29	C: 6.8/8.0	I: 7.5/8.0
			W 2015	28	4.5/5.0	
			W 2016	17	pending	
	This course covers the theory of the fate and transport of contaminants from soil to aquatic systems and soil and water management practices to protect water quality. Course includes demonstrations, calculations, problem solving, and case studies.					
PWS 306	Water Quality Laboratory	1	W 2014	10	C: 7.5/8.0	I: 7.8/8.0
			W 2015	17	4.5/5.0	
			W 2016	15	pending	
	In this hands-on laboratory, students are challenged to identify sources of nutrient pollution in a mixed-use, mountain watershed by applying tools including GIS analysis, historical data interpretation, water sampling and analysis, and environmental site assessment.					
PWS 375	Environmental Policies and Laws	3	W 2014	58	C: 7.0/8.0	I: 7.6/8.0
			W 2015	74	4.5/5.0	
			W 2016	62	pending	
	In this course, students examine key federal environmental laws, discover how environmental policies are developed, participate in current policy development, and write National Environmental Protection Act (NEPA) documents.					

PWS 494R	Mentored Learning	variable	F 2013	1	n/a	
			W 2014	2	n/a	
			F 2014	5	C: 7.7/8.0	I: 7.7/8.0
			W 2015	9	5.0	
			SP 2015	3	C: 8.0/8.0	I: 8.0/8.0
			S 2015	1	n/a	
			F 2015	6	4.7/5.0	
			W 2016	4	pending	

In this class, students meet as a team one time per week to learn various aspects of the research process including literature searching, hypothesis formulation, study design, data collection, data summary, and writing. I then meet individually with students to guide them in their own contributions to our research projects.

PWS 390R	Special Topics	1	F 2014	19	C: 7.1/8.0	I: 7.6/8.0
			W 2015	22	4.7/5.0	

I led a two-semester leadership course for student officers from three different academic clubs (Genetics and Biotechnology Club, Wildlife and Range Club, and Environmental Science Club).

PWS 699R	Masters Thesis	variable	F 2014	1	n/a	
			S 2015	1	n/a	

CSU Teaching (2004-2013; 25% teaching appointment)

- Crop and Soil Management (CSU; SOCR 421; 4 cr.). This case study based, senior- level capstone course and laboratory addressed the principles of crop and soil management in an ecological context. (2004-2013 (fall semesters); avg. enrollment – 30 students; student ratings: course 4.7/5.0 and instructor 4.8/5.0).
- Soil Fertility Management (CSU; SOCR 350; 3 cr.). This course provided fundamental understanding of plant nutrition and the principles of soil fertility. Students learn practical aspects of soil testing, fertilizer recommendations, and environmental protection related to plant nutrients. (2011-2013 (winter semesters); avg. enrolment 60 students; student ratings: course 4.6/5.0 and instructor 4.8/5.0).
- Scientific Writing (CSU; SOCR 530; 1 cr.). Graduate students are taught and mentored in this course using their own research results to write a journal manuscript (2008-2013; avg. enrollment 16 students).

UMN Teaching (1998-2004; no formal teaching appointment)

- Contaminant Hydrology (U of MN; ES 4216). This upper level undergraduate course addresses mechanisms of contaminant movement in the vadose zone and in surface runoff. (1999-2003; average enrollment 25 students).

PROFESSIONAL SERVICE

- American Society of Agronomy
  - Elected Chair: Semiarid Dryland Cropping Systems Community (2011-12)
  - Water Policy Task Force (2011-2012)
  - Elected Section Leader: Agronomic Production Systems Section (2013-14)
  - Agronomic Science Foundation Board Member (2016-2018).
- Soil Science Society of America
  - Elected Chair: Soil and Water Conservation Division (Div. S-06, 2008-2009)
- Editorial Service
  - Associate Editor, Agronomy Journal (2015-2018)
  - Associate Editor, Soil Science Society of America Journal (2007-2009)
- Manuscript Refereeing: I serve as a referee on 5-10 manuscripts annually. Journals include: Agronomy Journal, Journal of Soil and Water Conservation, Soil and Tillage Research, Field Crops Research, and Journal of Environmental Quality
- U.S. Forest Service, Office of Policy Analysis, Resident Policy Analyst (2009, Washington, D.C.).
- Invited Grant Program Review Panels
  - On Site Panel Reviewer - Agriculture Food and Research Initiative (AFRI), A3144 Climate Resilient Land Use for Agriculture. 2015.
  - On Site Panel Reviewer - Forestry and Global Food Security: National Strategy for Sustainable Production; Joint panel of USDA, National Institute of Food and Agriculture (NIFA) and The Institute of Bioenergy, Climate and Environment (IBCE). 2015.
  - Panelist - The Research Competitiveness Program, American Association for the Advancement of Science (AAAS) in behalf of King Abdulaziz City for Science and Technology (KACST), the national science agency of Saudi Arabia. 2015.
  - External Dissertation Reviewer for The University of Western Australia. Dissertation Title: The Role of Potassium in the Improvement of Growth, Water Use and Yield of Canola under Varying Soil Water Conditions. Author: Max Bergmann. 2015.
  - Panelist - The Research Competitiveness Program, American Association for the Advancement of Science (AAAS) in behalf of King Abdulaziz City for Science and Technology (KACST), the national science agency of Saudi Arabia. 2012.
  - On Site Panel Reviewer – National Institute of Food and Agriculture (NIFA), Bioenergy Coordinated Agricultural Projects. 2011.
  - Panelist - The Research Competitiveness Program, American Association for the Advancement of Science (AAAS) in behalf of King Abdulaziz City for Science and Technology (KACST), the national science agency of Saudi Arabia. 2010.

International Collaboration, Activities, and Service

- Invited presenter, Water conservation in irrigated crop production, multiple locations in Chile, 2014 (sponsored by Decagon Devices).
- International Academic Reviews
    - Faculty Promotion Reviews for The University of Agriculture, Faisalabad, Pakistan. Three candidates reviewed for promotion to Associate Professor. 2013.
    - External Dissertation Reviewer for The University of Western Australia. Dissertation Title: Managing Crop Residues to Improve Wheat Growth and Yield. Author: George B. Swella. 2013.
- Organizer and presenter, Sino U.S. Bilateral Workshop on Precision Agriculture, China Agricultural University, Beijing China, 2012.
- Organizer and presenter, India and U.S. Bilateral Workshop on Precision Agriculture, Punjab Agricultural University, Lidhiaha, India, 2011.
- Collaborator with NW Agricultural and Forestry University, Xian Province, China. I hosted visiting scientist, Dr. Hu Xiaotao, from Feb 2008-Feb 2009. I visited NWA&F in 2012.
- Collaboration with Saratov State Agrarian University. I hosted academic administrators from SSAU at CSU in 2006 and 2008. I was part of a CSU delegation spending 2 weeks at SSAU to develop an agricultural research and demonstration farm for the University in 2007.
- Graduate advisor or co-advisor for international students: Hamdan Al Wahaibi, PhD, Oman; Muhammad Abulobaida, PhD, Lybia; Abdulkariem Aljrbi, Ph.D., Lybia. Frantisek Majs, Czech Republic.
- Afghanistan Agricultural Water Training Grant. My part of a multi-university USAID project in Afghanistan was to provide curriculum for a soil management course.
- Undergraduate student exchange, Univ. Lleida, Spain. Advisor of students Daniel Plaza and Jordi Tugues.

OUTREACH

Throughout my career, public outreach and education has been a critical part of my professional responsibilities and interests. At both Colorado State University and University of Minnesota, I participated in statewide outreach programs focused on agricultural water conservation. While not part of my current job responsibilities, I continue to maintain involvement in these activities because I believe it makes me a better teacher and research scientist. I also regularly participate in educational opportunities for K-12 teachers and students.

PROFESSIONAL ORGANIZATIONS, HONOR SOCIETIES, AND AWARDS

- American Society of Agronomy (1992-Present)
- Soil Science Society of America (1992-Present)

- Soil and Water Conservation Society (1998 – present)
- Sigma Xi, Scientific Research Society & Phi Kappa Phi Honor Society
- 2010 Outstanding Faculty Advisor (CSU Agronomy Club), Colorado State University
- 2009 Shepardson Outstanding Teaching Award, Colorado State University
- 2006 Syngenta Crop Protection Recognition Award, America Society of Agronomy

Pima County

v.

City of Tucson *et al.*

Statement of Expert Opinion

For

Pima County

December 9, 2022

Prepared by
Yves Khawam, PhD

ANALYSIS OF CITY OF TUCSON DIFFERENTIAL WATER RATE

Submitted by Yves Khawam, PhD

PURPOSE AND SCOPE

This expert report is prepared at the request of Snell & Wilmer, LLP of Phoenix, Arizona in connection with Pima County v. City of Tucson, et al. Case No. CV2022-001141 (Maricopa Cty. Sup. Ct.). I have prepared this report early in the litigation, before many depositions have occurred and before the parties have completed discovery. I therefore reserve the right to supplement or amend this report based on information discovered after the submission date. In addition to the documents cited throughout this analysis, in putting together this report I have reviewed the transcripts for the depositions of Timothy Thomure and Mike Czechowski.

I am a Senior Advisor to the Pima County Administrator and have worked in various capacities within Pima County government since 1998. I have been involved in water-management and feeing efforts for almost two decades, starting with my role as Pima County Chief Building Official where I oversaw the incorporation of water conservation measures into the adopted County Building Code. During that time, I also worked with Tucson Water and Pima County Regional Wastewater Reclamation departments regarding changes to water meter sizing requirements used to set both water and wastewater rates.

In my role as Assistant County Administrator for Public Works, I oversaw County public works departments including the Regional Wastewater Reclamation Department, the largest provider of water reclamation services in Pima County metro areas, to include the City of Tucson. The department manages over 3,500 miles of sanitary sewers and eight water reclamation facilities treating and generating mostly class A+ water for recharge and delivery to County facilities and the City of Tucson. My role included oversight of planning, operations and fiscal management of this utility with annual revenues exceeding $180 million.

My current role of Senior Advisor consists of conducting research and analysis to assist with the development of policy recommendations and strategies for consideration by the Pima County Board of Supervisors. In that role, I have been tasked with leading a water-working group comprising Pima County department directors to develop a strategic plan addressing water issues currently faced in the Pima County region. I have routinely provided the County Administrator with policy recommendations and issue analysis, including in the areas of water, wastewater rates, and annexation.[1]

I am a Pima County employee and was not paid any additional compensation outside my regular salary to produce this report. I am a resident of the City of Tucson not subject to the differential rate for Tucson Water service delivery.

[1] See Appendix A for curriculum vitae.

My work as an expert in this case consists of analyzing the City of Tucson's justifications and methodology related to the differential rates adopted in City Ordinance No. 11881. Specifically, this report will address the following items:

SUMMARY OF EXPERT OPINIONS

1. The Phase 1 and Phase 2 Cost of Service Studies conducted by Galardi Rothstein Group / Raftelis ("Raftelis") (collectively referred to as the "cost of service study") to determine the differential rate fails to consider, or fails to appropriately allocate, various factors that show the cost to serve water to customers in unincorporated areas is cheaper than to serve in-city customers. These factors include Capital Improvement Project costs, fixed costs, contamination mitigation operational costs, reclaimed water costs and subsidies provided by the County to the City, and taxes paid to the Central Arizona Water Conservation District. These expenses alone, had they been considered by Raftelis, would have resulted in a finding that the "cost of service" to unincorporated customers is *cheaper* than to incorporated customers.

2. The methodology used by Raftelis to determine the "cost of service" assumes that Tucson Water customers or preferred other jurisdictions exempted by the differential rates face greater financial liabilities than customers not exempted. While it may be true that "inside" customers in other municipalities do face greater financial risks, this is not the case for Tucson Water. Tucson Water is financially structured as an enterprise fund which pays for costs and liabilities through rates charged to all customers and thus all customers—regardless of where they live—face the same "liabilities."

3. One of the City's justifications for the differential rates is that unincorporated customers consume on average more water than City customers do. However, the inverse is true.

4. One of the City's justifications for the differential rates is to promote annexation. However, there is no evidence that differential rates will increase annexation. The various "benefits" of annexation cited by the City in justifying the differential rates are questionable.

5. One of the City's justifications for the differential rates is that there is proportionally more infrastructure in the unincorporated area. However, this position ignores the significant amount of unincorporated infrastructure primarily serving incorporated areas.

6. The City's claims that it is not a "regional" water provider do not stand up to serious scrutiny. The City has consistently sought to service the unincorporated area, including in its original application for Central Arizona Project water.

OPINIONS

I. Cost of Service Study: Inputs

One of the primary issues with the cost of service study is that it ignored many elements tending to show that the cost of service is actually higher for *inside* city customers.

A. Capital Improvement Projects Costs

Perhaps the most significant element ignored by Raftelis is the cost associated with Capital Improvement Projects (CIP). CIP consists of projects that helps maintain or improve infrastructure assets. CIP costs make up a large portion of utility expenses and so cannot be ignored when creating two classes of customers. The cost of service study did not address these costs, even though they are a large cost component of Tucson Water. In fact, using Raftelis' model, I analyzed what the "cost of service" would have been had Raftelis actually considered these costs. When CIP costs are added to Raftelis' model, that model shows that ***it costs approximately 16.23% more to provide inside water services than outside***. A more thorough discussion of my analysis is below.

To put together this analysis, I reviewed the approved City of Tucson FY 2021-25 Five-Year Capital Improvement Program.[2] I categorized each CIP project into one of three categories: 1) benefiting primarily the inside group, 2) benefiting primarily the outside group, and 3) benefiting both inside and outside groups.[3] I have provided a list of categorized projects and associated budgets in Appendix B.

To perform the analysis, I first pulled the excel spreadsheet titled "Copy of OC Differential Model 09-09-21" from a folder entitled "OC Differential Analysis/Final Model" provided by Raftelis to Snell & Wilmer. My understanding is that this spreadsheet represents the final cost model analysis done by Raftelis to determine the differential rate.

To account for the differential CIP cost, I deducted average annual totals for "inside" and "outside" from Appendix B (totaling $36,218,000) from the Raftelis spreadsheet "Differential" tab, "Revenue Requirements" section, "Capital Requirements" element in the Cash Basis Cost Model, such that the single "Capital Requirements" line item of $101,562,771 was split into two lines: one for "Capital Requirements (specifically allocated)" ($36,218,000) and another for "Capital Requirements (distributed)" ($65,344, 717). These two line items total the original Raftelis $101,562,771 capital requirements amount. The "both" category in Appendix B was not transferred as it can be reasonably assumed to be contained within the "distributed" allocation along with cost of debt and other capital expenses. The methodology is represented in Table 1.

[2] https://www.tucsonaz.gov/finance/budget/prior-year-budgets

[3] The FY 2021-25 Five-Year Capital Improvement Program categorizes CIP projects as "City," "County," or "City and County." I did not rely on these categorizations because they are mostly based on the geographic location of the project and not the location benefited by the project. Examples of CIP projects that I changed the designation include: 1) improvements to the Central Avra Valley Storage and Recovery Project (CAVSARP), which are coded as "County" projects. Because these project serves the entire system, I designated them as "Both" within my analysis; 2) the Tucson Airport Remediation Project (TARP) and similar projects, which are coded as "City and County." However, because these programs are entirely located within and solely benefit the City of Tucson, I have coded them "inside" for my analysis; and 3) I designated projects located in the unincorporated County but serving City annexation growth, Tucson Fire Department or conveying water to other municipalities as "inside" for my analysis.

Table 1
Revised Cash Basis Cost Model to Include CIP Costs

Revenue Requirements

Cash Basis (Omitting Reclaimed)				**Inside City %**	**Outside City %**	**Inside City**	**Outside City**
Operation & Maintenance Expenses	$	112,085,837		71.70%	28.30%	$ 80,362,964	$ 31,722,873
Utility Tax	$	6,489,736		100.00%	0.00%	6,489,736	0
Pilot/In Lieu of Property Tax	$	2,000,000		70.70%	29.30%	1,413,982	586,018
Capital Requirements (distributed)	$	65,344,771	9.8% Reclaimed share	71.70%	28.30%	46,850,696	18,494,075
Capital Requirements (specifically allocated)	$	36,218,000		93.97%	6.03%	34,034,000	2,184,000
Total Potable Costs	**$**	**222,138,344**		**76.15%**	**23.85%**	**$ 169,151,378**	**$ 52,986,965**
Current Usage						29,762,239	10,970,256
Unit Cost						$ 5.68	$ 4.83
Water Rate Differential							**-16.23%**

Within this revised cost model, "Capital Requirements (specifically allocated)" were allocated to "Inside City" and "Outside City" based on Appendix B splits. Conversely, "Capital Requirements (distributed)" were distributed to inside and outside based on the number of meters used within the model for the O&M distribution (71.7% inside and 28.3% outside).

Including CIP costs shifts the Cash Basis Cost Model from the 5% additional outside cost claimed by Raftelis, to 16.23% additional cost for inside City. Restated, the inclusion of CIP costs into Raftelis' own model shows that it costs 16.23% more to provide *inside* water services than outside without consideration of cost of capital debt, which would further inflate this number. Thus, because Raftelis estimated that it costs 5% more to service the *outside* city customers in the cost of service study, even without considering all of the other flaws outlined in this report, the Raftelis analysis inflates the overall costs to unincorporated customers by approximately 21.2%.

B. Fixed Costs

The Raftelis cost model also allocates several fixed Operations and Maintenance (O&M) expenses to inside and outside customers based on consumption or usage rates. Allocating fixed costs to inside/outside customers based on usage or consumption is a significant error because fixed costs are incurred regardless of the amount of water consumed by customers. Instead, Raftelis should have allocated these costs based on number of meters to share them equally among customers.

I analyzed the impact that this error had on Raftelis' cost of service estimate. Fixed costs that were inappropriately allocated based on consumption include: Director's Office; Customer Services; Business Services; Water Quality and Operations; Planning and Engineering; Potable Hydrants; Potable Meters; and "other budgetary requirements".[4] The total amount for these line items in the Raftelis cost model is $108,644,381, or 48.9% of the total potable costs.

Raftelis allocated 73.07% of peaking-indexed usage ("usage") to inside city customers and 26.93% to outside city customers, derived from the "peaking Summary" sheet into the "differential" sheet within the Raftelis excel spreadsheet OC Differential Model described *supra* Section I.A.[5] In contrast, it allocated 71.70% inside and 28.30% outside based on number of customer meter distribution.[6] Because these "usage" allocation factors become a denominator in in the differential rate calculation,

[4] *See* PIMA000353 (calculating O&M costs); PIMA000358 (showing that O&M costs were partially allocated based on peaking and consumption).
[5] PIMA000356.
[6] *Id.*

they have the effect of shifting costs from the inside to the outside group. By incorrectly allocating fixed costs based on "usage," Raftelis shifted 2.74% ((73.07-26.93) – (71.7-28.3)) of costs attributable to inside customers to outside customers—which equates to $2,976,856.

When considering the total potable costs of $222,138,344, as shown in Table 1 *supra*, the $2,976,856 cost shift equates to 1.34% of total costs and reduces the Raftelis claimed 5% additional outside cost to 3.6%, by itself. When considered in conjunction with the CIP costs discussed in Section I.A, it is clear that the Raftelis cost model dramatically inflated the actual cost to provide water to unincorporated citizens.

C. Contamination Mitigation Costs

Tucson Water operates facilities to treat water contaminants like trichloroethylene (TCE), 1,4-Dioxane, and per- and polyfluorinated alkyl substances (PFAS). These facilities include: 1) the Tucson Airport Remediation Project (TARP)[7] treatment facility near Irvington Rd and Interstate 10, which has cost the city tens of millions of dollars since its inception to treat PFAS, TCE and 1,4-Dioxane, and 2) a recently approved $7.5 million facility at the Randolph Park Complex to treat PFAS (Central Tucson PFAS Project). Capital project costs for these facilities have already been addressed in the *supra* I.A CIP analysis but costs associated with operating these facilities have not.

While both these facilities have requested and obtained partial federal and state grant funding, they provide examples of costs shared by the Tucson Water outside group in the unincorporated area which otherwise would fall entirely to Tucson residents. Because PFAS, TCE, and 1,4-Dioxane only impact the water sources that they are found in, other water utilities operating within the region have not incurred contaminant cleanup costs associated with the Tucson contamination plume.

Conceptually, because Tucson now claims in Ordinance No. 11881 and the Cost of Service Study that unincorporated residents are a separate group, and because unincorporated customers would not be paying for contaminant mitigation if they were served by a water utility other than Tucson Water, the costs for operating these contamination projects should be solely assigned to the inside city group within the cost of service study. However, the Raftelis analysis did not consider the operational costs associated with these projects.

D. Reclaimed Water Costs and Subsidy

The cost of service study also did not consider the benefits provided to the City by the County. As discussed in Section VI, in 1979 Pima County and the City of Tucson entered into an Intergovernmental Agreement ("1979 IGA"), which allocated Tucson control over 90 percent of effluent from the County's two metropolitan wastewater reclamation facilities, after deductions for the Southern Arizona Water Rights Settlement Act.[8]

The 1979 IGA was signed during a period of large federal investments in wastewater treatment on the mistaken belief that these investments would continue. The reality was very different. Following the initial federal investments, the County absorbed the entire responsibility and cost of complying with federal water quality standards. The County produces effluent suitable for either indirect or direct

[7] http://www.azdeq.gov/superfund/tucson-airport-remediation-project
[8] Appendix C: KHAWAM0075

potable reuse treatment per Arizona Department of Environmental Quality standards and provides it to the City free of charge.

It should be noted that the 1979 IGA did not consider that a significant portion of the wastewater flowing to the metropolitan facilities does not originate from Tucson Water. Instead, it originates from multiple water providers, primarily in existence prior to City annexation increases. Table 2 contains a list of water providers with customers connected to the County's metropolitan wastewater reclamation facilities, including those to whom the City of Tucson does not provide an effluent allocation.

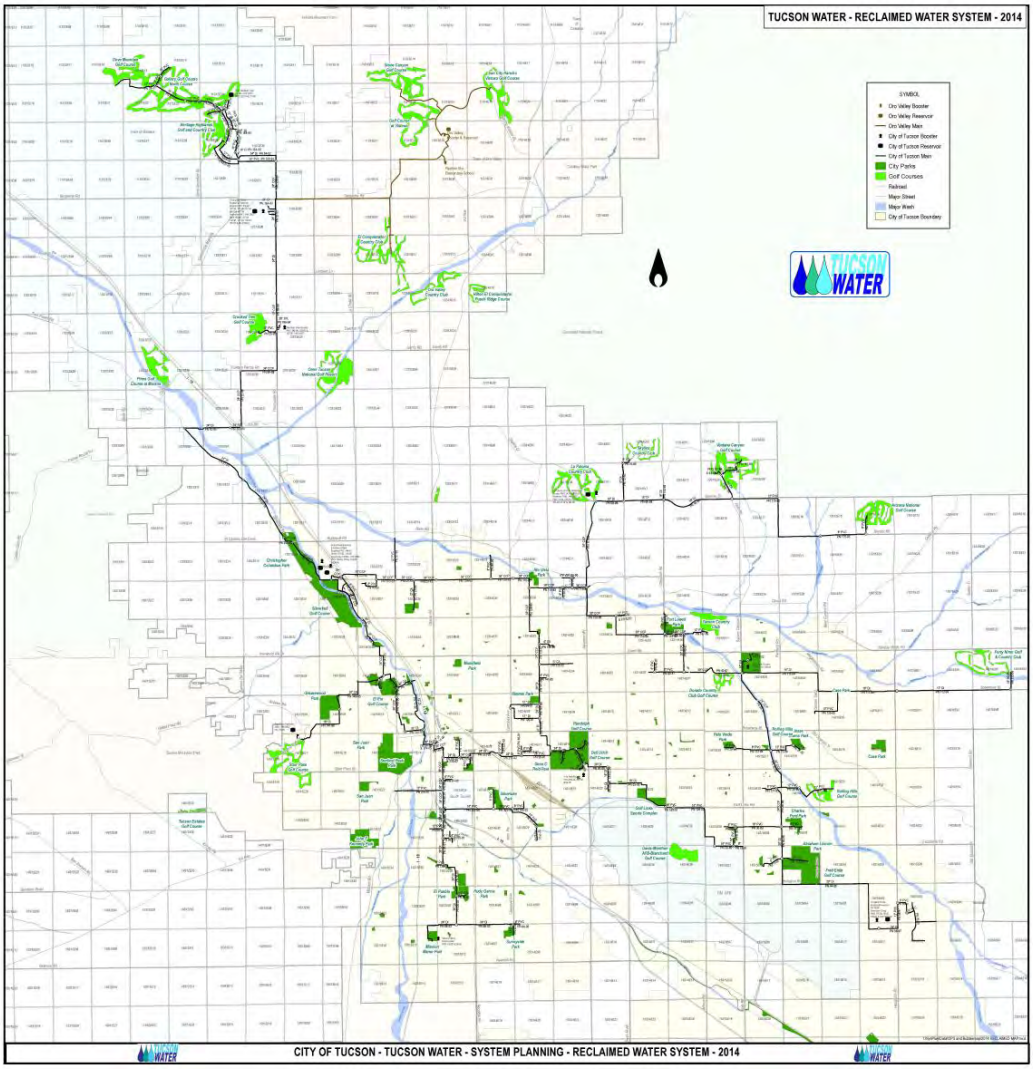
Table 2
Water Providers in Pima County with Customers Discharging Wastewater to County Metropolitan Facilities

Water Provider	**City of Tucson Effluent Allocation**
Arizona State Prison	No
Davis-Monthan Air Force Base	No
City of Tucson	Yes
Flowing Wells Irrigation District	Yes
Lago del Oro	No
Lazy C Water Service	No
Logan Hills Water Co	No
Metro Water	Yes
Pima County Fairgrounds	No
Ray Water Co	No
Rincon Creek Water Co	No
Saguaro Water Co	No
Spanish Trail Water Co	Yes
Town of Marana	Yes
Town of Oro Valley	Yes
University of Arizona	No
Vail Water Co	No
Voyager Water Co	No
Winterhaven Water Co	No

In 2021, it cost Pima County $2,698 to treat and produce an acre-foot (af) of Class A+ reclaimed water. This number is derived from the production of 61,370 af of effluent[9] at a budgeted cost of $165.6 million.[10] More than 95 percent of this water was delivered to the City of Tucson for its use and to satisfy the City's legal obligations. By comparison, the City purchases CAP water at a cost of only $211 per af. The reclaimed water system primarily serves the Tucson Water "inside" group with the vast majority of connections occurring within the City of Tucson and other municipalities as shown in Figure 1.

[9] 2021 Pima County Effluent Generation Report
[10] FY 2122 Adopted Budget (pima.gov)

Figure 1
Map of Tucson Water Reclaimed Water System



In addition to reclaimed water provided to the City of Tucson at no cost, the reclaimed system is further subsidized by water rates paid by all Tucson Water potable water customers. Although I do not currently have access to the specific data necessary to calculate the exact amount of subsidy provided by unincorporated customers to incorporated customers as of the date of this report, it is clear that including these costs within the cost of service study would have further reduced the overall "costs" associated with unincorporated customers.

E. Central Arizona Water Conservation District Tax

The cost of service study also does not consider Central Arizona Water Conservation District (CAWCD) taxes, which are disproportionately paid by unincorporated Tucson Water customers.

Pima County's CAP water allocation is delivered by CAWCD. CAWCD is supported by property taxes paid by all Pima County property owners. Specifically, property in Pima County is assessed a 14-cent tax per $100 assessed valuation, of which 10 cents goes to CAWCD and 4 cents goes to the

Arizona Water Banking Authority to store water underground and purchase long term storage credits.[11] Through 2021, Pima County residents have paid a total of $250.5 million to the CAWCD. Of that amount, City of Tucson residents paid $102.3 million. Residents in unincorporated Pima County paid $102.9 million and residents in Oro Valley, Marana and Sahuarita paid the remainder. These amounts are summarized in Table 3.[12]

Table 3
Distribution of Total CAWCD ad Valorem and Water Storage Tax Collected based on 2021 Net Assessed Valuation (NAV)

Jurisdiction	2021 NAV	% NAV	CAWCD Tax
Marana	$671,072,055	6.9210%	$17,335,354
Oro Valley	$758,352,130	7.8212%	$19,590,127
Sahuarita	$295,801,166	3.0507%	$7,641,232
South Tucson	$24,975,636	0.2576%	$645,223
Tucson	$3,962,584,979	40.8676%	$102,362,997
Unincorporated PC	$3,983,364,389	41.0819%	$102,899,764
Total	**$9,696,150,355**	**100%**	**$250,474,696**

In addition to paying these two tax levies, County residents on smaller private water systems supplied through wells impacting the aquifer within the Tucson Active Management Area (TAMA), pay an additional CAWCD tax to the Ground Water Replenishment District based on water consumed, thereby creating a further disparity with Tucson Water users.

Despite the fact that unincorporated customers and customers living within Tucson pay an equivalent amount of CAWCD taxes, the City of Tucson receives around *78.45%* of all CAP water delivered to Pima County as show in Table 4.[13]

[11] Central Arizona Water Conservation District website: Property Taxes (cap-az.com)
[12] PIMA000015
[13] PIMA000014

Table 4
2021 CAP Entitlements

Recipient	Acre-feet/year	Percentage
Community Water of Green Valley	2,858	1.55%
Flowing Wells Irrigation District	2,854	1.55%
Freeport-McMoran	2,906	1.58%
Marana	2,336	1.27%
Metro DWID	13,460	7.32%
Oro Valley	10,305	5.61%
Spanish Trail Water Company	3,037	1.65%
Tucson	144,191	78.45%
Vail Water Company	1,857	1.01%
TOTAL	**183,804**	**100.00%**

In other words, the City of Tucson is the largest beneficiary of CAP water in Pima County even though capital costs funding construction and operation of the CAP is borne by all Pima County property owners. CAWCD costs were not considered as a water subsidy in the cost of service study; had they been, they would have lowered the cost of service to unincorporated areas.

II. Cost of Service Study: Methodology

A. Utility Basis Model

The cost of service study uses a "Utility Basis" approach to determine the "cost of service" to provide water to unincorporated Pima County.[14] The "Utility Basis" approach calculates the "cost of service" based on a "rate of return" which assumes that the "owner" of the utility is entitled to a "fair rate of return" on its investment in the utility.[15] For this reason, as acknowledged in the Raftelis memorandum, "[t]he utility approach for determining revenue requirements is typically utilized by investor-owned utilities, and also for governmental utilities that are regulated by state public service agencies."[16] On the other hand, Government-owned utilities not subject to regulation typically use a "Cash Needs" approach to determine the cost of service.[17]

There is no basis to apply a return-based differential private utility profit model to Tucson Water, for at least two reasons. *First*, the City of Tucson is not investor-owned and it is exempt from Arizona Corporation Commission oversight, the public service agency that evaluates and approves appropriate rates of return for Arizona utilities.

[14] PIMA000352-353.
[15] American Water Works Association (AWWA) Manual of Water Supply Practices M-1 "Principles of Water Rates, Fees, and Charges", at 14 (hereinafter "AWWA Manual").
[16] Appendix C: KHAWAM0150; *see also* AWWA Manual at 14.
[17] AWWA Manual at 13.

Second, the City of Tucson is a municipal utility fiscally structured as an enterprise fund.[18] As described by the City in its yearly budgets: "The City of Tucson's Enterprise Funds are established to *set fees or charges to recover the cost of providing services*, including capital costs. The Enterprise Funds may also issue *debt backed solely by the fees and charges* of the funds."[19] In other words, Tucson Water's costs are paid by rates charges to customers—not by the City's General Fund. Thus, all customer ratepayers have contributed equally to investments made and secured against Tucson Water, either directly or through developer funded expansions.

It is true, as Raftelis notes in the cost of service study, that the American Water Works Association ("AWWA") Manual of Water Supply Practices M-1 "Principles of Water Rates, Fees, and Charges" ("AWWA Manual") provides that government-owned utilities may use a "Utility Basis" approach to develop inside-outside differential rates.[20] Additionally, the AWWA Manual is also clear in its rate-making objectives that simply because a method might be suitable in one instance, does not make it the appropriate method in all instances.[21] Furthermore, the reasoning behind using a "Utility Basis" approach to develop inside/outside customer differential rates is not present here. Generally speaking, the AWWA Manual endorses using a Utility Basis approach for differential rates on the *assumption* that "inside" customers incur higher risks associated with the utility than "outside" customers. However, the commonly cited financial "risks" justifying this approach, are not true of Tucson Water.

For instance, Tucson has claimed that City of Tucson General Fund acts to "backstop" Tucson Water in the event it defaulted on its loans or faced some other catastrophic financial event—this rational is also mentioned in the AWWA Manual. First, I have reviewed and am not aware of any time that the City to Tucson General Fund has actually had to "backstop" Tucson Water. Regardless, to the extent that the City of Tucson General Fund actually "backstops" the Tucson Water Enterprise Fund is irrelevant here because ultimately any "backstopping" would be recovered through *fees charged to all Tucson Water customers*. For instance, were Tucson Water to default, the City of Tucson would cover the default amount by taking a loan out from the City's General Fund or some third party loaning entity. That loan would, however, be repaid with future revenues generated *by all Tucson Water ratepayers*, regardless of jurisdictional location, thereby leaving Tucson Water residents in the unincorporated areas as exposed as Tucson resident ratepayers.

As such, any financial "risks" associated with Tucson Water are borne by all ratepayers. City residents contributing to the City General Fund though property taxes are no more "owners" of Tucson Water than international visitors contributing to the City General Fund through sales tax payment for goods and services. Similarly, a city resident moving outside corporate boundaries cannot sell their "ownership share" of Tucson Water securities—because there is no such thing.

In fact, to the extent that any single customer group holds a "disproportionate" financial risk, it is *unincorporated customers*. This is because Tucson Water uses unincorporated customers to subsidize in-city customers, as discussed in Section I. There are many expenses recovered from Tucson Water

[18] *See e.g.*, City of Tucson, Arizona Fiscal Year 2014 Adopted Budget, at C-19. https://www.tucsonaz.gov/files/budget/14book-op.pdf
[19] *See e.g.*, City of Tucson, Arizona Fiscal Year 2014 Adopted Budget, at C-19. https://www.tucsonaz.gov/files/budget/14book-op.pdf
[20] *E.g.*, AWWA Manual at 14.
[21] *See* AWWA Manual at 1. (explaining that the rate methodologies in the Manual can be considered fair and equitable "when appropriately applied").

rates paid by all customers that only benefit the City which could have been paid from the City's General Fund—including the reclaimed water shortfall discussed in Section I.D, costs to mitigate contaminated City water wells, and constructing green infrastructure. This demonstrates an additional burden placed on unincorporated residents, because they draw no direct benefit from these liabilities. As such, the outside (unincorporated) areas are paying a greater proportion of the Tucson Water Enterprise risk even prior to consideration for a differential rate.

In short, Raftelis' approach assumes all public utilities structure ownership, debt and risk in the same manner. This is not the case. Some public utilities generate profits to shareholders; other municipal utilities may structure debt through the municipality general fund, thereby placing liability squarely within the municipal corporate boundaries. For Tucson Water, employing a utility basis cost model that applies a greater rate of return for the outside group is simply not supported by the facts or industry standards.

B. Assignment of Inside and Outside Groups

Even assuming that inside-Tucson customers are somehow "owners" of Tucson Water from a rate-making perspective (they are not), the cost of service study would still be flawed because it considered customers exempted from the differential rates—*e.g.*, customers in other municipalities served by Tucson Water (*e.g.* the Town of Marana), native nations located within the unincorporated area, and Tucson Unified School District schools within the unincorporated areas—as "owners" of Tucson Water for purposes of calculating the "cost of service."[22]

If the justification for employing a Utility Basis is that customers *inside Tucson* city limits face "financial risks" due to the *City of Tucson's General Fund's* supposed "backstopping" of the utility, there is no basis to consider all of these outside Tucson customers as "owners" for purposes of calculating the relative costs to serve "inside" and "outside" customers. If it were true that customers living inside Tucson face "financial risks" (and it is not, as discussed above), customers in Marana, TUSD, and customers in native nations do not face these same "risks" and should not have been included as owners.

III . Policy Justification for the Differential Rate: Consumption and Conservation

The City of Tucson claims that a differential water rate is required to reduce average consumption and promote conservation. This justification fails for several reasons.

First, and generally speaking, the City's focus on reducing consumption through differential rates cannot be squared with the City's other water policies, which exacerbate water conservation efforts.

For example, in 2010, the City of Tucson adopted a "Water Service Area Policy" in an attempt to control growth for long-term water sustainability.[23] In reality, however, this Policy does not prevent small developments outside the Tucson Water service area from drawing down the aquifer within the Tucson Active Management Area.[24] Because Tucson Water is the only provider in Pima County

[22] PIMA000353.
[23] https://www.tucsonaz.gov/water/water-service-area-policy
[24] Despite its name, the Tucson Active Management Area covers 3,800 square miles, including eastern Pima County and Portions of Pinal County and Santa Cruz County.

currently delivering Central Arizona Project ("CAP") water via recharge and recovery infrastructure, refusing to serve areas outside the Tucson Water obligated areas exacerbates water sustainability, as other domestic water service options in Pima County lack access to a renewable source. In addition, and due to limited distribution infrastructure, water providers other than Tucson Water contribute to a hydrological "disconnect" where water is pumped in one location but recharged in another location—negatively impacting environmentally-sensitive locations where the water is pumped. These issues were discussed and captured by the City/County Water and Wastewater Study Oversight Committee in 2008[25] as well as in a recent Bureau of Reclamation report.[26]

Thus, instead of incentivizing renewable water resources, the Tucson Water Service Area Policy actually promotes increased reliance on groundwater dependency. Parcels denied service into Tucson Water's service area are likely to rely on groundwater. Newly developing areas denied water service will either be groundwater dependent or enroll in the Groundwater Replenishment District (GRD). However, even though the GRD must replenish groundwater pumped, it is typically replenished outside the area of hydrologic impact and the future of GRD is uncertain based on reduced Colorado River supplies. Consequently, without access to renewable water resources, expansion areas and unobligated areas will contribute to declining local groundwater levels. In areas denied water service surrounding the Tucson Water service area, the Arizona Department of Water Resources will issue permits to drill exempt wells per ARS §45-454 (C) (D) (1-4). Exempt wells provide no incentives for conservation due to their exempt status.

Second, the City's claim that differential rates promote conservation and reduce consumption rests on a questionable theory that is not supported by factual analysis or actual surveys. In an October 2021 presentation to Tucson's Citizens Water Advisory Committee ("CWAC") by Assistant City Manager Timothy Thomure, the City claimed that customers in unincorporated areas consume 10 CCF (centum cubic feet) on average per month, compared to seven CCF for City consumption—*i.e.*, the City claims that customers in the unincorporated County use 43 percent more water on average than City customers.[27] My understanding is that these numbers are derived from Tucson Water usage data from January 2020 through June 2020. However, during that time span, the fact that city customers average seven CCF and outside city customers average 10 CCF was only true for the single-family residential meter category. Looking at all users over the same time period, and using raw data provided directly to Pima County by City of Tucson through an automated transfer process to support County wastewater billing services provided by the City, inside city customers average consumption was 14.8 CCF while outside city customers average consumption was 13.1 CCF. In other words, outside city customers actually consumed *less* water on average than inside city customers from January 2020 to July 2020.

Third, even assuming unincorporated areas do consume more water, this additional consumption results in unincorporated customers further subsidizing Tucson Water infrastructure and operations costs for City residents based on the tiered residential rate where the upper tiers of consumption cost significantly more than the lower tiers per volume. Additionally, and as noted by the CWAC, water use is complex and influenced by a number of factors including multi-family units, which have lower overall consumption per residential unit and are more prevalent in the City.

[25] Water & Wastewater Infrastructure, Supply & Planning Study ... (pima.gov) at 33.
[26] Lower Santa Cruz River Basin Study
[27] PIMA000323

Fourth, while water conservation is a regional aspiration, utility incentives and disincentives to promote conservation should be applied regardless of geographic distribution. There are environmentally-minded, extremely low water users in the unincorporated areas just as there are extreme water users in the City. An equitable sustainable water use policy should target consumption of each user and not discriminate based on geographic location. The Tucson Water residential tiered rate structure is a good example of one method already in place that supports a sustainable and equitable water use policy.

IV. Policy Justification for the Differential Rate: Annexation

The City has also claimed that differential rates could increase annexation. This justification fails at the outset, because to my knowledge the City has never conducted a study showing that differential rates would actually increase annexation or incorporation.

Even if it were true that differential rates would increase annexation or incorporation, there is no evidence that this would actually "benefit" the City or the Region. The City claims that increased annexation could bring up to $42.6 million in increased state-shared revenue to the Pima County area—based on County Administrator Huckelberry's June 17, 2016 memorandum to the Board of Supervisors.[28]

State Shared Revenues are state-collected monies distributed to Arizona cities and towns. These shared revenues come from the "Vehicle License Tax ("VLT"), the Highway User Revenue Fund ("HURF"), the State Transaction Privilege Tax ("TPT") and the State Income Tax ("URS").

A city or town receives its VLT shares based on its population in relation to the total incorporated population in the county. One-half of HURF shares are based on the municipality's population in relation to the population of all incorporated cities and towns in the state. The other half is allocated based on the municipality's population in relation to all incorporated cities and towns in their county. A municipality receives its TPT share in relation of its population to the total population of all incorporated cities and towns. Finally, municipalities receive their URS shares based on their population in relation to the total population of all incorporated cities and towns.[29]

Restated, the City of Tucson's policy position has been that it is beneficial for unincorporated areas to incorporate in any of Pima County's towns via annexation or new incorporation. However, incorporating in jurisdictions other than City of Tucson would result in a decrease in City of Tucson state-shared revenue.

Furthermore, the benefit of increased state shared revenues cannot be evaluated without consideration of increased expenditures resulting from annexation. In a 2021 whitepaper,[30] County Administrator Huckelberry provides the example of law enforcement, where municipal police forces operate in incorporated areas in addition to the Sheriff operating in the unincorporated area. One may think that if a larger portion of the unincorporated area incorporates or is annexed, that these expenditures would displace each other. However, what instead occurs is that the incorporated areas need to increase

[28] Memorandum from C.H. Huckelberry to Pima County Board of Supervisors, June 17, 2016.
[29] State Shared Revenue (azleague.org)
[30] April 30, 2021 - Whitepaper Re- Annexation and Incorporation and the Impact on State Shared Revenues and other Related Issues.pdf (pima.gov) at 4.

expenditures for police at a greater rate than reductions in unincorporated expenditures. For example, Pima County unincorporated population is 35 percent of the County with a Sheriff Department budget of $171 million whereas Maricopa County unincorporated population is seven percent with a Sheriff Department budget of $434 million. Even though Maricopa County Sheriff provides contract services to certain municipal areas, the proportional reduction is not one to one since a smaller unincorporated population is typically dispersed across a much larger relative area and so needs a per capita denser and more costly law enforcement operational network to provide acceptable response times.

The whitepaper goes on to indicate that if the Pima County unincorporated population were to incorporate, municipal law enforcement cost would be increased by $119.5 million which far exceeds the overall regional gain in state-shared revenues. This is further demonstrated in Mr. Huckelberry's 2016 memorandum where an evaluation of cities with populations similar to unincorporated Pima County have annual budgets that far exceed the $42.6 million in increased state shared revenue by factors ranging from 9.5 to 12, demonstrating that new communities or annexed areas would need to rely on increased taxes in addition to state-shared revenue increases. Therefore, without further study, one cannot assume that annexing unincorporated areas or incorporating new municipalities will result in a net regional tax decrease as the exact opposite appears to occur.

Furthermore, a policy-based annexation policy to justify a differential rate ignores that unincorporated residents are already significantly subsidizing municipal revenues and associated resident services. The vast majority of commercial services exist within Pima County municipalities. When these services are purchased by unincorporated residents, those residents pay a municipal sales tax without benefiting from many of the services funded by these sales taxes, which are available only to municipal residents.

This can be demonstrated through an analysis I conducted of FY 2020 Municipal and Regional Transportation Authority sales tax collections in Pima County. That analysis shows that the City of Tucson collects approximately 75.75% of the Municipal and Regional Transportation Authority sales tax, even though the City population comprises only 52.4% of the County. Conversely, only 4.65% of sales taxes are collected in the unincorporated area, even though the unincorporated population comprises 34.79% of the county. These numbers are captured in Table 5 based on normalized collections derived from Table 7 in the 2021 County Administrator whitepaper[31].

Table 5
Geographic Distribution of Local Sales Tax in Pima County

Jurisdiction	Tax Rate	Collections	Population	Population	Per Capita Collections	Collections @ 1%	Collections Distribution
RTA (County-wide)	0.5%	$89,326,341	1,050,906	100.00%	$85	$178,652,682	100.00%
Tucson	2.6%	$351,840,591	550,878	52.42%	$639	$135,323,304	75.75%
South Tucson	5.0%	$3,380,165	5,678	0.54%	$595	$676,033	0.38%
Marana	2.0%	$40,069,585	49,910	4.75%	$803	$20,034,793	11.21%
Oro Valley	2.5%	$22,654,650	46,446	4.42%	$488	$9,061,860	5.07%
Sahuarita	2.0%	$10,482,789	32,351	3.08%	$324	$5,241,395	2.93%
		$517,754,121					
Unincorporated			365,643	34.79%			4.65%

[31] Id. at 6.

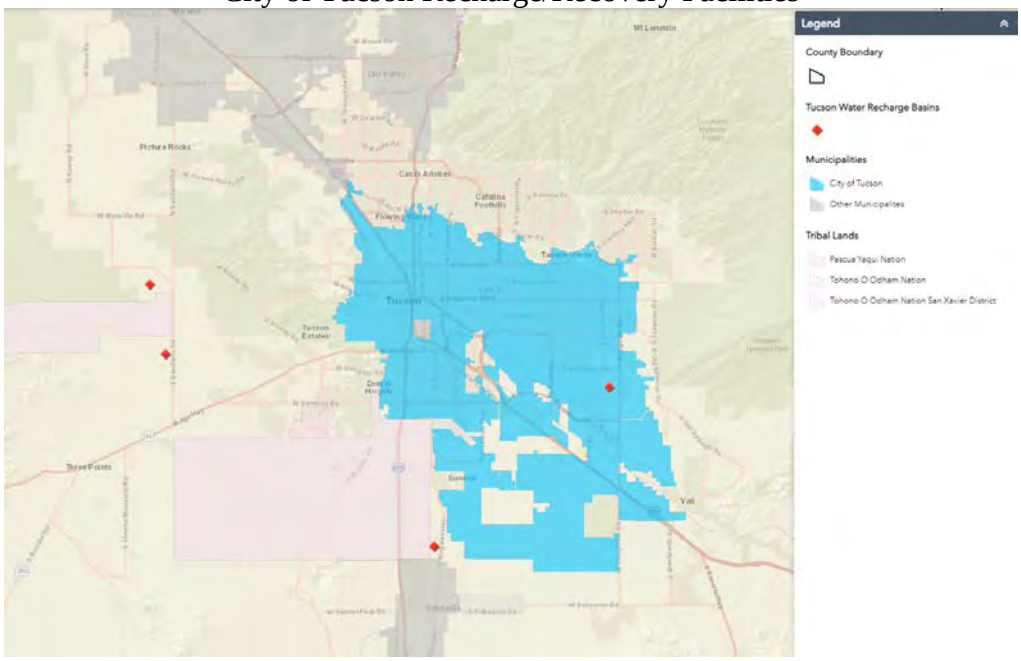
Finally, I am not aware of any comprehensive cost/benefit analysis looking at regional tax equity and service delivery. In the absence of such an analysis, no substantive positions can be taken regarding the regional value of annexation.

V. Policy Justification for the Differential Rate: Differential Infrastructure

Another flaw with the differential rate policy justification is that infrastructure costs were claimed to be based on the physical location of assets – like transmission and distribution pipes.[32] This approach is consistent with repeated claims from the City that, although unincorporated customers are only 29% of total Tucson Water customers, those customers use 36% of Tucson Water assets—again, apparently based on the physical location of pipes.[33]

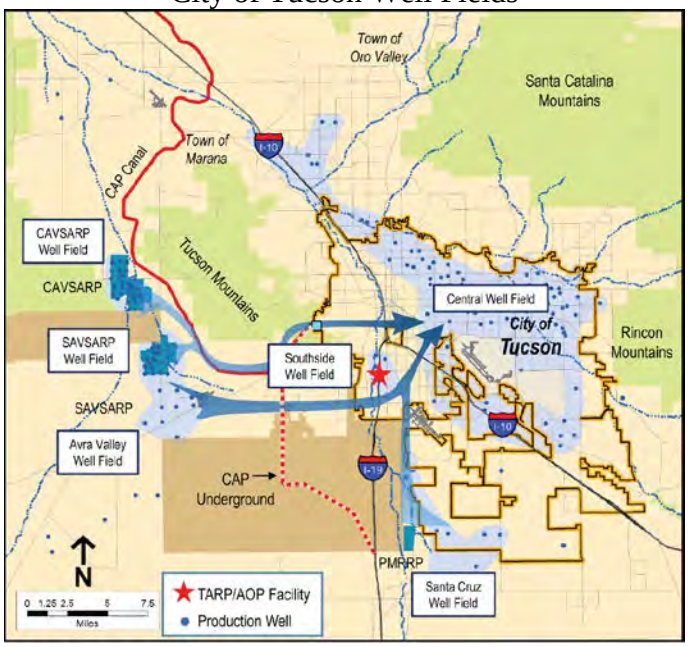
Allocating infrastructure based solely on location is a significant error because most of the Tucson Water infrastructure that benefits the *entire* system is physically located within the unincorporated area, as illustrated by Figures 2 and 3, *infra*. Figure 2 shows recharge/recovery facilities that benefit all Tucson Water customers are primarily physically located in the unincorporated area. Figure 3 depicts Tucson Water well fields serving Tucson Water customers. Only one of the four recharge facilities and two of the six well fields are entirely contained within the City.

Figure 2
City of Tucson Recharge/Recovery Facilities



[32] *See* PIMA000358.
[33] PIMA000321

Figure 3
City of Tucson Well Fields



There is also significant transmission infrastructure located in the unincorporated area serving other municipalities to include the Towns of Marana and Oro Valley conveying Tucson water to these areas.

This major infrastructure proportionally benefits the inside group more than the outside group because there are more customers within the municipalities and native nations than outside of them—even though most of this infrastructure is located in the unincorporated area. Furthermore, to the extent that there are costs associated with extending infrastructure in the unincorporated area, the City does not bear these costs; they are primarily borne by the entity developing the property.

Categorizing this shared infrastructure as attributable to the outside group for purposes of policy justification incorrectly inflates infrastructure allocation to the outside group.

VI. Regional Water Service

Finally, the City's new-found position that Tucson Water is not a "regional" water supplier is inconsistent with Tucson's long-standing tradition of providing regional water service. Indeed, that so many Tucson Water customers live outside the City's jurisdiction clearly demonstrates that Tucson Water actively sought to expand water service beyond city limits. A brief history of Tucson's role as regional water supplier is set forth below.

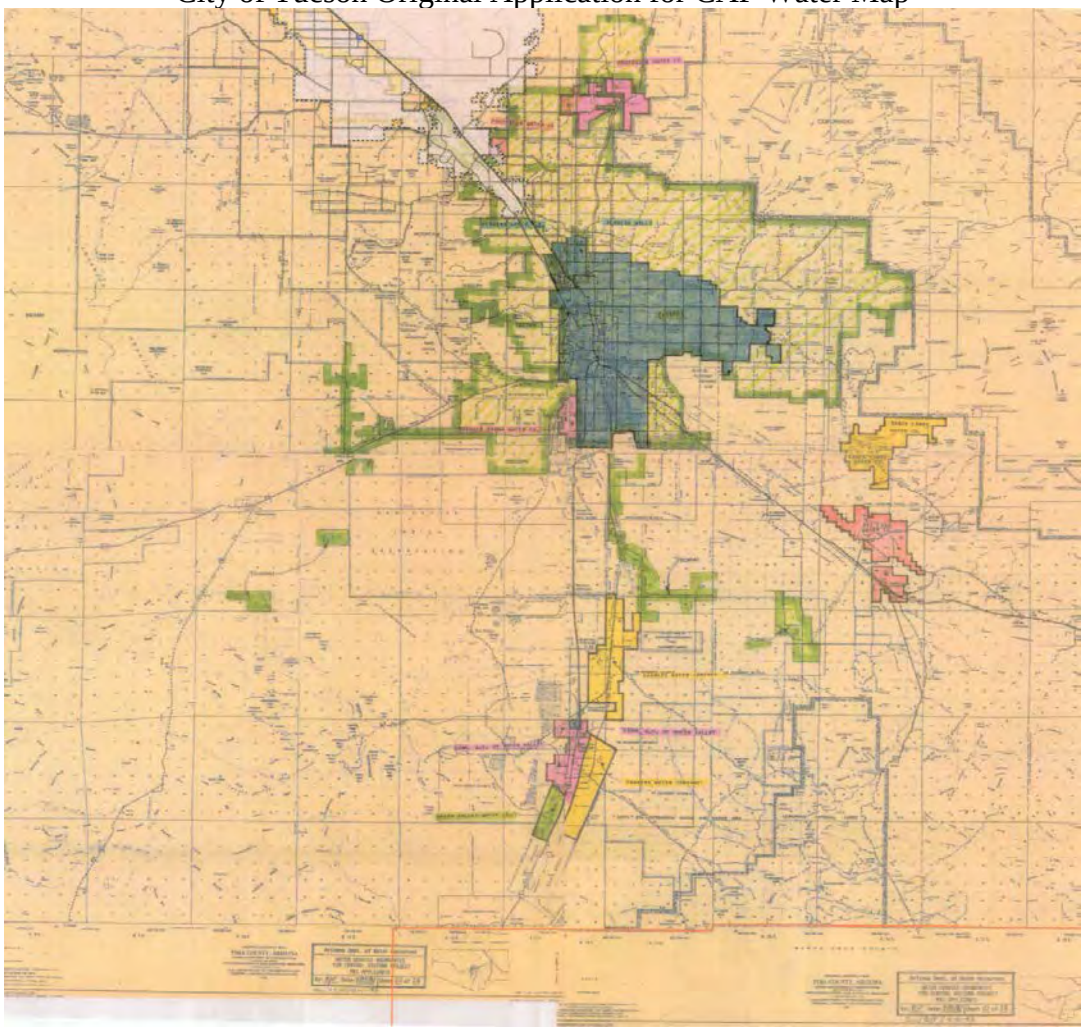
A. Establishment of CAP and Joining the CAWCD.

Due to the drawdown of the Tucson region aquifer and the need for renewable resources, the Pima County Board of Supervisors adopted a resolution in 1967 urging Congress to enact legislation for the construction of the CAP. Joining the CAWCD required committing to service debt associated with construction of the CAP and so there was much public discussion on this topic, as recorded in the

minutes of the May 4, 1971 Pima County Board of Supervisors Meeting. These discussions did not, however, mention who would receive the water as it was generally assumed that the City of Tucson was the regional water provider, as demonstrated *infra* Section VI.B, and that it would continue to perform in that capacity into the future. On February 13, 1975, Pima County passed Resolution 1975-20 joining the CAWCD.

Figure 4 is the City's original CAP water allocation map, showing a City of Tucson 1977 incorporated area of 49,555 acres in blue, compared to a water service area into the unincorporated County of 228,450 acres in green. This water service area, comprising 78.3 percent of unincorporated County land, was used to estimate population projections that determined CAP allocations to the City via a Record of Decision issued by the U.S. Secretary of the Interior on March 24, 1983.

Figure 4
City of Tucson Original Application for CAP Water Map



In other words, in order to receive its sizable CAP water allocation, Tucson Water represented that it would serve the *region*—not just the City of Tucson. Figure 5 shows Tucson Water's current service area compared to its 1977 CAP allocation request and the 1977 Tucson City limits.

Figure 5
Tucson Water 2021 Service Area Reductions from Figure 4 Map

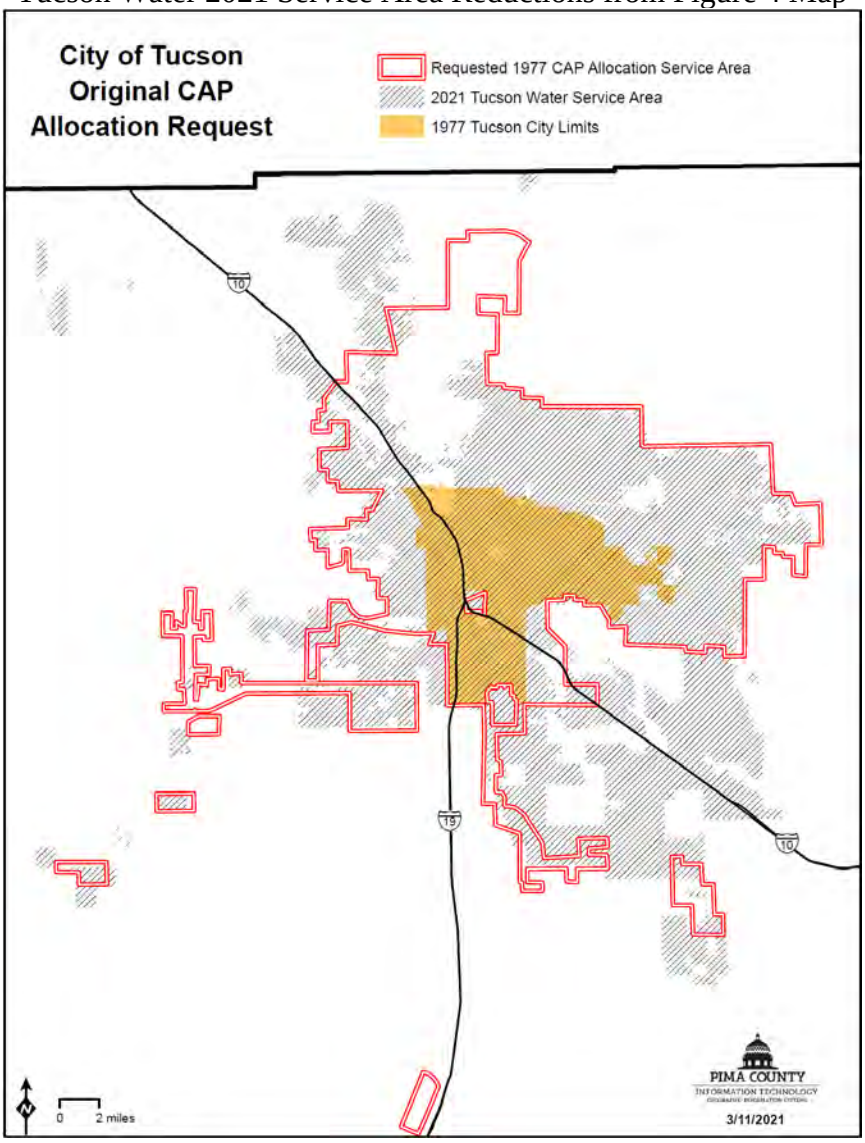
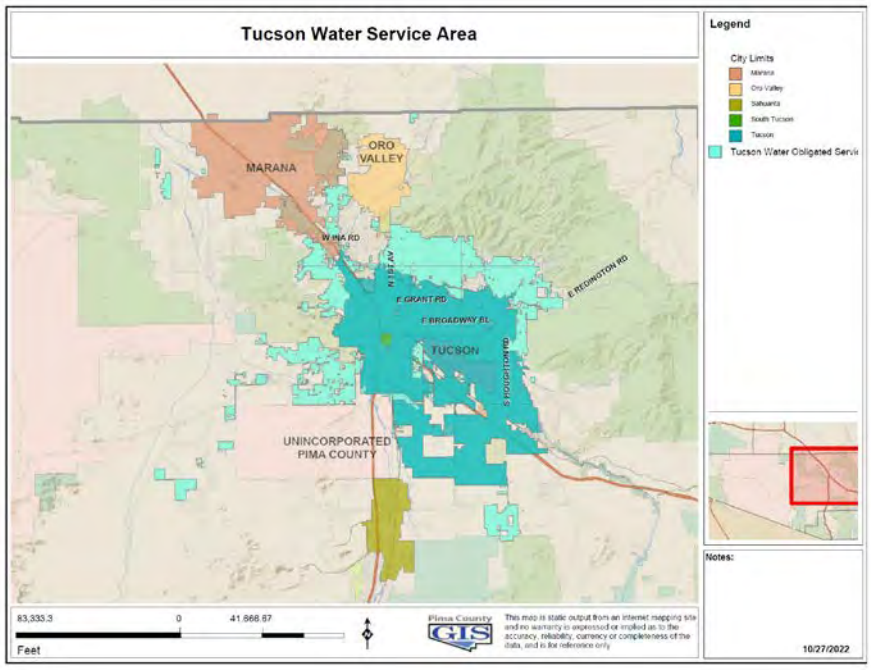


Figure 5 makes clear that Tucson Water continues to serve areas included within its original CAP allocation request. It has also expanded its service from that of the initial CAP allocation request in areas annexed by the City, while reduced it in other areas contrary to the City of Tucson CAP representation for allocation.

Fast forwarding to the present day, Figure 6 shows Tucson Water's current service area (designated as "obligated"), highlighting that Tucson Water serves isolated areas, such as Catalina, Diamond Bell, Corona de Tucson and others–without the City's intention or requirement to annex these remote areas into the City.

Figure 6



B. <u>The M.U.M and the 1979 IGA</u>.

In 1972, Congress passed amendments to the Water Pollution Control Act requiring a single representative organization for effective region-wide resource management and the development of a plan for an equitable system of user charges. In response to those amendments, the Tucson Mayor and Council and the Pima County Board of Supervisors prepared a joint policy statement expressing their desire that there be:

> "total basin-wide control over water quality; water allocation; regional and local water systems; regional and local wastewater facilities and solid waste disposal systems…"[34]

The policy statement adopted by the two governing boards reiterated the principles behind the policy statement as:

> "1. We endorse the concept of regional management of our water, wastewater and solid waste resources.
> 2. We agree in principal to equal representation of the Mayor and Council and the Board of Supervisors on a regional policy board…
> 3. We support the establishment of an equitable system for funding those services on behalf of the residents of Tucson, South Tucson and Pima County."[35]

[34] Appendix C: KHAWAM0002
[35] Id.

To accommodate the Water Pollution Control Act amendments, Pima and Tucson created a policy board to manage water, wastewater, and solid waste at a regional level. The policy board was a nine-member board with three members appointed by the Mayor and Council, three members appointed by the Board of Supervisors, one member appointed by South Tucson and two appointed at-large; one by the Board of Supervisors and one by the Mayor and Council.

On July 8, 1974, the City of Tucson Mayor and Council and the Pima County Board of Supervisors approved an Intergovernmental Agreement establishing the Metropolitan Utilities Management Agency (M.U.M.). M.U.M. was formed to address a fragmented wastewater system operated by both the City and County in response to federal enactment of the Clean Water Act in 1974 that required a single management organization to receive federal assistance for wastewater construction projects.

Establishing M.U.M. in 1974, the City of Tucson Mayor and Council recognized the need to provide some type of representation to water users outside the City limits. In a 1974 resolution, the City stated:

> "Now, therefore, the City and County pursuant to the provisions of ARS §11-951, et seq., do hereby enter into the following intergovernmental agreement in order to more efficiently and economically manage and coordinate the metropolitan water and sewerage and solid waste systems; and to provide Pima County, which although it does not presently have the authority to provide water service, does represent a substantial number of persons residing in the County who are provided water by the City with a role in representing County residents in the formulation and administration of water supply, distribution and finance policies to be carried out by the City as herein designated."[36]

Clearly, the message in the mid-1970s was regional management of water resources for both water and sewer. Historically, the financing of both City and County systems was funded through ad valorem and sales taxes in the case of the City of Tucson and only ad valorem taxes of the County. The United States Solicitor General and the Environmental Protection Agency then "ruled that financing wastewater systems from ad valorem taxes is inequitable in Pima County since two large non-users of the sewer system (vacant land and the mines) account for over 40 percent of the assessed valuation."[37] Hence, those paying for the system were not using the system and based on federal law, the new Clean Water Act as well as the rules regarding federal grant funding for wastewater facilities, a system that charges user fees was required to be put in place to have each user pay their fair and equitable share of the cost of operation. This concept has given rise to the present system of user fees and charges for actual service in use today.

By 1976, it was clear that M.U.M would not survive. Attachment A of an April 12, 1976 M.U.M Mayor and Council Communication on the proposed M.U.M budget, stated:

> "In addition, this recommended budget incorporates the terms of the various agreements between the Board of Supervisors and the Mayor and Council concerning M.U.M. These agreements, itemized below are designed to more efficiently utilize the financial resources available and to equitably distribute the costs of operating M.U.M. to the community."[38]

[36] Appendix C: KHAWAM0018
[37] Appendix C: KHAWAM0076
[38] Appendix C: KHAWAM0051

In a May 21, 1976 M.U.M. correspondence to City of Tucson Manager Joel Valdez, the primary reason for the establishment of the M.U.M. was stated to be:

> "to establish a regional water resource management and planning agency to effectively manage and plan water use and wastewater reuse programs designed to ensure water quality and availability in the Tucson basin."[39]

In addition, the concept of regional resource management in both wastewater and water supply was also reemphasized by stating:

> "the long term need for resource management requires the development and implementation of unified wastewater reuse programs and groundwater management programs to ensure the availability of potable water for our community."[40]

In a communication dated June 11, 1976, County Manager Kenneth S. Scharman indicated to the Board of Supervisors that upon dissolution of M.U.M.:

> "Federal funds for the entire region could be in jeopardy if the user and connection fees are not calculated and expended in accordance with prior commitments to EPA. EPA's stand has been that the fee structure must be equitable to users within the identifiable region that is being served."[41]

This communication discusses an equitable fee structure to users within the region. In discussing significant federal funding for wastewater treatment facilities in excess of $30 million, the correspondence states:

> "Staff feels that there are no projects or programs in jeopardy and should be no problems unless the City or County would deviate from the joint setting of an equitable fee system on a regional basis."[42]

Again, equitable fees on a regional basis continues to be stressed even after the dissolution of M.U.M. This communication speaks directly to the fact that EPA required fee equity for the treatment facility grants. The County accepted the responsibility of taking over City sewers. The primary reason the City provided water outside its boundaries was due to the lack of enabling legislation for the County to operate a water utility.

After the dissolution of M.U.M., it was generally accepted policy that the County would be the regional wastewater provider and the City would be the regional water provider. The City continued to manage water resources in this manner until institutional memory was lost related to the original equity distribution in fees and representation required by federal wastewater grants.

[39] Appendix C: KHAWAM0075
[40] Appendix C: KHAWAM0079
[41] Appendix C: KHAWAM0083
[42] Id.

Finally, in his June 22, 1976 memorandum to the Board of Supervisors, then County Manager Kenneth Scharman cautioned the Board regarding the City Manager's recommended budget to Mayor and Council by stating:

> "That recommendation would undoubtedly necessitate the future establishment of differential user fees respecting political boundaries within the metropolitan sewer system. We are fearful that differential fees would jeopardize EPA funding for any projects within the metro system, be they city or county projects."[43]

In November 1977, the County attempted to lease or sell effluent produced by the County operated Ina Road Treatment Facility to a third party. The City then sued the County to stop the sale and claimed the effluent was the property of the City of Tucson. Since the water furnished by the City to its customers was developed from groundwater underlying lands owned by the City of Tucson, the City argued that it owned the water as well as the wastewater discharged or effluent.

A number of recitals in the lawsuit are of interest and instructive for the present dispute. Paragraph II of Count One states:

> "The City owns and operates a municipal water utility which serves all of the metropolitan Tucson area without respect to corporate boundaries with the exception of the areas served by franchised private water companies."[44]

This seems to reinforce the fact that the City, at the time of the lawsuit, fully embraced the concept of providing water service throughout all of metropolitan Tucson. Of more importance is the argument set forth by the City in Count Two, Paragraph VI stating:

> "Implementation of the County position would result in the County charging the sewer users for the cost of treatment and again charging the City and the water utility water rate payers of the City for the same costs of such treatment."[45]

This sounds a lot like differential rates. Based on Count 2, Paragraph VI, it is clear the City was opposed to differential rates in 1977.

On June 9, 1978, Marvin S. Cohen (a long time Outside Counsel Water Attorney for the City of Tucson) sent a memorandum to the City Mayor and Council and the Pima County Board of Supervisors recommending an IGA for Fiscal Year 1978/79 that ultimately led to the sewer merger agreement that was executed on June 26, 1979. There are a number of recommendations contained in Mr. Cohen's communication to the Mayor and Council and Board of Supervisors that are applicable to the present dispute over differential water rates. In his June, 9, 1978 communication, Mr. Cohen stated, maintenance, conveyance, collection and treatment costs from wastewater plants:

> "...will be funded by a sewer user fee schedule in which there shall be no differential based upon city or county residence and no differential based upon the plant at which the wastewater is treated….

[43] Appendix C: KHAWAM0088
[44] Appendix C: KHAWAM0091
[45] Appendix C: KHAWAM0094

> "Connection fees shall also have no differential based upon city or county residence or based upon the plant at which waste water is treated."[46]

In additional comments, Mr. Cohen stated, the threat of a continued impasse over the issue would result in losing $28 million in EPA grants. Mr. Cohen then recommended:

> "…the city and county now agree that the county be the single management entity for the sewer system. While certain considerations seem to favor city management, I believe these are outweighed by the following factors favoring County management:
>
> 1. The broader tax base of the county would provide greater financial flexibility and strength for the long range capital needs of the sewer system.
> 2. The county Board of Supervisors is politically responsible to all of the users of the sewer system, while the Mayor and Council are politically responsible only to city residents. Power without political responsibility would be contrary to important principles of our governmental system."[47]

At this time, because of the adoption of differential water rates, unincorporated County residents find themselves in the exact position that Mr. Cohen warned against in 1978, where the City holds power without having political responsibility for their action. It should be noted the water policy board, the Citizens' Water Advisory Committee appointed by the Mayor and Council to give some voice to the Tucson Water-served unincorporated residents voted against the differential rates.[48]

On June 26, 1979, the City of Tucson and Pima County finalized the division of utility responsibility between the City and the County with the City providing water service and Pima County providing sewer service. The agreement is a culmination of a series of previous documents that have been referenced that finalized Pima County providing wastewater services and the City providing water services.[49]

The IGA is mostly a division of assets between the City and County related to these utilities with Article VII discussing single entity management by stating on Page 13:

> "Pima County, as the single management entity, is committed to the concept of equal service for all users of the metropolitan system without regard to jurisdictional location."[50]

This stated policy objective, again reinforces the concept that service was to be equitable for all users and is specific in using the words "equal service" and importantly instructive in "without regard to jurisdictional location." This language further reinforces the concept of traditional utility operation where a utility operates under a cost of service concept. Cost of service is an overall utility concept that is founded on the principle that utilities are essential services and should not be operated as a profit center for the operator. Cost of service is a driving principle of utility operation to ensure equal and fair access of individuals to an essential service.

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[46] Appendix C: KHAWAM0098
[47] Appendix C: KHAWAM0101
[48] PIMA000309
[49] Appendix C: KHAWAM0117
[50] Appendix C: KHAWAM0129

The 1979 Intergovernmental Agreement between the City and County states that:

> "…effluent is a major water resource that must by controlled by the City of Tucson in order to maintain management of total water resources of the Santa Cruz and adjacent water basins."[51]

The 1979 IGA made no reference to either limited service area or differential rates. It further established that the City will:

> "…endeavor to use effluent in such a manner as to preserve the underground water supply and minimize costs to water rate payers in City and County."

While the City has claimed that other jurisdictions in Arizona charge differential rates, I am not aware of any study or analysis showing that these jurisdictions intended to be regional water providers. The City of Tucson, however, demonstrated clear intent to be the regional water provider within the 1979 agreement through control the regional water basins, the request for CAP allocations and reclaimed water from the metropolitan facilities serving unincorporated areas.

In summary, it is the regional nature of City of Tucson water service policy that has resulted in 34 percent of customers living outside City limits. To contrast this with other Arizona municipalities, the municipality with the second highest percentage of outside city connections a June 2021 Pima County survey[52] was able to identify is the City of Tempe with only 4.5 percent of connections located outside city limits followed by City of Chandler with 1.9 percent (Table 6).

Table 6
Arizona Large Municipal Water Providers—Percent of Customers Outside City

Municipality	Percent
Peoria	0.1
Phoenix	0.5
Glendale	1.2
Scottsdale	1.7
Chandler	1.9
Tempe	4.5
Tucson	34.0

Had the City of Tucson not historically promoted a regional service policy, outside city residents would have received service from other water utilities and not been charged differential rates without political representation.

[51] Appendix C: KHAWAM0121
[52] Appendix C: KHAWAM0173

VII. Summary

This report finds that the City of Tucson's justifications and methodology related to the differential rates adopted in City Ordinance No. 11881 do not support the facts. Specifically, erroneous justifications were provided regarding water conservation, annexation, infrastructure distribution, and regional service. Additionally the selected rate methodology does not stand up to scrutiny. Finally, when more comprehensive factors are considered in the cost of service study, the analysis demonstrates that it costs *less* to serve the unincorporated area than the incorporated ones.

Submitted by 

Yves Khawam, PhD

Appendix A

Yves Khawam

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Tucson, AZ 85701

August 2022

MAJOR AREAS OF COMPETENCY

- Operations and fiscal management
- Strategic planning and leadership
- Vision-based policy development
- Systems engineering/process organization and automation
- Principles of planning, architecture and engineering
- Quantitative and qualitative research methodology
- Parametric and nonparametric statistical techniques
- Project management, systems analysis and expert systems design
- Sustainability planning and programs

EDUCATION

- **Certified Public Manager** 2006; Advanced Public Executive Program—School of Public Affairs, Arizona State University.
- **PhD** 1990; University of Wisconsin—Madison. Systems Analysis/Statistics.
- **MLIS** 1988; University of Wisconsin—Milwaukee. Information Science.
- **BA** 1985; University of Wisconsin—Madison. Arts/Science.

CERTIFICATIONS

- **LEED-Accredited Professional**
- Over 25 current *International Code Council* certifications including **Master Code Professional**.

WORK EXPERIENCE

7/22-present	**Senior Advisor to the County Administrator**. Pima County, AZ
4/19-7/22	**Assistant County Administrator for Public Works**. Pima County, AZ
9/17-4/19	**Chief Deputy Director.** Pima County Transportation Department. Tucson, AZ
6/05-9/17	**Chief Building Official/Deputy Director.** Pima County Development Services. Tucson, AZ
12/04-6/05	**Building Codes Administrator**. Pima County Development Services. Tucson, AZ
7/98-12/04	**Codes Enforcement Inspector/Plans Examiner**. Pima County Development Services. Tucson, AZ

6/96-7/98: **Code Consultant-Principal**. Analytic Inspections. Tucson, AZ

6/92-6/96: **Builder-Principal**. Khawam Restoration. Forestville, WI

6/90-6/92: **Assistant Professor**. Ecole de Bibliothéconomie et des Sciences de l'Information, Université de Montréal. Montréal, Québec

6/89-6/90: **Instructor**. School of Information Studies, University of Wisconsin—Madison.

8/88-6/89: **Director**. Center for Limnology Library, University of Wisconsin—Madison.

PUBLICATIONS

Khawam, Yves (2016). "Providing a Solution for Effective and Efficient Inspection Service Delivery." *Building Safety Journal*, February: p30-33.

Khawam, Yves (2011). "Continued Quest for Building Department Quality Management: A Systems Approach to Data and Workflow." *Building Safety Journal*, April: p21-26.

OTHER

No expert hearing or trial testimony provided in last four years.

Appendix B

Assignment of City of Tucson Five-Year Capital Improvement Program FY21-25 Projects

Based on Approved City of Tucson 5 Year CIP Program for Tucson Water (FY21-FY25)					
Project Name		5-Year	Project Serves	Inside	Outside
A062 12-inch Transmission Main	0.36	$360,000	Outside		$360,000
Advanced Metering Infrastructure	3.36	$3,360,000	Both		
Advanced Treatment for Emerging Contaminents	9.08	$9,080,000	Inside	$9,080,000	
Aerospace 24-inch Transmission Main	4.35	$4,350,000	Inside	$4,350,000	
Aerospace 24-inch Transmission Main Loop	1.46	$1,460,000	Inside	$1,460,000	
Ajo Wash Raw Water Discharge	1.01	$1,010,000	Inside	$1,010,000	
Ajo Wash Raw Water Main	4.36	$4,360,000	Both		
Alvernon 16-inch Transmission Main	3.94	$3,940,000	Inside	$3,940,000	
Anklam Road Relocate PRV	0.19	$190,000	Inside	$190,000	
Annual Production Well Equipping	13.8	$13,800,000	Both		
Arc Flash System Upgrades	0.16	$160,000	Both		
Armoring CAVSARP Basins	1.69	$1,690,000	Both		
Billing System	9.18	$9,180,000	Both		
Calle Santa Cruz Transmission Main Replacement	1.71	$1,710,000	Inside	$1,710,000	
Cathodic Protection for Critical Pipelines	3.37	$3,370,000	Both		
CAVSARP Well Pump Improvements	1.68	$1,680,000	Both		
Columbus PCCP Rehabilitation	5.56	$5,560,000	Inside	$5,560,000	
Control Panel Replacements: Potable	0.56	$560,000	Both		
Control Panels: Reclaimed System	0.84	$840,000	Both (reclaimed)		
Craycroft Road D-E Booster Station	10.29	$10,290,000	Inside (serves City growth)	$10,290,000	
Devine Reservoir Rehabilitation	3.22	$3,220,000	Both		
Diamond Bell I-K Reservoir Rehabilitation Project	1.28	$1,280,000	Outside		$1,280,000
Diamond Bell Production Facilities Improvement	0.59	$590,000	Outside		$590,000
Drill Production Wells	27.38	$27,380,000	Both (includes TARP)		
Drill Replacement Well A-032B	1.48	$1,480,000	Inside	$1,480,000	
Drill Replacement Well B-045C	1.63	$1,630,000	Inside	$1,630,000	
Drill Replacement Well B-051C	1.62	$1,620,000	Inside	$1,620,000	
Drill Replacement Well C-049	1.64	$1,640,000	Inside	$1,640,000	
Drill Replacement Well C-124B	1.88	$1,880,000	Inside	$1,880,000	
Drill Replacement Well F-033B	1.74	$1,740,000	Outside		$1,740,000
Emergency Main Replacement	5.61	$5,610,000	Both		
Enterprise Asset Management System Implementation	2.42	$2,420,000	Both		
Equip Tarp Well R-006B	0.32	$320,000	Inside	$320,000	
Equip Tarp Well R-007B	0.32	$320,000	Inside	$320,000	
Equip Well A-027C	0.51	$510,000	Inside	$510,000	
Equip Well A-032B	0.57	$570,000	Inside	$570,000	
Equip Well A-062A	0.55	$550,000	Outside		$550,000
Equip Well AV-003B	0.51	$510,000	Both (Avra Valley)		
Equip Well AV-009B	0.57	$570,000	Both (Avra Valley)		
Equip Well B-045C	0.59	$590,000	Inside	$590,000	
Equip Well B-051C	0.59	$590,000	Inside	$590,000	
Equip Well B-052B	0.51	$510,000	Inside	$510,000	
Equip Well C-049C	0.59	$590,000	Inside	$590,000	
Equip Well C-124B	0.59	$590,000	Inside	$590,000	
Equip Well F-001B	0.51	$510,000	Outside		$510,000
Equip Well F-003B	0.57	$570,000	Outside		$570,000
Equip Well SC-001B	0.43	$430,000	Both		
Equip Well SC-004B	0.43	$430,000	Both		
Equip Well SC-014B	0.43	$430,000	Both		
Equip Well W-004B	0.7	$700,000	Inside (Marana)	$700,000	
Equip Well W-005B	1.65	$1,650,000	Inside (Marana)	$1,650,000	
Escalante Reservoir Rehabilitation	1.67	$1,670,000	Both		
Facility Safety and Security Infrastructure	2.81	$2,810,000	Both		
Fire Hydrants in Annexation Areas	0.28	$280,000	Inside (annexation work)	$280,000	
Fire Services	9.82	$9,820,000	Inside (annexation work)	$9,820,000	
Gas Engines	2.27	$2,270,000	Both		
Green Storm Infrastructure	11.5	$11,500,000	Inside	$11,500,000	
H-002A Well Re-Equipping	0.48	$480,000	Outside		$480,000
Harrison Road 24-inch Transmission Main, Harrison -Old Vail Bo	0.4	$400,000	Inside	$400,000	
Harrison Road F-G Booster Station	4.74	$4,740,000	Inside	$4,740,000	
Install Well R-006B Replacement for R-006A	0.91	$910,000	Inside	$910,000	
Install Well R-007B Replacement for R-007A	1.11	$1,110,000	Inside	$1,110,000	
La Estancia 24-inch Transmission Main Phase I	1.18	$1,180,000	Inside	$1,180,000	
La Estancia 24-inch Transmission Main Phase II	0.74	$740,000	Inside	$740,000	
La Paloma Reclaimed Reservoir Rehabilitation	2.95	$2,950,000	Outside		$2,950,000

Las Vista Neighborhood-Phase 1	0.98	$980,000	Inside	$980,000	
Linda Vista to Thornydale to Oasis Transmission Interconnection	1.47	$1,470,000	Inside (interconnect to Metro Water)	$1,470,000	
Maryvale Manor Subdivision-Phase I	0.51	$510,000	Inside	$510,000	
Miscellaneous Land and Right-Of-Way Acquisitions	0.84	$840,000	Inside (serves City growth)	$840,000	
New Building and Plant 1 Complex	15.45	$15,450,000	Inside	$15,450,000	
New Metered Services	0.34	$340,000	Both		
North Satellite Mustering Room Expansion	0.97	$970,000	Both		
Old Vail Road 36-inch Transmission Main: Alvernon to Wilmot	7.77	$7,770,000	Inside	$7,770,000	
Old Vail Road 36-inch Transmission Main-Phase 2: Pantano to Ha	2.97	$2,970,000	Inside	$2,970,000	
Old Vail Road 36-inch Transmission Main: Wilmot to Pantano	4.03	$4,030,000	Inside	$4,030,000	
One Stop City Development Center	0.59	$590,000	Inside	$590,000	
One Water Master Plan 2100	0.54	$540,000	Both		
Online Water Quality Monitoring Network Upgrade	0.87	$870,000	Both		
Pantano Road E-F Booster Station	10.76	$10,760,000	Inside	$10,760,000	
Payments to Developers for Oversized Systems	0.28	$280,000	Both		
Pressure Tank Replacement	2.53	$2,530,000	Both		
Production Well Sites	0.42	$420,000	Both		
Raw Water Pump Station Modifications	1.33	$1,330,000	Inside	$1,330,000	
Relocate Camino De Los Ranchos PRV	0.32	$320,000	outside		$320,000
Relocate Via Velazquez PRV	0.16	$160,000	Outside		$160,000
Reservoir and Tank Rehabilitation program	22.85	$22,850,000	Both		
Review Developer: Financed Potable Project	0.84	$840,000	Both		
Review Developer: Financed Reclaimed Project	0.17	$170,000	Both		
Rio De La Roma D-C PRV	0.14	$140,000	Outside		$140,000
Rita Road "F2" To "G2" Zone Booster Station	1.48	$1,480,000	Inside (serves City growth)	$1,480,000	
Rita Road 16-inch Transmission Main	0.09	$90,000	Inside	$90,000	
Road Improvement Main Replacements	28.06	$28,060,000	Both		
Routine Main Replacements	14.68	$14,680,000	Both (majority inside since older pipes)		
Sahuarita Supply Line Slipliner	9.3	$9,300,000	Inside	$9,300,000	
San Paulo Village Main Replacement Phase II	4.1	$4,100,000	Inside	$4,100,000	
Santa Cruz River Heritage Project	2.89	$2,890,000	Inside	$2,890,000	
SCADA Potable Upgrades	30.23	$30,230,000	Both		
Snyder Hill Pump Station Forebay Rehabilitation Project	3.16	$3,160,000	Inside	$3,160,000	
Southeast Houghton Recharge Project	0.02	$20,000	Inside	$20,000	
Southern Santa Cruz Well Field 28-inch Main Liner	2.36	$2,360,000	Both		
Sweetwater Reclamation Facility System	3.8	$3,800,000	Both (majority inside since reclaimed)	$3,800,000	
System Enhancements: Reclaimed Main	0.56	$560,000	Inside	$560,000	
TARP AOP Treatment Upgrade	8.19	$8,190,000	Inside	$8,190,000	
TARP SCADA and Communication Upgrade	0.24	$240,000	Inside	$240,000	
TARP Well R127A Drill	0.22	$220,000	Inside	$220,000	
TARP Well R-127A Equipping	0.82	$820,000	Inside	$820,000	
TARP Well R-127A Transmission Main	0.16	$160,000	Inside	$160,000	
Thornydale Reclaimed Reservoir Rehabilitation	2.85	$2,850,000	Both		
Thunderhead Old Spanish Trail Distribution Main	0.87	$870,000	Outside		$870,000
Thunderhead Old Spanish Trail PRV	0.24	$240,000	Outside		$240,000
Trails End Reservoir Rehabilitation	1.07	$1,070,000	Both		
Tucson Estates Parkway and Michigan Street PRV Relocation	0.16	$160,000	Outside		$160,000
University of Arizona Science Park 16-inch Transmission Main	1.79	$1,790,000	Inside	$1,790,000	
Upper Impound Closure at Hayden Udall Water Treatment Facilit	0.55	$550,000	Both		
Valencia Stand Pipe Rehabilitation	1.07	$1,070,000	Both		
Valve Access Vault	2.81	$2,810,000	Inside	$2,810,000	
Violet Avenue 12-inch Distribution Main	0.14	$140,000	Inside	$140,000	
Water Services	7.3	$7,300,000	Both		
Well B-025B Distribution Main	0.24	$240,000	Inside	$240,000	
Wellfield Upgrades	1.68	$1,680,000	Both		
			TOTAL	**$170,170,000**	**$10,920,000**

Budget impact	**Inside**	**Outside**
FY 21-25 average Annual CIP allocation	$34,034,000	$2,184,000

Appendix C

Source Documents in Support of this Report

JOINT STAFF REPORT

FOR THE TUCSON MAYOR AND COUNCIL

AND THE PIMA COUNTY BOARD OF SUPERVISORS

ESTABLISHMENT OF A REGIONAL WATER, WASTEWATER, AND SOLID WASTE MANAGEMENT AGENCY

PRELIMINARY DRAFT FOR REVIEW ONLY

MARCH 21, 1974

BACKGROUND

On January 28, 1974, the Board of Supervisors and the Mayor and Council adopted a joint policy statement expressing their desire that there be ... "total basin-wide control over water quality; water allocation; regional and local water systems; regional and local wastewater facilities and solid waste disposal systems ...". The policy statement adopted by the two governing bodies is as follows:

1. We endorse the concept of regional management of our water, wastewater, and solid waste resources.

2. We agree in principal to equal representation of the Mayor and Council and the Board of Supervisors on a regional policy board, and to representation of the town of South Tucson and the public at large.

3. We support the establishment of an equitable system for funding those services on behalf of the residents of Tucson, South Tucson and Pima County.

4. We recognize and support the desirability of combining City and County staffs for the efficient performances of these functions.

The respective staffs were directed to jointly prepare a report delineating the necessary methods to implement the above policy. The management problems associated with water resource systems are somewhat similar to those encountered in solid waste management. Each originates from the consumption of regional resources by urban jurisdictions without the wherewithal to manage or control the resource.

The following report deals with the problem of integrating regional water resources management efforts separately from the consideration of solid waste management. However, the proposed solution for regional water resource management problems would create an agency which could easily be modified to include additional functions such as regional solid waste management. Although a method for providing representation on a regional policy board in accordance with the stated policy of the City and County governing bodies is suggested herein, the powers and responsibilities of that board have not been delineated. A number of the powers required for effective basinwide water resources management are tied to the City or County governing bodies by existing legal structures. Other such powers are not held by either entity, but would have to be obtained through legislative action. The City and County Attorney's offices are currently investigating the interrelationships between these necessary powers, the proposed policy board, and the existing legal structure. Upon completion of this legal investigation, a supplementary report will be prepared dealing specifically with the powers and responsibilities of the regional policy board. It is anticipated that this supplementary report will be completed by April 15.

REGIONAL WATER RESOURCES MANAGEMENT

The objective of forming a water resource management agency is to provide a legal vehicle whereby existing water and wastewater management efforts within the Tucson regional area (primarily by agriculture, mines, and municipalities) can be channeled into more effective, regionally-oriented action. Although the establishment of such an agency with the full powers required for true regional control is not possible without special State legislation, integration of the existing City Department of Water and Sewers and County Department of Sanitation would result in an organization capable of implementing the most significant of the water resources management programs which will be required for effective regional control.

Integration of the existing municipal water and wastewater utility functions is only the first step towards the development of a regional water resources management agency. The second step and by far the most difficult, will be the integration of non-municipal water users into the first-step agency.

The implementation of this second step is envisioned as a rather lengthy and involved process of extracting proper water resources management laws from an historically reluctant state legislature, and of developing detailed agreements between municipal, mining and agricultural water users relating to groundwater rights and reclaimed water utilization. It is apparent that the implementation of the second stage of the regional water resources agency is largely dependent upon the good will and interest of parties over which the City and County governing bodies have only limited control. For this reason, the following report is concentrated primarily upon delineating the actions required to implement step one, integration of the City Water and Sewers and County Sanitation Departments.

It is recommended that a series of functional divisions be formed by mutual agreement between the City and the County. These jointly-staffed divisions would operate within an overall organizational structure agreed upon by both governing bodies and operating under the control of a regional policy board. A possible organization chart for the proposed regional water resources management agency has been prepared by staff for consideration by the governing bodies (attachment A).

As shown in the figure, the organization would be divided into three major functions: (1) Operations; (2) Finance; and (3) Engineering. These three areas would be under the control of an Executive Director, who would report directly to the policy board. The policy board would act in an advisory capacity to the Board of Supervisors and Mayor and Council regarding the overall direction of the proposed agency.

IMPLEMENTATION SCHEDULE

The implementation schedule of the proposed agency is related to the time schedule set forth in the Federal Water Pollution Control Act Amendments of 1972 (FWPCAA-72). EPA guidelines governing eligibility for wastewater facility funding stipulate that:

1. A single representative organization, including local elected officials or their designees, capable of developing an effective area-wide wastewater management plan be designated; and

2. An approvable plan and schedule of implementation for an equitable system of user charges be developed.

These steps must be taken according to the law, by July 1, 1974, to retain funding eligibility. FWPCAA-72 further required that by 1977, the powers of the designated area-wide wastewater management agency must be expanded to encompass basin-wide water quality control. To effectively achieve basin-wide water quality control, it is necessary to first practice basin-wide wastewater management.

Given the expressed desire of the two governing bodies to move forward as rapidly as possible with the formation of a regional water resources management agency, staff offers the following implementation timetable for consideration:

Phase I; Before July 1, 1974

1. Selection of policy Board members.

2. Designation of management level staff positions.

3. Development of a joint financing system and selection, adoption, and partial implementation of an equitable system of user charges for the municipal wastewater system.

4. Integration of sub-management level staff to deal with the following functional areas:

   a. Sewer rebate agreements

   b. Design and construction specifications

   c. Rights-of-way and land acquisition

   d. Planning

   e. Metropolitan area treatment capacity

   f. Collection system monitoring

   g. Wastewater analysis

   h. Wastewater reclamation and groundwater rights

Phase II: Before July 1, 1975

1. Complete implementation of wastewater system user charge plan as a part of the total finance plan.

2. Complete integration of City and County staff and functions.

Phase III: After July 1, 1975

1. Obtain legal authority for basin-wide water resources management.

2. Develop agreements with non-municipal water users and wastewater generators for basin-wide water resources management.

3. Continue to refine and update water resources management planning.

POLICY BOARD

In line with the stated policy of the City and County governing bodies regarding the composition of the Regional Policy Board, the staff suggests that a nine member board be selected as follows:

1. Three members of the Policy Board be appointed by and from the City of Tucson Mayor and Council, and three members be appointed by and from the Pima County Board of Supervisors.

2. One member be appointed by the Town of South Tucson, and that the balance of the Policy Board members should not have veto powers on South Tucson's appointment.

3. Two members of the public at large be appointed, one by the Pima County Board of Supervisors, and one by the City of Tucson Mayor and Council.

The resultant nine-member Policy Board would thus provide equal representation for the City and County governing bodies and representation for the Town of South Tucson and the public at large.

Financing and Sewer User Charge System

Implementation of the proposed MUM entity requires that the City and County proclaim similar objectives with respect to water resources management. One of the first steps was taken when the Mayor and Council and Board of Supervisors authorized a joint City-County Cost Recovery System Study in January, 1974.

One of the objectives of this study was to come up with a "user charge" which would apply uniformly to all residents of the area. It was felt that, because the current method of funding of the wastewater functions is from the general fund of the City and County, implementation of a system which was entirely divorced of this type of funding would be an administrative nightmare. Some portion of the funding of the

entity would have to continue to come from that source at least until MUM got started and some operational experience was developed so as to better assess the financial picture of water resources management. It was also felt that the ultimate end of any financial plan should be to have the MUM entity become independent of an "ad valorem type" tax within the first decade of its existence.

An ad valorem basis for some of the O&M costs of MUM in the long range plan can be justified on a number of points. It is an undisputed fact that adequate water and wastewater facilities in an area enhances the market value of property in the area, whether the property fully utilizes those facilities or not. The availability of these services contributes to the health and welfare of the entire area. Industries do not have to provide these services for their employees which they have to do in remote areas where they are trying to develop. Another justification for some portion of the funding of MUM to have an ad valorem type of base is that the HUD 701(b) study found that wastewater flows from a residence are highly correlated to the property value, i.e., the higher value property generates a greater wastewater flow.

The draft of the Cost Recovery Study discusses the short and long term requirements for fiscal integration of the City of Tucson Water and Sewers Department and the Pima County Department of Sanitation. The following is a summary of the short term recommendations to be found in that report:

1. A uniform schedule of County-wide connection fees be established which would be approximately $250 for a single-family residence or equivalent connection.

2. A single County-wide ad valorem tax rate for wastewater services be established each year at a level which will provide the revenue requirements needed from the residential class of users. Initially, when the mechanism of commercial and industrial surcharge is not yet available, the tax rate would have to include an amount which would generate the revenue required from these user classes. It is estimated that the County-wide tax rate for wastewater operations would be $0.4054 per $100 assessed valuation in 1975 and increase to $0.5688 per $100 assessed valuation in 1979.

3. A commercial and industrial surcharge is recommended for institution for fiscal year 1975-1976. This surcharge would recover from these user classes the additional costs allocated to them for the increased strengths and/or volumes associated with their discharges relative to that of an average residential user. The delay in implementation of this surcharge is to allow a period for an extensive survey, monitoring, and chemcial analysis program which the City and County will have to develop.

4. The City and County should immediately establish and adopt a uniform system of accounts. The recommended system is that which was drafted by the National Water Pollution Control Federation to standardize accounts in the water pollution field nation-wide.

5. The foregoing require that the City and County adopt joint or identical ordinances relating to taxes and fees.

The above represent short term requirements of a cost recovery system; much of the long term requirements hinge on acquiring enabling State legislation. This is discussed further under the section titled "Legal Powers Required for Regional Water Resources Management."

Some of the long term requirements could be met without special legislation. One of these is bond monies for capital improvements. The City has some $3 million in G. O. bonds available for wastewater. The County has $19 million in G. O. bonds available for wastewater facilities. The Cost Recovery Study indicated that an additional $11 million in bonds would be required to meet the capital improvement needs of the area. If MUM is created by merging the City Water and Sewers Department, it would be possible, given the revenue generation capacity of MUM as envisioned in the Cost Recovery Study, to set up revenue bonds which would be guaranteed by the G. O. of the City and/or County.

Sub-Management Level Staff

Once selection of management level staff for the proposed Agency has been accomplished, integration of sub-management level staff may begin. It is recommended that this integration process be carried out over a period of time (as indicated in the above implementation schedule) on a functional area basis. Examples of how this integration process can be carried out may be drawn from current staff efforts to coordinate in specific activities.

The present status of staff thinking on the functional areas listed in the proposed implementation schedule is subsequently summarized in this report. The integration of sub-management level staff to deal with the problems in these functional areas represents the degree of integration which staff feels could reasonably be instituted by the end of the current fiscal year. Complete integration of City and County personnel will probably require until the end of the 1974-75 fiscal year.

Preliminary analysis of the results of staff integration indicated that elimination of duplicative efforts in a number of functional areas should result in significant manpower savings. These savings will be reflected in the form of lower manpower requirements in future budgets, or in the ability of the proposed agency to more fully cover some functions.

It is recommended that staff be given the authority to enlist the aid of management consultants in resolving the problems of staff integration which will undoubtedly arise.

It is further recommended that until management staff has had an opportunity to sort out the tangle of fringe benefits and salary levels involved in the integration of these two major departments, that City and County employees continue to fall under their existing respective jurisdictions with respect to payroll and fringe benefits.

Emphasis must be given to the fact that it is staffs intent that all personnel currently employed by the respective City and County departments will be utilized in the integration process. Job descriptions and duties may be altered to a degree but current levels of employees will not be reduced.

The following items, as enumerated earlier, represent additional areas where staff feels the City and County can immediately effect joint agreements as the first step toward basin-wide water resources management.

Connection Rebate Policy

As a measure directed toward full financial integration, the City of Tucson is seeking to achieve a "sewer construction grants in aid" or rebate policy similar to that of the County's. Subdivision or other construction requiring extensions of the existing systems, to secure sewer service, will be required to do so in their own behalf, but the legal possibility of their recovering their excess expenditures through connection fee rebates will be offered. We recommend that the policies of the City and County in this regard be identical.

Design and Construction Specifications

Currently, the two staffs are working on updating, revising, and publishing design and construction specifications for each of the departments. We have agreed that we will standardize these specifications when each feels that their respective review is completed. Subsequent to this standardization, the Pima County Department of Sanitation will additionally seek recognition of these standards by the Superintendent of Streets as coordinator for County improvement districts. The City of Tucson Water and Sewer Divisions will seek the approval of the agreed-upon standards by the City Engineering Division so that are similarly manifested on City improvement districts. Each existing department intends to achieve an identical interface between the department and the respective building code division.

Rights-of-Way and Land Acquisition

Additional agreements can be directed toward right-of-way and land acquisition functions which are currently applicable to both the City and the County. As soon as practically possible, the easements which the Pima County Department of Sanitation has traditionally acquired as exclusive easements will be modified to include municipal water utilities wherever and whenever possible. It is further recommended that the feasibility of a joint right-of-way and land unit be determined and implemented if feasible.

Planning

Planning the size, location, and staging of water and sewer utilities is difficult in the face of constantly changing population patterns and growth rates and limited availability of pertinent planning data. When,as is the case with the metropolitan Tucson area, responsibility for planning various portions of the same sewer system rests with two different agencies, the job becomes a practical impossibility without close cooperation between those agencies. A number of informal working agreements have greatly facilitated the coordination of water resources system planning, but effort from duplicative planning still occurs simply because of the physical and organizational separation of the City and County personnel involved in the system planning process.

It is proposed that a joint water and wastewater system planning unit be formed. This unit would be staffed by existing personnel from the City Department of Water and Sewers and the County Sanitation Department and financed jointly by the City and County governments.

Metropolitan Area Treatment Capacity

One of the major recommendations of the HUD 701(b) water resources planning study is that the existing City treatment plant near Roger Road, together with the proposed County plant at Ina Road, be integrated to serve as regional treatment facilities for the central metropolitan area. The study further recommended that the City plant be eventually either phased out of existence or converted into an upstream reclamation facility and that the Ina Road plant ultimately become the major treatment plant for the metropolitan area. Under this recommended plan, the City plant capacity will be limited to a maximum of 40 million gallons per day. Because it is estimated that this capacity limit will be exceeded before 1980, it is imperative that an agreement be reached between the City and County regarding the allocation of capacity and costs in the proposed Ina Road treatment facility.

Collection System Monitoring

Until recently, monitoring of the wastewater collection system has been basically limited to the measurement of rates of flow from residential areas. This type of information is used to determine available capacities and to deduce design criteria and is currently exchanged by City and County staffs on an informal basis. Because of an Environmental Protection Agency requirements that certain commercial and industrial sewer system users be charged on the basis of the quantity and quality of their wastewater, monitoring of wastewater discharge from non-residential areas will be necessary. The measurement of commercial-industrial wastewater characteristics is vastly more complicated than for domestic wastewater. Because of this complexity, quite an expensive complement of staff and equipment will be required to expand the current City and County programs to include commercial-industrial wastewater monitoring. In order to avoid the duplication and unnecessary expense, it is recommended that an agreement be worked out between the two governing bodies regarding the institution of a cooperative wastewater monitoring program.

Wastewater Analyses

A substantial number of wastewater reclamation projects are either under way or being contemplated by both the City and the County. Both the implementation and continued operation of these types of projects required the performance of sophisticated analytical procedures on large number of samples. Although several local organizations currently provide analytical services (Health Department, University of Arizona. U. S. Geological Survey) on a limited basis, they cannot be expected to provide the extensive level of service which will be required for the reclamation program envisioned for the future. Cooperative agreements regarding the development of analytical services facilities should be developed in the early stages of the reclamation program, to ensure the availability of the necessary services.

Wastewater Reclamation and Groundwater Rights

To meet its growing needs, the City Water Utility is acquiring groundwater rights in Avra Valley through the purchase of agricultural lands. The County Department of Sanitation is investigating the feasibility of using reclaimed water from its proposed Ina Road wastewater treatment facility to meet agricultural water needs in northern Avra Valley. By integrating the City agricultural land acquisition program and County reclamation project, a number of substantial benefits can accrue to the entire community:

1. Because agricultural water quality requirements are lower than for direct discharge to the Santa Cruz River, less sophisticated, and consequently less expensive, treatment facilities would be required at the Ina Road site.

2. Groundwater rights presently being used to satisfy the water needs of agricultural operations, would be freed for municipal and industrial purposes.

These activities are now being coordinated on an informal basis by the City and County staffs. Because of the substantial amounts of funding involved, and because of the importance of the integration of the City and County programs to successful basin-wide water resources management, it is recommended that the possibility of a more formal cooperative agreement between the two governing bodies be initiated.

REGIONAL SOLID WASTE MANAGEMENT

Currently, the City of Tucson affords the City's residents free residential garbage collection and Pima County administers franchises by which private companies collect garbage in the urban portions of the County. The two operations are significantly different because the City consists of relatively dense areas within described limits while the County operations involve many sparesely-settled, foothills, and other developed areas.

The HUD 701(b) Systems Engineering Analysis considered the possible disposal alternatives available to the community. Sanitary landfills proved to be the most feasible method of disposal for the foreseeable future. The study also considered various combinations of collection and disposal such as transfer stations and concluded that current practices should prevail until higher value can be assigned to the reclamation aspects of solid waste practices.

In the HUD 701(b) Study, all of the measurements for alternative solid waste systems were economic. Since then, significant changes in the cost of transportation have occurred which may prompt the imposition of collection service charges within the City. Environmental constraints and fuel conservation may increase the desirability of disposal fees at both City and County landfills, it would then be necessary to re-evaluate the advisability of bringing solid waste within the scope of metropolitan operations.

RECOMMENDATIONS

It is recommended that the Mayor and Council and Board of Supervisors adopt the implementation schedule contained in this report as a general guideline for City and County efforts to create the proposed regional water, wastewater, and solid waste management agency. It is further recommended that the governing bodies authorize their respective staffs to take the following specific actions:

(1) Obtain the services of a management consultant for assistance in developing a staff integration plan.

(2) Obtain the services of a financial consultant for assistance in developing an integrated financing and accounting system.

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Mayor & Council Communication

July 1, 1974

Subject: ESTABLISHMENT OF METROPOLITAN UTILITIES MANAGEMENT AGENCY

The following documents are attached for consideration by the Mayor and Council:

Attachment A: Intergovernmental Agreement with Pima County for the creation of the Metropolitan Utilities Management Agency.

Attachment B: Proposed ordinance relating to the partial establishment of an equitable cost recovery system.

Attachment C: Resolution authorizing Pima County to engage in sewerage activities.

At their meeting of January 28, 1974, the Mayor and Council and the Board of Supervisors jointly adopted the following policies:

1. We endorse the concept of regional management of our water, wastewater and solid waste resources.

2. We agree in principle to equal representation of the Mayor and Council and the Board of Supervisors on a regional policy board, and to representation of the Town of South Tucson and of the public at large.

3. We support the establishment of an equitable system for funding these services on behalf of the residents of Tucson, South Tucson and Pima County.

4. We recognize and support the desirability of combining City and County staffs for the efficient performance of these functions.

The governing bodies have directed their respective staffs to cooperatively implement the stated policies:

Intergovernmental Agreement

The attached Intergovernmental Agreement (Attachment A), prepared by the joint legal staffs, is presented for Mayor and Council review.

JUL1044974

KHAWAM0013

Sewer Connection Fee Ordinance

On May 20, 1974, the Mayor and Council and the Pima County Board of Supervisors conducted a public hearing on the recommendations of the consulting firm of Brown and Caldwell, Inc. for an equitable cost recovery system for the combined City and County Sanitary Sewer System. The City and County staffs concurred with the consultants' recommendations regarding a county-wide ad valorem tax of approximately 41 cents per $100 assessed valuation, a county-wide sewer connection fee of $250 for a single-family residence or equivalent to be implemented by July 1, 1974, and a commercial-industrial surcharge to be made effective by July 1, 1975.

At the conclusion of the public hearing a majority of the Mayor and Council and a majority of the Board of Supervisors voted to accept the recommendations of Brown and Caldwell and instructed staff to begin implementation of the proposed sewer user charge system. An ordinance which will enable staff to initiate that portion of the cost recovery system, recommended for implementation by July 1, 1974, is attached (Attachment B) for consideration by the Mayor and Council.

County Seweraging Authorization

During the last State Legislative Session, Senate Bill 1207 was passed authorizing counties to engage in wastewater management activities. The legislation stipulates that the county can engage in seweraging activities only after the concurrence of the City of Tucson. A proposed resolution, which would authorize the County's seweraging operation, is attached as Attachment C.

Discussion of City and County Budgets

In preparing the cost recovery plan, the consultants conferred with both City and County staffs to determine their respective budget requirements for the 1974-75 fiscal year. A comparison of the budgeting figures which were supplied to the consultants by City and County staffs for preparation of the cost recovery report with the actual budgets later submitted to the respective governing bodies is attached. It is important to note the differences (See Attachment D, Columns 2 and 3) between the County budget amounts indicated for capital expenses supported from current revenues in the cost recovery report ($564,000) and in the actual County budget ($1,833,229). The difference ($1,269,229), was not included in the consultants' original

calculation of the tax levy requirement, and represents an additional 12 cents tax levy requirement above the consultants' calculations.

The basic result of this change in the proposed County portion of the M.U.M. budget is that the funds provided by the cost recovery system are inadequate to cover the full costs of the M.U.M. operation not funded by Bond Funds and Federal Grants. There are three alternative solutions to this budgeting problem. They are:

1. Decrease the county-wide ad valorem tax. Staff does not recommend this solution.

2. The City could provide the additional funds required from the City budget. Staff does not recommend this solution.

3. The County can revise its budget to provide an additional $1,269,229 for capital improvement projects from Bond Funds. This would reduce the County operation and maintenance budget to the amount originally indicated in the consultants' cost recovery report. This modification would result in a cost recovery system which would yield adequate funds for all City and County operation, maintenance, replacement, and debt service expenses, and still allow for a reduction in the 41 cents county-wide tax rate.

Recommendation

In view of the financial implications for the City's budget, it is recommended that Mayor and Council table action on the Intergovernmental Agreement and the Resolution establishing the legal right of Pima County to engage in seweraging activities until the County budget has been modified to allow the cost recovery system to cover all costs of M.U.M. operations. It is recommended that Mayor and Council approve the sewer connection fee Ordinance, since it is designed to recover the cost to the community of providing sewer service to each new customer and is desirable whether or not M.U.M. is established.

Respectfully,

Joel D. Valdez
City Manager

JDV:ch/FB
Water & Sewers
JUL1044974
Attachments: Attachments A,B,C,D

APPROVED ☐ OTHER ☐ _____

KHAWAM0015

ATTACHMENT A

ADOPTED BY THE
MAYOR AND COUNCIL

RESOLUTION NO. 9242

RELATING TO THE CREATION OF THE METROPOLITAN UTILITIES MANAGEMENT AGENCY; AUTHORIZING THE EXECUTION OF AN INTERGOVERNMENTAL AGREEMENT BETWEEN THE CITY OF TUCSON AND PIMA COUNTY REGARDING CREATION OF A COMBINED WATER AND SEWERS AGENCY.

WHEREAS, the City of Tucson, a municipal corporation, and the County of Pima, a political subdivision of the State of Arizona, which are collectively referred to hereinafter as the Governments, desire to enter into an Intergovernmental Agreement pursuant to Arizona Revised Statutes §11-951, et. seq., in order to form and constitute a Metropolitan Utilities Management Agency of Pima County, hereinafter referred to as MUM,

WHEREAS, the Mayor and Council of the City of Tucson have determined that such an agreement to form MUM will be of advantage to the City and its inhabitants;

NOW, THEREFORE, BE IT RESOLVED BY THE MAYOR AND COUNCIL OF THE CITY OF TUCSON, ARIZONA, AS FOLLOWS:

SECTION 1. That the City of Tucson enter into an Intergovernmental Agreement with Pima County to form the Metropolitan Utilities Management Agency of Pima County for the purpose of more efficiently and economically managing and coordinating the metropolitan water and sewer systems of the City of Tucson Department of Water and Sewers with the Pima County Department of Sanitation; and to provide a means for representation of County residents in the formulation of water utility policies to be carried out by the City, all in accordance with the attached Intergovernmental Agreement, marked Exhibit A, and made a part hereof as though fully set forth herein.

SECTION 2. That the Mayor be, and hereby is, authorized

and directed to execute said Intergovernmental Agreement, for and on behalf of the City of Tucson; and the City Clerk be, and hereby is, authorized and directed to attest the same.

SECTION 3. That the various City officers and employees be, and they hereby are, authorized and directed to perform all acts necessary to give effect to this resolution.

SECTION 4. WHEREAS, it is necessary for the preservation of the peace, health and safety of the City of Tucson that this resolution become immediately effective, an emergency is hereby declared to exist, and this resolution shall be effective immediately upon its passage and adoption.

PASSED, ADOPTED AND APPROVED by the Mayor and Council of the City of Tucson, Arizona, _____.

_____
MAYOR

ATTEST:

_____
CITY CLERK

APPROVED AS TO FORM:

_____
CITY ATTORNEY

REVIEWED BY:

_____
CITY MANAGER

H. Holub:al:sl
June 11, 1974

EXHIBIT A

INTERGOVERNMENTAL AGREEMENT

BETWEEN THE CITY OF TUCSON, A MUNICIPAL CORPORATION, AND THE COUNTY OF PIMA, A POLITICAL SUBDIVISION OF THE STATE OF ARIZONA, RELATING TO THE FORMATION OF A METROPOLITAN UTILITIES MANAGEMENT AGENCY TO OPERATE WATER AND SEWER SYSTEMS.

WHEREAS, the City of Tucson, a municipal corporation, (hereinafter referred to as "City"), and Pima County, a political subdivision of the State of Arizona, (hereinafter referred to as "County"), desire to cooperate with each other to the fullest extent allowed by law in order to provide a metropolitan-wide management system in the area designated in paragraph 4, and to coordinate the operation of the water and sewerage systems therein; and

WHEREAS, the Governing Bodies of the City, the Mayor and Council, (hereinafter referred to as "Mayor and Council"), and the County, the Board of Supervisors, (hereinafter referred to as "Board"), which are collectively hereinafter referred to as "Governing Bodies", have authorized, by their respective ordinances or resolutions, the creation of an agency to be known as the Metropolitan Utilities Management Agency of Pima County, hereinafter referred to as "MUM";

NOW, THEREFORE, the City and County pursuant to the provisions of A.R.S. §11-951, et seq., do hereby enter into the following intergovernmental agreement in order to more efficiently and economically manage and coordinate the metropolitan water and sewerage and solid waste systems; and to provide Pima County, which although it does not presently have the authority to provide water service, does represent a substantial number of persons residing in the County who are provided water by the City, with a role in representing

County residents in the formulation and administration of water supply, distribution and finance policies to be carried out by the City as herein designated:

IT IS HEREBY AGREED THAT:

1. The Governing Bodies shall cooperate in carrying out the policies, purposes and provisions set forth in this Agreement establishing the Metropolitan Utilities Management Agency or MUM.

2. The Metropolitan Utilities Management Agency shall be established as of July 1, 1974.

3. Each of the Governing Bodies has legal authority to enter into this Agreement and that nothing in this Agreement shall be construed as either limiting or extending the statutory jurisdiction of the Governing Bodies.

4. The geographical area to be served by this Agreement, and the jurisdictional area of MUM, is the corporate limits of the City of Tucson, and all of the unincorporated area of Pima County, Arizona; and such other areas the Governing Bodies contract to serve.

5. MUM represents a means of coordination of the activities of the now existing City of Tucson Water and Sewers Department, and Pima County Sanitation Department.

6. MUM shall be administered by a nine member Policy Advisory Board (hereinafter referred to as "Policy Board") composed of three members of the Mayor and Council, appointed by the Mayor and Council, three members of the Board of Supervisors, appointed by the Board of Supervisors, and three members at large, one appointed by the Mayor and Council, one appointed by the Board of Supervisors, and one appointed by the Town Council of the Town of South Tucson.

7. Members of the Policy Board shall serve terms of two years, with the initial members terms commencing July 1, 1974. Members may be reappointed by their respective Governing Bodies. Members may be removed at will by their appointing Governing Bodies.

8. Vacancies on the Policy Board created by termination of office or otherwise shall be filled for the period of the unexpired term within 30 days by the respective Governing Body whose member or appointee created the vacancy.

9. The Policy Board shall meet at least once a month. Additional meetings of the Policy Board may be called by a quorum of the membership upon notice to all members.

10. A quorum of the Policy Board necessary to act on any matter shall consist of five members, with at least one member from the Mayor and Council and one member from the Board of Supervisors continuously in attendance. A voting majority shall be a majority of a quorum, with at least one member from the Mayor and Council and one member from the Board of Supervisors casting votes.

11. Powers of the Policy Board are:

A. To review the policies and programs of participating agencies as they affect, directly or indirectly, the responsibilities of and functions set forth by the Governing Bodies controlling MUM, and to make recommendations for new or modified policies as appropriate.

B. To review and approve plans for all water supply and waste water collection, treatment and disposal facilities within MUM's jurisdiction for approval by the Governing Bodies.

C. To represent the Governing Bodies in applications for state and federal funds for water supply and waste water collection, treatment and disposal studies, planning and

projects, subject to review and acceptance by the Governing Bodies.

D. To establish necessary regulations and standards for the operation of waste water facilities which discharge into the combined waste water collection and treatment system so they conform with operational requirements of the system.

12. The Policy Board shall serve the Governing Bodies as follows:

A. Promulgate and periodically recommend revisions to the Regional Plan for Water, Sewage and Solid Waste Management (PAG 701-B Study).

B. Review the plans, policies, programs and proposals of the state and federal governments or other executive or administrative agencies which may substantially affect or apply to the operational program of MUM, and submit its recommendations to the Governing Bodies, and report such recommendations upon approval of the Governing Bodies to the state and federal government.

C. Propose improvement and assessment districts within MUM's area of jurisdiction for the purpose of allocating and assessing costs to property owners in the improvement or assessment districts in relation to benefits received.

D. Propose the acquisition of existing facilities, within or without the geographical area administered hereunder, which would become operational components of the combined water and sewer systems.

E. Propose the location of water and sewage and solid waste facilities, and in particular, in relation to their being within or crossing other utility installations or utility easements, and propose areas to be acquired by purchase, eminent domain, or otherwise.

F. Propose the acquisition of property or right-of-way outside MUM's area of jurisdiction which is or may be necessary or convenient for performing any of the work required to carry out the purpose of MUM.

G. Initiate, negotiate, and participate in contracts and agreements between the Governing Bodies, and negotiate and participate in intergovernmental contracts or agreements authorized by the state and/or federal government, for review and approval by the Governing Bodies.

H. Appoint officers, employ permanent and temporary personnel, and secure professional services on a fee basis, subject to ratification of the Governing Bodies.

I. Sell, lease, or otherwise dispose of any property held for MUM by the Governing Bodies, or any interest therein whenever it is no longer required for the purposes of MUM, subject to the approval of the Governing Bodies.

J. Accept or reject gifts of personal property subject to the approval of the Governing Bodies.

K. Propose to the appropriate Governing Bodies the issuance of general obligation and revenue bonds to secure funds for the construction of facilities needed by MUM.

L. Propose an ad valorem tax of the Governing Bodies to provide revenue for the metropolitan sewer system.

M. Propose the issuance of funding and refunding bonds; propose the acceptance of funds from federal, state and local agencies; propose the acceptance of short-term loans and issuance of interest-bearing warrants; propose assessments to cover the cost of improvements; and propose procedures to impose and collect connection fees, user fees and other service fees.

N. Propose a plan for the investment of any monies held in reserves or sinking funds, or any monies not required for immediate disbursement.

O. Propose a regional capital improvement program which will enumerate and describe the proposed projects.

P. Propose an annual development program which sets forth an annual schedule and priority list of capital improvements to be undertaken during the ensuing fiscal year, and to prepare and propose to the Governing Bodies the estimated expenditures and required revenue for each subsequent year over an ensuing five-year period.

Q. Propose to the Governing Bodies an annual capital budget which shall be in conformance with the coordinated capital improvement program.

R. Propose to the Governing Bodies an annual operation and maintenance budget and a uniform system of accounts for the waste water utilities.

S. Propose to the Governing Bodies sewer user fees, connection fees and water rates.

T. The Policy Board shall elect a Chair person and vice Chair person and shall adopt rules and operating procedures for the Policy Board of MUM in writing, subject to the approval of the Governing Bodies, certified copies of which to be kept in the clerks offices of each of the Governing Bodies.

U. Adminster all the above matters as provided and directed by the Governing Bodies.

13. A. All funds relating to water production and distribution shall be deposited with and disbursed by the Finance Director of the City of Tucson, pursuant to the City of Tucson Ordinance Number 3943, enacted November 28, 1972.

B. All funds relating to sewerage operations, except as provided in Section 16(C), shall be deposited with and disbursed by the Finance Director of the County.

14. The Finance Directors shall administer and disburse said sums on behalf of the Governing Bodies in accordance with customary accounting procedures of the respective City or County and further according to rules and operating procedures adopted by the Policy Board, and according to applicable state laws and charter provisions.

15. The failure of any Governing Body to approve and fund its share shall not prevent MUM from expending funds approved and funded by another Governing Body.

16. A. The Governing Bodies shall deposit the following funds with the City Finance Officer for functions administered by MUM as they are collected obtained or accrued:

(1) Water sales revenues.

(2) Charges for water utility hookups.

(3) Penalties levied in connection with water service.

(4) State and federal grants for water systems.

(5) Interest on invested funds of the city water operations.

(6) All other revenues generated for or by the operation of the metropolitan water systems of the Governing Bodies.

B. The Governing Bodies shall deposit the following funds with the County Finance Officer for functions administered by MUM as they are collected, obtained or accrued:

(1) Sewer connection fees, except as provided in Section 16(C), below.

(2) Commercial and industrial surcharges for sewage treatment, except as provided in Section 16(C), below.

(3) Charges for sewage utility hookups.

(4) Penalties levied in connection with sewage operations and water quality control ordinances.

(5) State and federal grants for sewage systems.

(6) Sale of products and effluent.

(7) Ad valorem taxes levied for MUM operations, capital improvements, or the metropolitan sewage system.

(8) Interest on invested funds of county sewer operations.

(9) All other revenues generated for or by the operation of the metropolitan sewage systems of the Governing Bodies.

C. County ad valorem taxes and sewer connection fees and sewer user fees derived from connections and services outside the corporate limits of the City shall not be used to satisfy service and sinking fund requirements on sewer bonds authorized by the voters of the City prior to July 1, 1974. Sewer connection fees and sewer user fees derived from connections and services within the corporate limits of the City shall be deposited with the Finance Director of the City and disbursed in the following order of priorities:

(1) First to satisfy interest and capital refunding requirements on sewer bonds authorized by voters of the City prior to July 1, 1974.

(2) Second, to repay to the City any sums that may have been disbursed from the general revenues of the City after July 1, 1974 for interest and capital refunding on the bonds described in subparagraph (1), in excess of sums disbursed pursuant to that paragraph.

(3) Third, to forward to the Finance Director of the County all remaining sums to be expended for sewerage and wastewater activities and facilities administered by MUM.

(D) The total amounts required to operate the sewerage systems of the City and County, except as provided in paragraph 16(C), will be encompassed in the County's annual budget for each fiscal year.

(1) County Sanitation Department expenditures will be made by demand of the County Sanitation Department to the County Finance Department.

(2) City Department of Water and Sewers expenditures will be made by the City, but the source of funding shall be the County.

17. All employees of the respective Governing Bodies' water and sewer departments shall remain employees of their respective Governing Bodies until such time as a system for employment by MUM is adopted by the parties to this Agreement.

18. This Agreement shall be for an indefinite time. However, it shall be subject to annual review and renegotiation. Such reviews shall be made on or before July 1, 1974, and each and every July 1st thereafter. Termination by the City or the County shall constitute a total dissolution of MUM. Notice of intent to terminate shall be in writing and termination shall not be effective for 180 days after notice.

19. Upon dissolution of MUM, the property coordinated by MUM shall be divided as follows:

A. If there exists, as a separate legal entity from the Governing Bodies, a metropolitan-wide management authority with the power to operate water and sewerage systems, the Governing Bodies, may, subject to applicable law and charter provisions, transfer all property, funds and operations coordinated by MUM to such separate legal entity.

B. If no such separate legal entity exists, the property coordinated by MUM shall be divided as follows:

(1) All real property relating to the water supply production and distribution system shall vest in the City of Tucson;

(2) All real property relating to the waste water and sewage collection and treatment system shall vest in either the City of Tucson or the County of Pima as follows:

a. Waste water and sewage collection and treatment real property located within the corporate limits of the City of Tucson at the time of dissolution shall vest in the City of Tucson.

b. Waste water and sewage collection and treatment property not within the corporate limits of the City of Tucson at the time of dissolution shall vest in the County of Pima, except for the City treatment plant and its accessory facilities and land located in the area of West Prince Road, which shall vest in the City.

(3) Any personal property acquired by MUM shall revert to the Governing Body whose revenue was used to purchase it; and if the source of the funds for each item cannot be identified, then the property shall revert to the County of Pima which will in turn distribute said property to the Governing Bodies in proportion to the amounts they have contributed for its acquistion cost.

(4) All division of property shall be under the supervision and approval of the Superior Court of the State of Arizona in Pima County.

20. This Agreement shall become effective upon the 11th day following the filing of an original thereof with the Secretary of State of Arizona.

SIGNED AND ATTESTED this _____ day of _____, 1974.

CITY OF TUCSON, a municipal corporation,

By _____
MAYOR

ATTEST & COUNTERSIGN:

_____
CITY CLERK

APPROVED AS TO FORM:

_____
CITY ATTORNEY

PIMA COUNTY, a political subdivision of the State of Arizona,

By _____
Chairman, Board of Supervisors

ATTEST:

_____
Clerk, Board of Supervisors

APPROVED AS TO FORM:

_____
COUNTY ATTORNEY

APPROVED BY THE ATTORNEY GENERAL OF THE STATE OF ARIZONA AS REQUIRED BY A.R.S. §§11-952(D).

_____
ATTORNEY GENERAL

ATTACHMENT B

ADOPTED BY THE
MAYOR AND COUNCIL

ORDINANCE NO. 4207

RELATING TO SEWERAGE AND SEWAGE DISPOSAL; REGULATING SEWAGE COLLECTION, TREATMENT AND DISPOSAL, PROVIDING CONNECTION FEES AND CHARGES; AMENDING CHAPTER 24 OF THE CODE OF THE CITY OF TUCSON AS AMENDED.

BE IT ORDAINED BY THE MAYOR AND COUNCIL OF THE CITY OF TUCSON, ARIZONA, AS FOLLOWS:

SECTION 1. That Chapter 24 of the Tucson Code, §2-24, be, and the same hereby is, repealed and replaced by the following sections:

SECTION 24-1. Definition of Terms

MUM shall be defined as the Metropolitan Utilities Management Agency established by Intergovernmental Agreement between the City of Tucson and the County of Pima dated July 1, 1974.

EXECUTIVE DIRECTOR refers to the general executive officer of MUM.

DIRECTOR OF WATER AND SEWERS refers to the administrator of the City Department of Water and Sewers and is hereafter referred to as Director.

AREA UNDER DEVELOPMENT refers to an area in which sanitary sewer improvements are being constructed and may include single family and multiple family residential subdivisions, mobile home subdivisions or parks, Improvement Districts, plats or development plans with intent of developing land for residential, commercial or industrial use. Generally the category includes all development in which "on-site" sewerage improvements have been provided by the applicant by Improvement District or contract.

APPLICANT FOR SERVICE shall be defined as an applicant for sewer service for personal use requiring

the extension of an existing sewer.

APPLICANT FOR DEVELOPMENT shall be defined as an applicant for sewer service for an area under development for marketing purposes.

SUBDIVISION shall mean any tract of land which is hereafter divided into five (5) or more parcels along an existing or proposed street, highway, easement, or right-of-way for sale, lease, or rent as residential, industrial or commercial building plots regardless of whether the lots or plots are described by metes and bounds, by reference to a map or survey of the property, or by any other method.

ACRE shall mean 43,560 square feet of land, excluding easements or rights-of-way and any other unusable portions of land.

POLLUTION shall mean contamination or other alteration of the physical, chemical, or biological properties of any waters in the City of Tucson, discharge of any liquid, gaseous, or solid substance into any waters, onto, or under any land within the City of Tucson that creates a nuisance or renders such waters or land harmful or injurious to public health, safety, or welfare, to domestic, commercial, industrial, agricultural, recreational, or other lawful beneficial uses, or to livestock, wild animals, birds, fish, or other aquatic life.

WATERS OF THE CITY shall mean all streams, lakes, ponds, marshes, watercourses, waterways, wells, springs, irrigation systems, drainage systems, and all other bodies or accumulations of water, surface and underground, natural or artificial, public or private, which are contained within, flow through, or border upon the corporate limits of the City or any portion thereof.

SEWAGE shall mean the wastes from toilets, baths, sinks, lavatories, laundries, and other plumbing fixtures in residences, institutions, public and business buildings, mobile homes, and other places of human habitation, employment, or recreation.

INDUSTRIAL WASTES shall mean the liquid, gaseous, or solid wastes produced as a result of any industrial operation.

SEWERAGE SYSTEM shall mean pipelines or conduits, pumping stations, force mains, and all other devices, appurtenances, and facilities used for collecting and conducting wastes to a point of treatment and disposal.

WASTE TREATMENT WORKS shall mean any plant, disposal field, lagoon, pumping station, incinerator, or other works used for the purpose of treating or stabilizing sewage and industrial wastes.

PERSON shall mean the state, a municipality, county, or other political subdivision, a cooperative, institution, corporation, company, firm, partnership or individual person.

RESIDENTIAL shall mean an area under development where a family unit normally resides.

IMPROVEMENT DISTRICT shall mean a district formed under the provisions of Title 9, Chapter 6, Article 2, A.R.S. 1956 (as amended) or formed by the City of Tucson for the purpose of installation of sanitary sewers, which district shall be considered as an area under development.

ON-SITE SEWERAGE IMPROVEMENTS shall consist of all sewage facilities within any plat, improvement plan, development plan or other improvement but shall exclude capacities in excess of capacities necessary to serve the development as may be required by the Director, subject to approval by the Executive Director.

OFF-SITE SEWERAGE IMPROVEMENTS shall include all sewerage construction necessary to connect "On-Site" facilities to an existing system as required by the Director of Water and Sewers and approved by the Executive Director.

MULTIFAMILY RESIDENCE shall mean a residential complex under single or corporate ownership designed for use by more than one family unit including apartments and mobile home parks and excluding townhouses and condominium projects.

NON-PARTICIPATING PROPERTY shall mean any property either residential, commercial or industrial that has not participated directly in the construction cost of a sanitary sewer providing service to that property.

PARTICIPATING PROPERTY shall mean any property, either residential, commercial or industrial that has participated directly in the construction cost of a sanitary sewer providing service to that property.

SECTION 24-2. GENERAL CONSIDERATIONS

(1) No sewage or industrial wastes shall be permitted to flow into waters within the City or upon or under any lands within the City in any manner determined by the Executive Director to be detrimental to the health, safety or welfare of persons who may be affected by the resulting environmental condition.

(2) No individual disposal system, development plan, or improvement plan shall be approved, nor shall any sewage disposal system be installed in a subdivision or development consisting of lots one acre in size or less, except as approved by the Director, subject to the approval of the Executive Director.

(3) Where soil conditions or topography are such that in the opinion of the Executive Director, based on his experience, knowledge, or engineering data, septic tank system cannot be expected to function satisfactorily or where ground water conditions are such that septic tank systems may cause pollution of the ground water supply, other sewage disposal methods satisfactory to the Executive Director shall be provided; and in no such case shall an individual disposal system be approved or installed.

(4) Subdivisions consisting of lots of one acre or less within the corporate limits of the City of Tucson shall be connected to a sewerage system.

SECTION 24-3. APPLICATION FOR APPROVAL

Before any person shall construct or contract for the construction of sewerage systems, sewerage system extensions, or waste treatment works or shall install any such process, device or equipment, either in whole or in part, an application for approval to construct the contemplated works shall be made to the Director on forms provided by the Executive Director. The Director, subject to approval of the Executive Director, shall act on the complete application within thirty (30) days upon receipt thereof by designating either approval or disapproval. In case of a disapproval, the Executive Director shall state in writing the reasons for the disapproval. No construction shall be commenced until approval has been obtained from the Director and the Executive Director.

SECTION 24-4. FEES FOR CONNECTION TO SANITARY SEWERS

(1) Connection fees relating to Participating Property in Areas Under Development:

(a) Single Family Residential

For service of residential subdivisions and residential Improvement Districts

said fee shall be charged at the rate of Two Hundred and Fifty Dollars ($250.00) per residential lot payable in cash at the time of application or upon execution of a written agreement between the owner and City for the sewer service.

(b) Multiple Family Residential

For service of residential subdivision and residential Improvement Districts, said fee shall be charged at the rate of One Hundred Fifty-Five Dollars ($155.00) per residential unit payable in cash at the time of application or upon execution of a written agreement between the owner and the City for the sewer service.

(c) Commercial and Industrial

For service of commercial and industrial property, said fee shall be charged at the rate of Twenty-Five Dollars ($25.00) for each fixture unit so connected as determined from the Uniform Plumbing Code as adopted by the City of Tucson, and according to the following tables:

TABLE 1

Kind of Fixture	Minimum Trap & Trap Arm Size	Units
Bathtubs	1-1/2"	2
Bidets	1-1/2"	2
Dental Units or Cuspidors	1-1/2"	1
Drinking Fountains	1-1/4"	1
Floor Drains	2"	2
*Interceptors for grease, oil, solids, etc.	2"	3
*Interceptors for sand, auto wash, etc.	3"	6
Laundry tubs	1-1/2"	2
Clothes Washers	2"	2
*Receptors (floor sinks) indirect waste receptors for refrigerators, coffee urn, water stations, etc.	1-1/2"	1

Table 1, con't

Kind of Fixture	Minimum Trap & Trap Arm Size	Units
*Receptors, indirect waste receptors for commercial sinks, dishwashers, airwashers, etc.	2"	3
Showers, single stalls	2"	2
*Showers, gang, (one unit per head)	2"	
Sinks, bar, private (1-1/2" min. waste)	1-1/2"	1
Sinks, bar, commercial (2" min. waste)	1-1/2"	2
Sinks, commercial or industrial, schools etc. including dishwashers, wash up sinks and wash fountains (2"min. waste)	1-1/2"	3
Sinks, flushing rim, clinic	3"	6
Sinks, and/or dishwashers (residential) (2" min. waste)	1-1/2"	2
Sinks, service	2"	3
Trailer park traps (one for each trailer)	3"	6
Urinals, pedestal	3"	6
Urinals, stall	2"	2
Urinals, wall (2" min. waste)	1-1/2"	2
Urinals, wall trough (2" min. waste)	1-1/2"	3
Wash basins (lavatories) single	1-1/2"	1
Wash basins, in sets	1-1/2"	2
Water closets	3"	6

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*NOTE--The size and discharge rating of each indirect waste receptor and each interceptor shall be based on the total rated discharge capacity of all fixtures, equipment or appliances discharging thereinto in accordance Table 2.

Drainage piping serving batteries of appliances capable of producing continuous flows shall be adequately sized to provide for peak loads. Clothes washers in groups of 3 or more shall be rated at 6 units each for the purpose of common waste pipe sizing.

Where trap sizes are increased over the minimums shown in Table 1 or greater waste loadings are evident, the discharge rating shall be determined in accordance with Table 2.

Trap sizes shall not be increased to a point where the fixture discharge may be inadequate to maintain their self-scouring properties.

TABLE 2

DISCHARGE CAPACITY

(in Gals. per min.)

Up to 7-1/2	Equals	1 Unit
8 to 15	Equals	2 Units
16 to 30	Equals	4 Units
31 to 50	Equals	6 Units

Over 50 gals. shall be determined by the Administrative Authority.

(2) Connection Fees Relating to Non-Participating Property in Areas under Development.

(a) Single Family Residential

For service of single family residential property, said fee shall be charged at the rate of Twenty-Five Dollars ($25.00) per fixture unit as determined from the Uniform Plumbing Code as adopted by the City of Tucson.

(b) Multy-family Residential

For service of multy-family residential property, said fee shall be charged at the rate of Twenty Dollars (20.00) per fixture as determined from the Uniform Plumbing Code as adopted by the City of Tucson, but not less than One Hundred Fifty-Five Dollars ($155.00) per residential unit.

(c) Commercial and Industrial

For service of Commercial and Industrial property, said fee shall be charged at the rate of Fifty Dollars (50.00) per fixture unit as determined from the Uniform Plumbing Code as adopted by the City of Tucson.

(3) Special Facilities

If the property to be connected to the sanitary sewer system necessitates the construction of special facilities required to handle the waste, the Director, subject to approval by the Executive Director, may require the applicant to provide these special facilities at his own expense.

SECTION 24-5. CONSTRUCTION OF SEWER SYSTEMS UNDER PRIVATE CONTRACT AUTHORIZED

(1) Upon written application, the Director, subject to approval of the Executive Director, may permit

construction of permanent sanitary sewer systems for sewer service where no existing sewer is available. Said sewer will be constructed at the sole expense and cost of the applicant within streets, avenues, alleys and rights-of-way pursuant to grants of easements and subject to approval of the Executive Director. The applicant will be required to construct all "on-site" and "off-site" facilities large enough to provide service to his development and in no case shall a line be less than 8-inches in internal diameter.

(2) Permits for Construction

Plans for construction will be provided by the applicant, certified by a Registered Professional Engineer and the Director, subject to approval by the Executive Director. The construction of sewer facilities authorized by said permit will be inspected by the Director, or his authorized representative. An inspection fee shall be charged. Said inspection fee will be computed to be 2.5% of the value of the proposed construction. Upon completion of the sewers and acceptance by the Director, title to such sewers shall be transferred to the City.

(3) Agreement for Construction

With each application for a permit for the construction of sewers authorized by this section, the applicant shall execute and deliver to the Director in duplicate, the agreement for the construction thereof by private contract. If the proposed construction is approved and the agreement otherwise conforms with the provisions of this chapter, it shall be

the duty of the Director to approve the agreement, subject to further approval of the Executive Director, and for and on behalf of the City, and issue the permit in accordance therewith.

SECTION 24-6. PROVISION FOR REFUND OF COST OF SEWERS INSTALLED BY PRIVATE CONTRACT UNDER CERTAIN CONDITIONS AUTHORIZED

(1) In cases of sewers installed by Applicant for development by private contract, should the Director require an applicant to install an "on-site" or "off-site" sewer system of a size and/or capacity larger than is required to collect the waste of the area under development, as determined by the Director, an agreement for refund of the cost of the oversizing may be made with the Applicant. In no case will the agreed refund amount exceed the total fees to be collected as authorized in Sec. 24-4 (1), above.

(2) Sewers installed by applicant for service by private contract

(a) Should a sewer system installed by an applicant for service be installed in such a manner as to provide service to a non-participating property, an agreement for refund of the cost of the sewer system may be made with the applicant. In no case will the agreed refund amount exceed the total fees to be collected as authorized in Sec. 24-4 (1), above, plus the fees when collected by the City, as authorized in Sec. 24-4 (2) in excess of the fees authorized in Sec. 24-4(1). Such refunds shall be made until the

full sum has been refunded, or for a maximum period of five (5) years from the date of the refund agreement, whichever shall first occur. In the event the full sum has not been refunded within the said five (5) year period, any balances remaining unpaid shall be considered cancelled, and the City shall be fully discharged from any further obligation under the agreement.

SECTION 24-7. PERMITS FOR TEMPORARY INSTALLATIONS FOR AREAS NOT CONTIGUOUS TO SEWERS ISSUANCE AUTHORIZED.

Upon written application, the Director may, subject to approval of the Executive Director, ussue a permit authorizing an area not contiguous to any sewer to be temporarily connected to a nearby sewer.

All permits issued and installations made pursuant to this section shall be on a temporary basis only, and shall be subject to the following terms and conditions.

(1) The temporary line referred to in this section shall be only at such locations as shall be approved by the Executive Director.

(2) All such installations shall be made without cost or expense to the City.

(3) Upon the installation of permanent sewers contiguous to the area being serviced by such temporary installations, the said temporary line shall be abandoned, and connection shall be made to the permanent sewers; and the area serviced shall be subject to the same charge set forth in Section 24-4 above.

(4) All charges and expenditures, including rental charges incurred or paid by the applicant in installing and maintaining such temporary line, shall in no manner be considered as having been incurred or paid with respect to any permanent sewer improvement district, private contract authorized by this ordinance, or any sewer installed by the City.

SECTION 24-8. FAILURE TO OBTAIN PERMITS AND APPROVALS AS REQUIRED

By this ordinance prior to the commencement of construction of sewer systems, temporary installations of waste treatment works shall be a misdemeanor and may be punishable by a fine of not to exceed Three Hundred and No/100 ($300.00) Dollars, or by imprisonment in the City Jail not to exceed six (6) months or by both such fine and imprisonment.

SECTION 2. This ordinance is effective and operative as of July 1, 1974.

SECTION 3. WHEREAS, it is necessary for the preservation of the peace, health and safety of the City of Tucson that this ordinance become immediately effective, an emergency is hereby declared to exist, and this ordinance shall be effective immediately upon its passage and adoption.

PASSED, ADOPTED AND APPROVED by the Mayor and Council of the City of Tucson, Arizona, _____.

_____
MAYOR

ATTEST:

_____
CITY CLERK

APPROVED AS TO FORM:

_____
CITY ATTORNEY

REVIEWED BY:

_____
CITY MANAGER

J. Dan O'Neill:lvg
June 26, 1974

ADOPTED BY THE
MAYOR AND COUNCIL

RESOLUTION NO. 9241

RELATING TO THE AUTHORITY OF PIMA COUNTY TO OWN AND OPERATE A SEWAGE SYSTEM.

WHEREAS, The City of Tucson, by virtue of Arizona Revised Statutes §11-264, and representing not less than one half of the population of the County, must consent to the purchase, construction or operation of sewage systems by the County in which the City is located; and

WHEREAS, the Mayor and Council of the City of Tucson have determined that such consent will be of advantage to the City and its inhabitants;

NOW, THEREFORE, BE IT RESOLVED BY THE MAYOR AND COUNCIL OF THE CITY OF TUCSON, ARIZONA, AS FOLLOWS:

SECTION 1. That the City of Tucson does hereby and in conformance with A.R.S. §11-264 grant its consent to the County of Pima to purchase, construct or operate a sewage system in Pima County.

SECTION 2. WHEREAS, it is necessary for the preservation of the peace, health and safety of the City of Tucson that this resolution become immediately effective, an emergency is hereby declared to exist, and this resolution shall be effective immediately upon its passage and adoption.

PASSED, ADOPTED AND APPROVED by the Mayor and Council of the City of Tucson, Arizona, ________________________.

____
MAYOR

ATTEST:

____
CITY CLERK

APPROVED AS TO FORM:

____
CITY ATTORNEY

REVIEWED BY:

____
CITY MANAGER

H. Holub:al
June 6, 1974

KHAWAM0041

ATTACHMENT D

COMPARISON OF CITY AND COUNTY SEWER BUDGETS

Budget Item	From JOINT Cost Recovery Report City	From JOINT Cost Recovery Report County	Actual County Budget	Actual City Budget
Operation and Maintenance	$ 1,791,800 ✓	$ 1,568,500 ✓	-11,729 $ 1,556,771	-93,466 $ 1,698,334
Debt Service	980,300 ✓	540,000 ✓	-246,000 Est. 294,000	-167,015 813,285
Capital Expense (From Tax Levy & Connection Fees)	600,000 ✓	564,000 ✓	+1269,229 1,833,229	⊖ 600,000
TOTALS	$ 3,372,100	$ 2,672,500	$ 3,684,000 +1011500	$ 3,111,619 - 260,481

Net deficit — $751,019

KHAWAM0042

PIMA001584

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MUM Budget

Mayor & Council Communication

April 12, 1976

Subject: Proposed M.U.M. Budget for Fiscal Year 1976-77

A preliminary M.U.M. Budget, including water and wastewater operations and capital requirements, is herewith submitted. The Mayor and Council are requested to approve a schedule for processing the M.U.M. Budget and also are requested to set a joint public hearing with Pima County prior to budget adoption.

PROCESS FOR ADOPTING M.U.M. BUDGET

City of Tucson Ordinance No. 3943, which is the basic ordinance governing Water Utility operations, requires the submission of a proposed Water Utility Budget to the Mayor and Council not less than 75 days prior to the beginning of the fiscal year (April 17). The ordinance requires that a public hearing be held on the Water Utility Budget at least 45 days prior to the beginning of the new fiscal year (May 17). The final adoption of the Water Utility Budget is to be made not later than 30 days prior to the beginning of the ensuing fiscal year (June 1).

At the January 8, 1976 joint meeting of the Mayor and Council and the Board of Supervisors, the governing bodies agreed to adopt the M.U.M. Wastewater Budget concurrently with the Water Utility Budget. The "Memorandum of Understanding," approved by the governing bodies at that joint meeting states in part:

> "...That discrepancies exist between the County and City budget process, and to resolve problems created thereby, it is understood that in 1976-77 sewer system budget preparations, identical constraints shall be applied to City and County departments respectively and, in furtherance of this objective, it is intended that the County and City budgets relating to sewer systems shall be adopted at a joint meeting of the governing bodies, after consideration of M.U.M. Policy Board recommendations, and not later than May 31, 1976."

Based on the foregoing requirements, the suggested budget calendar is as follows:

April 12, 1976	-	Submit water and wastewater budgets. Set date for public hearing (subject to Board of Supervisors' concurrence on: 1) Proposed M.U.M. Budget; and 2) Proposed Water System financing structure.
April 19 to May 10, 1976	-	Mayor and Council Board of Supervisors review of proposed Water System financing structure.
April 22, 1976	-	Mail notices on Water Budget Hearing to principal underwriters.

KHAWAM0044

AP12-76-222

May 12, 1976 - Mayor & Council - Board of Supervisors public hearing on: 1) Proposed M.U.M. Budget and 2) Water System financing structure.

May 13 to May 23, 1976 - Mayor & Council - Board of Supervisors Study Sessions(s) (Intergovernmental Conference) to review M.U.M. Budget and Water System financing structure and water and wastewater rates and charges.

May 24, 1976 - Final adoption of M.U.M. Budget and water and and wastewater charges and rates for fiscal year 1976-77.

GENERAL COMMENTS

The proposed budget calendar is predicated on the continuation of M.U.M. as a joint agency of the City and County. The schedule is admittedly a very ambitious one and will require cooperation by all concerned in order to successfully complete. If, for any reason, the legal requirements within the budget calendar cannot be met by joint action of the City and County, it will be necessary for the City to comply with the legal requirements for review and adoption of the water utility budget.

In view of the time restrictions that have existed and due to the legal requirements for the review and adoption of the water utility budget, this office has not formulated a final recommendation regarding the M.U.M. Budget. The attached M.U.M. Budget represents the current direction from the M.U.M. Policy Board and the Special M.U.M. Budget Review Committee. It is proposed that the Mayor and Council accept this budget and set it for public hearing with the understanding that additional evaluation will be required by budget and management staff and by the governing bodies.

Finally, while not addressed in this communication, it should be recognized that a M.U.M. Intergovernmental Agreement for fiscal year 1976-77 must be renegotiated.

RECOMMENDATION

It is recommended that the Mayor and Council order the proposed public hearing and approve the proposed budget calendar, both subject to concurrence by the Board of Supervisors.

Joel D. Valdez
City Manager

JDV:jb:fb
AP12-76-222
Attachments

KHAWAM0045

Board Communication

April 8, 1976

Subject: Proposed M.U.M. Water Utility Budget for Fiscal Year 1976-77

The M.U.M. Board Budget Review Committee held a budget review session on April 1, 1976, to discuss the proposed 1976-77 Water Utility Budget. The purpose of this Communication is to transmit the Committee's recommended Water Utility Budget and to advise the Board of the budget adoption schedule for M.U.M.

BACKGROUND

City of Tucson Ordinance No. 3943, which is the basic ordinance governing Water Utility operations, requires the submission of a recommended Water Utility Budget to the Mayor and Council not less than 75 days prior to the beginning of the fiscal year (April 12). The ordinance requires that a public hearing be held on the Water Utility Budget at least 45 days prior to the beginning of the new fiscal year (May 12). The final adoption of the Water Utility Budget is to be made not later than 30 days prior to the beginning of the ensuing fiscal year (May 31).

At the January 8, 1976 joint meeting of the Mayor and Council and the Board of Supervisors, the governing Bodies agreed to adopt the M.U.M. Wastewater Budget concurrently with the Water Utility Budget. The "Memorandum of Understanding," approved by the governing bodies at that joint meeting states in part:

> "... That discrepancies exist between the County and City budget process, and to resolve problems created thereby, it is understood that in 1976-77 sewer system budget preparations, identical constraints shall be applied to City and County departments respectively and, in furtherance of this objective, it is intended that the County and City budgets relating to sewer systems shall be adopted at a joint meeting of the governing bodies, after consideration of M.U.M. Policy Board recommendations, and not later than May 31, 1976."

The original budget review schedule for Fiscal Year 1976-77 was as follows:

February 19, 1976 - Preliminary Budget submitted to M.U.M. Policy Board.

March 25, 1976 - Final consideration and approval of the preliminary Budget by M.U.M. Policy Board and recommendation of a sewer user fee for Fiscal Year 1976-77.

KHAWAM0046

April 12, 1976	-	Proposed M.U.M. Budget submitted to Mayor and Council and Board of Supervisors, and a date set for a joint public hearing on the proposed budget.
May 12, 1976	-	Joint public hearing conducted by Mayor and Council and Board of Supervisors on the proposed M.U.M. Budget.
May 24, 1976	-	Final adoption of M.U.M.'s Budget for Fiscal Year 1976-77 by both governing bodies. Final adoption of sewer user fee.

M.U.M. BUDGET REVIEW COMMITTEE RECOMMENDATIONS

On February 19, 1976, the proposed M.U.M. Water and Sewer Budgets were presented to the M.U.M. Board for review and consideration. On March 11, 1976, the Board began preliminary review of the budgets and established a special Budget Review Committee to analyze the proposed budgets and make recommendations to the M.U.M. Board. On March 24, 1976, the Budget Review Committee recommended, and the Board approved, the proposed M.U.M. Wastewater Budget for 1976-77. This recommended budget has been transmitted to the Mayor and Council and the Board of Supervisors (Attachment A).

The Budget Review Committee reviewed the proposed Water Utility Budget on April 1, 1976. The results of the Committee's review are presented below.

The Budget Review Committee's recommended budget is attached (Attachment B). This budget includes a projection of 2,000 new connectees to the water system, and a revenue increase projection of 35 percent (including a 24 percent rate increase, the establishment of a System Development Charge, a discontinuation of aid-in-construction agreements and an evaluation of water connection fees to determine the actual cost of service installations which could lead to a revision of the connection fee rates. The Committee agreed that the budget is basically a "tight" budget, with little room for further reductions if efficient operation is to be maintained.

The basic recommendations of the Committee are:

1. The Capital improvement program should be approved, with the exception of the purchase of HUB Water Company. The Committee does not necessarily recommend the purchase of Metropolitan, Ray and Silver Shadows Water Companies at this time, but included funds for the purchase of these companies in the capital budget to provide flexibility at a later date. These proposed purchases should be thoroughly justified on a cost/benefit and water resources basis at the time they are considered for purchase.

2. The Committee recommends the allocation of $200,000 to provide funds to institute an intensive conservation program during fiscal year 1976-77. These funds can be made available from revisions to the 1975-76 capital budget and, therefore, represent carry-forward funds which will not affect revenue needs for 1976-77.

3. The Committee discussed the advisability of reducing projected operating costs as a result of the institution of the proposed water conservation program. The Committee decided to not revise projected operating costs until results of the proposed conservation program could be analyzed, especially since operational budget revisions would also require revisions of projected revenues.

4. In evaluating the O & M Budget and particularly the staffing level recommended for Fiscal Year 1976-77, the Committee was especially conscious of staff additions and their impact upon proposed increase in water rates. It was determined that if the staffing level for 1975-76 was retained for Fiscal Year 1976-77, the Water Utility would still require a water rate increase of 22 percent. Therefore, only a minimum impact would be made upon the projected rate increase by sacrificing cost effective operational expenditures. The Committee recommends the following staff level which represents a reduction of 6 positions originally requested by staff.

Production	92
Distribution	96
Commercial	97
Director's Office	13
Engineering	60
Planning & Technical Services	12
Water Resources	11
Total	381

Attachment B summarizes the proposed budget for each division. The recommended staff reductions will result in a savings of $55,000, which reduces the projected water rate increase from 25 percent to 24 percent.

5. The Committee eliminated the purchase of a proposed cable tool drilling rig from the budget. This also eliminated the necessity to hire two additional staff members to operate the drill rig. It was agreed to continue leasing these services for another year. This will result in a one-year saving of $25,000 during 1976-77. This item will be re-evaluated during preparation of the 1977-78 budget.

6. The Committee agreed that preventive maintenance programs should be funded (as proposed) since they represent long-term economy measures.

WATER REVENUE REQUIREMENTS

The Budget Review Committee's recommended Water Utility Budget requires a 24 percent increase in water sales revenues and the establishment of a System Development Charge for new connectees to the water system. Staff has formulated a water rate structure based upon the cost-to-serve and water conservation concepts, and has prepared the method of calculating the System Development Charge. Staff is prepared to present the recommended rate structure for consideration by the governing bodies. It is recommended that a special meeting of the governing bodies be conducted to consider this matter at the earliest possible time.

OTHER CONSIDERATIONS

The budget review and adoption schedule for M.U.M. requires the submission of the Water Utility Budget to the Mayor and Council on April 12, 1976, and the establishment of a public hearing on May 12, 1976. The governing bodies have agreed to follow the same schedule for the Wastewater Budget and the public hearing on May 12, 1976 will be a joint public hearing of the Mayor and Council and the Board of Supervisors. Since the Board has not recommended a Water Utility Budget, and due to time restraints for scheduling the submission of the budget, the Budget Review Committee's Recommended Budget has been transmitted to the Mayor and Council. This budget would be the basis for the public hearing on May 12, 1976 and can be changed based upon the M.U.M. Board's final review and the comments from citizens at the public hearing.

The M.U.M. Board does have the option of revising the Budget Review Committee's Recommended Budget at today's meeting and transmitting to the Mayor and Council the revised budget. This budget, then, would be the basis for the public hearing on May 12, 1976.

RECOMMENDATION

It is recommended that the Board review the attached budget and request the Mayor and Council and Board of Supervisors to hold a public hearing on May 12, 1976 regarding the M.U.M. Water and Wastewater Budgets. It is further recommended that a special meeting of the governing bodies be conducted to discuss the proposed water rate structure.

Respectfully submitted,

Frank Brooks
Executive Director

FB:eh
Attachments

KHAWAM0049

ATTACHMENT A

METROPOLITAN UTILITIES MANAGEMENT AGENCY ☐ P.O. BOX 5547 ☐ 111 EAST PENNINGTON STREET ☐ TUCSON, ARIZONA 85703

April 7, 1976

City of Tucson Mayor and Council
Pima County Board of Supervisors

Subject: M.U.M. Board's Recommended Budget for Fiscal Year 1976-77

Honorable Members of the Governing Bodies:

As Chairman of the M.U.M. Policy Board, I am transmitting to the Mayor and Council and the Board of Supervisors this Board's recommended Wastewater Budget for fiscal year 1976-77. This Board has devoted many hours in the review of the recommended budget and considers that the programs and projects it provides for are designed to meet the critical sewer problems confronting our community. At a time when the City and County are faced with financial difficulties which could result in increased taxes or the reduction of governmental services, the recommended M.U.M. Wastewater Budget for 1976-77 requires no increase in the sewer user fee rate and provides for a reduction of the Pima County property tax rate devoted to wastewater programs.

The M.U.M. Board wishes to emphasize the many positive programs of M.U.M. which are included in our recommended budget. We feel that local governments provide many beneficial services to the public and too often these positive actions are overshadowed by criticism of governmental activities. Therefore, the following are the significant aspects of the recommended budget:

1. The proposed capital improvement program provides for the construction of sewer system improvements totalling $29 million, including major interceptor and trunk sewers, the completion of the Ina Road Wastewater Treatment Plant, and revisions to the Roger Road Treatment Plant;

2. The operation and maintenance budget provides for the staffing of the Ina Road Treatment Plant, which is the second major plant serving the metropolitan area and is designed to meet all federal standards for the treatment of wastewater;

3. The development and implementation of a water conservation program (in conjunction with the Water Utility) designed to not only conserve our water resources but to also reduce sewer flow which could relieve critically overloaded sewer lines;

4. The expanded use of wastewater effluent for the watering of golf courses at Arthur Pack Park and Silverbell Road, thereby preserving groundwater for use by people. These golf courses, along with Randolph Park, will use over one billion gallons of effluent a year, which will not have to be provided from our potable water source; and

5. The reduction of the Pima County property tax assessment for M.U.M. by 2¢ per $100 of assessed valuation and the continuation of the sewer user fee rate at the present level.

In addition, this recommended budget incorporates the terms of the various agreements between the Board of Supervisors and the Mayor and Council concerning M.U.M. These agreements, itemized below, are designed to more efficiently utilize the financial resources available and to equitably distribute the costs of operating M.U.M. to the community:

1. The allocation of $250,000 from water revenues for water resource oriented wastewater programs;

2. The allocation of County-wide authorized sewer bond funds for projects within the Tucson City limits which amounts to $1.6 million in 1976-77;

3. The allocation of M.U.M. sewer connection fees to finance bond debt service costs, supplemented by Pima County property tax revenues when required;

4. The accounting of wastewater funds by the Pima County Department of Finance, if feasible;

5. The support of state-enabling legislation by the City of Tucson to permit Arizona counties to operate water systems, and;

6. M.U.M. will move to the Transwest Building, which will permit the consolidation of staff.

Finally, much has been said recently about dissolving M.U.M. M.U.M. is a viable organization, and the method of financing wastewater services is equitable to all citizens of Pima County. M.U.M.'s Wastewater Budget represents the most efficient use of available financial resources to solve this community's problems. If M.U.M. were dissolved and federal funding eligibility retained,

the City sewer operations could be financed from sewer user fees collected within the City, and the present rate could be reduced by 12 percent. However, the capital improvement needs of the City sewer system could not be met with the current bond funds available to the City. It would be necessary to immediately ask the voters of the City to pass a bond issue to finance sewer system capital improvements. Pima County would be required to increase the sewer user fee to residents outside the City by 97 percent to finance the County sewer operations.

The M.U.M. Board requests your full consideration of our recommended Wastewater Budget. The M.U.M. Board and M.U.M. staff are available to discuss the budget with you at your convenience.

Respectfully,

Ron Asta, Chairman
M.U.M. Policy Board

RA:eh
Attachment: M.U.M. Wastewater Budget, FY 1976-77

ccs: K. S. Scharman, County Manager
Joel D. Valdez, City Manager
Frank Brooks, Executive Director

ROPOLITAN UTILITIES MANAGEMENT AGENCY
M.U.M. BOARD RECOMMENDED 1976-77
SOLID WASTE AND SEWER UTILITY BUDGET

	STAFFING Adopted	STAFFING Proposed	REVISED 1975-76 BUDGET		PROPOSED 1976-77 SEWER BUDGET		PROPOSED 1976-77 SOLID WASTE BUDGET	
A. REVENUES								
Sewer User Fee			2,600,000		4,680,000			
Ad Valorem Tax			2,042,259	(.1722)	1,312,535	(.1094)	549,909	(.0458
Connection Fees			1,334,160		1,220,000			
Sale of Effluent & Sludge			75,000		208,000			
Sewer Rental Fees			4,000		-0-			
Water Utility Revenues			-0-		250,000			
Trash Collection			-0-		-0-		38,000	
Carry Forward			639,597		(55,317)			
TOTAL REVENUES			6,695,016		7,615,218		587,909	
B. OPERATION & MAINTENANCE EXPENSE								
CITY OPERATIONS:								
Wastewater Treatment	54	53	1,003,859		1,192,346			
Sewer Maintenance	35	33	477,412		531,063			
Wastewater Engineering	8	8	33,815		40,473			
Customer Services					238,106			
Planning					90,166			
Mapping & Records					69,591			
General Expense			285,271		243,078			
SUBTOTAL	97	94	1,800,357		2,404,823			
COUNTY OPERATIONS:								
Administration	13	14	200,312		217,046			
Engineering	26	22	326,761		344,299			
Treatment	9	76	152,713		521,734			
Operations	28	30	899,541		510,602		175,000	
Landfill	21	22	-0-		-0-		313,409	
General Expense			203,871		207,179			
SUBTOTAL	97	164	1,783,198		1,800,860		488,409	
TOTAL O & M	194	258	3,583,555		4,205,683		488,409	
C. DEBT SERVICE			1,804,880		2,532,535			
D. CAPITAL OUTLAY FROM CURRENT REVENUES								
Capital Equipment			193,655		128,550		49,500	
Construction & Replacement			792,831		350,000		50,000	
Wastewater Reuse Projects			-0-		250,000			
TOTAL CAPITAL OUTLAY			986,486		728,550		99,500	
E. DEFICITS								
75 Expenditures			375,412					
75-76 Expenditures					148,450			
TOTAL O & M, CAPITAL & DEBT			6,750,333		7,615,218		587,909	
DEFICIT			(55,317)					

KHAWAM0053

PIMA001595

MAJOR PROGRAM | CAPITAL PROGRAM | DEPARTMENT

RECOMMENDED FIVE YEAR CAPITAL IMPROVEMENTS PROGRAM SUMMARY

PROJECT	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81	TOTAL
1. South Rillito Interceptor Phase II	$ 530,000	$ 3,500,000	$ 2,500,000		$ 150,000		$ 6,680,000
Tucson Blvd. to Columbus Blvd.	500,000	2,600,000			150,000		3,250,000
Bonds	296,000	650,000			94,000		1,040
Federal	204,000	1,950,000			56,000		2,210,000
Pantano Interceptor Phase II	30,000		1,300,000				1,330,000
Bonds	30,000		325,000				355,000
Federal			975,000				975,000
Tanque Verde - Indian Ridge Terrace Sub. to Camino Seco			1,200,000				1,200,000
Bonds			300,000				300,000
Federal			900,000				900,000
Columbus Blvd. to Craycroft Rd.		900,000					900,000
Bonds		225,000					225,000
Federal		675,000					675,000
2. Canada del Oro Interceptor	77,000	1,500,000	$ 950,000				2,527,...
Phase I	77,000	1,500,000					1,577,000
Bonds	19,250	375,000					394,250
Federal	57,750	1,125,000					1,182,750
Phase II			950,000				950,000
Bonds			237,500				237,500
Federal			712,500				712,500
3. Roger Road WWTP Revisions	602,000	5,200,000	13,300,000				19,102,000
Bonds	300,500	1,175,000	3,325,000				4,800,500
Federal	301,500	3,900,000	9,975,000				14,176,500
Water Utility Rev.		125,000					125,000
4. Ina Road WWTF	12,701,000	15,136,000	1,752,000				29,589,000
Bonds	2,856,640	3,279,310	394,050				6,530,000
Federal	9,844,360	11,731,690	1,357,950				22,934,000
Water Utility Rev.		125,000					125,000

MAJOR PROGRAM — CAPITAL PROGRAM — DEPARTMENT

RECOMMENDED FIVE YEAR CAPITAL IMPROVEMENTS PROGRAM SUMMARY

PROJECT	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81	TOTAL
5. Regional Effluent Reuse Delivery Facilities	$ 460,000		$ 700,000	$20,000,000			$21,160,000
Bonds	185,000		175,000	5,000,000			5,360,000
Federal	225,000		525,000	15,000,000			15,750,000
Mines	50,000						50,000
6. Southwest Interceptor	1,700,000						1,700,000
Bonds	425,000						425,000
Federal	1,275,000						1,275,000
7. 29th Street Trunk							
Bonds	70,000	1,000,000					1,070,000
8. Mt. Lemon WWTF & Interceptor	50,000	50,000		200,000			300,000
Bonds	12,500	12,500		50,000			75,000
Federal	37,500	37,500		150,000			225,000
9. Green Valley WWTF & Interceptor	100,000	1,200,000	1,200,000				2,500,000
Bonds	25,000	300,000	300,000				625,000
Federal	75,000	900,000	900,000				1,875,000
10. Collectors to the S. Rillito	457,000	1,324,000	50,000	144,000			1,975,000
A. Columbus Blvd. Trunk							
Bonds	50,000	900,000					950,000
B. Stone Ave. Trunk							
Bonds	350,000						350,000
C. Country Club Trunk							
Current Revenue	47,000						47,000
Bonds	--	120,000					120,000
D. Craycroft Road Trunk							
Bonds			50,000	144,000			194,000
E. North First Avenue							
Bonds		65,000					65,000
F. Pima St. Reinf. east of Rosemont							
Bonds		23,000					23,000

KHAWAM0055

CAPITAL PROGRAM

MAJOR PROGRAM

DEPARTMENT

RECOMMENDED FIVE YEAR CAPITAL IMPROVEMENTS PROGRAM SUMMARY

PROJECT	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81	TOTAL
10. (cont'd)							
G. Palo Verde - Seneca to Pima & Richey - Pima to Fairmont							
Bonds		50,000					50,000
H. Mountain Ave. Trunk							
Bonds		166,000					166,000
I. Reinf. Pantano Pump Sta.							
Bonds	10,000						10,000
11. 29th St. Trunk Improvements							
Bonds		113,000	556,000	75,000		46,000	790,000
A. Golf Links - Wilmot to Sahuaro		43,000					43,000
B. Stella - Wilmot to Kolb			145,000				145,000
C. Sahuaro - 28th to Golf Links		70,000					70,000
D. Kolb Rd. - Stella to Escalante				75,000			75,000
E. Stella Rd. - Golf Links Carson Park			95,000				95,000
F. Stella Rd. - Pantano Rd. to Pantano Parkway			241,000			46,000	287,000
G. Wilmot Rd. - Golf Links to Stella			75,000				75,000
12. Southwest Trunk Improvements							
Bonds	10,000	20,000	41,000		71,000		142,000
A. Projections, Routing, Design	10,000						10,000
B. San Marcos Trunk		10,000	10,000				20,000
C. Right-of-way Procurement		10,000					10,000
D. Silverbell-Speedway to Anklam			31,000		71,000		102,000

KHAWAM0056

CAPITAL PROGRAM

MAJOR PROGRAM

DEPARTMENT

RECOMMENDED FIVE YEAR CAPITAL IMPROVEMENTS PROGRAM SUMMARY

PROJECT	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81	TOTAL
13. Southeast Interceptor	287,000		1,000,000	1,200,000	3,900,000		6,387,000
Bonds	83,000		250,000	300,000	975,000		1,608,000
Federal	204,000		750,000	900,000	2,925,000		4,779,000
14. Marana WWTF & Interceptor			40,000	460,000			500,000
Bonds			10,000	115,000			125,000
Federal			30,000	345,000			375,000
15. Southeast Trunk Improvements	22,000	445,000					467,000
A. Bilby - South Park Interconnect, current rev.		10,000					10,000
B. Fair St. - South Park Interconnect, Current Rev.		5,000					5,000
C. 36th Street Trunk							
Bonds		180,000					180,000
D. Flow Balance-18th St. & I-10							
Bonds		100,000					100,000
E. Calle Pinta Trunk							
Bonds	22,000	150,000					172,000
16. Relief & Replacement	187,440	410,000	600,000	600,000	600,000	600,000	2,997,440
A. 29th St. Reinf. Current Rev.	89,440						89,440
B. Various Relief & Rep. Current Rev.	48,000	83,000	478,000	600,000	390,000	600,000	2,199,000
C. Capital Equip. WWTP							
Current Rev.	15,000						15,000
Bonds	35,000						35,000
D. Elm St. - Tucson Blvd. Interconnect, Current Rev.		5,000					5,000
E. Main Aven. Trunk Current Rev.		12,000					12,000
F. Conc. Sewer Study Current Rev.		25,000					25,000

KHAWAM0057

CAPITAL PROGRAM

MAJOR PROGRAM

DEPARTMENT

RECOMMENDED FIVE YEAR CAPITAL IMPROVEMENTS PROGRAM SUMMARY

PROJECT	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81	TOTAL
16 (cont'd)							
G. Asthmatic School Pond Relief Pressure line Current Rev.		40,000					40,000
H. Santo Tomas Replacement Trunk, Current Rev.		45,000					45,0(
I. Rillito Vista Sewerage System, Collectors and Treatment Plant, HUD Grant application approved for $60,000		115,000					115,000
Public Works Funds		55,000					55,000
Federal		60,000					60,000
J. Roller Coaster Rd. Trunk Current Rev.		45,000					45,000
K. Hidden Valley Trunk Current Rev.		40,000					40,000
L. Ina Road Trunk Relief Current Rev.			12,000				12,000
M. C 53 Replacement Current Rev.			110,000				110,000
N. Casas del Oro Norte pressure sewer replacement Current Rev.					85,000		85,000
O. Sunrise to Aquimuri Drive Relief Trunk Current Rev.					65,000		65,000
P. La Buena Vista Relief Trunk Current Rev.					60,000		60,000
17. Camino Martin Trunk Bonds			50,000				50,000
18. Bear Claw Way Trunk Bonds			45,000				45,000

KHAWAM0058

CAPITAL PROGRAM

MAJOR PROGRAM

DEPARTMENT

RECOMMENDED FIVE YEAR CAPITAL IMPROVEMENTS PROGRAM SUMMARY

PROJECT	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81	TOTAL
19. Sabino Canyon Road Trunk Bonds				$ 40,000			$ 40,000
20. Rancho Perdido Trunk Bonds				60,000			60,000
21. Oversize Rebate Bonds	$ 26,000						26,000
22. Camino Seco Trunk-Wrightstown to Broadway Bonds			$336,000			$ 187,000	523,000
23. South Seventh Ave. Trunk - Irvington to 44th Street Bonds				200,000			200,000
24. Yaqui Indian Village Trunk Bonds				150,000			150,000
25. Magee to Ina Trunk Bonds				150,000			150,000
26. Ajo, Arizona Sewerage System Trunk and Treatment Bonds					250,000		250,000
27. Branding Iron Park Pond Connection Trunk Bonds						250,000	250,000
28. La Puerta del Norte Outfall Bonds						60,000	60,000
29. Marana, Arizona Outfall Bonds						500,000	500,000

CAPITAL PROGRAM

MAJOR PROGRAM

DEPARTMENT

RECOMMENDED FIVE YEAR CAPITAL IMPROVEMENTS PROGRAM SUMMARY

PROJECT	1975-76	1976-77	1977-78	1978-79	1979-80	1980-81	TOTAL
30. Aravaca Junction Outfall Bonds						100,000	100,000
31. Purchase Agreements and right-of way-Current Revenues		40,000					40,000
TOTAL	$17,279,440	$29,938,000	$23,120,000	$23,279,000	$4,971,000	$1,743,000	$100,330,440
BONDS	4,805,890	8,903,810	6,394,550	6,284,000	1,390,000	1,143,000	28,921,250
FEDERAL	12,224,110	20,379,190	16,125,450	16,395,000	2,981,000	-0-	68,104,750
OTHER (MINES)	50,000						50,000
CURRENT REVENUES	199,440	350,000	600,000	600,000	600,000	600,000	2,949,440
WATER UTILITY REVENUES		250,000					250,00
PUBLIC WORKS FUND - COUNTY		55,000					55,000

KHAWAM0060

ATTACHMENT B

METROPOLITAN UTILITIES MANAGEMENT AGENCY
PROPOSED 1976-77
WATER UTILITY BUDGET

	ADOPTED 1975-76 BUDGET	REVISED 1975-76 BUDGET	PROPOSED 1976-77 BUDGET	MUM BOARD RECOMMENDED 1976-77 BUD.
A OPERATING REVENUES				
Water Sales	15,750,000	15,750,000	19,017,414	18,870,295
Fire Protection	160,000	160,000	160,000	160,000
Connection Fees	500,000	500,000	500,000	500,000
System Development Charge	-0-	-0-	1,500,000	1,500,000
Interest Earnings	1,500,000	1,500,000	1,300,000	1,300,000
Service Charges	35,000	35,000	40,000	40,000
Other Fees & Charges	35,000	35,000	100,000	100,000
Cash Balance	-0-	-0-	945,000	1,145,000
TOTAL REVENUES	17,980,000	17,980,000	23,562,414	23,615,295
B OPERATION & MAINTENANCE EXPENSE				
Production	3,892,417	3,915,283	5,177,308	5,153,183
Distribution	1,160,545	1,053,019	1,326,821	1,300,736
Commercial	1,434,525	1,438,763	1,434,358	1,434,358
Director's Office	249,697	260,603	263,053	254,445
Engineering	330,905	329,309	478,410	485,795
Planning & Technical Services	107,885	91,332	155,769	152,544
Water Conservation	-0-	-0-	-0-	200,000
Water Resources *	(252,157)	(236,570)	(279,952)	(279,952)
General Expense	2,028,000	1,973,000	2,208,695	2,116,234
Non-Operating Expense	104,000	104,000	58,000	58,000
TOTAL O & M	9,307,974	9,165,309	11,102,414	11,155,295
C DEBT SERVICE				
Bond Principal	2,825,000	2,825,000	2,950,000	2,950,000
Bond Interest	2,718,600	2,718,600	3,344,000	3,344,000
Bond Reserve	600,000	600,000	700,000	700,000
TOTAL DEBT	6,143,600	6,143,600	6,994,000	6,994,000
D CAPITAL OUTLAY	2,528,426	2,528,426	5,466,000	5,466,000
E CITY MANAGER'S BUDGET FREEZE		142,665		
TOTAL O & M, CAPITAL, DEBT	17,980,000	17,980,000	23,562,414	23,615,295
STAFFING				
Production	85	84	94	92
Distribution	100	94	98.5	96
Commercial	94	94	97	97
Director's Office	14	14	14	13
Engineering	60	60	60	60
Planning & Technical Services	9	7	13	12
Water Resources	11	9	11	11
TOTAL STAFFING	373	362	387.5	381

* The Water Resources Program is capitalized and therefore is not included in total O & M.

KHAWAM0061

PRODUCTION DIVISION

ACTIVITY	1975-76 ADOPTED BUDGET	1975-76 ADOPTED POSITIONS	1975-76 REVISED BUDGET	1975-76 REVISED POSITIONS	1976-77 REQUEST BUDGET	1976-77 REQUEST POSITIONS	CHANGE BUDGET	CHANGE POSITIONS
117 - Sources & Pumping	3,623,338	67	3,483,579	64	4,640,254	71	1,156,675	7
137 - Equipment Maintenance	269,079	20	431,704	20	512,929	21	81,225	1
TOTAL	3,892,417	87	3,915,283	84	5,153,183	92	1,237,900	8

REQUEST SUMMARY:

Due to an increasing number of production facilities (wells, boosters, reservoirs), this activity is requesting an additional 5 maintenance positions. Basically, these positions are required in order to adequately maintain the pumping equipment and thereby minimize interruptions in service caused by equipment failures. Two of the additional 8 positions are transfers from other M.U.M. activities. One is an Administrative Assistant position to provide additional administrative support to the field divisions, while the other is a welder position to begin establishing a machine shop to support pumping equipment maintenance. In the Equipment Maintenance Activity, a Technical Inspector is requested for preventive maintenance functions. The power budget accounts for $882,165 of this Division's budget increase.

PROGRAM STATISTICS:

	TOTAL INSTALLATIONS	INSTALLATIONS PER MAINT. MAN	INSTALLATIONS PER PLANT OPERATOR	POWER COST PER MIL./GAL. PUMPED
FY 1971-72	327	11.2	25.2	$28.69
FY 1972-73	436	16.1	33.5	32.65
FY 1973-74	459	15.3	35.3	33.47
FY 1974-75	473	16.0	36.4	60.75
FY 1975-76*	528	17.1	40.6	88.00
FY 1976-77*	553	16.3	39.5	115.38

* Estimates

ATTACHMENT H

KHAWAM0062

DISTRIBUTION DIVISION

ACTIVITY	1975-76 ADOPTED BUDGET	1975-76 ADOPTED POSITIONS	1975-76 REVISED BUDGET	1975-76 REVISED POSITIONS	1976-77 REQUEST BUDGET	1976-77 REQUEST POSITIONS	CHANGE BUDGET	CHANGE POSITIONS
7217 - Mains & Services	1,039,144	92	957,619	89	1,181,910	90	224,291	1.0
7227 - Meter Shop	121,401	8	95,400	5	118,826	6	23,426	1.0
TOTAL	1,160,545	100	1,053,019	94	1,300,736	96	247,717	2.0

EQUEST SUMMARY:

It is proposed that two of the six positions frozen during fiscal 1975-76 be re-budgeted in 1976-77. One of the positions is an Account Clerk II which would provide additional clerical support for this Division. The other is a Meter Repairman position which is requested in order to implement a program of repairing or replacing all meters with 20 or more years of service.

ROGRAM STATISTICS:

	ADOPTED STAFFING	MILES OF MAINS	MAINS INSTALLED BY FORCE ACCT.	METERS & SERVICES INSTALLED	NUMBER OF FIRE HYDRANTS	NUMBER OF METERS REPAIRED
FY 1971-72	82	1,685	86,962 ft.	5,347	5,819	6,030
FY 1972-73	86	1,826	131,507 "	5,524	6,209	5,799
FY 1973-74	99	1,929	53,704 "	4,484	6,376	5,977
FY 1974-75	120	2,397	56,614	3,166	6,607	7,300
FY 1975-76*	100	2,502	68,000 "	2,900	6,821	7,094
FY 1976-77*	96	2,602	70,000 "	-	7,021	8,000

* Estimates

ATTACHMENT B

KHAWAM0063

PIMA001605

COMMERCIAL DIVISION

ACTIVITY	1975-76 ADOPTED BUDGET	1975-76 ADOPTED POSITIONS	1975-76 REVISED BUDGET	1975-76 REVISED POSITIONS	1976-77 REQUEST BUDGET	1976-77 REQUEST POSITIONS	CHANGE BUDGET	CHANGE POSITIONS
7317 - Customer Services	655,540	33	635,914	33	776,804	36	140,890	3
7327 - Field Services	705,066	56	728,189	56	814,825	56	86,636	-0-
7337 - Control Services	73,919	5	74,660	5	80,835	5	6,175	-0-
SUBTOTAL	1,434,525	94	1,438,763	94	1,672,464	97	233,701	3
Charge to Sewer					(238,106)		(238,106)	
Charge to Water	1,434,525	94	1,438,763	94	1,434,358	97	(4,405)	3

REQUEST SUMMARY:

It is proposed that for Fiscal 1976-77, the Customer Services budget of the Commercial Division be allocated 25% to the Sewer Utility and 75% to the Water Utility, except for postage costs, which are allocated on the basis of the number of water and sewer accounts. This allocation results in a charge of $238,106 to the Sewer Utility. In order to handle the increased billing workload resulting from the sewer user fee, it is requested that the Customer Services section be allowed three additional Customer Services Clerks. Postage, motor pool, and data processing services account for $145,000 of the budgeted increase, while a proposed upgrading of staff of the Field Services section accounts for approximately $23,000.

PROGRAM STATISTICS:

	TOTAL WATER & SEWER ACCOUNTS	ACCOUNTS PER CUSTOMER SVC. EMPLOYEE	NUMBER OF METERS READ	NUMBER OF METERS READ PER MAN-DAY
FY 1971-72	89,446	3,313	1,024,191	290
FY 1972-73	100,667	3,595	1,139,436	301
FY 1973-74	105,828	3,470	1,246,613	309
FY 1974-75	109,442	3,588	1,294,955	302
FY 1975-76 *	121,533	3,683	1,322,000	291
FY 1976-77 *	127,450	3,540	1,377,600	304

ATTACHMENT D

* Estimates

KHAWAM0064

DIRECTOR'S OFFICE

ACTIVITY	1975-76 ADOPTED BUDGET	1975-76 ADOPTED POSITIONS	1975-76 REVISED BUDGET	1975-76 REVISED POSITIONS	1976-77 REQUEST BUDGET	1976-77 REQUEST POSITIONS	CHANGE BUDGET	CHANGE POSITIONS
7417 - Director's Office	249,697	14	260,603	14	254,445	13	(6,148)	(1)

REQUEST SUMMARY:

The only change to this activity involves the transfer of an administrative position to the Production Division to provide additional administrative support to the field divisions.

ATTACHMENT B

KHAWAM0065

PIMA001607

ENGINEERING DIVISION

ACTIVITY	1975-76 ADOPTED BUDGET	1975-76 ADOPTED POSITIONS	1975-76 REVISED BUDGET	1975-76 REVISED POSITIONS	1976-77 REQUEST BUDGET	1976-77 REQUEST POSITIONS	CHANGE BUDGET	CHANGE POSITIONS
27 - Water Engineering	175,027	20	169,679	20	208,123	20	38,444	-0-
28 - Field Engineering	52,551	26	66,199	26	113,395	26	47,196	-0-
29 - Mapping & Records	208,022	14	186,861	14	233,868	14	47,007	-0-
SUB-TOTAL	426,500	60	422,739	60	555,386	60	132,647	-0-
CHARGE TO SEWER	(104,695)		(93,430)		(69,591		23,839	
CHARGE TO WATER	330,905		329,309		485,795		156,486	

QUEST SUMMARY:

The increase in the Engineering Division results from increased personnel and motor pool costs, and reduced transfers to the Capital Program and Sewer Utility. The charge to the Sewer Utility is for a share of the Mapping and Records Section and is based on the services of three full-time draftsman and five positions at one-third time.

ATTACHMENT B

KHAWAM0066

PIMA001608

PLANNING & TECHNICAL SERVICES DIVISION

ACTIVITY	1975-76 ADOPTED BUDGET	1975-76 ADOPTED POSITIONS	1975-76 REVISED BUDGET	1975-76 REVISED POSITIONS	1976-77 REQUEST BUDGET	1976-77 REQUEST POSITIONS	CHANGE BUDGET	CHANGE POSITIONS
430 - Planning & Technical Services	215,770	9	182,663	7	242,710	12	60,047	5
Charge to Sewer	(107,885)		(91,331)		(90,166)		1,165	
Charge to Water	107,885		91,332		152,544		61,212	

REQUEST SUMMARY:

Of the twelve positions requested for this Division for Fiscal 1976-77, six relate to wastewater planning and are to be charged to the Sewer Utility Budget. The five additional positions include three new wastewater monitoring staff to give the Planning Division the capability to implement and monitor the Industrial Waste Control Ordinance which is to become effective July 1, 1976. Also, an additional Civil Engineer I position is requested to assist with the maintenance of customer data files and to begin utilizing to a greater degree the information available for such applications as computerized mapping, revenue generation, customer class development, etc. The other additional position includes the re-budgeting of the Planning Director which was frozen during Fiscal 1975-76.

ATTACHMENT B

GENERAL & NON-OPERATING EXPENSE

ACTIVITY	1975-76 ADOPTED BUDGET	1975-76 ADOPTED POSITIONS	1975-76 REVISED BUDGET	1975-76 REVISED POSITIONS	1976-77 REQUEST BUDGET	1976-77 REQUEST POSITIONS	CHANGE BUDGET	CHANGE POSITIONS
7437 General Expense	2,028,000	-0-	1,973,000	-0-	2,116,234	-0-	143,234	-0-
7447 Non-Operating Expense	104,000	-0-	104,000	-0-	58,000	-0-	(46,000)	-0-
TOTAL	2,132,000	-0-	2,077,000	-0-	2,174,234	-0-	97,234	-0-

REQUEST SUMMARY:

The General Expense budget includes allocations for such expenses as consulting, legal, and auditing services in addition to the major items of the City's administrative overhead charge and sales tax expense. The overhead charge is budgeted at the same amount ($725,000) as this fiscal year. Sales tax expense, which is based on a 25 percent increase in water sales revenue, accounts for approximately $140,000 of the total increase. The Non-Operating Expense budget includes allocations for membership and subscriptions and bad debt expense. The reduction results from contract interest expense being budgeted next fiscal year in the Capital Budget.

ATTACHMENT B

KHAWAM0068

PIMA001610

WATER RESOURCES DIVISION

ACTIVITY	1975-76 ADOPTED BUDGET	1975-76 ADOPTED POSITIONS	1975-76 REVISED BUDGET	1975-76 REVISED POSITIONS	1976-77 REQUEST BUDGET	1976-77 REQUEST POSITIONS	CHANGE BUDGET	CHANGE POSITIONS
57 Water Resources*	252,157	11	236,570	9	279,952	11	43,382	2

* The Water Resources program is a capitalized expense, and is therefore not reflected in the total O & M Budget.

QUEST SUMMARY

Two additional Hydrologist positions are requested for the Water Division. Basically these people are being requested in order to initiate and carry out much needed research and development programs vital to the water resources of the area, including reducing the backlog of data interpretations and meeting the additional workload created by the production and test-hole drilling programs and the water quality requirements being implemented by E.P.A.

OGRAM STATISTICS

	PRODUCTION AND TEST WELLS DRILLED	WELL CUTTINGS ANALYZED	WATER QUALITY ANALYZED	WATER SAMPLES
FY 1975-76	20	7,500	-0-	4,700
FY 1976-77	32	11,500	300	4,900

ATTACHMENT B

KHAWAM0069

PIMA001611

CAPITAL PROGRAM

MAJOR PROGRAM	DEPARTMENT
WATER	M. U. M. AGENCY

RECOMMENDED FIVE YEAR CAPITAL IMPROVEMENTS PROGRAM SUMMARY

PROJECT	1976–77	1977–78	1978–79	1979–80	1980–81	TOTAL
1. Source Development & Transmission						
a) Research and Exploration	250,000	250,000	250,000	250,000	250,000	1,250,000
b) Drill Redrill and Equip Wells	1,000,000	1,410,000	1,380,000	840,000	790,000	5,420,000
c) Avra Valley Wells	200,000	520,000	590,000	630,000	670,000	2,610,000
d) Southwest Pumping Plant & Pipelines	-0-	7,135,000	461,000	370,000	216,000	8,182,000
e) Northwest Pumping Plant & Pipelines	-0-	-0-	-0-	-0-	25,240,000	25,240,000
f) Agricultural Land Purchases (Down Payments)	882,000	1,025,000	1,406	-0-	50,000	3,363,000
g) Agricultural Land Contract Payments	1,540,000	1,734,000	2,554,000	3,521,000	3,327,000	12,676,000
TOTAL	3,872,000	12,074,000	6,641,000	5,611,000	30,543,000	58,741,000
2. Storage						
a) Northwest Reservoir	1,900,000	-0-	-0-	-0-	-0-	1,900,000
b) Catalina Reservoir	-0-	270,000	-0-	-0-	-0-	270,000
c) Northeast Reservoir	100,000	250,000	-0-	-0-	-0-	350,000
TOTAL	2,000,000	520,000	-0-	-0-	-0-	2,520,000
TOTAL COST						
SOURCE OF FUNDS						
PRIOR YEAR FUNDING						
CURRENT REVENUE						
CITY BOND FUNDS						
HIGHWAY USER TAX						
ASSESSMENTS						
OTHER:						
FUNDS AVAILABLE						
UNFUNDED AMOUNT						
TOTAL FUNDS						

KHAWAM0070

ATTACHMENT B

CAPITAL PROGRAM

MAJOR PROGRAM: WATER

DEPARTMENT: M. U. M. AGENCY

RECOMMENDED FIVE YEAR CAPITAL IMPROVEMENTS PROGRAM SUMMARY

PROJECT	1976–77	1977–78	1978–79	1979–80	1980–81	TOTAL
3. Pumping Plant Improvements	500,000	380,000	210,000	190,000	1,350,000	2,630,000
4. Major Support Mains	1,800,000	1,500,000	600,000	1,700,000	1,900,000	7,500,000
5. Distribution System						
a) Major Mains (Fire Protection)	1,000,000	1,200,000	1,400,000	1,500,000	1,500,000	6,600,000
b) Minor Mains	150,000	160,000	172,000	175,000	175,000	832,000
c) Main Replacement	300,000	500,000	500,000	400,000	400,000	2,100,000
d) Fire Hydrants	200,000	200,000	200,000	200,000	200,000	1,000,000
e) Contract Payments (Aid-in-Construc.)	610,000	605,000	700,000	695,000	690,000	3,300,000
TOTAL	2,260,000	2,665,000	2,972,000	2,970,000	2,965,000	13,832,000
6. Services						
a) Fire Service	120,000	130,000	139,000	149,000	158,000	696,000
b) Metered Service	480,000	518,000	557,000	595,000	634,000	2,784,000
c) Extensions for Service	450,000	480,000	518,000	525,000	525,000	2,498,000
TOTAL	1,050,000	1,128,000	1,214,000	1,269,000	1,317,000	5,978,000
TOTAL COST						
SOURCE OF FUNDS						
PRIOR YEAR FUNDING.....						
CURRENT REVENUE.....						
CITY BOND FUNDS.....						
HIGHWAY USER TAX.....						
ASSESSMENTS.....						
OTHER:.....						
FUNDS AVAILABLE						
UNFUNDED AMOUNT						
TOTAL FUNDS						

KHAWAM0071

CAPITAL PROGRAM

MAJOR PROGRAM: WATER

DEPARTMENT: M. U. M. AGENCY

RECOMMENDED FIVE YEAR CAPITAL IMPROVEMENTS PROGRAM SUMMARY

PROJECT	1976–77	1977–78	1978–79	1979–80	1980–81	TOTAL
7. General Plant						
a) Land and Building	400,000	70,000	70,000	80,000	80,000	700,000
b) Equipment	390,000	420,000	450,000	480,000	500,000	2,240,000
TOTAL	790,000	490,000	520,000	560,000	580,000	2,940,000
8. Private Water Company Purchases						
a) Down Payments	900,000	2,375,000	-0-	-0-	-0-	3,275,000
b) Contract Payments	80,000	881,000	1,108,000	1,181,000	1,265,000	4,515,000
TOTAL	980,000	3,256,000	1,108,000	1,181,000	1,265,000	7,790,000
9. Wastewater Reuse-Water Resource	250,000	250,000	250,000	250,000	250,000	1,250,00
TOTAL COST	13,502,000	22,263,000	13,515,000	13,731,000	40,170,000	103,181,000
SOURCE OF FUNDS						
PRIOR YEAR FUNDING						
CURRENT REVENUE (R.&.R. FUND)	5,466,000	6,324,000	7,424,000	8,437,000	9,550,000	37,201,000
CITY BOND FUNDS	8,036,000	15,939,000	6,091,000	5,294,000	30,620,000	65,980,000
HIGHWAY USER TAX						
ASSESSMENTS						
OTHER:						
FUNDS AVAILABLE	13,502,000	22,263,000	13,515,000	13,731,000	40,170,000	103,181,000
UNFUNDED AMOUNT						
TOTAL FUNDS	13,502,000	22,263,000	13,515,000	13,731,000	40,170,000	103,181,000

KHAWAM0072

ATTACHMENT B

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Mayor & Council Memorandum

May 24, 1976

Subject: Impact of the Dissolution of M.U.M.

The M.U.M. Executive Director has prepared the attached report dealing with the impact of dissolving M.U.M. The City Finance Director has reviewed the financial facts presented therein and is confident of the accuracy of the City-related figures. The County figures are taken from the preliminary budget presented by M.U.M. and the County Sanitation Department.

Joel D. Valdez
City Manager

JDV:mm

SS/MAY24-76-226

Attachment: MUM Correspondence to Joel D. Valdez dtd. 5/21/76

Correspondence

DATE May 21, 1976

TO Joel D. Valdez
City Manager

FROM Frank Brooks
Executive Director

SUBJECT M.U.M. - Impact of Dissolution

Once again, the future of M.U.M. has become a community issue. I have prepared this report in an effort to illustrate the realities we face if dissolution of this first attempt at Metropolitan Utilities Management does occur. This report presents: (1) a brief history of why M.U.M. was formed; (2) the method adopted by the two governing bodies for financing wastewater activities; (3) the anticipated effect of dissolution upon our community's eligibility for Federal funding of wastewater programs, and; (4) the alternative methods to finance the community's wastewater system if either governing body effects the dissolution of M.U.M.

Why M.U.M. Was Established

On July 8, 1974, the Tucson Mayor and Council and the Pima County Board of Supervisors adopted an Intergovernmental Agreement establishing the Metropolitan Utilities Management Agency. The primary reasons for the establishment of M.U.M. were:

1) To establish a regional water resource management and planning agency to effectively manage and plan water use and wastewater reuse programs designed to ensure water quality and availability in the Tucson basin.

2) To establish equitable uniform policies and procedures for financing wastewater operations within Pima County and required by the Federal Water Pollution Control Act Amendments of 1972 as prerequisites to receive Federal funds for the construction of wastewater conveyance and treatment facilities.

3) To establish a single management organization for the day-to-day operation of the City and County wastewater systems which were physically integrated but separately administered.

Financing of M.U.M. Wastewater Activities

Since July, 1974, the financing of M.U.M. wastewater activities has been changed to comply with Federal regulations regarding the establishment of an equitable system of sewer charges. To receive Federal assistance for wastewater construction projects, local communities must institute a system of sewer charges requiring each recipient of wastewater treatment services to pay their proportionate share of: (1) the costs of operation; and (2) the cost of maintenance (including replacement) of waste treatment facilities provided by the community.

In compliance with Federal law, the governing bodies have implemented, and the Environmental Protection Agency (EPA) has tentatively approved, an equitable Cost Recovery System composed of: (1) Sewer User Fees, (2) Connection Fees, and (3) Ad Valorem Taxation. Basically, operation costs and maintenance costs (including replacement) are funded from User Fee revenues. Debt service costs for outstanding bonds are funded from Connection Fees and Ad Valorem Taxes.

Prior to M.U.M., City and County wastewater systems operational costs were financed from the General Fund (ad valorem taxes, sales taxes, etc.) of the City and ad valorem taxes of the County. The financing of the County system from ad valorem taxes was inequitable to City residents because they paid for the operation of both systems but used only the City system. The United States Solicitor General and EPA have ruled that financing the wastewater systems from ad valorem taxes is inequitable in Pima County since two large non-users of the sewer system (vacant land and the mines) account for over 40 percent of the assessed valuation.

The Federal law also requires the establishment of an industrial Cost Recovery System whereby industrial waste dischargers must pay a surcharge in addition to the sewer user fee if the strength of their waste exceeds standards established by EPA. The purpose of the industrial surcharge is to require industries to pay the actual cost of treating their waste at publicly-owned treatment facilities. In April 1975, the governing bodies tentatively approved the formula for calculating the industrial surcharge. Staff has prepared a proposed ordinance establishing the fee and it has been forwarded to EPA for consideration and approval. EPA is withholding the final grant payment for the Randolph Park Treatment Plant pending the review of this formula and the proposed ordinance. Following this review and approval, ordinances will be presente d to the governing bodies for final consideration and adoption.

M.U.M.'s Capital Improvement Program is financed from voter-authorized bonds of the City and County and Federal grant-in-aid funds. The City of Tucson has $3.3 million remaining in bond funds to finance $4.9 million in capital program improvement needs for fiscal year 1976-77. Pima County has $5.4 million remaining in County-wide bond authorization after financing projects planned for fiscal year 1976-77. At a meeting of the two governing bodies on January 27, 1976, the Board of Supervisors agreed to allocate $1.6 million of these County-wide, authorized bond funds for projects required within the City Limits. The budget recommended by the M.U.M. Board to the Mayor and Council and Board of Supervisors reflects this allocation of County-wide authorized bond funds for projects needed within the City Limits.

Based upon the proposed five-year Capital Program for sewer improvements, M.U.M. will require an authorization from the voters of Pima County for an estimated $36 million in the Spring of 1977 to provide the needed sewer improvements. Staff has previously proposed to the two governing bodies that all future bond funds for wastewater projects be sold under the auspices of Pima County so that all residents of the County would share equally in the benefits derived from the constructed projects and in the repayment of the bonds.

Impact of Dissolution and Alternative Financing Plans for City and County Wastewater Activities

Recently, both the Mayor and Council and the Pima County Board of Supervisors indicated an interest in dissolving M.U.M. and developing alternative management and financing methods for M.U.M. The County Manager has submitted a report to the Board of Supervisors on that subject. In evaluating the alternatives to M.U.M. as it exists today, staff considered the following conditions to be necessary for our community to remain eligible for Federal grants to finance wastewater capital facilities:

Condition 1. Whatever management structure is adopted by the governing bodies, the operation and maintenance and capital replacement expenses must be financed from an equitable system of sewer financing.

Condition 2. Whatever management structure is adopted by the governing bodies, provision must be made for coordinated regional wastewater planning activities.

Condition 3. Whatever management structure is adopted by the governing bodies, provision must be made for coordinated regional wastewater treatment facilities operation.

If these conditions are not met, it is staff's opinion that all existing and future EPA construction grants would be revoked. The United States Congress is presently considering the appropriation of grant funds for the construction of wastewater facilities throughout the nation. If additional authorization is not made, over $40 million in anticipated Federal grant funds will not be forthcoming to our community during the next five years even if the community continues an equitable Cost Recovery System.

Financial Consequences of Dissolution

The following evaluation of financing the separate agencies considers the estimated expenditures and revenue generation capabilities of the City and County within the three conditions presented previously in this report.

Approximately 77,000 sewer connections are located within the City Limits. The City sewer users generate approximately 75 percent of the wastes treated in the community - or 34 million gallons per day. If M.U.M. is dissolved and the City and County enter into the necessary agreements to retain Federal funding eligibility, the estimated revenues and proposed expenditures for the City wastewater department will be as follows:

FY - 1976-77
Estimated Revenues

Sewer User Fees	$3,480,000
Connection Fees	610,000
Miscellaneous Revenue	100,000
	$4,290,000

190,000

Proposed Expenditures

O & M Costs	$2,404,823
Debt Service	1,048,676
1974-75 Expenses	148,450
Capital Outlay (Current Revenue)	164,900
	$3,766,849

Carry Forward to FY 1977-78 = ~~$286,849~~ $521,359

Staff estimates that the City sewer user fee revenue for fiscal year 1976-77 would provide $286,849 more than the amount required to finance the needs for FY 1976-77. This amount could be carried forward to meet FY 1977-78 needs. Since connection fees are established to finance bond debt service costs, user fees would be used to fund the difference in connection fee revenues and debt service expenses. Therefore, no General Fund monies would be required to supplement the wastewater system and that would be a carry forward.

The City would have to present a proposed bond issue to the voters of the City one year earlier than anticipated, since County-wide authorized sewer bond funds would not be available for City projects.

All 1973 authorized sewer bonds ($5.6 million) have been sold and only $3.3 million for uncommitted projects remain to fund 1976-77 capital needs of $4.9 million. The five-year capital program requires a total capital expenditure of approximately $53,000,000. To meet this requirement, we would need $15 million in new authorization from the voters of the City. This estimated need assumes Federal funding of eligible projects which is not currently available. Staff would recommend a bond election for a proposed $15 million prior to January 1, 1977, if M.U.M. is dissolved.

Approximately 24,000 sewer connections are located in the County outside City Limits. These sewer connections are primarily single-family residences and are dispersed throughout the County from Green Valley to Marana. These sewer users generate approximately 25 percent of the wastes generated in Pima County and require numerous small treatment facilities due to the geographic dispersion of the users. For this and other reasons, the operation and maintenance of the County sewer system is more costly than the higher density City sewer system.

Estimated Revenues

Sewer User Fees	$1,020,000
Connection Fees	610,000
Sale of Effluent	108,000
Ad Valorem Taxes	713,859
	$2,451,859

Estimated Expenditures

O & M Costs	$1,800,860
Debt Service	1,323,859
Capital Outlay (Current Revenue)	313,650
	$3,438,369
Deficit	$986,510

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Staff estimates that the County sewer user fee revenue requirements for fiscal year 1976-77 would have to be increased 97 percent (from $1,020,000 to $2,006,510) if the County finances its wastewater system solely from revenues derived from County residents living outside the City Limits. Staff considers the financing of the County system through direct user charges to those discharging to the County system as the only equitable method of financing the system and ensuring the community's eligibility for Federal funds. If the ad valorem tax were to be used for this purpose, approximately .08 cents per $100 of assessed valuation would be required if the tax were applied to residents living both inside and outside the City Limits. This method of financing County debt service would be inequitable to City residents and probably would be challenged by EPA. The tax would be approximately $0.16 if applied to only those customers living outside the City.

Summary and Conclusions

Throughout the history of M.U.M., the financing of wastewater activities has been the major source of conflict between City and County governments. It is obvious that the immediate dissolution of M.U.M. would provide a short-term financial benefit to the residents of the City of Tucson. It is equally obvious that the original reasons for establishing M.U.M. have been over-shadowed by the discussions regarding the financing of M.U.M.

If costs were the only issue under consideration at this point in time, I would recommend the dissolution of M.U.M. The long-term need for resource management requires the development and implementation of unified wastewater reuse programs and groundwater management programs to insure the availability of potable water for our community. The success of M.U.M. in implementing water resource management programs requries firm commitment by both governing bodies and administrative staff to establish and follow these water resource programs. If this commitment is not evidenced through joint action by the two governing bodies, the goal is so important and the challenge so great that unilateral action by the City of Tucson is required to ensure that the necessary actions are taken to ensure the proper reuse of wastewater and continued groundwater management.

I am convinced that M.U.M. is a viable organization to implement regional water resource management policies and programs; however, the County government must be committed to unifying the administrative structure of M.U.M. and supportive of M.U.M.'s overall goals and policies. The lack of this commitment and support has adversely affected the operation of M.U.M. This condition has prevented the initiation of effective management of M.U.M. Therefore, I recommend that the governing bodies reiterate their commitment to M.U.M. and positively support staff in developing and implementing a unified management structure. Lacking these conditions, M.U.M. should be dissolved and the governing bodies should enter into agreements to plan and operate wastewater facilities and develop separate financing structures which follow the principles of the adopted Cost Recovery System.

Frank Brooks
Executive Director

FB:mm

Problems - Upon MUM Dissolution

1. Cost Recovery - Revenue Program

   a) User fee Ordinance
   b) Ind. Surcharge and Cost Recovery Ordinance

   Continuance, development and/or implementation of above programs.

2. EPA projects and studies

   a) Management
   b) Funding
   c) Grant Transfers

3. Regional Planning

   a) Vehicle to accomplish

4. Staff Requirements

   a) User Fee
   b) Ind. Surcharge and cost recovery
   c) System mapping, monitoring & analysis capability
   d) EPA projects

5. Sewer Policy and Development review comments

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John S.

OFFICE OF THE COUNTY MANAGER

TO: Chairman and Members
Board of Supervisors

FROM: K. S. Scharman
County Manager

DATE: June 11, 1976

RE: Pima County Status Upon
Dissolution of MUM

The City of Tucson's forcing the dissolution of MUM, I feel, does not alter the necessity to work cooperatively in solving wastewater problems on a regional basis. While certain administrative responsibilities can be divided between political jurisdictions, many facets of the total wastewater system must remain, through working agreements, a shared responsibility.

Following are the staff thoughts on areas that must be addressed if MUM is to be dissolved.

BUDGET (Exhibit I)

In the little time we have had this week, it appears that we will be able to adopt a Sanitation budget with no increase in user fees, connection fees, or the ad valorem rate. This is totally in line with the cost recovery allocation adopted by the Mayor and Council and Board of Supervisors, and no ad valorem tax revenues will be spent on operation and maintenance.

A number of problems are apparent, though. The MUM budget as prepared for Fiscal Year 1976-77 reflected consolidated staffing and work programs. That is to say, that if dissolved, Pima County is left without the current capabilities for computer sewer system analysis, mapping and record development and updating, sufficient depth in the subdivision review process, and a user fee billing and collection system, as these were common functions; but actually the capability was developed within the City System. It is our feeling that the County certainly has an equity in these through the joint funding of MUM for two years. Satisfactory agreements have to be reached with the City to continue these services and programs, as they are not reflected in our current budget.

The County's operating budget can be supported through projected revenues. We feel a problem exists in the City, as they may be

generating as much as $1,000,000 in excess user fee revenues than is necessary to meet their operation and maintenance budget. As we understand, EPA is currently reviewing this region's Cost Recovery System developed through the 701B Study, which was jointly adopted by the Board of Supervisors and Mayor and Council. Federal funds for the entire region could be in jeopardy if the user and connections fees are not calculated and expended in accordance with prior commitments to EPA. EPA's stand has been that the fee structure must be equitable to users within the identifiable region that is being served. It is impossible at this time to separate the pipeline and treatment within our metropolitan system. It's quite possible that the City of Tucson would be required to expend the excess user fee revenues as was originally intended towards the regional operation and maintenance expenses.

USER FEE - BILLING AND COLLECTION

This program was developed jointly as part of MUM and is performed by the City. Mr. Valdez verbally had agreed that at least for Fiscal Year 1976-77, the City would provide this service to the County with the only fee being the expense of mailing bills to non-City water users and a $1.00 fee for each new customer outside the City Water System.

County staff will evaluate this arrangement during Fiscal Year 1976-77, along with the development of an independent or partially independent system.

CAPITAL CONSTRUCTION FISCAL YEAR 1976-77 (Exhibit II)

Staff sees no problems with our capital program, nor the proportionate cost sharing with the City, as reflected in Exhibit II which includes all projects proposed in the MUM Budget.

CURRENT EPA COMMITMENTS

Staff feels that there are no projects or programs in jeopardy and should be no problems unless the City or County would deviate from the joint setting of an equitable fee system on a regional basis. A firm commitment should be made that, no matter where or how the monies are collected, they would be used as proposed and adopted. Anything other than this would cause chaos and jeopardize Federal funding.

EXISTING CONTRACTS

All contracts entered into during the existence of MUM, especially the Southeast, Southwest, South Rillito, and 201 Effluent Reuse,

should be reviewed and re-written, if necessary, to clarify Management, Administration, financial, and authority responsibilities. Any changes or revisions should be transmitted to EPA.

PLANNING REQUIREMENTS

Facilities planning for the next year or so will be done through the 208 Program, and we do not feel these activities will be hampered by the dissolution of MUM. At the end of the 208 Study, planning will be conducted through an agency or agencies developed through this process.

The administration, reporting, and interfacing of agencies to 208 should be reviewed to insure that Pima County has continuing input to the Program.

SEWAGE TREATMENT

An agreement needs to be reached concerning the reciprocal treatment of sewage at the Ina and Roger Road plants. We are not aware that the capability exists today to meter flows sufficiently to totally identify City-County sewage. For the foreseeable future, treatment should occur at both plants without regard to its original generation within the system.

The user fee for the Tucson Metro System is based upon the cost of operating and maintaining the entire system, irrespective of political boundaries. Revenues, as any other utility, should therefore be allocated to the activities of the system, and not according to the artificial political jurisdictions in which the revenues are collected.

Future improvements to the Roger Road Plant should be made only to the benefit of the regional system and after all operation and maintenance procedures and practices are evaluated.

County staff would also like to see an agreement to continue the joint laboratory operation.

EFFLUENT POLICY

The County and City need to adopt a policy in the reuse of effluent. Until the completion of the 201 Effluent Reuse Study, the City and County could agree to reuse effluent from their respective plants in conformity to the recommendations in the 701B Study.

3. At the Board of Supervisors' hearing, two actions may occur:

a. Sufficient information to document a recommendation of the Department of Sanitation will be transmitted to the Board Hearing. The Board may deny the rezoning on the basis of documentation presented. Documentation will include the collection and treatment availability.

b. The Board may act on the rezoning "subject to a satisfactory agreement regarding sewer service with the Department of Sanitation." In this case, the general requirements made upon the applicant will require approval of preliminary sewer plans prior to plat approval. Additionally, other conditions such as capacity limitations, offsite requirements, etc., constituting a satisfactory agreement will be manifested at this time, but they will be of a general nature.

Approved this 1st day of November, 1973.

Joseph C. Castillo

Chairman of the Board of Supervisors
Pima County, Arizona

KHAWAM0085

4. At the time of the rezoning ordinance, final sewer plans must have been approved, together with an agreement for sewer service.

5. In situations where zoning or rezoning now exists subject to general requirements, the Department of Sanitation will require preliminary sewer plans approval prior to final plat or development plan approval. Conditions such as capacity limitations, offsite requirements, collection and treatment availability, etc., constituting a satisfactory agreement will be manifested prior to final plat or development plan approval.

Approved this 5th day of November, 1973.

Chairman of the Board of Supervisors
Pima County, Arizona

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OFFICE OF THE COUNTY MANAGER

To: Board of Supervisors

From: Kenneth S. Scharman
County Manager

Date: June 22, 1976

Re: Dissolution of M.U.M.

The following is a recap of the events subsequent to the Mayor and Council's action to dissolve M.U.M.

1. June 7 - Action by Mayor and Council to dissolve M.U.M.

2. June 8 - meeting between myself and the City Manager to discuss the ramifications of dissolution and the aspects of his budget option #1 to the Mayor and Council.

3. June 11 - My recommendation to the Board on the county's status upon the dissolution of M.U.M.

4. June 16 - the City Manager's response to my recommendation to the Board. This response varies considerably with his budget recommendation of June 7 and our discussion and agreements of June 8.

My recommendation to you of June 11 was based upon county expenses for operation the Pima County Department of Sanitation, agreed upon construction and research projects, our understanding of E.P.A. requirements, and the apparent position of the City of Tucson as expressed in the City Managers memorandum of June 7 and my discussions with him on June 8.

The budget embodied in the June 11 recommendation properly recognizes operation and maintenance costs and the funding thereof. The City Manager's "option 1" budget does not include payment of a connection fee for the Kino Hospital, or payment of $254,594 to the city by the county or expenditure of county-wide approved bond funds for projects within the city limits. I concurred with this recommendation and proceeded in good faith accordingly.

Staff and myself are deeply concerned that funding mechanisims for the regional sewer system meet E.P.A. requirements. This is the reason my recommendation of June 11 notes that the presently established regional sewer user fee is based upon the O & M costs of the regional system. We are concerned that E.P.A. will require the user fee revenues to be allocated to the costs as they occur within the system, and not according to the political jurisdiction from which the revenues originate. The City Manager's budget recommendation to the Mayor and Council does not recognize the regional nature of the system or the criteria for the development of the user fee. That recommendation would undoubtedly necessitate

the future establishment differential user fees respecting political boundaries within the metropolitan sewer system. We are fearful that differential fees would joepardize E.P.A. funding for any projects within the metro system, be they city of county projects.

In order to avoid controversy and delay at a time when it is imperative to set budgets, I have recommended to the Board adoption of a budget consistant with that presented by the City Manager to the Mayor and Council and consistant with our understanding of E.P.A. requirements. However, I feel it is necessary to meet with E.P.A. representatives, as soon as possible, to resolve the questions surrounding cost recovery for the entire system.

Also, it is necessary that city and county staffs get together this week to develop agreements for management and responsibilities for ongoing studies and construction projects.

Since Mr. Valdez's memo in response to my recommendation to you appears to change most of the agreements and understandings with this office, and his accepted recommendation to the Mayor and Council, I feel your input would be necessary for further discussions with city staff toward reaching the necessary intergovernmental agreements. I feel it is imperative that we meet on this matter as soon as possible that we may proceed in a timely manner with the dissolution of M.U.M.

Kenneth S. Scharman

KSS:RGP:maq

28004

FILED
NOV 17 1977
77 NOV 17 P 1:54
CLERK SUPERIOR COURT

FREDERICK S. DEAN
City Attorney
LORETTA HUMPHREY
Assistant City Attorney
250 West Alameda
Tucson, AZ 85701
Telephone: 791-4221

IN THE SUPERIOR COURT OF THE STATE OF ARIZONA

IN AND FOR THE COUNTY OF PIMA

170727

CITY OF TUCSON, a municipal corporation,

Plaintiff,

v.

PIMA COUNTY, a body politic, and the PIMA COUNTY BOARD OF SUPERVISORS; E.S. "BUD" WALKER, Chairman; SAM LENA; KATIE DUSENBERRY; CONRAD JOYNER and DAVID YETMAN, Members of the Board,

Defendants.

NO. 170727

COMPLAINT - UNCLASSIFIED
(Seeking Order to Show Cause, Permanent Injunction and Declaratory Judgment)

OFFICE OF THE CITY ATTORNEY
P. O. BOX 27210
TUCSON, ARIZONA 85726

COMES NOW the Plaintiff herein, by and through its attorneys undersigned, and for its Complaint alleges as follows:

COUNT ONE

I

Plaintiff, CITY OF TUCSON, is a municipal corporation, duly incorporated under the laws of the State of Arizona (hereinafter referred to as "City"); PIMA COUNTY is a body politic and corporate duly organized under the Constitution and laws of the State of Arizona (hereinafter referred to as "County"); the BOARD OF SUPERVISORS OF PIMA COUNTY is the legislative and executive authority of Pima County.

. . .

. . .

KHAWAM0090

II

The City owns and operates a municipal water utility which serves all of the metropolitan Tucson area without respect to corporate boundaries with the exception of the areas served by franchised private water companies.

III

The water furnished by the City to its customers is developed from groundwaters underlying lands owned by the City; the so developed water is the property of the City.

IV

The City owns and operates a sewage treatment plant known as the Roger Road Wastewater Treatment Plant; the County owns and operates a sewage treatment plant known as the Ina Road Wastewater Treatment Plant.

V

Ninety percent of the treated and reclaimed water discharged from the Roger Road and Ina Road Wastewater Treatment Plants is derived from groundwater developed and owned by the City and furnished to the customers of the City water utility.

VI

The treated and reclaimed water which is water developed and owned by the City and used to transport waste materials through the sanitary sewer system to the treatment plants, and which is then discharged from the Roger Road Wastewater Treatment Plant, is the property of the City.

VII

The treated and reclaimed water which is water developed and owned by the City and used to transport waste through the sanitary sewer system to the treatment which is then discharged from the Ina Road Wastewater lant, is the property of the City.

OFFICE OF THE CITY ATTORNEY
P. O. BOX 27210
TUCSON, ARIZONA 85726

VIII

On November 9, 1977, in his office, Defendant Walker, in the presence of Defendant Dusenberry, Mayor Lewis C. Murphy, Councilmember Richard Amlee and members of City and County staff as well as a member of the press, stated that the County intended to execute a contract with a third party for sale of the treated and reclaimed water owned by the City.

IX

On Monday, November 14, 1977, the Board of Supervisors agreed to execute a contract with a third party for the sale of the treated and reclaimed water owned by the City.

X

The County has no estate, right, title, claim, lien or interest in the treated and reclaimed water owned by the City or any portion thereof.

XI

The County has no legal authority to sell, lease, distribute or otherwise engage in the business of furnishing water to others, except as provided in A.R.S. 11-701 et seq.

XII

The acts of the County constitute a cloud on the title to the City's treated and reclaimed water, diminish its value and impair the City's rights as owner to dispose of the treated and reclaimed water in a manner that is most beneficial to the citizens of Tucson, and the customers of the water utility.

XIII

The above described acts of the County are in violation of law and in excess of the authority of the County and constitute immediate and irreparable harm, damage and injury now accruing and which will continue to accrue to the City, its citizens and customers of the water utility.

. . .

OFFICE OF THE CITY ATTORNEY
P. O. BOX 27210
TUCSON, ARIZONA 85726

XIV

Unless the County is required to cease negotiating to sell, selling, and otherwise attempting to exercise dominion over the City's treated and reclaimed water, the City, its citizens and customers of the water utility will continue to suffer irreparable, immediate and substantial injury without timely or adequate remedy at law.

WHEREFORE, the City prays judgment against the Defendants and each of them as follows:

1. That this Court forthwith issue an order for the defendants to appear and show cause, if any there be, why they should not pay into court all proceeds they may have received or may receive in the future from the disposition of treated and reclaimed water to third parties, pendente lite.

2. That Defendants be permanently enjoined from negotiating to sell, selling, or otherwise exercising dominion over the treated and reclaimed water discharged from the Roger Road and Ina Road Wastewater Treatment Plants.

3. That Plaintiff have such other and further relief as the Court deems just and proper, together with costs of this action.

COUNT TWO

I

The allegations contained in Paragraphs I through XII of Count One are incorporated as if fully set forth herein.

II

The County, as operator of a sewage treatment system, including the Ina Road Wastewater Treatment Plant, is required by State and Federal law to meet certain discharge requirements relating to pollution.

. . .

. . .

OFFICE OF THE CITY ATTORNEY
P. O. BOX 27210
TUCSON, ARIZONA 85726

(R)

III

Federal law requires that all operation and maintenance, and some capital costs of the treatment system be recovered from the recipients of waste treatment services.

IV

Pursuant to such Federal law the City and the County have adopted sewer user fees and industrial cost recovery systems. City Code Sections 24-21 and 24-46 and County Ordinance Nos. 1976-142 and 1977-60 are attached hereto and incorporated herein.

V

The County has consistently maintained the position that it intends to charge the City for the cost of treatment of the treated and reclaimed water if it is determined by the Court that such water is the property of the City.

VI

Implementation of the County position would result in the County charging the sewer users for the cost of treatment and again charging the City and the water utility water rate payers of the City for the same costs of such treatment.

VII

The position taken by the County with respect to such payment is contrary to law and unlawfully places the burden of cost of treatment on the water users, and not on the sewer users.

VIII

The County has no legal authority to charge the City which is the owner of the treated and reclaimed water for any portion of the cost of treatment required by State and Federal regulations.

IX

An actual and justiciable controversy exists between the City and the Defendants regarding the ownership of the treated and reclaimed water discharged from the Roger Road and Ina Road Wastewater Treatment Plants.

OFFICE OF THE CITY ATTORNEY
P. O. BOX 27210
TUCSON, ARIZONA 85726

X

That an actual and justiciable controversy exists as to the authority of the County to buy, sell, distribute or otherwise engage in the business of furnishing water to others.

XI

That an actual and justiciable controversy exists as to the right and authority of the County to charge the owners of the treated and reclaimed water for the cost of the treatment required by State and Federal regulations.

WHEREFORE, the City prays:

1. For a Judgment declaring that the City is the owner of treated and reclaimed water derived from water developed by it and discharged from the Roger Road and Ina Road Wastewater Treatment Plants.

2. For a Judgment adjudging title in the said treated and reclaimed water to be in the City free and clear of any claim or claims of the Defendants; and that the Defendants be barred forever and estopped from claiming or having any right or title to the treated and reclaimed water which is adverse to the City.

3. For a Judgment that the County has no legal authority to buy, sell, distribute or otherwise engage in the business of furnishing water to others.

4. For Judgment that the City, as owner of the treated and reclaimed water that is derived from water developed by it, is not liable to the County as operator of the Ina Road Wastewater Treatment Plant for any of the cost of treatment which is required by State and Federal law before the treated and reclaimed water may be discharged.

5. For a Judgment that all monies received by the County in payment for treated and reclaimed water be paid over to the City of Tucson.

OFFICE OF THE CITY ATTORNEY
P. O. BOX 27210
TUCSON, ARIZONA 85726

6. For such other and further relief as the Court deems just and proper, together with costs of this action.

FREDERICK S. DEAN
City Attorney

By Loretta Humphrey
LORETTA HUMPHREY
Assistant City Attorney
Attorneys for Plaintiff

STATE OF ARIZONA)
) ss.
COUNTY OF PIMA)

LORETTA HUMPHREY, being first duly sworn upon her oath, deposes and says: That she is the attorney for Plaintiff herein; that she has read the foregoing Complaint, knows the contents thereof and that the same are true of her own knowledge save and except for those matters stated upon information and belief, and as to those matters she believes them to be true.

Loretta Humphrey
LORETTA HUMPHREY

SUBSCRIBED AND SWORN to before me this ____ day of November, 1977, by LORETTA HUMPHREY.

Rosemary Nafarrate
Rosemary Nafarrate
Notary Public

My Commission expires:
August 23, 1980

OFFICE OF THE CITY ATTORNEY
P. O. BOX 27210
TUCSON, ARIZONA 85726

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6H
XI-D

June 9, 1978

TO: MAYOR AND COUNCIL, CITY OF TUCSON
BOARD OF SUPERVISORS, PIMA COUNTY

FROM: MARVIN S. COHEN

SUBJECT: SEWER INTERGOVERNMENTAL AGREEMENT 78-79

The undersigned recommends to the governing bodies, after lengthy conferences with city and county staffs that the governing bodies agree to the following to resolve immediate differences concerning wastewater treatment, to establish a basis for entering into an intergovernmental agreement for fiscal year 1978-79 and to establish procedures for management of the sewer treatment and collection systems by one entity. These recommendations are generally in accord with the position of city and county staffs, except that staffs make no joint recommendation as to which entity should be the management entity.

1. Effluent within the area tributary to Roger, Ina and Randolph plants to be owned by the city subject to the following:

a. County to retain 10% of the effluent for its own use.

b. Net profits, if any, to be split 50/50 between the sewer fund (to the benefit of the sewer user fee) and the water fund (to the benefit of the water rates).

c. To the extent that the City uses the effluent to protect, benefit or enhance the water supply of the city without receiving payment for the effluent, the sewer fund will not receive any money in lieu of the value of such effluent.

d. The pending litigation regarding ownership of effluent shall be terminated by a judgment by stipulation which incorporates the provisions of Paragraphs 1, 2 and 3 of this document.

2. City and county agree that, except as otherwise provided below on a one-time basis for fiscal year 1978-79, the operation and maintenance costs of collection, conveyance and treatment of wastewater from the area tributary to the Ina, Roger and Randolph plants will be funded by a sewer user fee schedule in which there shall be no differential based upon city or county residence and no differential based upon the plant at which the wastewater is treated.

While the operation and maintenance costs of isolated county sewer systems must be included in the uniform user fee for the fiscal year 1978-79, the county will initiate the study necessary to separate the costs of these systems so that there will be separate cost based sewer user fees for the isolated systems in the 1979-80 fiscal year.

Connection fees shall also have no differential based upon city or county residence or based upon the plant at which waste water is treated.

3. The provisions of paragraphs 1 and 2 are interdependent and shall be specifically enforceable. In the event of breach by one party of either of the paragraphs, and failure or refusal of the Courts to specifically enforce, both paragraphs shall be null and void.

These provisions shall both be made an element of the City/County facility plan and shall be conditions of the grants from EPA to fund the capital program in the facility plan.

4. The proposed City and County wastewater budgets require $11,028,257 to fund operation and maintenance, debt and capital. The anticipated revenues from all sources other than sewer user fees under current rates are $2,868,251. The difference between anticipated revenues and anticipated total expenditures is $8,160,000. If the sewer user fee was set at a rate sufficient to raise the entire $8,160,000, it would constitute an increase of approximately 65%. The required sewer user fee revenues shall be reduced $850,000 by the following:

a. Existing connection fee rates were set more than three years ago. Construction costs have increased 40% or more since these rates were set. A 40% increase in connection fee revenues would raise approximately $560,000 in additional revenues in 1978-79 under current projections. This would offset a portion of county and city debt service expense and consequently lower the county ad valorem tax revenue requirements for debt service. Connection fee revenues shall be increased 40% by connection fee rate increases.

b. City and county staffs shall cut $105,000 each from the current revenue capital outlay budget. County staff shall make additional budget cuts of $80,000.

c. The result of these changes will be to allow the county to fund $560,000 of general sewer maintenance and operating expenses (other than treatment) from ad valorem taxes without increasing the County tax rate. Concomitantly, the amount to be raised by sewer user fees will be reduced from $8,160,000 to $7,310,006. This will mean a sewer use fee increase of approximately 47% rather than 65%. Dick Reavis of EPA has advised that general sewer expenses need not be funded by sewer user fees.

d. Sewer user fee shall be increased approximately 47%.

All of the above is recommended, provided that EPA confirms, in writing, the advice from Reavis.

5. The existing I.G.A. shall be renewed for one final year, subject to modifications in accordance with the other provisions of this document.

6. The city and county shall approve the Brown & Caldwell engineering contract for the facilities plan amendment.

7. Prior to December 31, 1978, the staffs of the city and county shall present to the governing bodies a detailed program for single management of the wastewater collection, conveyance and

treatment systems to take effect prior to June 30, 1979, in accordance with the following principles:

a. The management entity will follow the capital program, timing and priorities in the finally adopted facility plan.

b. The management entity will not seek to amend the capital program, timing and priorities in the finally adopted facility plan within the first three years after its adoption without consent of the other governing body.

c. With regard to matters not covered by the facility plan such as upgrading of the existing lines and growth:

1) If the city is management entity, capital funds will be expended for the benefit of city and county areas in the proportion which the total connection fees collected in the city during the previous year bears to the total connection fees collected in the non-city portion of the county during the previous year.

2) If the county is management entity, at least 20% (on a non-cumulative basis) of such capital funds will be expended for the benefit of city areas.

d. With regard to capital funding:

1) If the city is management entity, capital funding will be by fees and city bonds.

2) If the county is management entity, capital funding will be by fees and county bonds, and/or ad valorem tax.

3) Whichever entity takes over the system, it will pay annually to the other entity all of that entity's debt service related to sewer facilities.

e. In connection with firm commitment by the governing bodies to single entity management of the sewer system, it is recommended that capital funding of facility plan program (including Roger Road) be accomplished as follows until the single management operation is set in place:

1) If the city bond issue passes, city bond proceeds shall be used for the local share, supplemented by county bond proceeds for the funding of the facility plan program in accordance with facility plan priorities and timing.

2) If the city bond issue does not pass, city will devote its remaining unencumbered bonds and bond proceeds to the local share and county will supplement with county bond proceeds for local share -- for the funding of the facility plan program in accordance with facility plan priorities and timing. It is recognized that if the city is management entity, the city will reimburse the county debt service on these bonds, and if the county is management entity, it will pay debt service whether the bonds are city or county.

f. Staffs of both entities shall work together in planning the sewer capital program. The management entity shall have final responsibility for the program subject to the paragraph 7b limitation for three years on amendments to the facility plan.

g. In the event that the facility plan recommends upgrading of Roger Road beyond 30 MGD capacity, both entities agree that the capacity above 30 MGD shall be phased for later construction.

h. The facility plan shall include a management plan and financial plan for single agency operation and EPA funding shall be requested for consultant studies to develop such plans. Local shares for such studies shall be provided. The consultants shall, among other things, address the issues raised in the attached joint staff issues paper.

8. The governing bodies of city and county agree to accept the Brown & Caldwell report after technical review and input to Brown & Caldwell by city and county staff.

9. In addition to the Brown & Caldwell report, the governing bodies agree to accept the other elements of the regional facility plan as recommended by consultants after staff technical input.

HORTATORY COMMENTS

All of the above recommended agreements were developed in a day-long session in close consultation with Bill Ealey, Gene Cronk, Ken Sharman and Byron Howard. They are the result of hours of separate meetings with city staff, county staff, Mayor Murphy, Chairman Walker, the Mayor and Council, the Board of Supervisors, and Dick Reavis of EPA since May 10, 1978. These recommendations represent our best effort at a solution to the pending city-county impasse concerning the sewer system. If the impasse is not resolved very soon, Tucson and Pima County will probably lose $28,000,000 in EPA Grants in the next year or two. I strongly urge that the two governing bodies reach agreement as soon as possible.

In addition to the above recommendations which were jointly developed with the named city and county staff members, I am recommending that the city and county now agree that the county be the single management entity for the sewer system. While certain considerations tend to favor city management, I believe that these are outweighed by the following factors favoring county management:

1. The broader tax base of the county would provide greater financial flexibility and strength for the long range capital needs of the sewer system. Under city management, ad valorem taxes would not be available for capital programs.

2. The county Board of Supervisors is politically responsible to all of the users of the sewer system, while the Mayor and Council are politically responsible only to city residents. Power without political responsibility would be contrary to important principles of our governmental system.

3. There is general community support for county operation of the sewer system; city operation has not been publicly considered and could generate opposition from county residents.

4. The major consideration favoring city management would be unified management of the entire water resource. The effluent agreement recommended above would deliver the effluent to the city at each treatment plant, giving the city full ability to utilize the effluent as a water resource. This would mitigate the need for unified water and sewer system management.

Marvin S. Cohen, Attorney for
Citizens for Regional Water
Quality and Sanitation.

AREA: BUDGETING & FINANCE (Page 1)	DESCRIPTION	COMMENT	ISSUE
A. Cost Recovery System	The existing cost recovery system provides for (1) a uniform City and County sewer user charge to finance the costs of operation and maintenance and repair and replacement; (2) a uniform City and County sewer connection charge to help finance regional debt service costs; and (3) a county-wide ad valorem tax to finance the remaining debt service expense not covered by the connection fee revenue.	Except for a potential problem of the County financing existing City debt, this cost recovery system could be continued (See Item B).	
B. Debt Service - City	The City now has existing sewer bond indebtedness which is being financed from City connection fees and County ad valorem tax.	Future sewer bond issues would be County-wide with the requirement of County wide voters' authorization.	Can the County legally assume responsibility for the existing City debt? Could the bond holders call the bonds if the source of service was cut off?
C. Rate-setting	The Mayor and Council and Board of Supervisors now set uniform rates based on combined revenue requirements of the City and County.	With the transfer, the County would be responsible for setting all rates and charges necessary to finance the wastewater operations inside and outside the City. The County now possesses the authority to set these rates.	
D. Billing	The City now performs the billing services for all sewer users both inside and outside the City. There is an economic advantage of utilizing joint water and sewer billing functions, partially because the computation of sewer user fees are based on water use records	With the transfer, the County would need to develop its own sewer billing system.	The City and County must determine the method of billing sewer fees. Separate billing systems will be more costly for both utilities. The County may wish to contract with the City to provide billing services for the sewer utility.
E. City Administrative Support	The City Sewer Department now pays the General Fund ($225,000 for 1978-79) for support services such as accounting, personnel, legal, purchasing, etc. In addition, the City	The City General Fund would lose this revenue with the transfer of the wastewater operations to the County.	It needs to be determined what impact the transfer will have on these support services and how the loss of revenue is to be replaced.

KHAWAM0103

2. We agree with the comments and issues, but emphasis should be equal for wastewater treatment costs and any potential effluent reuse program. We should not penalize the sewer user fee customer for the benefit of an effluent reuse program.

3. We agree with the comments, but EPA will continue to establish effluent discharge standards on our community and all existing treatment facilities must be upgraded as additional requirements are mandated.

BUDGETING & FINANCE

1. We agree with the comments but would recommend the County Finance Dept. establish a short term/long term department analysis for Board/Council review.

2. We agree with the comments but we are under the impression that the Board already has assumed a portion of the existing City of Tucson wastewater bond indebtedness via County ad valorem tax.

3. We agree

4. We agree with the comments and issues.

5. We acknowledge the comments and issues but all services relating to Wastewater Management should be paid by the sewer user fee. Likewise only services which affect the Wastewater Department should be applied towards the sewer user fee budget.

6. We acknowledge the comments and issues by the City Water and Sewers Department, but should not be a problem for the ultimate merger of wastewater activities. The County likewise contracts services with other County Departments and this should be transferred to the existing County Wastewater Department and/or other County service Departments.

7. The existing agreements should be honored and continued until the entire effluent reuse program is established and implimented.

8. The existing agreement should be honored and continued until a detailed sludge sales program is established in our community.

9. We acknowledge the comments and issues, but do not agree there is a problem. We presently perform maintenance, repair and replacement activities in the City of South Tucson, Oro Valley and Marana without any substantial complications. We agree there should be a written understanding of authority, responsibility and procedure for this activity in the City of Tucson.

PLANNING

1. We acknowledge the comments and issues, but offer the following:

   A. The City Water Department should be involved in any major decision which would affect overall planning in our community.

2. We agree that water costs and rates would be affected by wastewater planning but decisions should not be changed at the expense of the sewer user fee customers. Any type of effluent reuse program which will be established must

JOINT STAFF ISSUES PAPER

Re: Single Management Entity for Sewer System

PIMA COUNTY

PERSONNEL ... Department of Pima County. The existing City personnel who spend 75% to 90% of their time on water matters should remain with

1. Existing County employees in Mapping and Records, Planning, Field Engineering and Business Services could assume the responsibility which is presently performed by City of Tucson employees, but these services should be contracted to the City of Tucson for a transition period and eventually transfer the functions and the necessary personnel to Pima County. The sewer user billing functions could be undertaken by the Finance Department of Pima County. The existing City personnel who spend 75% to 90% of their time on water matters should remain with the City to perform this function. The following information should be provided to the County for review and discussion:

   A. Identification of personnel who are doing both water and sewer functions including financial impact, duties and job descriptions.

   B. Do these employees charge the sewer user fee budget while working on sewer matters?

   C. Should the sewer user fee billing be separated from the water billing and should the County assume this responsibility?

2. We realize the obstacles and existing problems for the ultimate merger of functions and personnel, but we are very sensitive and concerned for the professional future of all Wastewater employees with the City of Tucson. Because there are many problems which cause a difficulty for the immediate transfer of personnel, we would recommend that we consider the following:

   A. Leave all existing Wastewater personnel under the City Civil Service System but enter into a contractual arrangement with the Board of Supervisors to pay for the services, benefits and retirements and other existing items, so personnel would only change on paper and not lose benefits accrued while City employees.

   B. As City employees retire, resign or transfer to another City Department to further their career, the position would automatically transfer to the County with the County pay scale, personnel policies and all other effected matters being under the auspices of the Board of Supervisors.

   We would have to agree with the alternative as suggested by the City Water and Sewer Department.

CITY OF TUCSON

... are in the areas of treatment plant operation and maintenance, sewer SEWER MANAGER ... to the Sewer Utility has not ... of those employees indirectly providing services ... taken to identify the impact of the sewer transfer on budget and personnel and upon other ...

AREA: PERSONNEL (Page 1)	DESCRIPTION	COMMENT	ISSUE
1. City Employees to be Transferred	Presently, 90 City employees are directly performing sewer services to City residents. These employees are in the areas of treatment plant operation and maintenance, sewer system engineering, and sewer line & facilities maintenance. Employees in other divisions of the Water Utility provide indirect services to the sewer system ranging from 10 - 25% of their work time. These employees work in the areas of mapping and records, planning, field engineering, and business services.	Employee benefits, seniority and other employee rights are discussed below. The identification of those employees indirectly providing services to the Sewer Utility has not been specifically addressed. For example, the Business Services Division has absorbed the additional work load created by the sewer user fee billing requirements primarily through technological applications. However, numerous employees in this division do transact sewer related business. A method to determine the equivalent personnel performing intermittent sewer functions must be established to assess staff to be transferred to the County.	A detailed evaluation of City support services must be undertaken to identify the impact of the sewer transfer on budget and personnel and upon other departments and the Water Utility. A joint organizational plan must be adopted to determine how and where employees will fit.
2. Method of Transferring City Employees	The employees of the Sewer Utility were hired through the City Civil Service System. The transfer of the sewer function from the City to the County would cause a material change in the organization of the Water and Sewer Department. Under the Civil Service Rules and Regulations, employees performing jobs affected by a material change in the organization of the City are subject to layoff.	The transfer without other arrangements would constitute a layoff situation for City employees. These employees would have "bump" rights within the Department of Water and Sewer. The Personnel Department is currently reviewing all classifications affected by the transfer to determine "bump" rights of the incumbents. It is very likely that, based upon employee rights and service records, some employees, ultimately subject to transfer will be from the Water Utility and have no experience in the Sewer Utility. This may be a cause for concern to the County, since they may not be willing to accept inexperienced employees.	Determine the acceptable method of transferring City employees to the County Merit System.

KHAWAM0105

JOINT STAFF ISSUES PAPER

Re: Single Management Entity for Sewer System

PIMA COUNTY

3. City employees would be under a contractual agreement with Pima County and any personnel changes should be discussed by mutual agreement and contract amendment.

CITY OF TUCSON

SEWER MERGER

AREA: PERSONNEL (page 2)	DESCRIPTION	COMMENT	ISSUE
2. Method of Transferring City Employees (Continued)		An alternative to transferring the employees to the County Merit System, could be that the employees remain City employees and be paid by the County. All new hiring would be through the County system. The contract approach has several potential problems associated with it. First, the City employees would continue to be under the City Civil Service and any personnel actions, termination, layoff, promotion, demotion, salary change, etc. would have to be acted upon by the City. If the employee disagrees with the action, his appeal would be through the City, but the action is initiated by Pima County. Such a system would be cumbersome and, possibly, illegal. Second, this approach would continue to affect Water Utility employees if a sewer employee is subject to layoff; he may have "bump" rights over a Water Utility employee.	
3. Seniority	City employees now accumulate seniority by time and grade in the City's Civil Service System. Employees in the Sewer Utility have employment histories with the City ranging from one year to more than 25 years. Seniority is a factor in determining promotional opportunities and "bump" rights in the event of layoff.	County sewer personnel have also accumulated seniority by time and grade under the County's Merit System.	How will City employees be allowed to transfer their seniority to the County Merit System under a layoff situation?

KHAWAM0106

JOINT STAFF ISSUES PAPER

Re: Single Management Entity for Sewer System

PIMA COUNTY

4. Agree with the comments and issues and recommend waiting for the study.

5. Agree with the comments and issues and recommend waiting for the study.

CITY OF TUCSON

SEWER MERGER

AREA: PERSONNEL (Page 3)	DESCRIPTION	COMMENT	ISSUE
4. Salary	The City and County operate under different classifications and pay plans. Some classifications and pay levels are similar but the combination of salary and benefits vary.	The City & County Personnel Departments have completed the attached study comparing classifications and pay levels of the City Department of Water and Sewer and the County Department of Wastewater Management.	Upon completion of this study, a determination can be made regarding the effects of the transfer upon City employees' salaries.
5. Fringe Benefits	The City and County offer different fringe benefits to their employees.	The fringe benefits provided differ substantially. In general, the City provides its employees a higher level of benefits than does the County. Therefore, fringe benefits must be evaluated along with salary levels in order to evaluate the overall impact of the transfer. The City Personnel Department has completed the attached study comparing the fringe benefits of the two jurisdictions.	Upon completion of this study, a determination can be made regarding the effects of the transfer upon City employees' fringe benefits.

KHAWAM0107

JOINT STAFF ISSUES PAPER

Re: Single Management Entity for Sewer System

PIMA COUNTY

EFFLUENT

1. We agree with the comments, but ownership of effluent should not affect any consolidation effort.

2. We agree with the comments and issues, but emphasis should be equal for wastewater treatment costs and any potential effluent reuse program. We should not penalize the sewer user fee customer for the benefit of an effluent reuse program.

3. We agree with the comments, but EPA will continue to establish effluent discharge standards on our community and all existing treatment facilities must be upgraded as additional requirements are mandated.

CITY OF TUCSON

SEWER MERGER

AREA: EFFLUENT	DESCRIPTION	COMMENT	ISSUE
1. Ownership	The City has taken legal action against Pima County regarding the ownership of effluent. The case is in Superior Court and a ruling has not been made.	It is staff's understanding that the merger is dependent upon City ownership of the effluent. Potential use by the Papago Indians is considered as part of the Papago water rights lawsuit settlement.	Should the transfer be held in abeyance until the effluent ownership is resolved?
2. Delivery and Quantity	In the Metropolitan area, effluent is presently delivered at the Roger Road, Ina Road and Randolph Park Wastewater Treatment Plants. Roger Road processes 27 - 30 million gallons per day; Ina Road 8 - 10 million gallons per day; and Randolph Park 1 - 1.5 million gallons per day.	Depending upon what decisions are made regarding effluent reuse, the point or points of delivery and quantity at such point(s) may be very important in determining the cost effectiveness of the reuse alternatives.	The City and County should enter into a formal agreement to jointly plan treatment facilities to ensure coordination of effluent reuse and sewer facilities.
3. Quality	The City and County are presently required to meet EPA standards for effluent quality.	Depending upon what decisions are made regarding effluent reuse, high standards for effluent quality may be required. This could require the City to construct another or advanced treatment plant and monitor the quality of the effluent. Additional staff requirements and operational costs are not known.	

KHAWAM0108

JOINT STAFF ISSUES PAPER

Re: Single Management Entity for Sewer System

PIMA COUNTY

BUDGETING & FINANCE

1. We agree with the comments but would recommend the County Finance Dept. establish a short term/long term department analysis for Board/Council review.

2. We agree with the comments but we are under the impression that the Board already has assumed a portion of the existing City of Tucson wastewater bond indebtedness via County ad valorem tax.

3. We agree

4. We agree with the comments and issues.

5. We acknowledge the comments and issues but all services relating to Wastewater Management should be paid by the sewer user fee. Likewise only services which affect the Wastewater Department should be applied towards the sewer user fee budget.

CITY OF TUCSON

SEWER MERGER

AREA: BUDGETING & FINANCE (Page 1)	DESCRIPTION	COMMENT	ISSUE
A. Cost Recovery System	The existing cost recovery system provides for (1) a uniform City and County sewer user charge to finance the costs of operation and maintenance and repair and replacement; (2) a uniform City and County sewer connection charge to help finance regional debt service costs; and (3) a county-wide ad valorem tax to finance the remaining debt service expense not covered by the connection fee revenue.	Except for a potential problem of the County financing existing City debt, this cost recovery system could be continued (See Item B).	
B. Debt Service - City	The City now has existing sewer bond indebtedness which is being financed from City and County connection fees and County ad valorem tax.	Future sewer bond issues would be County-wide with the requirement of County wide voters' authorization.	Can the County legally assume responsibility for the existing City debt? Could the bond holders call the bonds if the source of service was cut off?
C. Rate-setting	The Mayor and Council and Board of Supervisors now set uniform rates based on combined revenue requirements of the City and County.	With the transfer, the County would be responsible for setting all rates and charges necessary to finance the wastewater operations inside and outside the City. The County now possesses the authority to set these rates.	
D. Billing	The City now performs the billing services for all sewer users both inside and outside the City. There is an economic advantage of utilizing joint water and sewer billing functions, partially because the computation of sewer user fees are based on water use records	With the transfer, the County would need to develop its own sewer billing system.	The City and County must determine the method of billing sewer fees. Separate billing systems will be more costly for both utilities. The County may wish to contract with the City to provide billing services for the sewer utility.
E. City Administrative Support	The City Sewer Department now pays the General Fund ($225,000 for 1978-79) for support services such as accounting, personnel, legal, purchasing, etc. In addition, the City	The City General Fund would lose this revenue with the transfer of the wastewater operations to the County.	It needs to be determined what impact the transfer will have on these support services and how the loss of revenue is to be replaced.

KHAWAM0109

JOINT STAFF ISSUES PAPER

Re: Single Management Entity for Sewer System

PIMA COUNTY

6. We acknowledge the comments and issues by the City Water and Sewers Department, but should not be a problem for the ultimate merger of wastewater activities. The County likewise contracts services with other County Departments and this should be transferred to the existing County Wastewater Department and/or other County service Departments.

7. The existing agreements should be honored and continued until the entire effluent reuse program is established and implimented.

8. The existing agreement should be honored and continued until a detailed sludge sales program is established in our community.

9. We acknowledge the comments and issues, but do not agree there is a problem. We presently perform maintenance, repair and replacement activities in the City of South Tucson, Oro Valley and Marana without any substantial complications. We agree there should be a written understanding of authority, responsibility and procedure for this activity in the City of Tucson.

CITY OF TUCSON

SEWER MERGER

AREA: BUDGETING & FINANCE (Page 2)	DESCRIPTION	COMMENT	ISSUE
E. City Administrative Support (continued from Page 1)	also pays the General Fund approximately $200,000 annually for direct services such as motor pool, building maintenance, and data processing.		
F. Water Utility Administration Support	The Water Utility now performs various support services for the Sewer Utility. This includes administrative, engineering, planning, and billing services. For 1978-79, the Water Utility is budgeted to receive approximately $886,500 from the Sewer Utility for these services.	With the transfer, the Water Utility would lose some, or all, of the revenue it now receives for the support services provided to the Sewer Utility.	As with the General Fund support services, it must be determined what impact the transfer will have on the support services provided by the Water Utility and how the loss of revenue is to be replaced.
G. Effluent Sales to City Parks and Recreation Department	Currently, the City's Sewer Utility provides effluent from its Roger and Randolph Treatment Plants to the Silverbell and Randolph golf courses. The Sewer Utility receives revenue from the Parks and Recreation Department for the effluent based on a previously agreed upon rate.	With the transfer, the County will assume the operation of these treatment plants. The County golf courses do not pay for effluent delivered.	It needs to be determined what the impact will be of the transfer on the existing arrangements regarding the provision of the effluent and the rates charged to the City's Parks and Recreation Department and the County's golf course.
H. Sludge Sales to City Parks and Recreation Department	The City's Sewer Utility also provides sludge to the City's Parks and Recreation Department for fertilization purposes. The City's Sewer Utility receives revenue from Parks and Recreation based on a previously established amount ($10,000/Year.	With the transfer, the County will assume operation of the Roger Road Treatment Plant where this sludge is generated.	It needs to be determined if the existing arrangements regarding the provision of sludge to the City's Parks and Recreation Department will be continued.
J. Legislative Authority	Does the existing legislation permit the County to establish a sewer district inside an incorporated area.	The Attorney General's opinion has been requested.	Legislation would have to be introduced to permit the County to operate within the City limits.

KHAWAM0110

16

JOINT STAFF ISSUES PAPER

Re: Single Management Entity for Sewer System

PIMA COUNTY

PLAN

1. We acknowledge the comments and issues, but offer the following:

   A. The City Water Department should be involved in any major decision which would affect overall planning in our community.

2. We agree that water costs and rates would be affected by wastewater planning but decisions should not be changed at the expense of the sewer user fee customers. Any type of effluent reuse program which will be established must affect the water budget but could directly affect the Board of Supervisors in a bond program and the sewer user fee customer. For obvious reasons, all major decisions relating to Wastewater Management should continue as it is established which is by public hearings.

3. We acknowledge the comments and issues on allocation of sewer capacity, but disagree with both items. The following items are the most salient points which should be mentioned:

   A. The County did not establish the policy because of the high percentage of undeveloped land in the County. We just don't feel we should administrate the sewer capacity allocation issue like the airline industry which is over subscribe and hope the improvements materialize efore all committed development occurs.

   B. The County has a very involved and intricate capacity allocation program with a legal sewer service agreement for each development. The City has not established a Sewer Service Agreement program, but has administrated this program based on the legal opinion of the City Attorney's Office in relationship to the zoning and density rights of a property owner/developer.

   C. We would recommend we establish a similar policy in both the City and County and plan for proper augmentation of existing facilities where necessary.

   D. We recommend the County Attorney's Office review the existing City and County policies and legal commitments and provide a legal opinion on this item.

CITY OF TUCSON

SEWER MERGER

AREA: PLANNING (Page 1)	DESCRIPTION	COMMENT	ISSUE
1. Coordination with Water Resource Planning	Planning and operation of wastewater management facilities must be consistent with water resource planning. Wastewater effluent is a major element of the total water resource. Effluent delivery system capital and operational costs are directly affected by interceptor and treatment plant locations and capacities. Effluent quality is directly affected by treatment plant design and operation.	The City and County currently are jointly developing regional wastewater facility plans. The City's input assures coordination with water resource planning. Water consumption is generally the basis for projected wastewater generation. Water costs will be affected by the decisions made regarding sewage collection and treatment facilities and effluent reuse.	Will the County retain the consistency in magnitude and spatial distribution of population and land-use projections between water and sewer planning?
2. Prioritization of Sewer Facility Needs	City sewer facility needs are prioritized by relating current sewer capacities, public health standards, City development policies, estimated capital and operational costs, and short-range growth projections to the long-range wastewater management plan.	The City and County jointly prioritize regional sewer facility needs (treatment plants and interceptors). Localized sewer needs are prioritized by the City utilizing the adjacent described process.	The City should reserve the right to review and approve County prioritization of facility needs regionally and locally.
3. Allocation of Sewer Capacity	City policy for allocation of sewer capacity allows rezoning and platting to proceed if the relief sewer is scheduled for early relief (budgeted in current or next fiscal year) Also, sewer connections are approved unless the proposed connection will create an unreasonable risk to public health and safety. County policy for allocation of sewer capacity is more restrictive than the City policy because of the higher percentage of undeveloped land in the county.	There is justification for the two existing policies due to the wide ranging densities in the city and county. If the County policy were utilized in the city, approximately 60 percent of the city area would be denied sewer connections.	The City should require that the City policy for allocation of sewer capacity be utilized by the county within the city limits.

KHAWAM0111

JOINT STAFF ISSUES PAPER

Re: Single Management Entity for Sewer System

PIMA COUNTY

4. We are cognizant of the existing City of Tucson policies and procedures relating to zoning/plat review and recommend we continue the same process with the following exceptions:

   A. We professionally disagree with the legal opinion on connecting additional customers to an identified, overloaded, surcharged sewer line. The necessary augmentation should be identified and committed prior to additional connection when it is engineering/technically proven an existing system is overloaded and insufficient capacity is the condition.

5. We agree with the comments and issues.

6. We disagree with the City--the County should not issue plumbing permits in the City as this is a function of a Building Codes Department and should remain with the City of Tucson. Once again the allocation policy must be established and we recommend it be consistent in both jurisdictional areas.

7. We acknowledge the position of the City on this item, but would recommend the County review responsibility of the Roger Road Treatment Facility very carefully prior to renovation of the plant, as there is pending litigation and a potential 10 to 20 million dollar commitment needed for this facility. ...e County should have legal authority to assume responsibility but the ...estion is do you want to assume this liability until such time as the plant has been renovated?

CITY OF TUCSON

SEWER MERGER

AREA: PLANNING (Page 2)	DESCRIPTION	COMMENT	ISSUE
4. Coordination with City Zoning, Rezoning, and Plat Review Process	The Department of Water and Sewer currently advises the Planning Department of the impact of proposed zoning, rezoning, or plats on the sewer system. In instances where existing sewers are surcharged, recommendations are made conforming to the City policy for allocation of sewer capacity.	The City should require that the County advise the Planning Department of the impact of zoning, rezoning, or plats in conformance with the City policy for allocation of sewer capacity.	There are two different methods of determining capacity.
5. Review of Construction Plans for Developer-Financed Extension to the Sewer System	The Department of Water and Sewer reviews and approves sewer construction plans and inspects construction for conformance with plans, specifications, and City Engineer permit requirements.	The County Department of Wastewater Management shall review and approve sewer construction plans, and inspect construction for conformance with County plans, specifications and City Engineer permit requirements.	The disposition of existing and proposed development plans needs to be status quo.
6. Issuance of Sewer Permits and Coordination with Inspections Division on Issurance of Plumbing Permits	The Department of Water and Sewer issues sewer permits and coordinates with the Inspections Division on issuance of plumbing permits in conformance with the City policy on allocation of sewer capacity.	The City should require that the County issue sewer permits and coordinate with the Inspections Division on issuance of plumbing permits in conformance with the City policy on allocation of sewer capacity.	Coordination of plumbing and sewers.
7. Environmental Protection Agency National Pollutant Discharge Eliminates System (NPDES) Permit	The City Roger Road Wastewater Treatment Plant operation and effluent discharge quality is controlled by an NPDES permit. The E.P.A. is empowered to order the City to take specific corrective actions necessary to meet permit conditions. The E.P.A. is empowered to prosecute the City if E.P.A. determines the City has not responded in good faith to E.P.A.-directed corrective action.	The City should require that the Roger Road NPDES permit be transferred to the County, and that the County be solely responsible for complying with all permit conditions.	Does the County have legal authority to assume responsibility for the RRTP NPDES permit? In the event of continued nonconformance to the point of limiting federal funding, how will other City services be affected?

KHAWAM0112

JOINT STAFF ISSUES PAPER

Re: Single Management Entity for Sewer System

PIMA COUNTY

The City has established the SWCICR program that was agreed upon by both parties as most of the industry is presently located within the City and it properly belonged under their guidance. With the possibility of merging the functions, the County would continue this function, as the City personnel had prior to the responsibility being transferred to the County.

We agree.

We do not see a problem (legal or procedural) as we had to transfer grants from HUM and we did not encounter problems.

CITY OF TUCSON

SEWER MERGER

AREA: PLANNING (Page 3)	DESCRIPTION	COMMENT	ISSUE
8. Industrial Waste Control and Industrial Cost Recovery System	To retain its eligibility for EPA 201 grant funds, the City and County have jointly adopted an ordinance which provides for IWCICR implementation. Industrial waste control has heretofore been developed and implemented by the City. The Industrial Cost Recovery System as it exists within the ordinance was developed by the City.	The transfer would require the County to implement its own county-wide Industrial Waste Control Program. Amendments to PL92-500 provide for changes to simplify the existing ICR System. The county would have to modify and implement the ICR system beginning July 1979. This requires the development of both monitoring, computing, and billing functions.	Will the County's control over implementation of ICR result in attraction or repulsion of new industry inside Tucson? The City will be required to adopt County changes to the IWCICR ordinance.
9. Regional 208 Water Quality Planning	Both City and County participate in the management of and technical problem-solving within the 208 plan development process. Efforts have been made by the City to assure a coordinated approach to both water quality and quantity planning. Key issues developing from the process include what form of agency should plan for and operate the region's sewage collection and treatment facilities.	The transfer would simplify the 208 designation of management agencies in that a single agency would have all planning authority. The City must be assured that water quantity considerations are included in maintenance and implementation of the 208 Plan.	The City should maintain planning and grant funding identity.
10. Grant Transfer and Accountability	Both City and County, individually and jointly, have received EPA 201 grants for planning, design, and construction. The transfer would require reassignment to the county.	Reassignment and accountability are legal questions and are affected by specific grant conditions such as equitable cost recovery and IWCICR implementation.	The City Attorney's Office should be requested to evaluate methodologies and impacts of grant transfers.
11. Annexation	The City presently has an annexation policy whereby areas desiring to be annexed or will be revenue supporting are presented to the Mayor & Council for approval.	The City presently has the capability to prioritize and schedule sewer improvements within the corporate limits.	Without the authority to prioritize sewer capital improvements within the corporate limits, annexations to the City may be adversely affected.

KHAWAM0113

JOINT STAFF ISSUES PAPER

Re: Single Management Entity for Sewer System

PIMA COUNTY

PROPERTY

1. Real Property - Although we appreciate the City's position on this, we have to disagree as all property which is related to Wastewater Management and is purchased from the user fee fund should remain with the Sewer Department. We agree this is a legal question which should be addressed by legal counsel.

2. Equipment, Vehicles, etc.

   We agree with the comments and issues but we would recommend a transfer of all equipment, vehicles, etc., to the regional agency.

3. Easements and Right-of-Way

   We are confused with this issue, as many of the easements and right-of-ways now in the City were consummated in the County prior to annexation into the City. We do not understand how this can be a problem as easements are dedicated to the public for the installation and maintenance of utilities and sewers. We should also mention that we perform work in South Tucson, Marana and Oro Valley right-of-way now and have little problem and never has become an issue.

CITY OF TUCSON

SEWER MERGER

AREA: PROPERTY	DESCRIPTION	COMMENT	ISSUE
1. Real Property	All property used by the Sewer Utility is owned by the City of Tucson General Fund. This includes the Sewer Farm where the Roger Road Wastewater Treatment Plant is located and Randolph Park where the Randolph Park Wastewater Treatment Plant is located.	By Charter, The City cannot donate or give real property to other parties without a bid process. Arrangements can be made, such as long-term leases, to accomplish the transfer. The Randolph Park Treatment Plant is located on City Parks Department property, which was deeded to the City with reversion restrictions.	Legal review of the potential effects of the transfer upon sewer properties must be accomplished prior to the transfer after needs are defined.
2. Equipment, Vehicles, etc.	There are 26 vehicles and numerous pieces of equipment, office furnishings and miscellaneous items assigned to the Sewer Utility.	By Charter, the City must competitively bid these items if they are declared surplus. Under the pool concept both light and heavy duty equipment is being transferred into the general fund.	The City Attorney's Office will have to determine how these items can be transferred to the County. The staff has agreed the ownership should follow the function.
3. Easements and Rights of Way	The City has numerous easements and rights of way dedicated for sewer purposes	Most dedications are not transferable.	The law office will have to determine how these transfers can be made. The County's power of eminent domain within the corporate limits of the City must be investigated for future easements.

KHAWAM0114

JOINT STAFF ISSUES PAPER

Re: Single Management Entity for Sewer System

PIMA COUNTY

Legal

A. Sewer Improvement Districts - This could be handled by either our Property Management Department or remain in the City Engineer's Department with coordination with our staff. This should not pose a serious problem.

CITY OF TUCSON

SEWER MERGER

AREA: LEGAL	DESCRIPTION	COMMENT	ISSUE
1. Sewer Improvement Districts	City residents presently petition the City Engineer's Office to have their neighborhoods upgraded with sewer and other improvements. Generally, sewer improvements are scheduled in conjunction with street improvements to prevent digging up of recently paved streets. After approval of an improvement district, the City sets the assessments to the property owners and collects the fees semiannually.		Does the County have authority to establish improvement districts within the City? Can they set and collect assessments?

KHAWAM0115

11

PIMA001657

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EXHIBIT "A" TO RESOLUTION NO. 1060

AGREEMENT

THIS INTERGOVERNMENTAL AGREEMENT, entered into pursuant to Title 11, Chapter 7, Article 3, A.R.S., by and between:

THE CITY OF TUCSON, a municipal corporation (hereinafter sometimes referred to as the "City"); and

THE COUNTY OF PIMA, a body politic and corporate, a political subdivision of the State of Arizona (hereinafter sometimes referred to as the "County").

WHEREAS, Pima County is authorized by A.R.S. §11-254 to purchase, construct or operate a sewerage system, including the collection, transportation, pumping, treatment and disposal of sewage; and

WHEREAS, the City of Tucson is authorized by Chapter IV, Section 1 (12) of its Charter to construct and maintain sewerage systems within and without its corporate limits; and

WHEREAS, the sewerage systems of the City of Tucson and Pima County in the metropolitan area in and surrounding the City of Tucson physically constitute an integrated system with no regard to jurisdictional boundaries; and

WHEREAS, Pima County and the City of Tucson have undertaken a metropolitan Tucson Regional Wastewater Facilities Plan Program; and

WHEREAS, said plan has been prepared and subjected to a public hearing; and

WHEREAS, in November of 1977, in a special election held in the City of Tucson, the qualified electors of the City voted in favor of the following proposition:

> Shall the City be authorized, until June 30, 1979, to transfer to the County of Pima its sewers, drains, and all other works for disposition of sewage and wastewater both within and without the City, under such terms and conditions as shall be determined by the Mayor and Council.

WHEREAS, on December 11, 1978, the Mayor and Council adopted the Metropolitan Tucson Regional Wastewater Facility Plan, dated November, 1977, and the First Addendum Report, dated November, 1978, each prepared by Brown and Caldwell; and

WHEREAS, on December 11, 1978, the Mayor and Council adopted Intergovernmental Agreements (IGA) relating to each of the following subjects: (1) wastewater flow routing, (2) construction of Phase I of Roger Road Wastewater

Treatment Plant improvements, (3) design and construction of the Phase I elements of the Santa Cruz-Southeast Interceptor System, (4) design and construction of the Oshrin Interceptor; and

WHEREAS, on December 18, 1978, the Mayor and Council approved the Coopers and Lybrand Financial Study and Phase I of the Arthur D. Little Management Study, each study being a component of the Regional Wastewater Plan; and

WHEREAS, also on December 18, 1978, a motion was made and seconded and passed by the Mayor and Council to adopt the City Manager's recommendation to transfer the City sewer system to Pima County subject to four conditions; and

WHEREAS, on December 18, 1978, the Mayor and Council adopted an Intergovernmental Agreement with Pima County relating to the financing and planning of their respective sewerage systems for the fiscal year 1978-1979; and

WHEREAS, on December 11, 1978, the Board of Supervisors adopted, subject to conditions, the Metropolitan Tucson Regional Wastewater Facility Plan, dated November, 1977, and the First Addendum Report, dated November, 1978, each prepared by Brown and Caldwell; and

WHEREAS, on December 11, 1978, the Board of Supervisors adopted, subject to conditions, Intergovernmental Agreements (IGA) relating to each of the following subjects: (1) wastewater flow routing, (2) construction of Phase I of the Roger Road Wastewater Treatment Plant improvements, (3) design and construction of the Phase I elements of the Santa Cruz-Southern Interceptor System, (4) design and construction of the Oshrin Interceptor; and

WHEREAS, on December 18, 1978, the Board of Supervisors approved the Coopers and Lybrand Financial Study and Phase I of the Arthur D. Little Management Study, each study being a component of the Regional Wastewater Plan; and

WHEREAS, on February 26, 1979, the Board of Supervisors adopted the Intergovernmental Agreement relating to the financing and planning of their respective sewerage systems for the fiscal year 1978-1979; and

WHEREAS, on December 18, 1978, the Board of Supervisors upon motion unanimously approved the transfer of the City sewer system to the County by June 30, 1979, subject to the four conditions set out in the City Manager's memorandum; and

WHEREAS, on December 21, 1978, the Regional Council of the Pima Association of Governments passed and adopted a resolution in which the Council concurred with the actions taken by the City of Tucson and Pima County, in adopting the

Regional Facilities Plan prepared in accordance with the requirements of Section 208 of the Federal Water Pollution Control Act Amendments of 1972 and 1977, in agreeing to transfer the City sewerage system to Pima County subject to four stipulated City conditions no later than June 30, 1979, whereupon Pima County will be the sole management and operating agency in the PAG designated planning area, and provided for the submission to EPA of the Facilities Plan and a plan for implementation of the transfer; and

WHEREAS, the City and County, in furtherance of their actions taken on both December 11 and December 18, 1978, intend, in good faith, to proceed in the orderly transfer of the City sewerage system to Pima County and to provide that such transfer be accomplished with the minimum amount of disruption.

NOW, THEREFORE, City and County agree as follows:

ARTICLE I

PURPOSE

The purpose of this agreement is to:

A. Set forth and clarify the previous actions taken by the Mayor and Council and Board of Supervisors with respect to the City and County sewerage systems.

B. Provide guidelines for the orderly and timely transfer of the City of Tucson sewerage system located within and without the incorporated areas of the City to Pima County.

C. Provide for the identification of and procedures for resolution of matters related to and affected by the transfer of the City sewer system to Pima County.

D. Provide for the establishment of approximate time frames with which matters are to be resolved in order to effectuate an orderly and efficient transition with a minimal amount of disruption.

ARTICLE II

PREVIOUS ACTIONS CLARIFIED

A. City and County hereby confirm and by reference herein incorporate and make a part hereof their motions of December 18, 1978, whereby it was moved and carried by the City Council and subsequently moved and carried by the Board of Supervisors that the ownership of the entire City of Tucson sewerage system be transferred to Pima County, subject to the following four conditions:

1. County acceptance of the City's terms on the effluent issue.
2. County acceptance of the responsibility for existing City sewer debt.
3. County commitment to the Regional Facilities Plan for a period of three (3) years and award of a construction contract for the Roger Road Plant by September 30, 1979. (End of Federal fiscal year)
4. County commitment to not turn the sewerage system over to an independent agency for a period of ten (10) years.

B. The City and County hereby confirm their approval and adoption of Volumes I and II of the November, 1977, Metropolitan Tucson Regional Wastewater Management System Plan, and the November, 1978, Addendum Report (Regional Facility Plan), and by reference herein incorporate and make same a part of this Agreement.

C. The City and County hereby confirm their approval of and by reference incorporate and make the following a part of this Agreement:

1. The Wastewater Management Study entitled "Evaluation of Organizational Alternatives for Wastewater Management in the City of Tucson and Pima County," prepared by Arthur D. Little, Inc. and selecting the second recommendation, Pima County Management Agency.
2. The Regional Financial Plan prepared by Coopers and Lybrand.

D. The City and County hereby rescind their respective actions adopting the following Intergovernmental Agreements:

1. Agreement between City and County related to design (Step 2) and construction (Step 3) of the Southeast-Santa Cruz Interceptor Project (City Resolution No. 10687 and 10688).
2. Agreement between City and County related to design (Step 2) and construction (Step 3) of the Oshrin Interceptor Project (City Resolution No. 10685 and 10686).
3. Agreement between City and County related to construction (Step 3) of the Roger Road Treatment Plant (City Resolution No. 10684).
4. Agreement between City and County related to division of wastewater flows between City and County treatment plants (City Resolution No. 10682).

E. The subject matter covered by the IGA rescinded by Article II, D(3), above, is now covered in Article V of this Agreement. The matters covered by the IGAs rescinded by Article II D(1) (2) (4), above, are not covered herein for the reason that the transfer of the entire City sewerage system to the County renders such Agreements unnecessary.

ARTICLE III

TREATED AND RECLAIMED WATER (EFFLUENT)

As part of the consideration of the City's agreement to transfer its sewer system to Pima County, County agrees with City as follows with regard to effluent (treated and reclaimed water):

A. As a basis for agreements on effluent, the City and County agree that effluent is a major water resource that must be controlled by the City of Tucson in order to maintain management of total water resources of the Santa Cruz and adjacent water basins. It is further agreed that the City will endeavor to use effluent in such a manner as to preserve the underground water supply and to minimize costs to water rate payers in the City and County.

B. Notwithstanding other sections of Article III, County agrees that all effluent from all County sewer treatment plants may be used by the City to settle or satisfy litigation relative to water rights pending with the City at the time of closing. In the event all the effluent is not required to settle or satisfy litigation, City and County agree that the effluent that is required for settlement will be provided by the City and County on a pro-rata basis with each providing an equal proportion from the total effluent controlled by each.

C. Insofar as there is no conflict with this agreement, the County agrees that as successor to Sanitary District One, it has agreed to be and is bound by each and every obligation of the District. The matter set out in this paragraph (Article III, Paragraph C) shall not be deemed an admission against interest on the part of the County. The foregoing, however, shall not prevent the City from offering the above judgment in any litigation between the parties.

D. County agrees to relinquish, quitclaim, and transfer to the City, all of County's interest, estate, right, title, claim or lien in effluent which is discharged from metropolitan treatment facilities. The term "metropolitan" means the area which is or may be served by the Roger Road,

Ina Road or Randolph Park Treatment Plants, or by any additional collection and treatment facilities hereafter constructed which are physically integrated into the existing metropolitan sewerage system. The City shall have unilateral control, without limitation, over the use and disposition of all such effluent discharged from any and all treatment facilities so located. City shall take delivery of its effluent at any or all of the said treatment facilities at no cost to County.

E. County agrees to continue to operate the Randolph Park Wastewater Treatment Plant unless otherwise mutually agreed to by the City and County in writing or unless the County provides, at no cost to the City, a comparable quantity and quality of effluent at Randolph Park from another source.

F. Notwithstanding Article III D, County shall be entitled to take up to ten (10) percent of the effluent discharged from metropolitan treatment facilities, which City owns or controls, for use only on County parks, golf courses, and recreational facilities, except as provided in Article III H below.

1. County may take its total daily effluent entitlement at the Ina Road Plant. County may, at its option, take from other treatment plants at their discharge points such portions of its entitlement not to exceed ten (10) percent of the flow at any such plant, provided however that taking from the Randolph Park Treatment plant shall be excess to the needs of the City. City agrees to grant, at no charge to County, easements, rights-of-way, and access to facilitate County use of its effluent, and City shall bear no costs associated therewith.
2. The County entitlement shall be daily and non-cumulative.
3. The total daily effluent entitlement of County shall be determined on the basis of a measurement method to be agreed upon between City and County staffs. As may be required, County agrees to construct measuring devices and City agrees to read and maintain such devices.

G. City and County agree that there will be no charge to the County for the effluent taken by the County pursuant to Article III F(1) above.

H. City agrees that any portions of County's ten percent (10%) entitlement may be used by the County as a basis for a contract with the Cortaro-Marana Irrigation District.

I. City and County agree that the City shall have unilateral control, without limitation, over the use and disposition of all effluent discharged from County treatment plants located outside of the Metropolitan Area. City shall take delivery of such effluent at any or all of said treatment facilities at no cost to County.

1. In the event that disposition by the City of effluent to which it is entitled within the non-metropolitan area results in a net profit, the net profit shall be divided as follows:

   50% of the net profit will be treated as water revenues and deposited to the same accounts and funds as receipts from City water sales;

   50% of the net profit will be treated as sewer user fee revenues and deposited to the same accounts and funds as sewer user fee revenues.

   a. Net profit shall be determined by the City and the County in accordance with generally accepted accounting methods. Net profit will include the cash revenue remaining after costs for capital, operation and maintenance, including indirect and administrative expenses, and the cost for additional treatment, if any, have been met.

   b. Use of effluent to settle water related claims against the City or County, exchange for groundwater pumping rights, Central Arizona Project, or in any other manner to protect, benefit or enhance the water supply of the City where there is no cash revenue shall not be valued in any way for purposes of determining net profit.

2. Notwithstanding Article III I (1)(a)(b), City agrees that County may take effluent from County treatment facilities located outside the metropolitan area commensurate with their needs for irrigation of parks, golf courses, and recreational facilities located outside the metropolitan area.

J. County agrees not to provide or divert wastewater from any portion of its collection and treatment systems to any person or other entity without the prior written consent of the City.

K. In order to assure that the full potential quantity and quality of City effluent is not reduced, the County agrees to the following:

1. Maintain effluent quality at the Ina Road, Roger Road, Randolph Park Treatment Plants and other treatment plants within the metropolitan area, regardless of whether or not there is a discharge into the waters of the United States, in accordance with Federal and/or State standards for discharge into the waters of the United States within the State. The disposition of treated wastewater from a treatment plant shall not constitute a part of the treatment process.

2. At other treatment facilities outside the metropolitan area, the treatment processes will be maintained in accordance with EPA and State requirements.

3. Except as may be required in Article III M, City agrees County shall not be required by City to exceed NPDES Permit Standards. City further agrees that County shall not be responsible for any additional treatment costs required by City to meet its reuse plans which is in excess of NPDES Standards.

L. City agrees that specific effluent allocations made to County shall not be subsequently denied in whole or in part unless approved by City and County.

M. County agrees to make untreated wastewater available to the City for treatment and use on other recreational facilities in the City, all at no cost to the County. County further agrees to treat wastewater in accordance with Arizona Department of Health Services standards where such effluent will be used to irrigate the Randolph, Silverbell and Arthur Pack Golf Courses, or future similar facilities.

N. County agrees to grant, at no charge to City, easements, rights-of-way and access to treatment facilities to facilitate City use and disposition of its effluent, and County shall bear no costs associated therewith.

O. County agrees that at closing it will withdraw its Application for Permit to Appropriate Water, No. 33-47023, and thereafter it will not refile such Application(s). Further, County agrees to withdraw its opposition to City's Application for Permit No. 33-42494.

P. City and County agree to settle Cause No. 170727, City of Tucson, a municipal corporation v. Pima County, a body politic, et al., presently pending in the Superior Court of the State of Arizona in and for the County of Pima by a stipulation for dismissal without prejudice.

ARTICLE IV

ASSUMPTION OF SEWER SYSTEM FINANCING AND LIABILITIES

A. County agrees that it shall assume the responsibility of paying the existing City sewer bond debt pursuant to the Schedule attached hereto and made a part hereof (Exhibit A). Existing sewer debt shall mean all debt of the City as of June 30, 1979 incurred from the expenditure of sewer bond funds for the construction, design or planning of any component of the City's sewer system and all other debt of the City incurred as a result of sewer bond sales, the proceeds of which have not been used for construction, design or planning and which shall be used on or after June 30, 1979 for City debt service payments or payments pursuant to IV D (1) (c).

County's obligation herein is subject to annual appropriation. Revenues used for this purpose shall be expended in accordance with State law.

B. Unexpended City Sewer Bond proceeds existing at time of closing will be used to reduce the existing City Sewer debt or as provided in IV D (1) (c). These proceeds and interest earnings shall be applied in accordance with the existing debt service schedule of the City shown in Exhibit A herein.

C. City and County agree that after closing the County shall be solely responsible for all financing for capital and operation and maintenance costs of the combined sewer system incurred after June 30, 1979. Any costs incurred in the City system prior to June 30, 1979 will be the responsibility of the City.

(1) Consistent with the foregoing, the following existing City contracts shall be assigned to the County effective June 30, 1979.

Contract No.	Project	Contractor
0182-79	Main Avenue Trunk Sewer	J.S. Anderson Construction Company
0296-79	I-19 Trunk Sewer	Gus's Trenching & Pipeline Co., Inc.
033-79	I-19 Trunk Sewer/Pile Driving	Gus's Trenching & Pipeline Co., Inc.
0312-79	YWCA Relief Sewer	R.E. Miller Paving & Construction, Inc.
0365-79	Craycroft Trunk Sewer	R.E. Miller Paving & Construction, Inc.

(2) Notwithstanding other sections of Article IV, the City shall be financially liable for tort claims and court judgments arising from City's negligent actions in connection with the City's

operation of the City sewer system whether the injury occurred before or after June 30, 1979. A contingent liability fund shall be established by the City from 1978-79 sewer user revenues in the amount of One Hundred Thousand Dollars ($100,000) for payment of such tort claims, court judgements (excluding the Dow Chemical Judgment) and other liabilities pursuant to IV E. The fund shall be closed at the end of two years and any balance therein shall be disbursed to the County.

(3) The County shall be financially liable for tort claims and court judgments arising from County's negligent actions in connection with the County's operation of the combined sewer systems when the injury occurs after June 30, 1979.

D. (1) City and County agree to the disposit on of existing City grants in the following manner, subject to EPA approval:

(a) The following grants will be transferred to the County effective June 30, 1979.

	EPA Grant No.	Project
i.	C-04-0160-01	Santa Cruz Interceptor System Phase I Steps 2 & 3
ii.	C-04-0134-01	Randolph Park Wastewater Reclamation Plant Step 3
iii.	C-04-0147-01	South Rillito Interceptor System Phase I Steps 2 & 3
iv.	C-04-0147-03-1	South Rillito Interceptor Sewer Phase II Step 1
v.	C-04-0147-03-2	South Rillito Interceptor Sewer Phase II Step 2
vi.	C-04-0147-03-3	South Rillito Interceptor Sewer Phase II Step 3
vii.	C-04-0178-01-1	Metropolitan Tucson Regional Wastewater Management System (Facility Plan) Step 1
viii.	C-04-0178-02	Design of Modification to Roger Road Wastewater Treatment Plant Step 2
ix.	C-04-0178-03	Modifications to Roger Road Wastewater Treatment Plant Phase I Step 3

(b) All City shares of local costs in connection with EPA grants discussed in IV D (1) (a) shall be the responsibility of the City when incurred prior to June 30, 1979 and shall be the responsibility of the County when incurred after June 30, 1979.

i. The County shall meet this obligation from County sewer bonds and sewer connection fees.

ii. The City shall meet their obligation from a Five Hundred Thousand Dollar ($500,000) fund which shall be established prior to June 30, 1979 comprised of City sewer bond funds. This fund shall be closed after final EPA audit approval has been received on all EPA grants listed in IV D (1)(a), any balance therein shall be used to reduce the existing City sewer debt.

iii. In the event that EPA grant reimbursements are received by the City after July 1, 1979, these payments shall be distributed to either the fund identified in IV D (1)(b)(ii) or the County if so provided for in existing IGA's.

(2) Consistent with the disposition of grants in IV D (1), the following existing City contracts shall be assigned to the County effective June 30, 1979.

City Contract No.	Contractor
0037-79	Burdick Contractors, Inc.
4551-77	Brown & Caldwell
4596-78	Black & Veatch
P.O. 51659	Arizona State Museum

E. City and County agree that any other City sewer system cost not specifically covered elsewhere in this Agreement shall be the responsibility of the County if incurred after June 30, 1979 and shall be the responsibility of the City if incurred prior to June 30, 1979.

ARTICLE V

REGIONAL FACILITY PLAN

County agrees not to change the adopted Regional Facility Plan for three (3) years from the date of this Agreement. County agrees to implement the recommended first phase of construction in the Facility Plan as follows:

A. All City and County approved facility plan modifications to Roger Road Wastewater Treatment Plant, County agrees:

1. The City, as sole Applicant, shall forthwith apply for an EPA Step 3 Construction Grant, including plantwide treatment modifications (including digestor modifications).

2. In order to insure EPA funding in the 1978-79 Federal fiscal year and in order to clarify the third condition of transfer as set out in Article II A(3) of this Agreement, the County shall award a construction contract for 30 MGD plantwide modifications, including digestor modifications as approved by the joint City-County Technical Advisory Committee, prior to September 30, 1979, or in compliance with the grant conditions of EPA grant number C-04-0178-03.

3. The City and County agree that early completion of the solids storage and disposal facilities at Roger Road is necessary. County therefore agrees that it shall complete the design and construction of such facilities at the earliest possible date by endeavoring to comply with the following guidelines. City and County further agree that the County's obligations under this subsection are subject to EPA approval.

   a. Complete design of Roger Road plant solids storage and disposal facilities prior to June 30, 1980.

   b. Apply for EPA Step 3 Construction Grant for solids storage and disposal by June 30, 1980, and accept grant offer within ten days of receipt thereof.

   c. Award construction contract for solids storage and disposal by September 30, 1980.

4. The City will, from time to time, request information regarding progress of the project. The County will furnish the requested information in a timely professional manner. The City will be advised of progress meetings between County and contractor or the EPA and, at its option, may attend same. The City will pay for the costs associated with providing City requested information. The County shall advise the City prior to initiating any substantial changes to the Roger Road Project.

B. County agrees to implement the remainder of the facility plan and to follow to the extent possible the following priority and schedule used as a guideline, subject to EPA approval and availability of funding.

1. Pantano Interceptor - Speedway to 29th Street, and Tanque Verde Interceptor - Tucson Country Club to Camino Seco

2. Santa Cruz/Southeast Interceptor: Award construction contracts by August 31, 1980.

County agrees that in the event the Phase I Santa Cruz/Southeast Interceptor does not have sufficient priority on the Arizona Construction Grants Priority List to receive EPA Step 3 Construction Grants, and there are insufficient County funds for 100% local funding of this Project, the Project may be implemented as part of phased overall prioritized County capital program as follows:

1. Santa Cruz/Southeast Interceptor Phase I.
2. Canada del Oro Interceptor to the Highlands.
3. Other interceptors and trunks.

C. Regardless of Article V, B priorities, County agrees that the local share of the Roger Road Plant 30 MGD modifications, including digestor modifications, sludge storage and disposal, as well as the Pantano and Tanque Verde Interceptors, will be funded in total prior to initiation of phased overall prioritized County Capital Program.

Nothing in this Article V shall be construed to relieve the County from implementation of any other portion of the adopted Facilities Plan.

ARTICLE VI

PIMA COUNTY: SINGLE MANAGEMENT ENTITY

Pima County, as the single management entity, is committed to the concept of equal service for all users of the metropolitan system without regard to jurisdictional location. Therefore, the County agrees:

A. To accept the adopted Mayor and Council current policy with regard to allocation of sewer capacity and to utilize the current methodology employed by the City in computing sewer capacity. The current City policy and methodology, attached hereto as Exhibit B, shall be continued within the City by the City and County until surcharged conditions are relieved by implementation of the approved facility plan and related capital projects. The exact terms and conditions regarding the allocation of sewer capacity as agreed to herein shall be a part of the final agreements between the parties at closing.

B. Prior to adoption the County shall submit its proposed annual sewer capital budget to City for review and shall consult with City in planning and prioritizing all sewer capital improvements in the metropolitan area and shall coordinate such planning with City water planning. Such coordination may be accomplished through any means acceptable to the City and County.

ARTICLE VII

INDEPENDENT AGENCY

County agrees not to turn its sewer system over to an independent agency for a period of ten (10) years, said period to begin running upon the effective date of this Agreement.

ARTICLE VIII

TRANSFER OF CITY SEWERAGE SYSTEM - CLOSING

A. City and County agree that the legal transfer of the City sewerage system shall be accomplished on or before June 30, 1979.

B. City and County further agree that they shall cooperate so that all documents related to said transfer shall be executed not later than June 30, 1979.

C. The executed documents to be delivered on or before closing shall include, but are not limited to, the following:

1. Appropriate documents conveying to the County title to real property or easements or licenses necessary to carry out the intent of this Agreement. Bills of Sale transferring to County all specialized equipment, vehicles, supplies and other personal property necessary to operate the City's sewerage system. Said deeds and other applicable documents shall contain the power of termination as set forth in Exhibit C attached hereto and by this reference incorporated herein.
2. Documents by which the County relinquishes, quitclaims, and transfers to the City, all of the County's interest, estate, right, title, claim or lien in effluent in accordance with Article III;
3. Documents whereby the County grants to the City permission to use the public right-of-way in Pima County for the purpose of installing, extending, enlarging, or maintaining the water system owned by the City of Tucson.
4. Documents whereby the City grants to County permission to use the public right-of-way within and without the City for the purpose of installing, extending, enlarging, or maintaining the sewerage system owned by the County.
5. Such other documents as are necessary to implement Article III with regard to Application No. 33-47023 and Article III with regard to Case No. 17027.

6. Such other documents of any type whatever as are necessary or advisable to implement this Agreement.

D. After the closing the County will be solely responsible for the operation and maintenance of all portions of the sewerage system, within and without the territorial limits of the City.

E. At the closing, the City shall transfer to the County all permits to discharge into the waters of the United States issued by the EPA to the City pursuant to Section 402 of the Clean Water Act. Thereafter, the County will be and remain responsible for any and all conditions of the permit and shall be solely liable for the consequences of failure to meet NPDES permit standards.

F. The City agrees that after the closing and as long as this Agreement is in full force and effect, the City shall no longer provide City sewer services. However, the foregoing shall not preclude the City from constructing sewer facilities under the provisions of Paragraph III M; or from constructing sewer improvements in Improvement Districts formed pursuant to statute; or from constructing on or off-site sewer improvements for the benefit of City owned property or from constructing sewer improvements that may be required in connection with City projects, i.e., industrial development projects, inner city revitalization projects. The plans and specifications for the construction of any sewer improvements permitted under this paragraph are subject to the review and approval of the Pima County Wastewater Management Department.

G. After the closing, County shall assume all responsibility for inspection of main line sewer lines lying within the incorporated areas of the City of Tucson.

The City shall continue to be responsible for inspection of HCS connections and private sewerage systems. However, in the event an HCS connection or private sewerage system is to be connected to a manhole, County shall be responsible for the inspection of such connection.

H. After the closing, County shall be solely responsible for the establishment, collection, processing, and disposition of all sewer connection fees arising out of the connection of any property, real or personal, to any public sewer within the incorporated areas of the City of Tucson.

I. After the closing, City agrees that County, as the single management and operating agency for the Regional Sewerage System, shall be the sole authority responsible for the establishment and setting of sewer user fees and rates within and without the incorporated areas of the City of Tucson.

J. After the closing, the County shall be solely responsible for the collection, processing and disposition of sewer pipeline extension rebate sums due pursuant to agreements previously entered into by the City. The City shall provide County with copies of all such agreements.

K. After the closing and until July 1, 1980, the City agrees to bill and collect sewer user fees authorized by the sewer user fee ordinance adopted by the County. As part of the billing and collection system for the water utility, it is understood that the City will be billing and collecting the following types of accounts:

Water Only Accounts - customer has provided information to show that the wastewater at the water billing address is not being discharged to the County sewer system.

Water and Sewer Accounts - customer is receiving water from the City water utility and discharging wastewater to the County sewer system.

Sewer Only Account - customer is discharging wastewater to the County sewer system but is not being supplied water from the City water utility.

1. The City shall provide the following sewer billing and collection services for the County:
   a. Provide water consumption data for each water and sewer account and provide billings and collection of these accounts monthly;
   b. Provide monthly billings and collection for sewer only accounts from data on water consumption provided by the County;
   c. Update all water and sewer accounts (turn-on and turn-off) to maintain an accurate active customer file;
   d. Update sewer only and private well accounts upon receipt of necessary information from Pima County;
   e. Bill delinquent sewer accounts in conjunction with the water billing system and transmit to Pima County for collection those delinquent sewer accounts that cannot be collected through the water billing system;
   f. Process sewer user fee adjustments transmitted by Pima County and adjust sewer user fees in accordance with adjustment policies authorized by Pima County;

g. Provide County with read-only access to computerized customer account records;

h. Provide County with all necessary forms required in maintaining an accurate sewer billing system;

i. Provide County with winter water use data for those sewer users on the City water system;

j. Provide County with all necessary and agreed upon computer-oriented reports required to effectively manage the revenues and customer accounts of the sewer utility;

k. Maintain an accurate, error-free, computerized sewer billing and collection system;

l. Provide County access to the monthly billing system for the purpose of inserting sewer utility-related information with the exception that where such inserts are in conflict with a scheduled water bill insert by the City and in such cases the City insert shall take precedent;

m. Upon receipt of sewer user fee payments, the City shall credit a refundable deposit account to account for the receipt of money and deposit all receipts in the City's deposit clearing account. On a weekly basis, the City will make a disbursement of all sewer user fee collections to the County less the weekly portion of the monthly administrative and billing fee mutually agreed upon in paragraph o below. The City and County shall cooperate in effecting procedures necessary, on a day-to-day basis, to provide for the billing, collection, data processing, and other daily operational aspects of administering County sewer user fees;

n. At the County option, the City will provide a register showing active account status of each account on a monthly basis and will provide a final delinquent account register of all accounts considered as the inactive final billing register;

o. For the above service, the County agrees to pay and the City agrees to offset against amounts owed the County, a monthly administrative and billing fee of $50,000. Such fee will reimburse the City for the direct and indirect cost of billing and collection service as detailed on the attached Exhibit D.

p. On July 1, 1980, at the request of the County, City shall provide

to County all data except water usage data, related to the billing and collection of sewer user fees within the City, all at no cost to the City.

2. The County agrees to provide the following:

   a. Establish all new sewer user accounts served by City water, private water companies and by private wells;

   b. Adjust all sewer user fee accounts as required;

   c. Answer all sewer user complaints;

   d. Process all turn-on and turn-off of sewer only accounts;

   e. Accept responsibility to collect all delinquent sewer accounts served by City water after they have become 90 days old;

   f. Provide necessary data for the billing of sewer only accounts;

   g. County will inspect any computer errors and notify City Data Processing of necessary change.

ARTICLE IX

IMPLEMENTATION

A. PERSONNEL - TRANSFER OF CITY EMPLOYEES

Upon execution and the effecting of the Agreement herein, County shall accept for employment any and all City Water and Sewer Department employees choosing to transfer to the County Wastewater Management Department under the following conditions:

1. Said employees accepting employment with the County Wastewater Management Department shall not be subjected to nor shall such employee experience any period of layoff from the time such employee leaves City employment to the time in which said employee begins employment with the County.

2. Said employee shall receive a starting salary equal to the total of what his/her salary and longevity pay would have been with the City of Tucson as of July 1, 1979. In the event that amount is below the minimum of the established salary range, the employee will be hired at the minimum step of that range.

3. Said employee shall be accepted and placed into a classification comparable to what the employee enjoyed as a City employee, as determined by the Personnel Director of Pima County, said acceptance and placement to be effective 0001 A.M. on Sunday, July 1, 1979.

In the event the employee's salary and longevity compensation is in excess of the maximum for the comparable classification, the employee's qualifications will be given consideration in making the determination of an appropriate classification for employment.

4. Said employee shall be accepted for employment by the County in an equivalent status to his/her City position (for example, a probationary City employee would be transferred as a probationary County employee and a permanent City employee would be transferred as a permanent County employee). Time served as a probationary City employee will count as an equivalent period toward completion of the County's probationary period.

5. Any employee transferring into a classification requiring registration or certification is encouraged to acquire such registration or certification within a one-year period from the date of transfer. During that one year time period, those duties which require registration or certification may be withheld from the position. If such registration or certification is not obtained with the one year time period, the employee shall be placed into a classification appropriate to his or her duties devoid of those responsibilities requiring the registration or certification, but retaining the same salary range.

6. Employees transferring into a classification requiring an appropriate type of Arizona State driver's license will be required to show proof of such license prior to assuming the duties of the position at ~~Pima~~ County. If the employee does not possess the license, he or she will be reassigned to a position in the same or like classification series where such a license is not required.

7. Said employee shall be given credit for the period of time worked with the City as if the equivalent period of time had been worked with the County.

8. Said employee shall be entitled to and County agrees to accept vacation, sick leave and compensatory time accumulation that said employee may have as of June 30, 1979, subject, however, to a County accrual limitation of 240 days for sick leave, that being the maximum that can be carried.

9. Said employee shall be permitted to enroll in the life, health and dental insurance plans available to County employees without regard to pre-existing conditions and without any waiting period. This provision shall also apply to any eligible dependents of the employee. Consistent with recently enacted State legislation, the County shall pay 75% of the cost of dependent insurance coverage.

10. Consistent with recently enacted State legislation, said employee shall be afforded the opportunity to transfer City retirement credits to the State Retirement System.

11. Any employee choosing to accept employment with the County shall submit completed Pima County Application for Employment, and resume, when requested, delineating education, experience and training. The application shall include copies of all necessary registration, certification or license required for employment in the classification.

12. Said employee shall be afforded all benefits and rights provided other County employees in the terms and conditions of employment, including, but not limited to opportunity for promotion, merit increases and layoffs.

B. County may, by separate agreement, contract with City for the supervision of any contracts transferred to the County pursuant to the provisions of Article IV (C) (1) and IV (D) (2).

C. City and County , in order to effectuate the orderly and efficient transfer of the City sewerage system to the County with a minimal amount of disruption to daily operations, do hereby agree to the extent possible that the City shall provide the County with the following:

1. City inventory of all buildings, treatment plants, sewer lines, and all specialized equipment, vehicles, office furnishing, and other personal property necessary to the management and operation of the City of Tucson sewerage system;

2. Financial statement with full disclosure of:

   (a) total assets

      (i) revenue

   (b) liabilities

      (i) contingent

      (ii) accrued

   (c) short and long-term indebtedness

      (i) bonded indebtedness

3. Statements of pending claims or litigation or any other adverse events materially adversely affecting operations or the financial condition of the City of Tucson sewerage system;

4. Personnel

(a) organizational chart disclosing

(i) titles

(ii) job classification and duties

(iii) other pertinent information

(b) wages

(i) pay rates

(ii) wage progressions

(iii) job evaluation, classification and reclassifications

(c) hours of work

(d) vacations, sick leave

(e) promotions

(f) discharge and other discipline, grievance procedure

(g) employee benefit plans

5. Capital Improvement Program

(a) financial program

(b) contractural obligations

D. The City Manager and the County Chief Administrative Officer shall be responsible for implementing the provisions of this Agreement and specific requirements associated with the transfer of the City Sewerage System to the County, such responsibility to include but not be limited to the following areas:

1. Billing/collections
2. Rate setting
3. Grants program
4. Zoning/new development process
5. Land/building acquisition
6. Planning-current, advanced, regional
7. Legal
8. Personnel matters
9. Transfer of real and personal property
10. Bonds, debts and funding

E. City and County will provide each other with all necessary information required for the purpose of this Agreement.

ARTICLE X

A. City agrees to reserve sixty-eight (68) acres of City-owned land in proximity to the Roger Road Wastewater Treatment Plant for purposes of County sludge disposal activities. Such land is to remain the property of the City and is subject to the rights of the City to use or dispose of the land at such time as the land is not required by the County for sludge disposal activities as may be determined by the EPA approved facility plan for sludge disposal activities to be adopted in accordance with Article V of this agreement.

B. The County agrees to reserve twenty (20) acres of County-owned land in proximity to the Ina Road Wastewater Treatment Plant for purposes of effluent reuse activities. Such land is to remain the property of the County and is subject to the rights of the County to use or dispose of the land at such time as the land is not required by the City for effluent reuse activities. City rights under this section must be exercised within a period of ten (10) years.

ARTICLE IX

MISCELLANEOUS

A. Effective Date of Agreement

This Agreement shall be effective upon filing the original executed Agreement with the Office of the Pima County Recorder.

B. Duration

The Agreement shall terminate on June 30, 1979, at midnight, if the provisions of Article VIII of this Agreement have not been fully executed. If the provisions of Article VIII of this Agreement have been fully executed by midnight on June 30, 1979, then this Agreement shall continue indefinitely and shall be subject to termination by any of the parties or their successors or assigns hereto upon ninety (90) days prior written notice and based only upon the material breach of the provisions of this Agreement.

C. Prior to, or at the time of closing, additional agreements may be required to be executed to carry out this Agreement.

D. Legal Jurisdiction

Nothing in this Agreement shall be construed as either limiting or extending the legal jurisdiction of either the City or the County.

E. Assignment

The terms of this Agreement shall be binding on the successors and assigns of the parties hereto.

F. Remedies

Any party to this Agreement may seek specific performance hereof, or any other judicial relief in the event of breach of this Agreement. The election of a remedy shall not be deemed a waiver of any other remedy.

G. Modification

City and County recognize that from time to time modification of this Agreement may be necessary in order to meet the needs and requirements of the community in future years. Therefore, City and County agree that, from time to time, either party to this Agreement may, upon thirty (30) days prior notice to the other, request a joint meeting of City and County officials to discuss proposed changes to this Agreement.

H. Non-Severability

If any portion of this Agreement is finally adjudicated invalid, the entire Agreement shall be null and void. The provisions of this Agreement are intended to be non-severable.

SIGNED AND ATTESTED this 26th day of June, 1979.

CITY OF TUCSON, a municipal corporation,

by _____
MAYOR

ATTEST AND COUNTERSIGNED:

_____
CITY CLERK

APPROVED PURSUANT TO A.R.S. §11-952(d)
AS AMENDED

_____
CITY ATTORNEY

PIMA COUNTY, a political subdivision of the State of Arizona

By E.S. Walk
Chairman, Board of Supervisors

ATTEST:

Eugenia H. Wells
Clerk of the Board

APPROVED PURSUANT TO A.R.S. §11-952(d) AS AMENDED:

-Rose Silver
Special Counsel to the Civil Division of Pima County Attorney's Office

CITY SEWER UTILITY DEBT SERVICE

FOR BONDS OUTSTANDING AT JUNE 30, 1979

	Total Principal, Interest, and Mandatory Sinking Fund	Less Application Unused Bond Funds	Net
1979-80	$1,469,135	(1)	(1)
1980-81	1,492,600	(1)	(1)
1981-82	1,415,525		
1982-83	1,390,886		
1983-84	1,305,610		
1984-85	1,108,563		
1985-86	797,160		
1986-87	402,446		
TOTAL	$9,381,925	(1)	(1)

EXHIBIT A to Ex 1 3 Res. 10868

KHAWAM0141

EXHIBIT B

ALLOCATION OF SEWER CAPACITY

Purpose

The purpose of this interim policy is to provide guidance to City and County officials in the review of development applications until such time as a more comprehensive policy and means for the allocation of sewer capacity can be prepared by staff, reviewed by interested citizens and presented to the Mayor and Council. The interim policy is intended to provide review criteria that are equitable, legally defensible and consistent with public health and safety.

Definitions

(1) "Surcharge" means a sewer pipe flow condition in which the actual, not theoretical, peak dry weather flow equals or exceeds 100 per cent of the sewer pipe capacity.

(2) "Surcharge condition planned for early relief" means a surcharge condition, the sewer improvements for the relief of which have been budgeted by the County in the current fiscal year, and are planned for completion by the following fiscal year.

(3) "Critical area" means a geographic area within the City Limits which is tributary to a reach of sewer pipe that is being operated in a surcharged condition as defined in (1) above.

I. Rezoning and Subdivision Plat Review

A. Scope. These guidelines shall apply to:

1. Any rezoning application in which an ordinance has not been adopted by the Mayor and Council prior to the effective date; or
2. Any subdivision application in which a final plat has not been approved for recording by the Mayor and Council prior to the effective date; and
3. Such applications involve proposed development which would require a sewer connection in a critical area.

B. Guidelines.

1. Following the effective date, the Zoning Administrator shall provide all applicants for rezoning and subdivision plat review with written notice that a surcharge condition affecting the proposed development may be grounds for denial of the rezoning, plat or building permits.

2. Rezoning and subdivision plat applications within the scope of this policy will be approved, provided

a) such applications satisfy all non-sewer-related criteria and conditions; and

b) the surcharge condition affecting the proposed development is planned for early relief; or

c) the applicant has in good faith relied on prior City representations of adequate sewer capacity and denial would result in substantial financial damage to the applicant.

3. In the event that an application for rezoning or subdivision plat review is denied solely on the basis of this policy, reapplication shall be without prejudice or duplicative fees.

4. In the event that an application for rezoning or subdivision plat review is approved pursuant to this policy, the Mayor and Council may condition such approval with the provision that no building permits or sewer permits will be issued for the proposed development until such time as the surcharge condition has been relieved.

C. County shall review proposed City rezoning and subdivision plats. County shall advise the City in writing within five (5) working days:

1. whether the proposed rezoning or plat would require a sewer connection in a "critical area" or "non critical area."

2. if in a "critical area," whether the surcharge condition affecting the proposed development is scheduled for early relief, and the estimated date of completion.

II. Building Permits

A. Scope. These guidelines shall apply to any application for a building permit:

1. Which is received by Building Inspections following the effective date; and

2. Which involves proposed development requiring a sewer connection in a critical area.

B. Guidelines.

1. Following the effective date, the Chief Building Inspector shall provide all applicants for building permits with written notice that a surcharge condition affecting the proposed development may be grounds for denial of the building or occupancy permits.

2. The County shall review City building permit applications. County shall advise City within five (5) working days:

a) whether the building permit application would require a sewer connection in a "critical area" or "non critical area;"

b) if in a "critical area" the County will recommend the building permit be approved, provided that immediate connection of the proposed development to the surcharged sewer will not create an unreasonable risk to public health and safety.

3. Building permit applications within the scope of this policy will be approved, provided that immediate connection of the proposed development to the surcharged sewer will not create an unreasonable risk to public health and safety. In making this determination, the City Manager will consider the following factors to be provided by the County:

a) Severity of the existing surcharge condition downstream from the proposed connection, as indicated by:

(i) degree and duration of existing surcharge condition;

(ii) length of the downstream surcharged segments; and

(iii) known localized sewer system deficiencies, including manhole depths, local topographic conditions, maintenance history, physical condition of sewer, number of existing service connections, wet weather infiltration problems, and existing hydrogen sulfide generation problems.

b) Estimated impact of the proposed connection on the existing surcharge condition, as indicated by:

(i) wastewater discharge and peaking characteristics of the proposed connection;

(ii) the incremental increase to the existing surcharge condition relative to the sewer diameter at the point of surcharge; and

(iii) the incremental increase to the existing surcharge condition relative to known downstream system deficiencies, as described in (a)(iii) above.

c) The timing of sewer improvements intended to relieve the surcharge condition (the longer the duration of the surcharge condition, the greater the likelihood of system damage).

d) The possibility that the immediate effect of the proposed connection on the existing surcharge condition can be mitigated, either:

(i) by staging of development in conjunction with planned sewer improvements, or

(ii) by developer-financed off-site improvements.

3. In the event that a building permit application is denied solely on the basis of this policy, reappliation shall be without prejudice or duplicative fees.

4. In the event that building permits are approved pursuant to this policy the City Manager may condition such approval with the provision that

no occupancy or sewer permits will be issued for the proposed development until such time as the surcharge condition is relieved, either by the staging of development in conjunction with planned sewer improvements or by developer-financed off-site improvements.

QUITCLAIM DEED

FOR AND IN CONSIDERATION of the sum of ONE ($1.00) DOLLAR, and other valuable considerations, the undersigned, CITY OF TUCSON, a municipal corporation, does hereby release, assign, and quitclaim unto PIMA COUNTY, a political subdivision of the State of Arizona, all right, title, interest, claim and demand in the property situated in Pima County and described in Exhibit "A" attached hereto and incorporated as if fully set forth herein subject to the following four conditions:

1. County acceptance of and compliance with the effluent terms agreed to in Article III of the Intergovernmental Agreement (IGA) of the City and County, dated_____.
2. County acceptance of responsibility for the existing City sewer debt, pursuant to Article IV of the Intergovernmental Agreement (IGA) of the City and County, dated_____.
3. County commitment to the Regional Facilities Plan for a period of three (3) years from the date hereof and award of a construction contract for the Roger Road Plant, all as set forth in Article V of the Intergovernmental Agreement (IGA) of the City and County, dated_____.
4. County commitment not to turn the sewer system over to an independent agency for a period of ten (10) years as set forth in Article VI of the Intergovernmental Agreement (IGA) of the City and County, dated_____.

Articles III, IV, V and VI of said Intergovernmental Agreement (IGA) of the City and County, dated_____, are attached hereto as Exhibit "B" and are incorporated as though fully set forth herein.

The foregoing four conditions are express conditions subsequent upon which this conveyance is made. If the County, its successors and assigns, shall fail to perform or comply strictly with any of the four conditions, then the City, its successors and assigns, may at anytime thereafter serve on the County a notice in writing specifying the particular or particulars in which default or a breach thereof has been made and directing the County to remedy such default

Replaced See recorded Box 6060 Pg 1027 to 1028

EXHIBIT C To Ex. 1 in Rpt 10560

KHAWAM0147

PIMA001689

or breach. Should the County fail fully and entirely to remedy such breach within ninety days of such notice, the City may notify the County in writing that the City elects that the title to the whole of the conveyed system or any part thereof shall revert to the City, and thereupon the title to the whole or designated part of the conveyed system shall immediately and without necessity of any further action on the part of the City revert to and revest in the City and the County shall lose all of its right, title and interest in and to the conveyed system or designated portions thereof, and the grantor shall have the right of re-entry to the conveyed system. Such reversion is subject to then existing encumbrances provided that those encumbrances represent funds actually spent to improve the sewerage system conveyed herein. The City shall assume obligation for payment of such encumbrances. This obligation is subject to annual appropriation and is payable solely from sewer revenues. Sewer revenues shall be expended in accordance with the provisions of A.R.S. § 9-530.

In the event the power of termination set forth herein is successfully invoked by the City, any and all provisions related to effluent and in particular the provisions of Article III contained within that certain Intergovernmental Agreement (IGA) between the City of Tucson and County of Pima dated_____, 1979, shall become null and void and of no further cause and effect. Further, all documents executed by County in order to carry out the provisions of Article III and in particular Article III (c) shall become automatically void and of no effect or validity as if said documents had never been executed by the County.

Each and all of the conditions and agreements contained herein shall be deemed and construed to be continuing, according to their terms, and the fulfillment of any condition(s) shall not impair or affect any of the remaining conditions or agreements, so far as any future or other breach is concerned. It is understood and agreed by and between the parties hereto that no waiver of a breach of any of the conditions and agreements herein contained shall be construed to be a waiver of any other breach of the same or other conditions and agreements, nor shall failure to enforce any of such conditions, either by re-entry or otherwise, be construed as a waiver of the same.

If any portion of the Intergovernmental Agreement (IGA) of City and County, dated_____, is finally adjudicated invalid, this Deed shall be null and void.

KHAWAM0148

SEWER USER
BILLING AND COLLECTION SERVICES

CUSTOMER SERVICES	$267,040
For processing of sewer user fee bills, monitoring of revenue collections, processing applications for new services, maintaining sewer customer files.	
Based on 25% of Customer Services Budget, except for postage costs, which are allocated on the basis of the number of water and sewer accounts.	
METERING SERVICES	248,790
For water use data on City of Tucson Water Utility customers and file maintenance of up-to-date records of customers by address and account number.	
Based on 25% of Metering Services Budget.	
COLLECTION SERVICES	33,230
For sewer user fee revenue collection services provided by the City Finance Department's Revenue Division.	
Based on the ratio of sewer user fee revenue to the total revenue collections of the Revenue Division.	
DEVELOPMENT AND LIAISON SERVICES	50,940
For the development and implementation costs of the redesigned water and sewer bill, assistance with rate setting and formulation, and other liaison requirements regarding sewer user billing and collecting	
TOTAL AMOUNT	$600,000
PER MONTH	50,000

EXHIBIT D to Ex. 1.g Res. 10860

KHAWAM0149

PIMA001691

TECHNICAL MEMORANDUM

To: John Kmiec, Interim Utility Director, Tucson Water

From: Harold Smith, Raftelis Financial Consultants, Inc.

Subject: Outside Differential Analysis

CC: Deborah Galardi, Galardi Rothstein Group

On June 22, 2021, the City of Tucson Mayor and Council approved a rate differential for Tucson Water customers located within unincorporated Pima County (Outside City Customers). This decision was policy based and goes into effect on December 1, 2021. Mayor and Council further directed Tucson Water to conduct a cost-of-service analysis using standard industry practices to determine the cost basis for differential rates. The results of the cost-of-service analysis are supplemental to the policy basis already used to approve the differential rate.

Tucson Water engaged Raftelis to develop a range of possible cost-based differentials as the first step in this cost-of-service analysis. The analysis performed by Raftelis involved using readily available data to develop revenue requirements for the entire Tucson Water system using the utility basis, allocating those revenue requirements between inside city customers and Outside City Customers and then comparing the revenue requirements for Outside City Customers to the revenue generated by Outside City Customers under Tucson Water's existing rates. The difference between the calculated revenue requirements and revenue at existing rates serves as an approximation of a cost-based rate differential. The second phase of the cost-of-service analysis will refine the differential rate range presented in this Memorandum and will address the detailed information now decided by Mayor and Council, namely the differential rate schedule to be implemented (Option 7 from the original Notice of Intent), the projected differential rate revenues, and the projects and programs within the utility where Mayor & Council directed that the revenues be used.

Overview of the Utility Approach

The utility approach for determining revenue requirements is typically utilized by investor-owned utilities, and also for governmental utilities that are regulated by state public service agencies. The utility approach provides for a utility to recover operating and capital costs as determined by generally accepted accounting principles. In addition, the utility is provided a return on its investment in utility plant-in-service and other capital facilities. O&M costs are typically based on the utility's operating budget and capital costs are estimated based on actual or projected depreciation and adjusted for additions, retirements, "contributions in aid of construction," and "customer capital advances."

Under the utility approach, a return is calculated by applying a rate of return on the investment by the owner of the utility (typically the original cost of assets less accumulated depreciation and adjustments). The utility's investment is defined as a "rate base." In situations where outside-city service is provided, two separate rate base values can be determined, the rate base for inside-city service and the rate-base for outside city service. The utility's return should provide for the payment of interest on outstanding

debt, the funding of certain capital items, and a payback (dividend) to the investors of the utility. In situations where a municipal utility is the service provider, this dividend is sometimes used to offset the revenue requirement to be recovered from inside-city rates, thereby lowering the rates paid by inside-city customers. Tucson Water has been directed to use the differential rate revenues within the utility to fund programs in the areas of financial resilience, water resources resilience, and infrastructure resilience.

The most widely recognized method for selecting an appropriate rate of return is the weighted average cost of capital (WACC) approach. This approach can be used by both public and private utilities and represents the weighted average of the utility's cost of debt (outstanding bonds) and cost of equity. A utility's average cost of debt is the average interest rate that it pays on all its outstanding bonds and loans. Since a utility is often required to issue debt at various times to meet capital needs, the average cost of debt reflects both the utility's financial strength and the prevailing market interest rates at the time each bond series is issued. Therefore, the average cost of a utility's debt should be weighted based on the duration of payments and the amount of funds outstanding for each bond series. The cost of equity for an investor-owned utility represents its average cost of debt, as well as a risk premium and return on investment, or dividend for its investors. For a government utility, the cost of equity generally represents its average cost of debt and a risk premium. Once the average cost of debt and average cost of equity are determined for a utility, the WACC is determined by weighting the cost of debt and equity by the proportion of debt to equity as presented in the utility's balance sheet.

As mentioned previously, If the utility is governmental, the return is still appropriate, although the utility is "nonprofit." As with investor-owned utilities, the return is used to pay interest, and possibly, along with depreciation, retire principal on debt and fund certain capital items. In some instances, however, the dividend component for government utilities may be eliminated because a return or profit component may be excluded from revenue requirements. However, if the government utility has customers who are "non-owners" of the system, a return to the utility (such as the treasury bill rate or the municipality's current investment rate) may be appropriate to be charged to the non-owner customers.

The major advantage of the utility approach is that there is typically less interpretation when establishing revenue requirements than under the cash-needs approach. In other words, the utility approach provides for a less subjective methodology for identifying revenue requirements. A major disadvantage of the utility approach is that in a governmental environment, revenue requirements that would be recovered under the utility approach could be significantly more or less than is required for cash flow purposes.

When setting outside-city rates, use of the utility approach is most appropriate when there is a clear distinction between owner customers and non-owner customers because the utility approach allows for the development of rates that recover a return on the owner's investment in the system thereby compensating them for the risk incurred to construct the utility system. In cases where the distinction between owner and non-owner customers is not clear, for instance when the utility's legal or policy driven service area extends beyond the parent municipality's corporate limits, justification of a return on investment may be complicated by a number of factors.

Data Used In the Analysis

Data used for the analysis was derived from a variety of sources and brief descriptions of each data set are provided below:

- *Customer Demand Data* – Customer demand data for FY2019 was used for this analysis. However, detailed demand data regarding consumption within each of Tucson Water's rate tiers was not available for FY2019 so the FY2019 data was calibrated based on actual revenue generated by water sales to the Outside City Customers in FY2019. This calibration involved determining the percentage of consumption for customer classes with tiered rates that fell within each rate tier. These percentages were then applied to FY2019 demand to develop an approximation of consumption within each tier for FY2019.
- *Operation & Maintenance (O&M) Expenses* – O&M expenses were derived from Tucson Water's FY2019 budget. FY2019 was chosen as the test year because it was the rate year for cost of service analysis used to develop the rates currently in effect.
- *Rate Base and Depreciation* – Rate base and depreciation was determined using asset data from FY2019. Similar to the customer demand and O&M expense data, FY2019 was chosen as the test year because existing rates are based on FY2019 data. Additionally, asset data that excluded contributed capital was readily available for FY2019.
- *Cost of Capital*- Tucson Water's weighted average cost of debt was based on outstanding water debt as of July 1, 2020 included in "City of Tucson, Arizona; 2020-21 Summary of Outstanding Debt" prepared by Piper/Sandler.

Revenue Requirements

For this analysis, revenue requirements for the entire Tucson Water system were determined using the utility approach and then a portion of the system revenue requirements were allocated to the Outside City Customers. Under the utility approach, a utility's revenue requirements are comprised of O&M expenses, depreciation, and a return on rate base.

Operation & Maintenance Expenses

As mentioned previously, for this analysis Tucson Water's O&M expense are based on the FY2019 budget. Costs associated with operating and maintaining the reclaimed water system were excluded from the analysis. A portion of the FY2019 budgeted O&M expenses are allocated to the Outside City Customers based on their proportionate share of consumption.

Schedule 1 shows the system O&M expenses and the allocation to Outside City Customers.

Rate Base

The rate base, or the value of the assets used to provide service to the Outside City Customers, was determined by first excluding the value of contributed assets from Tucson Water's net plant in service. Additionally, the value of all reclaimed water assets was excluded from rate base. The value of the remaining assets was then allocated between inside city customers and Outside City Customers based on each group's proportionate share of consumption.

Schedule 2 shows the development of rate base and the allocation to Outside City Customers.

Rate of Return

Given time constraints for the analysis, Raftelis did not perform a cost of capital study. As mentioned previously, the rate of return is typically set equal to the utility's WACC. As discussed previously, s utility's WACC is comprised of its weighted average cost of debt (WACD) and the cost of equity. The determination of Tucson Water's WACD is demonstrated in Schedule 3. As shown, Tucson Water's WACD is 4.57%.

Since Tucson Water is a municipally owned water system, it is difficult to determine a cost of equity. AWWA's M-1 manual suggests four different options for determining an appropriate cost of equity for municipally owned systems. These options include:

1. Base the cost of equity on the return allowed by regional regulatory bodies in recent rate cases for similar utilities.
2. Perform a discounted cash-flow analysis.
3. Use a risk-free rate with an appropriate risk premium.
4. Use a multiplier on top of the WACD.

Given the time constraints for performing the analysis the only feasible option was to use recently allowed costs of equity for water utilities regulated by the Arizona Corporation Commission as a proxy for Tucson Water's cost of equity. However, review of recent rate cases did not reveal any decisions for utilities that would be considered similar to Tucson Water. Therefore, it was decided to calculate cost justified outside differentials using a range of cost of equity values. Research of recent ACC rate cases did reveal a wide range of approved rates of return on rate base. Given this information it was decided to calculate outside city differentials using cost of equity values ranging between 5% and 10%.

In order to recognize that Outside City Customers have contributed to the equity in the system by virtue of paying rates and system equity fees that funded the assets that comprise the system, the calculation of system equity includes a downward adjustment commensurate with the Outside City customer's share of revenue.

Schedule 3 shows the development of the rate of return on rate base.

Depreciation

Depreciation was derived from Tucson Water's asset records and only depreciation on those assets included in rate base was included in the system revenue requirements. Similar to O&M expenses and rate base, depreciation was allocated to Outside City Customers based on consumption.

Table 1 below shows the revenue requirements under five different cost of equity scenarios.

Table 1
Outside City Revenue Requirements Under Various Cost of Equity Assumptions

	Cost of Equity					
	5.0%	6.0%	7.0%	8.0%	9.0%	10.0%
Operation & Maintenance Expenses	$ 35,834,858	$35,834,858	$35,834,858	$35,834,858	$35,834,858	$35,834,858
Depreciation	$ 8,750,060	$ 8,750,060	$ 8,750,060	$ 8,750,060	$ 8,750,060	$ 8,750,060
Return on Rate Base	$ 17,601,576	$19,897,029	$22,192,482	$24,487,935	$26,783,388	$29,078,841
Total Outside City Revenue Requirements	**$ 62,186,494**	**$64,481,947**	**$66,777,400**	**$69,072,853**	**$71,368,307**	**$73,663,760**

Determination of Outside City Differential

To determine the appropriate outside city differential, outside city revenue requirements are compared to the revenue that is generated by Outside City Customers at the existing rates that are assessed to all customers, both inside and outside the city limits. The percent difference between these two values is the percent increase to existing rates that would be required for revenue from Outside City Customers to equal outside city revenue requirements. Table 2 below shows the resulting outside differentials under each cost of equity assumption.

Table 2
Outside City Differential Under Various Cost of Equity Assumptions

	Cost of Equity					
	5.0%	6.0%	7.0%	8.0%	9.0%	10.0%
Outside City Revenue Under Existing Rates	$ 58,607,302	$58,607,302	$58,607,302	$58,607,302	$58,607,302	$58,607,302
Outside City Revenue Requirements	$ 62,186,494	$64,481,947	$66,777,400	$69,072,853	$71,368,307	$73,663,760
Cost Justified Differential	**6.1%**	**10.0%**	**13.9%**	**17.9%**	**21.8%**	**25.7%**

Conclusions

Results of the limited analysis described in this memo indicate that by using standard industry practices for determining rates for outside city customers an outside city differential can be cost based, but that the magnitude of the justified differential is highly dependent upon the assumed value for Tucson Water's cost of equity. Additionally, a more detailed analysis of O&M expenses and rate base could yield different allocations of costs to the Outside City Customers resulting in outside city revenue requirements that are different from those that resulted from this analysis.

Phase 2 of this cost-of-service analysis will be to assess an outside city differential based on cost-of-service principles alone. It should be noted, however, that it is not uncommon for utilities to charge a higher rate to outside city customers on a policy basis and Arizona law allows for the assessment of higher outside city rates as long as the higher rates are "reasonable". That is the basis of the action already taken by the City of Tucson Mayor and Council. Measures of reasonableness may include comparisons of rate differentials in other communities, as well as general considerations of risk, ownership relationship, and cost of service. Recent surveys of other Arizona utilities indicate that many utilities that assess rates to outside city customers have no cost justification for the higher rates, and rate differentials range from 10% to 50%. This cost of service analysis is supplemental to the recently established policy basis for Tucson's differential rate.

TECHNICAL MEMORANDUM

To: John Kmiec, Interim Utility Director, Tucson Water

From: Harold Smith, Raftelis Financial Consultants, Inc.

Subject: Response to County Letter to Citizens' Water Advisory Committee

CC: Deborah Galardi, Galardi Rothstein Group

The purpose of this memorandum is to address certain technical issues raised by Pima County in its letter to the Citizens' Water Advisory Committee (CWAC) dated July 30, 2021. Specifically, the following items are addressed:

- The appropriateness of the use of the utility approach to determine the revenue requirements to be recovered from the Outside Customers
- Return on Equity issues, and
- Cost-of-service factors to be considered in the Phase 2 outside city differential analysis that is currently being conducted.

Appropriateness of Utility Basis for Municipal Utilities

The County states that the utility basis is designed for use by private utilities such that they can earn a return on their investment and generate a profit. While it is true that the utility approach is commonly used by investor owned utilities as the basis for determining rates, this is only one use of the methodology. For example, municipal utilities regulated by the Wisconsin Public Utility Commission are required to use the utility basis in the determination of rates. Additionally, municipal utilities across the country utilize the utility approach when calculating rates for outside-city and wholesale customers. Some examples include the utilities that serve Milwaukee, Wisconsin; Salt Lake City, Utah; Portland, Oregon and Oklahoma City, Oklahoma.

The County letter states that there is no basis for a municipal utility to use the utility approach when determining rates. In fact, it is not uncommon for municipal utilities to use the utility approach when determining rates, especially when setting rates for customers located outside the municipality's corporate boundaries. The American Water Works Association (AWWA), delineates the use of the utility approach by municipal utilities when calculating rates for outside city customers in its Manual of Water Supply Practices, M-1, *Principles of Water Rates, Fees and Charges*:

> *"Municipal or government-owned utilities may also use the utility-basis approach for purposes of cost allocation. It is considered an appropriate method for calculating the costs of service applicable to all classes of customers, but it is particularly applicable to those customers located outside the geographical limits of a government-owned utility. (Page 14, AWWA Manual M-1, Seventh Edition)*

Return on Equity

The County's letter states that the only basis for establishing a differential rate for a municipal utility, aside from differential infrastructure and operational costs, is if one class of customers incurs risk beyond that of another class. While it is true that differential rates of return may reflect differences in risks, they may be imposed to secure ownership benefits (irrespective of differential risks).

Again, from AWWA:

> *When a government-owned utility provides service to customers outside its geographical limits or corporate boundary, the situation is similar to the relationship of an investor-owned utility to its customers because the owner (political subdivision) provides services to nonowner customers (customers outside its geographical limits).* ***In this situation, the government-owned utility, like an investor-owned utility, is entitled to earn a reasonable return from nonowner customers based on the value of its plant investment required to serve those customers.*** *(Page 14, AWWA Manual M-1, Seventh Edition, emphasis added)*

Furthermore, the County questions application of ROE ranges to "outside City customers" on the basis that outside customers are being required to pay dividends to inside customers who "somehow hold a greater risk-based ownership stake in the utility". Yet, the fact is that as the serving municipal utility, the City of Tucson does own the assets – as reflected in financial statements, bond offering documents, etc. And, importantly, per the historical review, the outside City customers could not own such assets "due to the lack of enabling legislation for the County to operate a water utility." (p. 4.)

Phase 2 Analysis

The County letter provides a number of recommendations related to issues that should be addressed as part of the Phase 2 Outside City Differential Analysis that is currently being performed. The Phase 2 analysis will expand on the analysis conducted in Phase 1 to include customer service characteristics beyond annual water use (e.g., peak demands, number of accounts and meter equivalents, etc.) that formed the basis of the Phase 1 analysis. Furthermore, data available to support other operating and capital cost differences will be considered.

TECHNICAL MEMORANDUM

To: John Kmiec, Interim Utility Director, Tucson Water

From: Harold Smith, Raftelis Financial Consultants, Inc.

Subject: Phase 2 Outside Differential Analysis

CC: Deborah Galardi, Galardi Rothstein Group

On June 22, 2021, the City of Tucson (City) Mayor and Council approved a rate differential for Tucson Water customers located within unincorporated Pima County (Outside City Customers). This differential will be in addition to the rates assessed to all other customers (Inside City Customers). This decision was policy based and goes into effect on December 1, 2021. Mayor and Council further directed Tucson Water to conduct a cost-of-service analysis using standard industry practices to determine a potential cost basis for differential rates. The results of the cost-of-service analysis are supplemental to the policy basis already used to approve the differential rate. In making this decision to assess a higher rate, Mayor and Council made a policy decision that Outside City Customers would be considered "non-owners" of the Tucson Water system from a rate-setting perspective and should be assessed rates consistent with that status.

Tucson Water engaged Galardi Rothstein Group and Raftelis (GRG/Raftelis) to perform a cost-of-service analysis to assess various options for calculating rate differentials to be applied to non-owner customers. The Phase 1 analysis performed by GRG/Raftelis used readily available data to develop revenue requirements for the Tucson Water system. Using a utility basis structure, revenue requirements were allocated between Inside City Customers and Outside City Customers based solely on annual water use. The Outside City Customer revenue requirements were compared to the revenue generated by Outside City Customers under Tucson Water's existing rates. The difference between the calculated revenue requirements and revenue at existing rates serves as an approximation of a cost-based rate differential. The results of the Phase 1 analysis indicated outside city rate differentials ranging between 6.1% and 25.7%, depending on the cost of equity applied to Outside City Customers for determining a return on investment for Inside City Customers.

Upon completion of the Phase 1 analysis, Tucson Water tasked GRG/Raftelis with performing a Phase 2 analysis. Phase 2 involved exploring potential differences in the costs to serve Outside City Customers in more detail, and to narrow the range of returns on investment that could be used to calculate a differential rate. The results of the Phase 2 analysis are presented in this memo.

Overview of the Utility Basis with Differential Rates of Return Approach

As discussed in Chapter IV.1 of the American Water Works Association (AWWA) Manual of Water Supply Practices M-1 "Principle of Water Rates, Fees and Charges" (M-1 Manual), the utility basis with differential rates of return approach is an industry standard method of determining rates to be assessed to non-owner customers of a utility. This approach involves first determining the revenue requirements of the entire system using the cash-needs approach. The cash-needs revenue requirements include all costs necessary to provide utility service during the rate year and in the future. Cash-needs revenue requirements include O&M expenses, taxes, and capital costs (debt service and annual rate funded capital).

The next step is to recast the cash-needs capital requirements as utility basis revenue requirements (depreciation and a return on investment), and then determine the return on rate base that would be required to generate a return on investment equal to the cash-needs capital costs. The required return on investment is calculated by subtracting the annual O&M expenses and depreciation from the cash-needs revenue requirements. An imputed rate of return on rate base is then calculated by dividing the required return by the rate base.[1]

Next, in order to recognize the owner/non-owner relationship, differential rates of return are developed for Inside City and Outside City Customers to generate an equivalent overall return on investment sufficient to meet the annual cash-needs revenue requirements.

Finally, the utility basis O&M and capital components are allocated between Inside City Customers and Outside City Customers based on the different usage characteristics and ownership status of the two groups of customers. The allocated costs of both groups of customers are divided by their respective annual water usage to determine an overall unit cost of service for each group. The difference between the Inside City unit cost of service and the Outside City unit cost of service represents the cost-based rate differential for Outside City Customers.

Data Used in the Analysis

Data used for the analysis were derived from a variety of sources. Brief descriptions of each data set are provided below. It should be noted that data used in the Phase 1 analysis was further refined in Phase 2 to represent Outside City Customer characteristics more precisely. New data were developed in Phase 2 to allow for consideration of additional usage characteristics as outlined below.

- *Customer Data* – Customer data, including monthly consumption by customer class and meter counts by meter size and customer class, was available for FY2021 and prior years. The data was coded according to whether it was in an incorporated or unincorporated area of Pima County. With a few exceptions, all customers located in unincorporated areas within Tucson Water's service area are considered Outside City Customers. Policy-based exceptions include customers located in Tribal areas (e.g., Pascua Yaqui, Tohono O'odham) and Tucson Unified School District (TUSD) customers, both of which are considered Inside City customers for the purposes of this analysis.

- *System and Customer Peaking Data* – Average day, max day, max hour, and max month system production data was used to determine three-year averages of max day to max month (MD:MM) and max hour to max month (MH:MM) ratios. These system ratios were then applied to the maximum month to average month use ratio for each customer class to determine Inside City and Outside City Customer class peaking factors, consistent with Tucson Water's typical rate-setting process. The peaking factors are used to allocate peak-related operating expenses and net plant revenue requirements between Inside City and Outside City Customers.[2]

[1] Rate base equals the original cost of the assets less contributions and accumulated depreciation.
[2] The allocations of individual line-item O&M cost and net plant investment categories to service characteristics (average demand, peak demand, etc.) is based on the most recent Tucson Water rate process conducted in FY2019-20.

- *Distribution Lines* – Data on inch-miles of distribution pipeline for Inside City and Outside City Customers were provided by Tucson Water based on GIS data. For the purposes of this analysis, distribution lines for Outside City customers are defined as 8-inch diameter and smaller pipes located in the unincorporated service area. The respective inch-miles of Inside and Outside pipeline are used to allocate distribution-related maintenance expenses and net plant revenue requirements between Inside City and Outside City customers.

- *Cash Basis Revenue Requirements*– O&M and capital expenses (debt service and cash funded capital) net of non-rate revenues reflect a FY2020-21 test year, as it was the most recent year a cost-of-service analysis was conducted, and customer data was available.

- *Rate Base and Depreciation* – Rate base and annual depreciation was determined using asset data from FY2019-20, as it was the most recent fixed asset dataset available. The FY2019-20 fixed asset data was used to determine total Net Plant (the value of assets less contributed capital and accumulated depreciation). Revenues generated from system equity fees were also deducted from the Net Plant value, yielding total rate base which was then allocated between Inside City and Outside City Customers based on relevant service characteristics for each type of asset. System equity fee revenues were also attributed to Inside City and Outside City Customers as reported by Tucson Water's financial system.

Cash-Needs Revenue Requirements

Each component of the FY2020-21 Test Year (Test Year) revenue requirements is summarized below.

Operation & Maintenance Expenses

Tucson Water's budget includes projected expenses associated with operating, maintaining, and repairing the infrastructure used to provide water service. For the purposes of this analysis, O&M expenses related to the Reclaimed system have been excluded since a portion of Reclaimed expenses are recovered through Reclaimed rates, and this analysis is focused only on rates for potable water. In addition, a portion of Tucson Water's O&M expenses are offset by revenue from other sources. After exclusion of the Reclaimed expenses and adjusting for non-rate revenue, net O&M expenses to be included in revenue requirements are $112,539,677.

Table 1 on the following page provides a summary of net O&M expenses.

Table 1 – Net Operation & Maintenance Expenses

Director's Office	$ 6,523,190
Customer Services	10,154,100
Business Services	6,294,550
Water Quality and Operations	48,617,890
Planning & Engineering	9,034,690
Maintenance	30,712,260
Other Budgetary Requirements	23,963,040
Total O&M	$135,299,720
Less: Reclaimed Costs	(5,917,643)
Less: Non-Rate Revenue	(16,842,400)
Net O&M Expenses	$112,539,677

Taxes

Also included in Tucson Water's budget are two tax expenses: a Utility Tax expense and a Payment in Lieu of Taxes (PILOT) expense. The Utility Tax is a payment to the City equal to 4.5% of revenue generated from water sales from customers located inside the city limits. The PILOT, as the name implies, is a payment to the City in lieu of property taxes. The PILOT is based on the value of the assets located within the City. These two tax expenses total $8,489,736.

Table 2 provides a summary of tax expenses.

Table 2 – Tax Expenses

Utility Tax	$ 6,489,736
PILOT	2,000,000
Total Taxes	$ 8,489,736

Capital Expenses

Capital expenses included in revenue requirements consist of Tucson Water's debt service payments (both principal and interest) plus budgeted annual costs associated with projects funded with rate revenues. Capital expenses related to Reclaimed projects were excluded for the reason discussed above. Capital expenses included in revenue requirements are $101,562,771.

Table 3 on the following page provides a summary of net capital expenses.

Table 3 – Net Capital Expenses

Bond Debt Service Payments	$ 58,908,186
Capital Improvements from Annual Revenues	63,750,000
Capitalizable Equipment	2,250,000
Additions to Working Capital	(7,996,433)
Total Capital Costs	$ 116,911,752
Less: Reclaimed Capital Costs	$ (10,973,981)
Less: Non-Rate Revenue	$ (4,375,000)
	$ 101,562,771

As shown below in Table 4, Tucson Water's Test Year cash-needs potable water revenue requirements are $222,592,184.

Table 4 – Cash-Needs Revenue Requirements

Operation & Maintenance Expenses	$112,539,677
Utility Tax	6,489,736
Pilot/In Lieu of Property Tax	2,000,000
Capital Requirements	101,562,771
Total Revenue Requirements	$ 222,592,184

Imputed Rate of Return

The first step in determining the imputed rate of return is to recast Tucson Water's cash-needs revenue requirements as utility basis revenue requirements, as described previously. Annual depreciation is derived from Tucson Water's fixed asset records and the required return on rate base is determined by subtracting O&M expenses and depreciation from the cash-needs revenue requirements. The remainder is the required return on rate base necessary to ensure that Tucson Water can meet its annual cash needs.

Tucson Water's Test Year utility basis revenue requirements related to potable water are shown below.

Table 5 – Utility Basis Revenue Requirements

Operation & Maintenance Expenses	$ 112,539,677
Utility Tax	6,489,736
Pilot/In Lieu of Property Tax	2,000,000
Depreciation	29,691,941
Required Return on Investment	71,870,830
	$ 222,592,184

Imputed Rate of Return

As discussed earlier, the potable water rates that Tucson Water assesses to its customers must generate $222,592,184 in revenue, which under the utility basis includes a $71,870,830 return on rate base. By dividing the required return on rate base by Tucson Water's rate base, an imputed rate of return can be determined. This imputed rate of return is the rate of return that would need to be used to calculate

rates for all of Tucson Water's customers if Tucson Water's rates were determined using the utility basis. Calculation of the imputed system-wide rate of return is show below.

Calculation of Imputed Rate of Return

Required Return on Rate Base	$	71,870,830
Divided by Rate Base	$	810,386,764
		8.87%

Allocation of Utility Basis Revenue Requirements

The next step in the process is the allocation of the utility basis revenue requirements between the Inside City Customers and Outside City Customers. For this analysis, total O&M expenses, depreciation, and rate base were allocated to each customer group based on service characteristics, following the Base/Extra Capacity allocation approach used in prior Tucson Water cost-of-service analyses. The costs by service characteristic are then allocated to the Outside City Customers and Inside City Customers based on their service requirements. Schedules summarizing the allocation of O&M expenses, depreciation and rate base can be found in Appendix A to this memo.

Allocation to Base/Extra Capacity Cost Categories

O&M and capital costs are allocated to service characteristic categories in a manner consistent with the way in which they are allocated during Tucson Water's regular rate setting process. It should be noted that costs allocated to the "Readiness-To-Serve" category are primarily costs associated with Tucson Water's distribution system. Both readiness-to-serve O&M and capital costs associated with distribution assets are allocated between the Inside City and Outside City customer groups based on inch-miles of mains.

Schedule 1 shows the allocation of O&M costs to Base/Extra Capacity cost categories.

Schedules 2 and 3 show the allocation of depreciation and rate base to service characteristic categories.

Allocation to Inside City and Outside City Customers

Once O&M costs, depreciation and rate base have been allocated to service characteristic categories, they are then allocated between Inside City Customers and Outside City Customers using the allocation factors shown in Table 6 on the following page.

Table 6 – Inside City and Outside City Allocation Factors

Allocation Factors	Inside	Outside
Usage	73.07%	26.93%
Max Day	70.43%	29.57%
Max Hour	72.27%	27.73%
Customer Accounts	71.62%	28.38%
Meter Equivalents	73.44%	26.56%
Inch-Miles	63.65%	36.35%
All Inside	100.00%	0.00%
Neither	0.00%	0.00%
O&M	71.70%	28.30%
Assets	70.70%	29.30%
Depreciation	71.13%	28.87%

Base O&M Costs, Depreciation and Rate Base – Allocated based on total annual consumption using the Usage allocation factor.

Max Day O&M Costs, Depreciation and Rate Base – Allocated based on the Max Day demands of each customer group using the Max Day allocation factor.

Max Hour O&M Costs, Depreciation and Rate Base – Allocated based on the Max Hour demands of each customer group using the Max Hour allocation factor.

Meters and Services O&M Costs, Depreciation and Rate Base – Allocated based on the number of 5/8" meter equivalents using the Meter Equivalents allocation factor.

Billing O&M Costs, Depreciation and Rate Base – Allocated based on the number of customer accounts using the Customer Accounts allocation factor.

Readiness-To-Serve O&M Costs, Distribution Depreciation and Distribution Rate Base – Allocated based on inch-miles of distribution pipe 8" inches or less in diameter using the Inch-Miles allocation factor. This allocation factor recognizes that more distribution system piping per customer is required to serve Outside City Customers, based on data provided by Tucson Water.

Fire Protection O&M Costs, Depreciation and Rate Base – Since Tucson Water recovers its fire protection costs through its fixed monthly service charge (consistent with industry practice), these costs are allocated based on the number of 5/8" meter equivalents using the Meter Equivalents allocation factor.

CAP O&M Costs, Depreciation and Rate Base – Allocated based on the total annual consumption using the Usage allocation factor.

Reclaimed O&M Costs, Depreciation and Rate Base – As discussed previously, costs associated with the reclaimed system are excluded from this analysis and are not allocated to either customer group.

After rate base has been allocated between the Inside City and Outside City customer groups, rate base is adjusted to recognize the investment in the system made by both groups through the payment of System Equity Fees.

The results of the process to allocate O&M costs, depreciation and rate base between the Inside City and Outside City Customer groups are shown in Schedules 4, 5, and 6. Rate base is adjusted to recognize contributions made through the payment of System Equity Fees is shown in Schedule 7.

The detailed allocation of O&M expenses indicates that 71.70% of the O&M component of the utility basis revenue requirements should be allocated to Inside City Customers and 28.30% should be allocated to Outside City Customers.

The detailed allocation of depreciation indicates that 71.13% of depreciation should be allocated to Inside City Customers and 28.87% should be allocated to Outside City Customers.

The Utility Tax expense is allocated 100% to Inside City Customers since this tax is only assessed to customers living within the city limits.

The PILOT is allocated between Inside City Customers and Outside City Customers based on the allocation of assets to each group. While the amount of the PILOT is based on the value of Tucson Water assets located within the City, these assets are used to serve all customers and therefore both customer groups contribute to the recovery of this expense. 70.07% of the PILOT is allocated to Inside City Customers and 29.30% is allocated to Outside City Customers.

Once O&M costs, depreciation and taxes have been allocated between the Inside City Customers and the Outside City Customers, the next step in the process is to determine the allocation of the required return on investment. As discussed previously, the total return on rate base that must be recovered from rates is $71,870,830. The rate of return required to generate this return from the system as a whole is 8.87%.

The use of the “utility basis with differential rates of return” approach allows for the recognition of the risks borne by the Inside City owners by applying a higher rate of return to the rate base allocated to Outside City Customers. Given that Tucson Water’s Outside City differentials were established based on policy, a range of rate of return differentials were analyzed. Each rate of return scenario involved applying a rate of return to the rate base allocated to each customer group such that the combined return on rate base was equal to the required return for the system as a whole.

Finally, the respective rate of return values for Inside and Outside City were added to the other allocated revenue requirements to determine the total requirements for each group under the various rate of return scenarios. The total requirements of each group were then divided by the annual consumption for that group to arrive at a unit cost of service for each group. The difference between the calculated unit cost for each group under each rate of return scenario is the calculated rate differential based on the cost-of-service analysis. Table 7 on the following page shows the unit costs and cost-of-service based differentials resulting from rate of return (ROR) differentials ranging from 1% to 5% in 0.5% increments.

Table 7 – Range of Rate Differentials

ROR Differential	1.00%	1.50%	2.00%	2.50%	3.00%	3.50%	4.00%	4.50%	5.00%
Inside City ROR	8.57%	8.43%	8.28%	8.13%	7.98%	7.83%	7.69%	7.54%	7.39%
Outside City ROR	9.57%	9.93%	10.28%	10.63%	10.98%	11.33%	11.69%	12.04%	12.39%
Inside City Unit Cost	$5.33	$5.30	$5.28	$5.25	$5.22	$5.19	$5.16	$5.13	$5.11
Outside City Unit Cost	$5.82	$5.90	$5.98	$6.05	$6.13	$6.21	$6.28	$6.36	$6.44
Outside City Differential	9%	11%	13%	15%	17%	20%	22%	24%	26%

As shown in Table 7, depending on the differential in the rate of return between Inside City and Outside City Customers, cost-based rate differentials range between 9% and 26%. The choice of an appropriate rate of return differential is a policy decision; however, it should be noted that even if there is no rate of return differential, there is still a cost-based differential of approximately 5%. This 5% differential is driven by the higher peak demands of the Outside City Customers as well as the greater relative cost of constructing, operating, and maintaining the distribution system that serves the Outside City Customers.

Appendix A to Phase 2 Outside City Differential Analysis

Appendix A – Cost Allocation Schedules

Schedule 1 – Allocation of O&M Expenses to Base/Extra Capacity Cost Categories

Operating and Maintenance Expenses - Total

	Total	Base	Max Day	Max Hour	Meters/Services	Billing	Readiness-to-Serve	Fire Protection	CAP
Director's Office	$ 6,295,797	$ 2,077,307	$ 645,282	$ 40,778	$ 196,454	$ 2,645,059	$ 511,732	$ 179,185	$ -
Customer Services	10,154,100	-	-	-	-	10,154,100	-	-	-
Business Services	6,240,915	380,835	86,719	9,618	46,337	5,554,438	120,702	42,264	-
Water Quality and Operations	44,480,047	22,924,267	3,682,713	452	14,675	-	18,788	853,452	16,985,700
Planning & Engineering	7,942,589	3,332,881	1,693,350	1,485,387	680,328	-	440,417	310,226	-
Maintenance	30,424,437	9,372,266	3,217,096	403,888	4,070,775	-	10,549,885	2,810,527	-
Other Budgetary Requirements	23,844,191	5,730,095	233,558	(878,914)	103,916	2,014,335	1,664,195	467,445	14,509,560
Total O&M	$ 129,382,077	$ 43,817,652	$ 9,558,718	$ 1,061,210	$ 5,112,485	$ 20,367,932	$ 13,305,719	$ 4,663,100	$ 31,495,260

Schedule 2 - Allocation of Depreciation to Service Characteristic Categories

	Total	Base	Max Day	Max Hour	Meters/Services	Billing	Distribution	Direct Fire Protection
Depreciation - Total								
Land	$ 46,021	$ 28,763	$ 17,258	$ -	$ -	$ -	$ -	$ -
Wells	$ 3,827,681	2,392,301	1,435,380	-	-	-	-	-
CAP/Hayden Udall WTP	$ 2,387,329	1,492,081	895,248	-	-	-	-	-
Reclaimed Water System	$ -	-	-	-	-	-	-	-
Buildings	$ 1,115,886	697,429	418,457	-	-	-	-	-
Pumping Equip. - Well Related	$ 454,894	284,309	170,585	-	-	-	-	-
Pumping Equip. - Other	$ 450,869	281,793	169,076	-	-	-	-	-
Tanks and Reservoirs	$ 4,042,908	1,443,896	-	2,599,012	-	-	-	-
Transmission Mains	$ 4,499,905	2,812,441	1,687,464	-	-	-	-	-
Distribution Mains	$ 4,570,911	-	-	-	-	-	4,570,911	-
Services and Meters	$ 4,529,616	-	-	-	4,529,616	-	-	-
Hydrants	$ 770,281	-	-	-	-	-	-	770,281
General Plant	$ 2,995,640	1,214,774	617,195	541,396	503,770	-	-	118,505
Total Depreciation	$ 29,691,941	$ 10,647,785	$ 5,410,664	$ 3,140,408	$ 5,033,386	$ -	$ 4,570,911	$ 888,786

Appendix A – Cost Allocation Schedules

Schedule 3 - Allocation of Rate Base to Service Characteristic Categories

	Total	Base	Max Day	Max Hour	Meters/Services	Billing	Distribution	Direct Fire Protection
Rate Base -Total								
Land	$ 45,540,395	$ 28,462,747	$ 17,077,648	$ -	$ -	$ -	$ -	$ -
Wells	90,582,823	56,614,264	33,968,559	-	-	-	-	-
CAP/Hayden Udall WTP	47,251,680	29,532,300	17,719,380	-	-	-	-	-
Reclaimed Water System	-	-	-	-	-	-	-	-
Buildings	21,354,533	13,346,583	8,007,950	-	-	-	-	-
Pumping Equip. - Well Related	12,806,625	8,004,141	4,802,485	-	-	-	-	-
Pumping Equip. - Other	7,452,824	4,658,015	2,794,809	-	-	-	-	-
Tanks and Reservoirs	133,677,709	47,742,039	-	85,935,670	-	-	-	-
Transmission Mains	172,152,798	107,595,499	64,557,299	-	-	-	-	-
Distribution Mains	164,709,257	-	-	-	-	-	164,709,257	-
Services and Meters	88,048,688	-	-	-	88,048,688	-	-	-
Hydrants	30,398,590	-	-	-	-	-	-	30,398,590
General Plant	23,027,385	9,337,928	4,744,357	4,161,697	3,872,461	-	-	910,942
Total Rate Base	$ 837,003,306	$ 305,293,515	$ 153,672,486	$ 90,097,367	$ 91,921,149	$ -	$ 164,709,257	$ 31,309,531

Schedule 4 – Allocation of O&M Costs Between Inside City and Outside City Customer Groups

Operating and Maintenance Expenses - Allocated to Inside-City

	Total	Base	Max Day	Max Hour	Meters/Services	Billing	Readiness-to-Serve	Fire Protection	CAP
Director's Office	$ 4,497,740	$ 1,517,838	$ 454,484	$ 29,471	$ 144,274	$ 1,894,373	$ 325,708	$ 131,592	$ -
Customer Services	7,272,297	-	-	-	-	7,272,297	-	-	-
Business Services	$ 4,466,240	278,267	61,078	6,951	34,030	3,978,050	76,825	31,039	-
Water Quality and Operations	$ 32,404,867	16,750,202	2,593,799	327	10,777	-	11,958	626,768	12,411,036
Planning & Engineering	$ 5,709,201	2,435,254	1,192,656	1,073,518	499,627	-	280,318	227,827	-
Maintenance	$ 21,174,226	6,848,086	2,265,857	291,898	2,989,542	-	6,714,816	2,064,027	-
Other Budgetary Requirements	$ 17,239,399	4,186,841	164,499	(635,208)	76,315	1,442,653	1,059,231	343,288	10,601,781
Total Inside-City O&M	$ 92,763,970	$ 32,016,487	$ 6,732,373	$ 766,957	$ 3,754,565	$ 14,587,374	$ 8,468,856	$ 3,424,540	$ 23,012,817

Operating and Maintenance Expenses - Allocated to Outside-City

	Total	Base	Max Day	Max Hour	Meters/Services	Billing	Readiness-to-Serve	Fire Protection	CAP
Director's Office	$ 1,798,057	$ 559,470	$ 190,799	$ 11,307	$ 52,180	$ 750,686	$ 186,023	$ 47,593	$ -
Customer Services	$ 2,881,803	-	-	-	-	2,881,803	-	-	-
Business Services	$ 1,774,675	102,568	25,641	2,667	12,308	1,576,388	43,877	11,226	-
Water Quality and Operations	$ 12,075,180	6,174,065	1,088,914	125	3,898	-	6,830	226,684	4,574,664
Planning & Engineering	$ 2,233,388	897,626	500,694	411,869	180,701	-	160,099	82,399	-
Maintenance	$ 9,250,211	2,524,180	951,239	111,990	1,081,233	-	3,835,069	746,500	-
Other Budgetary Requirements	$ 6,604,792	1,543,255	69,059	(243,706)	27,601	571,682	604,964	124,157	3,907,779
Total Outside-City O&M	$ 36,618,107	$ 11,801,164	$ 2,826,345	$ 294,253	$ 1,357,920	$ 5,780,559	$ 4,836,863	$ 1,238,560	$ 8,482,443

Schedule 5 – Allocation of Depreciation Between Inside City and Outside City Customer Groups

	Total	Base	Max Day	Max Hour	Meters/Services	Billing	Distribution	Direct Fire Protection
Depreciation - Inside-City	$ 21,119,033	$ 7,780,076	$ 3,810,826	$ 2,269,635	$ 3,696,475	$ -	$ 2,909,305	$ 652,717
Depreciation - Outside-City	8,572,908	2,867,709	1,599,838	870,774	1,336,911	-	1,661,607	236,069
Total Depreciation	$ 29,691,941	$ 10,647,785	$ 5,410,664	$ 3,140,408	$ 5,033,386	$ -	$ 4,570,911	$ 888,786

Schedule 6 – Allocation of Rate Base Between Inside City and Outside City Customer Groups

	Total	Base	Max Day	Max Hour	Meters/Services	Billing	Distribution	Direct Fire Protection
Rate Base - Inside-City	$ 591,753,962	$ 223,070,513	$ 108,234,229	$ 65,115,131	$ 67,506,094	$ -	$ 104,834,546	$ 22,993,448
Rate Base - Outside-City	245,249,344	82,223,002	45,438,257	24,982,235	24,415,055	-	59,874,711	8,316,083
Total Rate Base	$ 837,003,306	$ 305,293,515	$ 153,672,486	$ 90,097,367	$ 91,921,149	$ -	$ 164,709,257	$ 31,309,531

Appendix A – Cost Allocation Schedules

Schedule 7 – Allocation of Rate Base Between Inside City and Outside City Customer Groups Adjusted for System Equity Fees

Rate Base Net of System Equity Fee Revenues:	
Net Plant - Inside-City	$ 570,943,150
Net Plant - Outside-City	239,443,614
Bate Base - Adjusted	$ 810,386,764

PIMA COUNTY
Sustainability, Conservation & Historic Preservation

MEMORANDUM

Date: June 4, 2021

To: Yves Khawam, Assistant County Administrator for Public Works
Linda Mayro, Director

From: Kathleen Chavez, Water Policy Manager

RE: **Arizona Municipal Water Utilities with Differential Water Rates**

As requested we have researched municipal water utilities that have adopted a differential rate to customers outside their jurisdiction. The League of Cities and Towns lists over 80 member cities and towns in Arizona. Of these, over 60 operate a municipal water utility according to the Arizona Department of Water Resources (ADWR). Many are in rural Arizona, but for this analysis we focused on 24 of the largest municipal water utilities, with the number of connections ranging from 1,300 in Buckeye to over 400,000 in Phoenix. The cities researched are in one of the state's active management areas, plus Flagstaff and Yuma, representing the most populous cities in Arizona.

- Of the 24 cities researched, 11 have differential rates and 13 do not. The city is incorrect when they say most jurisdictions have differential rates.

- The differential rates vary from a low of 10% to a high of 50%. Although the City of Phoenix is charging a 50% base and volumetric differential, their water rates are incredibly low. The average residential water bill is $18.78 per month, compared to the statewide median residential bill of $43.13 per month. Phoenix has 2,200 customers paying the differential rate. Their customer base is over 400,000. The average residential water bill outside the city limits is $28.17, still far below the statewide average. In comparison, a 50% base and volumetric differential charged by the City of Tucson would be $75.42 for single family residences.

- No municipal water utility has as many customers outside their jurisdiction as Tucson Water does.

- Scottsdale conducted a cost of service analyses for their differential rates determining it is 15% costlier to provide water service to customers outside the city. They deliver Carefree's CAP water through a wheeling agreement. They also charge higher rates to customers hauling water.

- The City of Buckeye considered differential rates in 2019 and conducted a cost of service analysis that included adjustments to the overall water rate structure, along with differential rates. Ultimately, the proposed rate package, including differential rates, was not approved due to concerns about the impact of increased landscape rates.

- Chandler and Tempe have had differential rates for some time and cost of service documentation is no longer available. The City of Chandler's differential rate was created as an effort to recoup some of the costs associated with debt service for facilities and infrastructure

that have not been paid for by city property taxes or system development fees over time. These individuals do not reside in Chandler and therefore do not pay these revenues to the city.

Table 1 lists municipal water providers with over 40,000 customers. Based on a review of published water rates for each municipality, five cities charge a differential rate, while four currently do not. Table 2 lists municipal water providers with less than 40,000 customers. Based on published water rates, six cities charge differential rates and nine do not.

In summary, cities charging differential rates justify them by noting customers outside the city limits pay no city property taxes and/or did not contribute to previous utility infrastructure debt. Other cities with differential rates have had them in place for some time and couldn't locate legacy cost of service studies.

Should you have any questions, please feel free to let me know.

Attachment

Arizona Municipal Water Utilities with Differential Rates

Table 1 – Municipal Water Providers in Arizona – Greater Than 40,000 Customers

Municipal Water Provider	Charging Differential Rate[1]	Based on Cost of Service	Base Charge[2]		Volume Charge[3]		Percent Outside City	Connections Outside City	Total Number Of Connections[4]
			Inside City	Outside City	Inside City	Outside City			
Phoenix	Yes	Unknown	$4.64	$6.96	$3.73	$5.60	0.5	2,200	427,354
Tucson	Proposed	No	$16.33	Same	$2.07	Same	34.0	86,750[5]	247,625
Mesa	No	NA	$28.52	Same	$3.24	Same			137,480
Scottsdale	Yes	Yes	$13.00	$14.95	$3.00	$3.45	1.7	1,500	87,000
Gilbert	No	NA	$16.30	Same	$1.20	Same			84,000
Chandler	Yes	Unknown	$9.05	$12.70	$1.60	$2.24	1.9	1,608	81,165
Glendale	Yes	Unknown	$12.00	$15.60	$2.66	$3.46	1.2	747	63,000
Peoria	No	NA	$16.46	Same	$1.19	Same	0.1		47,872
Tempe	Yes	Unknown	$13.15	$17.10	$2.83	$3.68	4.5	1,800	40,000

[1] Each city publishes water and sewer rates on their websites, including differential rates, if any
[2] Based on 5/8" residential service
[3] Volume charges using lowest tier assessed per 1,000 gallons, except Tucson are per hundred cubic feet
[4] Estimated number of connections obtained from the Arizona Water and Wastewater Rates Dashboard published by the Water Infrastructure Finance Authority of Arizona. Connections may not be identical to the number of customers, but is a close approximation. Average residential water bills are also available on the dashboard
[5] 71,260 customers are in unincorporated Pima County and 15,490 customers are in other jurisdictions

Table 2 – Municipal Water Providers in Arizona – Less Than 40,000 Customers

Municipal Water Provider	Charging Differential Rate[6]	Base Charge[7]		Volume Charge[8]		Total Number of Connections[9]
		Inside City	Outside City	Inside City	Outside City	
Yuma	Yes	$16.15	$21.48	$1.42	$1.89	32,641
Queen Creek	No	$18.33	Same	$1.77	Same	26,287
Avondale	No	$11.87	Same	$1.21	Same	23,721
Prescott	Yes	$14.96	$19.45	$4.26	$5.54	22,327
Prescott Valley	No	$9.00	Same	$3.21	Same	21,087
Surprise	No	$28.82	Same	$2.37	Same	18,725
Goodyear	Yes	$18.54	$23.18	$2.15	$2.69	18,227
Oro Valley	No	$18.26	Same	$2.34	Same	17,499
El Mirage	No	$19.77	Same	$3.55	Same	11,517
Marana	No	$16.84	Same	$3.32	Same	7,873
Florence	Yes	$29.00	$37.70	$1.84	$2.28	3,593
Eloy	No	$19.13	Same	$3.06	Same	2,876
Tolleson	Yes	$14.00	$18.20	$3.72	$4.84	1,814
Flagstaff	Yes	$16.64	$18.30	$4.62	$5.08	1,600
Buckeye	No	$32.91	Same	$2.97	Same	1,345

[6] Each city publishes water and sewer rates on their websites, including differential rates, if any
[7] Based on 5/8" residential service
[8] Volume charges using lowest tier assessed per 1,000 gallons
[9] Estimated number of connections obtained from the Arizona Water and Wastewater Rates Dashboard published by the Water Infrastructure Finance Authority of Arizona. Connections may not be identical to the number of customers, but is a close approximation. Average residential water bills are also available on the dashboard

TUCSON WATER

Trending of Incorporated vs Unincorporated Consumption

Customers in unincorporated County use 43% more water on average than City customers

Average monthly residential water use

- System-wide = 8 CCF*
- City customer = 7 CCF
- County customer = 10 CCF

*1 CCF is 100 cubic feet of water or 748 gallons. This is the unit of measurement we use for our water rates and billing.

Unincorporated

Row Labels	Average of Meter Reading Total Consumption Average	Count of Location Rate Class
TU	10.3	71,515
Grand Total	**10.3**	**71,515**

Incorporated

Row Labels	Average of Meter Reading Total Consumption Actual2	Count of Location Rate Class
MA	7.5	11,999
MT	9.2	1,143
OV	9.3	1,183
ST	7.1	1,310
TU	7.1	159,182
Grand Total	**7.2**	**174,817**

TUCSON WATER

Impacts of the Differential on Consumption

Single Family

Single Family Residential

	Incorporated (Ccfs/month)	% Chg	Unincorporated (Ccfs/month)	% Chg	Unincorporated Difference
Pre Differential	7.2		10.3		43%
CY21*	7.8	8%	11.0	7%	41%
CY22	7.0	-10%	9.8	-11%	40%
CY23**	6.6	-6%	8.9	-9%	35%

*Differential went into effect December 2021

**Differential discontinued November 2023

Commercial

Commercial

	Incorporated (Ccfs/month)	% Chg	Unincorporated (Ccfs/month)	% Chg	Unincorporated
Pre Differential	45.7		48.1		5%
CY21*	47.5	4%	51.7	7%	9%
CY22	46.7	-2%	48.0	-7%	3%
CY23**	44.7	-4%	43.1	-10%	-4%

*Differential went into effect December 2021

**Differential discontinued November 2023

TUCSON WATER

Overall Consumption Trending

Overall Consumption					
	Incorporated (annual Ccfs)	% Chg	Unincorporated (annual Ccfs)	% Chg	% Unincorporated
Pre Differential	26,800,633		10,222,059		28%
CY21*	28,862,950	8%	11,059,716	8%	28%
CY22	27,386,187	-5%	9,828,657	-11%	26%
CY23**	26,171,759	-4%	8,905,263	-9%	25%
*Differential went into effect December 2021					
**Differential discontinued November 2023					

Overall Services					
	Incorporated Accounts (annual avg)	% Chg	Unincorporated Accounts (annual avg)	% Chg	% Unincorporated
Pre Differential	167,428		66,099		28%
CY21*	169,230	1%	66,601	1%	28%
CY22	170,919	1%	66,395	0%	28%
CY23**	172,115	1%	66,337	0%	28%
*Differential went into effect December 2021					
**Differential discontinued November 2023					

TUCSON WATER

Table 6 – Inside City and Outside City Allocation Factors

Allocation Factors	Inside	Outside
Usage	73.07%	26.93%
Max Day	70.43%	29.57%
Max Hour	72.27%	27.73%
Customer Accounts	71.62%	28.38%
Meter Equivalents	73.44%	26.56%
Inch-Miles	63.65%	36.35%
All Inside	100.00%	0.00%
Neither	0.00%	0.00%
O&M	71.70%	28.30%
Assets	70.70%	29.30%
Depreciation	71.13%	28.87%

Thoughts for Discussion:

- The differential appears to have had impact on consumption in unincorporated areas where it was in effect.
- Could changes in consumption potentially weaken the justification for a differential?
- What is the best way to move forward with a cost-based differential on the basis of updated data?
- If, in future years, a differential drives consumption behaviors to be more closely aligned between incorporated and unincorporated areas, does there remain material justification for continuing to charge a differential on the basis of:
    - Differences in distribution piping
    - Peaking
    - Risk-based premium

TUCSON WATER

City of Tucson Differential Analysis

Third SME Meeting

July 29, 2024

Attendees:

Tucson Water Representatives:

Silvia Amparano, Tucson Water Deputy Director

Chris Avery, Assistant City Attorney

Amber Kerwin, Rates and Revenue Manager

Tucson Water Contracted Rate Consultants:

Deb Galardi, Principal, Galardi Rothstein Group

Harold Smith, Vice President, Raftelis

Subject Matter Experts:

Michael Matichich, Economic and Financial Consulting Team Lead, Jacobs

Shawn Koorn, Associate Vice President/Senior Professional Associate, HDR

Bart Foster, President, Foster Group

Dan Jackson, Vice President, Willdan Financial Services

Agenda

1.) Discussion of Draft Report
   a. Final comments/suggestions

2.) Discussion of Rate Methodology Options – Harold Smith

3.) Next Steps:
   a. Incorporate methodology options feedback into draft report – 8/2
   b. Distribute final draft report to panel for review/edits – 8/5 – 8/16

Preliminary Framework For Outside-City Rate Methodology

Basic Revenue Requirement Structure Option: Hybrid Approach – Utility Basis with Cash Residual

See description of basic structure options attached. The specific hybrid approach could be determined following consultation with a cost of capital expert to determine preference for development of single rate of return for outside-city ("Utility Basis with Cash Residual"), or if it is advantageous to determine an overall imputed rate of return and then a basis for a differential rate of return for outside-city ("Utility Basis with Rate of Return Differential").

Other Elements of Framework

Determination of Outside-City Rate Base

Rate base = plant in service less contributed capital. The previous differential analysis determined outside-city rate base following a 2-step process:

1. Plant in service net of depreciation and contributed capital is allocated to system service characteristics (base, max day, max hour, etc.)
2. Plant in service value by service characteristic is allocated to outside-city in proportion to units of service estimated for each characteristic.

    Question for SME panel (and Tucson Water staff): Are there any refinements or other approaches recommended for consideration, for example:

    - Relative need for reserve capacity as opposed to actual use as basis for determining service units?
    - Individual assets – are there facilities that should be allocated specifically to inside or outside-city customers?
    - Should rate base be valued based on original cost or replacement cost?

Determination of Rate of Return

1. Contract with a cost of capital expert to determine defensible outside-city rate of return specifically for Tucson Water.
2. Application of rate of return to rate base:
    - Consider excluding distribution assets from outside-city rate base (for purposes of developing rate of return) given lack of information on contributed capital?

Development of O&M cost factors

1. For purposes of determining proportionate cost responsibility for distribution maintenance, determine inch-diameter miles of water mains used to serve inside vs. outside-city customers from hydraulic modeling analysis (conducted by either Tucson Water or an outside contractor.) Example from Providence, Rhode Island

2. Confer with utility staff to determine any other bases for service characteristics to evaluate in context of differential analysis, for example:
    - Fire protection
    - Elevation (pumping, storage)
    - Others?

Peaking Factors

Estimated based on monthly water use data consistent with AWWA M1 Manual approach given data limitations (no AMR data).

Description of Basic Revenue Requirement Structure Options

Cash Needs

- Develop revenue requirements using cash needs approach
- Create new set of customer classes for outside-city customers
- Allocate costs to inside and outside-city customer classes consistent with current allocation approach, with refinement to include additional cost factors determined in consultation with TW staff (e.g., pipe maintenance costs allocated to customer areas based on inch-diameter miles)
- Rate design could be the same for inside and outside or different to support different policies (e.g. more aggressive inclining block volumetric structure for outside-city to strengthen conservation message)

PROS:

+ Consistent with historical approach to rate setting
+ Appears more equitable
+ Reduced risk of legal challenge
+ No need to determine rate of return
+ Requires minimal rework of rate model

CONS:

– May limit effectiveness in promoting City Council policy objectives

Hybrid Approach- Utility Basis with Cash Residual

- Develop system revenue requirements using the cash needs approach
- Determine outside-city revenue requirements using utility approach
- Determine appropriate rate of return for outside-city rates
- Deduct outside-city revenue requirements from inside-city revenue requirements
- Rate design could be the same for inside and outside or different to support different policies (e.g. more aggressive inclining block volumetric structure for outside-city to strengthen conservation message)

PROS:

+ Recognizes risk associated with serving outside-city customer
+ No need for modifications to existing rate model
+ Determination of inside-city rates consistent with historical approach

CONS:

– Requires determination of rate of return
– Significant risk of legal challenge
– Requires development of outside-city rate model

Hybrid Approach- Utility Basis with Rate of Return Differential

- Develop system revenue requirements using the cash needs approach
- Recast cash needs revenue requirements as utility basis revenue requirements
- Determine the imputed rate of return
- Determine the appropriate rate of return differential
- Determine outside-city rates using utility basis revenue requirements including appropriate return on rate base.
- Determine inside-city rates using system cash needs revenue requirements less outside-city revenue requirements.
- Rate design could be the same for inside and outside or different to support different policies (e.g. more aggressive inclining block volumetric structure for outside-city to strengthen conservation message)

PROS:

+ Recognizes risk associated with serving outside-city customers
+ No need for modifications to existing rate model
+ Determination of inside-city rates consistent with historical approach
+ Consistent with approach previously used

CONS:

– Requires determination of rate of return
– Significant risk of legal challenge
– Requires development of outside-city rate model

Rate Differential Approach

- Determine appropriate rate of return for outside-city customers
- Use existing outside-city model to determine the differential revenue generated by outside-city rates based on appropriate outside-city rate of return
- Determine outside-city multiplier to apply to inside-city rates such that outside-city rates generate appropriate level of differential revenue

PROS:

+ Recognizes risk associated with serving outside-city customers
+ Should result in a meaningful differential between inside and outside
+ No need for modifications to existing rate model
+ Determination of inside-city rates consistent with historical approach
+ Consistent with approach previously used
+ Require no modification to existing rate model

CONS:

– Requires determination of rate of return
– Significant risk of legal challenge

Attachment C

Differential Rate Methodologies

Preliminary Framework For Outside-City Rate Methodology

Basic Revenue Requirement Structure Option: Hybrid Approach – Utility Basis with Cash Residual

See description of basic structure options attached. The specific hybrid approach could be determined following consultation with a cost of capital expert to determine preference for development of single rate of return for outside-city ("Utility Basis with Cash Residual"), or if it is advantageous to determine an overall imputed rate of return and then a basis for a differential rate of return for outside-city ("Utility Basis with Rate of Return Differential").

Other Elements of Framework

Determination of Outside-City Rate Base

Rate base = plant in service less contributed capital. The previous differential analysis determined outside-city rate base following a 2-step process:

1. Plant in service net of depreciation and contributed capital is allocated to system service characteristics (base, max day, max hour, etc.)
2. Plant in service value by service characteristic is allocated to outside-city in proportion to units of service estimated for each characteristic.

   Question for SME panel (and Tucson Water staff): Are there any refinements or other approaches recommended for consideration, for example:

   - Relative need for reserve capacity as opposed to actual use as basis for determining service units?
   - Individual assets – are there facilities that should be allocated specifically to inside or outside-city customers?
   - Should rate base be valued based on original cost or replacement cost?

Determination of Rate of Return

1. Contract with a cost of capital expert to determine defensible outside-city rate of return specifically for Tucson Water.
2. Application of rate of return to rate base:
   - Consider excluding distribution assets from outside-city rate base (for purposes of developing rate of return) given lack of information on contributed capital?

Development of O&M cost factors

1. For purposes of determining proportionate cost responsibility for distribution maintenance, determine inch-diameter miles of water mains used to serve inside vs. outside-city customers from hydraulic modeling analysis (conducted by either Tucson Water or an outside contractor.) Example from Providence, Rhode Island

2. Confer with utility staff to determine any other bases for service characteristics to evaluate in context of differential analysis, for example:
    - Fire protection
    - Elevation (pumping, storage)
    - Others?

Peaking Factors

Estimated based on monthly water use data consistent with AWWA M1 Manual approach given data limitations (no AMR data).

Description of Basic Revenue Requirement Structure Options

Cash Needs

- Develop revenue requirements using cash needs approach
- Create new set of customer classes for outside-city customers
- Allocate costs to inside and outside-city customer classes consistent with current allocation approach, with refinement to include additional cost factors determined in consultation with TW staff (e.g., pipe maintenance costs allocated to customer areas based on inch-diameter miles)
- Rate design could be the same for inside and outside or different to support different policies (e.g. more aggressive inclining block volumetric structure for outside-city to strengthen conservation message)

PROS:

+ Consistent with historical approach to rate setting
+ Appears more equitable
+ Reduced risk of legal challenge
+ No need to determine rate of return
+ Requires minimal rework of rate model

CONS:

– May limit effectiveness in promoting City Council policy objectives

Hybrid Approach- Utility Basis with Cash Residual

- Develop system revenue requirements using the cash needs approach
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- Deduct outside-city revenue requirements from inside-city revenue requirements
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PROS:

+ Recognizes risk associated with serving outside-city customer
+ No need for modifications to existing rate model
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CONS:

– Requires determination of rate of return
– Significant risk of legal challenge
– Requires development of outside-city rate model

Hybrid Approach- Utility Basis with Rate of Return Differential

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PROS:

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