UTAH RIVERS COUNCIL

UNITED STATES OF AMERICA
FEDERAL ENERGY REGULATORY COMMISSION

Utah Board of Water Resources,	)	
Lake Powell Pipeline Project	)	Project No. P-12966-001

MOTION TO INTERVENE BY THE UTAH RIVERS COUNCIL

Pursuant to Sections 212 and 214 of the Rules of Practice and Procedure of the Federal Energy Regulatory Commission ("FERC") promulgated at 18 C.F.R. § 382.212 and § 385.214, the Utah Rivers Council respectfully moves to intervene in this proceeding for the Lake Powell Pipeline Project (the "Project").

I. COMMUNICATIONS

All communications and correspondence regarding this matter should be addressed to the following:

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II. GROUNDS FOR INTERVENTION

Founded in 1995, the Utah Rivers Council (URC) is a non-profit 501(c)(3) grassroots community-based organization that advocates for sound water policy and protection and conservation of Utah's rivers, streams, and clean water sources for today's citizens, future generations, and wildlife. The URC and our members are seriously concerned with the impacts water diversions have on Utah's aquatic ecosystems as well as the fiscal impacts unnecessary water spending has on Utah taxpayers.

The URC has a long history working to protect Utah's portion of the Colorado River and its tributaries and we believe the proposed Lake Powell Pipeline Project (LPP) affects numerous stakeholders including the thousands of members of our organization, and many URC members in Washington and Kane Counties and other areas that will be impacted by the proposed LPP. These members are taxpayers, ratepayers, conservationists, fishermen, outfitters, guides and other recreationalists and business leaders who have a vested interest in sustainable water management, sustainable energy policy, fiscally conservative water spending, and economy-

sustaining flows on the Colorado River as well as the continued existence of aquatic ecosystems across the Colorado River Basin. Our experience in drafting and implementing statewide water policy, analyzing municipal water use data, studying water project economics, initiating water conservation programs and our ability to provide expertise on sustainable water policy have made our organization a leader in the conservation community in Utah.

Our organization has a history of advocating for sustainable water policies throughout the river basins that flow into and out of Utah and the Colorado River Basin. Our organization is particularly concerned with the impacts the LPP would have upon Utah taxpayers, Washington County and Kane County ratepayers, local landowners, as well as the fragile desert aquatic ecosystems in the region. These ecosystems include the entire Colorado River below Glen Canyon Dam, Kanab Creek and its Area of Critical Environmental Concern, the Virgin River, the Paria River, their tributaries, and the species they support.

The URC has standing with this proposed Pipeline because of the organization's longstanding involvement dating back to 2006. Our organization has been advocating for the concerns of Utah taxpayers and concerns of ratepayers in the affected areas in and around the area of the Pipeline over this time period. In addition, we have devoted several years of staff time to conducting extensive research regarding the water demand and supply forecasts which form the basis for the purpose and need discussions as contained in the FERC docket and in materials which have not been shared with FERC but authored by local, regional and state water agencies. Our research has been focused on several specific aspects that are unique to Utah. We have been carefully studying the use of water for energy development as proposed in the Lake Powell Pipeline and we have been leading a public engagement process regarding the project's repayment economics.

The URC also has a unique history with this project because over the last five years, our organization has been involved in analyzing the financial feasibility and fiscal repercussions of the proposed Lake Powell Pipeline and its economic impacts upon the residents of Utah. Beginning in 2011, our organization recruited a broad group of Utah economists to analyze what impacts the proposed LPP construction loan and the State of Utah's repayment plan would have upon all Utah taxpayers and local residents in the LPP project area, as well as upon the water demand and water pricing policies in Southwest Utah.

Although the Utah Division of Water Resources claimed publicly it would create an open discussion regarding the repayment economics of the Lake Powell Pipeline and the need for water from the project, the agency has worked to avoid public discussion of this multibillion proposal and refused to answer questions posed by the public and in official correspondences regarding the most basic aspects of the LPP loan repayment scheme.

The Division's stance has forced our organization to devote extensive research resources to studying the LPP and its project environment, hydropower generation, construction costs and repayment economics, the project's purpose and need including water demand and elasticity modeling and other details relevant to this FERC proceeding. The Utah Rivers Council seeks intervention status to share the revelations of this research with FERC and other interveners since the project applicant is unwilling to address these issues outside the intervention process. Our research can clearly demonstrate major contradictions between what the Division is communicating to FERC and what it is communicating on the same topics to other parties including members of the Utah Legislature, the public, and the media in Utah.

Given the Division's lack of consistency and lack of public information about the purpose and need for the project alongside its refusal to share basic information about the financial repercussions of the LPP's large expenditures, in 2012 the Utah Rivers Council elected to create its own process to determine the purpose of the project, the impacts of the LPP debt upon Utah taxpayers and upon Washington and Kane County water ratepayers, and what effects the project will have in reducing the water demand behaviors of these latter residents after their water rates are greatly increased because of the LPP construction cost debt.

Our goal was to build a robust body of information and analyses on the LPP that could be used to help guide stakeholders, to educate and engage the public about the scope and impacts of this large water diversion project, evaluate the likelihood of whether hydropower facilities would actually be constructed or not, and communicate this information to FERC and interveners during this proceeding.

During this process and continuing to this day, our staff have invested thousands of hours researching documents related to the LPP submitted to FERC, analyzed scores of other official correspondences and plans, researched official testimonies regarding the LPP by the Division and its partners and subordinates, attended Utah Legislative committee meetings, examined water pricing policies and elasticity effects in the areas associated with the LPP, and consulted with water and energy experts across the United States about the project.

We involved economists from the University of Utah, Brigham Young University, Utah State University and Southern Utah University in this process who have spent many years and hundreds of hours studying and carefully documenting the State of Utah's proposed Pipeline construction costs and repayment scheme and its effects upon all Utah taxpayers, and upon Washington and Kane County ratepayers among other audiences.

This combined work has resulted in the creation of a lengthy body of materials related to the LPP and its financial, environmental and economic affects on Utahns

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and the residents of adjoining states. Much of this material has been widely referenced by members of the public, as well as the media, and some of it has been submitted to FERC during these proceedings by other parties.

Our longstanding work has been so impacting that FERC's August 11, 2017 Additional Information Request from the Division included several of the concerns our organization and Utah economists have been asking and expressing for the last 6 years in official legislative committee and state administrative meetings as evidenced by numerous meeting minutes, media stories, and correspondences.

It should be noted that our concerns have been expressed repeatedly by the Utah Rivers Council in written and oral form to the public, the media, the Utah Governor, the Utah Auditor, members of the Utah Legislature and among state and federal agencies in official meetings, personal conversations and correspondences, yet the Division has consistently ignored our concerns and those of local, state and federal agencies.

The Utah Rivers Council seeks intervention status in this FERC proceeding because this work has bestowed upon our organization a unique working knowledge of the impacts, effects, concerns and problems posed by the LPP upon the residents of Utah, among other stakeholders, and we seek to engage and educate other individuals and institutions through this proceeding. Given the extensive nature of this work and its complexity, a short summary of some of this history follows.

The purpose of the first economic analysis completed in 2012 was to study how the Washington County Water Conservancy District would repay its Lake Powell Pipeline construction cost debt. Specifically, we sought to know what measures would be taken by the District to increase their revenues to make LPP debt payments back to Utah taxpayers and how those increases would impact water rates and water demand in Washington County, which is central to evaluating purpose and need for the LPP. Since Utah taxpayers are slated to effectively act as a 'bank' for the LPP construction cost loan, this question is relevant to all Utahns.

In October 2012, 11 economists from academic institutions across the State of Utah completed this analysis and wrote a letter to the President of the Senate, Speaker of the House, and Chair of the Revenue and Taxation Interim Committee of the Utah Legislature. This analysis raises important questions regarding the ability of the Washington County Water Conservancy District to repay debt issued by the State of Utah for this project.

Based upon the information collected and analyzed, future anticipated annual debt service to the Washington County Water Conservancy District due to the LPP was, at the time of this 2012 analysis, estimated to be $47 million annually. This initial analysis determined the Washington County Water Conservancy District would need to increase its net annual revenues by roughly 370 percent. No official information could be found to indicate how the District can raise this revenue,

although a number of documents were carefully analyzed including the Capital Facilities Plan.

At least some of the increase in revenues would have to come from raising water rates in order to generate an increase in revenues from residents to make debt payments. Depending upon how large these water rate increases would be, this could lead to a significant reduction in total water use. The economists concluded that the only financially prudent way forward is for the State to carefully study whether Washington County residents have the capacity to actually repay these debt obligations before the State indebts itself with this project.

Since the LPP would service Kane County as well, we felt it was important to understand how the debt payments would affect a smaller water district with no need whatsoever for the water from the LPP. The purpose of the second analysis was to study the indebtedness to the Kane County Water District and the taxpayers of Kane County by virtue of their participation in the LPP.

In October 2013, 19 economists from academic institutions across the State of Utah, including the University of Utah and Brigham Young University, completed an analysis about the impacts of this LPP debt upon Kane County residents and water users. These concerns were summarized in a cover letter sent to Governor Herbert, the President of the Senate, and the Speaker of the House. The letter expresses major concerns about the ability of the Kane County Water District to repay debt associated with the Lake Powell Pipeline.

Unless the Kane County Water District increases its property tax rate, water rates, impact fees, and raises revenues from a proposed nuclear power plant that must be approved to help generate revenues to repay the LPP debt, the KCWD's cumulative debt would grow to $663 million by the end of the project repayment period. This far exceeds the repayment ability of this community of 10,000 residents.

The analysis indicates that in order for KCWD to repay its debt it would have to raise impact fees 344%, to an average of $28,577 per connection; together with raising water rates by 538%; together with raising property tax rates by 61% and receive revenues of $1 million per year from an as-of-yet unapproved and unconstructed nuclear power plant in Utah. The conclusion from this analysis is that these debt obligations raise serious questions about the KCWD's participation in the LPP, and the State should not facilitate Kane County's acquisition of this debt without a careful and thoroughly detailed study of whether Kane County residents have the capacity to repay it.

Seeking more details to the work completed in 2012 on the impacts the LPP Loan would have upon Washington County ratepayers and Utah taxpayers, a third

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analysis was conducted with a more extensive research phase and a greater diversity of research materials.

In October 2015, 22 economists from the University of Utah and Brigham Young University once again sent a summary of their concerns regarding the impacts of the Lake Powell Pipeline debt to Governor Herbert, the Speaker of the House and the Senate President. Chief among their concerns was the determination that in order for Utah taxpayers to be repaid for the construction costs of the Lake Powell Pipeline with interest, as is required by Utah law, water rates in Washington County would have to be increased 576 percent, impact fees would have to be increased at least 123 percent and property taxes would have to be increased to their maximum level.

After the release of these findings, the Division of Water Resources refused to provide more details about the impacts of the Lake Powell Pipeline debt upon Washington and Kane County residents, and the subsequent effects of lowering water demand that these residents would experience at having their water rates increased in such a dramatic fashion.

Simultaneously, the Division's apparent partner in the hydropower generating operations of the Lake Powell Pipeline, the Washington County Water District, claimed it had its own financial model that assured repayment of the Lake Powell Pipeline debt. The Utah Rivers Council sought to acquire this financial repayment model but the Washington County Water District and the Division of Water Resources refused to provide our organization or the public with a copy of this financial model.

We spent roughly 6 months pursuing this financial repayment model by utilizing Utah's public information access law, the Government Records Access Management Act (GRAMA). GRAMA allows the public to petition for information from a state agency when it refuses to share such information voluntarily. After a lengthy hearing, the arbitrator of GRAMA, the State Records Committee, ordered the agency possessing the LPP repayment financial model to give the model to the Utah Rivers Council so we could analyze the repayment impacts upon Washington County residents and their water rates to in turn determine how much water demand would be reduced by, in order to evaluate purpose and need for the proposed LPP.

After finally attaining a copy of this financial model, we shared it with the public and carefully evaluated its contents. This research process yielded a number of timely and relevant findings that have not yet been incorporated into the FERC proceeding for the Lake Powell Pipeline. The Utah economists spent several months analyzing its contents before once again preparing an analysis document and summary correspondence, which was sent to Governor Herbert, the Speaker of the House and the Senate President.

The economists found that because the Division was not mindful of repaying Utah taxpayers for the Pipeline's costs, the Division was proposing that Utah taxpayers pay 72 % of the costs of the Pipeline, with recipients of the water repaying just 28 % of the Pipeline's costs. These shortfalls are assuming the highly optimistic and error-prone cost estimates for the LPP made by the Division and its subordinates are overlooked. This debt could impact Utah's bond rating, depending upon Utah's current debt portfolio at the time of LPP construction cost debt issuance and market factors.

All told, nearly 100 pages of summaries, cover letters, economic analysis and references have been prepared in this process and the project applicant, the Division of Water Resources, has consistently tried to ignore these detailed findings in its information submitted to FERC during this proceeding. This material has great relevance to FERC in its analysis about the hydropower economics that are unique to the Lake Powell Pipeline. This info is also vital in determining to what extent the proposed Lake Powell Pipeline should be permitted by FERC as opposed to other federal agencies, and to the purpose and need for the proposed Pipeline.

The URC also should be allowed to intervene because of our efforts to improve the accuracy of Utah water demand planning by the project sponsor, the Utah Division of Water Resources. The Division has long claimed that Washington County is running out of water and that the LPP is needed to prevent a pending water shortage in the area. However, after attending dozens of public presentations by the Division and closely analyzing the agency's reports and methodologies, URC staff noticed several problems with the Division's water demand forecasts. These problems range from the agency's flawed analysis of public water use data, antipathy to conserving water, ignoring growth in municipal water supply from surplus agricultural water source conversion and severely outdated river basin and statewide planning data.

Rather than addressing our concerns, which were echoed by several Utah decision-makers, the Division dismissed them leaving the URC no choice but to seek assistance elsewhere. In the summer of 2013 we launched a campaign to initiate a Legislative Audit of the Division, which garnered substantial media attention and the support of thousands of Utahns who signed a petition to legislative leadership in support of an Audit. A bipartisan coalition of Utah legislators authored a letter to legislative leadership in support of the Audit request and the Legislature authorized the Audit. Over then next 18 months Legislative Auditors met with dozens of Utah water experts, including URC staff. The URC outlined our concerns about the Division's claims of a pending water shortage in a comprehensive 30-page letter to the Auditors complete with scores of references, tables, charts and figures.

The Office of the Legislative Auditor General released their 80-page Audit of the Division in May of 2015, validating numerous concerns outlined by the URC. The

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URC has long been perplexed by the Division's claim there is a pending water shortage in Washington County when the agency has not encouraged water conservation in the area, as is commonplace is other growing communities throughout the southwest. Auditors found the Division had much less ambitious water conservation goals than neighboring states and that the Division's goal for Southwest Utah, the area where the Division claims there is a pending water shortage. According to Auditors:

> *"The Southern Nevada Water Authority, which serves the Las Vegas region, has a goal to reduce water use to 199 by 2035. In contrast, the communities in Southwestern Utah, which have a climate similar to that of Southern Nevada, have a goal to reduce water use to 292 gpcd by the year 2060."*[i]

Casting even further doubt on these numbers is the fact that the Audit revealed that no data exists to document water use in the year 2000, which is the water use year the Division has used to communicate a pending water shortage to stakeholders. According to Auditors there is no documentation to support the Division's anecdotal claims of a future water shortage:

> *"Division staff were unable to document their methodology or provide source documentation for the data used in their baseline 2000 M&I report."*[ii]

Auditors also validated the URC's concern that the Division is ignoring other water sources available to meet the needs of growing communities across Utah and explained this in detail in Chapter IV of the Audit, "*Growth in Future Water Supply Should Be Reported to Policy Makers*."

Auditors found the Division is ignoring the fact that many Utah municipalities have their own water supplies to meet future demand and identified this as a problem on page 47:

> *"(The) Division's projections understate Utah's future water supply by only identifying the new water to be provided by four water conservancy districts…. By excluding this added water supply, the (Division's) projections accelerate the timeframes for developing costly, large-scale water projects."*[iii]

According to Auditors:

> *"As a result, the (Division's) charts appear to overstate the supply deficits and predict that the state's developed water supply will be exhausted sooner than it would be if it had included the local growth in supply."*[iv]

Legislative Auditors interviewed local water managers across Utah who said they had water supplies they plan to tap in the future to provide more water to their communities as they grow. Additionally, as future urban development replaces former agricultural lands, a surplus of water supply is created that was formerly used to irrigate crops. According to Auditors:

> "*The state's municipal water supply routinely grows each year. The main source of additional supply for M&I will come from converting agriculture water to municipal use, however, some water providers also have the ability to expand their current capacity."* [v]

Auditors validated the URC's concern that the Division of Water Resources has intentionally been ignoring this growth in water supply occurring as irrigated farmlands are developed into urban lands:

> *"The division has not attempted to identify the incremental growth in supply that will occur as municipalities develop additional sources of water. That additional supply will mainly come from agriculture water that is converted to municipal use as farmland is developed*."[vi]

Several years after this Audit was presented, the Division continues to ignore the abundance of water available inside Utah and the LPP project area, in apparent attempt to force Utah taxpayers into unnecessary government spending. The revelatory Audit drew the attention of elected officials who held numerous legislative hearings with the intent of forcing greater scrutiny upon the Division. Because of the Audit, the URC was approached by several Utah lawmakers interested in passing bills at the 2016 Utah Legislature to implement recommendations of the Auditors.

In December of 2017, Legislative Auditors released a follow-up report on their biting 2015 Audit of the Division. Auditors analyzed the Division's 2015 water data made public by the URC's 2016 GRAMA request and appeal granted by the State Records Committee and found major discrepancies between their analysis and numbers reported by the Division. It should be noted this is the same data the Division refused to give to FERC in the agency's response to FERC's August 11, 2017 AIR. Astonishingly, nearly three years after the Audit, not much has changed at the Division as evidenced by the fact that the agency is still using 18 year-old water use figures in official discussions with legislators related to approval and funding for the proposed Lake Powell Pipeline.

Numerous questions still remain about the purported need for, economic feasibility and taxpayer liability of the Lake Powell Pipeline and the Utah Rivers Council has important information and perspectives to bring to this process, which will serve the public interest. Our organization respectfully requests permission to intervene

because of our leadership role in advocating for the consideration of the environmental and economic impacts that would be brought on by the proposed Lake Powell Pipeline project.

This in time request for intervention in the proceeding is not interposed for delay nor will it create any burden or hardship on the applicant. The recent announcement by FERC that the Division's License Application is Ready for Environmental Analysis is evidence that the process is moving forward and therefore intervention would not further delay the project.

Respectfully submitted this 16th day of November, 2018,

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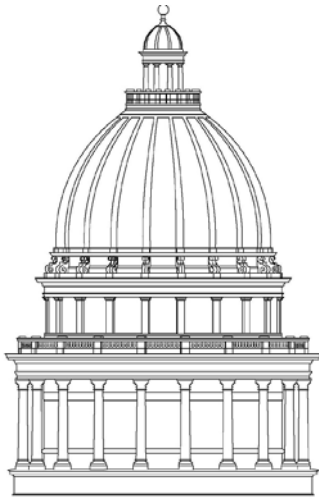
[i] Office of the Legislative Auditor General. *A Performance Audit of Projections of Utah's Water Needs*, May 2015, Page 29. http://le.utah.gov/audit/15_01rpt.pdf
[ii] Office of the Legislative Auditor General. *A Performance Audit of Projections of Utah's Water Needs*, May 2015, Page 19. http://le.utah.gov/audit/15_01rpt.pdf
[iii] Office of the Legislative Auditor General. *A Performance Audit of Projections of Utah's Water Needs*, May 2015, Page 47. http://le.utah.gov/audit/15_01rpt.pdf
[iv] Office of the Legislative Auditor General. *A Performance Audit of Projections of Utah's Water Needs*, May 2015, Page 51. http://le.utah.gov/audit/15_01rpt.pdf
[v] Office of the Legislative Auditor General. *A Performance Audit of Projections of Utah's Water Needs*, May 2015, Page 49. http://le.utah.gov/audit/15_01rpt.pdf
[vi] Office of the Legislative Auditor General. *A Performance Audit of Projections of Utah's Water Needs*, May 2015, Page 47. http://le.utah.gov/audit/15_01rpt.pdf

REPORT TO THE

UTAH LEGISLATURE

Number 2015-01



A Performance Audit of Projections of Utah's Water Needs

May 2015

Office of the
LEGISLATIVE AUDITOR GENERAL
State of Utah

STATE OF UTAH

Office of the Legislative Auditor General

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Audit Subcommittee of the Legislative Management Committee
President Wayne L. Niederhauser, Co–Chair • Speaker Gregory H. Hughes, Co–Chair
Senator Gene Davis • Representative Brian S. King

JOHN M. SCHAFF, CIA
AUDITOR GENERAL

May 2015

TO: THE UTAH STATE LEGISLATURE

Transmitted herewith is our report, **A Performance Audit of Projections of Utah's Water Needs** (Report #2015-01). A digest is found on the blue pages located at the front of the report. The objectives and scope of the audit are explained in the Introduction.

We will be happy to meet with appropriate legislative committees, individual legislators, and other state officials to discuss any item contained in the report in order to facilitate the implementation of the recommendations.

Sincerely,

John M. Schaff

John M. Schaff, CIA
Auditor General

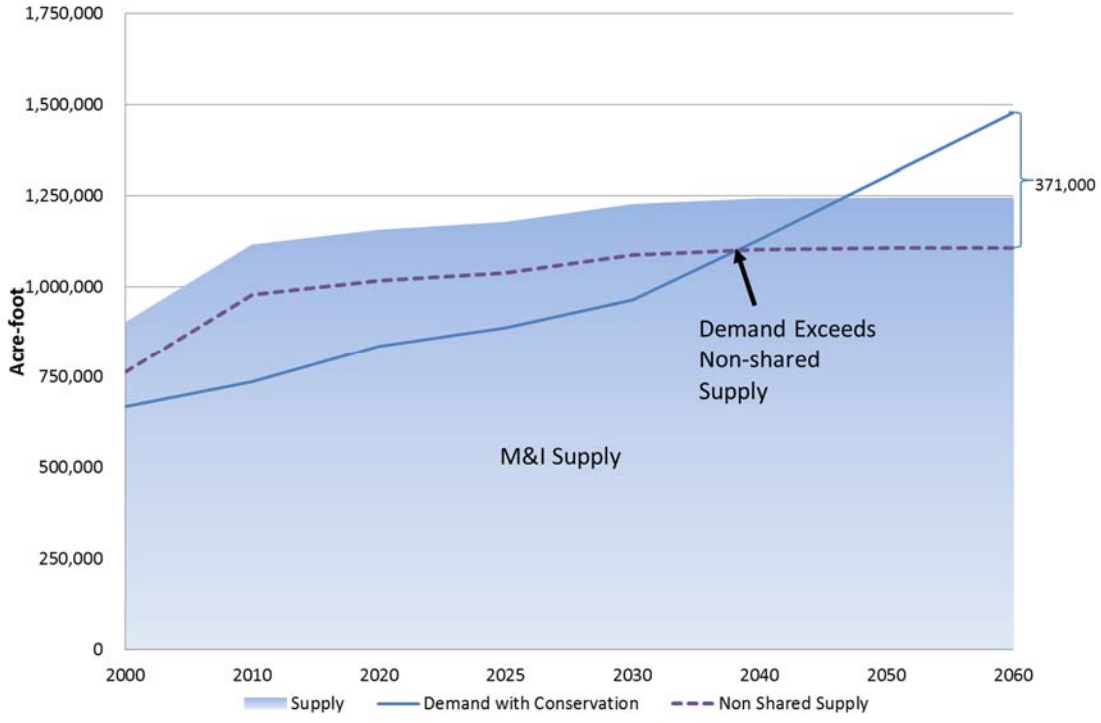
JMS/lm

Digest of
A Performance Audit of
Projections of Utah's Water Needs

The Division of Water Resources' projections indicate that Utah's statewide demand for water will outstrip the currently developed supply in about 25 years. Some believe the state can address its growing demand for water through conservation and by developing local supplies, including the conversion of agriculture water to municipal use. Others believe the state's growing demand for water will require the development of major new sources of supply that will cost billions of dollars. Considering the importance of water to the health, social and the economic well-being of our state's residents, it is essential that the division provide the best possible data to guide water planning decisions.

Our assignment was to determine the reliability of the division's data in the figure shown below and assess the accuracy of the division's projections of water demand and supply. We were also asked to review options for extending Utah's currently developed water supply.

Figure 1. Utah's Projected Municipal and Industrial Water Demand and Supply. The division projects that the demand for water in Utah will exceed the current non-shared supply by about 2040.



Source: Adapted from a Division of Water Resources figure.

Chapter II
Reliability of Water Use Data Needs to Improve

The Division Does Not Have Reliable Local Water Use Data. In order to effectively manage the state's water resources and plan for future water needs, accurate water use data is critical. The Division of Water Resources relies on water use data submitted by local water systems to the Division of Water Rights as the starting point for projecting future water needs. Unfortunately, we found that the submitted data contains significant inaccuracies. State water agencies as well as local water systems operators also acknowledge these inaccuracies.

The Division Needs an Improved Process for Ensuring Water Data Is Reliable. In response to the problems with water use data, the Division of Water Resources attempts to verify data accuracy and correct any mistakes by contacting all local water providers every five years. Besides this process being inefficient, we question the effectiveness of the division's efforts to validate the data. The Department of Natural Resources needs to take a leading role in coordinating efforts between Division of Water Resources and The Division of Water Rights to improve the process of gathering accurate water use data. To support this effort, the legislature should consider giving the Division of Water Resources statutory authority to validate water use information from local water systems.

We Question the Reliability of the Division's Baseline Water Use Study. We also have concerns about the 2000 water study, which the division uses as a baseline to project Utah's future water needs. We could not confirm the study's results because of the lack of documentation of the source data and the steps used to prepare the report. In addition, the 2000 water study relies on a compilation of water studies performed between 1992 and 1999, which may not be representative of the year 2000. Finally, because secondary water systems are not typically metered, much of the reported outdoor water use is based on estimates.

Chapter III
Conservation and Policy Choices Can Reduce Demand for Water

Conservation Will Lead to Less Water Use. We question the division's projected demand for water, which assumes Utah residents will consume on average 220 gallons per day through the year 2060. The accuracy of this projection appears overstated for a number of reasons. First, the projected amount of water use, 220 gpcd, is based on a 2000 baseline water study, which, as described in Chapter II, may be unreliable. Second, other western states appear to use less water than Utah, indicating Utah residents may be able to further reduce their water use. Third, ongoing trends towards conservation should continue to

reduce per capita water use beyond the state's 25 percent conservation goal. The division stated that they intend to update the state goal once it has been met.

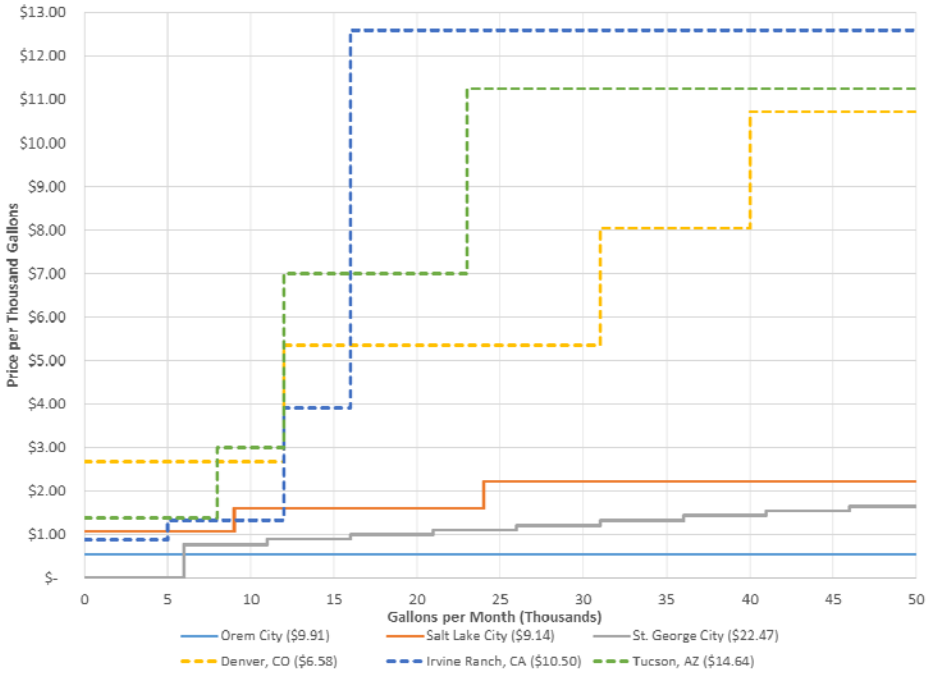
Some Regions Can Reduce Water Use More Than the Statewide Goal of 25 Percent. Some river basins have the ability to reduce water use well beyond the state conservation goal of 25 percent. In fact, two river basins already met that goal by 2010, and two other regions had nearly met the goal. This is another reason why we think the long-term projected use of 220 gallons statewide (as shown in Figure 1) is too high. Rather than applying the same 25 percent conservation goal to all basins, the division should work with local water providers to establish a new set of conservation goals that reflect each region's unique conditions and ability to conserve.

State Policies on Metering and Pricing Can Affect Water Demand. Utah's relatively low water costs appears to contribute to higher per capita water use when compared with other states. Unless per capita water use is reduced, new, more costly sources of supply will need to be developed. As pressures on Utah's currently developed supply intensify, local and state policymakers will need to consider policy options to reduce demand, including universal metering and water pricing.

- One option is to require the metering of all water service connections including those for secondary water customers. Universal metering provides water managers with the data needed to effectively manage their systems. Metering can also be used to provide consumers with information regarding their use. Finally, metering allows water providers the ability to charge water users based on their actual use. The Legislature should consider adopting policies that will require the phasing in of universal metering.

- Policymakers should also consider the way water is priced in Utah. Utah's existing price structure does not adequately encourage conservation. For example, the use of property tax to subsidize the cost of water may lead to an increase in use. In addition, rather than using relatively flat pricing structures, water systems should adopt conservation pricing, or increasing block rates, to incentivize efficient water use. As shown in Figure 2, cities with block rate structures charge consumers an increasingly higher price as consumption increases. The Legislature should consider changes to pricing policies that will encourage efficient water use.

Figure 2. Comparison of City Water Rate Structures. A selected group of Utah Cities are shown to have flatter block rate structures when compared to those of other major western cities. More pronounced block rates tend to encourage conservation.



Source: City Water Departments.

Chapter IV
Growth in Future Water Supply Should Be Reported to Policy Makers

Division Projections Should Include Expected Local Water Development. The division's projections of future water use do not include growth in the state's water supply beyond what was already developed in 2010, with a few exceptions. Those exceptions include the additional supply from a few new water projects. In contrast to division projections, Utah's developed water supply will grow incrementally as agricultural water becomes available for municipal use and as municipalities develop their remaining sources of supply. By excluding much of the growth in local water supplies, the division's projections accelerate the timeframe in which costly new water projects appear to be needed.

Good Basin Plans Should Be the Basis for Better Statewide Planning. As with the statewide projections, most of the division's basin plans do not estimate the growth in the region's water supply. The basin plans also understate the amount of agriculture water available for municipal use. We recommend the division update its basin plans on a more regular basis. We also recommend that they estimate the incremental growth in supply that will occur as municipalities develop additional sources of water.

REPORT TO THE
UTAH LEGISLATURE

Report No. 2015-01

A Performance Audit of Projections of Utah's Water Needs

May 2015

Audit Performed By:

Audit Manager	Richard Coleman
Audit Supervisor	James Behunin
Audit Staff	Tyson Cabulagan Anndrea Parrish

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Chapter I
Introduction

Water is a vital resource that is essential to the health, social and economic well-being of the every resident in the state of Utah. It is also becoming an increasingly scarce resource. By 2060, the state's population is projected to double to nearly 6 million people. This jump in population will strain our currently developed water supply, which has sparked a debate about the need and time frames for developing additional sources of supply. Careful management and planning is critical for ensuring a reliable water supply for future generations.

Although most water use in Utah is for agriculture, this report only addresses Utah's municipal and industrial (M&I) water needs. To avoid future M&I water shortages, state and local water managers project that Utah will need to spend $33 billion[1] over the next several decades to repair existing water systems and add additional supply. These costly investments have prompted the Legislature to ask our office to evaluate the accuracy of the state's projected demand and supply for water and to investigate options for extending Utah's currently developed water supply.

State and local water managers project that Utah will need to spend $33 billion to repair existing water systems and add additional supply.

Planning Utah's Water Future Is Increasingly Important

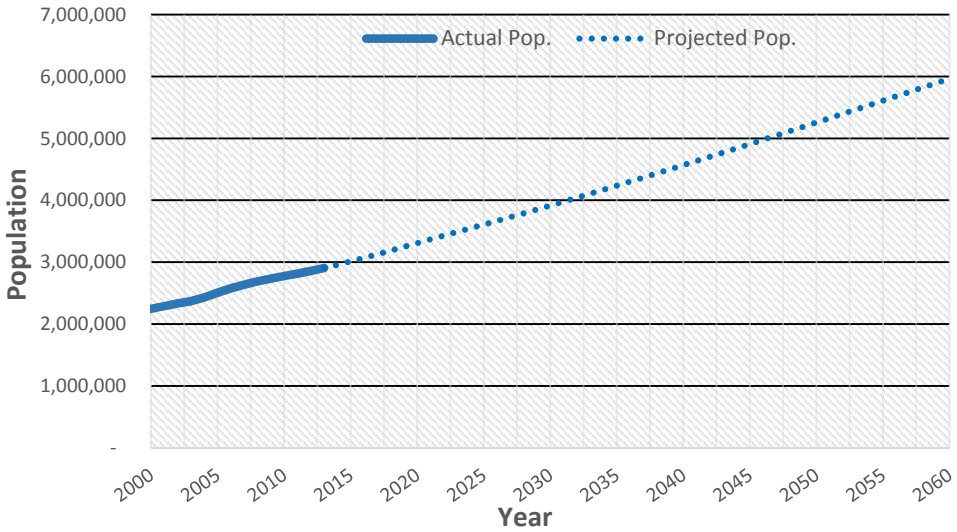
Planning is becoming increasingly important for identifying and evaluating options for meeting Utah's future water needs. The Division of Water Resources (the division) is the state's water planning authority. The division predicts that water demand by Utah's growing population will exceed the state's currently developed water supply sometime around 2040. However, questions have been raised regarding the accuracy of the division's predictions. This debate highlights the need for a more sophisticated approach to forecasting Utah's future water needs.

[1] Prepare 60, "Statewide Water Infrastructure Plan"

Utah's Population Is Expected To Grow to 6 Million by 2060

The division uses population projections to plan for Utah's future water needs. According to population projections prepared by the Governor's Office of Management and Budget (GOMB), Utah's population will double by 2060 to nearly 6 million people, as shown in Figure 1.1.

Figure 1.1 Utah's Projected Population. Utah's population is expected to double to 6 million by 2060.



Source: Governor's Office of Management and Budget

Much of this growth is expected to occur in urban areas along the Wasatch Front, resulting in more dense living arrangements, which could lower per capita water use. GOMB's population projections assume water availability will not constrain growth.

The Division Is the State's Water Planning Authority

Comprehensive water planning is one of the division's critical responsibilities.

Comprehensive water planning is one of the division's primary responsibilities. The ***Utah Code*** 73-10-18 describes the Division of Water Resources as "the water resource authority for the state" and gives the director authority to "make studies, investigations, and plans for the full development and utilization and promotion of water and power resources of the state." Furthermore, the division reports its mission is "to plan, conserve, develop and protect Utah's water."

The division has a challenge to balance the competing elements of its mission. To some extent promoting the full development and utilization of water in the state is at odds with promoting conservation. In fact, in a legislative committee, one member questioned whether Utah should wait to promote conservation until after the state has developed its full allocation of interstate waters. Other policymakers hold the competing view that more focused conservation efforts are needed before investing in large-scale infrastructure projects. It was beyond our audit scope to consider such issues. Instead, we focused on the division's planning role including estimates of future water demand and supply.

This audit focuses on the division's planning role including estimates of future water demand and supply.

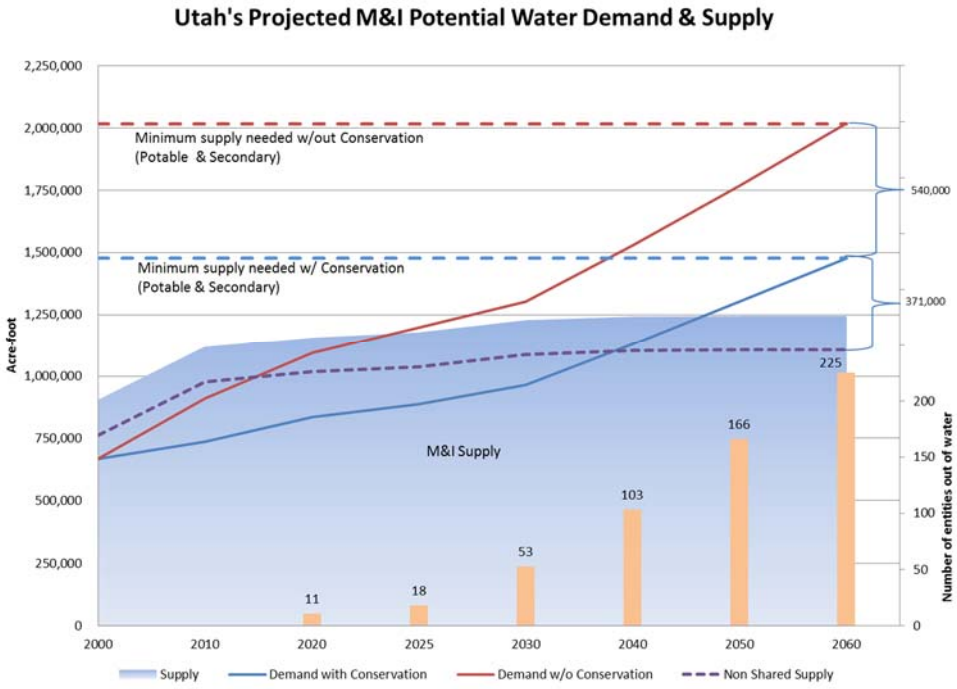
To fulfill this planning objective, the division has prepared a number of documents, including a statewide water plan as well as individual water plans for each of the state's eleven major hydrologic river basins. These documents identify water use trends and make projections about future water demand.

Division Projections Indicate Utah's Current Water Supply Will Not Meet Future Water Needs

The division's analysis indicates Utah's demand for water will outstrip its currently developed supply in about 25 years. Figure 1.2 shows the graphic used by the division to illustrate potential water shortages. The important aspects of Figure 1.2 are explained in the bullets below.

The statewide demand for water is projected to exceed the currently developed non-shared supply of water by 2040.

Figure 1.2 DWRe Analysis of Utah's Projected M&I Potential Water Demand and Supply. The Audit Subcommittee directed auditors to review the reliability the division's analysis.



Source: Division of Water Resources

Figure 1.2 is somewhat confusing with two different vertical scales and a non-linear horizontal scale. However, the main points of interest are as follows:

- **Projected water demand.** The red line shows projected water use without conservation. It is based on estimated use of 293 gallons per capita per day (gpcd) in 2000. The blue line shows projected water use with conservation. It assumes a gradual reduction in water use to 220 gpcd in 2025 (25 percent conservation goal), with no further reductions thereafter.

- **Water supply.** The blue area shows the state's currently developed reliable M&I supply of water. Unlike demand, growth in supply is not projected. The currently developed supply includes some growth for four large water conservancy districts. However, all other water providers' supply is held constant at 2010 levels. The blue shaded area above the dashed purple line shows supply that cannot be shared from one region to another.

- **Projected water shortages.** The brackets on the right side of the figure show the benefits of conservation and the difference between projected demand and the non-shared supply. The figure also shows that, even with conservation, there will be a water shortfall of 371,000 acre-feet per year in 2060. The vertical bars show the estimated number of local water entities that are projected to run out of water at various times in the future.

The division projects a water deficit of 371,000 acre-feet in 2060.

While everyone agrees that Utah cannot afford to run out of water, the situation portrayed by the division in Figure 1.2 has led to differences of opinion regarding how to meet Utah's future water demand. One viewpoint is that through increased conservation, the development of local water projects, and the conversion of agriculture water to municipal use, the state should be able to accommodate the water needs of its growing population. Contrasting views hold that these actions alone will not meet the states growing water needs and that major water development projects are necessary. The division has stated that conservation, agricultural conversion, and water development are needed to meet the state's growing water demand.

In fact, the division is statutorily charged with planning for the development of two large-scale water projects: the Lake Powell Pipeline and the Bear River Project. Existing interstate compacts grant Utah more water than is currently developed so the projects contribute to the division's goal "to defend and protect Utah's rights to develop and use its entitlement to interstate streams." The estimated cost of these two projects alone is $2.5 billion. The huge expense of the proposed projects highlights the need for a reliable forecast of water demand and supply.

The estimated cost of Utah's two major proposed water projects totals $2.5 billion.

Detailed analysis of basin level information would have been required for us to evaluate the need for these two major water projects, which was beyond the scope of this audit. Instead, our assignment was to assess the accuracy of state-level data presented to policymakers by the division.

Questions about Accuracy of Division's Projections Led to Audit Request

Legislators have expressed concern over the accuracy of the Division of Water Resource's projections.

In response to requests for costly, large-scale water development projects, legislators asked for an audit of the accuracy of the division's projections of demand and supply. Specifically, House of Representatives leaders asked that we review the reliability of "data used to make predictions that look out 20 and 40 and 50 years" into the future. Senate leaders asked that we review whether the division had adjusted its projections to reflect "development being more dense that it was years ago." Other legislators asked whether the state is making adequate progress towards conservation and whether the division is considering future conversions of agricultural water to M&I use.

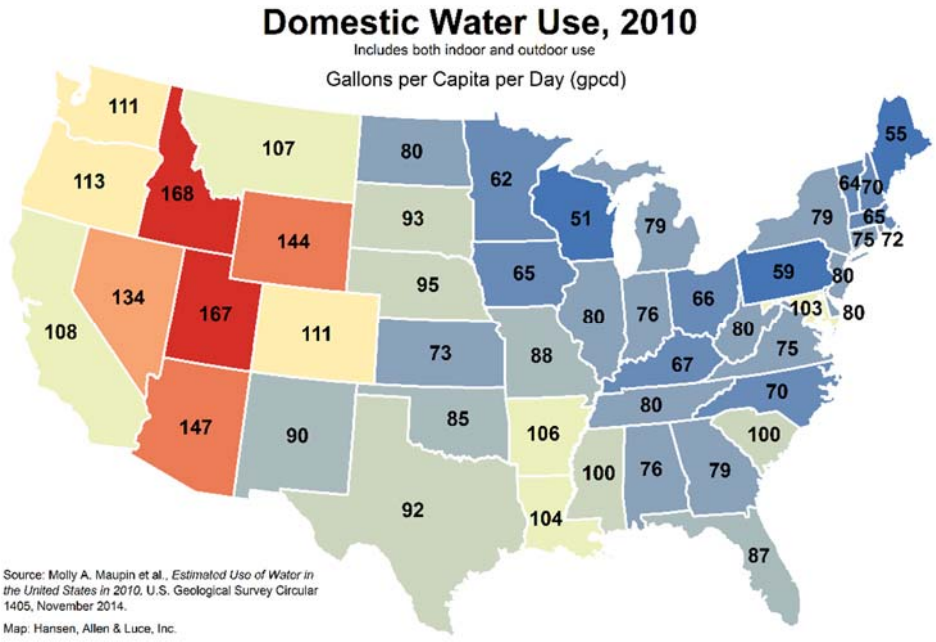
Is the Data Used to Predict Utah's Future Water Needs Reliable?

Division projections of future water demand rely on the division's estimate of the state's municipal and industrial water use in 2000. This baseline study reported that the average annual amount of water used by residential, commercial, industrial, and institutional water users in the year 2000 was 293 gallons per capita per day (gpcd). Because projections of future water demand are based on 293 gpcd, it is important that this per capita water use rate is accurate. If 293 gpcd is not accurate, then it casts doubt on the reliability of the projections derived from it. For this reason, verifying the accuracy of the 2000 baseline study was one of our primary audit objectives.

Has the Division Fully Considered Water Conservation?

Data published in national sources suggest that Utah residents consume relatively large amounts of water when compared to other states. Such comparisons should be regarded with caution. According to the US Geological Survey, state water use data "will have varying levels of accuracy" due to the differences in how each state accounts for their water use. In a 2010 US Geological Survey report, Utah has the second highest rate of residential water use. Figure 1.3 describes the results of state-level water use.

Figure 1.3 United States Domestic Water Use in 2010. Utah's combined indoor and outdoor water use exceeds nearly every other state.



Utah residents consume more water than residents in other Western states.

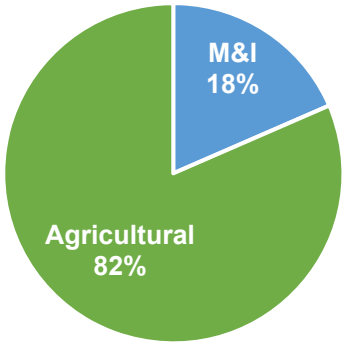
Figure 1.3 shows that Utah's per capita residential water use (which does not include commercial, industrial, and institutional uses) was 167 gpcd in the year 2010. Utah was second only to Idaho at 168 gpcd, suggesting that our state can better manage its water use. Legislators specifically asked us to examine the state's efforts to reduce water demand through conservation.

Is Agricultural Water Available for Alleviating Water Supply Shortages?

Agricultural water has the potential to address some of Utah's future M&I water needs. Utah does not actively pursue a policy of transferring agriculture water rights to cities that are in need of water. However, as land is converted from farms to urban development, the water rights attached to the farmland are typically made available for M&I uses. Figure 1.4 shows that agriculture, at 82 percent, is the largest user of the state's developed water supply.

Figure 1.4 Utah's Agricultural, Municipal, and Industrial Water Use. The vast majority of the state's developed water is used for agricultural purposes.

The majority of the developed water in the state is used for agricultural purposes, a portion of which could be made available to meet future municipal water needs.



Source: Division of Water Resources

Agriculture water, once made available, could become a significant source of new water for municipal and industrial use. Legislators have asked if the division's projections fully account for this source of additional water supply.

Audit Scope and Objectives

The primary audit objective was the accuracy of the division's projections of Utah's future water needs.

Members of the Legislative Audit Subcommittee asked for a performance audit of the Division of Water Resources. Their primary concern was that we verify the accuracy of the division's projections of Utah's future water needs. The committee also requested that we investigate whether division projections account for the potential effects of water conservation and the conversion of agricultural water as options for extending and increasing our state's water supply. Our response to these audit issues are addressed in the following chapters:

- Chapter II – Reliability of Water Use Data Needs to Improve
- Chapter III – Conservation and Policy Choices Can Reduce the Demand for Water
- Chapter IV – Growth in Future Water Supply Should Be Reported to Policy Makers

Chapter II
Reliability of Water Use Data Needs to Improve

Accurate water use data is essential for water management, planning, and policy decisions. State policy makers need assurances that when they support costly, large-scale water projects, the need for additional supply is real and the state's investment is sound. The Division of Water Resources (the division) uses the Division of Water Right's data as the foundation for its analysis of the state's water use. However, water use data reported by public water systems to the Division of Water Rights contains significant inaccuracies. While the division strives to verify the accuracy of the data before using it in its planning process, a lack of documentation and changes in methodology raise doubts about the reliability of the division's water use studies.

Chapter II reviews the reliability of Utah's water use data.

According to Utah statute, "All waters of this state, whether above or under the ground, are hereby declared to be the property of the public." In order to protect the public's interest, the state is dedicated to a) conserving its scarce water resources, b) providing adequate water supplies, c) ensuring the availability of the state's streams for meeting its needs, and d) controlling its water resources. To meet these objectives accurate water data is critical. Unfortunately, the accuracy of Utah's water use data is not commensurate with its importance to the division's planning effort and needs to improve.

The accuracy of Utah's water use data is not commensurate with its importance to the division's planning effort and needs to improve.

The Division Does Not Have Reliable Local Water Use Data

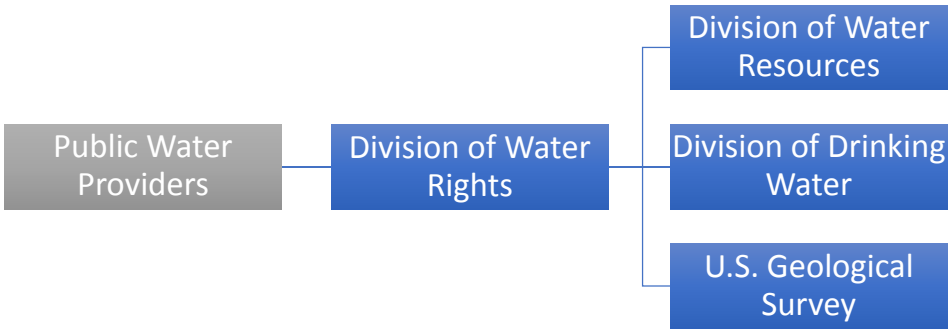
In order to effectively manage the state's water resources and plan for future water needs, accurate water use data is critical. The Division of Water Resources relies on water use data submitted to the Division of Water Rights as the starting point for projecting future water needs. Unfortunately, we found that the data submitted to the Division of Water Rights contains significant inaccuracies. State water agencies as well as local water systems also acknowledge these inaccuracies.

Division of Water Resources Relies on Water Use Data Submitted by Water Providers to the Division of Water Rights

The Division of Water Rights collects water use data from public water providers throughout the state of Utah. This data is used by many state and federal water agencies for a variety of purposes, which includes water resource studies and water policy decisions. Our review revealed significant inaccuracies in the water use data reported by local water entities.

Division of Water Rights Is the Primary Source for Water Use Data in Utah. Each year, the Division of Water Rights submits a water data form to all 468 community public water providers throughout the state requesting information about their water use. The data form requires public water providers to submit information regarding the monthly amount of water diverted from each water source, the monthly amount of water billed, and other water system information. This water use form is the primary source of data used by the Division of Water Resources for water planning purposes.

Figure 2.1 Flowchart of Local Water Use Data. The Division of Water Rights collects water use data from public water providers and shares this data with other state water divisions as well as U.S. Geological Survey.



The Division of Water Rights collects annual water use data from all 468 public water providers in the state and shares this data with other water agencies.

As shown in Figure 2.1, data from public water providers is compiled by the Division of Water Rights and shared with the Division of Water Resources, the Division of Drinking Water, and U.S. Geological Survey for each agency's specific data needs.

Unfortunately, the submitted data is subject to inaccuracies. The Division of Water Rights website reads, "In many cases the data submitted by water providers are estimated and the reliability of these

data are unknown." The next section will discuss some of the data errors we encountered in our audit tests.

Local Water Use Data Contains Significant Inaccuracies

Our review of local water use data revealed significant errors. Some errors were obvious. Some local water systems reported large swings in their water use, indicating that the data was not reliable. For example, one city's reported water use data in 2013 was more than double the amount reported for 2012. We also surveyed the data for inconsistencies and found a number of specific examples of data inaccuracies. For example, instead of reporting total metered use as recorded at each connection, the city reported its total source production at the well, which was a much higher figure. We also found several instances in which the water use data reported to the Division of Water Rights did not match the amount reported in other, internal city reports. Additionally, one city's reported water use for 2012 was the water use of another city with an identical name in the state of New York.

Our review of local water use data revealed significant errors. For example, one city's reported water use for 2012 was sourced to a city with an identical name in the state of New York.

After detecting the above data errors, many local and state water managers told us that they found the data submitted to the Division of Water Rights unreliable. For this reason, we concluded that it was not necessary for us to conduct a systematic review of the data. As the following section suggests, it is widely recognized that there are fundamental problems with the way the state's water use data is gathered and submitted by local water providers.

State Water Agencies and Local Water System Operators Know Water Use Data Is Unreliable

Management in the Division of Water Rights, The Division of Water Resources, and the Division of Drinking Water validated our concerns with the reliability of the state's water use data. They told us that the data is unreliable. Many local water system operators also reported concerns about the accuracy of the water use data.

State Water Agencies Participate in the Annual Water Use Surveys But Do Not Trust the Data. Management from all three agencies expressed concern about the accuracy of the water use data. For example, the Division of Water Resources stated, "the data received by the Division of Water Rights was simply not accurate

enough to make sound future water planning decisions." For this reason, the Division of Water Resources has attempted to compile more accurate water use data since the early 1990's.

The Division of Drinking Water stated that the data collection process invites inaccurate data. When asked about the cause of these inaccuracies, the manager responsible for overseeing the reporting function at the Division of Water Rights acknowledged that they have not devoted sufficient resources towards monitoring the accuracy of the reports, correcting mistakes, and auditing local water system data.

Division of Water Rights acknowledges that they do not have sufficient staff to monitor accuracy of water use data.

Local Water Systems Report Concerns with the Process for Collecting Water Use Data. We contacted staff at a number of water systems about their process for submitting water use data. These discussions revealed several reasons why local entities are not submitting accurate water use reports.

- **The purpose of the data and instructions for collecting the data are unclear.** Staff at several water systems we contacted reported that they were unclear about how the data is used. Consequently, it appears the reporting process is not always taken seriously. They also reported that the instructions are inadequate and subject to misinterpretation.

- **Feedback is not provided when errors are identified.** Water systems operators reported that they did not receive any feedback after submitting the data. As one water system operator stated, "We would like to know if the submitted data is inaccurate or incomplete."

- **The person responsible for submitting the data does not always have the training or expertise to report the data accurately.** For example, one water system manager explained that large differences in their water use from one year to the next were due to misunderstandings by city staff regarding how to interpret the city's water metering systems.

- **There is a perception that a city's unused water rights may be revoked.** Municipalities may intentionally overstate their water use because they are concerned that if they do not report using their full allotment of water rights, the state engineer may someday revoke any unused rights. Although state law allows cities to retain

their unused water rights to meet future water needs, this perception could add to data inaccuracies.

Given the concerns raised by local water systems staff, it is not surprising that state agencies and other interested parties consider the data submitted to Division of Water Rights unreliable. The following section will discuss the validation process the division uses to improve the reliability of the state's water use data.

The Division Needs an Improved Process For Ensuring Water Data Is Reliable

In response to the problems with water use data, the Division of Water Resources attempts to verify data accuracy and correct any mistakes by contacting all water providers every five years. Besides this process being inefficient, we question the effectiveness of the division's efforts to validate the data. The Department of Natural Resources needs to take a leading role in coordinating efforts between Division of Water Resources and The Division of Water Rights to improve the process of gathering accurate water use data. To support this effort, the Legislature should consider giving the Division of Water Resources statutory authority to gather water use information directly from local water providers.

Unreliable Water Use Data Has Resulted In an Inefficient Verification Practice

The Division of Water Resources uses an inefficient practice of contacting individual water systems to verify water use data.

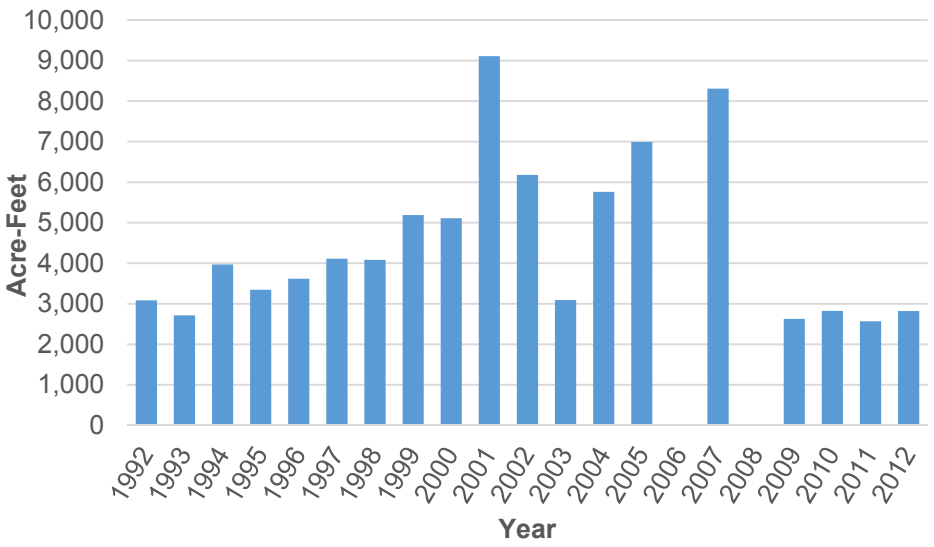
Because the Division of Water Resources cannot rely on the Division of Water Rights' water use data, they have developed a process for verifying the data. The process involves contacting nearly every regulated drinking water systems in the state, every five years, in each of the 11 hydrological basins to verify the accuracy of submitted data and to obtain data from water systems that did not submit use data. This verification process is inefficient. A better process would be to ensure that the data submitted by water providers is accurate to begin with and is reviewed on an annual basis.

The effectiveness of the division's data verification process is also a concern because much of the submitted data is accepted at face value. The division reports that if a water system states that its data is accurate and appears reasonable, then the division "has no other alternative than to accept that data." The problem with this approach

is that inaccurate data can still be submitted. Another concern is that by verifying the data every five years, the division is unable to perform annual trend analysis, which would help in detecting inconsistencies in water use from year to year. The following figure illustrates the value of annual data.

Figure 2.2 One City Reported Large Differences in Water Use From One Year to the Next. Over a period of just a few years, one city's reported water use went from 9000 acre-feet to just 3000 acre-feet. This type of information led us to question the reliability of the data submitted to the Division of Water Rights.

One city reported large swings in its water use indicating something was wrong with their data.



Source – Division of Water Rights.

Figure 2.2 shows how annual water use data can help the division to identify inconsistencies in the data from year to year. This city's large swings in water use indicated something was wrong with their data. We asked the city's Public Works Director to explain the extreme volatility in his city's water use numbers. He told us that for several years before he was hired there were serious problems with the way the staff were reporting the city's water use. He recommended that we not trust any of the data submitted prior to the year 2009. Nonetheless, the division did not recognize the problems with the data and used it in their 2000, 2003, 2005 and 2010 M&I studies. Had the division reviewed the data year by year, they too would have been alerted to the problems with the data. The following section discusses the need for the division to work with local entities to improve the accuracy of the data they submit.

The Department of Natural Resources Can Improve Data Accuracy by Working with Local Entities

The Division of Water Resources and the Division of Water Rights both acknowledge that the accuracy of the data reported by local water systems must improve. Since our audit focused on how water use data is incorporated in the Division of Water Resources' plans, we think that the division should have a role in ensuring data is accurate. However, both divisions, as well as the Department of Natural Resources managers told us they think data collection should remain primarily the responsibility of the Division of Water Rights.

Regardless of which division collects the data, we think the Department of Natural Resources should develop a way to ensure accurate data is collected. First, local water managers should be held accountable for submitting accurate data by signing off on the water use form. Second, a greater effort should be made to verify the accuracy of the data as it is received. Third, water use data should be compared with local sources of data such as a water system master plan, rate study, or impact fee study to identify and resolve data inconsistencies. Finally, audits can be used to validate and educate local entities about accurately collecting and reporting water use data.

Local Water Managers Should be Held Accountable for Submitting Accurate Water Use Data. In recognition of the need for more accurate data, managers from the three state water agencies began a working group this past year resulting in several recommendation for improvements to the water use form and collection process. The proposed form would require "water system personnel with direct knowledge of flow measurements" collect the data and fill out the form. This person would certify that the information is correct, sign the report, and provide their water operator certification number. By placing their professional credentials on the line, local water operators may take greater responsibility for the accuracy of the data they submit. We support this approach and recommend that this change in reporting process be implemented.

By placing their professional credentials on the line, local water operators may take greater responsibility for the accuracy of the data they submit.

The new focus on accountability should improve the quality of the information reported by local entities. This effort should also be combined with an effort to better educate local water managers regarding the importance of submitting accurate data.

Although the Division of Water Resources says it verifies the data before using it, we found errors that were included in the reports they use for planning purposes.

The Division of Water Resources Should Do More to Identify Inaccuracies in the Water Use Data. Although the Division of Water Resources says it verifies the data before using it, we found that some of the errors in the Division of Water Rights data had been included in the M&I studies. This suggests the division needs to develop additional methods for efficiently verifying water use data.

To test for errors in the division's water use reports, we examined those water systems that experienced extremely large drops in water use from 2005 and 2010. We found inaccuracies in the data reported for several of these water systems. For example, the division reported a 48 percent decline in American Fork City's water use between 2005 and 2010. We discovered that this decline was due to the installation of a new pressurized irrigation system. Since water systems are not required to report secondary water use, which is generally unmetered, American Fork's reduced use of its culinary system reflected the increased use of that separate, secondary system for its outdoor watering.

Although the division contacted American Fork City to verify their data, this effort to verify the data did not uncover that city's actual water use. Instead of declining by 48 percent, the data we obtained from the city suggests water use actually increased after residents began to use the secondary water system. The amount of increase is unclear because we do not have an accurate estimate of past secondary water use in American Fork City.

Evaluating water use data every five years, as is currently done, is not sufficient for identifying unusual data trends during the intervening years.

This example indicates that more validation efforts are needed to ensure accurate water use data. Evaluating water use data every five years, as is currently done, is not sufficient for identifying unusual data trends during the intervening years. Instead, by analyzing an entity's water use annually, the division would be more likely to spot errors in the data and identify entities needing follow-up contact.

Inconsistencies with Locally Reported Data Should Be Identified and Resolved. Another method for testing water use data for errors is to compare the data with a variety of sources such as an entity's water master plan, water conservation plans, rate study, or impact fee study. By comparing the data with municipal plans and studies, we identified several inconsistencies.

For example, by comparing Sandy City's 2010 Water System Master Plan with the division's water reports we found a mismatch in

the reported data. In some years, the difference was small, but in 2010, the difference was significant. In 2010, the division reported that Sandy City residents used 208 gpcd. The city's internal reports show a 12 percent difference in per capita water use at 234 gpcd. This discrepancy highlights the need for better controls, including a comparison of locally reported data to check for inconsistencies.

Validity Checks, Audits, and Training Should Be Used to Improve the Accuracy of Locally Reported Data. Local entities have the option of submitting water use reports online. With a few improvements to the programming, the online form could be used to validate the data as it is entered and to check for errors in the data. For example, we found that Salt Lake City's reported 2013 water use was more than double the amount reported for prior years. This error would have been caught as it was entered into the system, if a validation feature had been included in the online form.

When data errors are found, through either validity checks or audits, staff can visit local entities and provide training to improve their reporting practices.

Periodic audits of water use data can also improve the accuracy of reporting by pinpointing errors. When data errors are found, through either validity checks or audits, staff can visit local entities and provide training to improve their reporting practices. Additionally, the division could use local water conferences to provide training to local water systems on how to accurately report water use data.

More Resource Need to Be Dedicated to Collecting and Analyzing Accurate Water Data Annually. Currently, the Division of Water Rights has one staff person responsible for overseeing the reporting of local water use data. This person acts as an educator and auditor by attempting to obtain accurate water use data and by verifying the accuracy of the data. This is not a sufficient level of investment. To improve data reliability, which is essential for water management and planning, the Department of Natural Resources needs to devote more staff and resources to the state's water use database. A request to the Legislature for additional resources will be necessary to satisfy this important objective.

The Division of Water Resources does not have statutory authority nor have they adopted administrative rules requiring local water systems to submit water use data.

Division of Water Resources Should Be Given Statutory Authority to Validate Water Supply and Use Data

While ***Utah Code*** 73-10-15 requires state agencies to "cooperate with the Division of Water Resources in the formulating their state water plan," the division does not collect its own water use data. Instead, the Division of Water Resources relies on the Division of

Water Rights to gather the data it needs to perform its statewide planning responsibilities. The Division of Water Resources cited their lack of regulatory authority as one reason that they "must accept data submitted by each water system." They said, "the only verification that [the division] can do is utilize its engineering personnel and expertise to question some of the submitted data that looks suspect."

Because gathering accurate water use data is essential for managing and planning purposes, we recommend that the Legislature consider granting the Division of Water Resources statutory authority to validate the data submitted to the Division of Water Rights. Requiring local entities to submit accurate data should not be overly burdensome, as they should already be generating this information for their own purposes. The Division of Water Resources should have a role in improving this important data.

We Question the Reliability of the Division's Baseline Water Use Study

In addition to our concerns about the source data, we also question the reliability of the division's 2000 M&I study. One concern is the lack of documentation of the methods used to prepare the report. In addition, the 2000 water study does not include any data for 2000, which is acknowledged in their report. Instead, the report consists of data from studies conducted during the prior eight years. Finally, because secondary water systems are not metered, much of the reported outdoor water use is based on estimates.

While the division's methods for estimating water use have improved in recent years, it still relies on its 2000 M&I study as a baseline for evaluating the state's conservation efforts.

After issuing its 2000 M&I study, the division began to improve its methods for reporting water supply and use in the state. While the 2010 M&I study showed marked improvements in its methodology, the division still uses the 2000 study as the baseline for estimating future water use and evaluating the state's conservation efforts. We believe good data and a sound methodology should be used in studies that drive projections of future water use in the state.

Methods Used to Prepare Baseline Report Are Poorly Documented

Division staff were unable to adequately document their methodology or provide source documentation for the data used in their baseline 2000 M&I report. According to one division manager, "some staff members in the past just entered M&I use data into a spreadsheet as they would talk to people on the phone." Therefore, the manager reports the source data was not documented. Division management stated that while they trusted staff to enter the correct data, the accuracy of the study depends on the ability of local water system staff to report the data accurately.

Division staff were unable to document their methodology or provide us with source documentation for the data used in their baseline 2000 M&I report.

Because division staff were unable to document the source of the data used in their baseline study, we could not verify the accuracy of the reported data. Additionally, the methodology used was also difficult to document. For example, the division requires its staff to estimate the amount of secondary water used by some entities. However, without documentation of the methodology, we were unable to verify whether a reasonable and consistent method was used to estimate secondary water use. In addition, without proper documentation, the division's managers and supervisors would have been unable to verify if staff followed consistent procedures as they gathered the data.

2000 Baseline Study Contains Data That May Not Be Representative of 2000

The division's 2000 baseline study includes water use data from reports that span a period of seven years between 1992 through 1999. Variability in the weather and growing conservation efforts over these years, suggests that prior basin studies may not be representative of water use in 2000.

The 2000 M&I study is based on data from 1992 through 1999, which may not be representative of water use in 2000.

The division's 2000 baseline study acknowledges that the data used in the study was a combination of basin studies performed during the prior eight years. The preface of the 2000 study states:

> The Municipal and Industrial Water Supply Studies were completed for the eleven hydrologic basins with data collected for 1992 and up to the year 2000 from each of the over 450 water systems of the state. This statewide summary is a compilation of the data and can

> be considered, for reference purposes, to be representative of the statewide municipal and industrial water usage for the calendar year 2000.

Although the statement "up to the year 2000" suggests some of the data gathered was from 2000, we verified that all the data used in the study came from prior studies from 1992 through 1999. Even so, the division concluded that the basin studies conducted during the prior eight years were representative of the state's water use during 2000 and a per capita use of 293 gallons per day was reasonable. They said one reason they felt confident in their results was that 293 gpcd closely matches similar figures reported for Utah during the year 2000 by U.S. Geological Survey. However, the U.S. Geological Survey told us that their figures were based on the water production in the state, not metered use, and that the source production is normally higher than the use.

We question whether prior water studies are "representative of the …usage for the calendar year 2000." For example, water use data for Davis, Morgan, and Weber counties was gathered in 1992 but reported as if it were the use in 2000. During the eight years the data was gathered, the increased use of low flow appliances and a growing interest in water conservation should have led to a decline in water use. In fact, the division's own studies show a decline in potable water use of 6 percent between 1992 and 2001. In addition, during the 1990s, there was variability in the average temperature and rainfall from year to year, which would have affected outdoor water use. This variability in the weather in addition to growing conservation efforts suggest that prior basin studies may not be representative of the water use in 2000.

The divisions own studies show potable water use declined by 6 percent between 1992 and 2001.

The division's use of the 2000 study as a baseline measure is important for understanding of each river basin's performance. For example, in 2010, the division reported that the Weber River Basin had reduced its water use by 24 percent. That is a remarkable achievement in just ten years. However, it appears to be less of an accomplishment once we understand the reduction in water use actually occurred over 18 years.

Secondary Water Is Estimated Due to a Lack of Metered Data

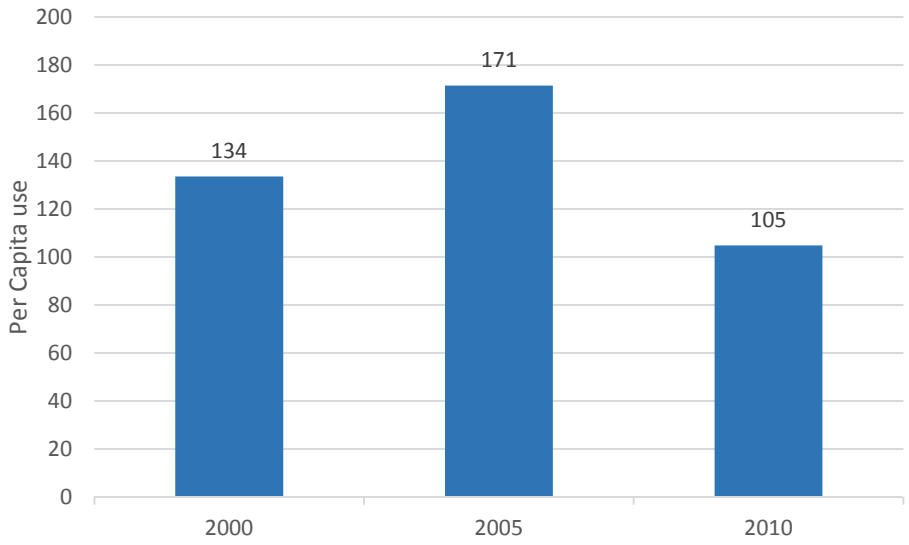
Due to the lack of metered data, the need to estimate secondary water use and the changes in methodology over the years, the accuracy of some of the division's secondary water use estimates are questionable. Swings in the water use figures described for the Weber River Basin are typical of many communities whose secondary water use was estimated by the division.

Secondary users are generally charged a flat rate for unlimited water use because secondary water is typically unmetered.

Secondary Water Use Is Based Largely on Estimates Rather than Actual Metered Water Use Data. More than half of Utah's public water systems offer secondary water. In about 30 percent of the systems, secondary water is the primary source of outdoor irrigation water. Secondary water connections are typically not metered and users often receive unlimited use for a flat fee. Because most secondary water use is unmetered, the division relies on its staff to estimate the amount of secondary water used in each community. This practice means about 23 percent of the water use reported by the division is not based on actual data but on staff estimates.

Changes in Methodology Undermine the Accuracy of Unmetered Water Use Estimates. An evolving methodology for estimating secondary water use has resulted in large swings in the reported data. The water use data reported for the Weber River Basin offers a good example of how changes in the methodology can affect water use estimates. The data, shown in Figure 2.3, shows large swings in secondary water use from one study to the next.

Figure 2.3 Estimates of the Weber River Basin's Secondary Water Use Show Inconsistencies. The reported secondary water use, which is not metered, shows large swings in the data.



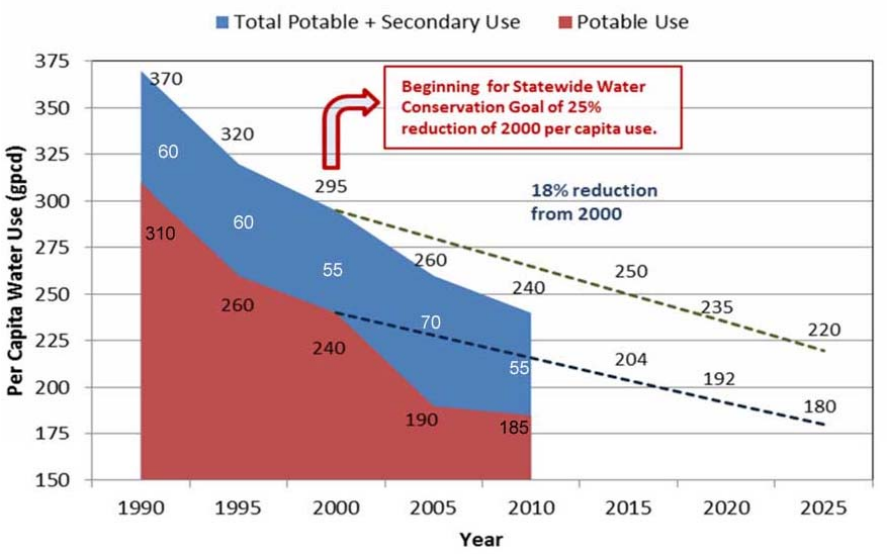
Source: Division of Water Resources' 2000, 2005, 2010 Municipal and Industrial Water Supply and Use Studies.
**Weber River Basin's data for the 2000 M&I study was gathered in 1992.*

Estimates of secondary water in Weber Basin show large swings in water use due to methodological changes.

Figure 2.3 shows the division's estimates of Weber Basin's secondary water use over the years. According to the division's estimates, secondary water use increased 28 percent in 2005 and then declined 39 percent in 2010. Because these numbers are not based on actual metered data, are not affected by wet or dry years or by changes in the population served, we attribute these swings to changes in the methodology used to estimate secondary water use. Such large swings are common in the division's water use studies, casting doubt on the accuracy of the division's secondary water data.

Methods Used for Estimating Secondary Water Add Uncertainty in the Accuracy of Utah's Water Use Projections. Figure 2.4 is a chart often used by the division to show the state's progress toward its water conservation goal. The goal is to reduce water use at least 25 percent below the level of use in 2000 by 2025.

Figure 2.4 Utah's Water Use Since 1990. Volatility in the reported secondary water use raises doubts about the comparability of past water studies. It also raises questions about the accuracy of the report that water use has declined by 18 percent from 2000.



Source: Division of Water Resources

Figure 2.4 shows large fluctuations in secondary water use (shown in blue) during 2000, 2005, and 2010. It shows that the secondary water use in 2000 was 55 gpcd. This is the difference between year 2000's total water use of 293 gpcd and the potable use of 240 gpcd. In 2005, that reported secondary water use rose to 70 gpcd. Then it declined to 55 gpcd in 2010. These swings in the reported use are explained, in part, by the use of different methods to estimate secondary water use.

Over the years, the division has improved its methods for estimating secondary water use. We believe the most recent estimates are more accurate than prior year estimates. Unfortunately, by changing the methods used, the division has made it difficult to compare the results of different M&I studies. For example, Figure 2.4 shows that from 2000 to 2005 secondary water use increased 27 percent from 55 to 70 gpcd at the same time that potable use declined by 21 percent from 240 to 190. These results suggest contradictory trends in water use. Due to concerns about changing methodologies, we do not know the extent to which the changes in reported use were due to the new estimating methods or whether they were due to actual changes in water use.

Over the years, the division has improved its methods for estimating secondary water use.

A consistent methodology and accurate water use data are both necessary to prepare a reliable baseline estimate of the state's future water demand. The current projections are based on a 2000 M&I study which indicates that water was used at a rate of 293 gpcd. Due to concerns with the accuracy of the source data as well as methodology used, we cannot validate the accuracy of 293 gpcd or the projections of future water demand, which is as discussed in the next chapter.

Recommendations

1. We recommend that the Division of Water Resources review water use data annually to perform trend analysis.

2. We recommend that the Department of Natural Resources work with state water agencies to develop an efficient and effective system of collecting accurate water use data from public water providers. Methods that should be considered include:

    a. Making local water managers responsible for submitting accurate water use data more accountable by requiring them to sign their report and identify their position and credentials.

    b. Incorporating a routine data edit check feature in the online data collection form that is used to validate the accuracy of the data submitted by public water providers.

    c. Validating the accuracy of water use data by comparing it to other sources with similar information.

    d. Conducting data validity checks, periodic audits, and training of local water systems to verify the accuracy of water supply and use data.

    e. Committing additional staff and resources to improving the state's water use database.

3. We recommend that the Legislature consider giving statutory authority to the Division of Water Resources to validate the annual water use reported by public water providers.

Chapter III
Conservation and Policy Choices Can Reduce Demand for Water

Chapter III examines the division's estimates for future water use.

The Division of Water Resources (the division) projects that Utah's demand for water will exceed its currently developed supply by 2040. This projection is based on the assumption that per capita water use will not decline after the year 2025 when the state is expected to reach its current goal to reduce water use by 25 percent. However, we believe, current trends suggest per person water use in Utah should continue to decline for the next several decades. If use does decline further, then the date when water demand exceeds supply may be delayed. In addition, water demand can be further reduced depending on how policy makers respond to certain policy choices. For example, policymakers should consider whether to require universal metering of secondary water and whether to further promote pricing structures that encourage conservation.

Conservation Will Lead To Less Water Use

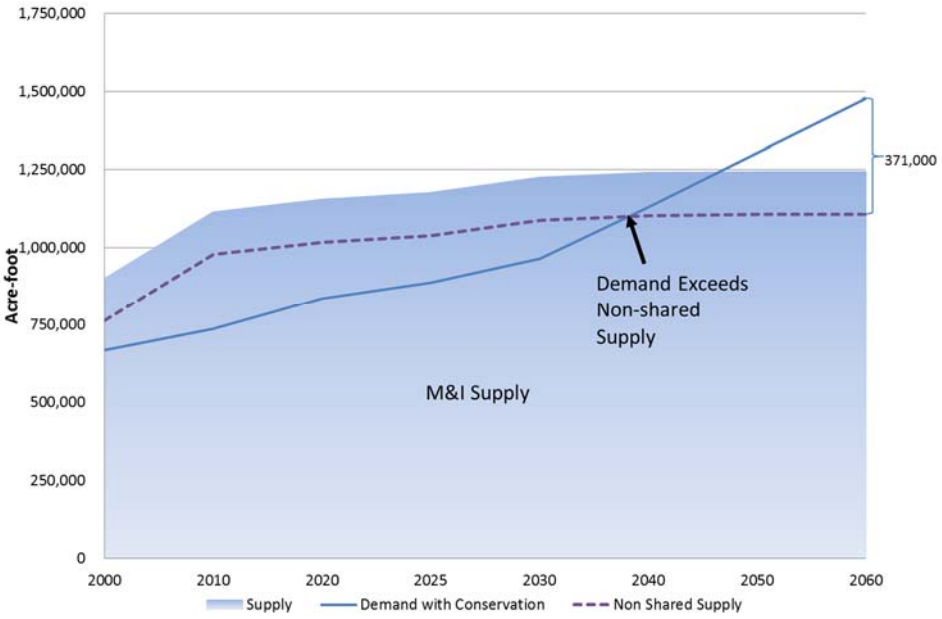
We question the division's projected demand for water, which assumes the average Utah resident will consume 220 gallons per day through the year 2060. The accuracy of this projection is uncertain for a number of reasons. First, the projected water use of 220 gpcd is based on a 2000 baseline water study, which, as described in Chapter II, may not be reliable because of a lack of documentation and methodological concerns. Second, other western states use less water than Utah, suggesting that Utah residents may be able to reduce their water use. Third, ongoing trends towards conservation should continue to reduce per capita water use by more than the state's 25 percent conservation goal. The division has stated they intend to update the goal once it has been met.

Accuracy of Water Demand Projections Are Uncertain

The division relies on its 2000 M&I study as the basis for projecting the state's future demand for water. The study was based on a survey of all public water systems between 1992 and 1999. Based on

those surveys, the division determined that statewide water consumption was about 667,000 acre-feet in 2000. That equals about 293 gallons per person per day (gpcd). The division's projection of future water demand assumes that each river basin will achieve the state's conservation goal. That is, each basin will reduce water use by 25 percent by 2025, which will equal a statewide average use of 220 gpcd. When projected out to 2060, when the state's population is expected to be 6 million, statewide demand for water will be nearly 1.5 million acre-feet per year. See Figure 3.1.

Figure 3.1 Utah's Projected Municipal and Industrial Water Demand and Supply. The division projects that the demand for water in Utah will begin to exceed the current non-shared supply by about 2040.



Source: Adapted from a Division of Water Resources' figure.

According to division projections, the water supply deficit will grow to 371,000 acre-feet by 2060.

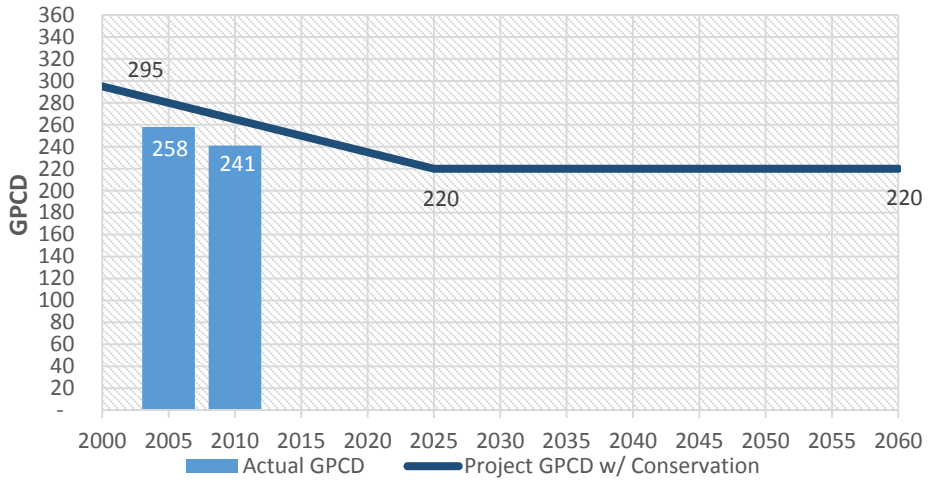
According to the above figure, even if the state's conservation goals are achieved, the state's currently developed supply will run out around 2040. From that point, the water supply deficit is projected to grow to 371,000 acre-feet by 2060. Concerns about the reliability of the state's water use data, as discussed in Chapter II, not only undermine the reliability of the division's water demand projections, but also contribute to uncertainty about progress toward the statewide conservation goal.

We Question Whether 220 GPCD Is a Reasonable Goal. As reported in Chapter II, the accuracy of the division's baseline water demand projection of 293 gpcd could not be validated. Because the state's conservation goal assumes a 25 percent reduction of that amount by the year 2025, we are equally unsure if the statewide conservation goal is reliable. While we agree that water consumption rates have and will continue to decline, without reliable water use data, we question whether 220 gpcd actually is a reasonable goal. Better water use data would help us to conclude whether a lower or higher goal is achievable.

The Division's Current Goal Assumes Future Water Demand Will Not Continue to Decline after 2025. Using the state's current conservation goal of reducing water use by 25 percent, the projection assumes that once this goal is achieved, no further reductions will occur after 2025. We disagree with this assumption. Figure 3.2 shows the division's projection of daily per capita water use through 2060.

The division assumes that once the state's water conservation goal is achieved, and water use is reduced by 25 percent, no further reductions will occur after 2025.

Figure 3.2 Utah's Per Capita Water Use Projection by Year. The division assumes the state's per capita water use will gradually decline to 220 gpcd by 2025 and remain at that level through 2060.



Source: Division of Water Resources 2000, 2005, 2010 Municipal and Industrial Water Supply and Use Studies.

Actual water use indicates that the state is progressing well ahead of its conservation goal.

Figure 3.2 shows water consumption rates declining until 2025, when the state conservation goal of 220 gpcd is projected to be reached, at which point, per capita water use will continue at that rate through 2060. Also shown (in blue bars) is the actual water use, as reported by the division, for 2005 and 2010, which shows the state is progressing well ahead of its conservation goal. Based on this data, the

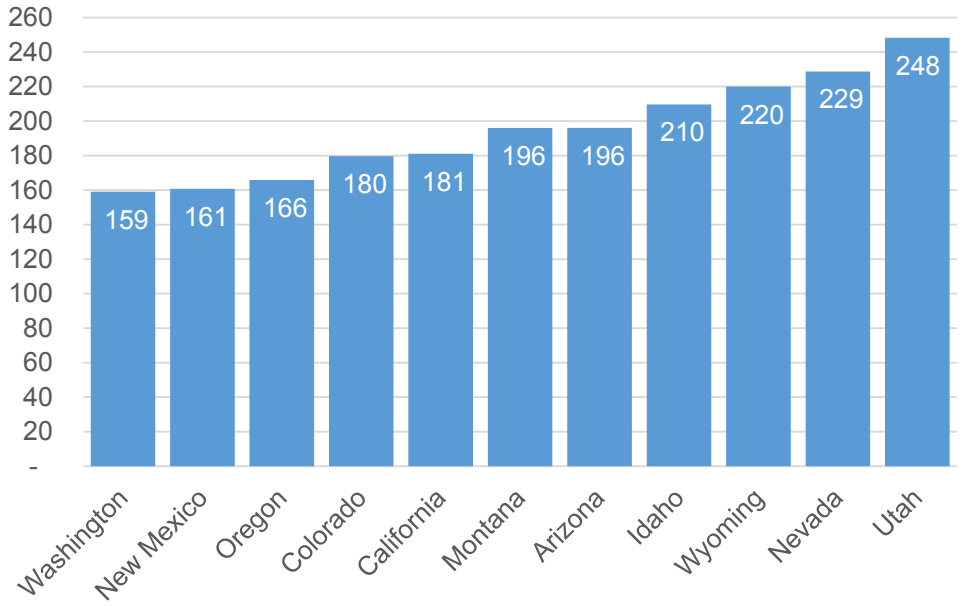
division appears overly cautious in projecting that water use will drop no lower than 220 gpcd for 35 years. Other states' water use also supports the likelihood of future use reductions below 220 gpcd.

Neighboring States Use Less Water and Have Lower Conservation Goals than Utah

According to the U.S. Geologic Survey, Utah has the highest per capita water use in the nation. Figure 3.3 compares M&I and residential water use in Utah to that of other western states.

Utah has the highest per capita water use of western states.

Figure 3.3 A Comparison of Water Use Among the Western States. At 248 gpcd, Utah's municipal and industrial water use, as well as residential water use, is reported to be the highest of these 10 western states.



Source: Estimated use of water in the United States in 2010: U.S. Geological Survey Circular 1405, 2014
Note: Use only includes water from public providers.

Most western states are at or below Utah's goal of 220 gpcd.

We recognize there are unique climate conditions, different reporting methods, and other factors that can lead to different rates of water use from one state to another. However, the differences in water use shown in Figure 3.3 are so large that they raise questions about why the division should expect Utah residents to consume so much more water than the residents of neighboring states. If per capita water use in most other states is already well below 220 gpcd, it is difficult to justify the division's current projection that Utah's water use will not drop below 220 gpcd after 2025.

We could not find many other states with conservation goals to compare to Utah's projected demand of 220 gpcd in 2060. Only California has a statewide conservation goal which is to reduce water use to 154 gpcd by the year 2020. However, we find one regional comparison that is insightful. The Southern Nevada Water Authority, which serves the Las Vegas region, has a goal to reduce water use to 199 by 2035. In contrast, the communities in Southwestern Utah, which have a climate that similar to that of Southern Nevada, have a goal to reduce water use to 292 gpcd by the year 2060.

Conservation Trends Will Continue To Reduce Utah's Water Use

Trends towards greater conservation suggest that per capita water use will continue to decline after Utah has reached its current water conservation goal of 220 gpcd. Research suggests outdoor water use in Utah is not very efficient. In addition, declines in residential lot sizes indicate a trend towards lower per-household use of outdoor water. Similarly, improved efficiencies of low-flow appliances suggest indoor water use can achieve further declines as well. Besides these examples, the division has identified an array of other conservation practices that will continue to reduce water use.

Landscapes Still Receive Too Much Water. Even though the state's "Slow the Flow" campaign seems to have helped reduce wasteful watering practices, USU researchers suggest there is still opportunity to reduce outdoor water use. The USU Center for Water-Efficient Landscaping conducted a 10-year study of outdoor watering practices in Salt Lake City. The researchers found that, as recently as 2010, residents were applying twice as much water as needed for their plants to be healthy. If instead, they were to use the efficient watering techniques recommended by the USU Center, the amount of water used for outdoor irrigation could be reduced by 26 percent.

USU researchers found that residents were applying twice as much water as needed for their plants to be healthy.

Trend Towards Smaller Lot Sizes Should Reduce Outdoor Water Use. Envision Utah is a regional planning organization that promotes quality growth in the state. It reports that, since 1998, the average lot size along the Wasatch Front has declined from 0.32 acres to 0.25 acres. Smaller lots should result in less irrigated landscaping. According to one of Envision Utah's urban planners, the trend towards smaller lots should continue as the state's population grows.

Declines in average lot size should result in less irrigated landscaping and a decline in outdoor water use.

Because 44 percent of M&I water use is for residential outdoor watering, a decline in average lot size will likely reduce the overall demand for water. However, a trend towards reduced household size may offset some of this reduction in per capita use.

Low-Flow Fixtures and Appliances Will Continue to Reduce Water Use. The use of low-flow fixtures and appliances is one of several factors that led to the division's belief that water use would decline by 25 percent. Based on a 1994 study, the division predicted a 7.5 percent decline in water use would be achieved as Utah residents installed low-flow toilets and showerheads. Recent information suggests that the water saved through use of low-flow fixtures and appliances may be even more than the division's original estimate.

Recent information suggests that the water saved through use of low-flow fixtures and appliances may be exceed the division's original estimate.

Since 1994, other appliances, such as washing machines and dishwashers have also become more efficient. For example, the EPA reports that washing clothes represents nearly 22 percent of indoor water use and that new high-efficiency washers can reduce water use for clothes washing by nearly half. This means that, as outdated household appliances are replaced, indoor water use will continue to decline. This information is not reflected in the state's current water conservation goal. In addition, the division's original estimate of a 7.5 percent reduction in water use was based on a 1994 study of low-flow toilets and showerheads.

Other Conservation Best Practices Will Continue to Reduce Water Use. The division's water conservation plan identifies best management practices that include: outdoor watering guidelines and ordinances, commercial and residential water audits, retrofit, rebates, universal metering, incentive programs, and leak detection and repair programs. Although difficult to quantify, we believe these practices will continue to be implemented throughout the state and continue to reduce water use.

Conservation efforts suggests a strong possibility that Utah's per person water use will continue to decline after 2025 and could be less than 220 gallons per person per day in 2060.

In conclusion, opportunities to continue reducing per capita water use remain abundant. This information suggests a strong possibility that Utah's per person water use will continue to decline after 2025 and could be less than 220 gallons per person per day in 2060. Better data, thoroughly analyzed, is needed to inform policymakers.

Some Regions Can Reduce Water Use Beyond the Statewide Goal of 25 Percent

Some river basins have the ability to reduce water use much more than the state goal of 25 percent. In fact, two river basins already met that goal by 2010, and two other regions have nearly met the goal. This is another reason we think the state's long-term projected use of 220 gallons statewide is too high. Rather than applying the same 25 percent conservation goal to all basins, the division should establish a new set of conservation goals that reflect each region's unique conditions and ability to conserve.

Division Has Already Established New Goals for Some Regions

When the division completed its 2010 M&I study, two river basins had already achieved the state's conservation goal to reduce water use by 25 percent. Those basins are the Kanab Creek/Virgin River Basin and the Cedar/Beaver Basin. In response, the division established a new conservation goal for both of those two basins. The new goal is to reduce water use by another 10 percent by 2060.

Two basins have already met the 25 percent water conservation goal prior to 2025 resulting in new conservation goals.

The 2010 M&I study also showed that the Sevier River Basin and the Weber River basin had reduced their water use by 24 percent. However, even though those two basins nearly accomplished the statewide conservation goal, the division decided not to revise their goals until they had fully completed the goal to reduce water use by 25 percent. Thus, the division continues to project that these two river basins will reduce their water use by 25 percent by the year 2060.

We believe these examples raise questions about the division's approach to setting conservation goals and its use of those goals as the basis for projecting future water use in the state. The division began by applying the same statewide conservation goal to all river basins. Once a region met the goal, a new goal was set for that region. However, the statewide projection of water demand, which is based on the conservation goal, was not adjusted. In order to provide better long range projection of the state's future water needs, the conservation goal should be established based on the best, most recent information available and then regularly adjusted as new information becomes available. The projected demand should then be updated to reflect the new goal as well. The division maintains that once the

state's goal has been met they will revise the goal and update water use projections.

Water Use Projections Do Not Account for Each Region's Unique Ability to Conserve

We are concerned that the division's conservation goals do not reflect the unique ability of each region's ability to conserve. Rather than applying the same 25 percent goal to each region, the division should establish conservation goals on the unique conditions that drive water use in each river basin.

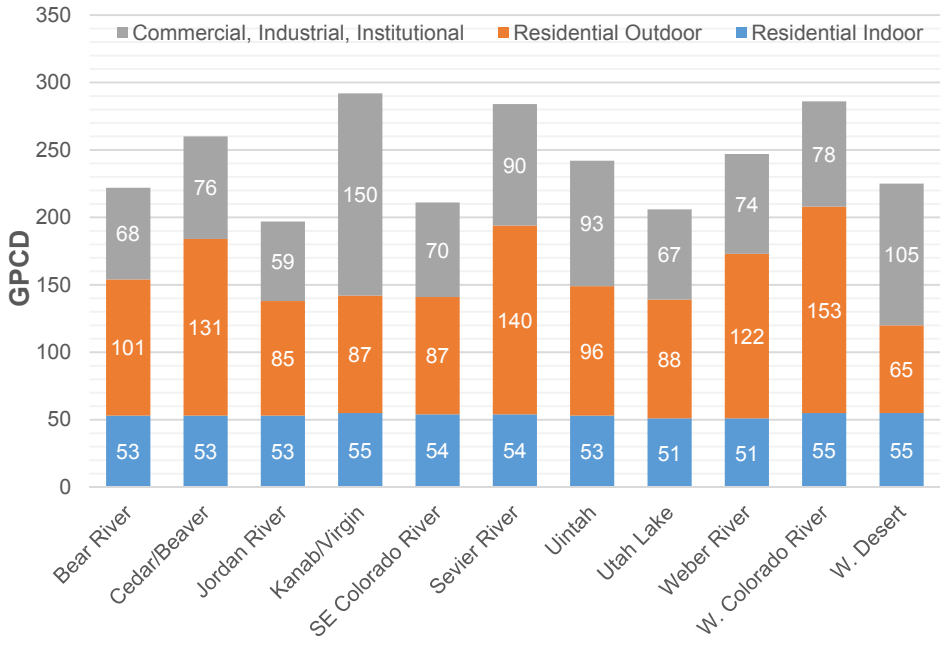
Each river basin will have a different demand for water and a different capability to reduce that demand.

Some River Basins Have a Greater Ability to Conserve than Others. By 2060, the division projects that some basins will still have much higher rates of water use than others. The reason is that the division assumes that each river basin should reduce its levels of water use by the same 25 percent goal, rather than considering each river basin's unique circumstances and ability to conserve. Due to differences in climate conditions, types of industry, and outdoor watering practices, each river basin will have a different demand for water and a different capability to reduce that demand.

Figure 3.4 shows the daily per capita water use each river basin will achieve in 2060 if it meets the state's goal to reduce water use by 25 percent. The water use is broken down into three categories: (1) residential indoor, (2) residential outdoor, and (3) commercial, industrial, and institutional (CII) water use. The indoor use (in blue) is about the same for each region. Larger differences are observed in the residential outdoor use (in orange). In that category, West Desert Basin uses the least at 65 gpcd, while the West Colorado Basin uses the most at 153 gpcd.

The third water category shown in Figure 3.4 is the water use by commercial, industrial and institutional users (in grey). The chart shows that water use by CII users is the lowest in the Jordan Valley Basin at 59 gpcd, while the Virgin River/Kanab Creek region has the highest at 150 gpcd. It should be noted that the Virgin River/Kanab Creek basin is the only one that includes water use at second homes in the CII category.

Figure 3.4 By 2060, the Division Projects Large Differences in the Per Capita Water Use Among the River Basins. For most river basins, the projected water demand represents a reduction by 25 percent of each basin's water use in the year 2000. For some basins, the goal has been increased to a 35 percent reduction of the 2000 water use.



Source: Prepare 60, "Roadmap of Utah's Future Water Development and Infrastructure."

Some regional differences in water use should be expected. For example, one river basin may have larger residential lots, or a climate that requires more outdoor watering than others. However, there is also evidence that some of the differences point to greater opportunities to conserve.

Weber River Basin Should Be Able to Make Additional Reductions in Its Water Use beyond the State Conservation Goal. The Weber River Basin is a region which appears to have a much greater opportunity to conserve than others. For this reason, the division should consider setting a more aggressive conservation goal for that river basin.

Weber River Basin use much more residential outdoor water than surrounding basins.

The outdoor residential water use in the Weber River Basin is quite high when compared to other regions, mainly because of the region's high rate of secondary water use. The division reports that 70 percent of total outdoor water use in Weber River Basin is provided by secondary water systems. The users of those secondary systems

water pay a flat fee for virtually unlimited use of irrigation water. This practice has led to higher residential outdoor water use than in neighboring river basins. As shown in Figure 3.4, per capita residential outdoor water use in the Weber River Basin is 122 gpcd compared to 88 gpcd in Utah County and 85 gpcd in Salt Lake County.

Because they have a greater opportunity to conserve, we think the division should expect a greater reduction in water use in the Weber River Basin than the Salt Lake or Utah Lake basins. In fact, the general manager of the Weber Basin Water Conservancy District agrees. He reports that unmetered secondary water use is the main reason water use is much higher in that river basin than in other basins along the Wasatch Front. Furthermore, he said that the district has begun to install meters on its secondary connections. As it does so, he predicts that the basin's outdoor residential water use will drop below the current projections.

Goals for the Kanab Creek/Virgin River Basin Should Be Based on an Analysis of Unique Conditions in That Region. The Kanab Creek/Virgin River Basin is another region that has unique conditions driving water use. As shown in Figure 3.4, the Kanab/Virgin River basin has high commercial, industrial and institutional use (or CII, shown in grey). The division's water conservation goals and projected use should reflect these unique conditions.

Water use in the Kanab Creek/Virgin River Basin is affected by the large number of tourists who visit the area and by the prevalence of second homes.

According to a local water district manager, the high rate of water use by visitors to the region is the main cause of the high CII water use in the Kanab/Virgin River Basin. Washington County has a large number of hotels, restaurants, golf courses, and second homes. Those facilities serve visitors who consume water but do not permanently reside in the area. The division should consider whether visitors' water use will grow at same pace as use by the region's permanent population. Ideally, the division's projection for the demand in the Kanab/Virgin River Basin should reflect a separate analysis of the likely growth in the CII category, rather than just assuming it will be proportionate to the growth in the permanent residential population. By considering the unique conditions that drive water use in a region, the division can improve the accuracy of its projections of Utah's future demand for water.

Division Should Not Wait to Update Its Projections of Future Water Use

The division has acknowledged that water use will likely decline after the current conservation goal is met. The division reports, "it appears the 25% conservation goal will be met soon…." The division also reports that they plan to wait until the current goal is "reached [before] another goal will be implemented…." However, we believe if the goal does not reflect their current expectations for the state's future water use, then the division should update its projections.

The division will wait to change the state's conservation goal once the current goal has been reached.

State policy makers have recently been presented with a proposal that the state establish financing for billions in new infrastructure projects. The division should provide them with the most up-to-date, accurate projections regarding the state's future water needs. Next year, the division will conduct a new statewide water study for 2015. The 2015 M&I study should be used to establish new water conservation goals that reflect each basin's ability to reduce its water use as well as new projections of each river basin's water needs.

The timing for developing costly new infrastructure projects is uncertain and depends on changing water use patterns, and population estimates. Climate change is also an important consideration, according to the division. As new water use information and population estimates become available, the division should update its projections of future water demand accordingly. A range of projections, as recommended in the 2014 Utah Foundation Report[2], could help the division better plan for Utah's future water needs by anticipating future water demand under a range of different population projections and water use levels. Scenario forecasting will improve planning efforts by pinpointing when costly projects that add additional water supply are needed.

State Policies on Metering and Pricing Can Affect Water Demand

Utah is fortunate to have some of the lowest-priced water in the nation. Historically this is due, in part, to a favorable climate and a gravity fed delivery system that is relatively close to much of Utah's

[2] Utah Foundation, "Flowing Towards 2050," September 2014

population. Pressures on Utah's currently developed water supply are projected to intensify with population growth. Unless water demand is reduced, new sources of supply will need to be developed and delivered from greater distances, resulting in increased costs. Given these costs, policies aimed at reducing per capita water use need to be prioritized.

Policymakers have a variety of options for reducing per capita water use. One option is to require the metering of all water service connections, including secondary connections. Metering promotes water savings through better water management and the ability to charge water users according to their use. Another option is for policymakers to alter the way water is priced. In additional to being relatively inexpensive, Utah's existing price structure does not adequately encourage conservation.

In additional to being relatively inexpensive, Utah's existing price structure does not adequately encourage conservation.

Metering Secondary Use Will Reduce Water Demand

Many Utah communities rely on unmetered secondary water systems for outdoor irrigation. Secondary water use is generally not metered. Two water systems that have placed meters on their secondary connection are finding that metering lowers water use. State and local policymakers should consider requiring metering of all secondary connections, as other states have done.

Twenty-three percent of the states total water use is from secondary water users, which use is generally not metered.

Metering Secondary Water Use Has the Potential to Greatly Reduce Utah's Water Use. Because 23 percent of water use is secondary water and is generally unmetered, it can have a large impact on future water demand. In its 2014 water conservation plan, the division recommended adopting universal metering "as soon as economical technology permits." Metering secondary water reduces water demand and promotes water management by encouraging:

- Accounting for water produced and delivered
- Providing consumers with information regarding use
- Detecting unaccounted water, such as leaks and waterline breaks
- Identifying possible water waste

When connections are unmetered and unlimited use is offered for a flat fee, residents generally have much higher rates of consumption. A 2011 study on Weber Basin Water Conservancy District's (WBWCD)

supply and demand indicated that per capita water use in unmetered secondary service areas resulted in 47 percent more water consumption than in metered potable service areas. In addition, those regions where secondary water is widely available tend to use more total water than those regions where secondary water is not available.

Utah Water Systems Are Moving Toward Metering. The City of Saratoga Springs plans to install meters on all its secondary connections by the end of 2015. Similarly, the WBWCD reported installing nearly 2,000 meters on some of its secondary connections. Three years after the first secondary meters were installed, WBWCD reported that water use declined by about 25 percent on the metered connections. This result was achieved without changing the flat rate pricing structure for their secondary water use. However, there is a significant cost to install meters on secondary connections. According to WBWCD's cost-benefit analysis, metering secondary connections is cost effective because reductions in water demand delay the costs of adding new water development.

Weber Basin Water Conservancy District has installed nearly 2,000 metered since 2010 resulting in a 25 percent reduction from metered users.

Some States Have Laws Requiring Metering. Arizona, California, Colorado, and Washington have adopted laws requiring that all use of public water systems be metered.

- Arizona requires all municipal service connections within active management areas to be metered, allowing for some exemptions.
- California requires meters to be installed on all connections by 2025 and fees to be based on the volume of water used.
- Colorado law requires "Every water supplier providing water in this state shall provide a metered water delivery and billing service" and allows for total cost of providing such services to be reflected in water rate increases.
- Washington implemented a water use efficiency program, which required production meters to be installed by 2007 and all service meters to be installed by 2017.

Many surrounding states have passed legislation to ensure all water connections are metered.

While secondary systems are not as common in these other states, Utah's Legislature should consider requiring metering all service connections, including secondary connections. If secondary water use

is metered, it can be more effectively controlled and possibly priced, as discussed in the next section.

Pricing Policies Will Impact Utah's Future Demand for Water

Utah residents pay some of the lowest water prices in the nation and consume more water than residents in other states. Because pricing influences the demand for water, policymakers should examine water-pricing policies as well as how water systems are funded. Tiered pricing structures have been used effectively in other states to reduce the demand for water, and if implemented, could reduce demand in Utah. Policymakers should also review current tax subsidies, which reduce water rates but also affect demand for water.

The cost of water in Utah is expected to increase as new water projects are constructed and ailing water infrastructure is repaired and replaced. As these projects are undertaken, imposing higher prices on ratepayers, policymakers should consider designing a rate structure, such as conservation pricing, that shifts the bulk of those costs to high volume users.

Salt Lake City's water rates are lower than nearly every other city surveyed.

Utah Residents Pay Relatively Low Water Rates. Circle of Blue, an independent, non-partisan journalism organization, compared the price of water in 30 major U.S. cities (see Appendix A). Salt Lake City's water rates are lower than nearly every other city surveyed. When comparing the average monthly bill for a family of four using 100 gallons of water per person per day, Phoenix charges 30 percent more, Las Vegas charges 36 percent more, and Santa Fe charges 82 percent more than Salt Lake City for water. Because Salt Lake City's rates are average for Utah, the data suggests Utah residents pay relatively little for their water.

According to the division's 2010 report titled *The Cost of Water in Utah,* several factors contribute to Utah's relatively low water costs:

> Utah's climate and geography make it possible for high quality water to be gravity fed into the larger urbanized areas of the state. After Utah was settled, there were several large water development projects funded by the state, as well as the federal government. These, coupled with water use conversion from agricultural irrigation to

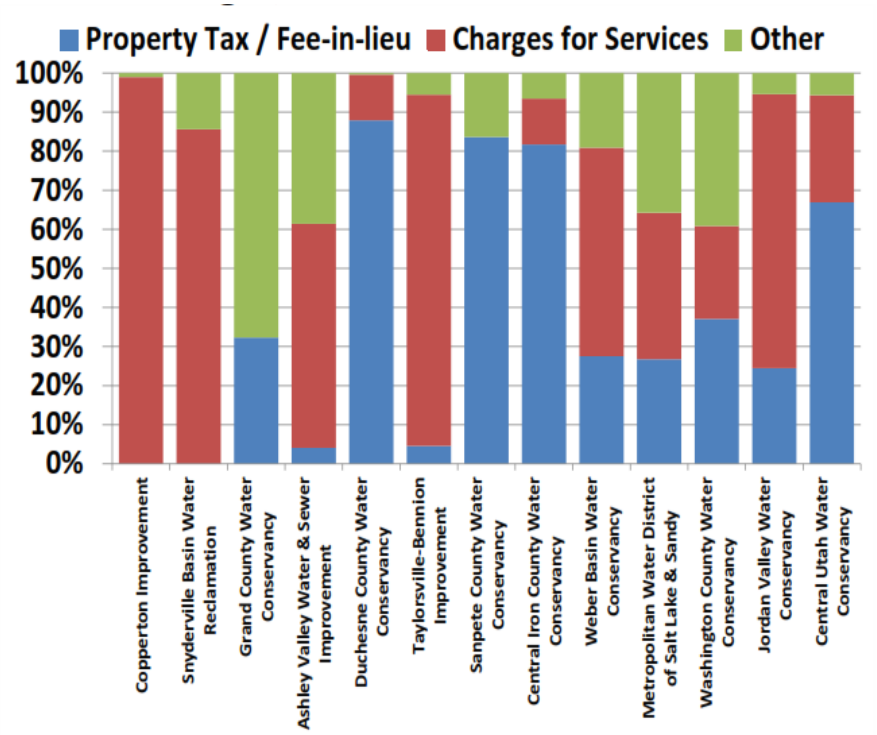
Municipal and Industrial (M&I) and low energy costs, have all contributed to low water costs in Utah.

This report also cites Utah's impact fees and property taxes as additional reasons why Utah water rates are low.

Similarly, a report by the Office of Legislative Research and General Counsel (OLRGC) also describes the common use of property taxes to subsidize water use. In a 2010 briefing paper titled How Utah Water Works, OLRGC includes the following figure describing the revenue sources for various water conservancy districts. The figure includes three categories: property tax/fee-in-lieu, charges for services, and other. The other category includes grants and interest.

Several factors, such as climate, geography, federally funded water development projects, and tax subsidies contribute to Utah's relatively low water costs.

Figure 3.5 Property Taxes and Charges for Service as a Percent of Total Budget, Selected Local Entities. One reason water prices in Utah are low is that many water conservancy districts rely heavily on local property taxes and other fees unrelated to water use.



Source: Office of Legislative Research and General Counsel from the District Financial Statements Submitted to Utah State Auditor.

Property tax revenue made up 70 percent of the income for Central Utah Water Conservancy District in 2012.

OLRGC reports that "since higher prices tend to influence consumer behavior by reducing the quantity demanded, use of a general tax like the property tax is more likely to increase the amount of water used, compared to a system relying only on user fees." For example, Central Utah Water Conservancy District received $48 million from property taxes in fiscal year 2012 equating to nearly 70 percent of the district's total revenue. While water providers prefer the existing pricing structure, because it provides a stable revenue source, the existing structure promotes the overuse of water.

Infrastructure Repair and Replacement Costs Need to Be Funded. Another reason the price of water in Utah is low is that water users are not paying the full cost of maintaining the system's infrastructure. Local and regional water managers describe a growing deficit in major system repairs and replacements with an estimated total cost of $18 billion. It is unclear which portion of these costs will be paid for by existing sources of revenue and which portion will require new sources of revenue. The cause of this problem, according to two consultants that perform water rate studies, is that most cities have not created sufficient capital reserve funds to repair and replace their aging water systems.

Most cities have not created sufficient capital reserve funds to repair and replace their water systems.

Given the importance of maintaining the public water infrastructure, good plans and polices are needed. Ideally, water providers should establish restricted reserve accounts to repair and replace existing infrastructure when needed. However, water prices must be set high enough to adequately fund these restricted accounts. If not, alternative funding sources will be needed.

One such funding source was identified in the 2015 General Session. Senate Bill 281 established the "Water Infrastructure Restricted Account" that can be used for the "repair, replacement, or improvement of federal water projects for local sponsors in the state of Utah when federal funds are not available." While this account only addresses maintenance costs associated with federal water projects, it acknowledges a funding need. In addition, the bill does not address the gap between water user fees and repair and replacement costs.

In conclusion, a number of factors contribute to Utah's low water prices. These include the low cost sources of water, the tendency to subsidized water use through property taxes, and underfunded repair and replacement needs. Pricing water below cost prevents normal market forces from taking effect; no strong pricing signal leads consumers to use the resource efficiently. As a result, according to the most recent U.S. Geological Survey in 2010, Utah ranks highest among all the states in per capita residential water use (see Figure 3.3). Existing price structures also contribute to Utah's high water use, as described in the next section.

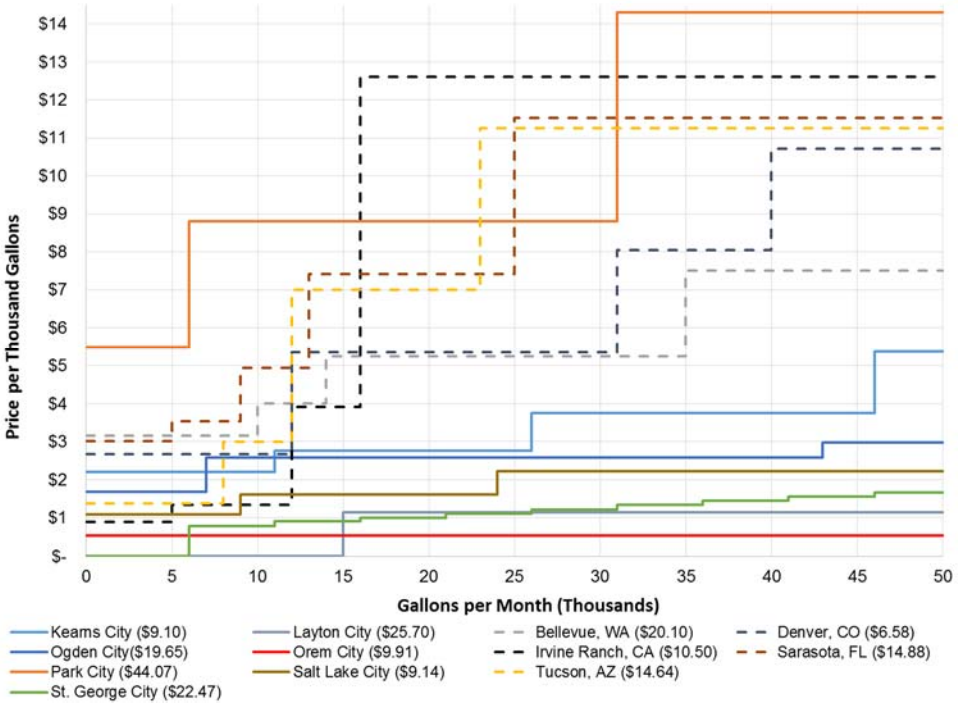
Pricing water below cost prevents normal market forces from taking effect; without a strong pricing signal, consumers are not led to use the resource efficiently.

Utah's Existing Price Structure Does Not Adequately Encourage Conservation. Conservation pricing, or increasing block rates, is a form of water pricing that incentivizes efficient water use through water price signals. For example, the first block rates are kept relatively low and cover basic water needs. The price paid for each additional block of water increases as residential water usage increases resulting in higher rates for excessive water use. The Division of Water Resources acknowledges in their 2014 water conservation plan, "very positive results for agencies that have implemented [conservation pricing]." In fact water systems receiving state water loan funds implement an incentive pricing structure to their rates.

We found that the majority of current rate structures used in Utah do not adequately encourage water conservation. Figure 3.6 shows the rates for a select number of Utah cities. It shows that some Utah cities charge a flat fee for water use. For comparison purposes, we have included the pricing structures for a few cities in Utah (solid lines) and other western states (dashed lines) that use more pronounced block rate structures to incentivize conservation.

Utah cities have less pronounced block rate structures compared to cities in other states. The solid line indicates cities in Utah and the dashed line indicates cites outside of Utah.

Figure 3.6 Comparison of City Water Rate Structures. Some Utah cities have increasing block rate structures, but the rate increases are relatively flat when compared to cities in other states.



Source: City Water Departments
Note: Monthly base fee in parentheses next to city name.

Figure 3.6 shows that, with a few exceptions, Utah cities tend to have relatively flat rate structures. Orem City's rate structure (in solid red) is completely flat. Flat rate structures do little to encourage conservation because higher water use is not penalized with significantly higher fees. In contrast, Park City's rate structure (in solid orange) offers a greater incentive for water users to conserve. The figure also shows several cities from other states with more pronounced block rate structures. Of course, comparing water rate structures across cities and states is difficult because differences in climate and geography affect the use and cost of water.

Research indicates that conservation pricing can be an effective tool for reducing water demand.

Research indicates that conservation pricing can be an effective tool for reducing water demand. For example, California's Irvine Ranch Water Conservancy District, which is well known for its water conservation efforts, implemented a block rate water pricing structure with large incremental increases in the rates charged. Irvine Ranch reports that since the pricing structure was adopted, per capita water consumption has dropped by 50 percent. Similarly, the Southwest Florida Water Management District reports that its block rate

structure reduced water consumption. The district found that after adopting a block pricing structure, consumers who could not access secondary water source reduced their water use by 13 percent.

Before pricing structure are altered in Utah, it is important that policymakers consider the potential effect that water rate structures can have on have on water system revenues. Planning for conservation pricing's effect on water demand must be done carefully to avoid subjecting a water system to unstable revenues.

Policymakers Can Alter Water Demand Through Pricing Policies. State legislators and other policymakers should study the potential benefits of policies that promote the efficient use of water in the state. The Governor proposed, for fiscal year 2016, a study of water pricing:

State legislators and other policymakers should study the potential benefits of policies that promote the efficient use of water in the state.

> Utah should conduct a comprehensive water funding, pricing, and usage study to understand the full costs of water in the state; how those costs are allocated among water users and taxpayers; state budget considerations; and how potential changes in water pricing and infrastructure could affect future water use, system planning and development.[3]

Policy recommendations found in the Utah Foundation's 2014 report echo the need to study pricing policy options. Specifically the report recommends that policymakers "Re-examine the role of property tax funding for water agencies, with a goal of reducing tax support and increasing water rates" and "Create more significant price gradations in block-rate water plans."

We agree with the Governor and the Utah Foundations recommendations that a study of pricing policies is needed to manage water demand. We suggest a review of the following questions:

- **Should Property Tax Subsidies of Water Be Eliminated or Reduced to Help Control Water Use?** Property taxes provide a stable source of revenue to some water districts. However, if water rates do not represent the full cost of water service, users may overuse the resource. By reducing

[3] Investing in the Future of Utah, Budget Recommendations, Fiscal Year 2016, Page 63.

property taxes for water and increasing prices on water use to be revenue neutral, consumers would be empowered to make market-based decisions. Policymakers will need to weigh the benefits of market-based pricing against the risk of subjecting water districts to less stable sources of revenue.

- **Should Water Rates Cover the Full Cost of Repair and Replacement of Existing Water Facilities?** Without question, existing public water infrastructure must be maintained. However, the source of funding for major infrastructure repairs and replacements is unclear. Policymakers should consider the extent to which these costs should be included in the prices charged to water users. To accomplish this objective, water systems may need to make regular contributions to a capital facilities replacement account.

- **Should Conservation Pricing Be Used to Promote Efficient Water Use?** A well-crafted conservation pricing structure can ensure that efficient water users are rewarded with relatively low rates, while high volume users pay a larger share of water system costs.

Considering the effect water pricing can have on the future demand for water, we recommend that the Legislature examine the pricing policy options discussed above. Such a review by policymakers is timely. With water costs expected to increase, decisions must be made about how to reduce water use and how costs should be shared between water users and taxpayers.

Recommendations

1. We recommend that the Division of Water Resources work with local water providers to create conservation goals for each river basin. The new goals should reflect each basin's individual capacity to conserve and account for their unique mix of residential, commercial, industrial, and institutional uses.

2. We recommend that the Division of Water Resources regularly update its projections of future demand as new information becomes available and provide a range of options that includes

investment, conservation, or supply development under a range of demand scenarios.

3. We recommend that the Legislature consider adopting policies that will require the phasing in of universal metering.

4. We recommend that the Legislature consider the following pricing policies to encourage efficient water use:

    a. Reduce water provider reliance on property taxes currently used to subsidize water system costs.

    b. Require that water providers create reserve funds to cover the cost of infrastructure repair and replacement.

    c. Promote the use of conservation pricing structures.

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Chapter IV
Growth in Future Water Supply Should Be Reported to Policy Makers

The Division of Water Resources understates the growth in the water supply when estimating Utah's future water needs. Its projections of future supply only includes the growth from the new water projects of four water conservancy districts. The division has not attempted to identify the incremental growth in supply that will occur as municipalities develop additional sources of water. That additional supply will mainly come from agriculture water that is converted to municipal use as farmland is developed. Local supplies may also grow as cities develop the remaining capacity of existing groundwater and surface water sources. By excluding this added water supply, the projections accelerate the timeframes for developing costly, large-scale water projects. We recommend the division prepare better regional plans that include the growth in supply from all sources, including locally developed supplies. If they do this, state policymakers will be better equipped to determine when to proceed with major water projects.

This chapter identifies two major sources of additional water supply that are not included in division projections.

Division Projections Should Include Expected Local Water Development

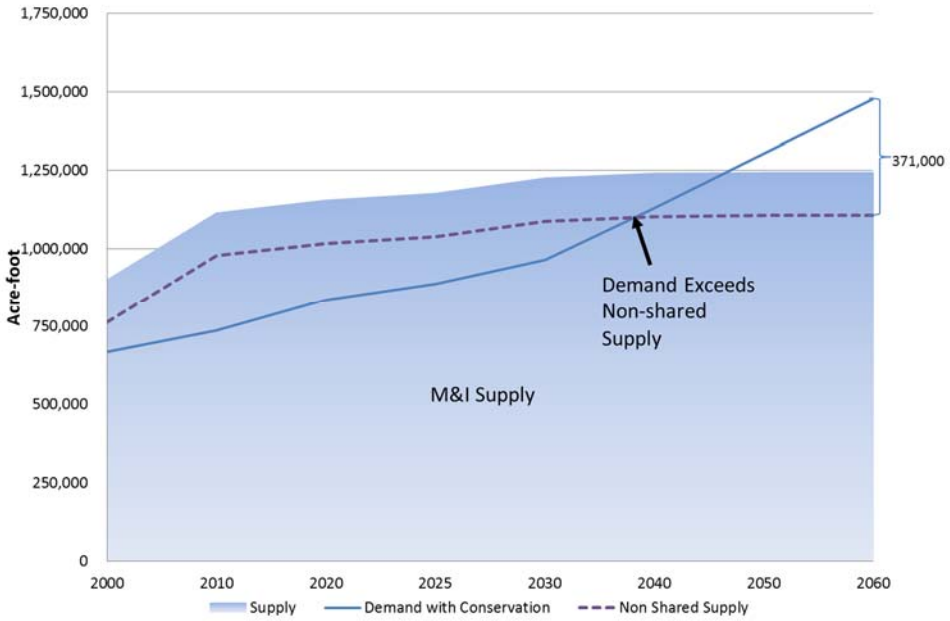
Currently, the division's projections compare the growth in the demand for municipal water with only a few sources of new supply. To improve its estimates, the division's projections should include the additional supply to be gained through the conversion of agriculture water to municipal use and through the development of the remaining local water supplies.

Division's Projection's Understate the Growth in Public Water Supplies

Division's projections understate Utah's future water supply by only identifying the new water to be provided by four water conservancy districts. The projections do show the growth in local water supplies up to the year 2010 but then assume that local waters supplies will remain constant through the year 2060. As shown in Figure 4.1, the division's projections compare the growing demand

for water to what the division describes as the state's currently developed supply.

Figure 4.1 Utah's Projected Municipal and Industrial Potential Water Demand and Supply. Projected demand is compared to the 2010 developed supply plus the new supply to be added by three water conservancy districts. Growth in supply from other sources is not included.



Source: Adapted form a Division of Water Resources' figure.

Division projections compare the growing demand for water to the state's currently developed supply in 2010 with a few exceptions.

The figure above only shows the growth in supply from water projects currently under development by four water conservancy districts. Those projects are listed in Appendix B and are expected to add an additional 128,000 acre-feet to the state's municipal water supplies. They include the additional water to be developed from new wells, surface water rights and reclaimed water. What is missing is the same type of growth in supply from similar projects that are being planned by municipalities and other local waters providers.

The division's analysis does not recognize the ability of cities and water districts expand their capacities.

In a separate chart, the division also identifies the number of entities that will be out of water over the next several decades. See Figure 1.2 in Chapter 1. Entities included in those counts are expected to have growth in demand for water that exceeds their currently developed water supply. However, the division's analysis does not account for the ability of local cities and water districts to expand their own water supplies. In fact, some entities, which the division identifies

as soon to be out of water, report that they have sufficient undeveloped water rights to meet their needs for many decades to come. They plan to develop additional water supply as the local demand for water grows. Ultimately, the state engineer will need to review these rights before they can be developed.

Municipal Water Supplies in Utah Grow as Demand Increases

The state's municipal water supply routinely grows each year. The main source of additional supply for M&I will come from converting agriculture water to municipal use, however, some water providers also have the ability to expand their current capacity. For example, between 2000 and 2010, local and district water supplies increased by over 200,000 acre-feet, an increase of 24 present. While the division's latest projections recognize past growth, they do not anticipate future growth in water supply. The following describes evidence that local water supplies may have the ability to grow as their population grows.

Cities Require Developers to Transfer Water Rights from Land Being Developed. As shown previously in Chapter I, Figure 1.4, 82 percent of Utah's developed water is used for agriculture. As cities grow, some farmland is sold and developed. This development means water rights previously used for agricultural purposes can be put towards municipal use. In fact, it is common for cities to require water rights to be transferred to the city as irrigated farmland is developed.

It is common for cities to require water rights to be transferred to the city as irrigated farmland is developed.

Springville City is an example of a city requiring water rights to be transferred to new development. According to the Springville City Code **11-3-307**, "At any time development occurs on any property annexed, the owner or developer of the property must tender water shares to the City in accordance with Springville City Code." Many Utah cities have similar requirements.

Springville City requires developers to transfer to the public water system any agricultural water rights associated with the property being developed.

Springville City is just one example of a community that requires developers to transfer to the public water system any agricultural water rights associated with the property being developed. In fact, some of the division's more recent basin plans contain estimates of future agricultural water that will be available by 2060. The division has estimated that 100,000 acre-feet of water in the Utah Lake Basin, 95,000 acre-feet in the Weber River Basin, and 25,000 acre-feet in the Jordan River Basin will be available for transfer. While the division's

plan acknowledges agriculture water will play a role in meeting the state's future water needs, it is not reflected in the division's projections of the future water supply.

Many local water providers develop their water rights as demand grows.

Local Water Providers Have the Ability to Expand their Own Sources of Supply. In addition to converting agricultural water, some local water providers may have the ability to develop their water supplies to help meet demand. We recognize that most water sources in Utah are over-appropriated[5] and consequently, some local water providers may not be able to take full advantage of their approved water rights. In addition, as local water providers develop their water rights, it may negatively affect water supplies of other water providers. However, this does not preclude a local water provider from expanding capacity from at least a portion of its undeveloped sources of supply.

Although, we did not conduct a systematic review of the untapped supplies claimed by local water entities, we did obtain several local water supply and demand studies that indicated that some cities have an ability to expand their capacity. We also interviewed several local water managers who said they had undeveloped supplies that they plan to draw from as the demand for water increases. In fact, the Division of Drinking Water approved the drilling of 25 new wells for drinking water purposes during 2014. In addition, Centerville, Herriman, Pleasant View, Provo, Salt Lake, Sandy, St. George, and West Bountiful are all cities that report having at least some additional sources of supply available for future development as their water need grows.

Provo City reports that it has the capacity to expand its reliable water supply to 56,000 acre-feet, supporting the city's growing needs well beyond 2060.

For example, Provo City reports that it has the capacity to expand its reliable water supply to 56,215 acre-feet. This amount should be sufficient to meet the city's water needs well beyond the year 2060. In contrast, the division supply and demand model assumes Provo City's reliable water supply will remain fixed at 31,550 acre-feet through 2060. For this reason, the division predicts the city's water supply will be exhausted in 2020. At that point it was assumed the city would

[5] In the divisions "Conjunctive Management of Surface and Ground Water in Utah," they define over-appropriation as when the approved water rights exceed the amount of natural recharge physically available.

purchase water from outside sources such as the Central Utah Water Conservancy District.

These examples stress the need for the division to work with cities and other local water providers to estimate the amount of water supply available for future development in both state and local plans. Although difficult to quantify, better understanding of current and future water capacity will help local and state water managers plan for a reliable supply to meet future water needs of the state.

As illustrated in the division's statewide projected demand and supply figure (Figure 4.1), the water supply is largely limited to the currently developed supply plus some growth due to a few water projects that are currently underway. Although cities and districts may have the ability to expand their water supply incrementally as population growth occurs, the division's projections do not include this growth in supply. As a result, the charts appear to overstate the supply deficits and predict that the state's developed water supply will be exhausted sooner than it would be if had included the local growth in supply. As the following section illustrates, some updated basin plans have begun to provide a more complete estimate of the growth in the water supply. This supply analysis is needed to plan the timing of large statewide development projects.

Although cities and districts expand their water supply incrementally as population growth occurs, the division's projections do not include this growth in supply.

Good Basin Plans Should Be the Basis for Better Statewide Planning

As described in the previous section, the division's projections of the supply and demand do not include estimates of locally developed water supplies. Most of the division's past basin plans also provide no estimate for future sources of supply. We are also concerned that the division's estimate of the amount of M&I water to be made available from agriculture is overly conservative.

Many Water Basin Plans Are Out of Date or Incomplete

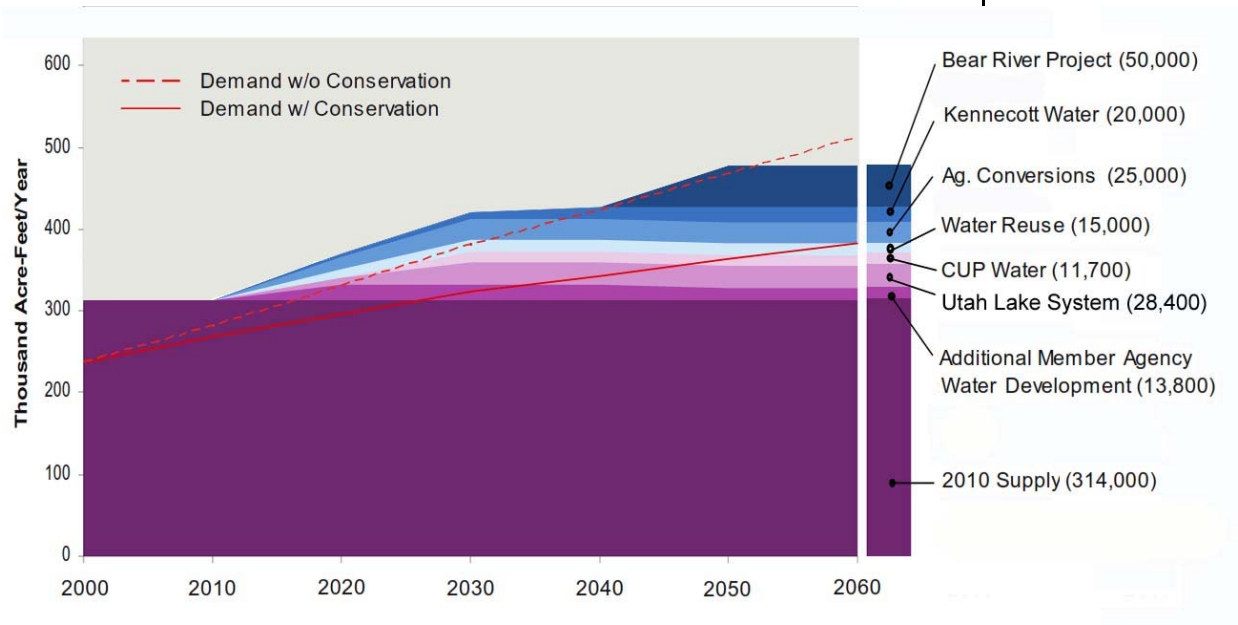
The division periodically updates plans for the state's 11 hydrologic basins. These plans examine the water needs at the basin level. The following is a list of the river basin reports and when they were last updated:

- Uintah Basin – 2015
- Utah Lake – 2014
- Jordan River – 2010
- Weber River – 2009
- Bear River – 2004
- West Desert Basin – 2001
- Southeast Colorado – 2000
- West Colorado – 2000
- Sevier River – 1999
- Cedar/Beaver – 1995
- Kanab Creek/Virgin River – 1993

Seven of the eleven basin plans are over a decade old.

The above list shows that seven of the eleven basin plans are over a decade old. In two of the recent basin plans, Utah Lake and Jordan River, the division has provided estimates for future supply as well as demand for water indicating the basin's ability to meet future water needs within the basin. The additional projected supply shown in these updated plans is not included in projections for future water demand at the statewide level. For example, the Jordan River Basin Plan offers a chart that compares the growth in both supply and demand for water. See Figure 4.2. The figure offers specific growth estimates for agricultural conversions, water reuse, and other planned water development projects in the basin.

Figure 4.2 Jordan River Basin's Projected Supply and Demand. The following figure illustrates how conservation and expanding supply affect the need for water in the future.



Source: Division of Water Resources, "Jordan River Basin Planning for the Future," 2010.

By identifying the potential new sources of supply, the division can provide a more realistic view of how the growing demand for water can be met.

The chart shows the benefits of projecting both the future supply and demand for water. If the chart did not identify the growth in supply, one might assume the region will run out of water in 2025, when the projected demand exceeds the 2010 supply. However, by identifying new sources of supply, the chart shows the basin has 164 thousand acre-feet or 34 percent more new water available to meet its needs through 2060.

In our view, Figure 4.2 offers a more realistic view than the division's statewide projections of how the growth demand can be met. We recommend that the division prepare charts that project both the growth in demand as well as the growth in supply for each river basin and the state as a whole. This information will be the useful to policy makers as they make important decisions regarding the state's water system needs.

Division's Agricultural Conversion Estimates Are Understated

When the growth in supply is not shown, the division's charts imply an impending water shortage.

Although the division provides estimates for future supply in some of the more recent basin plans, we are concerned that some of these estimates are overly conservative. We were specifically asked to assess

the validity of the division's estimates of the conversion of agricultural water. As mentioned, the division estimates that agricultural water available from the Utah Lake and Weber River Basins alone will be 195,000 acre-feet of water. We think the division's estimates actually understate the amount of agricultural water that will be available.

Division Should Base Agricultural Water Estimates on Actual Water Rights Conversion Data. The division's estimates show that only a fraction of agricultural water will be converted to municipal use. For example, in the Weber River Basin, the division assumes only a portion of an acre-foot of agricultural water can be converted to municipal use. According to the division, this limit is required by the state engineer in order to maintain stream flow. However, in the last decade the state engineer has not limited water right transfers. Figure 4.3 compares the division's estimated amount of agricultural water that will be converted to municipal use with the amount of water agriculture used for farming.

Although division estimates assume only a fraction of agricultural water will be converted to municipal use.

Figure 4.3 Division Understates the Amount of Agricultural Water to Be Converted to Municipal Use in the Weber River Basin by 2060. The Division estimates that only a portion of the state's agricultural water will be available for municipal use.

County	Water Now Used on Farmland to Be Converted to Municipal Use	Water DWRE Predicts Will Be Converted to Municipal Use	Difference
Davis	42,700	27,623	15,077
Morgan	15,300	9,896	5,404
Summit	37,000	23,965	13,035
Weber	52,600	34,008	18,592
Weber Basin Total	**147,600 af***	**95,492 af**	**52,108 af**

Source: Division of Water Resources, "Weber River Basin Planning for the Future," 2004.
** Acre-feet*

The division projects that, by the year 2060, 147,600 acre-feet of agricultural water in the Weber River Basin will no longer be needed for agricultural purposes. Of that amount, the division estimates that about 65 percent, or 95,491 acre-feet, of water will be available for municipal use, attributing the reduction to the state engineer's limiting the water available for conversion. However, our review of actual transfers shows the state engineer typically approves the conversion of 100 percent of agricultural water to municipal use.

Our review of actual transfers shows the state engineer typically approves the conversion of 100 percent of agricultural water to municipal use.

We reviewed the records for 326 cases in which agricultural water was converted to municipal use. We found only 34 instances in the last decade in which the Division of Water Rights granted a transfer of less than 100 percent of the historic water rights. Those were mostly cases in which the water rights were in dispute. As a result, we concluded that the actual rate of conversion appears to be about one acre-foot of agricultural water to an acre-foot of municipal water.

If we assume instead that 100 percent of the agriculture water will be converted in the Weber River Basin (where development is expected), an additional 52,000 acre-feet of water will be available by 2060. This additional water is shown in the fourth column of Figure 4.3. This is a 35 percent increase in agricultural water in Weber Basin alone. In fact, 52,000 acre-feet is roughly equivalent to the amount that the Weber River Basin expects to obtain from the proposed Bear River Project.

Assuming 100 percent of the Weber Basin's converted agriculture water will be available for municipal use, an additional 52,000 acre-feet of water will be available by 2060.

In other river basins, the division has taken an even more cautious stance. For example, in the Utah Lake Basin, the division assumes that just 50 percent of agricultural water will be available once it is converted to municipal use. Statewide, there appears to be far more water available for agricultural conversions than anticipated in the division's water plans.

Recommendations

1. We recommend that the Division of Water Resources begin estimating added supply in their M&I studies to account for water made available through the conversion of agricultural water and other locally developed sources of supply.

2. We recommend that the Division of Water Resources update state and basin plans on a regular basis as new information is gathered to ensure plans are relevant.

3. We recommend that the Division of Water Resources base its future estimates of the agricultural water available for municipal use on the actual historic data of past transfers.

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Appendices

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Appendix A

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Circle of Blue's 2014 Water Pricing Survey

City	Service Area Population (in thousands)	Average Monthly Bill for Family of Four Using 50 gallons/person/day	% change from 2013 bill (50 gpd)	Average Monthly Bill for Family of Four Using 100 gallons/person/day	% change from 2013 bill (100 gpd)	Average Monthly Bill for Family of Four Using 150 gallons/person/day	% change from 2013 bill (150 gpd)
Uniform Seasonal							
Phoenix	1600	11.55	0.0%	38.75	0.0%	68.45	0.0%
Uniform							
Fresno	122	19.38	30.2%	28.26	43.1%	37.14	50.9%
Memphis	583	12.04	2.1%	24.08	2.1%	36.12	2.1%
Chicago	N/A	19.86	14.9%	39.72	14.9%	59.58	24.9%
New York	8360	28.64	5.6%	57.28	5.6%	85.92	7.5%
Indianapolis	800	33.01	5.2%	57.32	8.1%	81.62	10.2%
Seasonal Increasing Block							
San Antonio	1000	22.65	5.2%	43.66	6.0%	74.25	6.5%
Salt Lake City	380	17.22	4.0%	27.19	4.1%	37.79	4.1%
Los Angeles	4000	36.53	19.0%	75.98	14.5%	122.41	8.0%
Seattle	630	55.25	8.1%	98.77	9.3%	153.22	8.1%
Santa Fe	78	54.78	0.0%	153.78	0.0%	284.10	0.0%
Increasing Block							
Denver	1300	22.66	3.6%	41.42	3.6%	73.58	3.5%
Tucson	775	24.40	12.0%	51.65	11.2%	111.01	9.4%
Dallas	1306	19.39	4.4%	44.87	5.3%	81.74	5.6%
Jacksonville	614	23.11	0.0%	43.30	0.0%	63.49	0.0%
Las Vegas	2000	25.68	3.6%	42.27	2.8%	62.90	2.2%
Charlotte	774	19.33	7.7%	53.73	10.9%	107.81	12.2%
Fort Worth	625	24.76	6.4%	47.16	3.3%	72.56	2.5%
San Jose	107	32.20	8.0%	56.43	8.0%	83.49	8.0%
Columbus	1115	28.91	0.0%	52.00	0.0%	75.08	0.0%
Houston	2060	30.62	1.2%	58.94	1.1%	105.62	1.1%
Austin	796	29.74	14.3%	79.64	10.3%	140.24	8.5%
Boston	609	37.81	4.8%	77.73	4.8%	118.40	4.8%
San Francisco	2400	48.50	6.4%	92.50	6.1%	136.50	6.0%
San Diego	1300	49.77	2.6%	89.37	10.6%	150.15	29.4%
Atlanta	1200	42.64	0.0%	91.92	0.0%	141.20	0.0%
Decreasing Block							
Milwaukee	661	20.81	3.0%	34.65	3.0%	48.49	3.0%
Detroit	740	22.08	4.4%	38.65	4.4%	55.21	4.4%
Baltimore	1800	36.77	15.0%	58.83	15.0%	88.25	15.0%
Philadelphia	1672	36.14	5.0%	65.83	5.0%	92.76	5.1%
Total Average Percent Change			6.1%		6.2%		6.6%

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Appendix B

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Appendix B: Water Projects Under Development for Four Water Conservancy Districts

District	Additional Water						
	2020	2025	2030	2040	2050	2060	Total
Central Utah Water Conservancy District							
Central Water Project	5,300	-	15,000	15,000	6,300	-	41,600
Utah Lake System	-	-	21,500	-	-	-	21,500
Total	5,300	-	36,500	15,000	6,300	-	63,100
Jordan Valley Water Conservancy District							
Provo River Purchases	1,100	-	-	-	-	-	1,100
Central Water Project	11,680	-	-	-	-	-	11,680
Southwest Jordan Valley Ground Water Project	8,000	-	-	-	(3,500)	-	4,500
Castro Springs Project	400	-	-	-	-	-	400
Utah Lake System	-	16,400	-	-	-	-	16,400
Waste Water Recycling (Secondary Water)	-	-	13,000	-	-	-	13,000
Total	21,180	16,400	13,000	-	(3,500)	-	47,080
Metropolitan Water District of Salt Lake and Sandy							
Utah Lake System	-	5,000	-	-	-	-	5,000
Total	-	5,000	-	-	-	-	5,000
Washington County Water Conservancy District							
Ash Creek Pipeline	2,840	-	-	-	-	-	2,840
Cottom Well	600	-	-	-	-	-	600
Sullivan Well	750	-	-	-	-	-	750
Diamond Valley Well	400	-	-	-	-	-	400
Pintura Well	600	-	-	-	-	-	600
Sandhollow Recharge	3,000	-	-	-	-	-	3,000
Gunlock Well	5,000	-	-	-	-	-	5,000
Total	13,190	-	-	-	-	-	13,190
Total Additional New M&I Supply	39,670	21,400	49,500	15,000	2,800	-	128,370

Source: Division of Water Resources

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Agency Response

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GARY R. HERBERT
Governor

SPENCER J. COX
Lieutenant Governor

State of Utah
DEPARTMENT OF NATURAL RESOURCE

MICHAEL R. STYLER
Executive Director

April 28, 2015

Dear Mr. Schaff,

We acknowledge and appreciate the Legislative Auditor General staff's considerable efforts in assessing the effectiveness and appropriateness of Division of Water Resources (DWRe) data practices. We recognize the great lengths taken to gather and analyze this information.

The responsibility to ensure Utah's families, environment and businesses have enough water is one we take very seriously. We believe the audit results will strengthen our processes. We agree with many of these results and look forward to improving the processes used to determine Utah's current and future water use and supply data.

Over the next 45 years, as our population doubles, we will press the limits of our developed water supplies. We encourage a balanced combination of responsible conservation, agricultural conversion, water infrastructure and development projects, and persistent innovation to proactively address Utah's water challenges.

As Utah moves into the future, the data needed to make important decisions will need to be increasingly sophisticated. Our division will combine applicable audit recommendations with our own innovative ideas to achieve the highest standard of data gathering, education and analysis processes. We appreciate the opportunity to respond to the audit recommendations and submit the following comments on behalf of the Department of Natural Resources and DWRe. Please note that additional resources will be needed in order to accomplish these recommendations.

Chapter 2 Recommendation Responses: Reliability of Water Use Data (Page 24)

Recommendation 1: We agree. Reviewing water use data annually will allow us to perform trend analysis.

Recommendation 2: We agree with all water use data collection recommendations and will consider the list of methods. We also recognize that in order to accomplish some of these recommendations legislative action will be needed.

Recommendation 3: We agree with the Legislature giving the Division of Water Resources statutory authority to validate the annual water use reported by public water providers.

Chapter 3 Recommendation Responses: Conservation and Policy Choices Can Reduce Demand for Water (Pages 44-45)

Recommendation 1: We agree to work with local water providers to create conservation goals for each river basin, taking into consideration each basin's unique attributes. These regional goals will be combined to determine a statewide goal.

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PO Box 145610, Salt Lake City, UT 84114-5610
telephone (801) 538-7200 • facsimile (801) 538-7315 • TTY (801) 538-7458 • *www.nr.utah.gov*

Recommendation 2: We agree, and will continue to regularly update projections and future demand as information becomes available.

Recommendation 3: We agree with this recommendation and offer to work with the Legislature in adopting policies that will require the phasing in of universal metering.

Recommendation 4: We agree with the recommendation that the Legislature research innovative pricing policies to encourage efficient water use.

Chapter 4 Recommendations: Growth in Future Water Supply Should Be Reported to Policy Makers (Page 55)

Recommendation 1: We understand the intent behind adding supply in M&I studies to account for water made available through the conversion of agricultural water and other locally developed sources of supply. We have estimated this in the past, but feel the accuracy is only useful for short-term projections. While we feel this recommendation is oversimplified, we will work with the State Engineer to perform a rigorous technical analysis to more accurately determine potential conversions and supplies.

Recommendation 2: We agree to update state and basin plans on a regular basis as new pertinent information is gathered.

Recommendation 3: We agree to base future estimates of agricultural water available for municipal use on the historic data of past transfers. We will work with the State Engineer's office and local providers to determine the appropriate estimates.

We are confident that our continued dedication in these areas, combined with the additional required resources, will result in ever improving processes, projections and communication. We appreciate your efforts to define opportunities for improvement. Thank you for the report and helpful recommendations.

Sincerely,

Eric L. Millis, P.E.
Director
Utah Division of Water Resources

Michael R. Styler
Executive Director
Utah Department of Natural Resources

Honorable Governor Herbert
Utah State Capitol Complex
350 North State Street, Suite 200
PO Box 142220
Salt Lake City, Utah 84114

Honorable President Niederhauser
Utah State Senate
320 State Capitol
PO Box 145115
Salt Lake City, Utah 84114

Honorable Speaker Hughes
Utah House of Representatives
350 North State, Suite 350
PO Box 145030
Salt Lake City, Utah 84114

October 26, 2015

Dear Governor Hebert, President Niederhauser, and Speaker Hughes,

There has been discussion over the last several years regarding the Utah Division of Water Resources' proposed Lake Powell Pipeline ("LPP") project and the subsequent repayment obligations of the taxpayers of Washington County. We have conducted an analysis of the indebtedness of the Washington County Water Conservancy District ("the District") and the residents of Washington County by virtue of their participation in the LPP. Based on our analysis we have major concerns about the debt and increased water rates and/or increased impact fees that will be caused by this proposal.

The following pages summarize our findings, based on the LPP Preliminary Application Documents, the District's audited financial statements, and other public documents made available by various agencies. Based on this initial analysis, we have major concerns about the likelihood that Utah taxpayers will be repaid by the District for the costs of the LPP.

The District intends to participate in the LPP, proposing to receive 94.5% of the water from the pipeline. This would amount to 69,000 acre-feet, according to the project's 2011 Water Needs Assessment. We calculated different repayment scenarios based upon the 2012 Socioeconomics and Water Resource Economics Report's low and high project cost projections of $1.4 billion and $1.8 billion, respectively, assuming an interest rate of four percent and a 50-year repayment period. These cost estimates are in 2012 dollars and this analysis did not account for inflation.

The District will have to repay between $61.8 and $131 million of LPP debt annually on top of its existing debt portfolio, depending on final LPP project costs. The District's current

annual revenues are approximately $29 million and current annual expenses are approximately $20 million. The remaining $9 million in net revenues available to shoulder additional LPP debt is not sufficient to service the debt. This shortfall poses a major challenge for the District, its ratepayers and Utah taxpayers.

This LPP debt service is equivalent to $369–$781 every year for 50 years for every man, woman, and child currently living in Washington County. Unless the District increases water rates, impact fees, and/or other revenues, its existing and LPP debt will not be repaid at the end of the 50-year loan period. This outstanding debt assumes the District's revenues increase at the same rate as the county's population.

Assuming the $1.8 billion high-cost LPP alternative from the 2012 Socioeconomics and Water Resource Economics Report, the District could raise the needed funds by:

- raising impact fees 138 percent, to an average of $14,514 per connection; together with
- raising water rates by 678 percent; together with
- selling 1200 acres of land owned by the District; together with
- continuing to collect property taxes near the maximum levy rate allowed by state law.

Assuming the $1.4 billion low-cost LPP alternative from the 2012 Socioeconomics and Water Resource Economics Report, the District could raise the needed funds by:

- raising impact fees 123 percent, to an average of $13,630 per connection; together with
- raising water rates by 576 percent; together with
- selling 1200 acres of land owned by the District; together with
- continuing to collect property taxes near the maximum levy rate allowed by state law.

Of course, increasing water rates this much would significantly decrease Washington County residents' demand for water—in our analysis, demand decreased so much that the LPP water would go unused—which the Division of Water Resources did not consider. Dozens of economic studies document the correlation between higher water prices and reduced water demand (citations available upon request). This fundamental principle of economics should be considered in forecasting future water demand in Washington County.

Currently, Washington County has some of the lowest water rates in the American West because the District collects property taxes on homes and businesses, which effectively lowers the price of water. Eliminating these property tax subsidies for water would lower the tax burden in the county while allowing the free-market forces of supply and demand to achieve more economically-rational water use. This is one of several water sources the Division of Water Resources has not considered in its most recent LPP proposal.

Other sources of future water which state water planners are not considering were revealed in the 2015 Legislative Audit of the Utah Division of Water Resources. The audit found that local water providers, including cities and towns, have the ability to expand their sources of water supply. The auditors noted that St. George City has the ability to expand its water supply without the assistance of the District through new well drilling and other water sources. The audit also showed the area's water supply is actually growing as new residential development occurs, due to water formerly used by agricultural operations being transferred to municipal uses. As Washington County continues to grow, more and more of its irrigated farmland will be transformed into sites for homes and businesses, adding large amounts of water to the public supply.

The auditors also noted Washington County has some of the highest water conservation potential in the nation. The area's per-person water use is over twice the national average and their current conservation goal would still put their per-person water use above nearly every similar community in the West. If the area implemented a more aggressive water conservation program they could further extend their water supply. When these additional water sources are included in the water supply estimates for Southwestern Utah, the need for the LPP becomes questionable.

Additionally, according to the Utah Division of Water Resources, the District claims it has supplemental water infrastructure needs outside of the LPP that total an added $1.1 billion in new debt for facilities, including a Master Plan, the Warner Valley Reservoir, and water treatment upgrades. Our analysis does not include this additional debt, which will require even larger increases in water rates and/or impact fees than described above.

Furthermore, the projected cost alternatives are now four to seven years old and these costs are likely to have increased because of inflation. Increased costs due to construction delays are not uncommon with water projects of such large size and cost, which would require additional increases in water rates and/or impact fees. While impact fees might appear to fall only on newcomers, free market competition for housing development among surrounding counties means that the District's impact fees will depress the value of Washington County land relative to its neighbors' land and relative to its current value.

In the past, the Division of Water Resources has claimed they have devised a repayment scenario, coined "Pay-As-You-Go," allowing the District to take portions of the water from the LPP and only pay the debt associated with this smaller portion. This scenario does not address the operation and maintenance costs, among other costs, which must be paid annually regardless of when the project's water is used by the District. If "Pay-As-You-Go" involves no State subsidy (that is, if it entails "negative amortization"), we find it causes ballooning debt as a function of not paying down the loan, unless the District raises water rates and/or impact fees even more. If, on the other hand "Pay-As-You-Go" does involve a State subsidy, then it constitutes an almost 50-year interest-free loan, a gift by Utah taxpayers potentially totaling billions of dollars. Finally, if the Division of Water Resources contends that only a portion of the LPP water is needed over the next 20–40 years and the area has a variety of alternative water sources, we question why the project is being proposed now.

We conclude from our initial analysis that these debt obligations raise serious questions about the project the Division of Water Resources is proposing. The State should not facilitate Washington County's acquisition of this debt without a careful and thoroughly detailed study of whether Washington County residents have the need for this water, the will to pay dramatically more in water rates and/or impact fees, and the financial capacity to repay this large debt owed to the taxpayers of Utah. Without this study and subsequent discussion, there is no assurance that Utah taxpayers will ever see their loan repaid. Indeed if repayment really was highly likely, the District by itself could have borrowed the money on the bond market from eager investors and started construction already, without any State financial involvement, as the District has done on many past occasions.

Thank you for the opportunity to participate in this discussion.

Sincerely,

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Lake Powell Pipeline Economic Feasibility Analysis for Washington County, UT

October 2015

Lake Powell Pipeline Feasibility for Washington County Water District

The following summarizes concerns about the ability of the Washington County Water Conservancy District (WCWCD) to repay debt issued by the State of Utah for the WCWCD's financial obligation for participating in the proposed Lake Powell Pipeline (LPP).

1. Washington County Water District's Questionable Water Needs. Based on declining population growth, potential to convert additional agricultural water, potential water conservation savings, and previously unconsidered water sources, Washington County has ample water to serve future populations without participation in the Lake Powell Pipeline.

1a. Outdated Population Forecasts. The Governor's Office of Planning and Budget (GOPB) 2012 Baseline Population Projections estimates Washington County will grow to 581,731 residents by the year 2060, 32.4 percent lower than population projections made by the GOPB in 2005.[1] Since the District's water needs projections rely on these population projections, the more updated data pushes the supposed need for the LPP back over 12 years. The labeled *2006 Population* and *2012 Projection with No Conservation* lines in Figure 2 on page 3 illustrates the difference between these two different population forecasts on water use.

1b. Potential Agricultural Water Transfers. In the most recent Kanab Creek/Virgin River Basin Plan by the Division of Water Resources (DWRe) from 1993 (1993 KCVRBP) it was estimated the basin had 25,600 acres of irrigated cropland, diverting over 123,000 acre-feet of water (pg. 10–14), with 87,800 acre-feet of the agricultural diversions in the basin occurring in Washington County. Much of the water diverted for agriculture in Washington County uses inefficient conveyance systems and it is estimated "If the overall irrigation efficiency could be increased one percent, it would save 2,500 acre-feet of water in the basin." (pg. 2–8 1993 KCVRBP).

TABLE 5-12
ESTIMATED CURRENT IRRIGATION WATER USE[15]

County	Area[a] (acres)	Diversion (acre-feet)	Depletions (acre-feet)
Washington	16,680	87,800	39,320
Iron	1,520	7,860	1,490
Kane	7,400	27,640	10,490
Total	25,600	123,300	51,300

[a]Includes idle cropland

As future development replaces former agricultural lands in the county, the new development creates a surplus of water formerly used to irrigate crops. Table ES-11 in the 2011 DWRe Water Needs Assessment claims that Washington County can only expect to convert 10,080 acre-feet of agricultural water for M&I needs. However Table 10-6 of the 1993 KCVRBP implies, using linear interpolation, that there will be a reduction of 27,100 acre-feet of irrigated cropland water diversions from 2011 to 2040.[2] According to the 2012 USDA Census of Agriculture, Washington County had 14,781 acres of irrigated lands in 2012, a reduction of over 10,000 acres since 1993.

The 2015 Legislative Audit of the Division of Water Resources found that "the state engineer typically approves the conversion of 100 percent of agricultural water to municipal use"[3] and thus Washington County can expect much more than 10,000 acre-feet of water to be available from agricultural conversions.

---

[1] http://governor.utah.gov/DEA/projections.html, 2012 Baseline Projections, "Population and Households by Area." Available as http://governor.utah.gov/DEA/ERG/ERG2012/Households%20by%20Area.xlsx

[2] Utah State Water Plan, Kanab Creek/Virgin River Basin, Utah Division of Water Resources, August 1993.

[3] "A Performance Audit of Projections of Utah's Water Needs," Office of the Legislative Auditor General, May 2015, Page 54. http://le.utah.gov/audit/15_01rpt.pdf

Table ES-11 Future Planned and Potential WCWCD Water Supply Projects

Project	Estimated Reliable Culinary Supply (ac-ft/yr)	Estimated Reliable Secondary Supply (ac-ft/yr)
Ash Creek Pipeline[1]	3,830	0
Maximize Existing Wastewater Reuse[2]	0	7,300
Agricultural Conversion from Development[3]	0	10,080
Lake Powell Pipeline	69,000	0
Potential Future Wastewater Reuse[4]	0	27,620
Total Potential Yield from Future Projects	72,830	45,000

TABLE 10-6
CURRENT AND PROJECTED IRRIGATED CROPLAND WATER USE

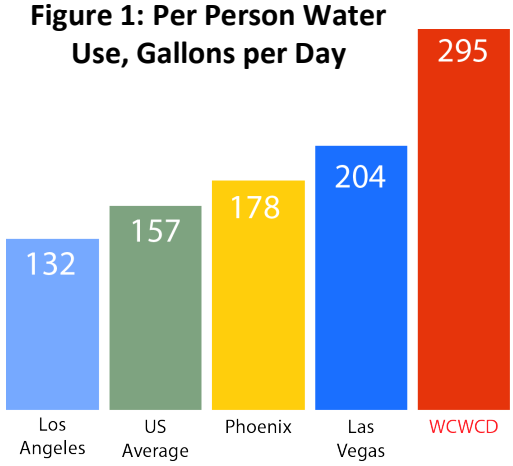
Year	Area[a] (Acres)	Diversions (acre-feet)	Depletions (acre-feet)
1990	25,600	123,300	51,300
2020	21,400	96,300	43,300
2040	18,600	80,000	37,600

aIncludes some idle land.

WCWCD claims only 10,080 ac-ft of water will be available for municipal use from the conversion of agricultural lands as a function urban growth, yet the 1993 KCVRBP projects there will be 27,100 acre-feet made available by 2040.

1.c Potential Water Conservation Savings. According to the 2011 DWRe Water Needs Assessment, WCWCD uses 295 gallons per capita per day ("GPCD"; p. ES-7) and had 13 percent water conservation savings from 2000–2009 (p. ES-10). If WCWCD encouraged residents to get closer to neighboring cities or the state conservation goal of 220 GPCD,[4] the district could extend its water supply even further into the future.

Figure 1: Per Person Water Use, Gallons per Day



Since WCWCD's per person water use is nearly twice the national average, it is clear there is great potential for additional water conservation efforts.

The recent legislative audit noted:

> *"The Southern Nevada Water Authority, which serves the Las Vegas region, has a goal to reduce water use to 199 by 2035. In contrast, the communities in Southwestern Utah, which have a climate similar to that of Southern Nevada, have a goal to reduce water use to 292 GPCD by the year 2060."*[5]

[4] Utah baseline per capita water use: http://state.awra.org/utah/sites/default/files/AdamsMillis-WaterNeeds.pdf.
[5] "A Performance Audit of Projections of Utah's Water Needs," Office of the Legislative Auditor General, May 2015, Page 41. http://le.utah.gov/audit/15_01rpt.pdf

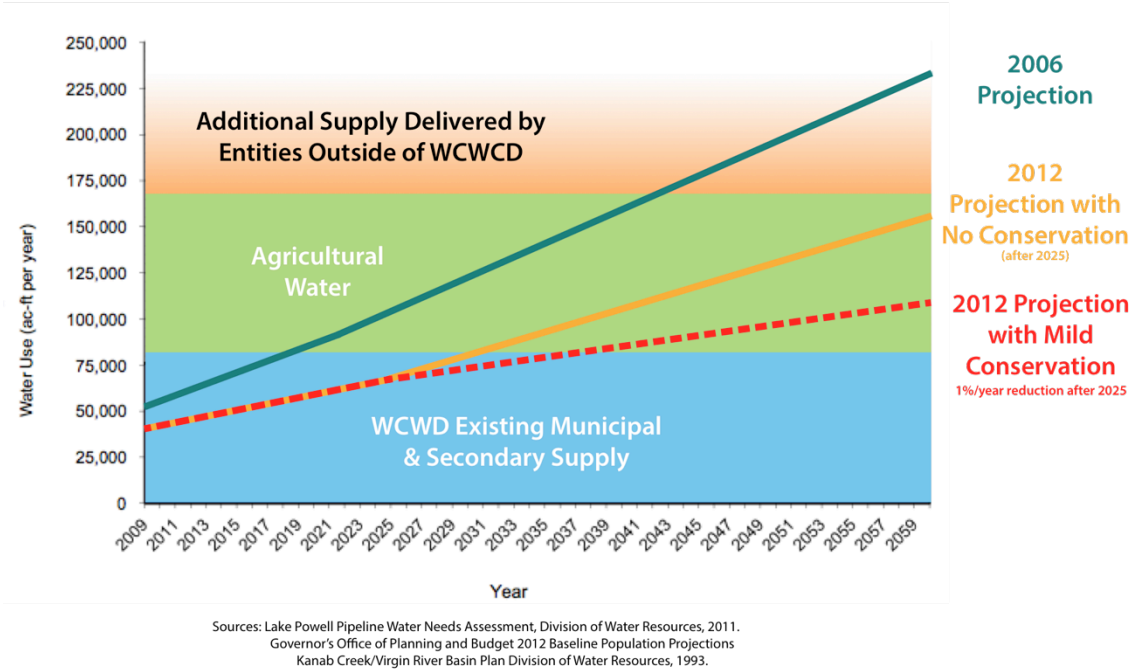


Figure 2: Population projections from the Governor's Office of Planning & Budget demonstrate reduced water demand for Washington County. The recent Legislative Audit of water needs projections questioned the conservation efforts of Utah and criticized the DWRe for not including local sources of water available outside of WCWCD supplies in planning documents. The dotted red line shows water demand if per capita water use was reduced each year after 2025 by 1 percent of the 2025 level.

1d. Previously Unconsidered Water Sources. According to a May 2015 bond rating update for WCWCD from Fitch Ratings:

> "The district has ample water supply, is expanding its water reserves through a groundwater recharge program, enjoys surplus system capacity, operates predominantly new infrastructure, and faces no known regulatory issues."

The District noted it operates a groundwater recharge program that currently provides 100,000 acre-feet of water and will provide access to up to 300,000 af in the future.[6] This amount of water more than twice the District's supply, yet is not accounted for in the LPP planning documents.

The 2015 Legislative Audit of the state sponsor of the Lake Powell Pipeline, the Utah Division of Water Resources, showed that water planners are ignoring the fact that local water providers have the ability to expand their own sources of water supply. The auditors noted St. George has the ability to expand its water supply without the assistance of WCWCD through new well drilling and other sources.[7] These future water sources were also not included in the LPP planning documents.

[6] "Fitch Affirms Washington County Water Conservancy Dist, UT's LTGOs at 'AA+'; Outlook Stable" Business Wire, May 22, 2015. http://www.businesswire.com/news/home/20150522005845/en/#.VW88PufqITk

[7] "A Performance Audit of Projections of Utah's Water Needs," Office of the Legislative Auditor General, May 2015, Page 62. http://le.utah.gov/audit/15_01rpt.pdf

2.Estimate of Existing Revenues vs. Debt Service for WCWCD.

One important question is whether or not local taxpayers can support Washington County's repayment obligation for the LPP as is required by Utah Law. The Lake Powell Pipeline (LPP) Development Act (Utah Code 73-28-402) mandates the entire project cost be repaid to the State of Utah with interest.

Repayment of the LPP construction costs requires the District's total revenues to cover their existing operation and maintenance costs, preexisting debt obligations, debt from LPP construction, and the operation and maintenance costs associated with the LPP.

A review of the WCWCD's revenue streams is warranted, based on the 2013 Audited Financial Statement Prepared for WCWCD, the "2013 WCWCDAFS".[8]

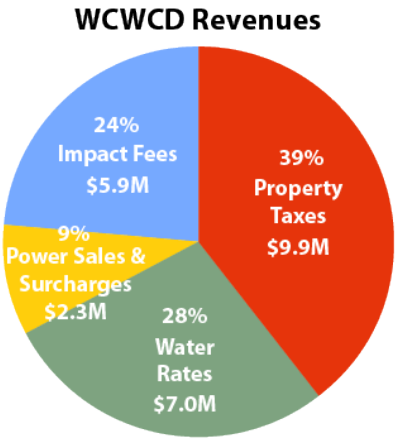


Figure 3: Revenue Sources from 2012 Audited financial statement from WCWCD

2a. Current Revenues

Operating Revenues. WCWCD received $7,013,377 in water sales revenue, $926,134 in power sales revenues and $1,379,171 in Water Development and Connection Fees (page 22 of the 2013 WCWCDAFS). These last two categories are represented as "Power Sales & Surcharges" in the above pie chart.

	2013
OPERATING REVENUES:	
Power Sales	$ 926,134
Water Sales (net of rebates)	7,013,377
Water Development and Connection Fees	1,379,171
Total Revenues	9,318,682

Property Tax Revenues. In 2013 WCWCD collected $9,938,660 from property taxes (see the source in the next paragraph). Its levy rate was 0.000970544 times the taxable value of the county (p. 19 of the 2013 WCWCDAFS).

Impact Fee Revenues. WCWCD collected $5,919,316 in impact fees for new development in 2013 (page 19 of the 2013 WCWCDAFS):

	General Fund	Virgin River Program	Capital Projects Fund	Total Governmental Funds
REVENUE:				
Property Taxes	$ 9,938,660	$ -	$ -	$ 9,938,660
Impact Fees - Current Year	-	-	5,919,316	5,919,316

[8] "Washington County Water Conservancy District Financial Statement With Other Government Reports For the year ending June 30, 2013."

Revenues from Sale of WCWCD's Surplus Real Property. According to page 7 of the 2013 WCWCDAFS, the District has between 1000–1200 acres in real property that can be sold at market value for additional funds. The District claims this property is valued between $50,000–$125,000 per acre. For this analysis it was assumed the District would sell 1200 acres at the highest market value to help pay for the LPP, giving the district a one-time revenue source of $150,000,000.

> The District owns real property which is shown on the books at cost. Approximately 1000 - 1200 acres may eventually be declared surplus property and sold at market value. The current fair market value for this property is $50,000 to $125,000 per acre. It is anticipated that the value will continue to increase over time. These values are not reflected in the statement of net position.

2b. Existing Debt Service by WCWCD (not including LPP). The WCWCD has $7,026,322 in annual debt service for previous obligations for FYE 2013, not including debt from the Lake Powell Pipeline, as shown on the 2014 row of the District's debt service schedule (p. 39 of the 2013 WCWCDAFS). This non-LPP debt service increases annually through 2037 before being extinguished in 2050, totaling $94.3 million. The District's debt schedule is included below.

Total remaining principle and interest debt service by year is as follows:

Year Ending December 31	Principal	Interest	Annual Debt Service
2014	$ 4,235,743	$ 2,790,579	$ 7,026,322
2015	4,422,856	2,616,602	7,039,458
2016	4,580,005	2,468,102	7,048,107
2017	4,780,193	2,268,125	7,048,318
2018	4,992,420	2,058,228	7,050,648
2019	4,599,688	1,851,402	6,451,090
2020	4,784,997	1,671,335	6,456,332
2021	4,657,349	1,481,231	6,138,580
2022	3,810,746	1,284,484	5,095,230
2023	3,999,189	1,102,551	5,101,740
2024	4,197,680	911,505	5,109,185
2025	4,380,220	719,745	5,099,965
2026	2,658,811	519,539	3,178,350
2027	2,782,454	396,541	3,178,995
2028	2,921,151	267,724	3,188,875
2029	1,653,905	132,385	1,786,290
2030	1,556,716	53,744	1,610,460
2031	1,558,587	51,873	1,610,460
2032	1,560,520	49,940	1,610,460
2033	1,562,516	47,944	1,610,460
2034	64,578	45,882	110,460
2035	66,709	43,751	110,460
2036	68,909	41,551	110,460
2037	71,183	39,277	110,460
2038	73,532	36,929	110,461
2039	75,956	34,504	110,460
2040	78,462	31,998	110,460
2041	81,051	29,409	110,460
2042	83,724	26,736	110,460
2043	86,486	23,974	110,460
2044	89,339	21,121	110,460
2045	92,286	18,174	110,460
2046	95,331	15,129	110,460
2047	98,476	11,984	110,460
2048	101,724	8,736	110,460
2049	105,080	5,380	110,460
2050	108,340	2,118	110,458
Totals	$71,136,912	$23,180,232	$94,317,144

WCWCD existing debt schedule, not including LPP debt.

2c. Existing Operation and Maintenance Expenses. In addition to its debt obligations, WCWCD has operating and maintenance expenses, totaling $13,231,636 according to the 2013 WCWCDAFS. These expenses are assumed to grow proportionally to the number of new households in the county, shown in the attached spreadsheet's Column J[9]. Operating and maintenance costs have been included as part of LPP participation in Column L. Our estimates of WCWCD Total Expenses are shown in Column N[10].

3. Estimate of Additional Debt Service from the Lake Powell Pipeline on WCWCD

3a. 50-Year Repayment Obligation for Lake Powell Pipeline by Washington County Taxpayers. The following is the calculation of total annual debt service the WCWCD would incur to participate in the LPP. The WCWCD has announced they intend to receive 94.5 percent of the project water[11], meaning they will be required to repay 94.5 percent of the roughly $1.4–$1.8 billion cost.[12] The WCWCD can therefore expect to repay $1.33 billion – $1.75 billion in capital costs to repay. Assuming a 50-year repayment period, the annual debt service varies with the interest rate as follows:

Annual Debt Service Payments for LPP
by the Washington County Water Conservancy District

	Interest Rate			
Repayment Cost	**0.03**	**0.04**	**0.05**	**0.07**
$1.33 Billion	$51,631,330	$61,840,170	$72,758,808	$96,260,153
$1.75 Billion	$101,799,606	$130,945,384	$166,211,969	$258,354,138

In other words, the repayment obligation from the LPP will add between $51.6 and $258 million in additional annual debt burden onto WCWCD's existing debt service, depending on final project cost and interest rate. A reasonable assumption for a 50-year interest rate is 4 percent, meaning an additional $61.8–131 million in new annual debt payments due to the LPP, shown in the attached spreadsheet's Column K.

3b. LPP Power Generation Revenues and Operation and Maintenance Costs. The different cost estimates put forward in the 2012 Lake Powell Pipeline Modified Draft Study Report 10 are due to different levels of pump-storage power generation capacities presented in the planning documents. The $1.8 billion cost estimate generates more power sales revenues than the $1.4 billion project cost projection, but also requires much more operation and maintenance costs. The expected revenues and expenses can been seen here:

Construction Cost	**2026 Power Sales Revenue**	**2026 Operation and Maintenance Expenses**
$1.4 Billion	$9,947,747	$23,493,231
$1.8 Billion	$72,005,740	$62,867,794

[9] The First and Second Scenarios in the spreadsheet represent the low and high cost estimates of the LPP project assumed in our analysis. Existing revenues and expenses of the District were assumed to stay the same in both scenarios (Columns B-F). Differences in the two project cost scenarios resulted in changes to the debt associated with the project (Columns G-P) and the repayment options (Columns Q-V).
[10] Note: Columns K and L differ between the two project cost scenarios.
[11] 69,000 af / 73,000 af, Page ES-5, 2011 LPP Water Needs Assessment. (For the CICWCD see "Iron County pulls out of Lake Powell pipeline project," Salt Lake Tribune, March 22, 2012.)
[12] Lake Powell Pipeline Modified Draft Study Report 10, Socioeconomic and Water Resource Economics, February 2012

Based on the expected growth of existing revenue streams due to population increase in the county, WCWCD's revenues can be projected over the next 50 years, as shown in Column H. The deficit schedule for the repayment period can be seen in Columns O and P. These columns show that the District's revenues fall significantly short of the District's expenses for every year of the 50-year repayment schedule (except for any initial payment-free years). Unless the District has an increase in revenues, WCWCD's cumulative debt would grow to between $5.84–6.76 billion (cell P73) by the end of the project repayment period. Clearly, participation by the WCWCD in the LPP will require significant increases in impact fees and/or water rates.

4. Water Rate and Impact Fee Increases Required to Repay Debt

The fundamental question is whether the WCWCD can make these debt payments via an increase in revenue[13], and if so how they will raise this revenue.

Increasing Property Taxes. According to Utah law, water conservancy districts in the Lower Colorado River Basin may not tax higher than 0.001 per dollar of taxable value of taxable property in the district.[14] WCWCD currently collects property taxes at the rate of 0.00097. However, even if WCWCD increased their levy to the maximum collection rate, this only increases revenues $301,642 and revenues would still fall short of their expenses by tens of millions of dollars each year, accumulating to a deficit of billions dollars at the end of the 50-year repayment period. Therefore increasing water rates and/or impact fees must also be implemented by WCWCD.

Increasing Water Rates. Columns Q and R examine whether increasing water rates alone, without any impact fee increases, could repay Washington County Water District's total future debt. Although one might think the WCWCD could simply increase water rates to raise revenues, raising water rates will result in a decrease in total water demand. Because the debt is relatively large, in order for water sales to cover the debt obligations of the project, water sales revenues would need to increase by 320–358 percent, depending upon the total cost of the LPP (spreadsheet cell B10). This would still require the WCWCD to shoulder significant deficits over time, but would result in a balance of essentially zero in 2063 (Columns Q and R; cell R73).

Due to the fact that the price elasticity of demand for water is estimated to be -0.5, repayment through water sales alone would require rate increases of 1665–1995 percent (cell B12). This enormous increase in water rates would lead Washington County water users to need less water in 2060 than they used in 2010 (cells O12 and AA12 of the "Water Demand" worksheet), meaning that there would be no need for the water supplied by the LPP. In other words, if the LPP is financed only by increasing water rates, water would become so expensive that future water demand would drop below the current water demand of WCWCD,[15] even if one ignores other water sources identified above.

Increases in water rates may slow the rate of population growth in Washington County, which would make the LPP both harder to pay back and less necessary. To avoid this and maintain the desirability of homes and building lots in Washington County in the face of increases in water rates, the price of that real estate would have to fall. The lower property values would decrease the

[13] In the low-cost scenario, we assumed repayments start immediately, which keeps costs as low as possible. In the high-cost scenario, we assumed repayments begin after a delay of 10 years, which is more realistic and raises costs.
[14] Utah Code, Section 17B-2a-1006. http://le.utah.gov/code/TITLE17B/htm/17B02a100600.htm
[15] This is because cell B11 is larger than cell B8 in both scenarios.

property taxes collected by the District, forcing water rates to go up more than anticipated and forcing real estate values to go down more than anticipated.

Increasing Impact Fees. Columns S and T examine whether increasing impact fees alone, without any additional revenue increases, could repay Washington County Water District's total future debt. Impact fees are the fees new development pays to hook up to the water system, and there has been some discussion about making debt payments through an increase in impact fees. Currently WCWCD has an average impact fee of $6,102[16] and if the District chose to repay debt just using impact fees, revenues from impact fees would need to increase by 247–276 percent (cell B15), requiring an average impact fee of between $21,158–$22,927 (cell B17).

The large impact fees required in Washington County would be among the highest in the nation,[17] likely deterring new growth in the county or significantly lowering property values (or both). Both effects would add even more problems for WCWCD's repayment obligations: the first would lower the amount of impact fees collected, and the second would lower property values and lower the total property taxes collected by the district. Our analysis did not compensate for these factors.

Combination of Increased Water Rates and Impact Fees. The significant debt to participate in the LPP will require WCWCD to raise revenues by tens of millions of dollars every year**.** The District's only real flexibility in raising revenues for its debt payments comes from deciding the proportion of increased revenues, which will come from increased water rates versus from increased impact fees.

Participating in the $1.4 billion low-cost alternative of the Lake Powell Pipeline from 2012 Socioeconomics and Water Resource Economics Report could require the WCWCD to raise its revenues by:

- raising impact fees 123 percent (spreadsheet cell B21), to an average of $13,630 per connection (spreadsheet cell B22); together with
- raising water rates by 576 percent (spreadsheet cell B20); together with
- selling 1200 acres of land owned by the District; and with
- continuing to collect property taxes near the maximum levy rate allowed by state law.

Participating in the $1.8 billion high-cost alternative of the Lake Powell Pipeline from 2012 Socioeconomics and Water Resource Economics Report could require the WCWCD to raise its revenues by:

- raising impact fees 138 percent (cell B21), to an average of $14,514 per connection (cell B22); together with
- raising water rates by 678 percent (cell B20); together with
- selling 1200 acres of land owned by the District; and with
- continuing to collect property taxes near the maximum levy rate allowed by state law.

In addition, the 576–678 percent increase in water rates means that Washington County water users would demand more than their current water demand[18] but only 84–90 percent of their current water supply in 2060 (worksheet "Water Demand" cells U11 and AG11), so there would be no need for LPP water.

[16] 2013 WCWCD Audited Financial Statement

[17] 2012 National Impact Fee Survey, Duncan Associates: http://www.impactfees.com/publications%20pdf/2012_survey.pdf

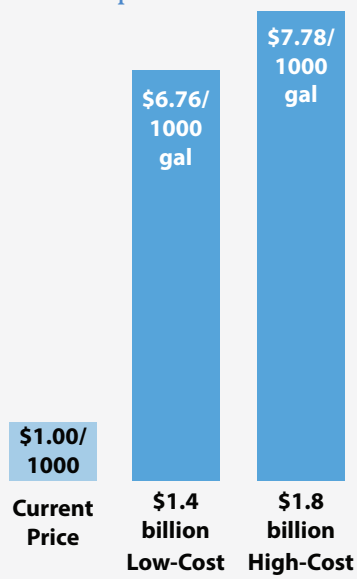
[18] This is because cell B19 is smaller than cell B8 in both scenarios.

Water Rate and Impact Fee Increases from LPP

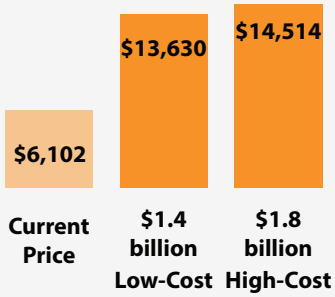
Debt Repaid with Impact Fees and Water Rates

Figure 4: The WCWCD would be required to increase revenues substantially to cover annual LPP debt payments. Since WCWCD cannot raise taxes further, this increase in revenues would have to come from water rates and/or impact fees.

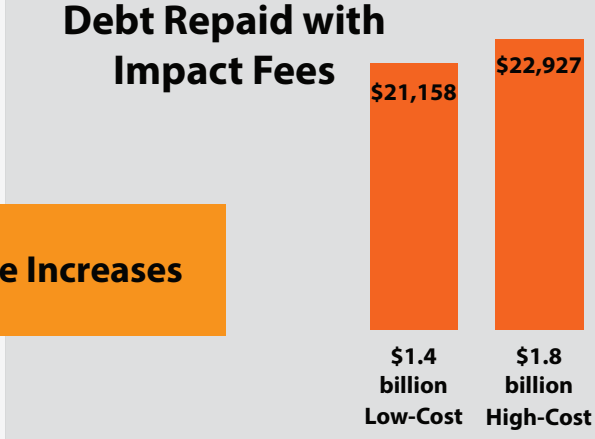
The right side of this graphic shows the increases required by WCWCD if they chose to only increase revenues from one source to repay the debt (cells B12 & B17). The left side of this graphic shows the increases required if WCWCD shifted the increases proportionally on the revenue sources (cells B20 & B22) The upper and lower parts of the graphic show the water price increases and impact fee increases required respectively.



Water Rate Increases
*Typical Washington County City



Impact Fee Increases



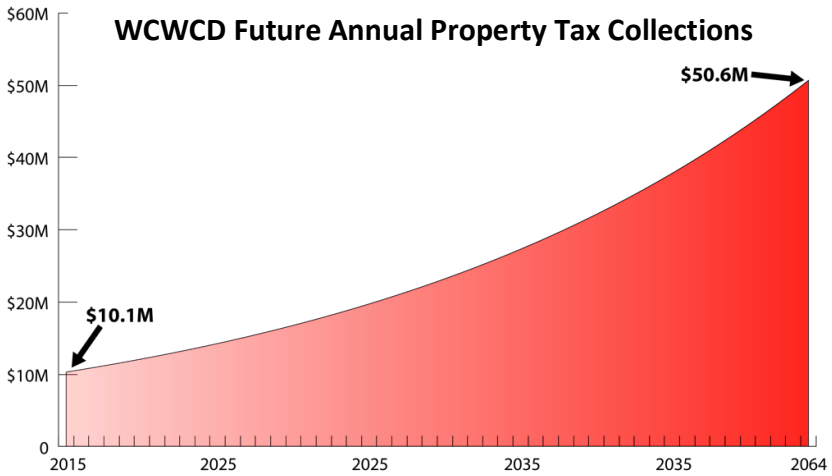


Figure 5. Since WCWCD's property tax collections are already near their maximum authorized levy amount, the future growth in property tax revenues will come from population growth (column B). Yet even with this increase in revenues the District must increase water rates and impact fees considerably to repay the annual debt from the Lake Powell Pipeline.

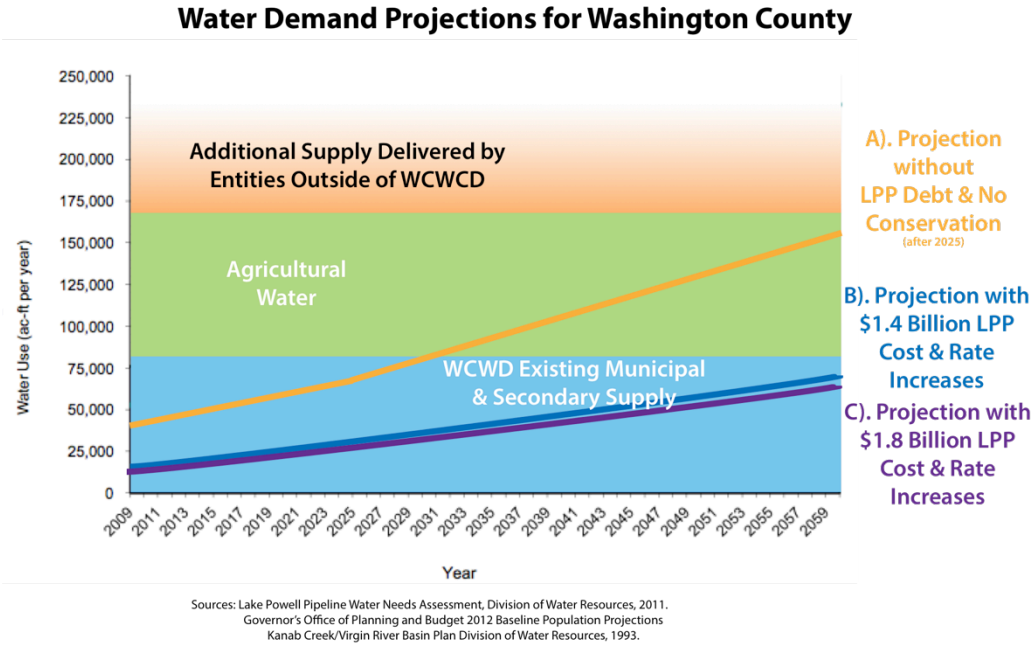


Figure 6. A). 2012 water demand projection for Washington County, which does not include the effect increased water rates would have on reducing water use. This projection assumes no additional water conservation after 2025, keeping water use at 241 GPCD until 2060. This is also the projection if the LPP is only paid for with impact fees.
B). Under the $1.4 billion LPP cost projection, WCWCD's water demand would decrease by 62% due to increased water rates to repay LPP debt (cell J21). This calculation assumes half the LPP debt would be paid through increased water rates and the other half through increased impact fees.
C). Under the $1.8 billion LPP cost projection, WCWCD's water demand would decrease by 64% due to increased water rates to repay LPP debt (cell J21). This calculation assumes half the LPP debt would be paid through increased water rates and the other half through increased impact fees.

5. Washington County Water District does not have a current repayment plan.

The most recent repayment plan for the LPP project was in the Regional Water Capital Facilities Plan and Impact Fee Analysis from 2006[19]. The 2006 CFP has many problems as it relies on data that is nearly a decade old, including growth projections made before the 2008 economic downturn. The 2006 CFP completely relied on impact fees for repayment of the project, increasing the fees by 5 percent per year to increase revenues. This impact fee increase is not sufficient to repay the WCWCD debt, as shown in Section 4 above.

The plan also relied on an outdated cost estimate for the LPP project of $562 million. Newer documentation shows the project will cost between $1.4 billion and $1.8 billion.

Despite these many problems, the WCWCD continues to rely on this plan to set their impact fee schedule. Due to the decrease in expected new growth in the area and the higher LPP construction costs, the fund is far behind where it should be to repay the project. The 2006 CFP projected the Impact Fee Fund balance to be $113,770,522 but in reality the 2013 WCWCDAFS showed the district had only $44,839,323, 61 percent lower than planned in the 2006 CFP.

6. 'Pay-As-You-Go' Repayment Concept Creates Large Subsidy Funded by State Taxpayers

In public discussions related to the repayment problems of the proposed Lake Powell Pipeline, water officials from the Division of Water Resources and the WCWCD coined a repayment concept called "Pay-As-You-Go." In a 2008 correspondence between WCWCD and the Division of Water Resources, the District's General Manager outlined this pay-as-you-go concept, asking for confirmation from the Division about the proposal. The concept would allow the WCWCD to defer paying for the entire project by instead buying smaller portions of the Lake Powell Pipeline's water, which they refer to as "blocks." According to these officials, the District would only pay the costs and interest associated with one small block of water at a time. This would leave the rest of the unused water and its costs to collect interest without any repayment for decades. This letter from WCWCD's general manager explicitly stated that he believed,

> *"No interest would be charged until such time as the actual contract to take the water occurs."*[20]

This was echoed and confirmed in correspondence from the Division of Water Resources.[21] The letters stated that WCWCD would not be required to pay interest on the entire project and would only have to pay interest on small blocks of the project which could be purchased at any point during the first 50 years after the project's completion. This would defer paying interest on the entire project, leaving the State of Utah holding billions of dollars of debt for an indeterminate amount of time.

[19] WCWCD Capital Facilities Plan, 2006.
[20] August 14, 2008 Letter from the General Manager of WCWCD to the Director of the Division of Water Resources.
[21] October 14, 2008 Letter from the Director of the Division of Water Resources to the General Manager of WCWCD.

Yet according to the LPP Development Act,

> *"The board [of Water Resources] shall establish and charge a reasonable interest rate for the unpaid balance of reimbursable preconstruction and construction costs."*[22]

We interpret this to mean that if "Pay-As-You-Go" is allowed—and we do not know whether it is allowed under the LPP Development Act—then any due-but-unpaid interest must be added to the principal owed by WCWCD, so that the due-but-unpaid interest must be paid back later with interest (a process called "negative amortization"). Our spreadsheet is constructed using this assumption. By making the District's repayment schedule to the State uncertain and conditional on how the District's wishes to take water during the next few decades, this "negative amortization" interpretation of "Pay-As-You-Go" increases the uncertainty of the State's financial condition during those decades, to the detriment of the State and, potentially, to the detriment of the State's bond rating.

In addition, if the District discovered the LPP water was not needed after all, as seems likely, the District might never buy LPP water, leaving the State to pay all the costs of the project. In the free market, a lender would not loan money without a documented income stream, and that would be a prudent policy for the State of Utah to follow when it lends.

The alternative to the "negative amortization" interpretation of "Pay-As-You-Go" is to forgive the interest for the Lake Powell Pipeline. This scenario would be much worse for the State and its bond rating since it would constitute an interest-free loan of billions of dollars for several decades from Utah taxpayers to the District. Such a lending scenario is completely alien to free-market lenders (except in bankruptcy proceedings, when attempting to recover funds that in hindsight were imprudently lent). The only grounds upon which interest forgiveness could be justified would be as a permanent subsidy from the State to the District, which would certainly violate the intent of the LPP Development Act. Accordingly, the "permanent interest forgiveness" interpretation of "Pay-As-You-Go" is irrelevant to LPP financing.

7. Consideration of the Public Bond Market

The USA has a deep and sophisticated municipal bond market whose participants are, for the most part, better equipped than anyone else to decide whether repayment plans for a public project are sound. The best solution would be for the WCWCD to go to those markets, instead of to the State of Utah, for LPP financing. If the markets decide the WCWCD's LPP financing scheme is sound, the markets will happily supply the needed funds. Otherwise, the market will have judged the WCWCD's LPP financing scheme unsound, and that judgment should stand.

[22] Utah Code, Section 73-28-403.

Appendices

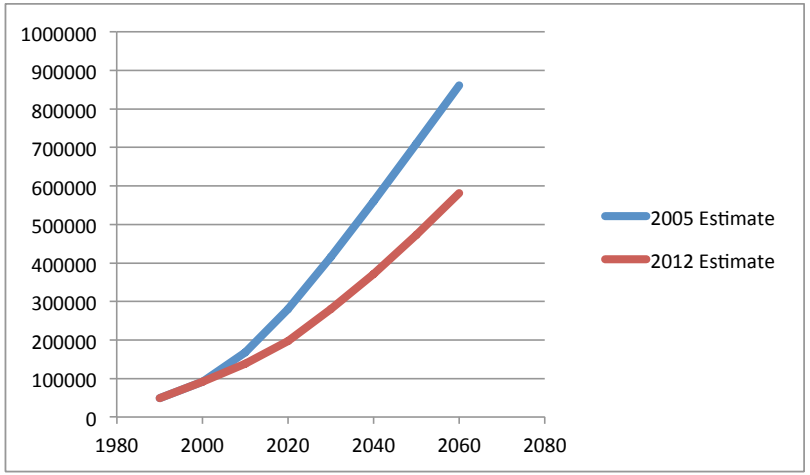
Appendix A

Washington County, UT Population Projections

GOPB Estimates	1990	2000	2010	2020	2030	2040	2050	2060
2005 Estimate	48,978	91,090	168,078	279,864	415,510	559,670	709,674	860,378
2012 Estimate	48,978	91,090	138,748	196,762	280,558	371,743	472,567	581,731
# Households (est. 2012)	15,481	30,191	46,545	70,919	112,378	151,647	192,884	237,065

To solve for geometric growth rates: x_2060 = x_2010 * Exp(r * (2060-2010)) and solve for r.
But that is for continuous compounding. For annual compounding:
x_2060 = x_2010 * (1+r)^(2060-2010) and solve for r.
=> Exp[Ln(x_2060/x_2010) / (2060-2010)] - 1 = r.
Also, for annual compounding, x_t = x_0 * (1+r)^t implies that
x_(t+1) - x_t = x_0 * (1+r)^t * r = x_t * r.

190,520	change in households
0.03309412	Annually Compounded Household Growth Rate, 2010--2060
0.02908183	Annually Compounded Population Growth Rate, 2010--2060



Source: GOPB 2012 Population Projections

Appendix B
Present Value Calculations

Data from the Draft Socioeconomics and Water Resource Economics Study Report

4.00%	interest rate declared in the "First Scenario" (its N11)
4.00%	interest rate declared in the "Second Scenario" (its N11)
4.00%	interest rate used on this page for our calculations (not for the Draft Report calculations, which are B6, I6, B23, and I23)
2.50%	FERC "escalation rate" (rate of benefit & cost increases) to be used in Scenario pages

Page 5-3, Table 5-1, No Pump Storage

4.14%	Discount Rate
2.50%	Escalation Rate

	PV, 2010$	***Annual, 2026***	***PV, 2015$***	
Benefits				
Power-Inline	45,167,000	2,587,006		from equation 5
Power-Pump Stations	127,587,000	7,307,733		from equation 5
Costs				
Capital Construction	1,124,717,000		1,402,458,713	from equation 6
Operation, Maintenance & Replacement	72,908,000	4,175,913		from equation 5
Power Opers.	284,353,000	16,286,737		from equation 5
Foregone Power	58,401,000	3,345,003		from equation 5

Page 5-4, Table 5-2, No Pump Storage

3.00%	Discount Rate
2.50%	Escalation Rate

	PV, 2010$	***Annual, 2026***	***PV, 2015$***	
Benefits				
Power-Inline	69,561,000	2,909,678		from equation 5
Power-Pump Stations	197,255,000	8,251,011		from equation 5
Costs				
Capital Construction	1,227,349,000		1,409,367,477	from equation 6
Operation, Maintenance & Replacement	95,113,000	3,978,497		from equation 5
Power Opers.	435,664,000	18,223,458		from equation 5
Foregone Power	88,843,000	3,716,228		from equation 5

Page 5-5, Table 5-3, Pump Storage Configuration

4.14%	Discount Rate
2.50%	Escalation Rate

	PV, 2010$	***Annual, 2026***	***PV, 2015$***	
Benefits				
Power-Inline	45,167,000	2,587,006		from equation 5
Power-Pump Stations	1,261,042,000	72,228,037		from equation 5
Costs				
Capital Construction	1,482,378,000		1,848,441,823	from equation 6
Operation, Maintenance & Replacement	96,015,000	5,499,401		from equation 5
Power Opers.	284,353,000	16,286,737		from equation 5
Power Pump Station Opers.	700,345,000	40,113,291		from equation 5
Foregone Power	58,401,000	3,345,003		from equation 5

Page 5-6, Table 5-4, Pump Storage Configuration

3.00%	Discount Rate
2.50%	Escalation Rate

	PV, 2010$	***Annual, 2026***	***PV, 2015$***	
Benefits				
Power-Inline	69,561,000	2,909,678		from equation 5
Power-Pump Stations	1,785,425,000	74,682,825		from equation 5
Costs				
Capital Construction	1,617,637,000		1,857,536,020	from equation 6
Operation, Maintenance & Replacement	125,256,000	5,239,353		from equation 5
Power Opers.	435,664,000	18,223,458		from equation 5
Power Pump Station Opers.	971,635,000	40,642,674		from equation 5
Foregone Power	88,843,000	3,716,228		from equation 5

For Washington County's share of these, see tab "Revenues and Expenses"

Avg. of 2 cases ***Annual, 2026***	***Avg. of 2 cases*** ***PV, 2015$***		
		Benefits	disagreement (ratio)
2,748,342		Power-Inline	0.89
7,779,372		Power-Pump Stations	0.89
10,527,714		*sum*	
		Costs	
	1,405,913,095	Capital Construction	0.995098
4,077,205		Operation, Maintenance & Replacement	1.05
17,255,098		Power Opers.	0.89
3,530,616		Foregone Power	0.90
24,862,918		*sum*	
		Benefits	
2,748,342		Power-Inline	0.89
73,455,431		Power-Pump Stations	0.97
76,203,774		*sum*	
		Costs	
	1,852,988,922	Capital Construction	0.995104
5,369,377		Operation, Maintenance & Replacement	1.05
17,255,098		Power Opers.	0.89
40,377,983		Power Pump Station Opers.	0.99
3,530,616		Foregone Power	0.90
66,533,073		*sum*	

Appendix C
WCWCD Revenues & Expenses

WCWCD Revenue Stream

Source: 2013 WCWCD Audited Financial Statement

Property Tax	$9,938,660
Impact Fees	
Total	$5,919,316
Cost per ERU	$6,102
Total New 2013 ERU's	970
Water Availability Surcharge	
Fee/ ERU	$1.75
2013 Total	$1,248,977
Total ERU's	713,701
2013 ERU Growth	0.001359199

Total Service Area Property Valuation	$10,240,302,002
2013 Property Tax Collection Rate	0.000970544
Maximum Legal Property Tax Rate	0.001
Additional Revenue if use Max. Rate	$301,642.00

Note: Equivalent Residential Unit (ERU) is the metric used to determine cost of impact fee per lot, equivalent to 1 ERU per 10,000 sq. ft. of irrigable land

Note: The Water Availability Surcharge is charged to all water bills as a monthly fee

WCWCD Revenue Stream

Source: 2013 WCWCD Audited Financial Statement

Long Term Debt	
Notes Payable	$1,165,000
GO Bonds	$2,680,000
Revenue Bonds	$67,291,912
Total	$71,136,912
Total with interest	$94,317,144
2013 Debt Payments	$7,026,322
Operating Expenses	
General Government	$4,443,620
Water and Power Utilities	$8,788,016
Total Operating Expenses	$13,231,636
Total Expenses	$20,257,958

Operating Revenues

Power sale revenue	$926,134	
water sales revenue	$7,013,377	
Water Development and Connection Fees	$1,379,171	$2,305,305
Total Operating Revenues	$9,318,682	

Real Property

Acres	1000	Annual	1200	Annual
Low Value	$50,000,000	$1,000,000	$60,000,000	$1,200,000
High Value	$125,000,000	$2,500,000	$150,000,000	$3,000,000
Average	$87,500,000	$1,750,000	$105,000,000	$2,100,000

According to page 7 of the 2013 WCWCDAFS the District has between 1000-1200 acres in real property that can be sold at market value for additional funds. The District claims this property is valued between $50,000-$125,000 per acre.

LPP Capital Costs

KCWCD	$53,200,000	
WCWCD	$912,500,000	Source: Facts: Lake Powell Pipeline Project - WCWCD (2012)
Total	$965,700,000	**0.94491043** WCWCD share of capital costs
(Baseline NED Assumptions)	$1,328,461,944	Source: 2012 Draft Study Report 10: Socioeconomics and Water Resource Economics - Page 5-3
FERC High Cost Estimate for WCWCD (Pump Storage Social Time Preference)	$1,750,908,555	Source: 2012 Draft Study Report 10: Socioeconomics and Water Resource Economics - Page 5-6

LPP Operation and Power Costs

Note: Since WCWCD is responsible for 94.5% (N5) of capital costs, it was assumed they would be responsible for 94.5% of OM&R costs.

FERC Low Cost Estimate for WCWCD (Baseline NED Assumptions)	$23,493,231	Source: 2012 Draft Study Report 10: Socioeconomics and Water Resource Economics - Page 5-3
FERC High Cost Estimate for WCWCD (Pump Storage Social Time Preference)	$62,867,794	Source: 2012 Draft Study Report 10: Socioeconomics and Water Resource Economics - Page 5-6

LPP Annual Power Revenues

FERC Low Cost Estimate for WCWCD (Baseline NED Assumptions)	$9,947,747
FERC High Cost Estimate for WCWCD (Pump Storage Social Time Preference)	$72,005,740

Appendix D

Repayment Obligation Scenarios

Scenario 1 - $1.4B Cost Option

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
1		$9,938,660	2013 Property Tax Collections												Scenario A	Scenario B	DSWRESR!I3 gives the FERC "escalation rate"					
2		$7,013,377	2013 Water sale revenue Revenue												FERC Low Cost	FERC High Cost Estimate						
3		$6,102	2013 Impact Fee per ERU											Cost Estimate	$1,328,461,944	$1,750,908,555						
4		0.03309	GOPB 50-Year Household Growth Rate Projection										LPP O&M Costs (Column K)		$23,493,231	$62,867,794						
5		1.03309	GOPB 50-Year Household Growth Rate Projection, plus one.										LPP Power sale revenue (Column F)		$9,947,747	$72,005,740						
6		**1.040**	**<- enter 1 plus assumed interest rate on reserves**											**A**	**<- enter A or B (capitalized) for which Scenario you want to analyze**							
7			Q ∝ P^(-1/2) is the assumed demand curve, so revenues R = P^(1/2), so to increase R by a factor of "x" requires P to go up by a factor of "x^2".											$1,328,461,944	Loan Amount							
8		5.09324	If price rises by a factor > this, (Q_2060 under new water price) < (Q_2010 under current water price).											2064	year when all debt has to be paid back							
9			**Given unchanged impact fees:** (see Column P)											2015	initial year of spreadsheet							
10		3.20085	The factor by which water sale revenue needs to increase to eliminate the debt by 2062, minus one											**0**	**<- enter number of initial payment-free years (can be zero); water rates & impact fees don't change during this time**							
11		4.20085	The factor by which water sale revenue needs to increase to eliminate the debt by 2062.											**4%**	**<- enter interest rate**						**Total Expected Project Costs**	
12		17.64717	The factor by which water prices need to increase to eliminate the debt by 2062.											50	years allowed for paying back the loan						Cost w/ interest and O&M	$3,092,008,489
13		0.23805	The factor by which water demanded will change vs. base case when water prices rise enough to eliminate debt by 2062 (since revenue = PQ ∝ B5^(-2t) Q^(-2) Q = B5^(-2t) (1/Q)).											$1,328,461,944	Loan Amount after initial years of negative amortization						minus power sale revenue	**$3,092,008,489**
14			**Given unchanged water prices:** (see Column R)											61,840,170	Annual Debt Service							
15		2.46738	The factor by which Impact Fees need to increase to eliminate the debt by 2062, minus one.											If either this ->	($0)	or this ->	$0	is not zero,				
16		3.46738	The factor by which Impact Fees need to increase to eliminate the debt by 2062.											click on this button ->	RECALCULATE	to make them zero.						
17		$21,158	2013 average Impact Fee per ERU, if Impact Fees increased as much as needed to eliminate the debt by 2062.											(This will ensure that R75 and T75 change in order to make Q73, S73, and hence U73 equal to zero.)								
18			**Given Split Between Impact Fees and Water Rates:** (see Column T)										**50%**	**<- enter Impact Fees' portion of Split financing**								
19		2.60043	The factor by which water sale revenue needs to increase to eliminate the debt by 2062.										**50%**	**Water Rates**								
20		6.76222	The factor by which water prices need to increase to eliminate the debt by 2062.																			
21		2.23369	The factor by which Impact Fees need to increase to eliminate the debt by 2062.							0.38	The factor by which water demanded will change vs. base case if water prices behave this way.											
22		$13,630	2013 average Impact Fee per ERU, if Impact Fees increased as much as needed to eliminate the debt by 2062.																			
23	Year	Property Taxes	Water sale revenue	Power sale revenue and Surcharges	Impact Fees	Real Estate sale revenue	LPP Power sale revenue	TOTAL REVENUES	Annual Debt Service on Existing Debt	Existing O&M Costs	Annual LPP Debt Service	LPP O&M Costs	Total Annual Debt Service	TOTAL EXPENSES	Net Annual Surplus (Deficit)	Cumulative Surplus (Deficit)	Repayment Option 1: Annual Surplus (Deficit) w/ Increased Water Rate sale revenue	Repayment Option 1: Cumulative Surplus (Deficit) w/ Increased Water Rate sale revenue	Repayment Option 2: Annual Surplus (Deficit) w/ Increased Impact Fees	Repayment Option 2: Cumulative Surplus (Deficit) w/ Increased Impact Fees	Repayment Option 3: Annual Surplus (Deficit) w/ 50/50 Split Between Impact Fees and Water Rates	Repayment Option 3: Cumulative Surplus (Deficit) w/ Split Between Impact Fees and Water Rates
24	2015	$10,267,571	$7,245,479	$2,381,597	$9,399,311	$15,000,000	$0	$44,293,958	$7,026,322	$13,231,636	$61,840,170	$0	$68,866,492	$82,098,128	($37,804,170)	($37,804,170)	($14,612,457)	($14,612,457)	($14,612,457)	($14,612,457)	($14,612,457)	($14,612,457)
25	2016	$10,607,367	$7,485,261	$2,460,414	$9,710,373	$15,000,000	$0	$45,263,415	$7,039,458	$13,669,525	$61,840,170	$0	$68,866,492	$82,536,017	($37,272,602)	($76,588,938)	($13,313,379)	($28,510,334)	($13,313,379)	($28,510,334)	($13,313,379)	($28,510,334)
26	2017	$10,958,409	$7,732,979	$2,541,839	$10,031,729	$15,000,000	$0	$46,264,956	$7,048,107	$14,121,906	$61,840,170	$0	$68,879,628	$83,001,534	($36,736,577)	($116,389,073)	($11,984,446)	($41,635,193)	($11,984,446)	($41,635,193)	($11,984,446)	($41,635,193)
27	2018	$11,321,068	$7,988,895	$2,625,959	$10,363,720	$15,000,000	$0	$47,299,643	$7,048,318	$14,589,258	$61,840,170	$0	$68,888,277	$83,477,535	($36,177,892)	($157,222,529)	($10,606,611)	($53,907,212)	($10,606,611)	($53,907,212)	($10,606,611)	($53,907,212)
28	2019	$11,695,728	$8,253,281	$2,712,863	$10,706,699	$15,000,000	$0	$48,368,571	$7,050,648	$15,072,077	$61,840,170	$0	$68,888,488	$83,960,565	($35,591,994)	($199,103,424)	($9,174,453)	($65,237,954)	($9,174,453)	($65,237,954)	($9,174,453)	($65,237,954)
29	2020	$12,082,788	$8,526,416	$2,802,643	$11,061,027	$15,000,000	$0	$49,472,874	$6,451,090	$15,570,874	$61,840,170	$0	$68,890,818	$84,461,692	($34,988,818)	($242,056,378)	($7,697,012)	($75,544,483)	($7,697,012)	($75,544,483)	($7,697,012)	($75,544,483)
30	2021	$12,482,657	$8,808,590	$2,895,394	$11,427,082	$15,000,000	$0	$50,613,723	$6,456,332	$16,086,178	$61,840,170	$0	$68,291,260	$84,377,438	($33,763,715)	($285,502,348)	($5,568,711)	($84,134,973)	($5,568,711)	($84,134,973)	($5,568,711)	($84,134,973)
31	2022	$12,895,760	$9,100,103	$2,991,214	$11,805,251	$15,000,000	$0	$51,792,328	$6,138,580	$16,618,536	$61,840,170	$0	$68,296,502	$84,915,038	($33,122,710)	($330,045,151)	($3,994,617)	($91,494,989)	($3,994,617)	($91,494,989)	($3,994,617)	($91,494,989)
32	2023	$13,322,534	$9,401,262	$3,090,206	$12,195,936	$15,000,000	$0	$53,009,938	$5,095,230	$17,168,512	$61,840,170	$0	$67,978,750	$85,147,262	($32,137,324)	($375,384,281)	($2,045,263)	($97,200,052)	($2,045,263)	($97,200,052)	($2,045,263)	($97,200,052)
33	2024	$13,763,431	$9,712,389	$3,192,473	$12,599,550	$15,000,000	$0	$54,267,843	$5,101,740	$17,736,688	$61,840,170	$0	$66,935,400	$84,672,088	($30,404,245)	($420,803,898)	$683,686	($100,404,368)	$683,686	($100,404,368)	$683,686	($100,404,368)
34	2025	$14,218,920	$10,033,812	$3,298,125	$13,016,520	$0	$0	$40,567,377	$5,109,185	$18,323,668	$61,840,170	$0	$66,941,910	$85,265,578	($44,698,201)	($482,334,255)	($12,581,442)	($117,001,984)	($12,581,442)	($117,001,984)	($12,581,442)	($117,001,984)
35	2026	$14,689,482	$10,365,872	$3,407,274	$13,447,291	$0	$9,947,747	$51,857,666	$5,099,965	$18,930,074	$61,840,170	$23,493,231	$66,949,355	$109,372,659	($57,514,994)	($559,142,618)	($24,335,359)	($146,017,423)	($24,335,359)	($146,017,423)	($24,335,359)	($146,017,423)
36	2027	$15,175,618	$10,708,921	$3,520,035	$13,892,317	$0	$0	$53,642,548	$3,178,350	$19,556,548	$61,840,170	$24,432,960	$66,940,135	$110,929,643	($57,287,095)	($638,795,418)	($23,009,410)	($174,867,529)	($23,009,410)	($174,867,529)	($23,009,410)	($174,867,529)
37	2028	$15,677,841	$11,063,324	$3,636,527	$14,352,071	$0	$10,759,483	$55,489,246	$3,178,995	$20,203,755	$61,840,170	$25,410,278	$65,018,520	$110,632,553	($55,143,307)	($719,490,542)	($19,731,232)	($201,593,462)	($19,731,232)	($201,593,462)	($19,731,232)	($201,593,462)
38	2029	$16,196,686	$11,429,455	$3,756,875	$14,827,040	$0	$0	$46,210,056	$3,188,875	$20,872,380	$61,840,170	$26,426,689	$65,019,165	$112,318,234	($54,918,317)	($803,188,480)	($18,334,311)	($227,991,511)	($18,334,311)	($227,991,511)	($18,334,311)	($227,991,511)
39	2030	$16,732,701	$11,807,702	$3,881,205	$15,317,728	$0	$11,637,457	$59,376,793	$1,786,290	$21,563,133	$61,840,170	$27,483,757	$65,029,045	$114,075,935	($54,699,142)	($890,015,162)	($16,904,420)	($254,015,592)	($16,904,420)	($254,015,592)	($16,904,420)	($254,015,592)
40	2031	$17,286,455	$12,198,468	$4,009,650	$15,824,654	$0	$12,102,955	$61,422,182	$1,610,460	$22,276,746	$61,840,170	$28,583,107	$63,626,460	$114,486,313	($53,064,131)	($978,679,899)	($14,018,626)	($278,194,842)	($14,018,626)	($278,194,842)	($14,018,626)	($278,194,842)
41	2032	$17,858,535	$12,602,165	$4,142,346	$16,348,357	$0	$12,587,073	$63,538,477	$1,610,460	$23,013,975	$61,840,170	$29,726,432	$63,450,630	$116,191,037	($52,652,560)	($1,070,479,655)	($12,314,879)	($301,637,514)	($12,314,879)	($301,637,514)	($12,314,879)	($301,637,514)
42	2033	$18,449,547	$13,019,223	$4,279,433	$16,889,392	$0	$13,090,556	$65,728,151	$1,610,460	$23,775,602	$61,840,170	$30,915,489	$63,450,630	$118,141,721	($52,413,570)	($1,165,712,410)	($10,740,949)	($324,443,963)	($10,740,949)	($324,443,963)	($10,740,949)	($324,443,963)
43	2034	$19,060,118	$13,450,082	$4,421,057	$17,448,331	$0	$13,614,179	$67,993,768	$1,610,460	$24,562,435	$61,840,170	$32,152,108	$63,450,630	$120,165,173	($52,171,405)	($1,264,512,312)	($9,119,665)	($346,541,387)	($9,119,665)	($346,541,387)	($9,119,665)	($346,541,387)
44	2035	$19,690,896	$13,895,201	$4,567,368	$18,025,768	$0	$14,158,746	$70,337,980	$110,460	$25,375,307	$61,840,170	$33,438,193	$63,450,630	$122,264,130	($51,926,150)	($1,367,018,954)	($7,449,651)	($367,852,693)	($7,449,651)	($367,852,693)	($7,449,651)	($367,852,693)
45	2036	$20,342,549	$14,355,050	$4,718,521	$18,622,315	$0	$14,725,096	$72,763,532	$110,460	$26,215,080	$61,840,170	$34,775,720	$61,950,630	$122,941,431	($50,177,899)	($1,471,877,611)	($4,229,489)	($386,796,290)	($4,229,489)	($386,796,290)	($4,229,489)	($386,796,290)
46	2037	$21,015,768	$14,830,118	$4,874,677	$19,238,604	$0	$15,314,099	$75,273,266	$110,460	$27,082,645	$61,840,170	$36,166,749	$61,950,630	$125,200,024	($49,926,758)	($1,580,679,473)	($2,457,727)	($404,725,868)	($2,457,727)	($404,725,868)	($2,457,727)	($404,725,868)
47	2038	$21,711,266	$15,320,908	$5,036,000	$19,875,289	$0	$15,926,663	$77,870,126	$110,460	$27,978,922	$61,840,170	$37,613,419	$61,950,630	$127,542,971	($49,672,845)	($1,693,579,497)	($632,868)	($421,547,771)	($632,868)	($421,547,771)	($632,868)	($421,547,771)
48	2039	$22,429,781	$15,827,940	$5,202,662	$20,533,044	$0	$16,563,730	$80,557,157	$110,460	$28,904,859	$61,840,170	$39,117,956	$61,950,630	$129,973,445	($49,416,288)	($1,810,738,965)	$1,246,623	($437,163,058)	$1,246,623	($437,163,058)	$1,246,623	($437,163,058)
49	2040	$23,172,075	$16,351,751	$5,374,839	$21,212,567	$0	$17,226,279	$83,337,512	$110,460	$29,861,440	$61,840,170	$40,682,674	$61,950,630	$132,494,744	($49,157,232)	($1,932,325,755)	$3,182,324	($451,467,257)	$3,182,324	($451,467,257)	$3,182,324	($451,467,257)
50	2041	$23,938,934	$16,892,898	$5,552,715	$21,914,578	$0	$17,915,330	$86,214,456	$110,460	$30,849,678	$61,840,170	$42,309,981	$61,950,630	$135,110,289	($48,895,833)	($2,058,514,619)	$5,175,854	($464,350,093)	$5,175,854	($464,350,093)	$5,175,854	($464,350,093)
51	2042	$24,731,172	$17,451,954	$5,736,477	$22,639,822	$0	$18,631,943	$89,191,368	$110,460	$31,870,621	$61,840,170	$44,002,380	$61,950,630	$137,823,631	($48,632,263)	($2,189,487,466)	$7,228,879	($475,695,217)	$7,228,879	($475,695,217)	$7,228,879	($475,695,217)
52	2043	$25,549,628	$18,029,511	$5,926,321	$23,389,067	$0	$19,377,221	$92,271,748	$110,460	$32,925,351	$61,840,170	$45,762,476	$61,950,630	$140,638,456	($48,366,708)	($2,325,433,673)	$9,343,109	($485,379,918)	$9,343,109	($485,379,918)	$9,343,109	($485,379,918)
53	2044	$26,395,171	$18,626,181	$6,122,447	$24,163,107	$0	$20,152,310	$95,459,217	$110,460	$34,014,986	$61,840,170	$47,592,975	$61,950,630	$143,558,591	($48,099,374)	($2,466,550,394)	$11,520,298	($493,274,816)	$11,520,298	($493,274,816)	$11,520,298	($493,274,816)
54	2045	$27,268,696	$19,242,598	$6,325,064	$24,962,764	$0	$20,958,402	$98,757,524	$110,460	$35,140,682	$61,840,170	$49,496,694	$61,950,630	$146,588,006	($47,830,481)	($2,613,042,891)	$13,762,252	($499,243,557)	$13,762,252	($499,243,557)	$13,762,252	($499,243,557)
55	2046	$28,171,129	$19,879,415	$6,534,386	$25,788,884	$0	$21,796,739	$102,170,554	$110,460	$36,303,632	$61,840,170	$51,476,561	$61,950,630	$149,730,823	($47,560,269)	($2,765,124,876)	$16,070,821	($503,142,478)	$16,070,821	($503,142,478)	$16,070,821	($503,142,478)
56	2047	$29,103,428	$20,537,307	$6,750,636	$26,642,345	$0	$22,668,608	$105,702,324	$110,460	$37,505,069	$61,840,170	$53,535,624	$61,950,630	$152,991,322	($47,288,999)	($2,923,018,870)	$18,447,906	($504,820,272)	$18,447,906	($504,820,272)	$18,447,906	($504,820,272)
57	2048	$30,066,580	$21,216,971	$6,974,042	$27,524,050	$0	$23,575,352	$109,356,995	$110,460	$38,746,266	$61,840,170	$55,677,049	$61,950,630	$156,373,944	($47,016,949)	($3,086,956,574)	$20,895,461	($504,117,622)	$20,895,461	($504,117,622)	$20,895,461	($504,117,622)
58	2049	$31,061,607	$21,919,128	$7,204,842	$28,434,934	$0	$24,518,367	$113,138,877	$110,460	$40,028,539	$61,840,170	$57,904,131	$61,950,630	$159,883,300	($46,744,422)	($3,257,179,259)	$23,415,488	($500,866,839)	$23,415,488	($500,866,839)	$23,415,488	($500,866,839)
59	2050	$32,089,563	$22,644,522	$7,443,280	$29,375,963	$0	$25,499,101	$117,052,429	$110,460	$41,353,248	$61,840,170	$60,220,296	$61,950,630	$163,524,174	($46,471,745)	($3,433,938,174)	$26,010,046	($494,891,466)	$26,010,046	($494,891,466)	$26,010,046	($494,891,466)
60	2051	$33,151,539	$23,393,922	$7,689,609	$30,348,134	$0	$26,519,065	$121,102,270	$110,460	$42,721,797	$61,840,170	$62,629,108	$61,950,630	$167,301,535	($46,199,265)	($3,617,494,966)	$28,681,246	($486,005,878)	$28,681,246	($486,005,878)	$28,681,246	($486,005,878)
61	2052	$34,248,660	$24,168,124	$7,944,090	$31,352,479	$0	$27,579,828	$125,293,180	$0	$44,135,638	$61,840,170	$65,134,272	$61,950,630	$171,220,539	($45,927,359)	($3,808,122,124)	$31,431,256	($474,014,857)	$31,431,256	($474,014,857)	$31,431,256	($474,014,857)
62	2053	$35,382,089	$24,967,946	$8,206,992	$32,390,062	$0	$28,683,021	$129,630,110	$0	$45,596,268	$61,840,170	$67,739,643	$61,840,170	$175,176,080	($45,545,970)	($4,005,992,979)	$34,372,761	($458,602,690)	$34,372,761	($458,602,690)	$34,372,761	($458,602,690)
63	2054	$36,553,028	$25,794,238	$8,478,596	$33,461,982	$0	$29,830,342	$134,118,186	$0	$47,105,236	$61,840,170	$70,449,229	$61,840,170	$179,394,634	($45,276,448)	($4,211,509,147)	$37,287,122	($439,659,676)	$37,287,122	($439,659,676)	$37,287,122	($439,659,676)
64	2055	$37,762,718	$26,647,876	$8,759,187	$34,569,377	$0	$31,023,556	$138,762,713	$0	$48,664,142	$61,840,170	$73,267,198	$61,840,170	$183,771,509	($45,008,796)	($4,424,978,309)	$40,287,143	($416,958,920)	$40,287,143	($416,958,920)	$40,287,143	($416,958,920)
65	2056	$39,012,442	$27,529,764	$9,049,065	$35,713,420	$0	$32,264,498	$143,569,188	$0	$50,274,639	$61,840,170	$76,197,886	$61,840,170	$188,312,694	($44,743,506)	($4,646,720,947)	$43,375,227	($390,262,050)	$43,375,227	($390,262,050)	$43,375,227	($390,262,050)
66	2057	$40,303,524	$28,440,837	$9,348,535	$36,895,324	$0	$33,555,078	$148,543,298	$0	$51,938,433	$61,840,170	$79,245,801	$61,840,170	$193,024,404	($44,481,106)	($4,877,070,892)	$46,553,838	($359,318,694)	$46,553,838	($359,318,694)	$46,553,838	($359,318,694)
67	2058	$41,637,334	$29,382,061	$9,657,917	$38,116,342	$0	$34,897,281	$153,690,935	$0	$53,657,290	$61,840,170	$82,415,633	$61,840,170	$197,913,093	($44,222,158)	($5,116,375,885)	$49,825,507	($323,865,934)	$49,825,507	($323,865,934)	$49,825,507	($323,865,934)
68	2059	$43,015,284	$30,354,435	$9,977,537	$39,377,769	$0	$36,293,172	$159,018,197	$0	$55,433,030	$61,840,170	$85,712,258	$61,840,170	$202,985,459	($43,967,262)	($5,364,998,183)	$53,192,828	($283,627,743)	$53,192,828	($283,627,743)	$53,192,828	($283,627,743)
69	2060	$44,438,837	$31,358,988	$10,307,735	$40,680,941	$0	$37,744,899	$164,531,400	$0	$57,267,538	$61,840,170	$89,140,749	$61,840,170	$208,248,456	($43,717,056)	($5,623,315,166)	$56,658,461	($238,314,392)	$56,658,461	($238,314,392)	$56,658,461	($238,314,392)
70	2061	$45,909,501	$32,396,786	$10,648,860	$42,027,241	$0	$39,254,695	$170,237,083	$0	$59,162,756	$61,840,170	$92,706,379	$61,840,170	$213,709,305	($43,472,222)	($5,891,719,994)	$60,225,135	($187,621,833)	$60,225,135	($187,621,833)	$60,225,135	($187,621,833)
71	2062	$47,428,836	$33,468,929	$11,001,275	$43,418,095	$0	$40,824,883	$176,142,017	$0	$61,120,695	$61,840,170	$96,414,634	$61,840,170	$219,375,499	($43,233,482)	($6,170,622,276)	$63,895,647	($131,231,060)	$63,895,647	($131,231,060)	$63,895,647	($131,231,060)
72	2063	$48,998,451	$34,576,554	$11,365,352	$44,854,979	$0	$42,457,878	$182,253,214	$0	$63,143,431	$61,840,170	$100,271,219	$61,840,170	$225,254,820	($43,001,606)	($6,460,448,773)	$67,672,866	($68,807,436)	$67,672,866	($68,807,436)	$67,672,866	($68,807,436)
73	2064	$50,620,011	$35,720,834	$11,741,479	$46,339,415	$0	$44,156,193	$188,577,932	$0	$65,233,107	$61,840,170	$104,282,068	$61,840,170	$231,355,345	($42,777,413)	($6,761,644,137)	$71,559,733	($0)	$71,559,733	$0	$71,559,733	($0)
74						$150,000,000					$3,092,008,489											
75																	Estimated Factors to make Final-Year Debt (the blue cells) almost zero:		3.20085321	0	2.46738435	

Scenario 2 - $1.8B Cost Option

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
1		$9,938,660	2013 Property Tax Collections												**Scenario A**	**Scenario B**	DSWRESR!I3 gives the FERC "escalation rate"					
2		$7,013,377	2013 Water sale revenue Revenue												FERC Low Cost	FERC High Cost Estimate						
3		$6,102	2013 Impact Fee per ERU											Cost Estimate	$1,328,461,944	$1,750,908,555						
4		0.03309	GOPB 50-Year Household Growth Rate Projection										LPP O&M Costs (Column K)		$23,493,231	$62,867,794						
5		1.03309	GOPB 50-Year Household Growth Rate Projection, plus one.										LPP Power sale revenue (Column F)		$9,947,747	$72,005,740						
6		**1.040**	**<- enter 1 plus assumed interest rate on reserves**											**B**	**<- enter A or B (capitalized) for which Scenario you want to analyze**							
7			Q ∝ P^(-1/2) is the assumed demand curve, so revenues R = P^(1/2), so to increase R by a factor of "x" requires P to go up by a factor of "x^2".											$1,750,908,555	Loan Amount							
8		5.09324	If price rises by a factor > this, (Q_2060 under new water price) < (Q_2010 under current water price).											2064	year when all debt has to be paid back							
9			**Given unchanged impact fees:** (see Column P)											2015	initial year of spreadsheet							
10		3.57688	The factor by which water sale revenue need to increase to eliminate the debt by 2062, minus one											**10**	**<- enter number of initial payment-free years (can be zero); water rates & impact fees don't change during this time**							
11		4.57688	The factor by which water sale revenue need to increase to eliminate the debt by 2062.											**4%**	**<- enter interest rate**						**Total Expected Project Costs**	
12		20.94781	The factor by which water prices need to increase to eliminate the debt by 2062.											40	years allowed for paying back the loan						Cost w/ interest and O&M	$5,237,815,370
13		0.21849	The factor by which water demanded will change vs. base case when water prices rise enough to eliminate debt by 2062 (since revenue = PQ ∝ B5^(-2t) Q^(-2) Q = B5^(-2t) (1/Q)).											$2,591,772,381	Loan Amount after initial years of negative amortization						minus power sale revenue	**$5,237,815,370**
14			**Given unchanged water prices:** (see Column R)											130,945,384	Annual Debt Service							
15		2.75724	The factor by which Impact Fees need to increase to eliminate the debt by 2062, minus one.												If either this ->	$0	or this ->	$0	is not zero,			
16		3.75724	The factor by which Impact Fees need to increase to eliminate the debt by 2062.												click on this button ->	RECALCULATE	to make them zero.					
17		$22,927	2013 average Impact Fee per ERU, if Impact Fees increased as much as needed to eliminate the debt by 2062.											(This will ensure that R75 and T75 change in order to make Q73, S73, and hence U73 equal to zero.)								
18			**Given Split Between Impact Fees and Water Rates:** (see Column T)										**50%**	**<- enter Impact Fees' portion of Split financing**								
19		2.78844	The factor by which water sale revenue needs to increase to eliminate the debt by 2062.										**50%**	**Water Rates**								
20		7.77539	The factor by which water prices need to increase to eliminate the debt by 2062.																			
21		2.37862	The factor by which Impact Fees need to increase to eliminate the debt by 2062.							0.36	The factor by which water demanded will change vs. base case if water prices behave this way.											
22		$14,514	2013 average Impact Fee per ERU, if Impact Fees increased as much as needed to eliminate the debt by 2062.																			
23	Year	Property Taxes	Water sale revenue	Power sale revenue and Surcharges	Impact Fees	Real Estate sale revenue	LPP Power sale revenue	TOTAL REVENUES	Annual Debt Service on Existing Debt	Existing O&M Costs	Annual LPP Debt Service	LPP O&M Costs	Total Annual Debt Service	TOTAL EXPENSES	Net Annual Surplus (Deficit)	Cumulative Surplus (Deficit)	Repayment Option 1: Annual Surplus (Deficit) w/ Increased Water Rate sale revenue	Repayment Option 1: Cumulative Surplus (Deficit) w/ Increased Water Rate sale revenue	Repayment Option 2: Annual Surplus (Deficit) w/ Increased Impact Fees	Repayment Option 2: Cumulative Surplus (Deficit) w/ Increased Impact Fees	Repayment Option 3: Annual Surplus (Deficit) w/ 50/50 Split Between Impact Fees and Water Rates	Repayment Option 3: Cumulative Surplus (Deficit) w/ Split Between Impact Fees and Water Rates
24	2015	$10,267,571	$7,245,479	$2,381,597	$9,399,311	$15,000,000	$0	$44,293,958	$7,026,322	$13,231,636	$0	$0	$7,026,322	$20,257,958	$24,036,000	$24,036,000	$24,036,000	$24,036,000	$24,036,000	$24,036,000	$24,036,000	$24,036,000
25	2016	$10,607,367	$7,485,261	$2,460,414	$9,710,373	$15,000,000	$0	$45,263,415	$7,039,458	$13,669,525	$0	$0	$7,026,322	$20,695,847	$24,567,568	$49,565,008	$24,567,568	$49,565,008	$24,567,568	$49,565,008	$24,567,568	$49,565,008
26	2017	$10,958,409	$7,732,979	$2,541,839	$10,031,729	$15,000,000	$0	$46,264,956	$7,048,107	$14,121,906	$0	$0	$7,039,458	$21,161,364	$25,103,592	$76,651,201	$25,103,592	$76,651,201	$25,103,592	$76,651,201	$25,103,592	$76,651,201
27	2018	$11,321,068	$7,988,895	$2,625,959	$10,363,720	$15,000,000	$0	$47,299,643	$7,048,318	$14,589,258	$0	$0	$7,048,107	$21,637,365	$25,662,277	$105,379,526	$25,662,277	$105,379,526	$25,662,277	$105,379,526	$25,662,277	$105,379,526
28	2019	$11,695,728	$8,253,281	$2,712,863	$10,706,699	$15,000,000	$0	$48,368,571	$7,050,648	$15,072,077	$0	$0	$7,048,318	$22,120,395	$26,248,176	$135,842,883	$26,248,176	$135,842,883	$26,248,176	$135,842,883	$26,248,176	$135,842,883
29	2020	$12,082,788	$8,526,416	$2,802,643	$11,061,027	$15,000,000	$0	$49,472,874	$6,451,090	$15,570,874	$0	$0	$7,050,648	$22,621,522	$26,851,352	$168,127,951	$26,851,352	$168,127,951	$26,851,352	$168,127,951	$26,851,352	$168,127,951
30	2021	$12,482,657	$8,808,590	$2,895,394	$11,427,082	$15,000,000	$0	$50,613,723	$6,456,332	$16,086,178	$0	$0	$6,451,090	$22,537,268	$28,076,455	$202,929,524	$28,076,455	$202,929,524	$28,076,455	$202,929,524	$28,076,455	$202,929,524
31	2022	$12,895,760	$9,100,103	$2,991,214	$11,805,251	$15,000,000	$0	$51,792,328	$6,138,580	$16,618,536	$0	$0	$6,456,332	$23,074,868	$28,717,460	$239,764,165	$28,717,460	$239,764,165	$28,717,460	$239,764,165	$28,717,460	$239,764,165
32	2023	$13,322,534	$9,401,262	$3,090,206	$12,195,936	$15,000,000	$0	$53,009,938	$5,095,230	$17,168,512	$0	$0	$6,138,580	$23,307,092	$29,702,846	$279,057,577	$29,702,846	$279,057,577	$29,702,846	$279,057,577	$29,702,846	$279,057,577
33	2024	$13,763,431	$9,712,389	$3,192,473	$12,599,550	$15,000,000	$0	$54,267,843	$5,101,740	$17,736,688	$0	$0	$5,095,230	$22,831,918	$31,435,924	$321,655,805	$31,435,924	$321,655,805	$31,435,924	$321,655,805	$31,435,924	$321,655,805
34	2025	$14,218,920	$10,033,812	$3,298,125	$13,016,520	$0	$0	$40,567,377	$5,109,185	$18,323,668	$130,945,384	$0	$136,047,124	$154,370,793	($113,803,415)	$220,718,622	($77,913,696)	$256,608,341	($77,913,696)	$256,608,341	($77,913,696)	$256,608,341
35	2026	$14,689,482	$10,365,872	$3,407,274	$13,447,291	$0	$72,005,740	$113,915,659	$5,099,965	$18,930,074	$130,945,384	$62,867,794	$136,054,569	$217,852,438	($103,936,778)	$125,610,588	($66,859,320)	$200,013,355	($66,859,320)	$200,013,355	($66,859,320)	$200,013,355
36	2027	$15,175,618	$10,708,921	$3,520,035	$13,892,317	$0	$74,885,970	$118,182,861	$3,178,350	$19,556,548	$130,945,384	$65,382,506	$136,045,349	$220,984,403	($102,801,543)	$27,833,469	($64,497,039)	$143,516,850	($64,497,039)	$143,516,850	($64,497,039)	$143,516,850
37	2028	$15,677,841	$11,063,324	$3,636,527	$14,352,071	$0	$77,881,409	$122,611,172	$3,178,995	$20,203,755	$130,945,384	$67,997,806	$134,123,734	$222,325,295	($99,714,124)	($70,767,316)	($60,141,966)	$89,115,558	($60,141,966)	$89,115,558	($60,141,966)	$89,115,558
38	2029	$16,196,686	$11,429,455	$3,756,875	$14,827,040	$0	$80,996,665	$127,206,720	$3,188,875	$20,872,380	$130,945,384	$70,717,719	$134,124,379	$225,714,478	($98,507,758)	($172,105,766)	($57,625,995)	$35,054,185	($57,625,995)	$35,054,185	($57,625,995)	$35,054,185
39	2030	$16,732,701	$11,807,702	$3,881,205	$15,317,728	$0	$84,236,532	$131,975,868	$1,786,290	$21,563,133	$130,945,384	$73,546,427	$134,134,259	$229,243,820	($97,267,952)	($276,257,949)	($55,033,243)	($18,576,891)	($55,033,243)	($18,576,891)	($55,033,243)	($18,576,891)
40	2031	$17,286,455	$12,198,468	$4,009,650	$15,824,654	$0	$87,605,993	$136,925,220	$1,610,460	$22,276,746	$130,945,384	$76,488,284	$132,731,674	$231,496,705	($94,571,485)	($371,879,752)	($50,939,055)	($70,259,022)	($50,939,055)	($70,259,022)	($50,939,055)	($70,259,022)
41	2032	$17,858,535	$12,602,165	$4,142,346	$16,348,357	$0	$91,110,233	$142,061,636	$1,610,460	$23,013,975	$130,945,384	$79,547,816	$132,555,844	$235,117,635	($93,055,999)	($490,210,941)	($47,979,593)	($121,048,976)	($47,979,593)	($121,048,976)	($47,979,593)	($121,048,976)
42	2033	$18,449,547	$13,019,223	$4,279,433	$16,889,392	$0	$94,754,642	$147,392,237	$1,610,460	$23,775,602	$130,945,384	$82,729,728	$132,555,844	$239,061,175	($91,668,938)	($601,488,317)	($45,100,768)	($170,991,704)	($45,100,768)	($170,991,704)	($45,100,768)	($170,991,704)
43	2034	$19,060,118	$13,450,062	$4,421,057	$17,448,331	$0	$98,544,828	$152,924,417	$1,610,460	$24,562,435	$130,945,384	$86,038,917	$132,555,844	$243,157,197	($90,232,779)	($715,780,629)	($42,123,477)	($213,115,181)	($42,123,477)	($213,115,181)	($42,123,477)	($213,115,181)
44	2035	$19,690,896	$13,895,201	$4,567,368	$18,025,768	$0	$102,486,621	$158,665,855	$110,460	$25,375,307	$130,945,384	$89,480,474	$132,555,844	$247,411,626	($88,745,771)	($833,157,625)	($39,044,334)	($252,159,515)	($39,044,334)	($252,159,515)	($39,044,334)	($252,159,515)
45	2036	$20,342,549	$14,355,050	$4,718,521	$18,622,315	$0	$106,586,086	$164,624,522	$110,460	$26,215,080	$130,945,384	$93,059,693	$131,055,844	$250,330,618	($85,706,096)	($952,190,026)	($34,359,834)	($286,519,349)	($34,359,834)	($286,519,349)	($34,359,834)	($286,519,349)
46	2037	$21,015,768	$14,830,118	$4,874,677	$19,238,604	$0	$110,849,529	$170,808,696	$110,460	$27,082,645	$130,945,384	$96,782,081	$131,055,844	$254,920,571	($84,111,875)	($1,074,389,501)	($31,066,353)	($356,450,224)	($31,066,353)	($356,450,224)	($31,066,353)	($356,450,224)
47	2038	$21,711,266	$15,320,908	$5,036,000	$19,875,289	$0	$115,283,510	$177,226,973	$110,460	$27,978,922	$130,945,384	$100,653,364	$131,055,844	$259,688,130	($82,461,157)	($1,199,826,239)	($27,660,141)	($398,368,374)	($27,660,141)	($398,368,374)	($27,660,141)	($398,368,374)
48	2039	$22,429,781	$15,827,940	$5,202,662	$20,533,044	$0	$119,894,851	$183,888,277	$110,460	$28,904,859	$130,945,384	$104,679,499	$131,055,844	$264,640,202	($80,751,925)	($1,328,571,213)	($24,137,318)	($438,440,427)	($24,137,318)	($438,440,427)	($24,137,318)	($438,440,427)
49	2040	$23,172,075	$16,351,751	$5,374,839	$21,212,567	$0	$124,690,645	$190,801,877	$110,460	$29,861,440	$130,945,384	$108,866,679	$131,055,844	$269,783,963	($78,982,086)	($1,460,696,147)	($20,493,868)	($476,471,912)	($20,493,868)	($476,471,912)	($20,493,868)	($476,471,912)
50	2041	$23,938,934	$16,892,898	$5,552,715	$21,914,578	$0	$129,678,270	$197,977,396	$110,460	$30,849,678	$130,945,384	$113,221,346	$131,055,844	$275,126,868	($77,149,472)	($1,596,273,465)	($16,725,639)	($512,256,427)	($16,725,639)	($512,256,427)	($16,725,639)	($512,256,427)
51	2042	$24,731,172	$17,451,954	$5,736,477	$22,639,822	$0	$134,865,401	$205,424,826	$110,460	$31,870,621	$130,945,384	$117,750,200	$131,055,844	$280,676,665	($75,251,839)	($1,735,376,243)	($12,828,332)	($545,575,017)	($12,828,332)	($545,575,017)	($12,828,332)	($545,575,017)
52	2043	$25,549,628	$18,029,511	$5,926,321	$23,389,067	$0	$140,260,017	$213,154,544	$110,460	$32,925,351	$130,945,384	$122,460,208	$131,055,844	$286,441,403	($73,286,859)	($1,878,078,151)	($8,797,502)	($576,195,519)	($8,797,502)	($576,195,519)	($8,797,502)	($576,195,519)
53	2044	$26,395,171	$18,626,181	$6,122,447	$24,163,107	$0	$145,870,418	$221,177,324	$110,460	$34,014,986	$130,945,384	$127,358,616	$131,055,844	$292,429,446	($71,252,122)	($2,024,453,400)	($4,628,546)	($603,871,886)	($4,628,546)	($603,871,886)	($4,628,546)	($603,871,886)
54	2045	$27,268,696	$19,242,598	$6,325,064	$24,962,764	$0	$151,705,235	$229,504,357	$110,460	$35,140,682	$130,945,384	$132,452,961	$131,055,844	$298,649,487	($69,145,130)	($2,174,576,666)	($316,706)	($628,343,468)	($316,706)	($628,343,468)	($316,706)	($628,343,468)
55	2046	$28,171,129	$19,879,415	$6,534,386	$25,788,884	$0	$157,773,444	$238,147,259	$110,460	$36,303,632	$130,945,384	$137,751,079	$131,055,844	$305,110,555	($66,963,296)	($2,328,523,029)	$4,142,944	($649,334,262)	$4,142,944	($649,334,262)	$4,142,944	($649,334,262)
56	2047	$29,103,428	$20,537,307	$6,750,636	$26,642,345	$0	$164,084,382	$247,118,097	$110,460	$37,505,069	$130,945,384	$143,261,122	$131,055,844	$311,822,035	($64,703,938)	($2,486,367,888)	$8,755,500	($666,552,133)	$8,755,500	($666,552,133)	$8,755,500	($666,552,133)
57	2048	$30,066,580	$21,216,971	$6,974,042	$27,524,050	$0	$170,647,757	$256,429,400	$110,460	$38,746,266	$130,945,384	$148,991,567	$131,055,844	$318,793,677	($62,364,277)	($2,648,186,880)	$13,526,236	($679,687,981)	$13,526,236	($679,687,981)	$13,526,236	($679,687,981)
58	2049	$31,061,607	$21,919,128	$7,204,842	$28,434,934	$0	$177,473,667	$266,094,178	$110,460	$40,028,539	$130,945,384	$154,951,230	$131,055,844	$326,035,613	($59,941,435)	($2,814,055,790)	$18,460,608	($688,414,893)	$18,460,608	($688,414,893)	$18,460,608	($688,414,893)
59	2050	$32,089,563	$22,644,522	$7,443,280	$29,375,963	$0	$184,572,614	$276,125,942	$110,460	$41,353,248	$130,945,384	$161,149,279	$131,055,844	$333,558,371	($57,432,429)	($2,984,050,451)	$23,564,260	($692,387,229)	$23,564,260	($692,387,229)	$23,564,260	($692,387,229)
60	2051	$33,151,539	$23,393,922	$7,689,609	$30,348,134	$0	$191,955,519	$286,538,723	$110,460	$42,721,797	$130,945,384	$167,595,250	$131,055,844	$341,372,892	($54,834,169)	($3,158,246,638)	$28,843,034	($691,239,684)	$28,843,034	($691,239,684)	$28,843,034	($691,239,684)
61	2052	$34,248,660	$24,168,124	$7,944,090	$31,352,479	$0	$199,633,739	$297,347,091	$0	$44,135,638	$130,945,384	$174,299,060	$131,055,844	$349,490,542	($52,143,450)	($3,336,719,954)	$34,302,976	($684,586,296)	$34,302,976	($684,586,296)	$34,302,976	($684,586,296)
62	2053	$35,382,089	$24,967,946	$8,206,992	$32,390,062	$0	$207,619,089	$308,566,178	$0	$45,596,268	$130,945,384	$181,271,022	$130,945,384	$357,812,674	($49,246,496)	($3,519,435,248)	$40,060,798	($671,908,950)	$40,060,798	($671,908,950)	$40,060,798	($671,908,950)
63	2054	$36,553,028	$25,794,238	$8,478,596	$33,461,982	$0	$215,923,852	$320,211,696	$0	$47,105,236	$130,945,384	$188,521,863	$130,945,384	$366,572,483	($46,360,787)	($3,706,573,445)	$45,902,053	($652,883,255)	$45,902,053	($652,883,255)	$45,902,053	($652,883,255)
64	2055	$37,762,718	$26,647,876	$8,759,187	$34,569,377	$0	$224,560,807	$332,299,964	$0	$48,664,142	$130,945,384	$196,062,738	$130,945,384	$375,672,264	($43,372,300)	($3,898,208,682)	$51,943,898	($627,054,687)	$51,943,898	($627,054,687)	$51,943,898	($627,054,687)
65	2056	$39,012,442	$27,529,764	$9,049,065	$35,713,420	$0	$233,543,239	$344,847,929	$0	$50,274,639	$130,945,384	$203,905,247	$130,945,384	$385,125,270	($40,277,341)	($4,094,414,371)	$58,193,261	($593,943,613)	$58,193,261	($593,943,613)	$58,193,261	($593,943,613)
66	2057	$40,303,524	$28,440,837	$9,348,535	$36,895,324	$0	$242,884,968	$357,873,189	$0	$51,938,433	$130,945,384	$212,061,457	$130,945,384	$394,945,275	($37,072,086)	($4,295,263,032)	$64,657,314	($553,044,044)	$64,657,314	($553,044,044)	$64,657,314	($553,044,044)
67	2058	$41,637,334	$29,382,061	$9,657,917	$38,116,342	$0	$252,600,367	$371,394,021	$0	$53,657,290	$130,945,384	$220,543,916	$130,945,384	$405,146,590	($33,752,569)	($4,500,826,122)	$71,343,476	($503,822,330)	$71,343,476	($503,822,330)	$71,343,476	($503,822,330)
68	2059	$43,015,284	$30,354,435	$9,977,537	$39,377,769	$0	$262,704,382	$385,429,407	$0	$55,433,030	$130,945,384	$229,365,672	$130,945,384	$415,744,087	($30,314,680)	($4,711,173,847)	$78,259,425	($445,715,798)	$78,259,425	($445,715,798)	$78,259,425	($445,715,798)
69	2060	$44,438,837	$31,358,988	$10,307,735	$40,680,941	$0	$273,212,557	$399,999,058	$0	$57,267,538	$130,945,384	$238,540,299	$130,945,384	$426,753,221	($26,754,163)	($4,926,374,964)	$85,413,107	($378,131,323)	$85,413,107	($378,131,323)	$85,413,107	($378,131,323)
70	2061	$45,909,501	$32,396,786	$10,648,860	$42,027,241	$0	$284,141,059	$415,123,448	$0	$59,162,756	$130,945,384	$248,081,911	$130,945,384	$438,190,051	($23,066,604)	($5,146,496,566)	$92,812,742	($300,443,833)	$92,812,742	($300,443,833)	$92,812,742	($300,443,833)
71	2062	$47,428,836	$33,468,929	$11,001,275	$43,418,095	$0	$295,506,702	$430,823,836	$0	$61,120,695	$130,945,384	$258,005,187	$130,945,384	$450,071,267	($19,247,431)	($5,371,603,859)	$100,466,840	($211,994,747)	$100,466,840	($211,994,747)	$100,466,840	($211,994,747)
72	2063	$48,998,451	$34,576,554	$11,365,352	$44,854,979	$0	$307,326,970	$447,122,306	$0	$63,143,431	$130,945,384	$268,325,395	$130,945,384	$462,414,210	($15,291,904)	($5,601,759,918)	$108,384,204	($112,090,332)	$108,384,204	($112,090,332)	$108,384,204	($112,090,332)
73	2064	$50,620,011	$35,720,834	$11,741,479	$46,339,415	$0	$319,620,049	$464,041,787	$0	$65,233,107	$130,945,384	$279,058,411	$130,945,384	$475,236,902	($11,195,114)	($5,837,025,429)	$116,573,946	$0	$116,573,946	$0	$116,573,946	$0
74						$150,000,000					$5,237,815,370											
75																	Estimated Factors to make Final-Year Debt (the blue cells) almost zero:		3.57687786	0	2.75724373	

Appendix E

WCWCD Water Demand with LPP Debt

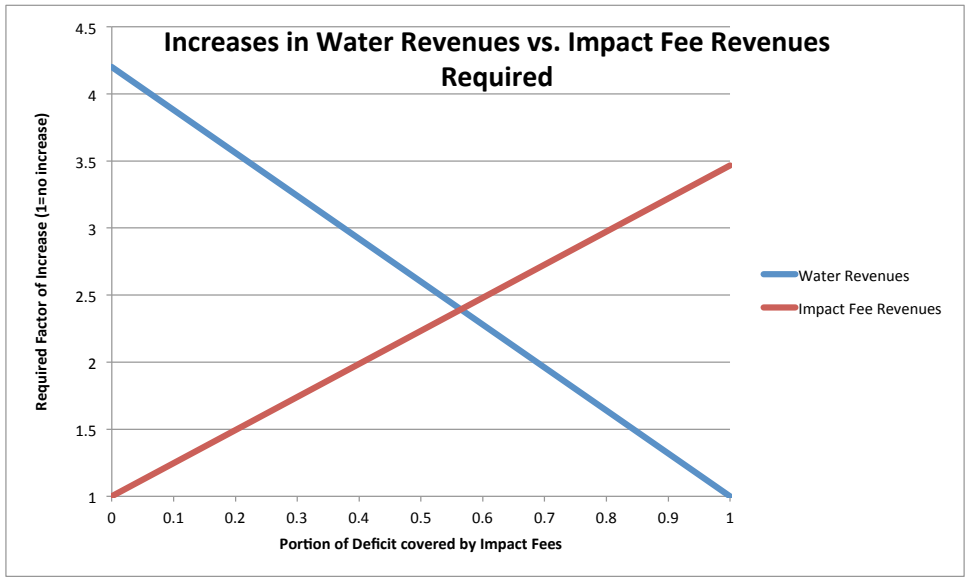
Year	Current Supply	Supply with LPP	Base Per Capita Use (GPCD)	Assumed Conservation from 2005	Per Capita Use with Conservation (GPCD)		Total Projected Water Demand (ac-ft/yr)	First Scenario: Total Demand with Increased Water Prices (ac-ft/yr)	First Scenario: Total Demand with Increased Water Prices and Impact Fees (ac-ft/yr)	First Scenario: GPCD With Increased Water Prices	First Scenario: GPCD with Increased Water Rates and Impact Fees	Second Scenario: Total Demand with Increased Water Prices (ac-ft/yr)	Second Scenario: Total Demand with Increased Water Prices and Impact Fees (ac-ft/yr)	Second Scenario: GPCD With Increased Water Prices	Second Scenario: GPCD with Increased Water Rates and Impact Fees
2009	82,010	82,010	294.3	0%	294.3	55408	*45,739*	*10,888*	*17,589*	70.1	113.2	*9,994*	*16,403*	64.3	105.5
2010	82,010	82,010	294.3	1%	291.4	54854	*45,282*	*10,779*	*17,413*	69.4	112.0	*9,894*	*16,239*	63.7	104.5
2020	130,840	151,010	294.3	5%	279.6	87646	*61,621*	*14,669*	*23,696*	66.6	107.5	*13,463*	*22,099*	61.1	100.3
2030	130,840	151,010	294.3	9%	267.8	124648	*84,164*	*20,035*	*32,365*	63.8	103.0	*18,389*	*30,183*	58.5	96.0
2040	130,840	199,840	294.3	12%	259.0	162359	*107,842*	*25,671*	*41,471*	61.7	99.6	*23,562*	*38,675*	56.6	92.9
2050	130,840	199,840	294.3	16%	247.2	196517	**130,859**	*31,151*	*50,322*	58.8	95.1	*28,591*	*46,929*	54.0	88.7
2060	130,840	199,840	294.3	18%	241.3	232576	**157,252**	*37,433*	*60,472*	57.4	92.8	*34,358*	*56,394*	52.7	86.5
	Red = some water from LPP is actually used (total demand > 130,840 acre-feet)						**192%**	*46%*	*74%*			*42%*	*69%*	**<- 2060 demand as a fraction of 2010 demand**	
	Blue = no water from LPP is actually used because water's so expensive that > 130,840 acre-feet are not demanded														
	Blue Italic = no water from LPP is actually used because water's so expensive that > 82,010 acre-feet (2010's supply) are not demanded														
	Source: 2011 LPP Water Needs Assessment														

Appendix F

WCWCD Debt Repayment: Water Rates vs. Impact Fees

	Water Revenues	Impact Fee Revenues
0	4.20085321	1
1	1	3.467384349

2.26 If Water Revenues rise by a factor > this, Q_2060 < Q_2010.



Appendix G

Repayment Scenario Supporting Formulas

by Gabriel A. Lozada, 9/28/15

1. Paths of Demand, Price, and Revenue when Elasticity is −1/2

Suppose the demand for water is given by

$$Q_t = \alpha \beta^t P_t^{-1/2} \tag{1}$$

where Q is quantity demanded, P is price, β is one plus the projected population growth rate, and t denotes the date. Assume price is constant:

$$P_t \equiv P \quad \text{for all } t.$$

Then

$$\begin{aligned} Q_t &= \alpha \beta^t P^{-1/2} \\ Q_0 &= \alpha P^{-1/2} \quad \text{so} \\ Q_t &= Q_0 \beta^t \quad \text{(which grows at rate } \beta\text{) and} \\ \text{total revenue } Q_t P_t &= Q_0 \beta^t P = Q_0 P \beta_t \quad \text{(which grows at rate } \beta\text{).} \end{aligned}$$

Now suppose there is a new situation, denoted by $\widehat{\ }$, and suppose we have discovered that the needed total revenue in the new situation is γ times the total revenue of the old situation:

$$\boxed{\widehat{Q_t P_t} = \gamma \cdot Q_t P_t}. \tag{2}$$

Suppose as before that

$$\begin{aligned} \widehat{P_t} &\equiv \widehat{P} \quad \text{for all } t. \quad \text{and} \\ \widehat{Q_t} &= \alpha \beta^t \widehat{P}^{-1/2}. \end{aligned}$$

Then as before, both $\widehat{Q_t}$ and $\widehat{Q_t P_t}$ grow at rate β, and also $\widehat{Q_t} = \widehat{Q_0} \beta^t$.

From (2),

$$\begin{aligned} \widehat{Q_t P_t} &= \gamma Q_t P_t \\ \widehat{Q_0} \beta^t \cdot \widehat{P} &= \gamma Q_0 \beta^t \cdot P \\ \widehat{Q_0} \cdot \widehat{P} &= \gamma Q_0 \cdot P \\ \alpha \widehat{P}^{-1/2} \cdot \widehat{P} &= \gamma \alpha P^{-1/2} \cdot P \\ \widehat{P}^{1/2} &= \gamma P^{1/2} \\ \boxed{\widehat{P} &= \gamma^2 P}. \end{aligned} \tag{3}$$

Using (3), $\widehat{Q_t} = \widehat{Q_0}\beta^t = \alpha\widehat{P}^{-1/2}\beta^t = \alpha(\gamma^2 P)^{-1/2}\beta^t = \gamma^{-1}\alpha P^{-1/2}\beta^t = \gamma^{-1}Q_t$, so

$$\boxed{\widehat{Q_t} = Q_t/\gamma}\,. \tag{4}$$

Note that in the spreadsheet (worksheets "First Scenario" and "Second Scenario"), $\widehat{Q_tP_t} = Q_tP_t + \texttt{B10} \cdot Q_tP_t = (1 + \texttt{B10})Q_tP_t$, so the value of γ in (2) is $1 + \texttt{B10}$ in the spreadsheet; this is `B11` and `B19`.

The answer to the question "when is $\widehat{Q}_{2060} < Q_{2010}$?" is, using (4), when

$$\begin{aligned} Q_{2060}/\gamma &< Q_{2010} \\ Q_{2010}\beta^{2060-2010}/\gamma &< Q_{2010} \\ \beta^{50} &< \gamma\,. \end{aligned}$$

This underlies `B8`.

2. Deriving Cost and Benefit Flows from their Present Values given in pages 5-3 to 5-6 of the Draft Socioeconomics and Water Resource Economics Study Report

This section derives relationships used in the spreadsheet tab "DSWRESR," whose name is the first letters of the "Study Report" named in the title of this section.

The Study Report describes the flows of costs and benefits from 2020 to 2060 (see for example Table 2-1 on page 2-2) in terms of the present value (in 2010) of those flows. Here we derive the implied magnitude of such a flow in our assumed initial year of operation, 2026.

Let the Study Report's "escalation rate" (the rate of real cost or benefit increases per year) be ϵ. The Study Report provides the value of ϵ but it provides no further information about how the Study Report authors assumed costs and benefits changed over time. In the absence of this information, the best we can do is to assume that their sequence of costs (or benefits)

$$\{c_{2020}, c_{2021}, c_{2022}, \ldots, c_{2060}\}$$

is equal to

$$\{c_{2020}, (1+\epsilon)c_{2020}, (1+\epsilon)^2 c_{2020}, \ldots, (1+\epsilon)^{40} c_{2020}\}\,.$$

Let the Study Report's discount rate be r and let the present value in 2020 of this sequence be denoted by PV_{2020}. Then

$$PV_{2020} = \sum_{t=0}^{40} \frac{(1+\epsilon)^t\, c_{2020}}{(1+r)^t} = \frac{1 - \left(\frac{1+\epsilon}{1+r}\right)^{41}}{1 - \left(\frac{1+\epsilon}{1+r}\right)}\, c_{2020}\,,$$

$$c_{2020} = \frac{1 - \left(\frac{1+\epsilon}{1+r}\right)}{1 - \left(\frac{1+\epsilon}{1+r}\right)^{41}} PV_{2020}\,, \text{ and}$$

$$c_{2026} = (1+\epsilon)^6 c_{2020} = (1+\epsilon)^6 \frac{1 - \left(\frac{1+\epsilon}{1+r}\right)}{1 - \left(\frac{1+\epsilon}{1+r}\right)^{41}} PV_{2020}\,.$$

Since $PV_{2010} = PV_{2020}/(1+r)^{10}$ because the only thing which happens to these flow costs between 2010 and 2020 is discounting, we have

$$c_{2026} = (1+\epsilon)^6 (1+r)^{10} \frac{1 - \left(\frac{1+\epsilon}{1+r}\right)}{1 - \left(\frac{1+\epsilon}{1+r}\right)^{41}} PV_{2010}\,. \tag{5}$$

If we are correct in assuming that the Study Report authors used $c_t = (1+\epsilon)^{t-2020} c_{2020}$ then (5) would give the same answer for c_{2020} regardless of the values of ϵ and r. However, the values which (5) gives for c_{2020} for the two "no pump storage" cases, Tables 5-1 and 5-2 (spreadsheet columns C and J, rows 12–19), slightly differ; so do the values which (5) gives for c_{2020} for the two "pump storage" cases, Tables 5-3 and 5-4 (spreadsheet columns C and J, rows 29–37). Therefore, the Study Report authors must not have used $c_t = (1+\epsilon)^{t-2020} c_{2020}$, but something slightly different. There is no way to know what that was (for example, the text "2024" does not appear in the report), so in column N, averages of the c_{2020} values derived from (5) for the two "no pump storage" cases given in the Study Report were calculated, and this average was used for the "no pump storage" c_{2020} in the rest of the spreadsheet. Similarly, in column N, averages of the c_{2020} values derived from (5) for the two "pump storage" cases given in the Study Report were calculated, and that average was used for the "pump storage" c_{2020} in the rest of the spreadsheet.

For construction costs the situation is the same except that the years of construction in the Study Report were 2016 to 2019. So

$$PV_{2016} = \sum_{t=0}^{3} \frac{(1+\epsilon)^t c_{2016}}{(1+r)^t} = \frac{1 - \left(\frac{1+\epsilon}{1+r}\right)^4}{1 - \left(\frac{1+\epsilon}{1+r}\right)} c_{2016}\,,$$

$$c_{2016} = \frac{1 - \left(\frac{1+\epsilon}{1+r}\right)}{1 - \left(\frac{1+\epsilon}{1+r}\right)^4} PV_{2016}\,, \text{ and}$$

$$c_{2015} = c_{2016}/(1+\epsilon)\,.$$

Let the present value for our spreadsheet, in which construction starts in 2015, be denoted by PV'_{2015}, and let our discount rate be r'. The Study Report gives

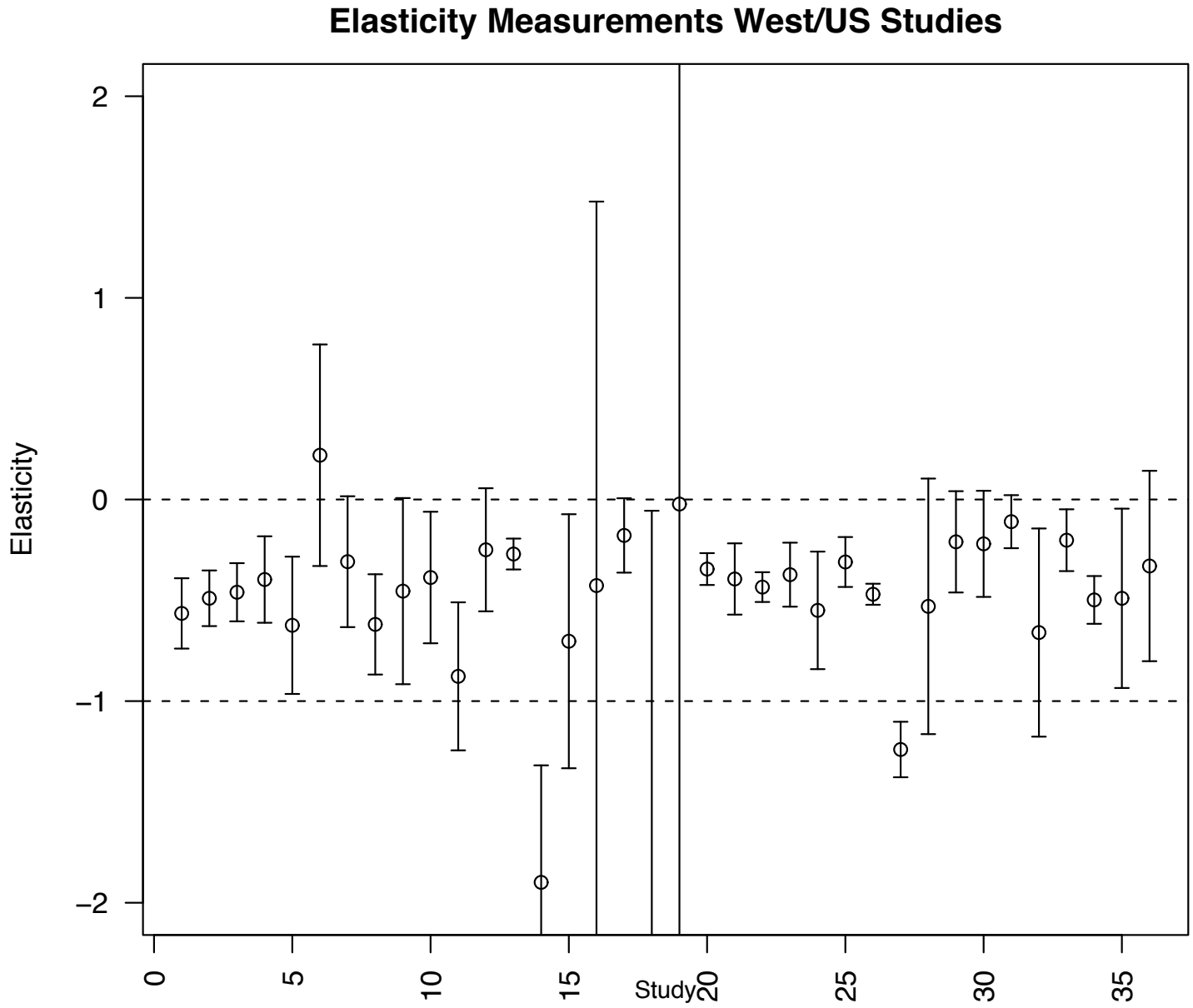
PV_{2010}. We have

$$
\begin{aligned}
PV'_{2015} &= \sum_{t=0}^{3} \frac{(1+\epsilon)^t\, c_{2015}}{(1+r')^t} = \frac{1-\left(\frac{1+\epsilon}{1+r'}\right)^4}{1-\left(\frac{1+\epsilon}{1+r'}\right)}\, c_{2015} \\
&= \frac{1-\left(\frac{1+\epsilon}{1+r'}\right)^4}{1-\left(\frac{1+\epsilon}{1+r'}\right)}\, \frac{c_{2016}}{1+\epsilon} \\
&= \frac{1-\left(\frac{1+\epsilon}{1+r'}\right)^4}{1-\left(\frac{1+\epsilon}{1+r'}\right)}\, \frac{1}{1+\epsilon}\, \frac{1-\left(\frac{1+\epsilon}{1+r}\right)}{1-\left(\frac{1+\epsilon}{1+r}\right)^4} PV_{2016} \\
&= \frac{1-\left(\frac{1+\epsilon}{1+r'}\right)^4}{1-\left(\frac{1+\epsilon}{1+r'}\right)}\, \frac{1}{1+\epsilon}\, \frac{1-\left(\frac{1+\epsilon}{1+r}\right)}{1-\left(\frac{1+\epsilon}{1+r}\right)^4} (1+r)^6\, PV_{2010}\,. \qquad (6)
\end{aligned}
$$

As before, if we are correct in assuming that the Study Report authors used $c_t = (1+\epsilon)^{t-2016}\, c_{2016}$ then (6) would give the same answer for c_{2016} and PV'_{2015} regardless of the values of ϵ and r. However, the values which (6) gives for PV'_{2015} for the two "no pump storage" cases, Tables 5-1 and 5-2 (spreadsheet columns D and K, row 16) differ by about one-half of one percent; so do the values which (6) gives for PV'_{2015} for the two "pump storage" cases, Tables 5-3 and 5-4 (spreadsheet columns D and K, row 33). Therefore, the Study Report authors must not have used $c_t = (1+\epsilon)^{t-2016}\, c_{2016}$, but something very slightly different. There is no way to know what that was (for example, the text "2017" does not appear in the report), so in column O, averages of the PV'_{2015} values derived from (6) for the two "no pump storage" cases given in the Study Report were calculated, and this average was used for the "no pump storage" PV'_{2015} in the rest of the spreadsheet. Similarly, in column O, averages of the PV'_{2015} values derived from (6) for the two "pump storage" cases given in the Study Report were calculated, and that average was used for the "pump storage" PV'_{2015} in the rest of the spreadsheet.

Appendix H

Survey of Water Price Elasticity Publications, Gail Blattenberger, PhD



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6 Berry & Bonen
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10 Casuto & Ryan
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12 Gershon
13 Griffin & Chang
14 Hewitt & Hanemann
15 Howe & Lineweaver
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17 Jones & Morris
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20 Moncur
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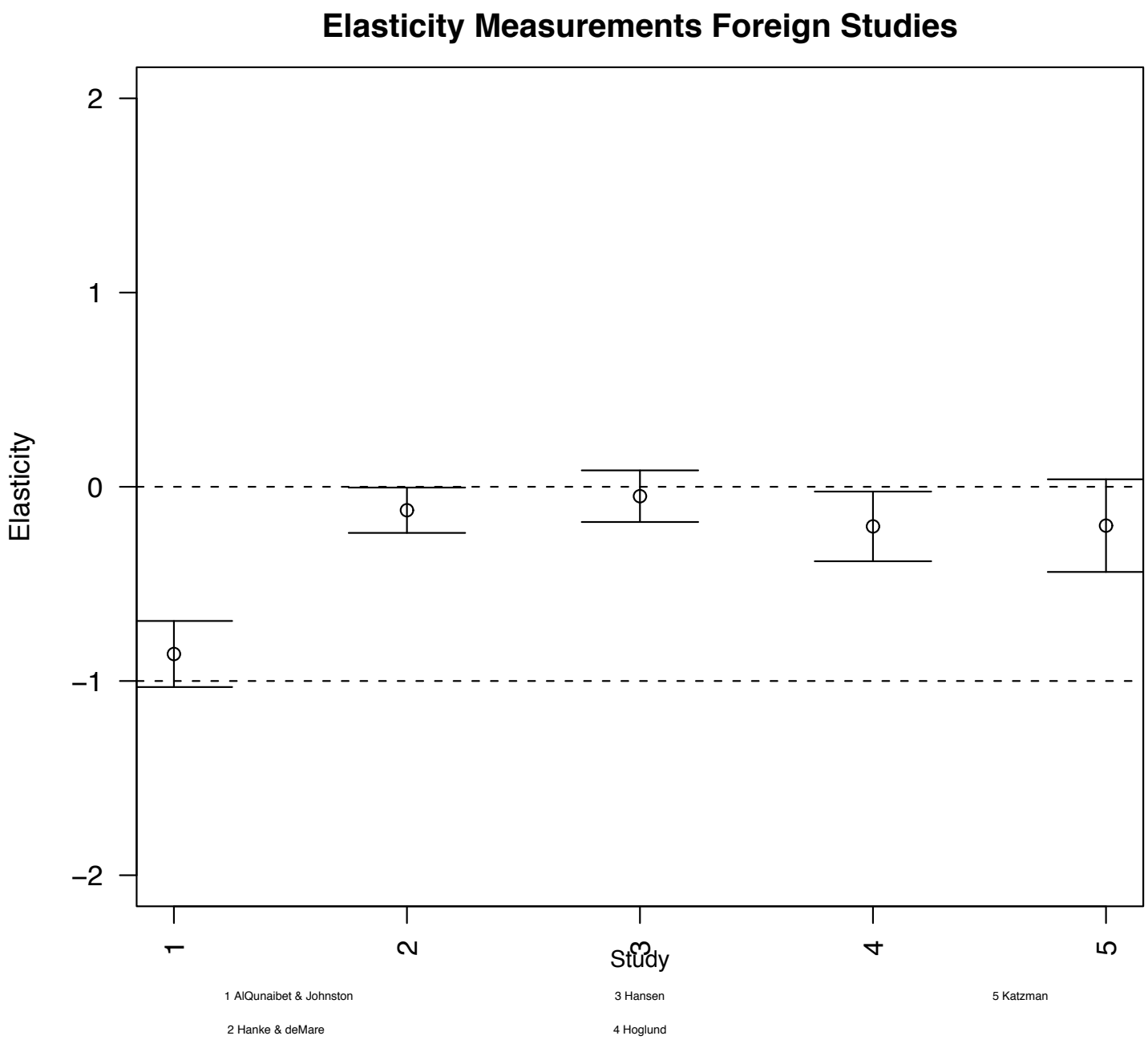
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Study
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3 Hansen
4 Hoglund
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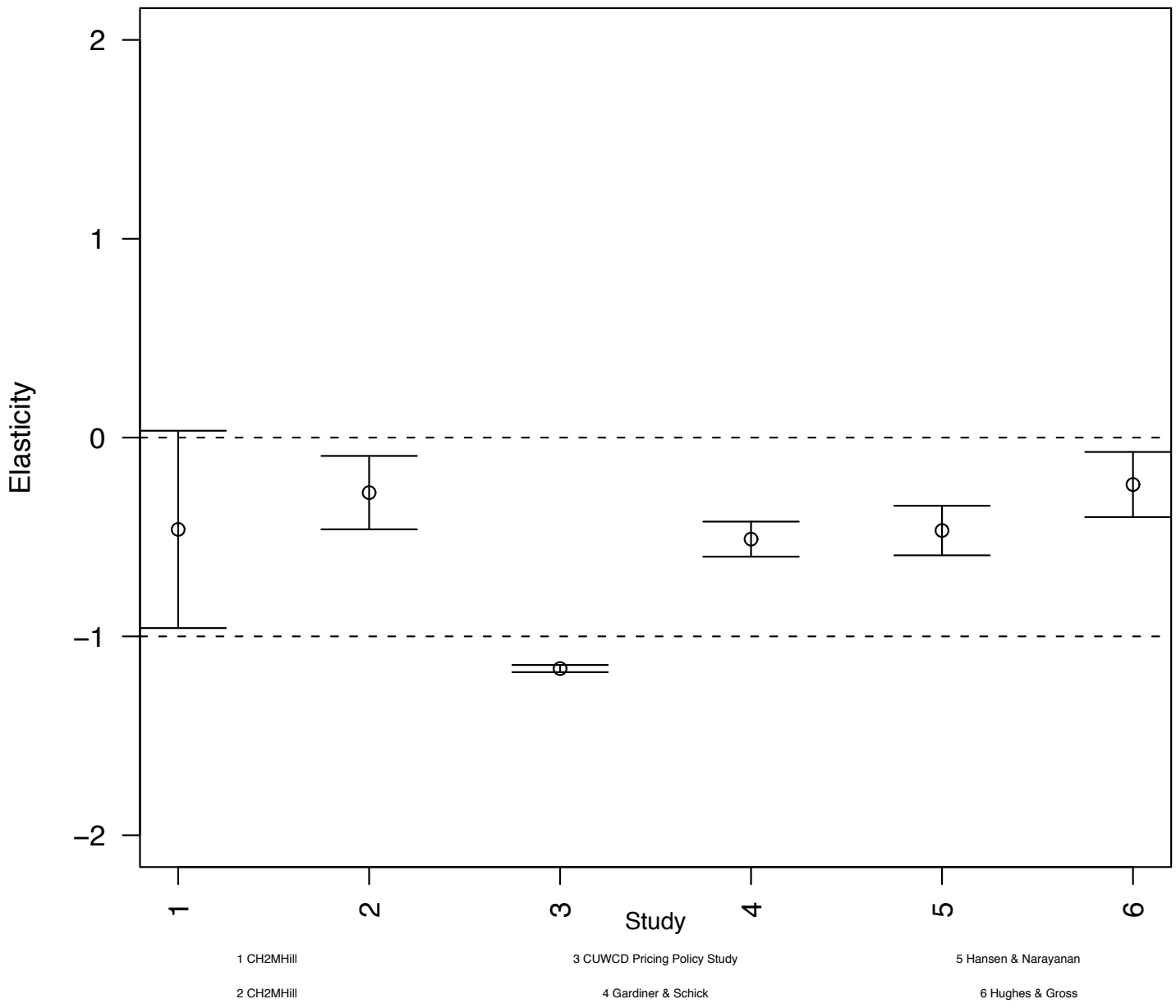
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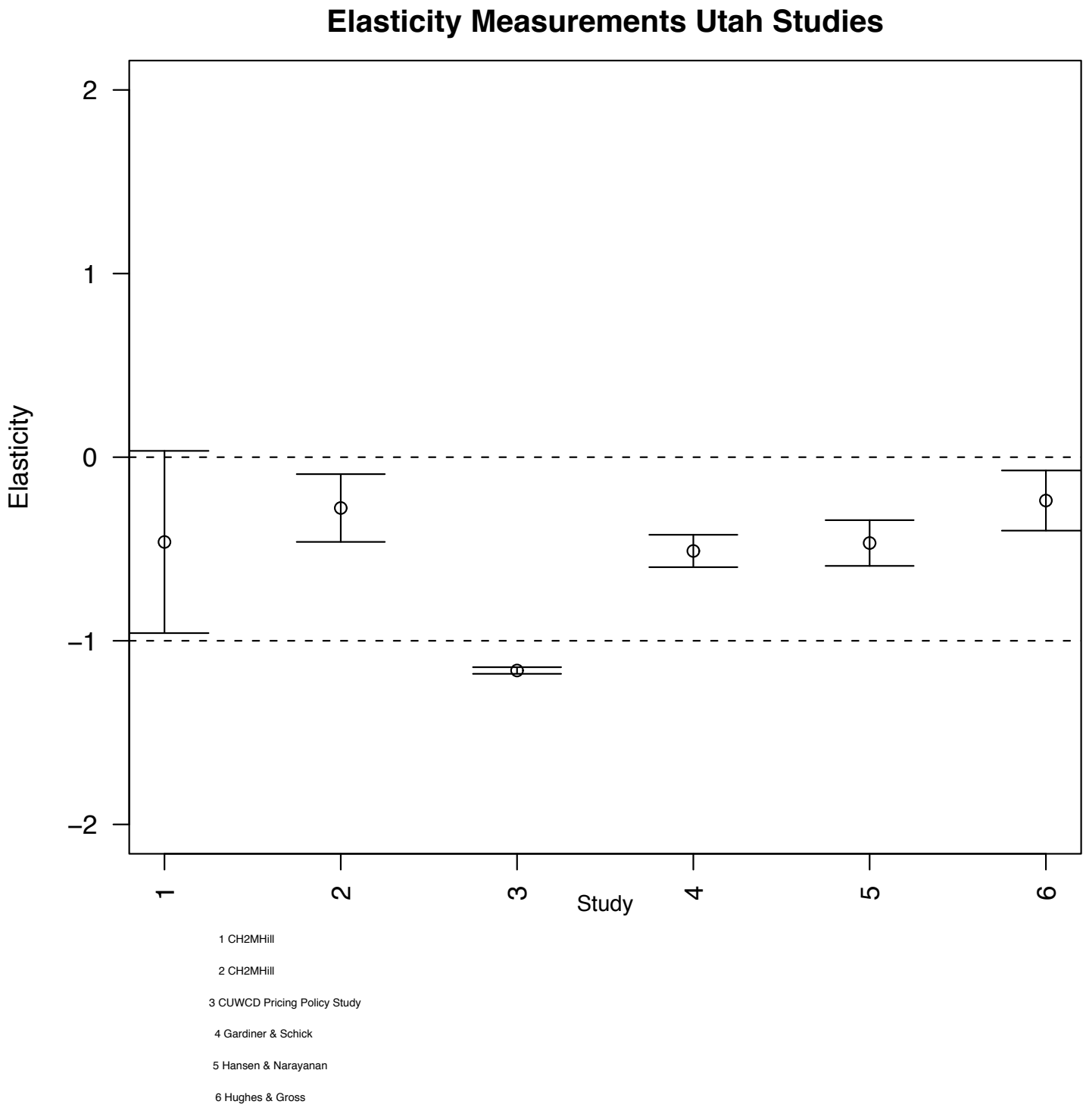
3 CUWCD Pricing Policy Study
4 Gardiner & Schick
5 Hansen & Narayanan
6 Hughes & Gross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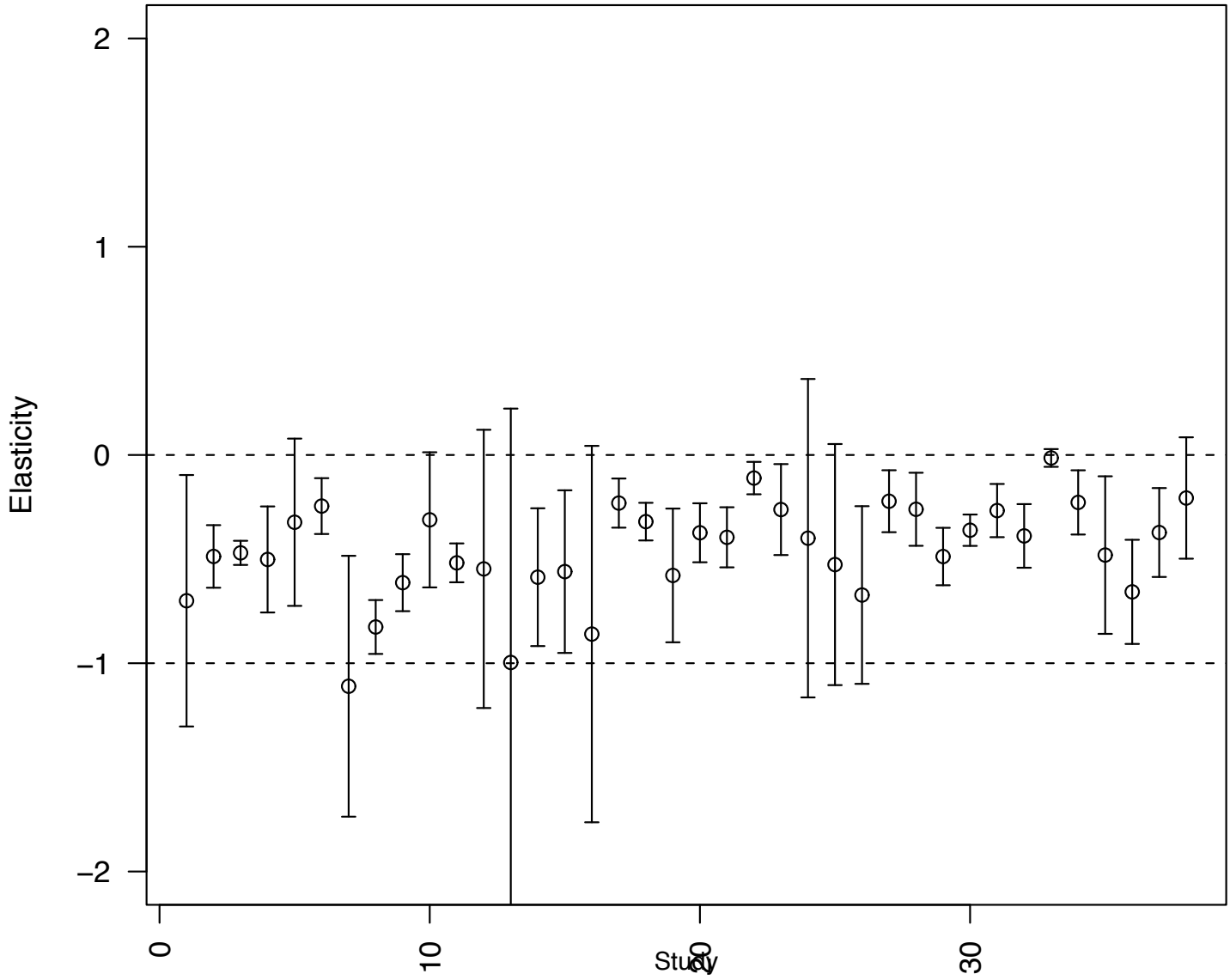
3 CUWCD Pricing Policy Study
4 Gardiner & Schick
5 Hansen & Narayanan
6 Hughes & Gross

Elasticity Measurements East/US Studies



1 Carver & Boland
2 Cavanagh, Haneman & Stavins
3 Chicoine & Ramurthy
4 Clarke
5 Cochrane & Cotton
6 Danielson
7 Danielson
8 Deller, Chicoine, & Ramamurthy
9 Foster & Beattie
10 Fourt
11 Gibbs
12 Gottlieb
13 Gottlieb
14 Grima
15 Hogarty & Mackay
16 Hogarty & Mackay
17 Howe & Lineweaver
18 Martin & Wilder
19 Martin & Wilder
20 Nieswiadomy & Cobb
21 Nieswiadomy & Cobb
22 Schafer & David
23 Schneider & Whitlach
24 Stevens, Miller, Willis
25 Stevens, Miller, Willis
26 Stevens, Miller, Willis
27 Turnovsky
28 Turnovsky
29 Williams
30 Williams
31 Williams
32 Williams & Suh
33 Wong
34 Wong
35 Wong
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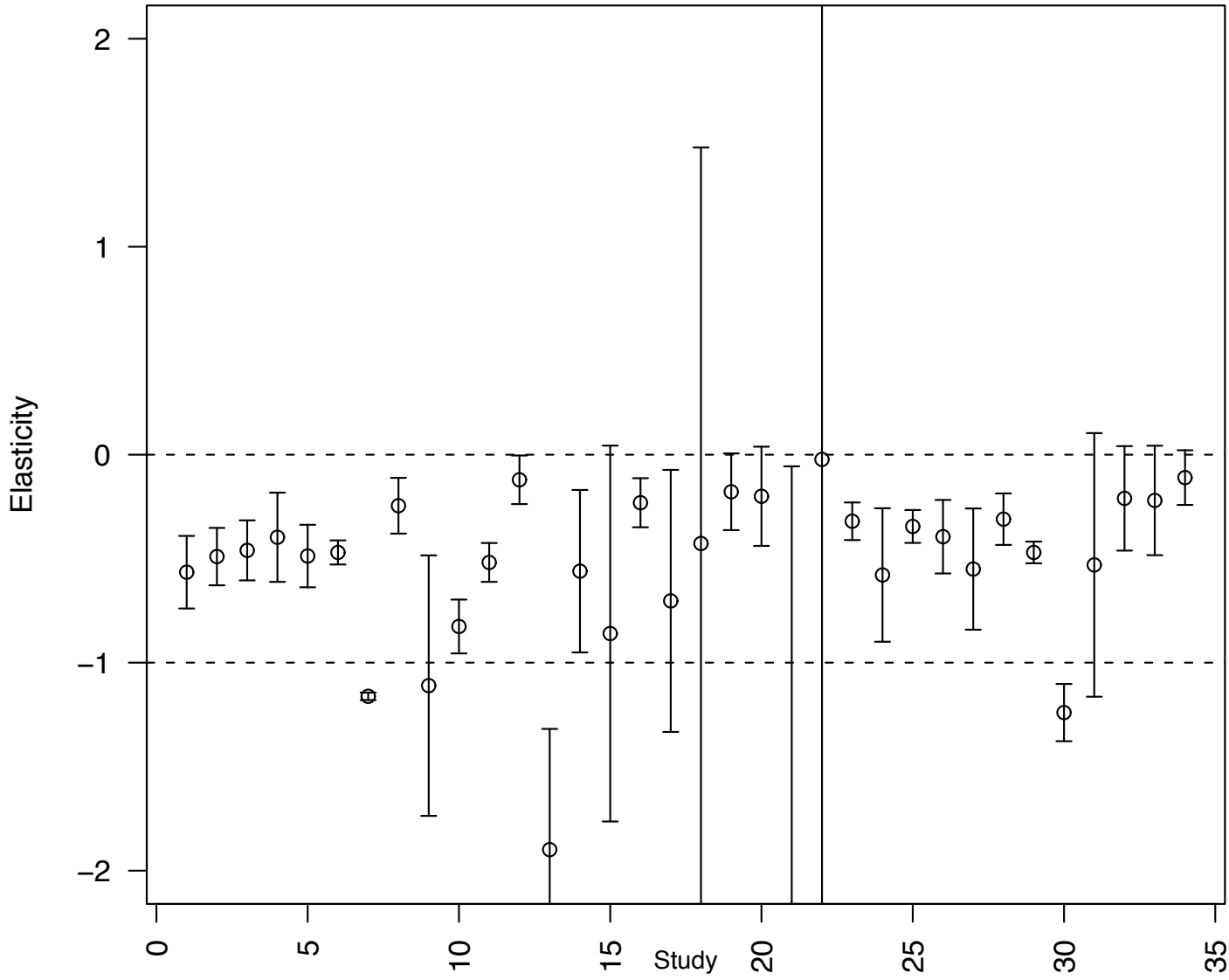
Elasticity Measurements Individual Customer Studies



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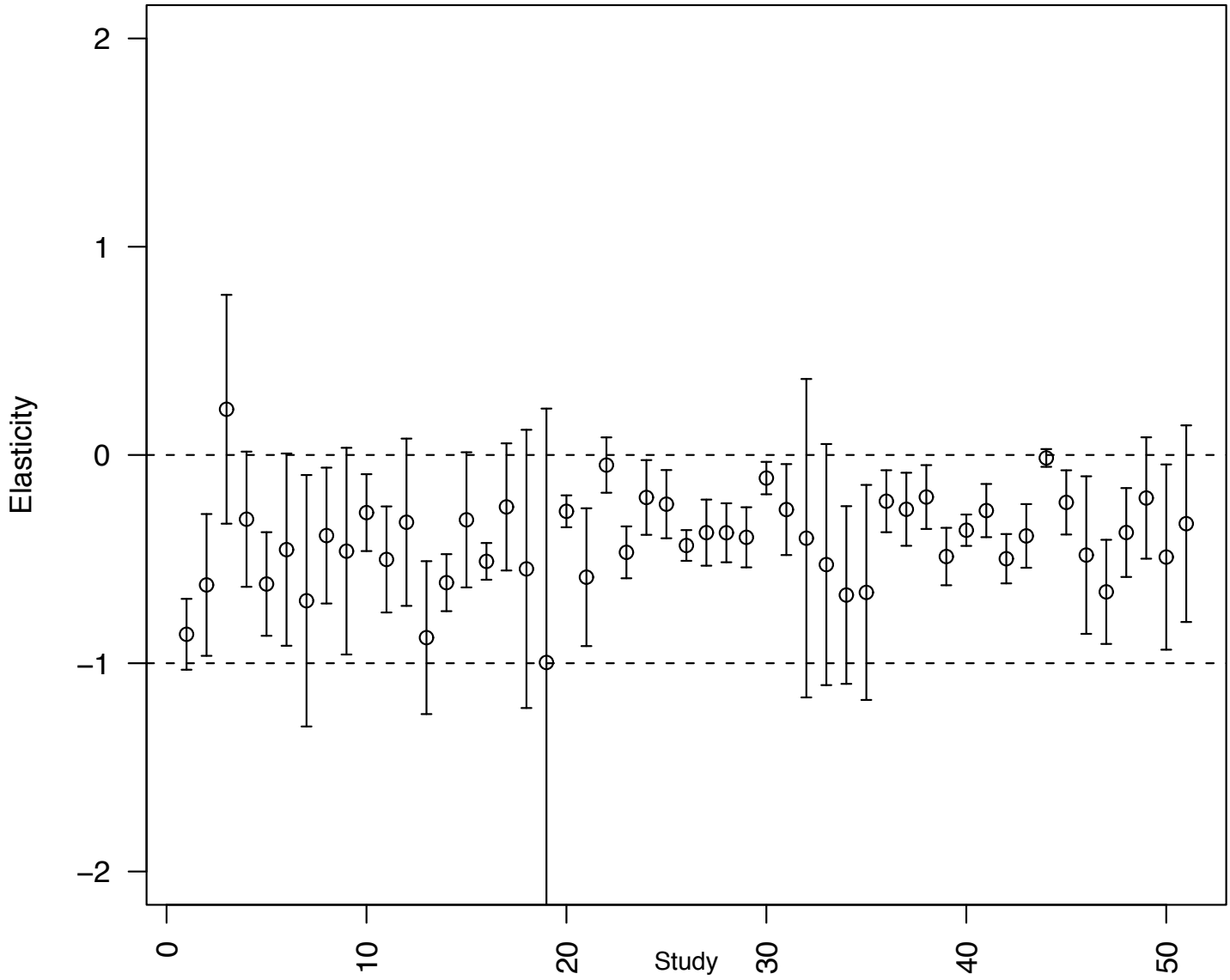
Elasticity Measurements Aggregate Customer Studies



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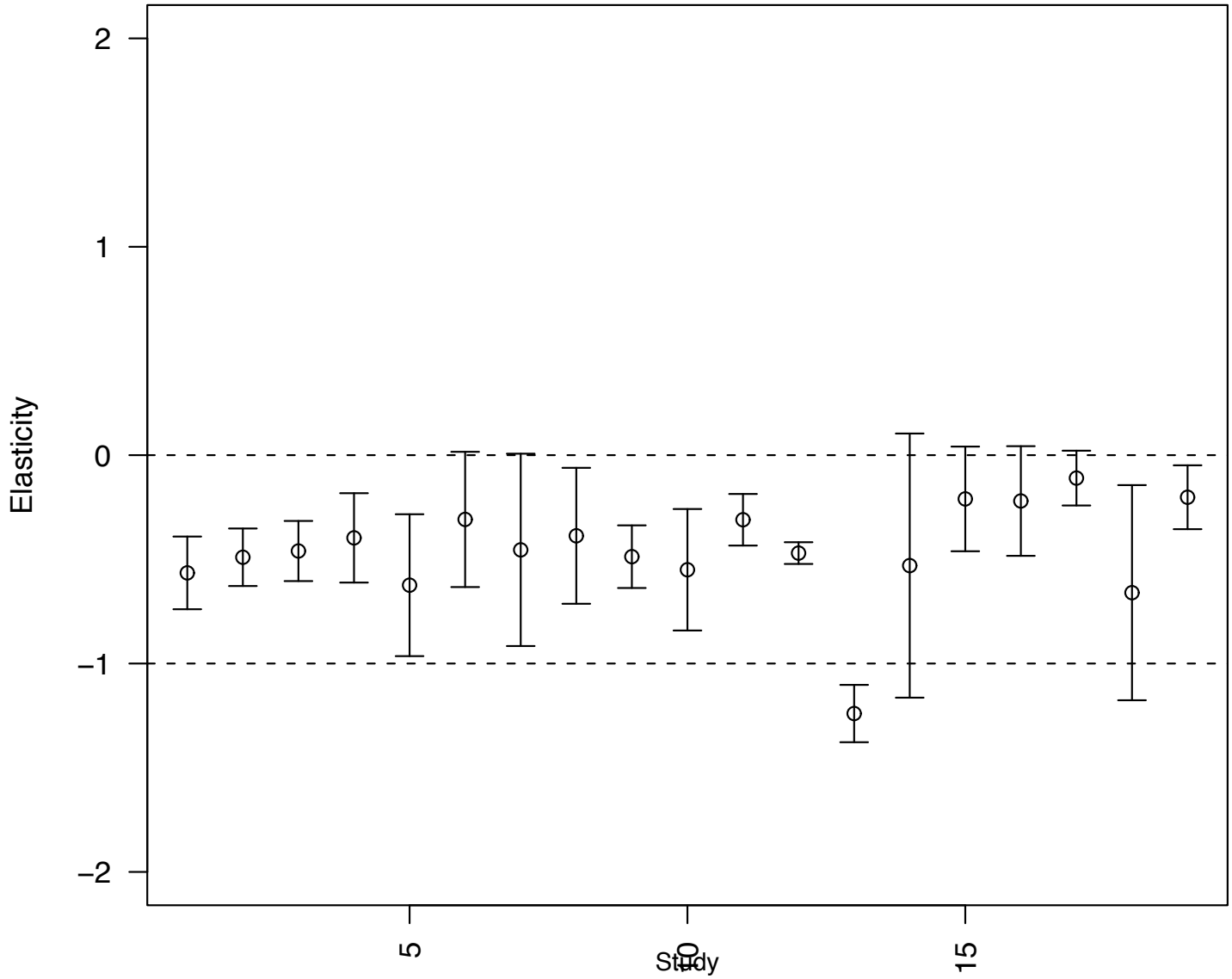
Elasticity Measurements Studies with Large Price Changes



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October 7, 2013

Over the last several years there has been extensive discussion about the proposed Lake Powell Pipeline ("LPP") and the consequent repayment obligations of the taxpayers of Washington County. The Kane County Water Conservancy District ("KCWD") has also expressed an interest in participating in the LPP, despite water from the LPP not being needed for Kane County's growth to 2060 based on the 2011 Water Needs Assessment of the Utah Division of Water Resources. We have conducted an initial analysis of the indebtedness to the KCWD and the taxpayers of Kane County by virtue of their participation in the LPP. The following pages summarize our initial findings, based on public documents made available by various Utah agencies.

Based on this analysis, we have major concerns about the ability of the KCWD to repay debt associated with the LPP. If the Kane County Water District receives its desired 5.5% share of the LPP's water and of the LPP's roughly $1 billion cost, then assuming an interest rate of 4% and a 50-year repayment period, the KCWD will have to repay $2.5 million of LPP costs every year ($344 for every man, woman, and child currently in the county), in addition to its existing debt schedule. Unless the District increased its property tax rate, water rates, impact fees, or revenue from other sources, KCWD's cumulative debt would grow to $663 million by the end of the project repayment period, even assuming its property tax revenue, water sales revenue, and impact fee revenue all rise with its projected rate of population growth.

Although one potential source of revenue to repay Kane County's portion of the debt would be payments commencing on the completion of the proposed Green River Nuclear Power Plant, no nuclear power plant has been constructed in the United

States since 1977, and this plant faces strong opposition. Counting on this plant being built may be imprudent.

Moreover, even if this nuclear power plant is constructed, KCWD will be forced to raise property taxes, water rates or impact fees significantly to repay its LPP debt. For example, our analysis indicates that if one assumes that the proposed nuclear power plant is constructed by 2024, one way for KCWD to repay its debt would be to:

- raise impact fees 344%, to an average of $28,577 per connection; together with
- raising water rates by 538%; together with
- raising property tax rates by 61%.

Of course, increasing water rates this much would significantly decrease Kane County residents' demand for water, making the LPP's water even more superfluous than the Division of Water Resources currently calculates it to be. Furthermore, if the proposed nuclear power plant is not constructed by 2024, these increases in water rates, impact fees and property taxes will fall short of what will be needed to make the debt payments.

We conclude from our initial analysis that these debt obligations raise serious questions about the KCWD's participation in the LPP. The State should not facilitate Kane County's acquisition of this debt without a careful and thoroughly detailed study of whether Kane County residents have the capacity to repay it.

Thank you for the opportunity to contribute to this discussion.

Sincerely,

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Lake Powell Pipeline Feasibility for Kane County Water District

The following summarizes concerns about the ability of the Kane County Water Conservancy District (KCWD) to repay debt issued by the State of Utah for their financial obligation for participating in the proposed Lake Powell Pipeline. The Lake Powell Pipeline (LPP) Development Act (Utah Code 73-28-402) mandates the entire project cost be repaid to the State of Utah with interest.

1. Kane County Water District (KCWD) Questionable Water Needs. The Governor's Office of Planning and Budget 2012 Baseline Population Projections estimates Kane County will grow by 11,375 residents by the year 2060.[1] Based on this growth, projected water demands indicate no need for additional water in Kane County from the Lake Powell Pipeline, according to the 2011 Water Needs Assessment prepared for the Utah Division of Water Resources (DWRe):[2]

> *"The difference between the projected KCWCD 2060 demand of 5,850 ac-ft/yr and the existing supply of 4,040 ac-ft/yr is 1,810 ac-ft/yr. For all four subbasins, a combination of existing and new ground water supplies is sufficient to meet all future needs within the planning horizon. Thus based strictly on water need, LPP supplies are not needed in the KCWCD service area within the 2060 planning horizon." (Page ES-24)*

If KCWD does not receive water from the LPP it will still have 10,810 acre-feet of additional supply in 2060 from "likely projects," and they will only have need for 1,810 ac-ft/year of that.[3] Kane County clearly has no need for LPP water.

According to the 2011 DWRe Water Needs Assessment, KCWD uses 420.3 gallons per capita per day ("GPCD"; p. ES-7) and had 0% water conservation savings from 2000-2009 (p. ES-10). If KCWD encouraged residents to get closer to the national average of 171 GPCD, estimated by USGS,[4] or state average of 295 GPCD, estimated by the Utah Division of Water Resources,[5] the district could extend their water supply even further into the future.

2.Estimate of Existing Revenues vs. Debt Service for KCWD.

One important question is whether or not local taxpayers can support Kane County's repayment obligation for the LPP. A review of the KCWD's revenue streams is warranted, based on the 2012 Audited Financial Statement Prepared for KCWD, the "2012 KCWDAFS".[6]

> **Water Sales Revenues.** KCWD received $713,865 in water sales revenue (page 9 of the 2012 KCWDAFS):

	2012	2011
Operating revenues:		
Water sales revenue	$ 713,865	$ 587,721
Total operating revenues	713,865	587,721

[1] http://governor.utah.gov/DEA/projections.html, 2012 Baseline Projections, "Population and Households by Area." Available as governor.utah.gov/DEA/ERG/ERG2012/Households%20by%20Area.xlsx.
[2] http://citizensfordixie.org/wp-content/uploads/2012/04/19DraftWaterNeedsAssessmentReport-1.pdf
[3] Pages ES-27 and 6-12, 2011 LPP Water Needs Assessment.
[4] USGS, http://pubs.usgs.gov/sir/2012/5163/.
[5] Utah baseline per capita water use: http://state.awra.org/utah/sites/default/files/AdamsMillis-WaterNeeds.pdf.
[6] "Kane County Water Conservancy District Financial Statements With Other Government Reports For the year ending June 30, 2012 and 2011."

Property Tax Revenues. In 2012 KCWD collected $769,298 from property taxes (see the source in the next paragraph). Its levy rate was 0.000621 times the taxable value (p. 7 of the 2012 KCWDAFS).

Impact Fee Revenues. KCWD collected $259,042 in impact fees in 2012 (page 9 of the 2012 KCWDAFS):

Nonoperating income (expense):		
Property tax revenues	769,298	767,223
Grant revenues	1,776,373	4,096,810
Investment earnings	126,204	130,919
Impact fees	259,042	48,750

Existing Debt Service by KCWD (not including LPP). The KCWD has $1,160,969 in annual debt service for previous obligations for FYE 2013, not including debt from the Lake Powell Pipeline, as shown on the 2013 row of the District's debt service schedule (p. 17 of the 2012 KCWDAFS). This non-LPP debt service increases annually through 2037 before being extinguished in 2052, totaling $34.6 million.

The District's debt service for the next forty year period is as follows.

Year	Principal	Interest	Total
2013	569,003	591,966	$ 1,160,969
2014	481,383	577,194	1,058,577
2015	491,727	565,123	1,056,850
2016	504,344	552,613	1,056,957
2017	501,127	539,841	1,040,968
2018-22	3,086,184	2,491,604	5,577,788
2023-27	3,343,276	2,114,186	5,457,462
2028-32	3,701,705	1,698,463	5,400,168
2033-37	4,171,155	1,243,653	5,414,808
2038-42	3,059,745	744,593	3,804,338
2043-47	2,497,553	247,184	2,744,737
2048-52	754,373	32,775	787,148
	$ 23,161,575	$ 11,399,195	$ 34,560,770

3. Estimate of Additional Debt Service on KCWD from the Lake Powell Pipeline

50-Year Repayment Obligation for Lake Powell Pipeline by Kane County Taxpayers. The following is the calculation of total annual debt service to the KCWD to participate in the LPP. The KCWD has announced they intend to receive 5.5% of the project water[7], meaning they will be required to repay 5.5% of the roughly $1.0 billion cost,[8] although some believe project costs will be higher. The KCWD can therefore expect to pay $55 million in capital costs (or more).

[7] 4000 af / 73,000 af, Page ES-5, 2011 LPP Water Needs Assessment. (For the CICWCD see "Iron County pulls out of Lake Powell pipeline project," Salt Lake Tribune, March 22, 2012.)

[8] http://www.water.utah.gov/LakePowellPipeline/projectUpdates/default.asp says "The Division of Water Resources' current cost estimate (June 2008) for the entire project is $1.064 billion" (accessed 9/24/2013).

Assuming a 50-year repayment period, the annual debt service varies with the interest rate as follows[9]

Annual Debt Service Payments
by the Kane County Water Conservancy District

	Interest Rate			
Repayment Cost	**0.03**	**0.04**	**0.05**	**0.07**
$55 Million	$ 2,137,602	$ 2,560,261	$ 3,012,720	$ 3,985,292

In other words, the repayment obligation from the LPP will add between $2 and $4 million in additional annual debt burden onto KCWD's existing debt service.

A reasonable assumption for a 50-year interest rate is 4%, meaning an additional $2.56 million in new annual debt payment due to the LPP, shown in the attached spreadsheet's Column F. In addition to its debt obligations, KCWD has operating expenses that are assumed to grow proportionally to the number of new households in the county, shown in Column I. This is a conservative estimate because no operating and maintenance costs have been included as part of LPP participation. It is likely there will be additional operation and maintenance costs associated with long-term management of KCWD's portion of the LPP. Our estimates of KCWD Total Expenses are shown in Column J.

Based on the expected growth of existing revenue streams due to population increase in the county, KCWD's revenues can be projected over the next 50 years, as shown in Column K. The deficit schedule for the repayment period can be seen in Columns O and P. These columns show that the District's revenues fall significantly short of the District's expenses for every year of the 50-year repayment schedule. Unless the District has an increase in revenues, KCWD's cumulative debt would grow to $663 million (cell P73) by the end of the project repayment period. Clearly, participation by the KCWD in the LPP will require significant increases in property taxes, impact fees and/or water rates.

4. Repaying Debt Through Revenues from Proposed Green River Nuclear Power. KCWD has entered into a contract with Blue Castle Holdings to lease 29,600 acre-feet[10] of water for a proposed nuclear power plant in Green River, Utah. The water for this lease will come from the water supply of the Green River, not out of Kane County's water delivery system. The contract stipulates Blue Castle Holdings would pay KCWD $1,000,000 per year once the plant comes online and $100,000 per year while the project goes though the permitting process[11]. The $1 million in revenues are contingent upon nuclear power plant construction, which is problematic since a new nuclear power facility has not been constructed in the U. S. since 1977[12].

This raises the probability that if the nuclear facility is not licensed, KCWD would have to find another way to pay a major portion of their debt service. In our analysis we assumed KCWD

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[9] N15—N18 of the attached spreadsheet.

[10] http://www.deseretnews.com/article/705393416/Nuclear-power-plant-in-Utah-First-step-is-securing-water-rights.html?pg=all

[11] http://www.bluecastleproject.com/files/news_items/60-35353680.pdf

[12] Of the 104 reactors now operating in the U.S., construction was started on all of them in 1977 or earlier. The two plants in operation that broke ground in 1977 are River Bend Nuclear Generating Station in Louisiana and Wolf Creek Generating Station in Kansas. http://www.eia.gov/nuclear/reactors/stats_table3.html

would begin to receive $1 million annually from the plant beginning in 2024, which is generous due to the length of time it takes for nuclear power plants to go though permitting and construction. This is shown in Column M. If the nuclear power plant is licensed on this timeline, but impact fees, water rates, and property taxes are kept at their current level, the KCWD will run a deficit every year of their operation, totaling a $566 million deficit in 2062 (Columns Q and R; cell R73). Clearly, then, revenues from nuclear power alone will not be sufficient to avoid financial difficulty.

5. Tax, Water Rate and Impact Fee Increases Required to Repay Debt

The fundamental question is whether the KCWD can make these debt payments via an increase in revenue, and if so how they will raise this revenue.

Increasing Property Taxes. Water conservancy districts in the Lower Colorado River Basin may not tax higher than 0.001 per dollar of taxable value of taxable property in the district.[13] If KCWD increased taxes on homeowners and businesses to the highest possible rate of 0.001, they would collect $1.24 million in 2012 tax dollars (($769,298/.000621) * .001) (based on 2012 values; see spreadsheet Column B). This represents a 61% increase in property taxes on Kane County homeowners and businesses to fund the LPP. However, even with this increase in property taxes, KCWD revenues would fall short of their expenses by many millions of dollars each year, cumulating to a deficit of $560 million dollars at the end of the 50-year repayment period, if the proposed nuclear power plants are not constructed (Columns S and T; cell T73). If the nuclear power plants are constructed by 2024 and property taxes are raised to the maximum levy amount, KCWD would still experience large deficits annually and a cumulative deficit of $463 million at the end of the 50-year repayment period (Columns U and V; cell V73).

Increasing Water Rates. Although one might think the KCWD could simply increase water rates to raise revenues, raising water rates will result in a decrease in total water demand. Because the debt is relatively large, in order for water sales to cover the debt obligations of the project, water sales revenues would need to increase by 305% (spreadsheet cell B10), even if property taxes were increased to the maximum allowable rate and the District received revenue from the Green River Nuclear Plant. This would still require the KCWD to shoulder significant deficits over time, but would result in a balance of essentially zero in 2062 (Columns W and X; cell X73). Due to the fact that the price elasticity of demand for water is conservatively estimated to be -0.5, repayment though water sales alone would require rate increases of 1542% (cell B12). This enormous increase in water rates would lead Kane County water users to demand in 2060 about a quarter (cell B13) of the water they demanded in 2010.

Increasing Impact Fees. There has been some discussion about making debt payments through an increase in impact fees, the fee new development pays to hook up to the water system. Currently KCWD has an average impact fee of $6,438[14] and if the District chose to repay debt using impact fees, revenues from impact fees would need to go up by 688% (cell B15), requiring an average impact fee of over $50,000 (cell B17), even if property taxes were increased to the maximum allowable rate and the District received revenue from the Green River Nuclear Plant (Columns Y and Z; cell Z73).

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[13] Utah Code, Section 17B-2a-1006. See http://le.utah.gov/code/TITLE17B/htm/17B02a100600.htm.

[14] 2010 and 2011 KCWD "Certification of Impact Fee Report" (Form CIF-CERT-1-2010). Reports (Note: KCWD has made the 2012 Impact Fee Report available to the public.)

The massive impact fees required would be among the highest in the nation,[15] likely deterring new growth in the county and significantly lowering property values. Both effects would add even more problems for KCWD's repayment obligations: the first would lower the amount of impact fees collected, and the second would lower property values and thus lower the total property taxes collected by the district. Our analysis did not compensate for these factors.

Combination of Increased Water Rates and Impact Fees. The significant debt to participate in the LPP will quite likely lead KCWD to raise property taxes to the maximum allowable by law**.** The District's only real flexibility in raising revenues for its debt payments comes from deciding the proportion of increased revenues which will come from increased water rates versus from increased impact fees. KCWD could, for example:

- raise impact fees 344% (cell B21), to an average of $28,564 per connection (cell B22); together with
- raising water rates 538% (cell B20), when considering -0.5 elasticity; together with
- raising property tax rates by 61%.

If one assumes the proposed nuclear power plant will be constructed by 2024, Columns AA and AB of the spreadsheet (and cell AB73) show that these increases would eliminate KCWD's debt by 2060 (though it would carry substantial deficits for much of the repayment period). If the proposed nuclear power plant is not constructed by 2024, these increases in water rates, impact fees and property taxes would need to be larger. In addition, the 538% increase in water rates means that Kane County water users would demand in 2060 less water than they demanded in 2010.[16]

6. Kane County Water District does not have a repayment plan. According to Section 11-36a-301 of Utah Code, districts that assess impact fees with service area populations greater than 5,000, as of the latest US census, must prepare an Impact Fee Facilities Plan (or General Plan that covers the impact fee schedule) to determine the public facilities required to serve development resulting from new development activity.[17] KCWD has not made such a plan available to the public despite collecting impact fees on a service area population of approximately 7,125 people[18]from 2685 accounts[19] in 2010.

[15] 2012 National Impact Fee Survey, Duncan Associates: http://www.impactfees.com/publications%20pdf/2012_survey.pdf

[16] This is because cell B20 is larger than cell B8.

[17] http://le.utah.gov/code/TITLE11/htm/11_36a030100.htm

[18] 2010 US Census: http://quickfacts.census.gov/qfd/states/49/49025.html.

[19] Page 7 of "Kane County Water Conservancy District Financial Statements With Other Government Reports For the year ending June 30, 2012 and 2011."

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4. Green River Nuclear Water Lease quantity - http://www.deseretnews.com/article/705393416/Nuclear-power-plant-in-Utah-First-step-is-securing-water-rights.html?pg=all
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6. Of the 104 reactors now operating in the U.S., construction was started on all of them in 1977 or earlier. The two plants in operation that broke ground in 1977 are River Bend Nuclear Generating Station in Louisiana and Wolf Creek Generating Station in Kansas. http://www.eia.gov/nuclear/reactors/stats_table3.html
7. Of the 104 reactors now operating in the U.S., construction was started on all of them in 1977 or earlier. The two plants in operation that broke ground in 1977 are River Bend Nuclear Generating Station in Louisiana and Wolf Creek Generating Station in Kansas. http://www.eia.gov/nuclear/reactors/stats_table3.html
8. Maximum property tax levy for a Lower Colorado Basin Water District - Utah Code, Section 17B-2a-1006. http://le.utah.gov/UtahCode/title.jsp
9. Average Impact Fee - 2010 and 2011 KCWD Certification of Impact Fee Reports (Note: KCWD has made the 2012 Impact Fee Report available to the public.)
10. Would be one of the highest impact fees in the nation - 2012 National Impact Fee Survey, Duncan Associates - http://www.impactfees.com/publications%20pdf/2012_survey.pdf
11. Capital facilities plan or general plan required - Utah Code, Section 11-36a-301 - http://le.utah.gov/UtahCode/title.jsp
12. KCWD Census population – 2010 US Census - http://quickfacts.census.gov/qfd/states/49/49025.html
13. GOPB Population Projections http://governor.utah.gov/DEA/projections.html

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
23	Year	Property Tax @ .001	Property Tax @ Current Rate	Water Sales	Impact Fees	Expected Annual LPP Debt	Annual Debt Service on Existing Debt	Total Annual Debt Service	Operating Expenses (2012)	TOTAL EXPENSES	Total Revenues w/ Current P. Tax Levy	Total Revenues w/ Max P. Tax Levy	GR Nuke, Estimate of Construction Time	Total Rev. W/ Max P. Tax and GR Nuke	Annual Surplus (Deficit) w/ Current P. Tax
24	2013	$1,260,186	$769,298	$726,186	$322,229	$2,560,261	$1,160,969	$3,721,230	$2,463,533	$6,184,763	$1,817,713	$2,308,601	$100,000	$2,408,601	($4,367,050)
25	2014	$1,281,935	$782,575	$738,719	$327,791	$2,560,261	$1,058,577	$3,618,838	$2,506,051	$6,124,889	$1,849,085	$2,348,445	$100,000	$2,448,445	($4,275,804)
26	2015	$1,304,060	$796,082	$751,468	$333,448	$2,560,261	$1,056,850	$3,617,111	$2,549,303	$6,166,414	$1,880,998	$2,388,977	$100,000	$2,488,977	($4,285,416)
27	2016	$1,326,567	$809,821	$764,438	$339,203	$2,560,261	$1,056,957	$3,617,218	$2,593,302	$6,210,520	$1,913,462	$2,430,208	$100,000	$2,530,208	($4,297,057)
28	2017	$1,349,462	$823,798	$777,631	$345,057	$2,560,261	$1,040,968	$3,601,229	$2,638,059	$6,239,288	$1,946,487	$2,472,151	$100,000	$2,572,151	($4,292,802)
29	2018	$1,372,753	$838,016	$791,053	$351,013	$2,560,261	$1,115,558	$3,675,819	$2,683,590	$6,359,408	$1,980,081	$2,514,818	$100,000	$2,614,818	($4,379,327)
30	2019	$1,396,445	$852,479	$804,705	$357,071	$2,560,261	$1,115,558	$3,675,819	$2,729,906	$6,405,724	$2,014,256	$2,558,221	$100,000	$2,658,221	($4,391,469)
31	2020	$1,420,546	$867,192	$818,594	$363,233	$2,560,261	$1,115,558	$3,675,819	$2,777,021	$6,452,840	$2,049,020	$2,602,374	$100,000	$2,702,374	($4,403,820)
32	2021	$1,445,063	$882,159	$832,722	$369,502	$2,560,261	$1,115,558	$3,675,819	$2,824,950	$6,500,769	$2,084,384	$2,647,288	$100,000	$2,747,288	($4,416,385)
33	2022	$1,470,004	$897,384	$847,094	$375,880	$2,560,261	$1,115,558	$3,675,819	$2,873,706	$6,549,524	$2,120,358	$2,692,978	$100,000	$2,792,978	($4,429,166)
34	2023	$1,495,375	$912,872	$861,714	$382,367	$2,560,261	$1,091,492	$3,651,753	$2,923,303	$6,575,057	$2,156,953	$2,739,456	$100,000	$2,839,456	($4,418,103)
35	2024	$1,521,183	$928,628	$876,586	$388,966	$2,560,261	$1,091,492	$3,651,753	$2,973,757	$6,625,510	$2,194,180	$2,786,736	$1,000,000	$3,786,736	($4,431,330)
36	2025	$1,547,438	$944,655	$891,715	$395,680	$2,560,261	$1,091,492	$3,651,753	$3,025,081	$6,676,834	$2,232,050	$2,834,832	$1,000,000	$3,834,832	($4,444,784)
37	2026	$1,574,145	$960,959	$907,105	$402,509	$2,560,261	$1,091,492	$3,651,753	$3,077,291	$6,729,044	$2,270,573	$2,883,759	$1,000,000	$3,883,759	($4,458,471)
38	2027	$1,601,313	$977,544	$922,761	$409,455	$2,560,261	$1,091,492	$3,651,753	$3,130,402	$6,782,155	$2,309,760	$2,933,530	$1,000,000	$3,933,530	($4,472,394)
39	2028	$1,628,950	$994,415	$938,687	$416,522	$2,560,261	$1,080,034	$3,640,295	$3,184,429	$6,824,724	$2,349,625	$2,984,159	$1,000,000	$3,984,159	($4,475,099)
40	2029	$1,657,064	$1,011,578	$954,888	$423,711	$2,560,261	$1,080,034	$3,640,295	$3,239,389	$6,879,684	$2,390,177	$3,035,663	$1,000,000	$4,035,663	($4,489,507)
41	2030	$1,685,663	$1,029,037	$971,368	$431,024	$2,560,261	$1,080,034	$3,640,295	$3,295,298	$6,935,593	$2,431,429	$3,088,056	$1,000,000	$4,088,056	($4,504,164)
42	2031	$1,714,756	$1,046,797	$988,133	$438,463	$2,560,261	$1,080,034	$3,640,295	$3,352,172	$6,992,466	$2,473,393	$3,141,352	$1,000,000	$4,141,352	($4,519,073)
43	2032	$1,744,351	$1,064,864	$1,005,187	$446,030	$2,560,261	$1,080,034	$3,640,295	$3,410,027	$7,050,321	$2,516,081	$3,195,569	$1,000,000	$4,195,569	($4,534,240)
44	2033	$1,774,457	$1,083,242	$1,022,536	$453,728	$2,560,261	$1,082,962	$3,643,223	$3,468,880	$7,112,103	$2,559,506	$3,250,721	$1,000,000	$4,250,721	($4,552,597)
45	2034	$1,805,082	$1,101,938	$1,040,184	$461,559	$2,560,261	$1,082,962	$3,643,223	$3,528,750	$7,171,973	$2,603,681	$3,306,826	$1,000,000	$4,306,826	($4,568,292)
46	2035	$1,836,236	$1,120,956	$1,058,136	$469,525	$2,560,261	$1,082,962	$3,643,223	$3,589,653	$7,232,875	$2,648,618	$3,363,898	$1,000,000	$4,363,898	($4,584,257)
47	2036	$1,867,928	$1,140,303	$1,076,399	$477,629	$2,560,261	$1,082,962	$3,643,223	$3,651,607	$7,294,829	$2,694,331	$3,421,956	$1,000,000	$4,421,956	($4,600,499)
48	2037	$1,900,167	$1,159,983	$1,094,976	$485,872	$2,560,261	$1,082,962	$3,643,223	$3,714,630	$7,357,852	$2,740,832	$3,481,015	$1,000,000	$4,481,015	($4,617,020)
49	2038	$1,932,962	$1,180,003	$1,113,875	$494,258	$2,560,261	$760,868	$3,321,129	$3,778,741	$7,099,869	$2,788,136	$3,541,094	$1,000,000	$4,541,094	($4,311,733)
50	2039	$1,966,323	$1,200,369	$1,133,099	$502,788	$2,560,261	$760,868	$3,321,129	$3,843,958	$7,165,086	$2,836,257	$3,602,210	$1,000,000	$4,602,210	($4,328,830)
51	2040	$2,000,259	$1,221,086	$1,152,655	$511,466	$2,560,261	$760,868	$3,321,129	$3,910,301	$7,231,429	$2,885,208	$3,664,381	$1,000,000	$4,664,381	($4,346,222)
52	2041	$2,034,782	$1,242,161	$1,172,549	$520,293	$2,560,261	$760,868	$3,321,129	$3,977,789	$7,298,917	$2,935,003	$3,727,624	$1,000,000	$4,727,624	($4,363,914)
53	2042	$2,069,900	$1,263,600	$1,192,786	$529,273	$2,560,261	$760,868	$3,321,129	$4,046,441	$7,367,570	$2,985,659	$3,791,959	$1,000,000	$4,791,959	($4,381,911)
54	2043	$2,105,625	$1,285,408	$1,213,372	$538,408	$2,560,261	$548,937	$3,109,198	$4,116,279	$7,225,477	$3,037,188	$3,857,405	$1,000,000	$4,857,405	($4,188,289)
55	2044	$2,141,966	$1,307,593	$1,234,314	$547,700	$2,560,261	$548,937	$3,109,198	$4,187,322	$7,296,520	$3,089,607	$3,923,980	$1,000,000	$4,923,980	($4,206,913)
56	2045	$2,178,934	$1,330,161	$1,255,617	$557,153	$2,560,261	$548,937	$3,109,198	$4,259,591	$7,368,789	$3,142,931	$3,991,704	$1,000,000	$4,991,704	($4,225,859)
57	2046	$2,216,540	$1,353,118	$1,277,288	$566,769	$2,560,261	$548,937	$3,109,198	$4,333,107	$7,442,306	$3,197,175	$4,060,597	$1,000,000	$5,060,597	($4,245,131)
58	2047	$2,254,796	$1,376,471	$1,299,332	$576,551	$2,560,261	$548,937	$3,109,198	$4,407,893	$7,517,091	$3,252,355	$4,130,679	$1,000,000	$5,130,679	($4,264,736)
59	2048	$2,293,711	$1,400,228	$1,321,758	$586,502	$2,560,261	$157,430	$2,717,691	$4,483,968	$7,201,659	$3,308,487	$4,201,970	$1,000,000	$5,201,970	($3,893,172)
60	2049	$2,333,298	$1,424,395	$1,344,570	$596,624	$2,560,261	$157,430	$2,717,691	$4,561,357	$7,279,048	$3,365,588	$4,274,492	$1,000,000	$5,274,492	($3,913,460)
61	2050	$2,373,569	$1,448,978	$1,367,776	$606,921	$2,560,261	$157,430	$2,717,691	$4,640,082	$7,357,772	$3,423,675	$4,348,266	$1,000,000	$5,348,266	($3,934,097)
62	2051	$2,414,534	$1,473,986	$1,391,382	$617,396	$2,560,261	$157,430	$2,717,691	$4,720,165	$7,437,856	$3,482,764	$4,423,312	$1,000,000	$5,423,312	($3,955,091)
63	2052	$2,456,207	$1,499,426	$1,415,396	$628,052	$2,560,261	$157,430	$2,717,691	$4,801,630	$7,519,321	$3,542,873	$4,499,654	$1,000,000	$5,499,654	($3,976,448)
64	2053	$2,498,598	$1,525,304	$1,439,824	$638,891	$2,560,261		$2,560,261	$4,884,502	$7,444,763	$3,604,020	$4,577,314	$1,000,000	$5,577,314	($3,840,743)
65	2054	$2,541,722	$1,551,630	$1,464,674	$649,918	$2,560,261		$2,560,261	$4,968,804	$7,529,065	$3,666,222	$4,656,314	$1,000,000	$5,656,314	($3,862,843)
66	2055	$2,585,589	$1,578,409	$1,489,953	$661,135	$2,560,261		$2,560,261	$5,054,560	$7,614,821	$3,729,497	$4,736,677	$1,000,000	$5,736,677	($3,885,324)
67	2056	$2,630,214	$1,605,651	$1,515,668	$672,545	$2,560,261		$2,560,261	$5,141,797	$7,702,058	$3,793,865	$4,818,428	$1,000,000	$5,818,428	($3,908,193)
68	2057	$2,675,609	$1,633,363	$1,541,827	$684,153	$2,560,261		$2,560,261	$5,230,539	$7,790,800	$3,859,343	$4,901,589	$1,000,000	$5,901,589	($3,931,457)
69	2058	$2,721,787	$1,661,553	$1,568,438	$695,961	$2,560,261		$2,560,261	$5,320,813	$7,881,074	$3,925,951	$4,986,186	$1,000,000	$5,986,186	($3,955,123)
70	2059	$2,768,763	$1,690,230	$1,595,507	$707,972	$2,560,261		$2,560,261	$5,412,645	$7,972,906	$3,993,709	$5,072,242	$1,000,000	$6,072,242	($3,979,197)
71	2060	$2,816,549	$1,719,402	$1,623,044	$720,191	$2,560,261		$2,560,261	$5,506,062	$8,066,323	$4,062,637	$5,159,784	$1,000,000	$6,159,784	($4,003,686)
72	2061	$2,865,160	$1,749,077	$1,651,056	$732,621	$2,560,261		$2,560,261	$5,601,091	$8,161,352	$4,132,754	$5,248,837	$1,000,000	$6,248,837	($4,028,598)
73	2062	$2,914,610	$1,779,264	$1,679,552	$745,265	$2,560,261		$2,560,261	$5,697,761	$8,258,022	$4,204,081	$5,339,427	$1,000,000	$6,339,427	($4,053,940)
74															
75															

	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB
23	Cumulative Surplus (Deficit) w/ Current P. Tax	Annual Surplus (Deficit) w/ Current P. Tax and GR Nuke	Cumulative Surplus (Deficit) w/ Current P. Tax and GR Nuke	Annual Surplus (Deficit) w/ Max P. Tax	Cumulative Surplus (Deficit) w/ Max P. Tax	Annual Surplus (Deficit) w/ Max P. Tax and GR Nuke	Cumulative Surplus (Deficit) w/ Max P. Tax and GR Nuke	Annual Surplus (Deficit) w/ Max P. Tax and GR Nuke and Increased Water Sales	Cumulative Surplus (Deficit) w/ Max P. Tax and GR Nuke and Increased Water Sales	Annual Surplus (Deficit) w/ Max P. Tax and GR Nuke and Increased Impact Fees	Cumulative Surplus (Deficit) w/ Max P. Tax and GR Nuke and Increased Impact Fees	Annual Surplus (Deficit) w/ Max P. Tax and GR Nuke and 50/50 Split Between Impact Fees and Water Rates	Cumulative Surplus (Deficit) w/ Max P. Tax and GR Nuke and 50/50 Split Between Impact Fees and Water Rates
24	($4,367,050)	($4,267,050)	($4,267,050)	($3,876,162)	($3,876,162)	($3,776,162)	($3,776,162)	($1,559,996)	($1,559,996)	($1,559,995)	($1,559,995)	($1,559,996)	($1,559,996)
25	($8,817,537)	($4,175,804)	($8,613,537)	($3,776,444)	($7,807,653)	($3,676,444)	($7,603,653)	($1,422,030)	($3,044,426)	($1,422,028)	($3,044,423)	($1,422,029)	($3,044,425)
26	($13,455,654)	($4,185,416)	($13,143,494)	($3,777,438)	($11,897,397)	($3,677,438)	($11,585,237)	($1,384,114)	($4,550,317)	($1,384,112)	($4,550,313)	($1,384,113)	($4,550,315)
27	($18,290,937)	($4,197,057)	($17,866,291)	($3,780,312)	($16,153,605)	($3,680,312)	($15,728,958)	($1,347,407)	($6,079,737)	($1,347,406)	($6,079,731)	($1,347,407)	($6,079,734)
28	($23,315,376)	($4,192,802)	($22,773,744)	($3,767,137)	($20,566,886)	($3,667,137)	($20,025,254)	($1,293,970)	($7,616,896)	($1,293,968)	($7,616,889)	($1,293,969)	($7,616,892)
29	($28,627,319)	($4,279,327)	($27,964,021)	($3,844,590)	($25,234,152)	($3,744,590)	($24,570,855)	($1,330,464)	($9,252,036)	($1,330,463)	($9,252,027)	($1,330,463)	($9,252,031)
30	($34,163,880)	($4,291,469)	($33,374,051)	($3,847,503)	($30,091,022)	($3,747,503)	($29,301,192)	($1,291,711)	($10,913,828)	($1,291,710)	($10,913,818)	($1,291,711)	($10,913,823)
31	($39,934,256)	($4,303,820)	($39,012,833)	($3,850,466)	($35,145,129)	($3,750,466)	($34,223,706)	($1,252,290)	($12,602,671)	($1,252,289)	($12,602,659)	($1,252,289)	($12,602,665)
32	($45,948,011)	($4,316,385)	($44,889,731)	($3,853,481)	($40,404,415)	($3,753,481)	($39,346,135)	($1,212,188)	($14,318,966)	($1,212,187)	($14,318,952)	($1,212,187)	($14,318,959)
33	($52,215,098)	($4,329,166)	($51,014,487)	($3,856,547)	($45,877,138)	($3,756,547)	($44,676,527)	($1,171,394)	($16,063,119)	($1,171,393)	($16,063,103)	($1,171,393)	($16,063,111)
34	($58,721,805)	($4,318,103)	($57,373,170)	($3,835,601)	($51,547,825)	($3,735,601)	($50,199,189)	($1,105,831)	($17,811,475)	($1,105,829)	($17,811,456)	($1,105,830)	($17,811,466)
35	($65,502,007)	($3,431,330)	($63,099,426)	($3,838,774)	($57,448,512)	($2,838,774)	($55,045,931)	($163,617)	($18,687,551)	($163,615)	($18,687,530)	($163,616)	($18,687,540)
36	($72,566,871)	($3,444,784)	($69,068,188)	($3,842,002)	($63,588,454)	($2,842,002)	($60,089,770)	($120,674)	($19,555,727)	($120,672)	($19,555,703)	($120,673)	($19,555,715)
37	($79,928,018)	($3,458,471)	($75,289,386)	($3,845,285)	($69,977,277)	($2,845,285)	($65,338,646)	($76,990)	($20,414,946)	($76,988)	($20,414,920)	($76,989)	($20,414,933)
38	($87,597,533)	($3,472,394)	($81,773,356)	($3,848,625)	($76,624,994)	($2,848,625)	($70,800,817)	($32,552)	($21,264,096)	($32,551)	($21,264,067)	($32,551)	($21,264,082)
39	($95,576,533)	($3,475,099)	($88,519,390)	($3,840,564)	($83,530,558)	($2,840,564)	($76,473,414)	$24,111	($22,090,548)	$24,113	($22,090,517)	$24,112	($22,090,533)
40	($103,889,102)	($3,489,507)	($95,549,672)	($3,844,021)	($90,715,801)	($2,844,021)	($82,376,372)	$70,096	($22,904,074)	$70,098	($22,904,040)	$70,097	($22,904,057)
41	($112,548,829)	($3,504,164)	($102,875,823)	($3,847,537)	($98,191,970)	($2,847,537)	($88,518,964)	$116,875	($23,703,362)	$116,877	($23,703,324)	$116,876	($23,703,343)
42	($121,569,856)	($3,519,073)	($110,509,929)	($3,851,114)	($105,970,763)	($2,851,114)	($94,910,836)	$164,461	($24,487,035)	$164,463	($24,486,994)	$164,462	($24,487,015)
43	($130,966,890)	($3,534,240)	($118,464,566)	($3,854,752)	($114,064,346)	($2,854,752)	($101,562,022)	$212,869	($25,253,648)	$212,870	($25,253,604)	$212,869	($25,253,626)
44	($140,758,162)	($3,552,597)	($126,755,745)	($3,861,382)	($122,488,301)	($2,861,382)	($108,485,885)	$259,183	($26,004,610)	$259,185	($26,004,563)	$259,184	($26,004,587)
45	($150,956,780)	($3,568,292)	($135,394,267)	($3,865,147)	($131,252,980)	($2,865,147)	($115,690,467)	$309,276	($26,735,519)	$309,278	($26,735,467)	$309,277	($26,735,493)
46	($161,579,308)	($3,584,257)	($144,394,295)	($3,868,977)	($140,372,076)	($2,868,977)	($123,187,063)	$360,233	($27,444,706)	$360,235	($27,444,651)	$360,234	($27,444,679)
47	($172,642,979)	($3,600,499)	($153,770,565)	($3,872,873)	($149,859,833)	($2,872,873)	($130,987,418)	$412,070	($28,130,425)	$412,072	($28,130,365)	$412,071	($28,130,395)
48	($184,165,719)	($3,617,020)	($163,538,408)	($3,876,837)	($159,731,063)	($2,876,837)	($139,103,752)	$464,801	($28,790,840)	$464,803	($28,790,777)	$464,802	($28,790,809)
49	($195,844,081)	($3,311,733)	($173,391,677)	($3,558,775)	($169,679,080)	($2,558,775)	($147,226,677)	$840,537	($29,101,937)	$840,539	($29,101,869)	$840,538	($29,101,903)
50	($208,006,674)	($3,328,830)	($183,656,174)	($3,562,876)	($180,029,120)	($2,562,876)	($155,678,621)	$895,104	($29,370,911)	$895,106	($29,370,838)	$895,105	($29,370,875)
51	($220,673,162)	($3,346,222)	($194,348,643)	($3,567,049)	($190,797,334)	($2,567,049)	($164,472,814)	$950,613	($29,595,134)	$950,615	($29,595,057)	$950,614	($29,595,096)
52	($233,864,003)	($3,363,914)	($205,486,503)	($3,571,293)	($202,000,520)	($2,571,293)	($173,623,020)	$1,007,080	($29,771,860)	$1,007,082	($29,771,777)	$1,007,081	($29,771,818)
53	($247,600,474)	($3,381,911)	($217,087,874)	($3,575,611)	($213,656,152)	($2,575,611)	($183,143,551)	$1,064,522	($29,898,213)	$1,064,524	($29,898,124)	$1,064,523	($29,898,169)
54	($261,692,783)	($3,188,289)	($228,959,678)	($3,368,073)	($225,570,470)	($2,368,073)	($192,837,366)	$1,334,885	($29,759,256)	$1,334,887	($29,759,163)	$1,334,886	($29,759,210)
55	($276,367,407)	($3,206,913)	($241,324,979)	($3,372,541)	($237,965,829)	($2,372,541)	($202,923,401)	$1,394,326	($29,555,300)	$1,394,328	($29,555,201)	$1,394,327	($29,555,251)
56	($291,647,962)	($3,225,859)	($254,203,837)	($3,377,086)	($250,861,548)	($2,377,086)	($213,417,423)	$1,454,794	($29,282,719)	$1,454,796	($29,282,613)	$1,454,795	($29,282,666)
57	($307,559,012)	($3,245,131)	($267,617,121)	($3,381,709)	($264,277,719)	($2,381,709)	($224,335,829)	$1,516,305	($28,937,723)	$1,516,307	($28,937,611)	$1,516,306	($28,937,667)
58	($324,126,109)	($3,264,736)	($281,586,543)	($3,386,412)	($278,235,240)	($2,386,412)	($235,695,674)	$1,578,877	($28,516,355)	$1,578,879	($28,516,236)	$1,578,878	($28,516,295)
59	($340,984,325)	($2,893,172)	($295,743,176)	($2,999,689)	($292,364,339)	($1,999,689)	($247,123,190)	$2,034,038	($27,622,971)	$2,034,040	($27,622,845)	$2,034,039	($27,622,908)
60	($358,537,158)	($2,913,460)	($310,486,363)	($3,004,556)	($307,063,468)	($2,004,556)	($259,012,673)	$2,098,789	($26,629,102)	$2,098,791	($26,628,968)	$2,098,790	($26,629,035)
61	($376,812,741)	($2,934,097)	($325,839,915)	($3,009,507)	($322,355,514)	($2,009,507)	($271,382,687)	$2,164,657	($25,529,608)	$2,164,660	($25,529,467)	$2,164,659	($25,529,537)
62	($395,840,342)	($2,955,091)	($341,828,603)	($3,014,543)	($338,264,278)	($2,014,543)	($284,252,538)	$2,231,663	($24,319,130)	$2,231,665	($24,318,980)	$2,231,664	($24,319,055)
63	($415,650,404)	($2,976,448)	($358,478,195)	($3,019,667)	($354,814,516)	($2,019,667)	($297,642,306)	$2,299,825	($22,992,070)	$2,299,827	($22,991,912)	$2,299,826	($22,991,991)
64	($436,117,163)	($2,840,743)	($375,658,065)	($2,867,449)	($371,874,545)	($1,867,449)	($311,415,448)	$2,526,593	($21,385,160)	$2,526,595	($21,384,993)	$2,526,594	($21,385,077)
65	($457,424,692)	($2,862,843)	($393,547,231)	($2,872,751)	($389,622,278)	($1,872,751)	($325,744,816)	$2,597,128	($19,643,439)	$2,597,130	($19,643,262)	$2,597,129	($19,643,351)
66	($479,607,004)	($2,885,324)	($412,174,444)	($2,878,144)	($408,085,313)	($1,878,144)	($340,652,753)	$2,668,880	($17,760,296)	$2,668,883	($17,760,110)	$2,668,882	($17,760,203)
67	($502,699,478)	($2,908,193)	($431,569,615)	($2,883,630)	($427,292,356)	($1,883,630)	($356,162,493)	$2,741,871	($15,728,837)	$2,741,874	($15,728,641)	$2,741,872	($15,728,739)
68	($526,738,914)	($2,931,457)	($451,763,857)	($2,889,211)	($447,273,261)	($1,889,211)	($372,298,204)	$2,816,122	($13,541,868)	$2,816,124	($13,541,662)	$2,816,123	($13,541,765)
69	($551,763,594)	($2,955,123)	($472,789,535)	($2,894,889)	($468,059,080)	($1,894,889)	($389,085,021)	$2,891,654	($11,191,889)	$2,891,656	($11,191,672)	$2,891,655	($11,191,781)
70	($577,813,334)	($2,979,197)	($494,680,313)	($2,900,664)	($489,682,108)	($1,900,664)	($406,549,086)	$2,968,489	($8,671,075)	$2,968,492	($8,670,846)	$2,968,491	($8,670,961)
71	($604,929,554)	($3,003,686)	($517,471,212)	($2,906,539)	($512,175,931)	($1,906,539)	($424,717,589)	$3,046,651	($5,971,267)	$3,046,654	($5,971,026)	$3,046,653	($5,971,147)
72	($633,155,335)	($3,028,598)	($541,198,659)	($2,912,516)	($535,575,484)	($1,912,516)	($443,618,808)	$3,126,162	($3,083,956)	$3,126,165	($3,083,702)	$3,126,163	($3,083,829)
73	($662,535,488)	($3,053,940)	($565,900,545)	($2,918,595)	($559,917,098)	($1,918,595)	($463,282,155)	$3,207,045	($269)	$3,207,048	($3)	$3,207,046	($136)
74								this is close enough to zero↑		this is close enough to zero↑		this is close enough to zero↑	
75						Estimated Factors to make Final-Year Debt almost zero:			3.05179		6.87761		

Honorable Governor Herbert
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Honorable President Niederhauser
Utah State Senate
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Honorable Speaker Hughes
Utah House of Representatives
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September 12, 2016

Dear Governor Hebert, President Niederhauser, and Speaker Hughes:

Over the last several years, an ad-hoc group of economists working in Utah universities have written to you regarding the Utah Division of Water Resources' proposed Lake Powell Pipeline ("LPP") and the subsequent repayment obligations of the taxpayers of Washington County. Based on this lengthy pro-bono financial analysis conducted over many months, we wrote to you in October 2015 that "we have major concerns about the debt and increased water rates and/or increased impact fees that will be caused by this proposal."

As you may recall, we outlined the required increases in water rate, impact fee and property tax revenues that will be needed to repay the Utah taxpayer for the cost of construction and financing for the Lake Powell Pipeline. Our findings were that, with an interest rate of 4%, the District could raise the needed funds by raising impact fees more than 120 percent, to an average of approximately $14,000 per connection, together with raising water rates by more than 570 percent. These estimated increases were based on a projected construction cost of $1.3 billion and included revenue increases due to the population growth forecasts prepared by the Governor's Office of Management and Budget.

In response, the Washington County Water Conservancy District ("WCWCD") and the State Division of Water Resources disputed our findings, based upon a financial analysis done by the WCWCD's consultant, Applied Analysis, Inc. of Las Vegas, Nevada ("the WCWCD model"). In June, this analysis became publicly available.

Two of us (Lozada and Blattenberger) prepared a detailed report investigating the WCWCD's model and all of us agree with its findings, which we summarize briefly.

The WCWCD model underestimates the cost of the LPP and its impacts on water rates and impact fees in several important ways:

- The WCWCD model includes no payments from the WCWCD reimbursing the Utah taxpayer for the interest the State has to pay on the bonds the State issues to pay for the project, despite Utah Code 73-28-402 (4) (part of the Lake Powell Pipeline Development Act) stating: "The board shall establish and charge a reasonable interest rate for the unpaid balance of reimbursable preconstruction and construction costs."

  This amounts to the State paying 72% of the true financial cost of the project (its "net present value") and the WCWCD paying only 28% of it. We question whether such a repayment ratio constitutes compliance with the Code above. Certainly a private bank would never agree to lend money to a borrower while only being repaid 28% of the loan's net present value.

- The WCWCD model takes the default cost of the pipeline to be $969 million, whereas the 2012 FERC low-cost and high-cost estimates were $1.328 billion and $1.751 billion, respectively. Were one to use these higher costs, it would dramatically change the required revenue increases needed to repay Utah taxpayers.

- The WCWCD model also omits LPP operations and maintenance costs, which are substantial, varying between $23 and $63 million each year the pipeline is in operation (in 2014 dollars), according to the documents prepared by the State.

The WCWCD model has another flaw which is serious and merits further consideration. Consumers typically buy more of a product if its price falls. Conversely, the higher a product's price, the lower its total consumption. This link between a product's price and its total quantity sold is sometimes called the "Law of Demand." Most Americans are familiar with this concept and laymen think of it simply as a part of 'market economics.'

The WCWCD model, by contrast, assumes there is no such link, and that instead, the price of water has no relationship to the quantity of water used or purchased by the consumer. This makes the WCWCD model inconsistent with the Law of Demand, invalidating its analysis of water prices. The fact that this inconsistency has not been corrected by anyone working for the Division of Water Resources or for the WCWCD raises the possibility that these institutions may currently lack the ability to handle even the most elementary principles of economic analysis. Alternatively, these institutions may understand this concept yet choose to ignore it because the

required increases in water rates and reduction of water use could negate the need for the LPP.

There are also elementary errors in the spreadsheet computer coding, giving rise to an incorrect number of repayment periods in several instances, and to incorrect treatment of the final year of the repayment plan.

Given the flaws of the WCWCD model, we stand by the model in our 2015 analysis, warning of significant water rate and impact fee increases. However, that model should only be a starting point for a comprehensive analysis of southwest Utah's water needs, including not only more sophisticated economic analysis but also geographical study of changing land use patterns, demographic modeling and its implications for real estate development, close study of future water use in agriculture, and reconsideration of using property taxes to partially fund water districts.

Thank you for the opportunity to participate in this discussion.

Sincerely,

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January 10, 2017

Dear Governor Hebert, President Niederhauser, and Speaker Hughes:

We have carefully investigated the claims raised in the letter and accompanying report which the Washington County Water Conservancy District ("the District") sent to you on Sept. 28, 2016 concerning the economic burden of the Lake Powell Pipeline ("LPP"), and found them completely without merit. Nothing in the District's letter changes our opinion that the District's financial model only has the District repaying 28% of Utah taxpayers' costs, nor our opinion that the District would have to dramatically increase water rates and/or impact fees in Washington County in order for state taxpayers to be repaid the LPP costs. We have attached a full analysis but our conclusions can be summarized quite briefly.

The District's strangest claim is that we underestimated "actual" water rates by 430% because we said the current water price per 1000 gallons is $0.45 whereas the St. George average retail price is $2.40. The Washington County Water Conservancy District is, as it surely knows, a water wholesaler, which receives $0.45 per 1000 gallons as we stated. The City of St. George is a water retailer which has nothing to do with the Lake Powell Pipeline, so the financial details of its water sales are completely irrelevant to the LPP. Why the District thinks the financial status of a completely independent governmental body is pertinent to the District's ability to repay the LPP is a mystery.

The District also complains that we assume the LPP will cost what the Utah Board of Water Resources said in 2012 the LPP will cost—a complaint hardly worth addressing, except to note that the LPP will almost surely cost *more* than its 2012 estimate. The

District complains that we called their financial analysis a "model," as if the word we called it mattered; and anyway, the consultant who built it for them called it a "model" as well. Finally, the District feels the fall in water demand which we project is unrealistically large. We did not conduct our analysis based on 'feelings' but on the results of many of studies of water demand, which predict that if water prices really were to go up by 576% then the demand for water really would fall by the amount we specified. The District writes that that estimate "is misplaced given water is an essential human commodity," but it is a water consumption level higher than the one that currently exists in San Francisco, California, a city which supports a vibrant economy.

The detailed analysis follows.

Sincerely,

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Detailed Response to the WCWCD's letter of 9/28/2016

Each item below starts with a quotation from the District's letter. Our response follows.

1. *"The district will repay the costs of the Lake Powell Pipeline, including the "reimbursable preconstruction costs, construction costs, and interest on those costs within the time period specified" in accordance to the terms of the Lake Powell Pipeline Development Act (Utah Code 73-28-403) and will pay operations and maintenance costs, as outlined in Utah Code 73-28-404."*
   The District paid hundreds of thousands of dollars for a financial model that included neither repayment of interest on the State's bonds nor operations and maintenance expenses. Anyone who doubts this is welcome to see for themselves by obtaining the District's model from the Internet, where we have posted it (in its original, uncorrected form) at `http://content.csbs.utah.edu/~lozada/Research/WCWCD%20Model%2011%20November%202013%20Meeting%20%28Working%20Draft%29.xlsx`.

2. *"The professors, in coordination with the Utah Rivers Council, are misrepresenting an interactive worksheet prepared for a 2013 focus group exercise as a 'district model' or 'repayment plan.' "*
   The District claims the repayment model they created through a paid consultant was not a repayment 'model' but instead simply an 'exercise' to educate the local community. The analysis is not dependent on what word is used. We used the word "model" to describe the District's spreadsheet. The District's consultant used exactly the same word in the public presentation at the District headquarters held on Nov. 21, 2013. This meeting of the District's "Community Integrated Resource Planning Advisory Committee" ("CIRPAC") was recorded and can be seen on YouTube. The District's consultant used the word "model" to describe his work at minutes 2:40 and 11:40 of Part 7 of the video (`https://www.youtube.com/watch?v=TwVXUXsrSZI`) and minutes 00:59 and 2:45 of Part 8 of the video (`https://youtu.be/oQUVq70Fs7g`). We suggest you watch these videos for yourself to determine whether the District presented to the community their document as a repayment model.

   Furthermore, when the District's consultant told the public and the news media that the pipeline would cost water users "about $52 per year," the District's spreadsheet was used in exactly the same manner as we have used ours: both are financial models to approximate the pipeline's repayment burden given various assumptions on costs, interest rates, and other data.

3. *"The claim that the district will only pay for '28 percent' of the project cost is the result of misuse of the worksheet."*
   The claim that the district will only pay for "28 percent" of the project cost is the result of the worksheet's omission of interest payments.

4. *The project cost used in the worksheet ($969 million) was the anticipated cost to the district based on the then-current estimate of the Utah Division of Water*

Resources, excluding the portion of costs for Kane County Water Conservancy District.

The repayment problems would not be eliminated with the District's number. Furthermore, our estimates came from the Utah Board of Water Resources' February 2, 2012 *Modified Draft Study Report 10: Socioeconomics and Water Resource Economics*, page 5-3 and 5-6 (excluding the portion of costs for Kane County Water Conservancy District, and adjusted for timing as described in tab "DSWRESR" of our speadsheet). This document obviously existed when the District's worksheet was made in 2013.

5. *The professors' analysis claims Washington County residents currently pay $0.45 per 1,000 gallons of water and that paying for the pipeline would necessitate 'raising water rates by more than 570 percent.' In fact, the average residential water user in St. George (the county's largest population center) currently pays an average of approximately $2.52 per 1,000 gallons of water. Adjusting for a conservative average water cost for all consumers (residential and non-residential) of $2.40 per 1,000 gallons, the professors underestimated actual water rates by approximately 430 percent (see appendix item C)."*

   We underestimated nothing. We used the wholesale price. The District wants to use the retail price. But the District is a wholesaler. It does not get the retail price. The retail price belongs to the retailer, not to the District. So the retail price has nothing to do with the District's ability to repay anything. The District is comparing apples to oranges.

   Either the District actually thinks it can spend money received from water sales by the City of St. George, or it does not. If it does not, then the District is making mistakes analyzed in this letter's Appendix. If it does, that constitutes a disturbing claim that raises major questions about the ability of the District and its consultants to understand that the basic concepts of debt, borrowing and repayment imply that the District cannot spend money that is not theirs, and that the retail price of the water collected by the City of St. George is not available to the District, which is a totally separate agency regardless of the fact that it also happens to be a water supplier. The Comprehensive Annual Financial Report for the City of St. George for the fiscal year 2014 indicates that St. George collected $18 million in revenues through its water sales, but that the costs of its water deliveries were $14 million. If the District is implying that these net revenues are available to the District for its own debt payments, the appropriate response shock and dismay.

6. *Based on the claim that water rates would increase 570 percent, the professors applied a 'law of demand' calculation that assumes water demand will decrease 5 percent for every 10 percent increase in the price (see appendix item C). This formula leads to the insupportable claim that water demand in Washington County would be 8 percent lower than it was in 2010 despite a population increase of more than 250 percent (Governor's Office of Management & Budget, 2012 Baseline Projections). Per capita water use will continue to decrease in the future with*

improved conservation, new technology and a larger/denser population; however, we must be realistic about water use in our planning efforts. The professors project a future water use that has not been achieved to date in any community in the nation."

The assumption that water will decline by 5% for every 10% increase in the water price is based studies of actual water use, including water use in Utah. An exhaustive list of these studies was provided in Appendix H (pages 30–44) of our original report of Fall 2015 (`http://content.csbs.utah.edu/~lozada/Research/2015_LPP_Economic_Analysis.pdf`). The 2014 Audit of Division of Water Resources called attention to the need to relate water and price.

Water use in our analysis is forecast to go down to 53 gallons per capita per day ("GPCD") by 2060 in the "low-cost" scenario (little pumped storage) with half the costs obtained from water rates. In September 2014, GPCD was less than 50 in the California cities of Santa Cruz and San Francisco, and "Australian households use an average of 54 GPCD for both indoor and outdoor uses. . . [having] decreased their water use dramatically in response to a decade of drought[1]." The forecast is not unreasonable, especially in the context of the 576% increase in water rates needed to pay for the pipeline.

7. *"District rates will increase as the costs to deliver, treat and store water increase. The use of the asserted demand price inflation formula is misplaced given water is an essential human commodity."*

   We agree that water is an essential human commodity: however, the many uses to which water is put by humans are not all essential. Washington County's water use in gallons per capita per day is one of the highest in the nation.

The District's final paragraph assures the reader that the District is committed to determining whether or not it can repay the pipeline *after* it spends many million dollars designing the pipeline. It seems that a prudent agent would instead determine what the District could afford *before* spending large sums of money on a design which might be unaffordable. If the District ever decides to engage in prudent planning, it is welcome to use our model, which we have provided to anyone free of charge, as its starting point.

[1] `http://pacinst.org/new-data-show-residential-per-capita-water-use-across-california/`.

Appendix: Wholesale and Retail Demand Curves with Markup Pricing
by Gabriel A. Lozada

We did not consider retail water rates because they are irrelevant: retail water providers will not be repaying the pipeline. Nevertheless, retail water rates are the most substantive part of the District's response and the sole concern of its accompanying document "The Relationship Between Water Cost and Water Prices: A Review and Analysis of Errors Identified in Utah Professors' Analysis of the Lake Powell Pipeline Project," so an in-depth response is warranted.

Refer to p. 31 of the District's accompanying document. The gray line is the wholesale demand for water, which we used in our calculations. The District points out that the retail demand for water is the blue line, which lies above the gray line. For example, as they point out, if the wholesale price of water is \$0.45 per thousand gallons, then the retail price is much more, \$2.40 per thousand gallons according to them. In the diagram, we only considered the \$7.2 million raised at the wholesale level, not the \$38.8 million raised at the retail level. But this was no oversight, or "underestimate," on our part. The District has to pay back the pipeline, and it only gets (in this example) \$7.2 million. The rest of the \$38.8 million does not belong to the District: it belongs to someone else (the water retailer). So the rest of the \$38.8 million is irrelevant to repaying the pipeline. Taking it into account would be a significant overestimate of the amount of money available to the District for repayment.

The difference between \$2.40 and \$0.45 reflects a "markup" of $2.40/0.45 - 1 = 433\%$ between the wholesale price and the retail price. In other words, to get the retail price from the wholesale price, one would multiply \$0.45 by $1 + 433\%$, which is $\$0.45 \times (1 + 4.33) = \$0.45 \times 5.33 = \$2.40$. Conversely, to get the wholesale price from the retail price, one would divide the retail price, \$2.40, by 5.33, getting $2.40/5.33 = 0.45$.

Now consider p. 33 of their document. On that page, the District calculates how to raise an additional \$50.2 M − \$38.8 M = \$11.4 M (or \$11.5 M with rounding). They claim \$50.2 M can be raised along the blue line: at a price of \$4.02 per thousand gallons, 12.4 B gallons of water are sold and \$50.2 M is received by the retailer. True: but how much of that would be received by the District, which is the entity that needs the \$50.2 M? Only \$9.4 M (which is $\$0.75 \times 12.48$). The reason is that if the markup stays at 433%, then the \$4.02 retail price corresponds to a $\$4.02/5.33 = \$0.75$ wholesale price. That is the price per gallon which the District would get—and it is on the gray line (as one can see by inspecting the height of the gray line along the left-hand vertical dashed red line: it is \$0.75). So we are back to where we began: the gray line is relevant. The blue line is a red herring.

The District then implies that even if our wholesale model is correct, the associated retail-level price changes would be more gentle. That is not right either. The District writes (in its letter, not in the accompanying report) that water rates per thousand gallons at the wholesale level are \$0.45 and at the retail level are \$2.52, a markup of approximately 430%. If wholesale water rates have to increase by 576%, as in one of the situations mentioned in our 2015 letter to you, then with a fixed markup the retail water

rates would have to increase by *exactly the same 576%*. This is simply because if

$$\begin{aligned}
\text{old retail price} &= (1 + 430\%) \times \text{old wholesale price}, \qquad \text{and if} \\
\text{new wholesale price} &= 576\% \times \text{old wholesale price}, \qquad \text{then:} \\
\text{new retail price} &= (1 + 430\%) \times \text{new wholesale price} \\
&= (1 + 430\%) \times 576\% \times \text{old wholesale price} \\
&= 576\% \times \text{old retail price}\,.
\end{aligned}$$

Furthermore, with the above figures, prices would rise to $\$0.45 \times (1 + 576\%) = \$3.04$ at the wholesale level and to $\$2.52 \times (1 + 576\%) = \$17.04$ at the retail level, so that in terms of "dollars per gallon" rather than percentages, the required retail price changes are not *less* than the required wholesale price changes but *more* than the required wholesale price changes. We conclude that the net result of the District's letter of September 28 is to strengthen the case we made to you in our previous letters.

In summary, if the wholesale price of water goes up by "x" percent, if the markup stays the same then the retail price of water will also go up by "x" percent. So the water price percentage increases we reported are apply equally to the retail and the wholesale level.

The distinction between wholesale and retail data does raise a potential technical issue which the District did not point out. The section below ends this Appendix by analyzing that technical issue and proving that our original analysis was correct, assuming a fixed markup.

If the markup is *not* fixed, a more complicated analysis would have to be performed. We have not performed this analysis, and neither has the District. The District says nothing about the markup being fixed or not, but if it thinks the markup is not fixed, it should extend our model to cover that case.

Wholesale and Retail Demand Curve Shapes with Markup Pricing

We assumed before, on the basis of strong empirical evidence which we specified in detail in our report of 2015, that

$$Q \propto P^{-1/2}$$

where Q is the quantity of water sold and P is its price (the symbol $\propto$ means "is proportional to"). The following question could be raised: if this relationship holds at the *retail* level, what is the relationship between *wholesale* quantity and price?

Proposition. *If $Q \propto P^{-1/2}$ at the retail level, and retail price is a constant markup over wholesale price, then $Q \propto P^{-1/2}$ at the wholesale level as well.*

Proof. Clearly $Q_{retail} = Q_{wholesale} = Q$. With markup pricing,

$$P_{retail} = (1+m)\, P_{wholesale} \tag{1}$$

where m represents the markup.

One can rewrite the assumption that $Q_{retail} \propto P_{retail}^{-1/2}$ using c as the constant of proportionality:

$$Q_{retail} = c\, P_{retail}^{-1/2}\,.$$

Then

$$\begin{aligned} Q_{wholesale} &= Q_{retail} = c\,P_{retail}^{-1/2} = c\,[(1+m)\,P_{wholesale}]^{-1/2} \\ &= c\,(1+m)^{-1/2} \cdot P_{wholesale}^{-1/2} \\ &= \hat{c}\,P_{wholesale}^{-1/2} \end{aligned}$$

for $\hat{c} = c\,(1+m)^{-1/2}$. ∎

It follows that even though our data is from the wholesale level, it is still true that $Q \propto P^{-1/2}$. The constant of proportionality between the left-hand side and the right-hand side is different in the retail versus the wholesale markets, but since we have data both on $Q_{wholesale}$ and on $P_{wholesale}$, we can (and did) solve for the correct constant of proportionality, called $\hat{c}$ above.