



System and Process for Assessing Water Use of Land Use Decisions One Water Solutions Institute-Colorado State University

November 2019 Board Meeting

Water Plan Grant Application



L O C A T I O N	
County/Countries: Larimer; Weld; Adams; Jefferson	
Drainage Basin:	South Platte; Metro

D E T A I L S	
Total Project Cost:	\$298,549
Water Plan Grant Request:	\$149,249
Recommended Amount:	\$149,249
Other CWCB Funding:	\$0
Other Funding Amount:	\$69,500
Applicant Match:	\$79,800
Project Type(s): Other- Long-term operational technology solution that integrates land and water planning	
Project Category(Categories): Conservation and Land Use Planning	
Measurable Result: 246,000 Coloradans impacted by incorporating water saving actions into Land use planning	

Increasing gaps between water supply and demand in Colorado necessitate a holistic approach to water planning and management. Many cities and water utilities are faced with new types of urban land developments with unknown water use implications that require extensive investigation.

The proposed work aims to streamline assessment and communication of water use implications given land development plans through both modeling and analysis of metered water use data within utilities throughout Colorado. Key steps of the work plan are to:

1. Interview partnering utilities and develop a report of results
2. Link metered water use with land use plans within a state-of-the-art, cloud-based, and collaborative municipal water modeling and geospatial information system (<http://erams.com/iuwm>), and
3. Automate report generation for simplifying both internal and external communication processes in partnering cities and utilities.

The proposed project advances the conservation and land use goals of the Colorado Water Plan by providing the technical tools necessary to streamline evaluation of land use impacts on water use, and consequently the feedback mechanisms that naturally incentivize conservation: the cost of water to support new development. The City of Westminster, East Larimer County Water District, Northern Weld County Water District, and Fort Collins-Loveland Water District will benefit directly through participation in this project. They will integrate land and water planning by evaluating and improving inter- and intra-departmental communication processes during comprehensive planning efforts. This directly impacts 246,000 (4.4% of Colorado) people who live in the partnering city and utility boundaries by addressing some of the primary drivers of water use: land use, zoning, and growth management.

The resulting web-based system will accelerate water use calculations for various land use types throughout the northern front range region. Indirectly, this effort will incentivize conservation by speeding analysis of the actual historical water use data that could concretely illustrate the conservation potential (or lack thereof) of various land and demographic areas.



Last Updated: July 2019

Colorado Water Conservation Board

Water Plan Grant Application

Instructions

To receive funding for a Water Plan Grant, applicant must demonstrate how the project, activity, or process (collectively referred to as “project”) funded by the CWCB will help meet the measurable objectives and critical actions in the Water Plan. Grant guidelines are available on the CWCB website.

If you have questions, please contact CWCB at (303) 866-3441 or email the following staff to assist you with applications in the following areas:

Water Storage Projects
Conservation, Land Use Planning
Engagement & Innovation Activities
Agricultural Projects
Environmental & Recreation
Projects

Anna.Mauss@state.co.us
Kevin.Reidy@state.co.us
Ben.Wade@state.co.us
Alexander.Funk@state.co.us
Chris.Sturm@state.co.us

FINAL SUBMISSION: Submit all application materials in one email to

waterplan.grants@state.co.us

in the original file formats [Application (word); Statement of Work (word); Budget/Schedule (excel)]. Please do not combine documents. In the subject line, please include the funding category and name of the project.

Water Project Summary

Name of Applicant	One Water Solutions Institute - Colorado State University	
Name of Water Project	System and Process for Assessing Water Use of Land Use Decisions	
CWP Grant Request Amount		\$149,249
Other Funding Sources <u>Partner Utilities</u>		\$69,500
Other Funding Sources _____		\$0
Other Funding Sources _____		\$0
Applicant Funding Contribution		\$79,800
Total Project Cost		\$298,549



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Applicant & Grantee Information
Name of Grantee(s) Colorado State University
Mailing Address 2002 Campus Delivery
FEIN 293183
Organization Contact Linda Loing
Position/Title Research Administrator
Email linda.loing@colostate.edu
Phone 970-491-6586
Grant Management Contact William Moseley
Position/Title Interim, Senior Research Administrator
Email bill.moseley@colostate.edu
Phone 970-491-1541
Name of Applicant (if different than grantee)
Mailing Address
Position/Title
Email
Phone
Description of Grantee/Applicant
Provide a brief description of the grantee's organization (100 words or less).
Colorado State University is a land grant university that is one of the top schools in Colorado and the United States for water resources research. The Civil and Environmental Engineering Department has been awarded several projects advancing the field of water resources through federally funded grants to local public-private partnerships. Within the Department of Civil and Environmental Engineering is the Colorado Stormwater Center (CSC). The CSC provides stormwater-related education, training and research for maintaining and improving healthy water bodies through proper stormwater management. The CSC prides itself on building relationships with Colorado municipalities to collectively develop solutions for stormwater problems.



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Type of Eligible Entity (check one)	
<input checked="" type="checkbox"/>	Public (Government): Municipalities, enterprises, counties, and State of Colorado agencies. Federal agencies are encouraged to work with local entities. Federal agencies are eligible, but only if they can make a compelling case for why a local partner cannot be the grant recipient.
<input type="checkbox"/>	Public (Districts): Authorities, Title 32/special districts (conservancy, conservation, and irrigation districts), and water activity enterprises.
<input type="checkbox"/>	Private Incorporated: Mutual ditch companies, homeowners associations, corporations.
<input type="checkbox"/>	Private Individuals, Partnerships, and Sole Proprietors: Private parties may be eligible for funding.
<input type="checkbox"/>	Non-governmental organizations (NGO): Organization that is not part of the government and is non-profit in nature.
<input type="checkbox"/>	Covered Entity: As defined in Section 37-60-126 Colorado Revised Statutes .

Type of Water Project (check all that apply)	
<input type="checkbox"/>	Study
<input type="checkbox"/>	Construction
<input type="checkbox"/>	Identified Projects and Processes (IPP)
<input checked="" type="checkbox"/>	Other – Long-term operational technology solution that helps integrate land and water

Category of Water Project (check the primary category that applies and include relevant tasks)		
<input type="checkbox"/>		
<input type="checkbox"/>	Water Storage - Projects that facilitate the development of additional storage, artificial aquifer recharge, and dredging existing reservoirs to restore the reservoirs' full decreed capacity and Multi-beneficial projects and those projects identified in basin implementation plans to address the water supply and demand gap.. <i>Applicable Exhibit A Task(s):</i>	
<input checked="" type="checkbox"/>	Conservation and Land Use Planning - Activities and projects that implement long-term strategies for conservation, land use, and drought planning. <i>Applicable Exhibit A Task(s):</i>	
<input checked="" type="checkbox"/>	Engagement & Innovation - Activities and projects that support water education, outreach, and innovation efforts. Please fill out the Supplemental Application on the website. <i>Applicable Exhibit A Task(s):</i>	
<input type="checkbox"/>	Agricultural - Projects that provide technical assistance and improve agricultural efficiency. <i>Applicable Exhibit A Task(s):</i>	
<input type="checkbox"/>	Environmental & Recreation - Projects that promote watershed health, environmental health, and recreation. <i>Applicable Exhibit A Task(s):</i>	
<input type="checkbox"/>	Other	Explain:



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Location of Water Project

Please provide the general county and coordinates of the proposed project below in **decimal degrees**. The Applicant shall also provide, in Exhibit C, a site map if applicable.

County/Counties	
Latitude	
Longitude	

Water Project Overview

Please provide a summary of the proposed water project (200 words or less). Include a description of the project and what the CWP Grant funding will be used for specifically (e.g., studies, permitting process, construction). Provide a description of the water supply source to be utilized or the water body affected by the project, where applicable. Include details such as acres under irrigation, types of crops irrigated, number of residential and commercial taps, length of ditch improvements, length of pipe installed, and area of habitat improvements, where applicable. If this project addresses multiple purposes or spans multiple basins, please explain.
The Applicant shall also provide, in Exhibit A, a detailed Statement of Work, Budget, Other Funding Sources/Amounts and Schedule.

Many cities and water utilities are faced with new types of land developments with unknown water use implications that require extensive investigation. The proposed work aims to streamline assessment and communication of water use implications given land development plans through both modeling and analysis of metered water use data within utilities throughout Colorado. Key steps of the work plan are to:

1. Interview partnering utilities and develop a report of results, L
2. Link metered water use with land use plans within a state-of-the-art, cloud-based, and collaborative municipal water modeling and geospatial information system (<http://erams.com/iuwm>), and
3. Automate report generation for simplifying both internal and external communication processes in partnering cities and utilities.

In addition to benefiting from the tool directly in planning processes, utilities can also choose to share summarized water use information with other cities in need of understanding water use implications of similar development patterns. Benefits of the tool will be spread across 246,000 (~4.4%) residents of Colorado within the 4 utilities (one with land use authority, three without) that will be partnering with Colorado State University in the proposed work.



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Measurable Results

To catalog measurable results achieved with the CWP Grant funds, please provide any of the following values as applicable:

	New Storage Created (acre-feet)	
	New Annual Water Supplies Developed or Conserved (acre-feet), Consumptive or Nonconsumptive	
	Existing Storage Preserved or Enhanced (acre-feet)	
	Length of Stream Restored or Protected (linear feet)	
	Efficiency Savings (indicate acre-feet/year OR dollars/year)	
	Area of Restored or Preserved Habitat (acres)	
	Quantity of Water Shared through Alternative Transfer Mechanisms	
246,000 (~4.4%)	Number of Coloradans Impacted by Incorporating Water-Saving Actions into Land Use Planning	
~200,000 in 3-5 years	Number of Coloradans Impacted by Engagement Activity	
4 diverse stakeholders	Other	This is an innovation directly impacting land-water integration in a city with both land authority and a water utility, and then also in three smaller utilities with no land use authority.

Water Project Justification

Provide a description of how this water project supports the goals of [Colorado's Water Plan](#), the most recent [Statewide Water Supply Initiative](#), and the applicable Roundtable [Basin Implementation Plan](#) and [Education Action Plan](#). The Applicant is required to reference specific needs, goals, themes, or Identified Projects and Processes (IPPs), including citations (e.g. document, chapters, sections, or page numbers).

The proposed water project shall be evaluated based upon how well the proposal conforms to Colorado's Water Plan Framework for State of Colorado Support for a Water Project (CWP, Section 9.4, pp. 9-43 to 9-44;)

City planners in Colorado are facing some critical challenges to maintain highly reliable water supply as growth occurs rapidly. Competition for water has grown as evidenced by a quickly rising price of water and agricultural land out of production (Dozier et al. 2017). Colorado's Water Plan (CWP) projects an unmet need of 196,000 acre-feet per year of water in 2050 in the South Platte River Basin (i.e., 17% of total water needs), and similar results for other basins throughout Colorado. Rough calculations of future water supply needs can often lead to significant overestimation and consequently oversizing expensive new water supply projects and treatment facilities, leading to both wasteful spending and water use. In response to this, Colorado's Water Plan aims to achieve 400,000 acre-feet in conservation and have 75% of Coloradans living in communities that have integrated water planning with land use planning (CWP, Section 10.2, p. 10-5).

Water management involves multiple types of water agencies. Increasing gaps between water supply and demand in Colorado, along with other water challenges, necessitate a holistic approach to water planning and management, and a complete understating of the connections between drinking water, wastewater, stormwater, and natural systems. A key consideration in addressing challenges identified in the Colorado's Water Plan is the location or design of urban development. Urban development patterns are not controlled by water managers who support effective and efficient water solutions.

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The proposed project advances the conservation and land use goals of the Colorado Water Plan by providing the technical tools necessary to streamline evaluation of land use impacts on water use, and consequently the feedback mechanisms that naturally incentivize conservation: the cost of water to support new development. The work will help to directly integrate land planning with water planning by studying and addressing communication needs and processes between city planning departments and the water utility during comprehensive planning efforts. This directly impacts 246,000 (4.4% of Colorado) people who live in partnering city and utility boundaries by helping the primary driver of water use: land use, zoning, and growth management (SPBIP, Section 4.3.1, p. 4-23).

The resulting web-based system will accelerate water use calculations for various land use types experienced throughout a region, enabling water utilities to focus less on technical details and more on the critical aspects of their work to more cost-effectively serve their customers. Indirectly, this effort will incentivize conservation by speeding analysis of the actual historical water use data that could concretely illustrate the conservation potential (or lack thereof) of various land and demographic areas. Although it is unknown what this conservation potential is currently, given the scale and extent of the proposed project, a potential volume of municipally conserved could be estimated more accurately than other studies have been able to in the past (Dozier et al. 2017).

The South Platte Basin implementation plan aimed to lead conservation efforts across the state. Upon successful completion of the proposed project, the impact of the system on land use plans can be used to measure the resulting effect on conservation. The technology within this proposal will certainly set cities within the South Platte River Basin apart as a leader of demand management.

This project engages a variety of stakeholders primarily city planners and water utility managers, another important facet of the Colorado Water Plan (CWP, Section 9.4, pp. 9-41). There are 4 partnering municipalities and water utilities, each matching some cash contribution to the project. This initial interest and buy-in from stakeholders indicate that this is a financially sustainable project beyond grant funding because of its commercial potential.

Related Studies

Please provide a list of any related studies, including if the water project is complementary to or assists in the implementation of other CWCB programs.

Researchers from Colorado State University that are leading this grant have performed basic research on urban water use and management practices supported by the National Science Foundation and U.S. Department of Agriculture (Dozier et al. 2017; Sharvelle et al. 2017). The resulting model, the Integrated Urban Water Model (IUWM) was adapted and applied to multiple utilities, including Denver Water, Miami, and Broward County, FL. IUWM also aided assessment of alternative water sources for the National Western Center (Connor et al. 2017). The proposed project advances this previous research by integrating metered water use within the system. The approach aims at commercializing the technology to support its valuable benefits to cities in a financially sustainable manner.

Denver Water performed a detailed study of their own system to build a spreadsheet model of use for other cities. The currently proposed project expands on the work performed by Denver Water, by providing an automated, web-based system to deliver city-specific findings on the linkages between land and water uses. Live reports will be a modified version of the Keystone Policy Center and Denver Water spreadsheet model (developed as part of the Colorado Water and Growth Dialogue, <https://www.keystone.org/our-work/energy-environment-climate/colorado-water-and-growth-dialogue/>) that is uniquely calibrated to the water uses observed at each individual city.



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Westminster has developed a manual process to link water use with land use planning that has historically worked well within the boundaries of their organization. Aurora Water has studied the impacts of landscape codes on their own water use through the Colorado Water and Growth Dialogue (report pending) and discovered that volunteer-based and educational landscape rebate programs were very effective in dropping individual water use. Aurora's work utilized metered water use for various land uses across Aurora, controlling for weather and different customer types. The system resulting from this work aims at automating this process to make updates to various planning processes and utility studies as easy as possible.

Connor, T., Sharvelle, S., Arabi, M., Dozier, A., Surendran, A. N. T., and Dell, T. (2017). Phase 1 Sustainability Review of National Western Center: One Water Considerations.

Dozier, A. Q., Arabi, M., Wostoupal, B. C., Goemans, C. G., Zhang, Y., and Paustian, K. (2017). "Declining agricultural production in rapidly urbanizing semi-arid regions: Policy tradeoffs and sustainability indicators." *Environmental Research Letters*, 12(8).

Sharvelle, S., Dozier, A., Arabi, M., and Reichel, B. (2017). "A geospatially-enabled web tool for urban water demand forecasting and assessment of alternative urban water management strategies." *Environmental Modelling & Software*, 97, 213–228.

Previous CWCB Grants, Loans or Other Funding

List all previous or current CWCB grants (including WSRF) awarded to both the Applicant and Grantee. Include: 1) Applicant name; 2) Water activity name; 3) Approving RT(s); 4) CWCB board meeting date; 5) Contract number or purchase order; 6) Percentage of other CWCB funding for your overall project.

N/A

Taxpayer Bill of Rights

The Taxpayer Bill of Rights (TABOR) may limit the amount of grant money an entity can receive. Please describe any relevant TABOR issues that may affect your application.

Not applicable as the applicant is aware.



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Submittal Checklist	
	I acknowledge the Grantee will be able to contract with CWCB using the Standard Contract .
Exhibit A	
x	Statement of Work ⁽¹⁾
x	Budget & Schedule ⁽¹⁾
	Engineer's statement of probable cost (projects over \$100,000)
x	Letters of Matching and/or Pending 3 rd Party Commitments ⁽¹⁾
Exhibit C	
	Map (if applicable) ⁽¹⁾
	Photos/Drawings/Reports
	Letters of Support (Optional)
	Certificate of Insurance (General, Auto, & Workers' Comp.) ⁽²⁾
	Certificate of Good Standing with Colorado Secretary of State ⁽²⁾
	W-9 ⁽²⁾
	Independent Contractor Form ⁽²⁾ (If applicant is individual, not company/organization)
Engagement & Innovation Grant Applicants ONLY	
	Engagement & Innovation Supplemental Application ⁽¹⁾

(1) Required with application.

(2) Required for contracting. While optional at the time of this application, submission can expedite contracting upon CWCB Board approval.

Colorado Water Conservation Board

Water Plan Grant - Exhibit A

Statement Of Work

Date:	7/29/2019
Name of Grantee:	One Water Solutions Institute - Colorado State University (CSU)
Name of Water Project:	A System and Process for Assessing Water Use of Land Use Decisions
Funding Source:	Colorado Water Plan Grant: Conservation & Land Use Planning and Engagement & Innovation Activities

Water Project Overview:

Many cities and water utilities are faced with new types of land developments with unknown water use implications that require extensive investigation, while attempting to balance reliable but expensive new supply developments with cheaper but uncertain demand reductions (Dozier et al. 2017). The proposed work seeks to streamline assessment and communication of water use implications given land development plans within cities and utilities in Colorado. This proposal leverages more than a decade of research and development from Colorado State University on a state-of-the-art modeling and geographical information system (GIS) framework to serve the needs of water utilities by exposing dependencies of water use on land use in addition to population, weather, behavior, and technology (Sharvelle et al. 2017). The process and associated cloud-based software-as-a-service, **Joseph**, that will be developed from this work is expected to streamline communication between water and land planners by providing a mechanism to quickly assess, understand, and report water use for comprehensive plans, master plans, and other planning activities across a city or utility service area.

Joseph will utilize metered water use data from a utility's own service area to simulate water use of new developments similar to existing developments with historically metered water use. Joseph will be built on the eRAMS, which is a platform for geospatial application development that provides collaborative and visual enhancements. A complementary open-source tool, the Integrated Urban Water Model (IUWM), developed by the grant applicants will be incorporated into this effort. IUWM offers assessment capacity for future management shifts in use and reuse of alternative sources of water in addition to modeling indoor, outdoor, residential, and commercial uses (Sharvelle et al. 2017). New data integration capacities will be developed that tightly integrate advancements from IUWM while supporting further development and benefits of cloud-based hosting using a subscription-based business model.

Key steps to advance the project towards its goal are to engage stakeholders from the very beginning in the design and direction of Joseph. The work plan is to:

1. Interview partnering cities and develop a report of results,
2. Link metered water use with land use plans within a state-of-the-art, cloud-based, and collaborative municipal water modeling and geospatial information system (<http://erams.com/iuwm>),
3. Automate report generation for simplifying both internal and external communication processes in partnering cities and utilities,
4. Integrate partnering utility water use data into Joseph, and
5. Report on the results.

Utilities will benefit from the tool directly in planning processes and will also be able to investigate phenomena, gather data insights, and answer data requests much more cost-effectively. Regional collaborations can be realized through Joseph because of its proposed web-based and collaborative features. If a city has not experienced a certain type of land development, but a neighboring city has, they can quickly summarize and share non-sensitive information.

Benefits of the design, development, and deployment of Joseph will be spread across 246,000 (~4.4%) residents of Colorado within the partnering utilities. Out of the 4 utilities, one has land use authority, Westminster, and three do not have land use authority, East Larimer County Water District (ELCO), North Weld County Water District (NWCWD), and Fort Collins-Loveland Water District (FCLWD). The mix of utility management types is an asset to this project because the disparity between land use authority and water utilities is a challenge to integrating land and water for many throughout Colorado.

The project is scheduled to start in September 2019 and end by August 2021. CSU will be leading the work, retrieving design requirements for the project, writing the reports, and developing the backend data integration and analysis system. CSU will provide the eRAMS platform on which the proposed system will be built and reside in the cloud. CSU will also provide developer support to design and build interface elements and plugins within the eRAMS platform for Joseph. CSU will make the tool available as open source to benefit cities throughout Colorado and globally by providing a well-supported, enterprise-level product initially developed within a university research setting. Modeling advancements of IUWM such as additions and uses of alternative and local water sources for a variety of end uses will carry over into the Joseph software system. The project team will leverage extensive experiences with the development of similar tools for effective and efficient planning and management of water systems.

Milestones have been outlined for the project that identify the primary tasks and sub-tasks to complete the project (see Budget spreadsheet), which is also found in the budget and schedule spreadsheet. Milestones and timeline (Table 1) come with a mix of deliverables involving reports, quarterly workshops, and the software product itself.

Table 1. Scheduled completion of primary milestones and total costs

Milestone	Scheduled Completion
1a - Interview partnering cities	October 31, 2019
2a - Develop robust web services for interacting with water use data	March 31, 2020
2b - Utilize GIS capabilities of eRAMS to display interactive maps	May 30, 2020
2c - Build visualizations of water and land use data in various forms	July 31, 2020
2d - Automate water use validation and prediction mechanisms	September 30, 2020
3a - Build a report generator	November 30, 2020
4a - Collect data from necessary departments/cities	February 28, 2021
4b - Build data converters for city partners	May 30, 2021
4c - Calibrate and demonstrate system capacity with utility data	July 15, 2020
5a - Reporting	August 30, 2021

If primary tasks are completed under budget, additional “stretch” milestones will be achieved that add value to the project in integrating land and water planning within utilities:

Stretch 1 - Build a public facing capacity to check assumptions of negotiated tap fees

- Build interface that lists assumptions and calculations, check against user's

Stretch 2 - Estimate average daily demand, peak daily demand, peak hour

- Integrate AMI data or produced water meters
- Build web services and interface to display metrics within reports

Stretch 3 - Add auto-calibration feature to Joseph-IUWM on eRAMS

- Web service to run and throttle jobs
- Web interface to manage running calibration

Stretch 4 - Incorporate geospatial water infrastructure information

- Streamline geospatial queries to determine proximity and intermediate properties

Outlining the Benefit to the State of Colorado

This project offers benefit to the State of Colorado in a variety of ways. All of the \$99,371 of CWCB grant funds go toward open-source and publicly available documents and software development (Table 1).

Results of the study, publicly available documents, and open-source tools offer the state the following benefits:

1. Use of the tool provides helpful insights directly to utilities and constituents
 - a. By the end of the project, more than 200,000 Coloradans will be served by a water utility that has streamlined its process of assessing water demands for land use decisions and plans, benefiting from reduced time and money in regular planning processes
 - b. Utilities that use the software will benefit from being able to more accurately and adaptively plan for water resource implications as land developments occur with increasingly specialized designs and unique projects, which will result in conserved water for the State and affordability for water rate payers
2. Publicly-available reports
 - a. A public report will be delivered as an output of this work discussing the methods and results of interviews with participating utilities that provides insight into a useful process and steps on how to project water demands from land use and development plans (in either type of water utility – one with land use authority and one without)
 - b. Progress and final reports will outline schematics of data and software systems that demonstrate how to implement a software system like this in a new utility
3. Publicly-available tools
 - a. Coordinating efforts with Colorado State University a state institution and land grant university to build generic visualization interfaces into the open-source software tool called the Environmental Resource Assessment and Management System (found at <http://erams.com>) or its rebranded open-source system eRAMS.
 - b. Automated conversion tools will be developed and documented to extract, transfer, and load metered water use data into a unified data warehouse system that could be used for further geospatial and temporal analytics
 - c. Updates to the open-source water demand simulation model (the Integrated Urban Water Model, IUWM, found at <http://bitbucket.org/iuwm/iuwm>) will be made to integrate data-based projection methods and better automated calibration routines to be able to handle requirements of projection modeling for partnering utilities given land use plans
 - i. IUWM is publicly and freely available for use and represents the core modeling engine of the primary work being done in this proposed work allowing utilities and the State of Colorado to reproduce this analysis on their own
 - ii. IUWM is a cross-platform Python tool that simulates water use, performs scenario analysis with various management options, and calculates various key performance indicators of sustainable water use
 - iii. IUWM streamlines calculations from spreadsheet-based inputs and outputs including timeseries data, observed data, and geospatially referenced data
 - iv. IUWM simulates use and reuse of various alternative water sources including reclaimed wastewater, stormwater, roof runoff, and recycled graywater
 - v. IUWM allows for various sub-models and methods to be used for each component of simulation
 - d. Analyzes water uses of land zones
 - e. Provides outlined and tracked steps for projecting water demand
 - f. Ensures security of data hosted in the cloud
4. Trainings and workshops
 - a. Results of this work (both reports, knowledge about the process, and the tools) will be disseminated to the participating utilities and any other interested utilities at quarterly workshops

Project Objectives:

The goal of the proposed work is to support municipal water providers with the proper understanding and tools necessary to assess water supply needs given land development plans. Objectives of this work are as follows:

1. Identify key aspects of integrating land and water planning that need to be addressed before effective integration occurs in partnering cities
2. Integrate water use data or calculations within a geographical information system (GIS) that houses comprehensive land use plans for each partnering city, streamlining estimation of water use impacts due to land development decisions
3. Enhance communication between land and water planners through effective reporting of results.

Benefits of this system align with the Colorado Water Plan which aims to have 75% of Coloradans live in communities that have incorporated water-savings actions into their land-use planning (CWP, Section 10.2, p. 10-5). The system helps cities, utilities, and developers understand the water use implications of their land-use plans and streamline their planning and design processes to understand tradeoffs with various management solutions. The system will also support engagement and innovation efforts through engaging 4 diverse utilities in Colorado during project execution.

Tasks

Task 1 – Process identification using in-depth interviews

Description of Task:

The goal of this task is to identify a consistent, standardized process with which to streamline integration of land and water planning. This project focuses on supporting municipal water providers to analyze and project water use implications of land use decisions by providing a supported, cloud-based software tool for implementation of a more integrative approach. Therefore, partnership and interaction with cities and utilities is a vital step in the approach taken herein. In setting up the project, various cities and utilities were asked if they would like to participate on three different levels:

- I. In-Kind Data Partner (\$5,000 cash match)
- II. Full-Service Data Partner (\$15,000 cash match)
- III. UrbanSim Supplement (Add \$5,000 if joining before Aug. 1 and \$10,000 if after)

Services provided by the project team for each level of partnership are listed in Table 2. An in-kind data partner will do more of the work, while a full-service data partner will be providing more of a cost match to enable CSU perform most of the necessary work. For both types of partners, CSU will build, calibrate, and deliver an initial IUWM model for scenario analysis. In the case of full-service data partners, CSU will develop a conversion utility that automatically extracts and adapts raw water use data to a format compatible with IUWM data requirements. Through in-depth interviews CSU will develop the software system to meet the land and water integration needs for each of the cities and utilities. Interviews will inform the data analytics, metrics acquired, and reports generated. For example, utilities may choose a living report in the form of a spreadsheet that could be automatically populated with calibrated data such as the spreadsheet model for residential water use that Denver Water created as a part of the Colorado Water and Growth Dialogue.

Support for Joseph and the underlying cloud system and infrastructure will be provided by the One Water Solutions Institute (OWSI) at CSU. Where simulated land uses and demographic information is desirable, the Denver Regional Council of Governments (DRCOG) will provide future land and population simulations linked within the IUWM system.

Tasks

Table 2. List of services performed by project team for different levels of partnership

Services performed by project team	In-Kind Data Partner	Full-Service Data Partner	UrbanSim Supplement
Joseph support during project execution or 1 year, whichever is larger	✓	✓	
Calibration of IUWM model to historical	✓	✓	
Water use data conversion tool by CSU		✓	
Customized report generator for partner		✓	
Future land, population, and water use projections			✓

Interest in a system or tool like Joseph is peaking throughout cities and utilities of Colorado and the U.S. Partnership levels and the UrbanSim supplement will be available to utilities throughout project execution, but if cities participate after the application deadline (August 1, 2019), they will have to pay the full cost to participate (about double in each level) since the project would no longer have cost matching from the grant opportunity. Thus, the collaboration between CSU and DRCOG will support new analyses and new utilities as needs come up.

Method/Procedure:

All partners will be invited to participate in quarterly workshops for both training and feedback on progression of tool development. Deeper discussions will be performed with each individual city to identify key information that will advance communication in their cities at least twice throughout execution of the project, once at the very beginning and once part of the way through development. These activities will ensure that all partners receive true value from the tool to best serve their needs.

Interviews will consist of a series of questions aimed primarily at understanding the comprehensive and master planning processes to identify points at which water resources planning personnel should play a significant role and what information needs to be communicated. This will inform design of a broader process to aid integration of land planning and water resources planning efforts. Initial interviews will also include mockups of the software system to identify beneficial design features. Interviews performed after some of the system has been developed, demonstrations of the tool will provide further direction as partnering utilities will be given opportunity to provide feedback during the development process. The goal of these interactions is to maximize benefits of an operationalized land and water integration system within utility processes.

Deliverable:

A small report on the results of interviews will be produced at the end of this task. The report will summarize an identified integrated planning process and evaluate the process for two different types of entities: 1) cities with both land use authority and a water utility, and 2) water utilities serving water to communities with land use authority. In this manner, the report could be used and published as a guidance document for cities, utilities, and the resulting web-based software system, Joseph. The vision is to incorporate this identified process as a checklist within the software system to the extent possible. For example, a checklist could include the items:

1. Collect geospatial information that outline existing land uses and planned developments
2. Collect geospatial information identifying water infrastructure and historical water uses
3. Collect water use statistics from existing land areas similar to planned developments

Tasks

4. Apply water use statistics to planned developments for determining water supply needs
5. Estimate costs and feasibility of new water supply and infrastructure
6. Communicate and iterate between land planning and water resources groups

The report will identify more specifics on a process like this example and have some specifics for utilities that are separated from the land use authority.

Tasks

Task 2 – Develop a Generalized System for Data Integration

Description of Task:

The proposed work will develop an understanding of partnering city water use as it relates to current and foreseen land use developments through the various planning processes that cities undertake. To project water demands with more certainty than other approaches, the resulting software system, Joseph, will utilize both the Integrated Urban Water Model (IUWM) which sits in the cloud-based, collaborative geospatial environment, eRAMS (<https://erams.com/iuwm>, Figure 1), and an approach cities and utilities trust more: their own metered water use data.

City water use data and zones of similar land use (“land use areas”) will be uploaded into Joseph, analyses will be performed on the data, and interactive visualizations will provide an easy user interface to results. A spreadsheet model developed by Denver Water through the Colorado Water and Growth Dialogue or a similar model may be used as a generated living report given positive support by partnering utilities through the interview process. Land use areas will be derived from existing land zoning, zoning plans, and comprehensive planning efforts. For partnering utilities that opt in with the UrbanSim supplement, the Denver Regional Council of Governments (DRCOG) will provide future projections of population and employment through analysis provided by UrbanSim. UrbanSim projections will be fed into IUWM to identify associated water demands for the various types of new developments.

IUWM is distinguished from Joseph in that IUWM is a simulation model using empirical relationships and models of physical processes useful for simulating long-term future projections well before details of new land developments are known. Joseph is data-driven, using historical water use data to evaluate expected water use of planned new developments of similar land uses for short to medium range planning. Joseph provides the necessary data for calibrating IUWM and currently used by IUWM to visualize validation output (Figure 2).

Tasks

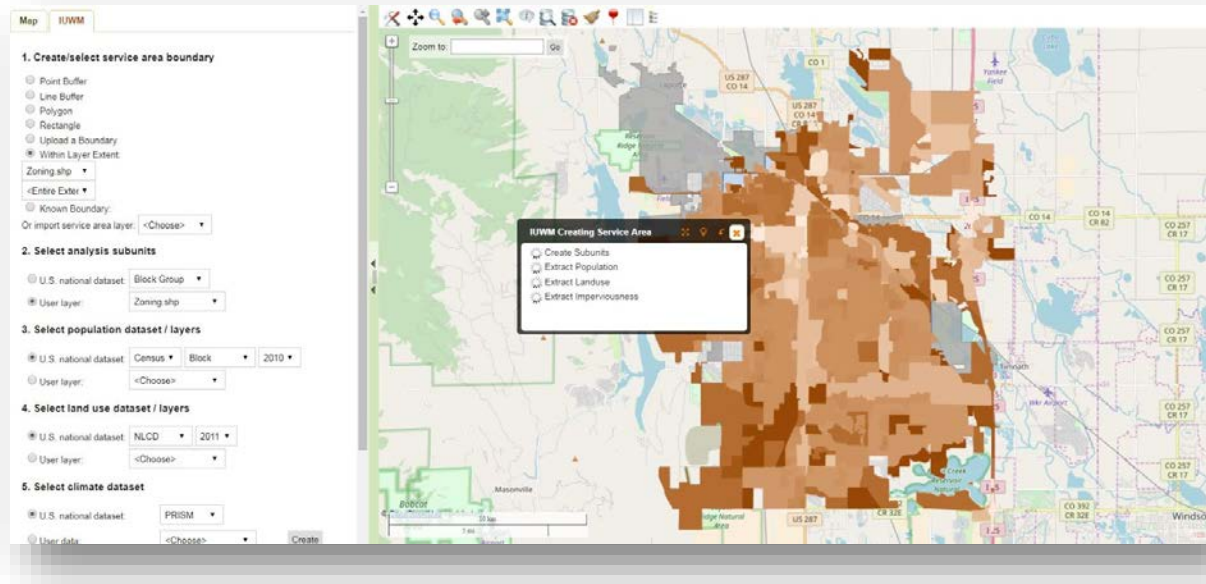


Figure 1: Screenshot of the existing IUWM model on eRAMS, the complementary tool to help cities project water demands using simulation modeling methods

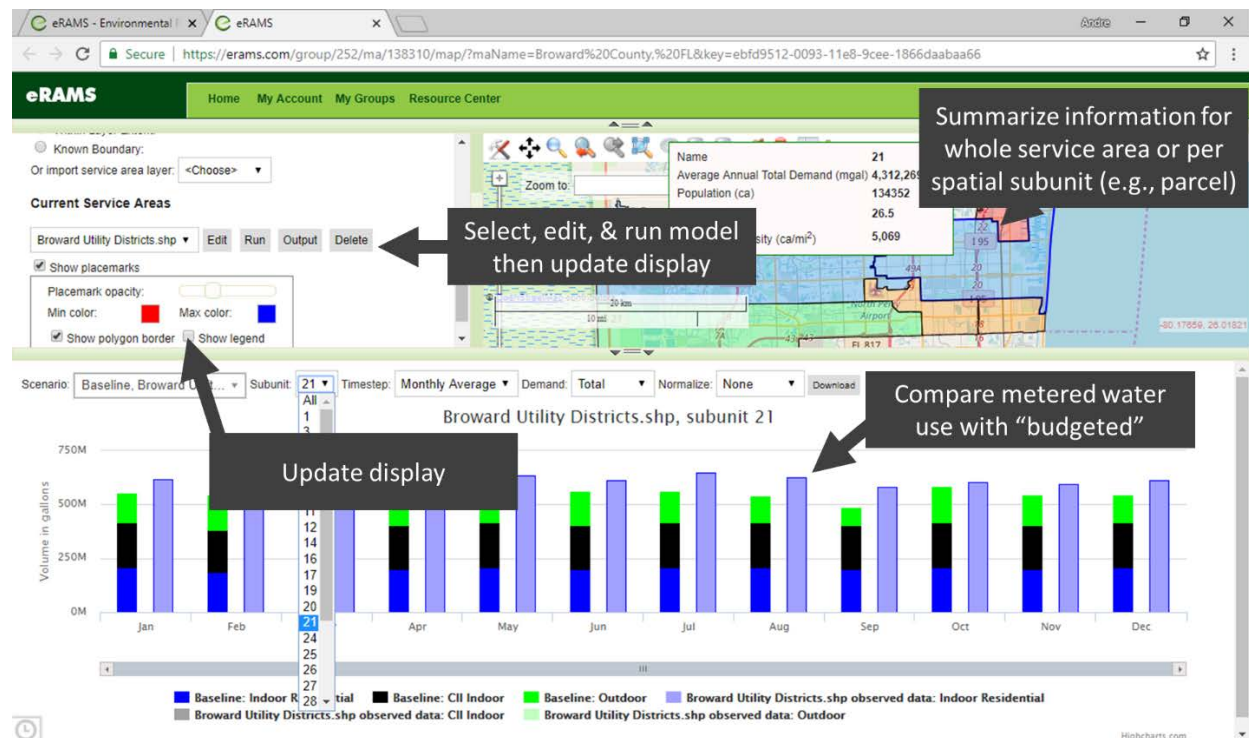


Figure 2: Screenshot of eRAMS-IUWM model output when compared to metered water use data

Tasks

Method/Procedure:

This task will involve development of the software for which requirements were determined in the previous city and utility interviews. Methods will involve statistical models and summaries of both water and land use data, a software system to hold data, make projections, and support decision-making during city planning processes. An assessment of uncertainty of water use for new developments will be made through Monte Carlo stochastic modeling. Source of uncertainty within Joseph include measured water use, irrigated land of various land uses, number of commercial or residential units in various land areas, number of residents living in an area, weather parameters, water efficiency of appliances, types of landscaping for new developments, or other ways customers may save on water.

Water use data integration in Joseph will involve automated aggregation of measured water use to land use areas (Figure 3), which will provide rapid assessment of proposed land developments during the comprehensive planning process and new development reviews. Joseph's data analytics system will also split data into indoor and outdoor uses and perform powerful statistical analyses for gathering insights on water uses for various land uses.

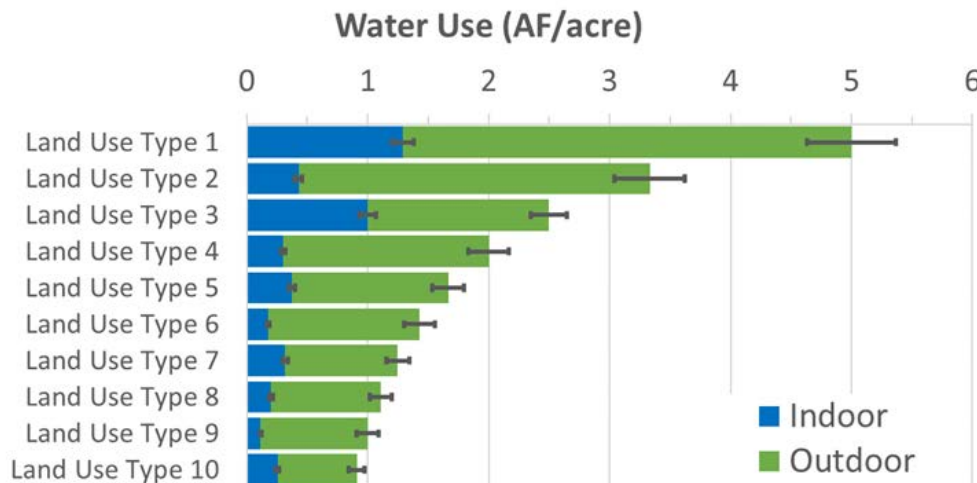


Figure 3: Example reported water use for different types of land uses

Cities that upload data to Joseph will be given the choice to share aggregated summaries (not sensitive material) internally to others within their organization, to other municipal water providers on the Joseph platform, and externally to those of their discretion. For example, Joseph could be used to streamline reporting to and communication with land developers regarding tap fee assessments. This collaborative framework will advance regional understanding of the land-water connection and immediately benefit individual cities that have not yet experienced certain types of land uses.

Joseph will prompt users for additional explanatory data for land uses to automate selection of similar land uses for new developments. Specifically, data will be requested that quantifies the amount of commercial and residential units within each zone, maximum levels of irrigated area, number of trees required, types of buildings allowed, etc. Statistical proximity to other land uses with similar features will be used to identify properties of water use for a new or planned development.

All water use data will be linked to a geospatial representation of land uses from a comprehensive plan or a land zoning geospatial layer. Geospatial and other database queries will be used to allow rapid

Tasks

summarization and dissemination of aggregated water use data (at the utility's discretion) using varying windows of time for either each land use area polygon or for the entire service area at once. Nationally available data such as the U.S. Census or the remotely-sensed National Land Cover Dataset, NLCD (Homer et al. 2004), will be downloaded and used by default when not provided by the user.

Deliverable:

Completion of this task will result in a working, software-as-a-service called Joseph, available on the web, similar to but different than the complementary Integrated Urban Water Model (IUWM), currently housed at the following URL: <http://erams.com/iuwm>. This system will allow a user the capability to login using a free registration, save and load previous analyses, subscribe to different levels of service, upload custom land use and metered water use data, analyze water use for new developments, explore uncertainty of water use projections with and without demand management responses, collaborate and share analyses, and generate reports on findings.

Tasks

Task 3 – Automate report generation

Description of Task:

This task automates report generation for simplifying both internal and external communication processes. Custom reports will be delivered to each of the full-service data partners and a "living" report in the form of an updatable spreadsheet will be used to enhance informative results of water use analysis on the Joseph platform, allowing additional customization. Reports produced by other eRAMS -based tools (Figure 4) will serve as a reference for this custom report generator, but will be updated to be live, cloud-hosted, interactive, and somewhat customizable.

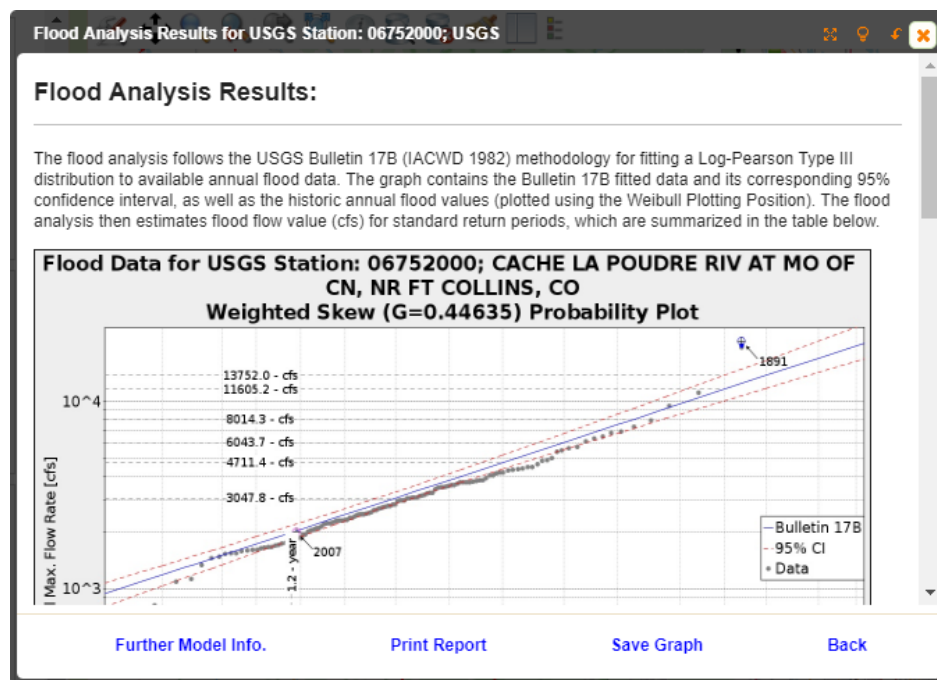


Figure 4. Example of a report generated from the Flow Analysis tools on eRAMS

Tasks
Method/Procedure:
Report components will be informed by interviews with cities to maximize the usefulness of information provided. Interviews will ensure report formats (whether HTML, Microsoft Word document, Microsoft Excel spreadsheet, PDF, or other) are of most direct compatibility with internal paperwork and processes of each partnering institution. Reports will be provided in addition to interactive visualizations that allow quick, easy access to data querying and summarization as part of the web-based graphical user interface.
Deliverable:
The deliverable will include example reports delivered to partnering cities and utilities. Reports can be updated and regenerated at any time.

Tasks
Task 4 – Integrate utility data into Joseph
Description of Task:
<p>Partnering utilities will provide land use (historical and planned, where available) and metered water use data. Both Joseph and IUWM will be tested and calibrated to utilize the data for projecting short-term and long-term water supply needs. The goal of this task is to realize the benefits of this land-water integration system within each of the four partnering institutions:</p> <ol style="list-style-type: none"> 1. East Larimer County Water District (ELCO) – full-service data partner 2. North Weld County Water District (NWCWD) – in-kind data partner 3. City of Westminster – in-kind data partner 4. Fort Collins-Loveland Water District (FCLWD) – full-service data partner <p>In-kind partnering utilities will perform most of the work necessary to upload the data within the correct format to Joseph. Full-service data partners will receive customized report generating capabilities within their first year of subscription and software setup support performed by CSU that includes a software utility to automatically convert water use data from the utility's raw file format to the format required by Joseph and IUWM. Both levels of partnerships will result in a calibrated IUWM model.</p>
Method/Procedure:
<p>Land use and metered water use data collected from partnering cities will be converted to compatible formats either by CSU (for full-service data partners) or by the utility itself (for in-kind partners). CSU will commit to building a data converter utility that aids the utility in automating the data conversion process so updates can be made relatively easily. Interviews with utility staff will inform the customized report design, content, and visualizations provided to full-service data partners. Both a global sensitivity analysis (Sobol 2001) and a subsequent calibration is built into open-source IUWM to automate parameter calibration and enhance the robustness of the analysis. A calibrated IUWM model will be delivered to each partnering utility that will provide the capability to run future scenarios with various levels of conservation and water efficiency.</p>

Tasks
<p>Deliverable:</p> <p>Data, simulations, and customized reports are property of the utility, but CSU will supply some examples or work with a partnering utility to share some of the findings.</p>

Tasks
<p>Task 5 – Reporting</p> <p>Description of Task:</p> <p>This task describes the continual process of documenting the steps taken to accomplish the project goals and objectives. A progress report will be written every 6 months and a final report at the end of the project execution. Documentation will aim at helping other cities and utilities understand how the process developed by this proposal can help them achieve land-water integration in planning processes.</p> <p>Method/Procedure:</p> <p>Documents will be types using word processors and provided to CWCB electronically, although printed copies can be made available.</p> <p>Deliverable:</p> <p>Throughout execution of the project, documentation of the process will be assembled and shared with CWCB. Progress reports provided to CWCB every 6 months will include a description of the tasks (outlined in this statement of work) accomplished during the reporting period. Challenges will be identified and adaptations to address issues will be discussed.</p> <p>A final report will also be provided to CWCB that details the process of integrating land and water, and improving the innovation landscape around the land-water nexus. It will summarize accomplishments, findings, and challenges to build Joseph and perform subsequent analyses with both Joseph and IUWM.</p>

Bibliography
<p>Dozier, A. Q., Arabi, M., Wostoupal, B. C., Goemans, C. G., Zhang, Y., and Paustian, K. (2017). "Declining agricultural production in rapidly urbanizing semi-arid regions: Policy tradeoffs and sustainability indicators." <i>Environmental Research Letters</i>, 12(8).</p> <p>Homer, C., Huang, C., Yang, L., Wylie, B., and Coan, M. (2004). "Development of a 2001 national land-cover database for the United States." <i>Photogrammetric Engineering & Remote Sensing</i>, 70(7), 829–840.</p> <p>Sharvelle, S., Dozier, A., Arabi, M., and Reichel, B. (2017). "A geospatially-enabled web tool for urban water demand forecasting and assessment of alternative urban water management strategies." <i>Environmental Modelling & Software</i>, 97, 213–228.</p> <p>Sobol, I. M. (2001). "Global sensitivity indices for nonlinear mathematical models and their Monte Carlo estimates." <i>Mathematics and Computers in Simulation</i>, 55(2001), 271–280.</p>

Budget and Schedule

This Statement of Work shall be accompanied by a combined Budget and Schedule that reflects the Tasks identified in the Statement of Work and shall be submitted to CWCB in excel format.

Reporting Requirements

Progress Reports: The applicant shall provide the CWCB a progress report every 6 months, beginning from the date of issuance of a purchase order, or the execution of a contract. The progress report shall describe the status of the tasks identified in the statement of work, including a description of any major issues that have occurred and any corrective action taken to address these issues.

Final Report: At completion of the project, the applicant shall provide the CWCB a Final Report on the applicant's letterhead that:

- Summarizes the project and how the project was completed.
- Describes any obstacles encountered, and how these obstacles were overcome.
- Confirms that all matching commitments have been fulfilled.
- Includes photographs, summaries of meetings and engineering reports/designs.

The CWCB will pay out the last 10% of the budget when the Final Report is completed to the satisfaction of CWCB staff. Once the Final Report has been accepted, and final payment has been issued, the purchase order or grant will be closed without any further payment.

Payment

Payment

Payment will be made based on actual expenditures and must include invoices for all work completed. The request for payment must include a description of the work accomplished by task, an estimate of the percent completion for individual tasks and the entire Project in relation to the percentage of budget spent, identification of any major issues, and proposed or implemented corrective actions.

Project costs not covered by those or other grants, and are therefore the responsibility of the grantee, will be eligible for CWCB funds at the following percentages of project costs:

Type of Activity	Percent of Project Costs		
	Recommended Grant Funding Request	Max Grant Funding Request (All CWCB Sources)	Minimum Funding Match (Non-CWCB Sources)
Engineering & Construction	20%	50%	50%
Feasibility Study	50%	50%	50%
Reducing Agricultural Dry Up	50%	80%	20%
Conservation/Efficiency Methods	50%	80%	20%
Educational Efforts	50%	80%	20%
Environmental Conservation	50%	80%	20%
Watershed Improvements	50%	80%	20%
Stream Improvements	50%	80%	20%
Land Use Planning	20%	50%	50%
Recreational Projects	20%	80%	20%

Costs incurred prior to the effective date of this contract are not reimbursable. The last 10% of the entire grant will be paid out when the final deliverable has been received. All products, data and information developed as a result of this contract must be provided to CWCB in hard copy and electronic format as part of the project documentation.

Performance Measures

Performance measures for this contract shall include the following:

- (a) Performance standards and evaluation: Grantee will produce detailed deliverables for each task as specified. Grantee shall maintain receipts for all project expenses and documentation of the minimum in-kind contributions (if applicable) per the budget in Exhibit B. Per Water Plan Grant Guidelines, the CWCB will pay out the last 10% of the budget when the Final Report is completed to the satisfaction of CWCB staff. Once the Final Report has been accepted, and final payment has been issued, the purchase order or grant will be closed without any further payment.
- (b) Accountability: Per Water Plan Grant Guidelines full documentation of project progress must be submitted with each invoice for reimbursement. Grantee must confirm that all grant conditions have been complied with on each invoice. In addition, per Water Plan Grant Guidelines, Progress Reports must be submitted at least once every 6 months. A Final Report must be submitted and approved before final project payment.
- (c) Monitoring Requirements: Grantee is responsible for ongoing monitoring of project progress per Exhibit A. Progress shall be detailed in each invoice and in each Progress Report, as detailed above. Additional inspections or field consultations will be arranged as may be necessary.
- (d) Noncompliance Resolution: Payment will be withheld if grantee is not current on all grant conditions. Flagrant disregard for grant conditions will result in a stop work order and cancellation of the Grant



COLORADO

Colorado Water
Conservation Board

Department of Natural Resources

Colorado Water Conservation Board

Water Plan Grant - Exhibit B

Budget and Schedule

Date: August 1, 2019

Name of Applicant: Colorado State University

Name of Water Project: A System and Process for Assessing Water Use of Land Use Decisions

Project Start Date: 2019-09-01

Project End Date: 2021-08-31

Task No.	Task Description	Task Start Date	Task End Date	Grant Funding Request	Match Funding	Total
1a	Interview partnering cities	9/1/2019	10/31/2019	\$ 12,720	\$ -	\$12,720
2a	Web services for water use data	1/2/2020	3/31/2020	\$ 24,760	\$ 30,800	\$55,560
2b	Display interactive maps	4/1/2020	5/30/2020	\$ 22,671	\$ 26,000	\$48,671
2c	Build visualizations of water/land use data	6/1/2020	7/31/2020	\$ 14,290	\$ -	\$14,290
2d	Water use validation and prediction tool	8/1/2020	9/30/2020	\$ 12,240	\$ 12,000	\$24,240
3a	Build a report generator	10/1/2020	11/30/2020	\$ 8,440	\$ 6,000	\$14,440
4a	Collect data from departments/cities	12/1/2020	2/28/2021	\$ 7,680	\$ -	\$7,680
4b	Build data converters for city partners	12/15/2020	5/30/2021	\$ 7,680	\$ 29,500	\$37,180
4c	Calibrate and demonstrate the system	2/15/2021	7/15/2020	\$ 14,400	\$ 24,000	\$38,400
5a	Reporting	6/1/2021	8/30/2021	\$ 24,368	\$ 21,000	\$45,368
Total				\$149,249	\$149,300	\$298,549



Tuesday, July 03, 2018

André Q. Dozier, PhD, Owner
Razix Solutions LLC
409 Junco Court
Fort Collins, CO 80526

Subject: CWCB Colorado Water Plan Grant Submission for "Water Use Implications of Land Use Decisions"

Dear Dr. Dozier:

This letter is to confirm that the East Larimer County ("ELCO") Water District is pleased to participate alongside Razix Solutions LLC ("Razix") and Colorado State University in development of a software tool to improve the impact assessment of land use changes on municipal water demands. ELCO's understanding is that the current interactive, collaborative, web-based water demand forecast model (the Integrated Urban Water Model, IUWM, <http://erams.com/iuwm>) will be updated to automatically summarize water use data for selected periods of time and space. A "living" report will be generated based on Denver Water's demand forecasting spreadsheet tool specifically calibrated to the ELCO service area that allows some quick adjustments to better understand water use implications of land use decisions.

ELCO anticipates that the proposed project will further our understanding of water use and consequently raw water supply needs for new development. It also has the potential to help improve our master and raw water resource planning and to aid in future communication with developers and other water utilities. Of particular interest to ELCO would be the possibility that other water utilities may opt to share their water use summary reports.

The ELCO Water District is willing participate as a full-service data partner by providing a \$15,000 cash contribution along with in-kind labor and expenses equivalent to \$6,000. As a partner in this effort, ELCO will commit to at least one in-depth interview and a follow-up interview with Razix regarding District needs and desires for the tool as its development progresses. ELCO further commits to providing Razix with a geospatial land use layer and parcel-level water use data (with appropriate non-disclosure agreements as necessary) in a nearly raw format to be converted to a compatible format by Razix and uploaded to the web system when available.

Should you have any questions, please don't hesitate to contact me.

Sincerely,

A handwritten signature in blue ink, appearing to read "Mike Scheid", is written over the "Sincerely," text.

Mike Scheid
Manager, ELCO Water District

FORT COLLINS-LOVELAND WATER DISTRICT

5150 Snead Dr., Fort Collins, CO 80525

Phone 970.226.3104 Fax 970.226.0186

www.fclwd.com

Tuesday, July 31, 2018

André Q. Dozier, PhD, Owner
Razix Solutions LLC
409 Junco Court
Fort Collins, CO 80526

Subject: CWCB Colorado Water Plan Grant Submission for "Water Use Implications of Land Use Decisions"

Dear Dr. Dozier:

This letter is to confirm that Fort Collins – Loveland Water District is pleased to participate alongside Razix Solutions LLC ("Razix") and Colorado State University in development of a software tool to streamline impact assessment of land use changes on municipal water demands. The current interactive, collaborative, web-based water demand forecast model (the Integrated Urban Water Model, IUWM, <http://erams.com/iuwm>) will be updated to automatically summarize our water use data for selected periods of time and space. A "living" report will be generated based on Denver Water's demand forecasting spreadsheet tool specifically calibrated to our service area that allows some quick adjustments to better understand water use implications of land use decisions. This effort will complement our ongoing coordination with the City of Fort Collins and Larimer County, as these land-use agencies update their Comprehensive and Land Use Plans. Changes in land use designations have a direct impact on water supply planning necessary to guide our water acquisition and infrastructure investments.

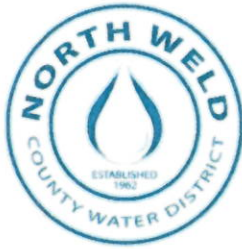
Fort Collins – Loveland Water District will participate as a **full-service data partner** by providing \$15,000 in cash contribution in addition to in-kind labor and expenses equaling \$15,000. As a partner in this effort, we commit to at least one in-depth interview and a follow-up interview with Razix regarding our needs and desires for the tool as its development progresses. We further commit to providing Razix with a geospatial land use layer and parcel-level water use data (with appropriate non-disclosure agreements as necessary) in a nearly raw format to be converted to a compatible format by Razix and uploaded to the web system when available.

Should you have any questions, please don't hesitate to contact me.

Sincerely,



Chris Matkins
General Manager
Fort Collins – Loveland Water District
chrism@fclwd.com



NORTH WELD COUNTY WATER DISTRICT

32825 CR 39 • LUCERNE, CO 80646

P.O. BOX 56 • BUS: 970-356-3020 • FAX: 970-395-0997

WWW.NWCWD.ORG • EMAIL: WATER@NWCWD.ORG

Tuesday, July 10, 2018

André Q. Dozier, PhD, Owner
Razix Solutions LLC ("Razix")
409 Junco Court
Fort Collins, CO 80526

Subject: CWCB Colorado Water Plan Grant Submission for "Water Use Implications of Land Use Decisions"

Dear Dr. Dozier:

This letter is to confirm that North Weld County Water District (NWCWD) is pleased to participate alongside Razix and Colorado State University in the study and software tool development regarding the impact of land use changes on water demands. The current interactive, collaborative, web-based water demand forecast model (the Integrated Urban Water Model, IUWM, <http://erams.com/iuwm>) will be updated to automatically summarize our water use data for selected periods of time and space. A "living" report will be generated based on Denver Water's demand forecasting spreadsheet tool specifically calibrated to our service area that allows some quick adjustments to better understand water use implications of land use decisions. The proposed project will advance our understanding of water use and consequently supply needs for new development that is occurring. It will also help to streamline our institutional processes when developing comprehensive plans and communicating with developers, between departments, and across cooperating institutions. Specifically of use to us is that other cities and utilities can opt to share their water use summary reports so that we can benefit from this automated system in other partnering cities.

NWCWD will participate as an **in-kind data partner** by providing \$5,000 in cash to Razix in addition to necessary in-kind labor. As a partner in this effort, we commit to at least one in-depth interview and a follow-up interview with Razix regarding our needs and desires for the tool as its development progresses. We further agree at our sole discretion if we deem appropriate to upload a geospatial land use layer of interest for our planning purposes and parcel-level water use data (with appropriate non-disclosure agreements as necessary) in a compatible format to the web-based system when available.

Should you have any questions, please don't hesitate to contact me.

Sincerely,

A handwritten signature in blue ink, appearing to read "Eric Reckentine", is written over a light blue circular background.

Eric Reckentine
General Manager
NWCWD
Ericr@NWCWD.org



WESTMINSTER

City of Westminster
4800 W 92nd Ave.
303-658-2425
WWW.cityofwestminster.us
Wednesday, August 01, 2018

André Q. Dozier, PhD, Owner
Razix Solutions LLC ("Razix")
409 Junco Court
Fort Collins, CO 80526

Subject: CWCB Colorado Water Plan Grant Submission for "Water Use Implications of Land Use Decisions"

Dear Dr. Dozier:

This letter is to confirm that the City of Westminster, Colorado is pleased to participate alongside Razix and Colorado State University in the study and software tool development regarding the impact of land use changes on water demands. The current interactive, collaborative, web-based water demand forecast model (the Integrated Urban Water Model, IUWM, <http://erams.com/iuwm>) will be updated to automatically summarize our water use data for selected periods of time and space. A "living" report will be generated based on Denver Water's demand forecasting spreadsheet tool specifically calibrated to our service area that allows some quick adjustments to better understand water use implications of land use decisions. The City of Westminster has historically integrated comprehensive land use and water resources planning to assure alignment in goals and available resources. Westminster has relied on internal GIS and Excel tools developed using water consumption and supply data the Comprehensive Plan, and other long term projections. This level of planning is critical to Westminster, especially as the City's vision evolves.

The City of Westminster will participate as an **in-kind data partner** by providing \$5,000 in cash to Razix in addition to in-kind labor and expenses estimated to equal \$4,500. As a partner in this effort, we commit to at least one in-depth interview and a follow-up interview with Razix regarding our needs and desires for the tool as its development progresses. We further commit to upload a geospatial land use layer of interest for our planning purposes and parcel-level water use data (with appropriate non-disclosure agreements as necessary) in a compatible format to the web-based system when available.

Should you have any questions, please don't hesitate to contact me.

Sincerely,

Stuart Feinglas
Senior Analyst
Public Works and Utilities
sfeingla@cityofwestminster.us

Planning and Engineering
15151 E. Alameda Parkway, Suite 3600
Aurora, Colorado 80012
303.739.7370

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July 9, 2018

André Dozier, PhD, Owner
Razix Solutions LLC (“Razix”)
409 Junco Court
Fort Collins, CO 80526

Subject: In support of a web-based geographical information system for planning water use of land use decisions

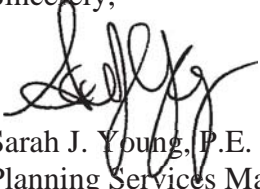
Dear Dr. Dozier:

This letter confirms that there is a value in the proposed innovations on the cloud-based software tool that aids cities in planning water needs for new land developments. The current interactive, collaborative, web-based water demand forecast model (the Integrated Urban Water Model, IUWM, <http://erams.com/iuwm>) will be updated to automatically summarize metered water use data for user selected periods of time and space. A “living” report will be generated based on a simplified spreadsheet tool specifically calibrated to individual service areas that allows quick adjustments to better understand water use implications of land use decisions within each city subscribing to the software system.

I believe that the proposed effort will add value for cities and water providers, rendering it a marketable product. Specifically, the work will streamline common time-consuming activities in both land and water planning processes including but not limited to comprehensive planning and master planning efforts. The resulting software system will then save time and money for municipalities and water providers as they develop robust plans for an uncertain future. The system will also allow rapid water use summarization, visualization, and consequently collaboration between cities regionally, which will particularly benefit cities undergoing development they have not previously experienced.

Should you have any questions, please don’t hesitate to contact me at syoung@auroragov.org.

Sincerely,



Sarah J. Young, P.E.
Planning Services Manager

Metro Roundtable

Friday, July 13, 2018

Greg Johnson
Water Supply Planning Section Chief
Colorado Water Conservation Board
1313 Sherman Street, Room 718
Denver, CO 80203

Re: CWCB Colorado Water Plan Grant, a web-based geographical information system for planning water use of land use decisions

Dear Mr. Johnson:

The Metro Roundtable was given a presentation by André Dozier, Ph.D., with Razix Solutions on the web-based GIS for water/land use decisions in planning at our Roundtable meeting on July 12, 2018. This letter confirms the Roundtable members voted unanimously that there is a value in the proposed innovations on the cloud-based software tool that aids cities in planning water needs for new land developments. The current interactive, collaborative, web-based water demand forecast model (the Integrated Urban Water Model, IUWM, <http://erams.com/iuwm>) will be updated to automatically summarize metered water use data for user selected periods of time and space. A "living" report will be generated based on a simplified spreadsheet tool specifically calibrated to individual service areas that allows quick adjustments to better understand water use implications of land use decisions within each city subscribing to the software system. The Roundtable members did urge the applicant to consider expanding the applicability of the GIS model to development in unincorporated areas of counties, since that is where much of the growth in the Metro area is occurring.

Roundtable members believe that the proposed effort will add value for cities and water providers. Specifically, the model could streamline common time-consuming activities in both land and water planning processes including, but not limited to, comprehensive planning and master planning efforts. The resulting software system could then save time and money for municipalities and water providers as they develop robust plans for an uncertain future. The system will also allow rapid water use summarization, visualization, and consequently collaboration between cities regionally, which will particularly benefit cities undergoing development they have not previously experienced.

Should you have any questions, please don't hesitate to contact me.

Sincerely,



Barbara Biggs
Chair
Metro Roundtable
barbara@roxwater.org

cc: Emily Hunt, Metro RT WSRF Committee Chair
Diane Kiely
André Dozier, PhD, Owner

**Garrett Varra, Chair
South Platte Basin Roundtable
Monday, August 20, 2018**

**Colorado Water Conservation Board
1313 Sherman Street, Suite 721
Denver, CO 80203**

RE: In support of a web-based geographical information system for planning water use of land use decisions for the CWCB Colorado Water Plan Grant

Dear Honorable Board Members,

André Dozier presented to the South Platte Basin Roundtable on August 14, 2018, and the roundtable voted to support the CWCB proposal. This letter confirms that there is value in the proposed innovations on the cloud-based software tool that aids in planning water needs for new developments as cities grow. The proposed web-based system that integrates metered water use data into a geographical information system alongside the Integrated Urban Water Model (IUWM) will speed city and utility efforts in comprehensive and master planning processes. Other potential benefits of this web software tool include rapid assessment of water use for new land developments, collaboration with other cities that have experienced similar land developments, and a dashboard consistent with our own water use to serve in negotiations with land developers, tracking water use and capacity agreements over time.

Roundtable members believe that the proposed effort will create value for cities and water providers, rendering it a marketable product by saving time and money for municipalities and water providers as they develop robust plans for an uncertain future.

Should you have any questions, please don't hesitate to contact me.

Sincerely,



**Garrett Varra, Chair
South Platte Basin Roundtable
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