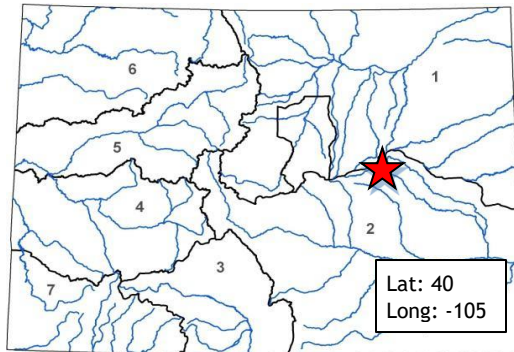




Modeling and Analysis of the Effects of Centralized Rainwater Harvesting on Streamflow University of Colorado Boulder

March 2023 Board Meeting

Water Plan Grant Application



L O C A T I O N

County:	Denver
Drainage Basin:	Metro and South Platte

D E T A I L S

<i>Total Project Cost:</i>	\$231,106
<i>Water Plan Grant Request:</i>	\$173,326
<i>Recommended amount:</i>	\$173,326
<i>Other CWCB Funding:</i>	\$0
<i>Other Funding Amount:</i>	\$1,500
<i>Applicant Match:</i>	\$57,780
<i>Project Type:</i>	Study
<i>Project Category:</i>	Conservation and Land Use Planning
<i>Measurable Result:</i>	2,700,000 Coloradans impacted by water savings

The University of Colorado Boulder has requested funding to quantify the effects of developing centralized rainwater harvesting on streamflow in the Denver metro area using statistical modeling, hydrologic modeling, and watershed-scale monitoring. Specifically, this work seeks to quantify the differences in streamflow in an undeveloped watershed vs. a traditionally developed watershed vs. a watershed developed with centralized rainwater harvesting.

Municipal water efficiency, reuse, and rainwater harvesting can serve to bolster water supplies in growing urban areas. Rainwater harvesting captures increased runoff from new development that senior water rights have not historically diverted as part of their supply.

The anticipated outcome of this project is to provide additional field data and analysis on the effects of rainwater harvesting on streamflow to develop scientifically sound and pragmatic guidance for stormwater management and urban conservation approaches in the Metro basin.

Match funding from the applicant is \$57,780 (\$28,890 in-kind and \$28,890 cash match) totaling 25% of the total project cost of \$231,106. Additionally, Leonard Rice Engineers (LRE) will support the project through sharing data about rainwater harvesting and water use and provide review and feedback on the anticipated study results that will provide guidance on the effects of rainwater harvesting on streamflow and water use in the Front Range. LRE's contribution will be limited to 10 hours of in-kind services, the approximate monetary value of this in-kind contribution is \$1,500.

Funding Recommendation: Staff recommends Board approval of \$173,326 for full funding to the University of Colorado Boulder for the Modeling and Analysis of the Effects of Centralized Rainwater Harvesting on Streamflow project.



Colorado Water Conservation Board

Water Plan

Water Project Summary

Name of Applicant	University of Colorado Boulder
Name of Water Project	Modeling and analysis of the effects of centralized rainwater harvesting on streamflow
Grant Request Amount	\$173,326.00
Primary Category	\$173,326.00
<i>Conservation & Land Use Planning</i>	
Total Applicant Match	\$57,780.00
<i>Applicant Cash Match</i>	\$28,890.00
<i>Applicant In-Kind Match</i>	\$28,890.00
Total Other Sources of Funding	\$0.00
Total Project Cost	\$231,106.00

Applicant & Grantee Information

Name of Grantee: University of Colorado Boulder
Mailing Address: 572 UCB Boulder CO 80309-0001
FEIN: 846,000,555

Organization Contact: Aditi Bhaskar
Position/Title: Associate Professor
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Grant Management Contact: Aditi Bhaskar
Position/Title: Associate Professor
Phone: 303-492-7577
Email: aditi.bhaskar@colorado.edu

Description of Grantee/Applicant

State/Public-controlled Institute of Higher Education

Type of Eligible Entity

- ☐ Public (Government)
- ☐ Public (District)
- ☐ Public (Municipality)
- ☐ Ditch Company
- ☐ Private Incorporated
- ☐ Private Individual, Partnership, or Sole Proprietor
- ☐ Non-governmental Organization
- ☐ Covered Entity
- ☒ Other

Category of Water Project

- ☐ Agricultural Projects
Developing communications materials that specifically work with and educate the agricultural community on headwater restoration, identifying the state of the science of this type of work to assist agricultural users among others.
- ☒ Conservation & Land Use Planning
Activities and projects that implement long-term strategies for conservation, land use, and drought planning.
- ☐ Engagement & Innovation Activities
Activities and projects that support water education, outreach, and innovation efforts. Please fill out the Supplemental Application on the website.
- ☐ Watershed Restoration & Recreation
Projects that promote watershed health, environmental health, and recreation.
- ☐ Water Storage & Supply
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.

Location of Water Project

Latitude 40.000000
 Longitude 105.000000
 Lat Long Flag
 Water Source
 Basins South Platte; Metro
 Counties Adams; Arapahoe; Clear Creek; Denver; Douglas; Gilpin; Broomfield; Cheyenne; El Paso; Elbert; Bou...
 Districts

Water Project Overview

Major Water Use Type Municipal
 Type of Water Project Planning
 Scheduled Start Date - Design 8/15/2023
 Scheduled Start Date - Construction
 Description
 Water scarcity driven by population growth and climate change are a major challenge to water security in Colorado and in the Metro and South Platte River Basins. Municipal water efficiency, reuse, and rainwater harvesting can serve to bolster water supplies in growing urban areas. Rainwater harvesting captures increased runoff from new development that senior water rights have not historically diverted as part of their supply. Following HB09-1129, Sterling Ranch has been the first pilot centralized rainwater harvesting project in Colorado. There are some barriers to expanded rainwater harvesting, as the 2023 Colorado Water Plan (Draft) states: "Water supply solutions and strategies can have unintended consequences for other water users in the basin. For example, return flows, driven by the use and successive reuse of water, is a fundamental characteristic of supply in the South Platte River Basin." This work seeks to better quantify the effects of developing centralized rainwater harvesting on streamflow in the Denver metro area using statistical modeling, hydrologic modeling, and watershed-scale monitoring. Specifically, this work seeks to quantify the differences in streamflow in an undeveloped watershed vs. a traditionally developed watershed vs. a watershed developed with centralized rainwater harvesting.

Measurable Results

New Storage Created (acre-feet)

New Annual Water Supplies Developed or Conserved (acre-feet), Consumptive or Nonconsumptive

Existing Storage Preserved or Enhanced (acre-feet)

New Storage Created (acre-feet)

Length of Stream Restored or Protected (linear feet)

Efficiency Savings (dollars/year)

Efficiency Savings (acre-feet/year)

Area of Restored or Preserved Habitat (acres)

Quantity of Water Shared through Alternative Transfer Mechanisms or water sharing agreement (acre-feet)

2,700,000 Number of Coloradans Impacted by Incorporating Water-Saving Actions into Land Use Planning

Number of Coloradans Impacted by Engagement Activity

Other

Coloradoans in the Metro and South Platte Basins and beyond will be impacted by water savings and the water efficiency and alternative water supply potential of rainwater harvesting and investigating its impact on streamflow.

Water Project Justification

“The success of Colorado’s Water Plan will ultimately be measured by whether or not the municipal water supply-and-demand gap is closed, and the choices we make to close it...In order to reduce the amount of water needed for future generations of Coloradoans and keep urban-adjacent agricultural lands in production, Colorado must support the growth of the next 5 million residents more strategically than the last 5 million” (CWP p.10-5). The proposed work addresses this need by supporting strategic future urban growth. The Colorado Water Plan (2015) also examines landscape water use reductions by 2050 that range from 15-35% (Table 5-1). The proposed work examines a mechanism by which landscape water use from potable supply could be reduced, namely by using the alternative water supply of rainwater.

Return Flows

The Colorado Water Plan (CWP) also states, “The South Platte Basin is leading the state in M&I water-use efficiency. Efficient use of the basin’s resources through water reuse and conservation is a critical step toward meeting future water needs. Nevertheless, increased M&I water-use efficiency will reduce the quantity of water available for agricultural and ecological practices and other uses, because M&I return flows will diminish.” (CWCB, 2015). This same theme is repeated in the 2023 Colorado Water Plan (Draft): “Water supply solutions and strategies can have unintended consequences for other water users in the basin. For example, return flows, driven by the use and successive reuse of water, is a fundamental characteristic of supply in the South Platte River Basin.” The proposed work directly analyzes the return flows from from a particular type of M&I reuse and conservation, rainwater harvesting.

The recent South Platte Basin Implementation Plan (2022) emphasizes the importance of M&I water use efficiency as well as the effects on return flows. This plan states, “Improving M&I water use efficiency will remain a key element of water resource management, but significant future gains will require continued, concerted efforts...Water supply solutions and strategies can have unintended consequences for other water users in the basin. For example, return flows, driven by the use and successive reuse of water, is a fundamental characteristic of supply in the South Platte River Basin. Efficiency improvements (whether municipal or agricultural), reuse, and watershed health projects involving recharge can reduce or change the timing of return flows that supply downstream water users of all sectors.” (CWCB, 2022). The proposed work directly addresses water use efficiency improvements, water supply solutions, and the unintended consequences for other water

users in the basin by quantifying the effect of urban development with rainwater harvesting on return flows.

Identified Goals

The proposed work advances towards three of the identified goals in the South Platte BIP (CWCB, 2022):

Goal 3: Maintain and promote municipal and industrial conservation and efficiency.

3.C: Encourage innovation and efficiency improvements.

The proposed project encourages innovation and efficiency improvements by investigating the on-site water supply alternative of rainwater harvesting.

Goal 4: Maintain and promote reuse

4.B: Support studies to help municipalities evaluate the trade-offs of new reuse projects, including the impacts of additional municipal and industrial water conservation on water available for reuse.

The proposed work is a study to help municipalities evaluate the trade-offs of centralized rainwater harvesting, which could be compared to other water supply alternatives and water conservation strategies.

Goal 6: Protect and enhance watershed function

6.A. Protect and improve water quality throughout the watershed.

6.A.4: Identify, assess, and implement actions, programs, and measures that aim to minimize the adverse effects on wetlands, lakes, streams/rivers, and associated ecosystems from water pollution, nutrient overload, reduced streamflows, and filling or dredging.

The proposed work quantifies the effect of conservation actions on reducing streamflows, which will have follow-on effects on water quality and watershed function as contaminants will become more concentrated in streams with less flow.

Related Studies

This proposed project is related to multiple CWCB-funded projects. In particular, this work is complementary to and assists in the implementation of the following CWCB Water Plan Grant projects focused on the centralized rainwater harvesting at Sterling Ranch:

- Dominion Water and Sanitation District Water Plan Grant project Drought and Water Shortages – Planning and Regulations
- The earlier Dominion Water and Sanitation District Water Plan Grant project Sterling Ranch Rainwater Harvesting Pilot Project Infrastructure
- Holistic Approach to Sustainable Water Management in Northwest Douglas County, January 2007, Prepared for CWCB, DWSD, CPNMD, Douglas County, TWSD, Plum Valley Heights HOA, by Leonard Rice Engineers, Inc., Meuer & Associates, Ryley Carlock & Applewhite PA.

This work is also complementary to the CWCB Water Plan Grant to the Pacific Institute on Diversifying Colorado's Water Portfolio: The Potential for Stormwater Capture and Use to Contribute to a Water Resilient Future. The stormwater capture and use potential is limited in part by the potential effects on streamflow, which this proposed project focuses on. Lastly, this proposed project is complementary to the CWCB Water Plan Grants on the Denver One Water Plan, as a focus of the one water approach is examining surface water resources, stormwater, groundwater, and water use together.

Other ongoing related projects funded by CWCB are mentioned throughout the Statement of Work and completed project information is provided in the works cited appendix.

Taxpayer Bill of Rights

Not Applicable.