



REQUEST FOR PROPOSALS (RFP)

Residential End Uses of Water, Version 3: A Single-Family and Multi-Family Study (5242)

Date Posted

Monday, September 11, 2023

Due Date

Proposals must be received by 3:00 pm Mountain Time on Tuesday, December 12, 2023

WRF Project Contact

Sydney Samples, ssamples@waterrf.org

Project Sponsors

This project is funded by The Water Research Foundation (WRF) as part of WRF's Research Priority Program. This project is co-sponsored by the Alliance for Water Efficiency (AWE).

Project Objectives

- Evaluate changes in disaggregated water uses in single-family households and a baseline for multi-family households by collecting current data from sites that statistically represent their service areas and analyzing the data to identify variations in water used by each fixture or appliance. Outdoor analysis should be limited (e.g., focus on analyzing outdoor usage with lot size and pervious areas).
- Evaluate differences and similarities between single-family and multi-family households (e.g., limited sub-categories, such as condos, townhomes, and apartments).
- Compare results from this study with past end-use studies, such as WRF projects DeOreo et al. 2016 and Mayer et al. 1999, to develop water use trends over time.
- At a high level, discuss how housing class composition has changed over the last 15 years in the study area.

Budget

Applicants may request up to \$600,000 in WRF funds for this project.

Background and Project Rationale

In order to ensure utilities can meet their customers' water needs, current water uses and how they are expected to change over time must be understood. Historically, utilities have forecasted their water needs largely based on population growth projections. However, population growth does not necessarily result in a proportional increase in water use. This

change has led utilities to turn to existing end-use research to better understand their customers' evolving water needs.

In search of residential end use data, utilities are given single-family household data that are often outdated or not representative of the entire community as well as multi-family data that are often not statistically significant or disaggregated and rely heavily on data from the US Census Bureau. Few studies exist with current, high-resolution water use data.

For example, while WRF documented the disaggregated uses of water in single-family homes in 1996 (Mayer et al. 1999), and again in 2016 (DeOreo et al. 2016), by the time the second study was complete, end use patterns had changed. It is expected that in 2023, those patterns will have changed again due to factors such as new construction policies, green building principles, updates to older household appliances, changes to housing demographics, water efficiency programs, and changes in customer behavior. While there are a few studies that investigate multi-family household end use (e.g., Kiefer and Krentz 2018; DeOreo and Hayden 2008), in general, it is less studied and less understood. Additionally, since DeOreo et al. 2016, there have been significant advancements in advanced metering infrastructure (AMI) and flow metering technologies, which can also influence demand patterns. Research is needed to provide the water sector with an updated and expanded assessment of disaggregated water use in single-family and multi-family households across North America.

It is crucial to fill this knowledge gap because:

- Climate change is making supply planning and capital planning more critical.
- Understanding current water use is important to developing successful efficiency and conservation programs.
- Utility housing demographics are changing to have higher proportions of multi-family housing units.
- Utilities are striving to reduce affordability challenges in their regions and improve their customer assistance programs (close to 80% of hard-to-reach customers live in multi-family buildings).
- Residential water use impacts wastewater influent quantity and quality. It also affects the source product for recycled water, making that source potentially more expensive.
- Once trusted supplies of water are increasingly imperiled, additional water sources are more limited and often very expensive.

Research is needed to understand single-family and multi-family households disaggregated end uses, and to holistically understand how water is used in a residential community. A better understanding of how water is used will allow utilities to reduce the assumptions they must make—especially regarding multi-family household water usage—when making long-term supply planning decisions. It is expected that at the end of this study utilities will better understand current water use in residential homes and have the capabilities to internally improve their supply planning efforts and water efficiency programs.

WRF will provide applicants with published research reports to help support proposal development upon request.

Research Approach

This RFP is intentionally flexible in the research approach to encourage creativity and originality from proposers. Applicants should describe how they will conduct the research to meet the listed objectives. The following approach is intended as a starting point.

The overall project objective is to comprehensively identify and evaluate the end uses of water in single-family and multi-family households on a per dwelling unit and per capita basis. A minimum of two multi-family household sub-categories (such as condos, townhomes, or apartments) should be included in the study and outlined clearly in the proposal. Proposers should also consider a variety of other types of housing diversity, such as the size of multi-family development, urban vs. rural, renter vs. owned, low-income vs. high-income, full-time vs. vacation home, and geographic diversity. In addition, the proposer is required to document customer/household characteristics to support, and compare against, the end use evaluation.

Applicants are not limited to studying the same appliances and water-saving devices used in DeOreo et al. 2016. The end uses studied can include, but are not limited to the following:

- The end uses included in DeOreo et al. 2016
- The maturation and penetration of new water-using technologies in existing homes and newly constructed homes
- Other non-conventional water use appliances and treatment systems
- The availability of on-line data via flowmeters or AMI customer use portals
- The prevalence of leaks and the accuracy range of the meters used to identify low flow leaks
- How remote and hybrid work positions have influenced residential water use

Applicants are not limited to using the end use data collection methods used in DeOreo et al. 2016, as technology has advanced since the 2016 study. The data collection techniques used must be able to distinguish between indoor and outdoor water use and be replicable throughout North America. While disaggregated outdoor water use will not be required, total outdoor water use (gallons per square foot) should be measured. Additionally, the research team needs to consider the source of water supply to the home. If non-potable supplies are being used, this usage must be identified and quantified, and specific end uses disaggregated. The proposer must clearly describe their intended sampling collection efforts, the tools and data loggers they will use, and information on how they plan to recruit customers to participate.

The research team should integrate and evaluate the logged data against the customer/household characteristics they collect. There are many different data sources teams can use to gather this information, including using customer surveys as was used in *Version 2*. Example customer/household characteristics that may be included:

- The number of bedrooms and the number of occupants
- The number of showers and toilets (year and flow rate)
- Presence of specific fixtures/features such as:
 - Fixture efficiencies and flow rates
 - In-unit water heating and cooling systems
 - In-unit clothes washer vs. laundry facility
 - Personal flow meter or on-line consumption data through AMI
 - Aggregate or disaggregated by end use
 - Washer and dryer
 - Water softeners or other scale inhibitor devices
 - Pools, hot tubs, club houses, gym/fitness areas, dog parks (irrigated or not)
 - Irrigation devices (manual vs. automatic)
 - Car washes
 - Evaporative cooling (cooling towers or swamp coolers)
 - Secondary suites
- Owned vs. rented
- Master metered vs. individually metered
- Housing value, household income data, income of the area
- Knowledge of leaks and maintenance requests
- Age of building
- Utility rate structure
- Parcel size
- Work from home status

A utility does not need to provide logged data to participate in the customer/household characteristics analysis portion of the project. For utilities that participate in both, the proposer should consider having a third party check a subset of single-family and multi-family homes for things such as high efficiency devices and number of fixtures to compare to collected customer/household characteristics.

Although WRF recognizes that the water savings potential is strong for outdoor residential water use, this project will not focus on disaggregated outdoor water use or outdoor conservation potential. Additionally, the emphasis on this project is not on developing models of water nor an assessment of conservation potential.

The final research product will be a report summarizing single-family and multi-family residential end uses of water throughout North America with socioeconomic information provided that allows utility water managers to better plan and coordinate supply planning programs. A chapter of the final research report should be dedicated to describing the similarities and differences between single-family and multi-family homes (and between types of multi-family homes), including to what extent these differences are explained by other housing patterns. Another chapter(s) should be dedicated to comparing this study with past studies, discussing how water use has evolved and describing how housing class composition has changed over the last fifteen years. Results should look at trends per dwelling unit, per

capita, and holistically across the North American water sector. End use data should be compiled in a readily available format for use by water utilities. Applicants are encouraged to provide detailed information in their proposal about data resulting from this research and how it can be used by utilities.

Expected Deliverables

The expected deliverables from this project include:

- Research report (must use WRF's Research Report Template, which can be found at <https://www.waterrf.org/project-report-guidelines#research-report-template>).
- Key findings report with infographics designed for lay audience
- End Use Data
- Minimum of one Alliance for Water Efficiency (AWE) Symposium presentation during project*
- Webcast

*AWE will hold a presentation spot for this project at their Symposium to allow the project team to provide an update before the project is completed.

Other deliverables from this project may include:

- Conference presentation
- Workshop
- Peer-reviewed journal article(s)
- Fact sheets, case studies, videos, etc.

Communication Plan

Please review WRF's *Project Deliverable Guidelines* for information on preparing a communication plan. The guidelines are available at <https://www.waterrf.org/project-report-guidelines#project-deliverable-guidelines>. Conference presentations, webcasts, peer-reviewed publication submissions, and other forms of project information dissemination are typically encouraged.

In addition to a Project Advisory Committee (PAC) hosted by WRF, AWE will facilitate a technical group to provide additional feedback / disseminate intermittent research results. While the PAC will receive communications quarterly and have dedicated PAC meetings, AWE's facilitated meetings will be more flexible and scheduled collaboratively with the research team.

Project Duration

The anticipated period of performance for this project is 36 months from the contract start date.

References and Resources

The following list includes examples of research reports, tools, and other resources that may be helpful to proposers. It is not intended to be comprehensive, nor is it a required list for consideration.

- DeOreo, W. B., Mayer, P., Dziegielewski, B., and Kiefer, J. 2016. *Technical Report: Residential End Uses of Water, Version 2*. Project 4309. Denver, CO: Water Research Foundation.
- Kiefer, J.C. and Krentz, L.R. 2018. *Technical Report: Water Use in the Multi-Family Housing Sector*. Project 4554. Denver, CO: The Water Research Foundation.
- DeOreo, W.B. 2011. *Technical Report: Analysis of Water Use in New Single-Family Homes*. Aquacraft, Inc. Water Engineering and Management.
- Beal, C., and Stewart, R.A. 2011. *Technical Report: South East Queensland Residential End Use Study: Final Report*. Urban Water Security Research Alliance.
- De Oreo, W.B., Mayer, P.W., Martien, L., Hayden, M., Funk, A., Kramer-Duffield, M., Davis, R., Henderson, J., Raucher, B., Gleick, P., and Heberger, M. 2011. *Technical Report: California Single-Family Water Use Efficiency Study*. Aquacraft Water Engineering & Management.
- Coomes, P., Rockaway, T., Rivard, J., and Kornstein, B. 2010. *Technical Report: North America Residential Water Usage Trends Since 1992*. Project 4031. Denver, CO: Water Research Foundation.
- DeOreo, W.B., and Hayden, M. 2008. *Technical Report: Analysis of Water Use Patterns in Multi-Family Residences*. Aquacraft, Inc. Water Engineering and Management.
- Mayer, P.W., Towler, E., DeOreo, W.B., Caldwell, E., Miller, T., Osann, E.R., Brown, E., Bickel, P.J., and Fisher, S.B. 2004. *Technical Report: National Multiple Family Submetering and Allocation Billing Program Study*. Aquacraft Inc. and East Bay Municipal Utility District.
- Mayer, P.W., DeOreo, W.B., Opitz, E.M., Kiefer, J.C., Davis, W.Y., and Dziegielewski, B. 1999. *Technical Report: Residential End Uses of Water*. Project 241. Denver, CO: AWWA Research Foundation.
- *Case Study: Marin Municipal Water District: Using Real-Time Data to Manage Drought*. 2022. Flume Data Labs.
- *Case Study: Municipal Water District of Orange County - Using End-Use Data to Improve Utility Planning, Build Future Programs, and Comply with State Regulations*. 2022. Flume Data Labs.

Proposal Evaluation Criteria

The following criteria will be used to evaluate proposals:

- Understanding the Problem and Responsiveness to RFP (maximum 20 points)
- Technical and Scientific Merit (maximum 30 points)
- Qualifications, Capabilities, and Management (maximum 15 points)
- Communication Plan, Deliverables, and Applicability (maximum 20 points)
- Budget and Schedule (maximum 15 points)

PROPOSAL PREPARATION INSTRUCTIONS

Proposals submitted in response to this RFP must be prepared in accordance with WRF's *Guidelines for Research Priority Program Proposals*. The current version of these guidelines and the *Instructions for Budget Preparation* are available at <https://www.waterrf.org/proposal-guidelines>. The guidelines contain instructions for the technical aspects, financial statements, indirect costs, and administrative requirements that the applicant must follow when preparing a proposal.

Proposals that include the production of web- or software-based tools, such as websites, Excel spreadsheets, Access databases, etc., must follow the criteria outlined for web tools presented in the *Web Tool Criteria and Feasibility Study for The Water Research Foundation Project Deliverables* at <https://www.waterrf.org/project-report-guidelines#webtool-criteria>.

Eligibility to Submit Proposals

Proposals will be accepted from both U.S.-based and non-U.S.-based entities, including educational institutions, research organizations, governmental agencies, and consultants or other for-profit entities.

WRF's Board of Directors has established a Timeliness Policy that addresses researcher adherence to the project schedule. The policy can be reviewed at <https://www.waterrf.org/policies>. Researchers who are late on any ongoing WRF-sponsored studies without approved no-cost extensions are not eligible to be named participants in any proposals. Direct any questions about eligibility to the WRF project contact listed at the top of this RFP.

Administrative, Cost, and Audit Standards

WRF's research program standards for administrative, cost, and audit compliance are based upon, and comply with, Office of Management and Budget (OMB) Uniform Grants Guidance (UGG), 2 CFR Part 200 Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal Awards, and 48 CFR 31.2 Contracts with Commercial Organizations. These standards are referenced in WRF's *Guidelines for Research Priority Program Proposals*, and include specific guidelines outlining the requirements for indirect cost negotiation agreements, financial statements, and the Statement of Direct Labor, Fringe Benefits, and General Overhead. Inclusion of indirect costs must be substantiated by a negotiated agreement or appropriate Statement of Direct Labor, Fringe Benefits, and General Overhead. Well in advance of preparing the proposal, your research and financial staff should review the detailed instructions included in WRF's *Guidelines for Research Priority Program Proposals* and consult the *Instructions for Budget Preparation*, both available at <https://www.waterrf.org/proposal-guidelines>.

Budget and Funding Information

The maximum funding available from WRF for this project is \$600,000. The applicant must contribute additional resources equivalent to at least 33% of the project award. For example, if an applicant requests \$100,000 from WRF, an additional \$33,000 or more must be contributed

by the applicant. Acceptable forms of applicant contribution include cost share, applicant in-kind, or third-party in-kind that comply with 2 CFR Part 200.306 cost sharing or matching. The applicant may elect to contribute more than 33% to the project, but the maximum WRF funding available remains fixed at \$600,000. Proposals that do not meet the minimum 33% of the project award will not be accepted. Consult the *Instructions for Budget Preparation* available at <https://www.waterrf.org/proposal-guidelines#RPP-instr-budget-prep> for more information and definitions of terms.

Period of Performance

It is WRF's policy to negotiate a reasonable schedule for each research project. Once this schedule is established, WRF and its sub-recipients have a contractual obligation to adhere to the agreed-upon schedule. Under WRF's No-Cost Extension Policy, a project schedule cannot be extended more than nine months beyond the original contracted schedule, regardless of the number of extensions granted. The policy can be reviewed at <https://www.waterrf.org/policies>.

Utility and Organization Participation

WRF encourages participation from water utilities and other organizations in WRF research. Participation can occur in a variety of ways, including direct participation, in-kind contributions, or in-kind services. To facilitate their participation, WRF has provided contact information, on the last page of this RFP, of utilities and other organizations that have indicated an interest in this research. Proposers are responsible for negotiating utility and organization participation in their particular proposals. The listed utilities and organizations are under no obligation to participate, and the proposer is not obligated to include them in their particular proposal.

Application Procedure and Deadline

Proposals are accepted exclusively online in PDF format, and they must be fully submitted before 3:00 pm Mountain Time on Tuesday, December 12, 2023.

The online proposal system allows submission of your documents until the date and time stated in this RFP. To avoid the risk of the system closing before you press the submit button, do not wait until the last minute to complete your submission. Submit your proposal at <https://forms.waterrf.org/cbruck/rfp-5242>.

Questions to clarify the intent of this RFP and WRF's administrative, cost, and financial requirements may be addressed to the WRF project contact, Sydney Samples at 571.384.2108 or ssamples@waterrf.org. Questions related to proposal submittal through the online system may be addressed to Caroline Bruck at 303.347.6118 or cbruck@waterrf.org.

5242 Utility and Organization Participants

The following utilities have indicated interest in possible participation in this research. This information is updated within 24 business hours after a utility or an interested organization submits a volunteer form, and this RFP will be re-posted with the new information. **(Depending on your settings, you may need to click refresh on your browser to load the latest file.)**

Ryan Shepler

Lead Demand Planner
Denver Water
1600 W 12th Avenue
Denver, CO 80204
(720) 277-7477
ryan.shepler@denverwater.org

Scott Winter

Project Manager
Colorado Springs Utilities
2855 Mesa Road
Colorado Springs, CO 80904
(719) 668-4590
swinter@csu.org

Kevin Kluge

Water Conservation Division Manager
City of Austin Water Utility
625 E. 10th Street
Austin, TX 78701
(512) 791-5715
kevin.kluge@austintexas.gov

Xiongfei Xie

Senior Engineer
Hillsborough County Water Resources Dept.
925 East Twiggs Street
Tampa, FL 33602
(813) 635-7392
xiex@hillsboroughcounty.org

Drew Beckwith

Sr. Water Resources Analyst
City of Westminster
6575 W 88th Avenue
Westminster, CO 80031
(303) 658-2386
dbeckwith@cityofwestminster.us

Rosanna Lau

Civil Engineering Associate
Los Angeles Dept of Water & Power
111 N. Hope Street
Los Angeles, CA 90012
(213) 367-0146
rosanna.lau@ladwp.com

Mariel Miller

Water Conservation Manager
Fort Collins Utilities
222 Laporte Ave.
Fort Collins, CO 80521
(208) 841-4705
mamiller@fcgov.com

Dylan Meagher

Chief of Staff, Bureau of Sustainability
NYC Dept. of Environmental Protection
59-17 Junction Blvd. FL 11
Elmhurst, NY 11373
(718) 595-7138
dmeagher@dep.nyc.gov

Gregory Plumb

Water Efficiency Specialist III
Marin Water
220 Nellen Ave
Corte Madera, CA 94925
(415) 945-1519
gplumb@marinwater.org

Grant Cullinan

Water Efficiency Analyst
City of Durham, Water Management
1600 Mist Lake Drive
Durham, NC 27704
919.560.4381
grant.cullinan@durhamnc.gov

Hope Bartlett

Water Conservation Specialist
City of Longmont
375 Airport Rd.
Longmont, CO 80503
(719) 252-2933
hope.bartlett@longmontcolorado.gov

Kathleen Duke

Water Efficiency Coordinator
City of Golden
1445 10th St.
Golden, CO 80031
(720) 878-1069
kduke@cityofgolden.net

Rodney Tilley

Water Conservation Manager
Toho Water Authority
951 Martin Luther King Blvd.
Kissimmee, FL 37441
(407) 944-5121
rtilley@tohowater.com

Susan Pokorny

Manager Customer Solutions
JEA
225 N. Pearl St
Jacksonville, FL 32222
(904) 703-3289
pokosg@jea.com

Mark Guthrie

Water Conservation Program Manager
Seattle Public Utilities
PO Box 34018
Seattle, WA 98124-4018
(206) 684-5955
mark.guthrie@seattle.gov

Laura Wing

Senior Water Resources Administrator
City of Thornton
12450 Washington St.
Thornton, CO 80241
(720) 977-6514
laura.wing@thorntonco.gov

Carlos Bustos

Water Conservation Manager
Albuquerque Bernalillo Co. Water Utility Auth.
PO Box 568
Albuquerque, NM 87103
(505) 933-1254
cbustos@abcwua.org

Claire Nordlie

Sustainability Coordinator
Santa Rosa Water
69 Stony Circle
Santa Rosa, CA 95401
(707) 543-3962
cnordlie@srcity.org

Benjamin Yoakum

Project Manager, Research & Innovation
Orange County Utilities
9150 Curry Ford Road
Orlando, FL 32825
(689) 258-2361
Benjamin.Yoakum@ocfl.net

Julie Ortiz

Water Conservation Manager
San Francisco Public Utilities Commission
525 Golden Gate Avenue, 10th Floor
San Francisco, CA 94102
(415) 551-4739
jnortiz@sflower.org

Keisha Thorpe

Chief Operations Officer
Clayton County Water Authority
1600 Battle Creek Road
Morrow, GA 30260
(770) 960-5217
keisha.thorpe@ccwa.us

Nick Teague

Water Resources Program Manager
City of San Luis Obispo
879 Morro Street
San Luis Obispo, CA 93401
(805) 781-7217
nteague@slocity.org

Liana D'Andrea

Supervisor, Environmental Programs
City of Guelph
1 Carden Street
Guelph, Ontario, Canada N1H 3A1
(226) 332-6313
liana.dandrea@guelph.ca

Kristi Wilson

Demand Management Coordinator
Capital Regional District
625 Fisgard Street
Victoria, British Columbia, Canada V8W 1R7
(250) 474-9697
kwilson@crd.bc.ca

Candice Rupprecht

Water Conservation Manager
City of Tucson
PO Box 27210
Tucson, AZ 85701
(520) 791-4331
candice.rupprecht@tucsonaz.gov

Jessica Ahlstrom

Water Conservation Program Manager
City of Bozeman
PO Box 1230
Bozeman, MT 59771
(406) 582-2265
jahlstrom@bozeman.net

Angie Marcus

Water Conservation Supervisor
Cobb County Water System
660 South Cobb Drive
Marietta, GA 30060
(770) 528-8214
angie.marcus@cobbcounty.org

David Wallenstein

Associate Engineer
EBMUD
375 11th Street
Oakland, CA 94607
(510) 986-7614
david.wallenstein@ebmud.com

Drew Beckwith

Sr. Water Resources Analyst
City of Westminster
6575 W 88th Avenue
Westminster, CO 80031
(303) 658-2386
dbeckwith@westminsterco.gov

William Granger

Water Conservation Coordinator
City of Sacramento
5730 24th Street, Building 22
Sacramento, CA 95822
(916) 808-1417
wgranger@cityofsacramento.org

Alicia Lee

Water Conservation Manager
City of Dallas Water Conservation
1500 Marilla St #2AN
Dallas, TX 75201
(214) 243-1174
alicia.lee@dallas.gov

Satish Tripathi

Managing Engineer
City of Houston - Houston Water
611 Walker Street, 18th Floor
Houston, TX 77002
(832) 395-3096
satish.tripathi@houstontx.gov

John Kij

Engineering Project Manager
American Water
1 Water Street
Camden, NJ 08102
(856) 955-4001
John.Kij@amwater.com

Eric Lindman

Director Public Works & Utilities
City of Wausau
407 Grant Street
Wausau, WI 54403
(715) 261-6740
eric.lindman@ci.wausau.wi.us

Curtis Czarnecki

General Manager
Kenosha Water Utility
4401 Green Bay Road
Kenosha, WI 53144
(262) 653-4306
cczarnecki@kenosha.org

Penny Milton

Water Efficiency Coordinator
Portland Water Bureau
1120 SW 5th Suite 400
Portland, OR 97204
(503) 865-6415
penny.milton@portlandoregon.gov

Mahmudul Hasan

CTO, Bureau of Water and Wastewater
200 N. Holliday Street, 3rd Floor
Baltimore, MD 21202
(669) 251-6443
mahmudul.hasan@baltimorecity.gov

Jason Hoye

Water Conservation Specialist
City of Lake Oswego
380 A Avenue
Lake Oswego, OR 97034
(503) 675-3747
jhoye@ci.oswego.or.us

Daniel Reisinger

Planning & Engineering
Tacoma Water
3628 S 35th Street
Tacoma, WA 98409
(253) 316-2477
dreisinger@cityoftacoma.org

Alexandra Wahlstrom

Environmental Compliance Manager
Acton Water District
693 Massachusetts Avenue, P.O. Box 953
Acton, MA 01720
(978) 263-9107
alex@actonwater.com

Marji Dukowitz

Water Planner II
City of Phoenix Water Dept.
200 W Washington Street, 9th floor
Phoenix, AZ 85003
(602) 495-3669
marji.dukowitz@phoenix.gov

Matthew Dickens

Sustainability Manager
Santa Clarita Valley Water Agency
27234 Bouquet Canyon Rd.
Santa Clarita, CA 91350
(661) 510-9733
mdickens@scvwa.org