FACT SHEET

UPC Appendix M Peak Water Demand Calculator

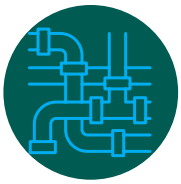
The purpose of this fact sheet is to provide information about an alternative approach for sizing water pipes in new residential buildings using 2024 Uniform Plumbing Code (UPC) Appendix M "Peak Water Demand Calculator" (also referred to as the WDC).

Scope of 2024 UPC Appendix M

2024 UPC Appendix M (the WDC) provides a method for estimating the demand load for the building water supply, principal branches, and risers for single family and multifamily dwellings.

The WDC applies to new construction and can justify the use of existing premise plumbing for renovation or adaptive reuse projects.

Background



Key points about the WDC:

- First major, peer-reviewed update of peak water demand sizing in buildings in over 80 years in response to the increased prevalence of low-flow fixtures in the United States.
- Culmination of a multi-year project (2011- 2017) sponsored by the International Association of Plumbing and Mechanical Officials (IAPMO) in collaboration with the University of Cincinnati and the American Society of Plumbing Engineers (ASPE).
- Initial adoption as Appendix M in 2018 UPC.
- Available as an Excel-based tool.

Benefits

Using the WDC to size water pipes results in:

- Construction cost savings due to smaller diameter pipes and fittings, less pipe insulation material, and reduced water service entrance size.
- Ongoing cost savings to occupants and homeowners from water and energy savings.
- Faster delivery of hot water to occupants.
- Water and embedded energy savings due to faster hot water delivery times.
- Additional energy savings due to decreased heat loss in the hot water distribution system, particularly in multifamily buildings with a recirculation system.
- Reduced carbon emissions due to material savings and energy reductions.
- Reduced public health and safety risk and improved water quality due to shorter water dwell times in premise plumbing systems.

Adoption in Minnesota and Other States

- In late 2023, Minnesota Plumbing Board formed 2024 UPC Ad Hoc Rulemaking Committee that plans to propose recommendations on adoption of 2024 UPC to the Plumbing Board in April 2025. The Committee plans to review UPC Appendix M for possible adoption.
- Ten states have already adopted the WDC as an alternative water demand sizing method including California, Hawaii, Montana, Nevada, New Jersey, New Mexico, North Dakota, Oregon, Washington, and Wisconsin.

More Information

- **2024 UPC, Appendix M "Peak Water Demand Calculator"**
  https://epubs.iapmo.org/2024/UPC/#p=466
  https://www.iapmo.org/water-demand-calculator/
- **2017 Study on Peak Water Demand** by S. Buchberger et al. (basis for the WDC)
  www.iapmo.org/media/3857/peak-water-demand-study-executive-summary.pdf
- **2020 Study on the WDC** by Stantec (assessment of cost savings from applying the WDC)
  www.iapmo.org/group/update/stantec-wdc-savings-study
- **2021 Report** on Connection Fees and Service Charges by Meter Size by Alliance for Water Efficiency (assessment of cost savings from downsizing meters)
  www.iapmo.org/media/25939/awe-meter-size-connection-fee-research.pdf
- **2023 Report** on Energy and Carbon Savings Opportunities by Arup (assessment of water, energy, and carbon savings from applying the WDC
  www.iapmo.org/media/31469/iapmo_energy_savings_arup_report.pdf
- **3-min Intro Video** by Towle Whitney
  https://vimeo.com/734711521/1874e812cd
- **1-hr Training** on How to Use the WDC from 2017 IAPMO Annual Conference
  https://youtu.be/TWKPfT1pu3U

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What's wrong with the current method?

The figure below shows how the current design method (using Water Supply Fixture Units or WSFU) drastically overestimates the peak water demand in multifamily buildings. The WDC design method is a closer match to the actual peak water use observed in 20 multifamily buildings.[i]

The design estimates calculated using the WSFU method (red markers) are 5 to 27 times larger than the observed peak flow rates. Overestimating peak water flow rates results in pipe diameters that are much larger than needed for modern buildings. The last four red markers are literally off the chart, predicting peak water use of over 140 gallons per minute.

The design estimates calculated using the WDC (blue markers) are between 2 and 6 times the observed peak flow rates. The WDC can be used to more accurately, but still conservatively, calculate peak water flow rates in residential occupancies.

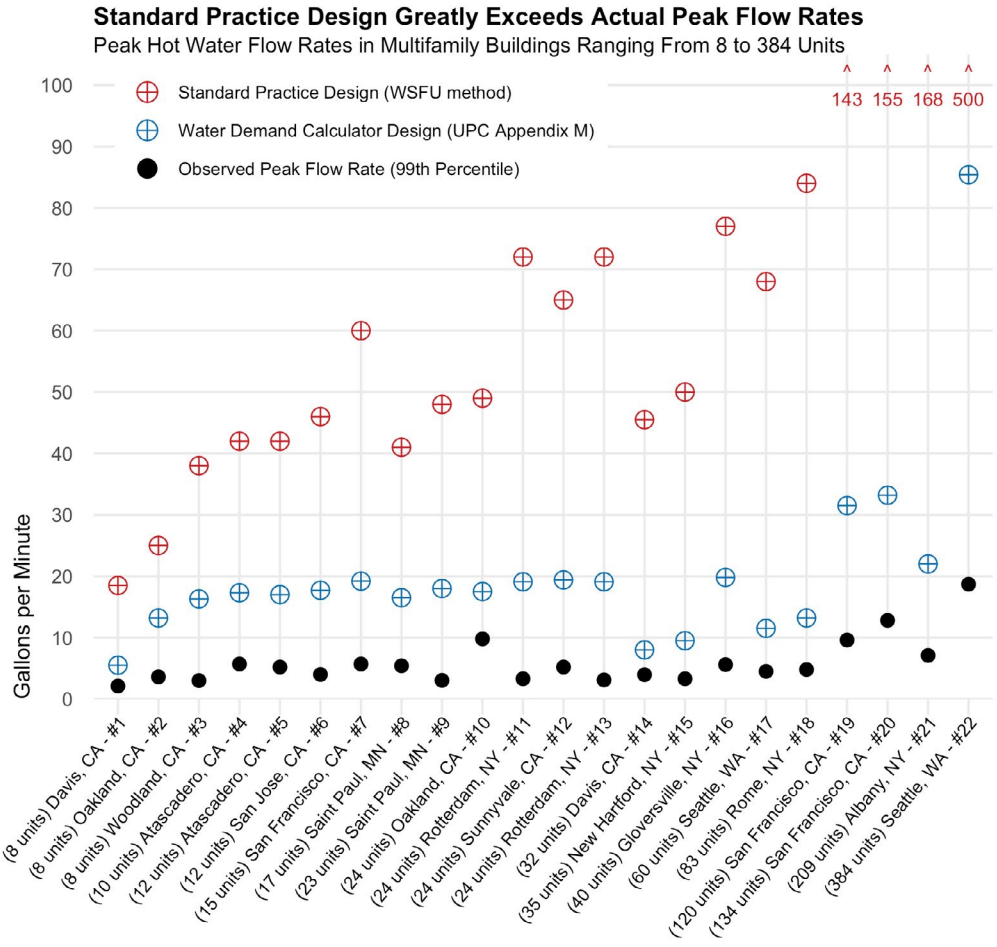
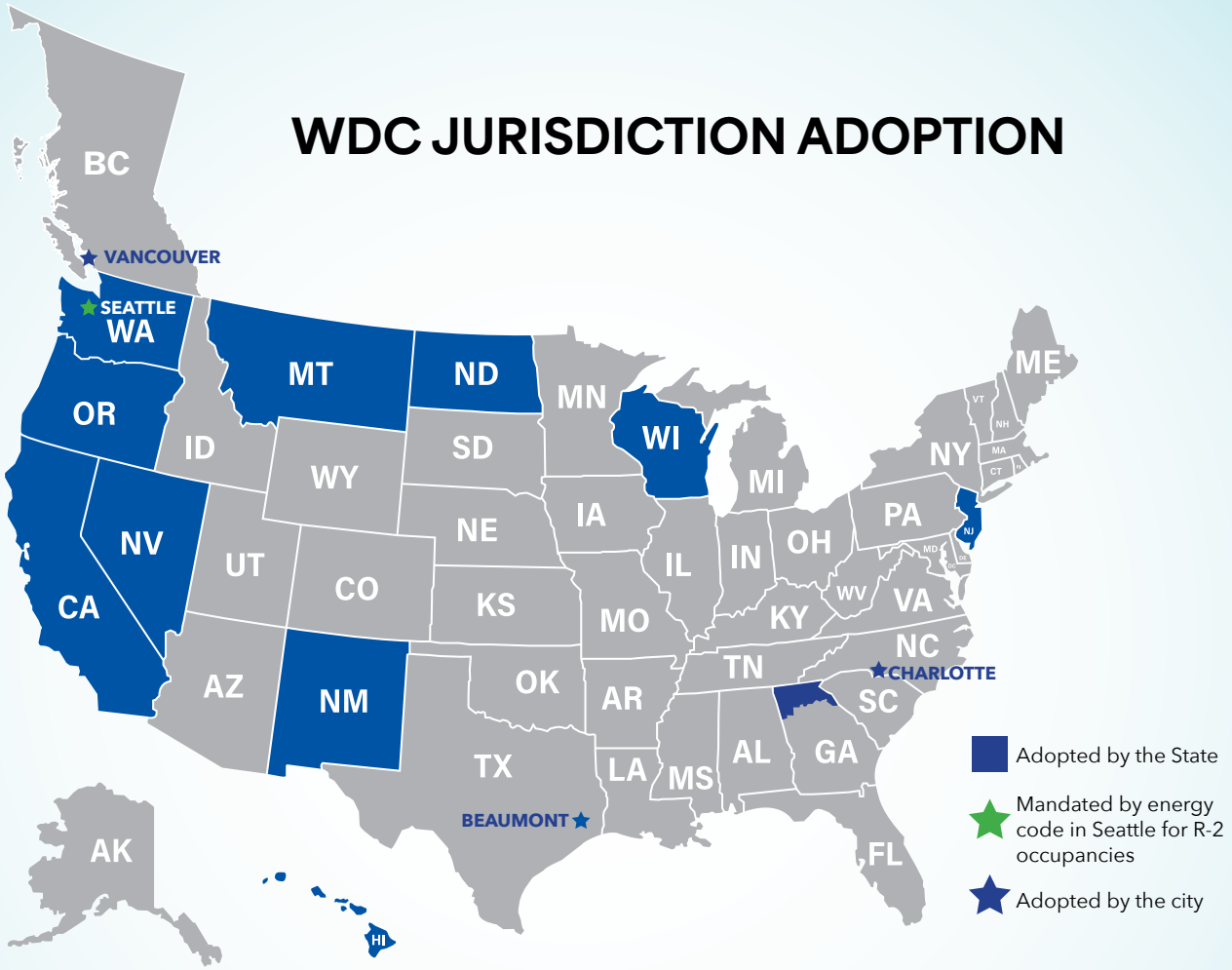


Figure 1 Comparison of Design to Actual Peak Flow Rates in Multifamily Buildings.

Credits: Observed peak flow rate data was collected and provided by the Association for Energy Affordability, Center for Energy and Environment, E2G Solar, Ecotope, Frontier Energy, and the University of California Davis Western Cooling Efficiency Center. This project was supported in part by a grant from the Minnesota Department of Commerce, Division of Energy Resources through the Conservation Applied Research and Development (CARD) program.

[i] The analysis compared WSFU and WDC design predictions to actual data for hot water flow rates in 20 multifamily buildings, which range in size from 8 to 384 apartments. The analyzed actual data was mostly for hot water flow rates because hot water data was readily available from data collection efforts serving energy efficiency projects not related to water pipe sizing. Data was collected during the period of 2019 to 2022; monitoring period ranged from 9 days to over 2 years, and logging interval ranged from 1 to 60 seconds. Buildings are ordered by Standard Practice Design (WSFU method) value. Standard Practice Design values for last four buildings on the left exceeded 100 gallons per minute and are not included in this figure. Observed peak flow rate is the 99th percentile of non-zero flow rates observed over each study's duration. The report summarizing the study can be found at https://localenergycodes.com/content/reach-codes/energy-plus-water-1.

WDC JURISDICTION ADOPTION



Note: This list represents the best information of known adoptions based on information between Technical Services & Research department and Field Services department.

Foster CIty, CA https://www.codepublishing.com/CA/FosterCity/?FosterCity15/FosterCity1516.html&?f
San Jose, CA https://library.municode.com/ca/san_jose/codes/code_of_ordinances?nodeId=TIT24TECO_CH24.04PLCO_PT1ADCPPR
Charlotte, NC (Water Department) domestic-meter-selection-guidelines.pdf (charlottenc.gov)
Hawaii https://up.codes/viewer/hawaii/upc-2018/chapter/M/peak-water-demand-calculator#M%20101.0
Nevada https://up.codes/viewer/nevada/upc-2018/chapter/M/peak-water-demand-calculator#M
New Mexico https://www.rld.nm.gov/wp-content/uploads/2022/03/14.8.2_Integrated-003.pdf
North Dakota Section 62-03.1-01-01 - Conformance with the North Dakota Plumbing Code, N.D. Admin. Code 62-03.1-01-01 | Casetext Search + Citator
Oregon https://epubs.iapmo.org/2021/OPC/
Seattle, WA https://www.seattle.gov/Documents/Departments/SDCI/Codes/PlumbingCode/2018SeattlePlumbingCode.pdf
Wisconsin https://www.iapmo.org/media/29759/wisconsin_pp-031603529-ptoaa.pdf

WDC STANDARD ADOPTION LIST

STATE	REFERENCED	NOTES
WELL Building Institute	X	Standard for wellness, water section
FGI Healthcare Guidelines	X (2026)	Healthcare Code Appendix (Proposed)
Green Building Initiative	X	Standard for green buildings
AWWA M22	X	Standard for water meter sizing
Pacific Institute Water Use Advisory Group Proposed	X	Report, structural water savings
ASPE Engineering Methodologies to Reduce the Risk of Legionella in Premise Plumbing Systems	X	Guide, Legionella Risk Mitigation. Recommend using WDC to reduce water age.
ASPE Plumbing Engineering Design Handbook 2: Plumbing Systems 2022 - 2023	X	Guidance for water systems sizing, referenced as accepted engineering practice