# Alternative Methodology for Sizing Water Demand

**California Plumbing Code** Effective Date: July 1, 2024

Complete Report

In California, it is standard practice to determine peak water demand and supply pipe sizing for a building using the California Plumbing Code (CPC) Appendix A. CPC Appendix A is based on the Uniform Plumbing Code (UPC) Appendix A model code, which in turn is based on the Hunter's curve developed in 1940. UPC Appendix M "Peak Water Demand Calculator" offers an alternative methodology for estimating the peak water demand (in gallons per minute) for the building supply, principal branches, and risers. The peak water demands derived using UPC Appendix M impact sizing of these water supply pipes in new single family and multifamily buildings. The alternative approach of using UPC Appendix M methodology in conjunction with CPC Appendix A for pipe sizing yields lower design flow rates and smaller distribution piping when compared to using only CPC Appendix A.

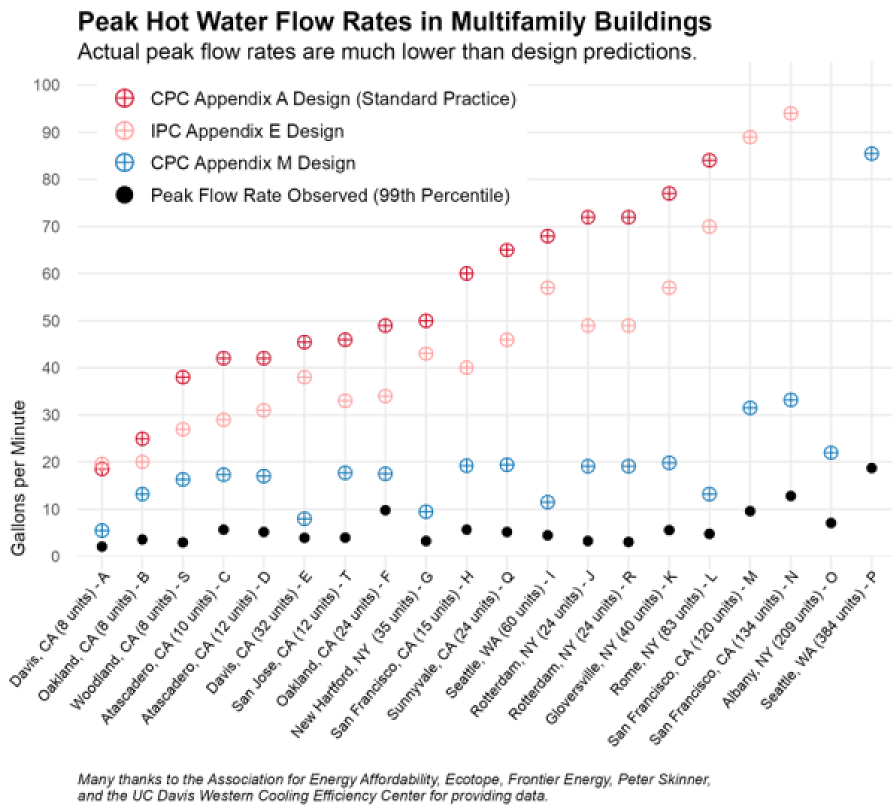
On August 1, 2023, the California Building Standards Commission approved the adoption of UPC Appendix M into the CPC, effective July 1, 2024. The statewide adoption of UPC Appendix M into the CPC enables the voluntary use of Appendix M for residential occupancies that fall within the jurisdiction of the California Department of Housing and Development. The statewide adoption makes it equally convenient to use CPC Appendix A or Appendix M for estimating peak water demand in single family and multifamily dwellings.

With this statewide adoption, there is an opportunity for local jurisdictions to facilitate the use of the alternative methodology on construction projects and to evaluate whether mandatory use of CPC Appendix M for estimating peak water demands in residential buildings is appropriate within their jurisdiction.

The analysis compared UPC/CPC Appendix A and M design predictions to actual data for hot water flow rates in 20 multifamily buildings, which range in size from 8 to 384 apartments. Data for a total of 20 multifamily buildings were collected during the period of 2019 to 2022. The monitoring period ranged from 9 days to over 2 years, and logging interval ranged from 1 to 60 seconds depending on the building.

Figure 1 compares the monitoring data for hot water flow rates in 20 multifamily buildings to design estimates for the peak hot water demand based on 2022 CPC Appendix A (red crosshairs), 2021 International Plumbing Code (IPC) Appendix E (pastel red crosshairs), and 2022 CPC Appendix M (blue crosshairs).This comparison shows that UPC/CPC Appendix M is a more accurate, but still conservative, approach to estimating peak water flow rates.

### Figure 1. Comparison of Design Predictions to Actual Peak Flow Rates




The report identifies two types of savings outlined below.

- Construction cost savings result from:
  - Smaller diameter pipes and fittings, valves, pumps, and other equipment,
  - Smaller inside diameter pipe insulation, and
  - Smaller water service entrance size, which allows smaller water meter size with lower connection fees.
- Operational cost savings, which will continue for the life of the building, result from:
  - Water savings from faster hot water delivery, producing smaller monthly water service charges and lower associated volumetric sewer charges,
  - Energy savings due to decreased heat loss in the hot water distribution system, particularly in multifamily buildings with a recirculation system, and
  - Embedded energy savings for the water and wastewater utilities due to customer indoor water savings.

The reduction in construction costs from right-sizing the supply piping is estimated to be on the order of $600-$1,200 per apartment or dwelling unit for multifamily buildings.

Table 1 offers preliminary conservative estimates for annual water and energy savings per dwelling unit.

### Table 1. Estimated Annual Water and Energy Savings Per Dwelling Unit

| Building Type | Water Savings (gal/Dwelling Unit per Year) | Embedded Electricity Savings (kWh/Dwelling Unit per Year) | Natural Gas Savings (therms/Dwelling Unit per Year) |
|---|---|---|---|
| Low-Rise Loaded Corridor, 3-story, 24-unit building in Sunnyvale, CA | 404 | 2.0 | 7.1 |
| Prototype Low-Rise Garden Style, two-story, eight-unit building | 257 | 1.2 | 2.8 - 3.0 |
| Prototype Mid-Rise Loaded Corridor, three-story, 36-unit building | 320 | 1.6 | 3.7 - 4.0 |
| Prototype Mid-Rise Mixed-Use, five-story, 96-unit building | 234 | 1.1 | 4.0 - 4.5 |
| Prototype High-Rise Mixed-Use, 10-story, 108-unit building | 248 | 1.2 | 4.4 - 4.9 |
| Single Family Dwelling | 1,096 | 5.3 | 7.7 |

The estimates of natural gas savings assume water heating using natural gas. For dwellings on a heat pump water heater instead of natural gas water heater, the estimated natural gas savings would need to be converted into electricity savings, accounting for a different water heater efficiency factor.

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This program is funded by California utility customers and administered by Pacific Gas and Electric Company, San Diego Gas & Electric Company (SDG&E®), and Southern California Edison Company under the auspices of the California Public Utilities Commission and in support of the California Energy Commission.

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