BSR/ASHRAE/ASPE/AWWA Standard 191P

Public Review Draft

Standard for Water Balances and Efficiency in Mechanical and Process Systems

Fifth Public Review (April 2025)
(Draft Shows Proposed Independent Substantive Changes to Previous Public Review Draft)

This draft has been recommended for public review by the responsible project committee. To submit a comment on this proposed standard, go to the ASHRAE website at www.ashrae.org/standards-research--technology/public-review-drafts and access the online comment database. The draft is subject to modification until it is approved for publication by the Board of Directors and ANSI.

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Foreword

In 2007, ASHRAE, USGBC, ASPE, and AWWA entered into an agreement to jointly sponsor Standard 191 and any subsequent addenda. (The USGBC subsequently withdrew from sponsorship.) By mutual agreement, ASHRAE is the lead organization responsible for the administration and maintenance of the joint standard. Although SPC 191 is the consensus body developing the proposed standard, the procedures of the individual organizations have been followed with regard to approval of this public review draft.

- *ASPE - the American Society of Plumbing Engineers. An international professional society serving the plumbing engineer and designer community by providing education, credentialing, research, standards and technical publications with the ultimate purpose of protecting public health and safety through adequate plumbing system design*.
- *AWWA – the American Water Works Association. An international nonprofit educational association dedicated to safe water. Founded in 1881 as a forum for water professionals to share information and learn from each other for the common good, AWWA is the authoritative resource for knowledge, information, and advocacy for improving the quality and supply of water in North America and beyond.*

The ASHRAE 191 Committee decided to develop a more comprehensive foreword to this standard to provide additional context for new users of the standard and to users that are new to water use in general. The primary goal of this standard is to not dictate solutions but to inform users of the comprehensive impact of their design choices. Energy and air quality are in general well understood and addressed by much of the buildings industry, but water less so. The goal of this standard is to put water on par with energy and indoor environmental quality given its criticality to the health and well being of building occupants and building systems and equipment.

Over the past several decades regulations have been implemented to encourage improved fixture performance and irrigation practices. Regulations governing the water performance of Mechanical systems and Process equipment have lagged, creating a gap. Standard 191 attempts to fill this gap by focusing on both Mechanical and Process systems. Furthermore, Standard 191 sets requirements for whole building water balances that will enable authorities having jurisdiction to account for water performance similar to the energy cost budget and performance rating methods found in ASHRAE Standards 90.1 and 90.2.

No additional plumbing or irrigation regulations are included in this standard as standards already exist to address these. Additional regulations have the potential for creating conflicts among codes and standards, which creates hardships for design professionals. Plumbing fixture flow rates and consumption values and irrigation are included following project specified codes and standards in the water balance to ensure all water uses are accounted for in the analysis.

Water efficiency and conservation are critical factors in the design and operation of buildings. Buildings use 20% of the world's available water, a resource that becomes scarcer each year, according to the United Nations Environmental Program. Efficient practices and products provide opportunities to save significant amounts of water. The reduction of energy use and operating costs and the expectation of increased government regulation will continue to drive faster adoption of water-efficient products and methods.

Buildings use water in many ways; sometimes too subtle for building occupants to notice such as slow water leaks that waste billions of gallons of water each year as not all leaks cause physical damage. Regulations on fixtures and irrigation have been out in front as it is water that users see and interact with at home and at work. However, for many water intense facilities, Mechanical or Process systems may account for most of the water consumption. For example, in water-cooled data centers, *over 99% of all water consumed is for heat rejection. In a hospital, less than 20% of water is consumed in fixtures with the bulk going towards heat rejection and process equipment such as sterilizers and cart washers. Still, there are other facilities where nearly 100% of the water is consumed in fixtures that building occupants interact with daily. To identify where water is consumed; Standard 191 begins with a water balance so that intelligent design decisions can be made as to where water is most likely consumed. The figure below shows how variable the typical water balance may be from building to building, which is why completing a balance is a critical first step.*

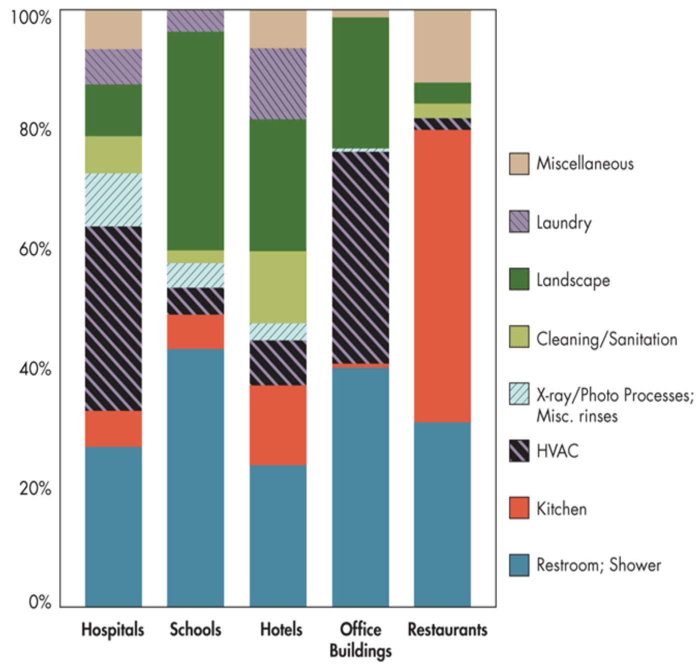


Figure I: Water Use in Buildings.

Maximizing the water efficiency of buildings is, by definition, an interdisciplinary process as no one discipline is always the largest water consumer. To optimize water efficiency in buildings, plumbing, fire protection, and HVAC&R engineers must work closely with civil engineers and landscape architects in putting together a functional building mechanical system. This new standard will rely heavily on the latest detailed design guidelines and information published by the National Fire Protection Association (NFPA), the American Water Works Association (AWWA), the American Society for Plumbing Engineers (ASPE), and the Irrigation Association.

Water:Energy Nexus

The continued security and economic health of the population depends on a sustainable supply of both water and energy. These two critical resources are inextricably and reciprocally linked. A nation's ability to continue providing both clean, affordable energy and water is being seriously challenged by a number of emerging issues.

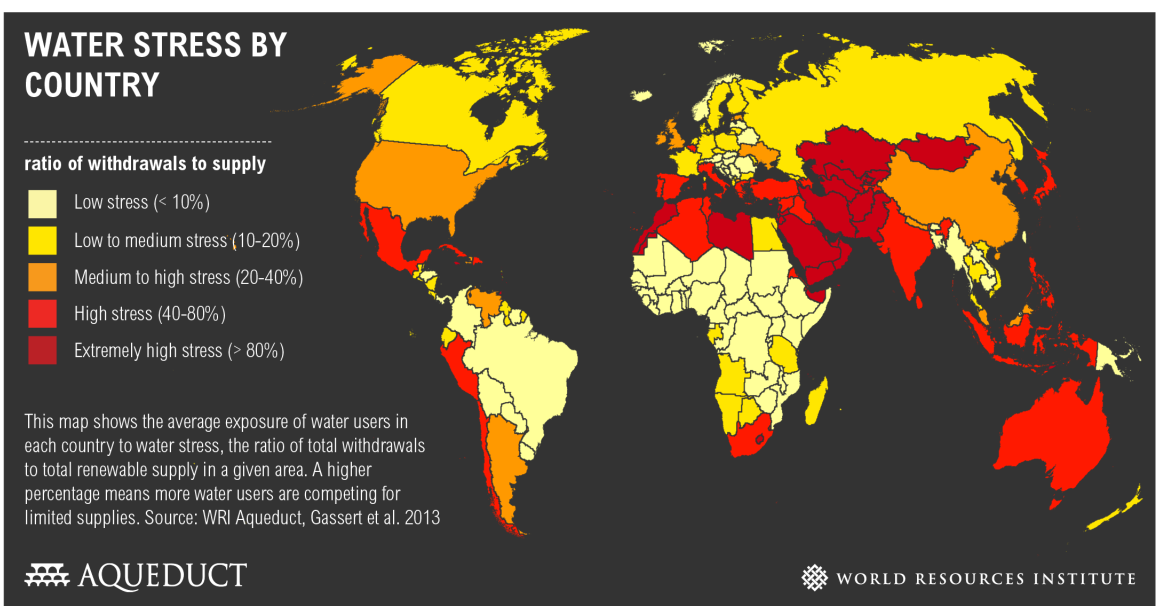
Energy production requires a reliable, abundant, and predictable source of water, a resource that is already in short supply throughout much of the U.S. and the world. The electricity industry is second only to agriculture as the largest user of water in the United States. Electricity production from fossil fuels and nuclear energy requires 133,000 million gallons of water per day, accounting for 41% of all freshwater withdrawals in the nation, with 71% of that going to fossil-fuel electricity generation alone[1].

According to the World Health Organization, approximately 2.4 billion people live in highly water-stressed areas. Two primary solutions—shipping in water over long distances or cleaning nearby,

[1] Estimated Use of Water in the United States in 2015. Circular 1441. U.S. Department of the Interior, U.S. Geological Survey. 2018. https://pubs.er.usgs.gov/publication/cir1441

but dirty, supplies—both require large amounts of energy. Therefore, there is a significant amount of embedded energy in the water we use to drink, cook, flush toilets, and bathe.

Figure II: US Water Availability Map.[2]



[2] Water Stress in the U.S. https://www.globalchange.gov/browse/multimedia/water-stress-us

Figure III: World Water Availability Map. [3]

In areas where water supply is not plentiful, a design engineer should consider taking into account the total energy required to operate a cooling plant, including the embedded energy of treating and conveying the water to the building and the power plant.

Therefore, when evaluating predicted energy (and carbon) loads for alternative building system design options, it is important to look at the embedded energy of the water.

Additional reference material:
Sandia National Laboratories- The Energy Water Nexus: https://energy.sandia.gov/programs/energy-water/

Energy versus Water: Solving Both Crises Together, Michael E. Webber, Scientific American Special Editions - October 22, 2008
https://www.scientificamerican.com/article/the-future-of-fuel/

Cooling Tower Institute Paper No: TP10-16 Water/Energy Nexus, Comparing the Relative Value of Water versus Energy Resources.

Water Supply & Cost

This basic resource is obviously essential at every building site, but what has changed over the last several decades is the realization that it is fast becoming a precious resource. While the total amount of water in its various forms on the planet is finite, the amount of fresh water, of a quality suitable for the purposes for which it may be used, is not uniformly distributed (e.g., 20% of the world's fresh water is in the United States' Great Lakes); elsewhere, it is often nonexistent or in very meager supply. Nevertheless, water must be allocated somehow to the world's populated lands, many of which are undergoing rapid development. In short, it is becoming more and more difficult to provide for the adequate and equitable distribution of the world's water supply to those users for whom it is essential.

This trend has implications for not only how prudently we use the water we have, but also what we do to avoid contaminating water supplies. While many of the measures to protect and preserve the world's freshwater supplies are beyond ASHRAE's purview, the purpose of this standard is to make sure that the building designers and operators address the appropriate measures relating to building sites that will have a significant impact on the availability of clean water for the local and global citizens.

The cost of water and sewer is rising at an average rate of 6% per year and as high as 30% per year in a single year in many locations (Black & Veatch). The drivers for this are many and are almost always local: population growth, aging infrastructure, climate change, declining water quality, and accounting practices are the common causes. Furthermore, water prices are local and are not always driven by scarcity. Designers are encouraged to review utility rates for all projects on a case-by-case basis as the prices may vary widely even a few miles down the road.

Water Quality
The intent of this standard is in no way to compromise health and safety of building occupants or occupants outside the building. Design engineers are encouraged to investigate technologies not only from efficiency perspectives but also water quality to ensure safety and long-term functionality of equipment.

Codes and Standards Alignment
There numerous other codes and standards that address water efficiency on a variety of levels. Standard 191 is meant to fill a gap that exists in the water efficiency industry at the building and systems level for mechanical systems and process equipment. Everywhere in the United States is

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[3] Water Stress by Country: http://www.wri.org/resources/charts-graphs/water-stress-country

already covered by plumbing efficiency codes and many jurisdictions have irrigation ordinances. Most jurisdictions however do not have codes or standards around mechanical systems or process equipment. Standard 191 is meant to address these missing pieces.

Furthermore, most jurisdiction in the United States have energy codes that do impact water efficiency, mostly through heat rejection. This standard is intended to work with energy codes and standards and should not make a building less energy efficient.

1. PURPOSE

1.1 The purpose of this standard is to document a comprehensive *water balance* and define baseline requirements for the efficient use of water in mechanical and process *systems*.

1.2 The purpose of the *water balance* is to identify the volumes of water from sources and to uses within a user-defined project boundary. The goal is to highlight potential opportunities to maximize the efficient use of water.

2. SCOPE

2.1 This standard provides minimum criteria that:

a. Apply to new *buildings* and renovation projects (new portions of *buildings* and their *systems*) and the surrounding *building site*: a *building* or group of *buildings*, that utilize a single submittal for a construction *permit* or which are within the boundary of a contiguous area under single ownership.
b. Addresses water use through the concept of a *water balance* and *efficiency* measures implemented during design, construction, and operation of *residential*, commercial, institutional, and industrial projects.

2.2 The provisions of this standard do not apply to:

a. Storm or *building* wastewater management, except as a means of reducing water use for mechanical and process *systems* as defined in the standard.
b. Industrial process *systems* that are not identified within the standard.

2.3 This standard shall not be used to circumvent any safety, health, or environmental requirements.

2.4 This standard shall not be used to circumvent local or state water rights laws or any other local, municipal, and/or state statutes.

3. DEFINITIONS, ABBREVIATIONS, ACRONYMS

~~***ASME:*** The American Society of Mechanical Engineers. A nonprofit organization that enables collaboration, knowledge sharing, career enrichment, and skills development across all engineering disciplines.~~

ASPE: The American Society of Plumbing Engineers. An International Organization for Plumbing System Design Professionals. ASPE is dedicated to the advancement of the science of plumbing engineering, the professional growth and advancement of its members, and the health, welfare, and safety of the public.

~~***Approved Source*:** an independent person, firm, or corporation, *approved* by the *code official*, who is competent and experienced in the application of engineering principles to materials, methods, or *systems* analyses.~~

Baseline Building Design: a computer representation of a hypothetical design based on the *proposed* design ~~*building* project~~. This representation is used as the basis for calculating the *baseline building performance* for rating above-standard design.

Baseline Building Performance: the annual water use for a *building* design intended for use as a baseline for rating above-standard design when using the *Performance Rating Method.*

Closed Water Loop: ~~a *control* system for an operation or process that provides feedback to the processes being controlled/executed, and/or a system by which the medium, resource, or entity conveyed within the system remains constant in net measure despite differential in energy level, form, or concentration at various points in the loop.~~ circulation systems that function in a contained environment where the water remains isolated from the atmosphere and the makeup requirements are minimal.

Commercial Food Service Operation: A *building* that contains water-using *equipment* for the purposes of preparing food/beverages and/or washing food/beverage preparation materials.

~~***Detention:*** the short-term storage of stormwater on a site in order to regulate the runoff from a given rainfall event and to *control* discharge rates to reduce the impact on downstream stormwater *systems*.~~

~~***Improved Landscape Area:*** any disturbed area of the site where new plant and/or grass materials are to be used, including green roofs, plantings for *stormwater controls*, planting boxes, and similar vegetative use. Improved *landscape* shall not include hardscape areas such as sidewalks, driveways, other paved areas, and swimming pools or decking.~~

~~***Irrigation Association:*** a non-governmental professional association dedicated to promoting efficient irrigation through improved industry proficiency, advocacy for sound water management, and increased *demand* for improvement in water-efficient products and services.~~

~~***Labeled:*** equipment or materials to which a *label*, symbol, or other identifying mark of an organization, acceptable to the authority having jurisdiction, has been attached. This organization is concerned with product evaluation and maintains periodic inspection of the production of labeled equipment or materials. By labeling the equipment or materials, the manufacturer indicates compliance with appropriate standards or performance in a specified manner.~~

Non-potable Water: water not intended for human consumption, such as water not intended for drinking, bathing, showering, hand washing, teeth brushing, food preparation, dish washing, and maintaining oral hygiene.

Open Water Loop: ~~a *control* system for an operation or process that does not provide feedback on the processes being controlled/executed, and/or a system by which the medium, resource, or entity conveyed within the system is exhausted after the desired exchange, transfer, or reaction is performed.~~ circulation systems that function in an uncontained environment where the water does not return to the beginning of the process.

~~***Operations:*** a facility is operational during the time when the primary activity that facility is designed for is taking place. For Group A and Group M occupancies, this is the time during which the facility is open to the public.~~

~~***Plumbing Fixtures and Fittings:*** (1) a device that is part of a system to deliver and drain away water and waste but is also configured to enable a particular use. (2) end-use equipment such as sinks, lavatories, toilets, showers, drinking fountains, etc.~~

Proposed building performance: the annual water use ~~cost~~ calculated for a *proposed design*.

Proposed Design: a computer representation of the actual proposed building design, or portion thereof, used as the basis for calculating the design water use.

~~***Rainwater Collection and Conveyance System:*** *rainwater* collection system components extending between the collection surface and the storage tank that convey collected *rainwater*, usually through a gravity system.~~

~~***Registered Design***~~ ***Water Quality Professional:*** ~~an individual who is registered or licensed to practice their respective design profession as defined by the statutory requirements of the professional registration laws of the state or jurisdiction in which the project is to be constructed.~~ An individual with additional training/experience such as AWT-Certified Water Technologist or equivalent.

~~***Registered Design Professional in Responsible Charge:*** a *registered design professional* engaged by the owner to review and coordinate certain aspects of the project, as determined by the~~

~~building official, for compatibility with the design of the building or structure, including submittal documents prepared by others, deferred submittal documents, and phased submittal documents.~~

~~***Retention (Stormwater):*** the permanent holding of stormwater on a site, preventing the water from leaving the site as surface drainage and allowing for use of the water on site, or loss of the water through percolation, evaporation, or absorption by vegetation.~~

~~***Roof Rain Water:*** Rain water falling onto a *building* roof prior to treatment or use.~~

~~***Salt Water:*** Saline waters above 1,000 mg per liter.~~

~~***Secondary Standards:*** standards, practices, or policies that ensure that wastewater has been treated to achieve a level of quality that is safe for release into the environment, such as, but not limited to, release into seas, rivers, lakes, and the ground.~~

~~***Tertiary Standards:*** standards, practices, or policies that ensure that wastewater has been treated to achieve a level of quality that is safe for limited reuse and release into the environment, such as, but not limited to, release into seas, rivers, lakes, but not for ground water replenishment.~~

~~***Water Treatment Professional:*** The term "water treatment professional" means any person, either employed by the owner or an outside firm contracted to provide water treatment services for the owner, knowledgeable on the requirements for implementing a water management program for the applicable water system(s) including, but not limited to the *control* of scale, corrosion, fouling, and biological growth while minimizing the use of water.~~

4. WATER BALANCE

4.1 Scope

4.2 Compliance

4.3 Mandatory Provisions

4.3.1 Water Quality

4.3.1.1 A ~~*design*~~ *water quality* *professional* shall determine the water quality needed for each end use and compare it to that expected from the alternate sources to determine applicability.

4.3.1.2 All alternate water sources utilized shall meet the water quality requirements of:

- the *AHJ,*
- applicable equipment manufacturer,
- International Association of Plumbing and Mechanical Officials, 2020 Water Efficiency and Sanitation Standard (WE-Stand), Chapter 6,
- 2014 ASHRAE 189.1 (2015 ICC Green Construction Code, Chapter 7),
- the 2017 ANSI/NSF 350 or 350-1 standard for water quality as applicable.

5. HVAC SYSTEMS AND EQUIPMENT

5.1 Scope

5.2 Compliance

5.3 Mandatory Provisions

5.3.3 *Meters*

5.3.4 Open Towers

5.3.5 The water treatment program for *systems* containing *open circuit cooling towers* for heat rejection~~-~~*systems* shall be designed, built, and operated for maximum water conservation by maintaining at least one of the limiting parameters at 90% or more of, but not to exceed the maximum value shown in Table 5-2.

5.3.6

5.3.7 General. Baseline Minimum Energy *Efficiency* Requirements – equipment shall comply with *ASHRAE* 90.1-2022 ~~2019~~, Efficiencies – Standard Rating and Operating Conditions.

5.4 Prescriptive Option

5.4.3 Ground Source Heat Pump *Systems*

5.4.3.1 Ground Water Heat Pump *Systems* (*Open Water Loop*)

1. *Ground water heat pump* (GWHP) *systems* shall conform to all regulatory requirements applicable to the *building site* at which the system is installed. 100% of water drawn from an *aquifer* shall be injected (re-injected to the *aquifer* from which it was withdrawn. The ground water shall be returned to the producing *aquifer* unchanged with the exception of temperature.

   Exception: Surface disposal of ground water withdrawn from an aquifer for use in a GWHP system shall be *permitted* only in those *non-residential* applications in which:

   a. *Aquifer* testing and analysis by a registered hydrology consultant demonstrates that surface disposal from the GWHP system does not result in *aquifer* decline over the expected life of the system, or

   b. All of the surface disposal flow from the GWHP system is subsequently delivered to a beneficial use (*irrigation system*, industrial use, stock water).

3. GWHP *systems* employing surface disposal for any portion of the ground water shall be equipped with a totalizing water *meter* to record the total flow diverted to surface disposal. Annual total ground water use shall be recorded by the owner and these records maintained in such a manner as to be available to the responsible regulatory agency.

4. The *building* loop piping of the GWHP system shall be subject to the same makeup water *metering* requirements for hydronic *systems* found in Section 5.3.3 of this standard.

5.4.3.2 Ground Coupled Heat Pump Systems (*Closed Water Loop*)

1. *Ground coupled heat pump* (GCHP) *systems* shall not be designed or installed incorporating a water supply system ("soaker system") intended to artificially re-hydrate the soil in the ground loop zone using anything other than *reclaimed water*.

2. GCHP *systems* involving the use of a *cooling tower* (aka Hybrid *systems*) shall conform to all requirements associated with cooling tower operation as provided in Section 5.3 of this standard.

3. Loop piping for GCHP *systems* shall be subject to the same makeup water *metering* requirements for hydronic *systems* found in Section 4.4.3 of this standard.

4. Leak detection: shall incorporate a leak detection system with an alarm or positive displacement *meter* on water makeup points to prevent fluctuation in the internal system pressure.

5.4.5 Evaporative Air Coolers

Direct and indirect evaporative air coolers greater than 30,000 cfm of supply air shall be designed to conserve water. Their design shall include:

1. Positive closing water makeup valves.
2. Overflow located in quiescent area of sump, away from makeup valve and return water.
3. Positively closing sump drain located in the lowest area of sump.
4. Fully drainable sump <u>with an overflow alarm</u>.
5. Sumps shall be sized to hold all returned water when pumps are shut off.
6. No water carry over through sufficient sizing of the system or using a mist eliminator.
7. When mist eliminators are used, the captured water shall be returned to the evaporative cooler sump.
8. Bleed off shall be controlled by *conductivity* controllers.
9. Temperature or humidity shall be controlled with a thermostat or humidistat.

6. APPLIANCES AND EQUIPMENT

6.1 Scope

6.2 Compliance

6.3 Mandatory Provisions

6.3.4 Laboratory Facilities (e.g., biomedical, chemical, animal, *vivarium*)

6.3.4.1 *Once through cooling* with *potable* water is prohibited for all laboratory equipment during normal operation and shall use one of the following:

1. Cooling tank
2. *Closed* <u>water</u> *loop* chilled water cooling
3. *Non-potable water* cooling with tempering system
4. Dry Heat

Informative Appendix B: Water Performance Modeling

B3 CALCULATION OF THE *PROPOSED BUILDING PERFORMANCE* AND SITE WATER

B3.1 *Building* Performance Calculations The simulation model for calculating the proposed and *baseline building performance* shall be developed in accordance with the requirements in Table B3.1.

Table B3.1 Modeling Requirements for Calculating *Proposed* and *Baseline Building Performance*

No	***Proposed Building Performance***	***Baseline Building Performance***
1. **Design Model**		
2. **Additions & Alterations**		
3. **Space Use Classification**		
Usage shall be specified using the *building* type or space type lighting usage classifications in accordance with *ASHRAE* 90.1-2022 ~~2016~~ Section 9.5.1 or 9.6.1. The user shall specify the space use classifications using either the *building* type or space type categories but shall not combine the two types of categories. More than one *building* type category may be used in a *building* if it is a mixed-use facility. If space type categories are used, the user may simplify the placement of the various space types within the *building* model, provided that *building*-total areas for each space type are accurate.		Same as *Proposed design*
4. **Schedules**		
5. **Plumbing *Fixtures***		
6. Process Water		
7. Mechanical *Systems*		
The mechanical system type and all related performance parameters in the *proposed design*, such as equipment capacities and efficiencies, shall be determined as follows: a. b. c. d. Where no cooling system exists or no cooling system has been specified, the cooling system shall be identical to the system modeled in the *baseline building design*.		Same as *Proposed Design*

Exception to (d): Spaces using *ASHRAE* 90.1-2022 ~~2019~~ baseline HVAC system types 9 and 10.	
8. *Irrigation System*	
9. Precipitation	