EBMUD Commercial Guidebook:
Pools and Spas

POOLS AND SPAS

Pools, spas and hot tubs can waste large volumes of water if not properly designed, equipped, and maintained for efficient operation. Recommended practices for suitable design, equipment, and maintenance of these water features can be summarized into five principles:

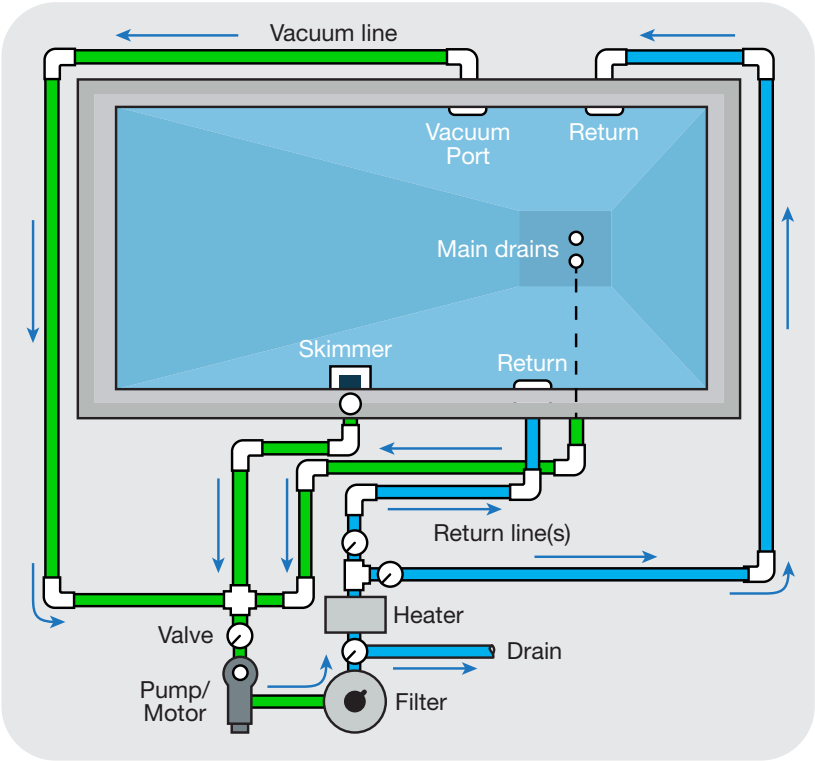
1. Install water features only where they provide tangible benefits.
2. Choose alternative types and sizes that use less water.
3. Design the mechanical equipment to filter, clean, and operate efficiently.
4. Design the water feature and ambient surrounding area to minimize water loss.
5. Promptly inspect, repair, and replace any components that are not working properly.

The primary uses of water in water features are for make-up (filling), splashing and drag-out (water removed when a person exits a pool or spa), backwashing the filter (cleaning the filter), and replacing water lost to leaks and evaporation. Practices and considerations that will result in more efficient water use include:

- Periodically checking for and repairing leaks.
- Installing a submeter for the pool or spa to track the feature's use and easily identify leaks.
- Tracking water use on a weekly or monthly basis.
- Choosing a filtration system that minimizes water use while accommodating cost considerations.
- Maintaining proper pool chemistry and keeping water features free of debris to limit cleaning and drainage events.
- Including splash troughs that drain back into the pool.
- Using a secure and durable pool cover anytime practicable, especially over an extended off-season period.
- Carefully monitoring backwashing to ensure that times are not excessive and reuse backwash water for irrigation where possible.
- Considering use of alternative water sources such as rainwater for fountains and other water features.

Draining and Refilling Pools and Spas

The following diagram shows how a pool works:



Water is used to refill a water feature to make up for water lost through evaporation, splash-out, or to replace water lost during filter backwash. Refilling also occurs when the water feature is drained, either for periods of non-use or when the total dissolved solids (TDS) content of the water has become too high. How often a pool or spa will require draining and refilling varies based on use, maintenance, temperature and more. Based on multiple sources, recommendations range from every three to seven years. The American National Standard for Water Conservation Efficiency in Residential and Public Pools, Spas, Portable Spas and Swim Spas recommends the following options to lower TDS levels as an alternative to draining and re-filling the water feature:

- Use reverse osmosis or nanofiltration.
- Use ozone and/or ultraviolet light (UV) to allow for lower chlorine demand which will help to reduce the buildup of TDS.[1]

1 Association of Pool & Spa Professionals. (2017). ANSI/APSP/ICC-13 2017 American National Standard for Water Conservation Efficiency in Residential and Public Pools, Spas, Portable Spas and Swim Spas. *https://issuu.com/thephta/docs/apsp-13_2017*

Drained water can be reused for irrigation if the dissolved solids are controlled, and chemical and chlorine levels are not too high

- Allow pool or spa drainage water to settle until the chlorine concentration is 1.0 milligrams per liter. This meets most municipal potable-water parameters, at which time it is safe to use for landscape irrigation.
- The pH level of public pool or spa water should be between 7.2 and 7.8.[2]
- The water should be clear with no algae present.
- Plants in the landscape where pool or spa water is being used for irrigation should have a salt tolerance. Some species do not tolerate water with salt, such as fruit trees, roses, and star jasmine.
- Lawns can be watered with pool or spa water if the chlorine content is low.

If using drained pool or spa water for irrigation is not an option, always check local ordinances regulating discharges to the sanitary sewer or storm drain system (if separate in the applicable jurisdiction). Many cities in California prohibit the discharge of pool or spa water to the street, gutter, or storm drain due to the possible presence of chlorine and copper. Copper is sometimes used in pool and spa treatment as an algicide, and both treatments are toxic to aquatic organisms.[3]

Operational Water Loss

Water loss in water features is primarily caused by evaporation, leaks, splashing, and/or "drag-out," the water that is removed when a person exits a pool or spa.

Evaporation

The rate of evaporation from a pool, spa, or other water feature is dependent on several variables, including temperature, humidity, wind speed, pH and chemical content of the water. The California Water Efficiency Partnership estimates that evaporation accounts for 56% of pool water use across all pools installed in California.[4] This water must be replaced to keep the water at the proper level.

To reduce evaporation, operators of pools, spas, fountains and other water features should observe the following practices when applicable:

- Cover pools and spas when not in use to reduce evaporation and keep water cleaner.

The Environmental Protection Agency (EPA) estimates that, depending on climate, an uncovered 500-square-foot swimming pool could lose between 12,000 and 31,000 gallons of water per year on average due to evaporation.[5]

  - Covers range from single sheets of plastic to insulated materials. Using a solid pool cover can reduce evaporation by over 90%.[6]
    - The EPA provides additional guidance on pool covers here.
  - In California, Title 24 requires that a heated pool be covered when not in use.[7]
- Reduce water temperature in pools and spas
  - The greater the temperature differential between ambient air temperature and water, the higher the rate of evaporation.
- Use low water, size appropriate plant material and fences as windbreaks to reduce water loss due to wind evaporation.
- Turn off the tile-spray device on automatic pool cleaners.

2 Centers for Disease Control and Prevention. (2022). Operating Public Swimming Pools. *https://www.cdc.gov/healthywater/swimming/aquatics-professionals/operating-public-swimming-pools.html*

3 Alameda County Clean Water Program. (2013). Proper Disposal of Wastewater. *https://cleanwaterprogram.org/wp-content/uploads/2022/11/Pools-Spas-and-Fountains.pdf*

4 U.S. Environmental Protection Agency. (2017). WaterSense at Work: Best Management Practices for Commercial and Institutional Facilities. *https://www.epa.gov/watersense/best-management-practices*

5, 6 U.S. Environmental Protection Agency. (2022). Jump Into Pool Water Efficiency. *https://www.epa.gov/system/files/documents/2022-09/ws-outdoor-pool-guide.pdf*

7 Koeller, John & Hoffman, H.W. Bill. (2010). Evaluation of Potential Best Management Practices - Pools, Spas, and Fountains. California Water Efficiency Partnership. *https://calwep.org/wp-content/uploads/2021/03/Pools-Spas-and-Fountains-PBMP-2010.pdf*

- Spray water often evaporates before it hits the tile, splashing invites evaporation losses, and over-spraying can send water out of the pool.

→ Avoid using sprays and finely divided streams of water in fountains and waterfalls.

- Aeration causes a significant amount of evaporation, especially on windy days

Leaks

Pools, spas, and other water features can leak with no obvious signs other than a high-water bill. Leaks can occur in several places in a pool, spa, or water feature, but the most common leaks are due to:

→ Mechanical issues

→ Structural damage, broken tiles

→ Plumbing

→ Broken pipes

→ Loose or broken fittings

Automatically refilling a pool can make it challenging to detect leaks. It is recommended that commercial or public pool and spa operators check for leaks at least once a month by shutting down all filtration systems for 24 hours or the maximum time between closing the pool or spa and opening the next day.[8]

A submeter should be placed on the make-up (fill) water line used for keeping the pool, spa, or other water feature full to determine whether leaks are occurring. A submeter on the make-up line can quickly identify abnormal use and help monitor water use volumes for backwashing filters and other operations. A submeter with Wi-Fi signal that reads water use by the hour could help automate water leak detection. See additional EBMUD guides for more information on submeters here.

TABLE 12-1: Primary Water Uses in Pools and Spas

WATER USE	EFFICIENT PRACTICES
MAKE-UP (filling)	→ Install a submeter so you can monitor water use and identify and repair leaks → Track water use on a weekly or monthly basis (see "Submetering" chapter) → Maintain proper pool chemistry; keep water features free of debris to limit cleaning and drainage events → Consider use of alternative water sources such as rainwater for fountains and other water features
SPLASHING AND DRAG-OUT (water removed when a person exits a pool or spa)	→ Include splash troughs that drain back into the pool
BACKWASHING THE FILTER (cleaning the filter)	→ Choose a filtration system that minimizes water use while accommodating cost considerations → Carefully monitor backwashing to ensure that times are not excessive and reuse backwash water for irrigation where possible
REPLACING WATER LOST TO LEAKS AND EVAPORATION	→ Periodically check for and repair leaks → Use a secure and durable pool cover anytime practicable, especially over an extended off-season period

8 Association of Pool & Spa Professionals. (2017). ANSI/APSP/ICC-13 2017 American National Standard for Water Conservation Efficiency in Residential and Public Pools, Spas, Portable Spas and Swim Spas. *https://issuu.com/thephta/docs/apsp-13_2017*

Finally, installing a length of Plexiglas pipe on the backwash line of a pool or spa can help operators verify if backwash valves are completely closed and that water is not being lost through the backwash line during normal operation.

Splashing and Drag-Out

Water loss due to splashing and drag-out in pools and spas can be reduced through design and operational changes such as:

- Design pools to incorporate splash troughs along the edge to catch water that would normally be splashed out onto the deck. Troughs should drain back into the pool.
- Keep the water level at the lower operational level of the skimmer opening.
- Block the overflow line when the pool is in use or during periods of particularly heavy use.

Filtration and Disinfection

All water features should have properly sized equipment to filter and disinfect the water. The three main types of filters are:

- Sorptive media such as diatomaceous earth filters, perlite filters, and regenerative filters that reuse the filter media
- Sand
- Cartridge

Each type of filter has advantages and disadvantages. Depending upon the type of filtration used, a substantial amount of water may be discharged when the filter is backwashed. The amount of water used to backwash a filter depends upon the size of the pump, which in turn depends upon the size of the pool or spa. In California, the recirculation system needs to have the capacity to provide a complete turnover of pool water (pump it through the filter) per the following specifications:

- One-half hour or less for a spa pool
- One-half hour or less for a spray ground (splash pad)
- One hour or less for a wading pool
- Two hours or less for a medical pool
- Six hours or less for all other types of public pools[9]

Pool filters should be backwashed based on pressure and never on a timer or pre-set schedule.

Manufacturing specifications will direct when to backwash. Automatic backwash equipment will not backwash a filter until the proper pressure drop has occurred, minimizing the number of backwashes to only what is needed.

The American National Standard for Water Conservation Efficiency in Residential and Public Pools, Spas, Portable Spas and Swim Spas recommends that filters be backwashed, replaced, or re-coated when the following conditions occur for each filter type:

- Sand Filters – when the pressure gauge reading is 8-12 PSI higher than the starting pressure or when flow decreases below the required or desired rate.

Table 12-2: Pool Filtration Method/Technology

CHARACTERISTICS	SORPTIVE MEDIA	SAND	CARTRIDGE
Filtration Ability	5 microns	20-40 microns	10-20 microns
Water Usage	**Moderate**	**High**	**Low**
Filter Media Lifetime	2-3 years	3-6 years	2-4 years
Recommended For Use In Large Public Pools	Yes, with proper design	Yes	No, too labor intensive

9 California Association of Environmental Health Administrators. (2018). Public Swimming Pools and Spas. *https://deh.acgov.org/operations-assets/docs/recreationalhealth/Pool_Code_Book_Title_22.pdf*

- Cartridge Filters - when the pressure rises 8-12 PSI above the starting pressure or when flow decreases below the required or desired rate.
- DE Filters - when the pressure rises 8-12 PSI above the pressure reading upon re-coating after cleaning, or when flow decreases below the required or desired rate.
- Vacuum DE/Sand Filters – when the working vacuum reading is 10 in Hg (inches of mercury) above the starting vacuum or when flow decreases below the required or desired rate.[10]

Sorptive Media Filters

Sorptive media filters include conventional diatomaceous earth (DE) filters, perlite filters, and regenerative filters that reuse the filter media. These filters remove particles down to 3-5 microns in size, while silica sand and cartridge filters work in the 10- to 40-micron removal range.[11] Sorptive media filters contain hundreds to thousands of fabric-coated tubes inside a pressure container. The medium (DE or perlite) is made into a slurry and mixed with the water in the filter. The medium is then deposited on the tubes by the water being pumped through the filter. Conventional sorptive media filters must have the DE or perlite replaced after each backwash. With regenerative sorptive media filters, the medium is periodically "bumped" off of the filter tubes by backflow, air agitation, mechanical shaking, or a combination of the three, and then recoated onto the filter cloth. No water is lost in the recoating process. This makes regenerative sorptive media filters very water efficient.

Sand Filters

Sand filters are commonly used for residential pools and can be used for large commercial applications such as public pools and water parks. Sand filters use silica sand, glass, or zeolite to capture particles between 20-40 microns. Sand may last for several years before needing to be completely replaced; however, sand may need to be added periodically to replace any lost during backwash. Backwashing a sand filter is a water intensive process, making these filters the least water efficient.

Cartridge Filters

Cartridge filters are not designed for larger size pools like municipal pools because of the waste of materials and labor-intensive cleaning process. A superior option is to use a reusable filter cartridge that lasts two to five years; however, this requires two sets of filters. When one set is removed for cleaning, it must be soaked in a cleaning solution and then brushed and rinsed off. A significant advantage is that no backwash water is used, making cartridge filters the most water efficient filter option.

Alternatives to Pools

Water-saving alternatives to pools include playscapes that use sprays and other water features activated only when someone is going to use them. Although fine spray and mist can increase evaporation, efficiency is possible if the water is captured and treated after each use. Water can be stored in a tank with a filtration and disinfection system. Tank storage also reduces evaporation and chemical use over an open wading pool, where water is dumped and refilled.

Recommendations

- Consider use of alternatives to wading pools, such as spray-scapes.
- Use pool and spa covers, especially during periods when a pool or spa is not in regular use.
- Require make-up submeters to be installed on all pools, spas, and other water features.
- Require all water features be equipped with recirculating filtration equipment.
- Require in-ground pools to be built with splash troughs around the perimeter.
- Maintain proper water quality levels for key indicators like pH, alkalinity, and hardness to avoid the need to drain the pool or spa.[12]
- Use sorptive media filters where possible for pools.
- Use cartridge filters for smaller spas, where the costs of filters and cleaning make them economically feasible.
- Ensure filters are only backwashed when needed.
- Reuse backwash water for irrigation or consider retreatment and reuse in the pool.
- Use low water, size-appropriate plant material or fences to shade pools and spas and block winds that increase evaporation.

10 Association of Pool & Spa Professionals. (2017). ANSI/APSP/ICC-13 2017 American National Standard for Water Conservation Efficiency in Residential and Public Pools, Spas, Portable Spas and Swim Spas. *https://issuu.com/thephta/docs/apsp-13_2017*

11 Leslie's Pool Care. Pool Filter Comparison. *https://lesliespool.com/blog/pool-filter-media-types-a-comparison-guide.html*

12 U.S. Environmental Protection Agency. (2017). WaterSense at Work: Best Management Practices for Commercial and Institutional Facilities. *https://www.epa.gov/watersense/best-management-practices*

References and Additional Resources

1. Alameda County Clean Water Program. “Proper Disposal of Wastewater.” 2022
   https://cleanwaterprogram.org/wp-content/uploads/2022/11/Pools-Spas-and-Fountains.pdf
2. Association of Pool & Spa Professionals. ANSI/APSP/ICC-13 2017 American National Standard for Water Conservation Efficiency in Residential and Public Pools, Spas, Portable Spas and Swim Spas, 2017
   https://issuu.com/thephta/docs/apsp-13_2017
3. Ibid. ANSI/APSP/ICC-1 2014 American National Standard for Public Swimming Pools, 2014
   https://issuu.com/thephta/docs/apsp-1_2014
4. California Department of Public Health. California Swimming Pool Requirements, 2019
   https://www.cdph.ca.gov/Programs/CEH/DRSEM/Pages/EMB/RecreationalHealth/California-Swimming-Pool-Requirements.aspx#
5. California Association of Environmental Health Administrators. Public Swimming Pools and Spas, 2018
   https://deh.acgov.org/operations-assets/docs/recreationalhealth/Pool_Code_Book_Title_22.pdf
6. Centers for Disease Control and Prevention. Operating Public Swimming Pools, 2018
   https://www.cdc.gov/healthywater/swimming/aquatics-professionals/operating-public-swimming-pools.html
7. De Haan, William. “Michigan Swimming Pool Pest Management - Category 5A.” Michigan State University, 2015
   https://www.canr.msu.edu/resources/swimming_pool_pest_management_category_5a_e2621
8. Harris, Tom. “How Swimming Pools Work.” HowStuffWorks.com, 2015
   https://home.howstuffworks.com/swimming-pool.htm
9. International Code Council. International Swimming Pool and Spa Code. 2021
   https://codes.iccsafe.org/content/ISPSC2021P2
10. Koeller & Hoffman. “Evaluation of Potential Best Management Practices - Pools, Spas, and Fountains.” California Water Efficiency Partnership, 2021
    https://calwep.org/wp-content/uploads/2021/03/Pools-Spas-and-Fountains-PBMP-2010.pdf
11. Leslie’s Pool Care. Pool Filter Comparison
    https://lesliespool.com/blog/pool-filter-media-types-a-comparison-guide.html
12. Northeast Spa & Pool Association
    www.nespapool.org/
13. Pool and Hot Tub Alliance
    https://www.phta.org/
14. U.S. Department of Energy. “Energy Conservation Program: Energy Conservation Standards for Dedicated-Purpose Pool Pumps.” Direct final rule. 2017
    https://www.regulations.gov/document/EERE-2015-BT-STD-0008-0109
15. U.S. Environmental Protection Agency. Cases in Water Conservation. 2002
    https://www.epa.gov/sites/default/files/2017-03/documents/ws-cases-in-water-conservation.pdf
16. Ibid. (2017). Best Management Practices for Commercial and Institutional Facilities
    https://www.epa.gov/sites/default/files/2017-02/documents/watersense-at-work_final_508c3.pdf
17. Ibid. “Jump Into Pool Water Efficiency.” 2002
    https://www.epa.gov/system/files/documents/2022-09/ws-outdoor-pool-guide.pdf
18. Ibid. “WaterSense at Work: Best Management Practices for Commercial and Institutional Facilities.” 2017
    https://www.epa.gov/watersense/best-management-practices
19. Water – Use It Wisely. Saving Water Outdoors
    https://wateruseitwisely.com/saving-water-outdoors/swimming-pools/

The Commercial Water Conservation Guidebook is a resource created and distributed by EBMUD to be used for educational and training purposes. Entities seeking to use any portion for educational or training purposes are authorized to use or reproduce relevant portions. EBMUD asks that you attribute any portion that is used or reproduced to EBMUD and note this book as the source.

East Bay Municipal Utility District

375 11th Street, Oakland CA 94607

Phone: 1-866-403-2683

E-mail: waterconservation@ebmud.com