State of California
The Natural Resources Agency
Department of Water Resources
Division of Statewide Integrated Water Management
Water Use and Efficiency Branch

DRAFT

Commercial, Institutional and Industrial Task Force Water Use Best Management Practices Report to the Legislature

Volume I

A report to the Legislature pursuant to Section 10608.43 of the California Water Code

~~June 28~~October 22, 2012

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Photo Page of Task Force Members

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List of Acronyms

ACWA	Association of California Water Agencies
AFY	Acre-feet per year
ANSI	American National Standards Institute
APN	Assessor's Parcel Number
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc
ASME	American Society of Mechanical Engineers
ASSE	American Society of Sanitary Engineering
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
B/C	Benefit/cost analyses
BMPs	Best Management Practices
CBSC	California Building Standards Commission
CC	Cycles of concentration
CCF	Hundred cubic feet
CDPH	California Department of Public Health
CECs	Chemicals of emerging concerns
CEE	Consortium for Energy Efficiency
CEQA	California Environmental Quality Act
CIP	Clean in place
CII Task Force	Commercial, Industrial and Institutional Task Force
CIWQS	California Integrated Water Quality System
CLCA	California Landscape Contractors Association
COP	Clean out of Place
CPUC	California Public Utilities Commission
CUWA	California Urban Water Agencies
CUWCC	California Urban Water Conservation Council
DE	Diatomaceous earth
DI	Deionization
DWR	Department of Water Resources
DX	Direct expansion
EBMUD	East Bay Municipal Utility District
EO	Federal Executive Orders
EPAct	Federal energy policy act
ET	Evaporation-transpiration
GAMA	Groundwater Ambient Monitoring and Assessment
GBI	Green Globes' Green Build Initiative
GDP	Gross domestic product
GPCD	Gallons per capita per day
GPM	Gallons per minute
GPV	Gallons per vehicle
HCD	(California) Department of Housing and Community Development

HEUs	High-efficiency urinals
HVAC	Heating, ventilating, and air conditioning
IAPMO	International Association of Plumbing and Mechanical Officials
ICA	International Carwash Association
ICC	International Code Council
IPC	International Plumbing Code
IRR	Internal Rate of Return
IRWMP	Integrated regional water management plan
IWIP	Illinois Water Inventory Program
kWh	Kilowatt-hour
LEED	Leadership in Energy and Environmental Design
MAF	Million Acre Feet
MCF	Thousand cubic feet
MEF	Modified Energy Factor
M&I	Municipal and industrial
MMWD	Marin Municipal Water District
MS4	Small Municipal Separate Storm Sewer System Permits
MWELO	Model Water Efficient Landscape Ordinance
NAICS	North American Industrial Classification System
NEPA	National Environmental Policy Act
NF	Nanofiltration
NGOs	Non-governmental Organizations
NPDES	National Pollutant Discharge Elimination System Permits
NPV	Net Present Value
NSF	National Sanitation Federation
OPLs	On-premises laundries
PBMP	Potential Best Management Practice
PCB	Printed circuit board
PG&E	Pacific Gas & Electric Company
PSI	Pounds per square inch
PRSV	Pre-rinse spray valve
PWSS	Public Water System Statistics Survey
RO	Reverse osmosis
ROI	Return on investment
RWQCB	Regional Water Quality Control Board
SWRCB	State Water Resources Control Board
TDS	Total dissolved solids
TWDB	Texas Water Development Board
UPC	Uniform Plumbing Code
USEPA	U.S. Environmental Protection Agency
USGS	U. S. Geological Survey
UWMP	Urban Water Management Plan
WF	Water Factor
WRDA	Water Resources Development Act

1.0 Introduction

As the most recent State Water Plan Update makes clear, the variability of California's water resources can be influenced by the variability in climate and how state residents use water. Likewise, the state's economic productivity can be correlated directly to the availability of water resources. Over time, California's economy has grown while the water used in the state has remained generally consistent. To reduce pressures on California's water resources, increasing water use efficiency is critical to growing and protecting the state's economy (see Figure 1-1).

> "Fortunately, there are numerous cost-effective strategies that can be applied to achieve significant water savings in the CII sector. Estimates indicate that this potential ranges between 710,000 and 1.3 million acre-feet per year"
>
> *(Making Every Drop Work: Increasing Water Efficiency in California's Commercial, Industrial, and Institutional (CII) Sectors 2009 NRDC)*

> California's water demands have begun to reach and, at some times in some places, exceed the available water supply. Although the State has a vast supply of water resources competing demands from agriculture, residential, commercial, industrial and institutional (CII) businesses and the environment are placing a strain on that supply. Yet water is essential to support California's 8th largest economy in the world and as the most populous state in the United States at 37 million (2010 census).

Growing population, climate change, and the need to protect and grow California's economy while protecting and restoring our fish and wildlife habitats make it essential that the state manage its water resources as efficiently as possible. The State of California Department of Finance's 2012 population projections estimate that California's population will continue to grow, approaching 40 million in 2018 and 50 million in 2048. The 2009 California Water Plan Update (Update 2009) addressed the variability of population, water demand patterns, environmental patterns, the climate, and other factors that affect water use and supply. Update 2009 incorporated consideration of uncertainty, risk, and sustainability and used the following three future scenarios to estimate population and other factors by 2050: Current Trends, Slow and Strategic Growth, and Expansive Growth. Under those scenarios, the population of California by 2050 is estimated to reach 59.5 million, 44.2 million and 69.8 million, respectively. Under these same scenarios, urban sector water use is estimated to increase by 6, 1.5 and 10 million acre-feet per year by 2050, respectively.

To address current and future increasing water demands on the States' water supply in February 2008, California's Governor Schwarzenegger issued an executive order that called for a 20 percent reduction of per capita water use in the urban sector by 2020. In November 2009 Senate Bill (SB) X7-7 (Steinberg) made that order a State law by amending the California Water Code.

Background and History

In February 2008 California's Governor issued an executive order that called for a 20 percent reduction of per capita water use in the urban sector by 2020. In November 2009, Senate Bill (SB) X7-7 (Steinberg) made that order a State law by amending the California Water Code.

SB X7-7 recognizes that:

- Reduced water use through conservation achieves significant energy and environmental benefits and can help protect water quality, improve stream flows, and reduce greenhouse gas emissions.
- Diverse regional water supply portfolios will increase water supply reliability and reduce dependence on the Sacramento- San Joaquin Delta.

- The success of state and local water conservation programs to increase efficiency of water use is best determined on the basis of measurable outcomes related to water use or efficiency.

> According to the 2009 CA Water Plan Update scenarios, urban sector water use is estimated to increase between 1.5 and 10 million acre-feet per year by 2050. The demands are heavily influenced by assumptions about future population growth and water conservation water savings. An increase of 6 million acre-feet per year represents the Current Trend Scenario.

SB X7-7 contains several mandates designed to promote water conservation, measurement, and reporting activities for urban and agricultural water suppliers. SB X7-7 includes 18 actions and identifies the Department of Water Resources (DWR) was assigned as the lead agency. DWR designated these actions as "projects" to implement the legislation.

One of the SB X7-7 mandates directs the Department of Water Resources (DWR), in coordination with the California Urban Water Conservation Council (CUWCC) to "convene a Task Force consisting of academic experts, urban retail water suppliers, environmental organizations, commercial, industrial, and institutional water users to develop alternative best management practices (BMPs) for the commercial, industrial, & institutional (CII) water sector (California Water Code 10608.43)."

The Commercial, Industrial and Institutional Task Force (CII Task Force) was also directed to assess the potential statewide water use efficiency improvements in CII sectors that would result from implementation of the alternative BMPs. The CII Task Force, in conjunction with DWR, was ordered to submit a report to the legislature by April 1, 2012.

It should be noted here that the CUWCC was created to "increase efficient water use statewide through partnerships among urban water agencies, public interest organizations, and private entities." The CUWCC's goal is to integrate urban water conservation BMPs into the planning and management of California's water resources.

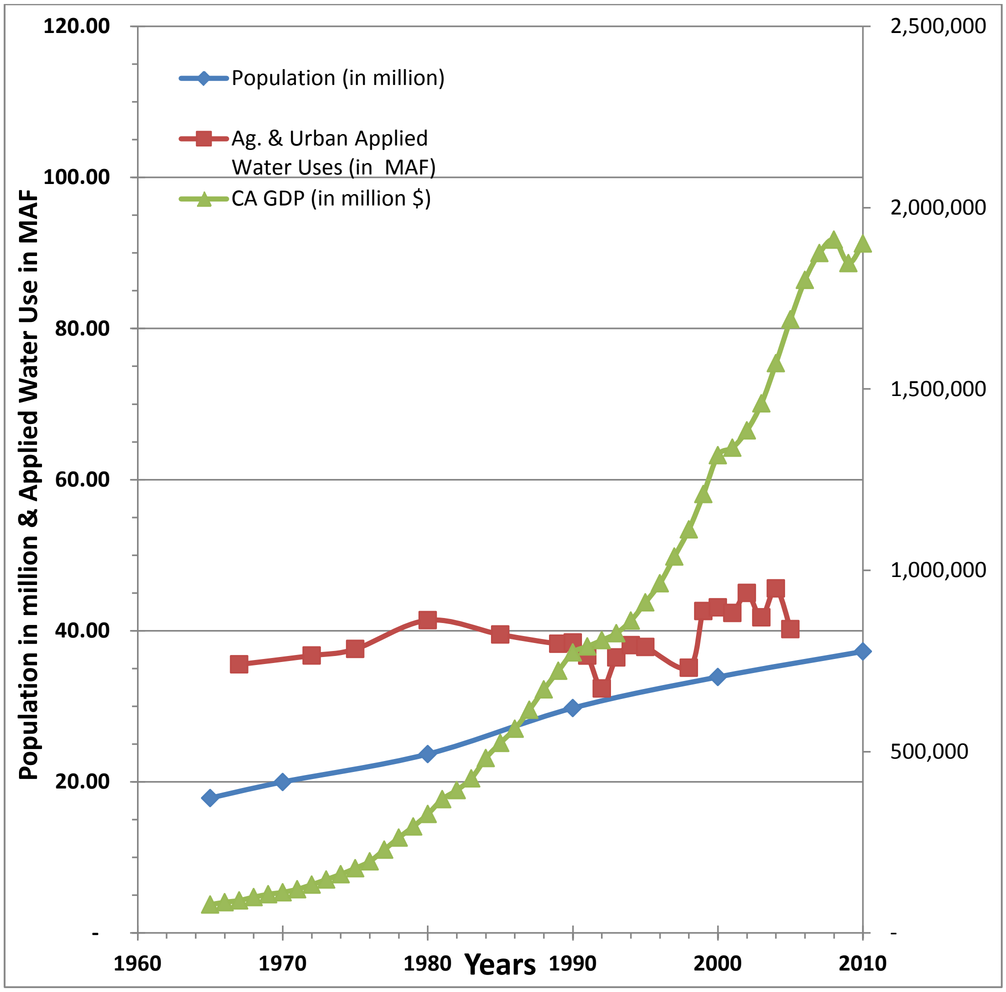


Figure 1-1 California population, gross domestic product (GDP) and water use comparison.

2.0 Report Contents and Layout

This report is intended to help businesses be more water efficient by providing information on water-saving technologies and best management practices (BMPs) applicable in the commercial, industrial, and institutional sectors. This report is presented in two Volumes. The first Volume introduces the reader to a brief overview of the history leading to the creation of the statute, the Task Force process, and a brief overview of the water demand in the CII sectors. The introduction is followed by a summary of Volume II with a discussion of the appropriate metrics and data applied to CII water use, the technical and cost feasibility of BMP's implementation, a description of the CII sectors and their associated BMPs, CII efficiency standards and barriers to use for devices, equipment and recycled water infrastructure and barriers to use. The targeted audience for Volume I is the general public, the legislature and other policy makers and managers.

- appropriate water use metrics and data activities;
- the technical feasibility and the costs/benefits of BMP implementation;
- an evaluation of the CII sector's water usage. The report provides the CII sector with valuable information to capture the multiple benefits of implementing BMP's for achieving reduced costs for water, energy, wastewater and on-site water and wastewater treatment facilities. Recommendations also include the use of alternate water sources for certain applications and many of the BMPs can be applied to other business types not specifically addressed herein; and
- the applicability of CII BMPS and standards, including possible barriers to use for devices and equipment, and recycled water infrastructure.

Volume II contains technical information covering an array of water use sectors and technologies. The target audience for this volume is those who would implement the BMPs and are interested in the more technical discussion of:

The report is intended for use as a resource for existing and new business, developers, consultants and designers, water service providers, planning agencies, and other interested parties.

Case studies of successful BMP implementation are provided in Appendix B.

Report Development Processes

DWR and the CUWCC project management team assembled the CII Task Force to develop BMPs, metrics and recommendations for the legislature. The Task Force members provided technical information which was incorporated into the report, reviewed technical material and documents, and provided comments, data and supporting information to the DWR and CUWCC project management team which prepared this report as stipulated under the CWC §10608.43. The recommendations in the report reflect a consensus of the Task Force members.

The CII Task Force initially convened March 1, 2011 and held monthly meetings to complete this report. Meetings of the CII Task Force were open to the public. Agendas were noticed ten days prior to meetings and posted on the CUWCC CII Task Force website, and on the DWR Water Use Efficiency web site (www.wateruseefficiency/sb7). Public participants were given an opportunity to comment during the process. This process was subject to the Bagley-Keene Act of 2004.

> Future increases in air temperature, shifts in precipitation patterns, and sea level rise could affect California's water supply by changing how much water is available, when it is available, and how it is used. (DWR Climate Change Effects)

Scope of the Commercial, Industrial, and Institutional Task Force

The CII Task Force scope was defined by the statute §10608.43 as outlined below: It was tasked with developing:

- Alternative BMPs for CII businesses and an assessment of the potential statewide water use efficiency improvement in the CII sectors that would result from implementation of these BMPs.
- A review of multiple sectors within CII businesses and recommended water use efficiency standards for CII businesses among the various water use sectors;
- Developing appropriate metrics for evaluating CII water use;
- Evaluating water demands for manufacturing processes, goods, and cooling;
- Evaluating public infrastructure necessary for delivery of recycled water to the CII sectors;
- Assessing the institutional and economic barriers to increased recycled water use within the CII sectors; and
- Identifying of the technical feasibility and cost of the BMPs to achieve more efficient water use statewide in the CII sectors that is consistent with the public interest and reflects past investments in water use efficiency.

3.0 Current Water Use and Demand in the Urban Sector

California's water demands have begun to reach and, at some times in some places, exceed the available water supply. Although the State has a vast supply of water resources competing demands from agriculture, residential, commercial, industrial and institutional (CII) businesses and the environment are placing a strain on that supply. Yet water is essential to support California's 8th largest economy in the world and as the most populous state in the United States at 37 million (2010 census).

It is estimated that the annual average water demand is 33.2 million acre feet (MAF) for the agricultural sector and 8.8 MAF for the urban sector. The additional state developed water is allocated, mitigated, legislated, designated, or otherwise supports the environment.

Current Water Use and Demand in the Commercial, Institutional and Industrial Sectors

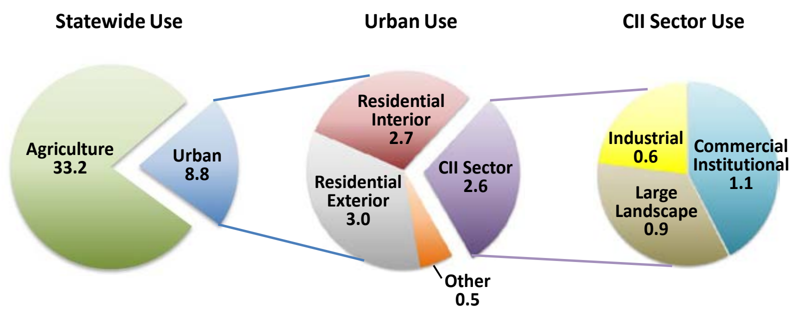
It is estimated the CII sectors use approximately 30%, or roughly 2.6 million acre feet (MAF), of total urban water use, as shown in Figure 3. Reductions in CII water use would contribute to the urban sector meeting its 2020 targets. Conservation and efficiency benefits the CII sector by reducing costs and physical, regulatory, and reputational water-related risks.

> DWR estimates that the CII sector accounts for approximately 30%, or roughly 2.6 (MAF), of total urban water use in CA.

Not included in the above estimate is an additional 418,000 AF of self-supplied water estimated by the U. S. Geological Survey "Estimated Use of Water in the United States in 2005".

Also not included is recycled water use. The State Water Resources Control Board (SWRCB) "2009 Municipal Wastewater Recycling Survey", estimates that recycled water provides an additional 209,500 AF of water a year to the CII sector including power plants.

Total freshwater and recycled water use from all sources for the CII sector is therefore estimated to be approximately 3.2 million acre feet a year. Saline water use from coastal sources also provides an estimated 14.5 MAF of additional water primarily to the mining and steam electric power plants sectors.



Note: Based on 1998-2005 CWP averages. Volumes shown are in millions of acre-feet per year.

Figure 3-1 Volumetric breakdown of California Non-Environmental Developed Water Use

4.0 Recommendations

As directed in legislation, this report explores a range of issues associated water use and efficiency opportunities within the CII sector, and includes Best Management Practices (BMPs), Best Available Technology (BAT), recommendations, and metrics for quantifying water conservation. However, the State must develop procedures relative to the aforementioned actions to further formalize, promote, assess, verify and report on implementation, and adopt changes as practices and technology improve.

> The “Recommendations” section of the report provides direction on how noted tasks can be accomplished, plus next steps and a list of potential recommended legislative actions.

While likely stakeholders in the implementation process have been identified; their support and specific roles must be confirmed. An assessment of the resources needed for implementation must be completed and sources of additional support, both financial and technical, must be defined. The implementation process should include state legislation, regulations and stakeholder buy-in. Also, a mechanism for verification of progress will need to be defined, implemented and monitored.

Throughout the implementation process it is important to remember that each CII site is unique and needs to be treated as such. Accordingly, the approaches to implementing BMPs, determining metrics, and cost-effectiveness need to consider that uniqueness. Finally, water use comparisons between various business sectors or between individual customers are generally can be helpful in determining metrics and selecting benchmarks and are best applied within an individual business or customer due to their unique site-specific characteristics.”

BMPs

A wide range of BMPs has been developed that centers on technical advancements and improved practices which will increase the efficiency of water use in the CII sectors.

Implementation of the BMPs could be facilitated by doing the following;

- Endorse and adopt a formal process and commit to ongoing support for CII water conservation measures to address issues identified in this report;

- Share and promote the importance of BMP implementation with CII businesses and the general public;

- Conduct state-wide workshops in coordination with industry organizations;

- Provide technical and financial assistance and advice to those implementing the BMPs;
- Develop a mechanism for reporting progress that could include:

  - Periodic reports to the Legislature through DWR or other designated entities;
  - Inclusion of progress reports in CUWCC reports to the State Water Resources Control Board (SWRCB); and
  - Inclusion of progress reports in urban water supplier Urban Water Management Plans (UWMPs).

- Identify a mechanism to assure these critical issues are addressed;
- Develop approaches to track the success and effectiveness of BMP implementation efforts and water savings results; and
- Develop a mechanism to update the CII BMPs as practices and technologies improve.

Implementation of Cost Effective BMPs

CII businesses should perform audits to identify opportunities for implementation of BMPs. Following audits, they should calculate the cost-effectiveness of various measures, factors such as: projected water and wastewater cost savings over time, energy savings, implementation cost, potential incentives available, and water supply reliability benefits.

Water agencies should incorporate audits into their conservation programs, consider financial incentives for BMP implementation, and provide other technical assistance as appropriate.

The CUWCC should continue to update their BMPs for water agency CII conservation programs and technology to incorporate the CII BMPs, audits, and cost-effectiveness assessments. All new businesses should consider implementing the recommended BMPs at the time of installation or construction.

> The applicability and feasibility of metrics are tied to the availability, consistency, and reliability of data collection, reporting and performance monitoring.

Metrics and Measuring Progress

Water Use metrics require further evaluation especially for the industrial sector. The following steps should be taken by the appropriate local and State agencies, professional groups and industry representatives to assure that the metrics used provide meaningful measurement of the progress that is taking place:

- Provide tools, guidance, and training to their CII constituents and businesses on BMPs.

- Establish and use metrics for benchmarking how to demonstrate improved water use efficiency over time.

- CII associations, water suppliers and the CUWCC among others should provide tools, guidance, and training to their constituents and customers on BMPs and the establishment and use of metrics in benchmarking to demonstrate improved water use efficiency over time.

- Develop software for voluntary and anonymous water use reporting using an approach similar to the U.S. Environmental Protection Agency (USEPA) Energy Star's Portfolio Manager. Programs or organizations such as the USEPA's WaterSense or CUWCC could develop these tools. The data can be used to develop norms and track trends in CII water use and assist DWR's Water Plan Update water use calculations.

> It is important to remember that each CII site is unique and needs to be treated as such when considering approaches to implementing BMPs, determining metrics, and cost-effectiveness.

- Set efficiency standards for certain water use devices and equipment similar to existing equipment standards for commercial pre-rinse spray valves and clothes washers. The CUWCC, water and energy utilities, manufacturers or equipment and products, and CII associations should collect and compile data on market penetration for installation of particular devices or BMPs where CII or regulatory water use efficiency standards exist.

- Collect and compile data on market penetration for installation of devices or BMPs where CII or regulatory water use efficiency standards exist

- Develop a full-spectrum, water-centric, water use standardized classification system of customer categories. This classification system should include consistent use of North American Industry Classification System (NAICS) codes, Standard Occupational Classification (SOC) System codes, and assessor parcel numbers.

- Develop a system and implementation plan for water production, delivery, and use data collection; for classification; and for reporting and tracking at the user, water supplier, state, and federal levels.

Recycled Water and Alternative Supplies

The following actions should be taken to encourage more aggressive use of recycled water and alternative water supplies by CII businesses:

- Improve regulatory and statutory requirements to overcome barriers to potable and non-potable recycled water use in a manner that is protective of public health and water quality.

- Encourage the State Building Standards Commission to consider national and international codes and to 1) periodically update and expand the plumbing code, and 2) address alternative water supplies.

- Encourage financial and technical assistance to increase recycled and alternative water use.

- The CEC should consider allowing offsets for the use of recycled water at power plants. Under an offset program, where it is not feasible to use recycled water at a power plant, a power plant operator would be allowed to provide funding to expand recycled water at another location.

Next Steps

To help assure that the work of the CII Task Force benefits the State of California, CII water users, water suppliers, wastewater agencies, the environment, CII stakeholders, and others. DWR and the CUWCC should:

- Commit to ongoing support for CII water conservation measures.

- Identify a mechanism to assure these critical issues are addressed through 2020 at a minimum.

- Develop a mechanism for reporting on progress that could include:
    - Periodic reports to the Legislature through DWR or other designated entities.
    - Inclusion of progress reports in CUWCC reports to the SWRCB.
    - Inclusion of progress reports in urban water supplier UWMPs.

- Ensure a process to address these issues is in place and is implemented by the end of 2013.

Legislative Opportunities

Opportunities for state legislation to assist in implementation of the CII Task Force BMPs and recommendations include:

1. Provide the State with a mechanism and the authority for collecting detailed water use data in the private and public agency sectors for the purpose of tracking the progress of statewide CII sector water use and implementation of this report’s CII BMPs and recommendations. This can be reported back to the legislature and assist DWR quantifying urban water use for the CA Water Plan Update.

2. Provide support and State funding for the implementation of recommendations in this report including: water conservation programs and recycled water projects commensurate with benefits to the State and to overcome financial barriers toward expanded use of recycled water.

3. Improve statutory requirements as appropriate to overcome barriers to potable and non-potable recycled water use in a manner that is protective of public health and water quality.

4. Promote updates to the plumbing code which encourages alternative water supplies and implementation of cost-effective BMPs.

5.0 Water Use Metrics and Data Collection

5.1 Introduction and Overview

This section summarizes the more technical Volume II Section 5, Water Use Metrics and Data Collection. The purpose of this section is to establish a path toward developing appropriate metrics for evaluating water use, efficiency, and productivity in the CII sectors and to demonstrate the potential future success of implementing the CII BMPs throughout California. The utility and feasibility of metrics are tied to the availability, consistency, and reliability of data collection, reporting and monitoring.

> The Task Force agreed upon the following recommendations for the development and use of metrics to evaluate water use and on an approach to improve data collection and reporting in California.

Section 5 Volume I of the report provides:

- A framework to understand water use metrics and their application.
- Criteria for selecting appropriate metrics.
- Recommendations for next steps to improve the use of metrics that encourage efficient water use and demonstrate the effectiveness of BMP implementation.
- Examples of metrics in use and metrics that may be used.
- Recommendations for CII water use data collection and reporting at the customer, sector, utility and state level.

Proper accounting (inventory, tracking, and measurement) of water is needed to ensure sufficient water is available to meet the needs of California's economy, society, and environment. It also provides a means to ensure that we can comply with the laws governing water allocation. Agreement on how and why we account for water is needed to achieve our common goals.

> It is recommended that an advisory group or committee be formed to further analyze and make recommendations regarding the development, use and capture of pertinent metrics and their associated data.

The intent in identifying and developing appropriate water use metrics is to effectively monitor and evaluate water use and water use efficiency or productivity in the CII sectors. There must be established a set of commonly accepted definitions and a terminology related to water use and measurement before there can be a useful discussion of metrics issues.

The most fundamental metric to plan and evaluate water use is total volume of water used over time. Water suppliers and state agencies often track these volumes aggregated into several major sectors. Even though this metric is valuable some measure of the efficiency and productivity of water use may provide better guidance in evaluating water use efficiency. Another common water-use metric, gallons per capita per day (GPCD), is required by SB X7-7 for setting and meeting urban water supplier targets. GPCD may not be informative about trends within many of the CII sectors this section, however, does not currently recommend any single metric for use in all CII sectors.

5.2 Recommendations

The Task Force agreed upon the following recommendations on the development and use of metrics to evaluate water use and on an approach to improve data collection and reporting in California.

The recommendations presented below are identical to those given in Volume 2 and stem from the information or conclusions found later in this section or the Water Use Metrics and Data Collection section in Volume 2 of this report.

The CII Task Force cautions against setting regulatory minimum standards for water use efficiency metrics that would be applicable to specific CII establishments, subsectors, or sectors. Even within subsectors, because of the variability in the types of products made or services provided and the many confounding factors in how water is used, it would be difficult to set uniform standards across CII establishments (defined as individual CII use sites).

5.2.1 Metrics Recommendations

Recommendation 5-1: CII establishments should use metrics to improve and track their water use efficiency over time. Where norms or ranges are available, establishments should compare their metrics to those norms.

> The recommendations presented here are identical to those in Volume II and the information or conclusions summarized in this section.

Recommendation 5-2: CII associations, water service providers and the CUWCC among others should provide tools, guidance, and training to their constituents and customers on BMPs and the establishment and use of metrics in benchmarking to demonstrate improved water use efficiency over time.

Recommendation 5-3: Organizations such as U.S. Environmental Protection Agency's (through the WaterSense program) or CUWCC should develop software for voluntary and anonymous water use reporting and trending using an approach similar to Energy Star's Portfolio Manager. These data can be used to develop norms for CII water use.

Recommendation 5-4: Manufacturers of equipment and products, CII associations, CII establishments, utilities, and the state should set efficiency standards for certain water use devices and equipment similar to existing device standards for commercial pre-rinse spray valves and clothes washers.

Recommendation 5-5: The CUWCC, water and energy utilities, and CII associations should collect and compile data on market penetration levels for installation of particular devices or practices for which industry or regulatory water use efficiency standards exist.

Recommendation 5-6: DWR should continue to develop appropriate efficiency or productivity metrics for the CII sector to determine and monitor, at the statewide level subsector water use, progress toward improving water use efficiency over time.

5.2.2 Data Collection and Reporting Recommendations

Recommendations 5-7 and 5-8 are intended to make improvements in data collection.

Recommendation 5-7: The Department of Water Resources (DWR) should work with the Association of California Water Agencies (ACWA), CUWCC, California Urban Water Agencies (CUWA), California Public Utilities Commission (CPUC), California Water Association (CWA), and American Water Works Association (AWWA) to develop a full-spectrum , water-centric standardized classification system of customer categories. This classification system should include consistent use of North American Industry Classification System (NAICS) codes and assessor's parcel numbers (APN's).

> The Task Force found there are limited centralized data concerning how much water is used in the CII sectors. Moreover, the data that exist are tracked inconsistently at the local level.

Recommendation 5-8: DWR, in consultation with a stakeholder advisory committee and through a public process, should develop a system and implementation plan for water production, delivery, and use data collection; for classification; and for reporting and tracking at the user, water service provider, state, and federal levels. One or more of the following options should be considered:

- **Option 5-8.1:** Water suppliers should classify water users using a common classification system and transition their customer databases to incorporate this system.
- **Option 5-8.2:** Water utilities should consider recording and maintaining key data fields such as assessor's parcel numbers for customers. This would enable the linking of water usage data with information from other sources for purposes of metrics, water demand analysis and demand projections.
- **Option 5-8.3:** Water utilities and self-supplied water users meeting defined criteria should be required to report water use to the state.
- **Option 5-8.4:** Water suppliers, CUWCC, and water users should expand on landscape irrigation water use categorizations that recognize and promote BMPs for separate metering, especially for larger and mixed use sites.

> In addition, a metric may include an additional factor that correlates to the benefits obtained from that water use in the CII sectors, such as employment, quantities of manufactured output, or square foot of land or building space.

5.3 Water Use Metrics

5.3.1 Metrics Terminology and Definitions

Common definitions are important to understanding water use metrics. This report adopts the following AWWA guidance report definition of "metric":

> *"Metric" means a unit of measure (or a parameter being measured) that can be used to assess the rate of water use during a given period of time and at a given level of data aggregation, such as system-wide, sector-wide, customer, or end-use level. Another term for a metric is "performance indicator."*

In addition, a metric may include an additional factor that correlates to the benefits obtained from that water use in the CII sectors, such as employment, quantities of manufactured output, or square foot of land or building space.

It is essential to also have a shared understanding of the terms "metric", "benchmark", and "target". These terms often are used interchangeably, but the different connotations of the words may lead to confusion if not clarified. An important distinction is that benchmarks and targets are not metrics in themselves or definitions of a metric; they are numerical values assigned to or derived from metrics. A "benchmark" is a numerical value of a metric that denotes a specific level of performance, or a current or beginning (baseline) value of a metric. A "target" is a benchmark that is expected at a future time. Benchmarks and targets may be used to set water use efficiency goals and measure progress over time. The Task Force encourages the use of benchmarks or targets to track progress in water use efficiency or productivity on both the statewide and local levels.

5.3.2 Calculation and Terminology

Metrics can take many forms, from simple to complex. The simplest water use metric is calculated as follows:

$$Basic\ quotient = \frac{Volume}{Time}\ \left(e.g. \frac{gallons}{day}\right)$$

The basic quotient may stand alone to show trends in total water use. However, to assess the efficiency or productivity of water use, we must apply a scaling factor to the equation. The scaling factor may take several different forms such as general population (per capita), employees, economic output or square feet of building space.

> The scaling factor may take several different forms such as general population (per capita), employees, economic output or square feet of building space.

The most common use of the scaling factor is to relate the basic quotient so comparisons may be made relative to the chosen scaling factor. The scaling factor becomes the denominator of a water-use efficiency or productivity metric equation, as shown below:

$$Water\ use\ efficiency\ metric = \frac{Basic\ quotient}{Scaling\ factor}$$

With the use of the scaling factor, the basic water use metric is normalized to allow comparisons of entities of different sizes or scales or comparisons of a common entity such as population that is changing in scale over time.

It is important to recognize that inconsistent definitions and factors unrelated to the purpose of a metric can lead to data inaccuracies.

5.3.3 Contexts and Selecting Water Use Metrics

Whether a metric is appropriate depends on the context of its use. One may consider the metric from a geographic or end-use profiling perspective. Geographic perspectives include looking at water use data at the level of an application or process, user, utility, region, state or nation. End-use profiling looks at water use by process or application, user, sector, subsector, or cross-sector perspective. The relationship of these perspectives is illustrated in Figure 5-1.

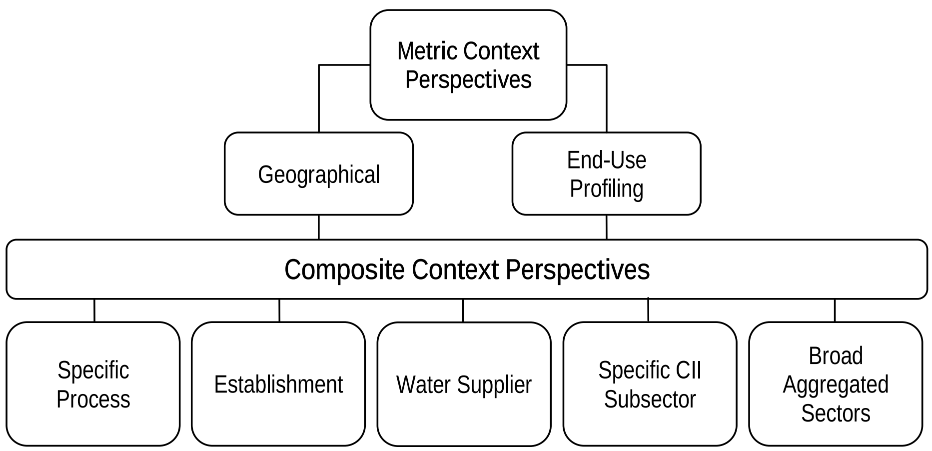


Figure 5-1. Metric Context Perspectives

Many water-use metrics are in use, as shown in Appendix A5.3. However, most have very narrow intended uses. In Volume II of this report, metrics are applied to specific BMPs or technologies. Water supply planners and policy-makers may use water-use metrics to make broad assessments of how trends in efficiency may affect future water demands, or look at the effectiveness of water use efficiency and management programs. For CII uses, the most commonly suggested and analyzed metrics are:

- GPCD
- Gallons per employee per day or year
- Gallons per square foot of building area per day
- Gallons per day per dollar of economic value added

- Gallons per product or service.

5.4 Data Collection and Reporting

Water resources management relies on data illustrating water use, the purposes of the use, and where and how efficiently it is used. The data may be used by water users, water agencies, land-use planning agencies, economists, nongovernmental organizations and others for:

> Water supply planners and policy-makers may use these metrics to make broad assessments of how trends in efficiency may affect future water demands, or look at the effectiveness of water use efficiency and management programs.

- Planning and designing water supply, treatment, and delivery facilities.
- Developing programs to use water more effectively and reduce waste.
- Managing water to reduce environmental impact.
- Developing funding sources to manage water supply and quality.
- Developing policies, regulations, and laws to govern the wise use of water.

5.4.1 Existing Water Data Collection by Water Suppliers

Virtually every study of water use has cited the lack of available detailed water use data in the state. Most water utilities collect customer data to provide adequate water service, collect revenue, meet state laws, and comply with local ordinances. Many water suppliers categorize data by residential (single family and multifamily), CII, large landscape and agriculture uses. Others use more sophisticated classification systems. The water use data reported to DWR and CUWCC indicate that water suppliers use inconsistent definitions of water use sectors when aggregating data.

> Currently, insufficient resources and time prevented conducting a thorough analysis of these and other metrics to determine if they are appropriate for CII sectors and subsectors. However, Volume II includes a limited analysis of some metrics.

5.4.2 Existing Statewide Water Data Reporting

The principal organizations collecting water use data in the state are DWR, Department of Public Health (CDPH), SWRCB, PUC, and CUWCC. At the federal level, water supply and use data are collected and reported by the U.S. Geological Survey (USGS) and the U.S. Bureau of Reclamation (USBR) which collects municipal and industrial (M&I) data

While statutory and regulatory requirements for reporting water use or diversions for storage and use exist, these requirements leave significant gaps that either are unreported or are not reported in sufficient granularity for adequate analysis.

The major issues and limitations for data collection by DWR's Public Water System Statistics Survey (PWSS), CDPH's annual reporting system, and CUWCC's reporting system include the lack of uniform definitions for water demand and supply categories; different population estimating techniques by user groups attempting to account for the variance between census and service area boundaries; differences in how multi-family and large landscape data are compiled, lack of a uniform definition for unaccounted for water, inconsistent distinctions between commercial, industrial and institutional water use, and a lack of self-supplied water data. The newer methodologies for population and demand calculations flowing from SBX7-7 GPCD calculations, and the water loss methodology adopted by CUWCC in 2009 are a good first step in providing some universal definitions; but more such effort is needed if demand data is to be tracked more accurately.

The major issues for and limitations of data collection by SWRCB is that data cannot be correlated to total water supply and delivery by water supplier service area or deliveries to water users.

5.4.3 Data Reporting in Other States

Other states have reporting on self-supplied water. They also have more detailed and consistent reporting of customer water use data. States with good examples of reporting systems include Kansas, Texas and Illinois. In Illinois, for example, the locations and amounts of water withdrawn from surface water and groundwater sources, as well as significant amounts of water purchased from other sources are inventoried every year for a variety of water-using facilities, including commercial and industrial facilities. Commercial-industrial data are published only in combination with township or regional totals and are kept confidential unless it is authorized to be released by the water using authority.

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6.0 Technical and Financial Feasibility of Implementing the BMPs

While all of the BMPs in this document are technically feasible and will be cost effective in certain situations, the appropriateness of using any single BMP must be assessed for each site by the site operator or owner. The CII user would need to conduct an audit of their site to determine which BMPs would be technically feasible. This would include a cost/benefit analysis to determine if it is cost effective to implement the BMPs. Organizations representing business and industry, water suppliers, the CUWCC and DWR should educate CII businesses on the BMPs and approaches to doing audits and a cost effectiveness analysis. All CII businesses should do this assessment to determine which BMPs are appropriate for their site.

> The legislation stated that the final report should contain "identification of technical feasibility and cost effectiveness of the best management practices to achieve more efficient water use statewide in the commercial, industrial and institutional section…" Because each use site is unique, cost effectiveness and the feasibility of using BMPs must be determined on a case by case basis for each site.

Consequently when developing and implementing the best BMPs, three guiding principles should be kept in mind.

1. One size does not fit all – For any given industry, there may be a dozen potential BMPs. Not all will be applicable. In many cases establishing one BMP could mean that another will not be applicable because they will "be saving the same water."
2. Every facility is unique - Analysis of potential payback is unique to each facility and situation. Facilities, even in the same industry, vary in their process, equipment selection and design. This means that what may work at one vegetable processing plant may not be applicable at another; what works in one research laboratory or hotel may not be applicable in another.
3. The list should be used only as a guide - The intent of the manufacturing BMPs is to provide a list of possible measures that plants can adopt for their specific situation.

6.1 Developing the Benefit/Cost Estimate

As the first guiding principle above states, the cost effectiveness and feasibility of using BMPs must be determined on a case by case basis for each site. When determining whether a BMP is cost effective, the customer will need to assess the financial costs and benefits of implementing the BMP. A variety of financial metrics are available to use for determining whether a particular BMP makes economic sense from a cost/benefit perspective. Costs are typically calculated for each recommended BMP within a comprehensive CII water conservation audit. Some important considerations when calculating the cost effectiveness of BMPs are:

- Water and wastewater savings
- Cost of the measure
- Expected usable life of the measure
- Energy cost decrease or increase
- Chemicals costs or savings
- Waste disposal costs associated with water treatment or use
- Labor costs or savings
- Liability
- Usable life of equipment or processes

There are several ways to calculate cost/benefit ratios for business/customer implementation of BMPs. When discussing cost/benefit analyses, some common terms used include "payback period," "return on investment": (ROI), and "internal rate of return" (IRR). These analyses provide guidance in the short term, and help to determine if a proposed modification is worth the investment. Longer-term analyses also consider lifecycle factors, such as net present value, inflation, and amortization.

Increased Water Rates
Water shortages and development of costly water supplies will result in increased water rates. Implementing water use efficiency measures will reduce the demand on the local water supply and the need to develop costly future water supplies, which may reduce the long-term costs of water to the business. Large water users are likely to feel the greatest impacts of increased water rates.

6.1.1 Payback Period

The payback period is the time required for an investment in efficiency to pay for itself. The simple payback is calculated by dividing the total costs (including installation, capital, permitting, and operation and replacement equipment costs) by the annual benefits, giving a simple payback in terms of years. Though a two-year payback is generally considered to be extremely cost effective many firms may choose a 3-4 year payback period. If a business using a more efficient device does not own the building or the equipment, some issues with the economics of payback become more challenging.

6.1.2 Return on Investment (ROI)

Another metric which is similar to payback is the ROI or the percent of payback the BMP produces per year. In the case of a one-year payback, the ROI is 100%. If the payback is in 1.6 years the ROI is equal to ($100%/1.6) or 62.6% a year.

6.1.3 Internal Rate of Return (IRR)

The IRR provides an indication of the efficiency of an investment. It is defined as the effective annual interest rate at which an investment accrues income. The IRR can be compared to the interest rate on borrowed funds or the rate of return that is possible from other investments. If IRR is higher than the agency's rate of return, then the investment is deemed to be worthwhile.[1].

[1] Note that the model calculates the IRR based on the undiscounted net cash flows. Therefore the resulting rate of return should be compared to the agency's undiscounted rate of return.

A business may also want to analyze the costs and benefits over the economic life of the BMP, particularly for large investments that may have longer payback periods. This analysis may be appropriate if the time for return on investments does not justify making the improvements in the short term and there is a long-term investment involved. Such an analysis takes into consideration the costs and savings over the full life of the BMP device being installed. In this type of analysis the business would consider the time value of money, savings through the life of the equipment, and the costs of water, energy or sewage disposal over the life of the equipment. This analysis may also include labor, tax, and insurance savings.

Change to a waterless process
There are many examples of replacing water using equipment with equipment that does not use water.

6.1.4 Net Present Value (NPV)

NPV sums all of the costs and benefits over the lifetime of the device and reports their value at the beginning of the project. A positive NPV indicates that the benefits of the project exceed the costs over the life of the device. This approach has not been as commonly used by business as the ROI or payback approach, but may become more applicable in the future

When making a decision to invest in water use efficiency, businesses may also consider other risk factors and benefits that are less quantifiable, such as potential future mandates, reliability of water supply, or reputational risks and benefits. This may also apply when deciding to upgrade to more water and energy efficient equipment when making a business decision to replace outdated equipment.

6.2 Consideration of Risk Factors by Businesses

These risks may include reduced reliability, potential for future mandates, costs, and reputational risks or benefits. Assessment of these risks will require close communication and cooperation between the business community and its local water supplier.

6.2.1 Reliability of Water Supply

A business may want to consider the reliability of the local water supply in the region or community, the possible impacts of disruptions in the water supply, or a lack of adequate supply would have on the operations and the long term profitability of the company.

6.2.2 Reputational Risks and Benefits

A business that has a large presence in a community will generally strive to maintain a positive reputation and good relations with the rest of the community. Companies that have taken this approach can include water use efficiency as a priority in demonstrating their environmental stewardship.

6.2.3 Replacement of Outdated Equipment

As improved technology becomes available CII businesses may decide to upgrade their water using equipment, fixtures, and machines when they reach their useful life as a cost effective measure. Older equipment by their design will use more water, energy, chemical, and wastewater than newly designed equipment.

6.3 Potential Savings by Implementation of the BMPs

Many CII facilities in California are already practicing up-to-date water efficiency techniques. The selection and implementation of these BMPs is determined by the local economics and design. Others have real opportunity to reduce water use further in an economic manner that is feasible to the individual business. The state does not currently have the data necessary to establish the baseline of use in each CII sector.

Volume II contains numerous examples of water savings on a case by case basis. However, in most cases, the information needed to estimate statewide savings must await the development of the baselines and metrics recommended in this report. In any case, the BMPs in Volume II describe many ways to reduce freshwater use and can be summarized into the following five categories:

- Water Loss Control - Adjust equipment, fix leaks and making repairs to existing equipment and processes so that it operates more efficiently.
- Water Efficiency Retrofits - Modify equipment or install or add water saving devices and controls, automated systems, or equipment to existing water using equipment and processes.
- Water Efficiency Replacements - Replace older inefficient water using equipment and fixtures with water saving types of equipment is one of the most recognized ways to reduce water use.
- Alternative Water Sources/Water Reuse/Recycle – There is significant potential for use of recycled municipal wastewater, on site recycling and reuse of water and use of alternative non-potable supplies.

  Non-Water Using Technology/Change to a waterless process - There are many examples of replacing water using equipment with equipment that does not use water.

6.4 Conducting an Audit

This BMP report provides CII water users with information they can use to reduce water and wastewater use and help to reduce bills, recognizing it is up to the entity to evaluate specific circumstances. The facility can either conduct the audit or hire a professional consultant. Many facilities managers have found that they can begin the process by simply looking at water and wastewater use and utility bills and comparing their use to similar facilities that their company may operate.

The audit looks at the current water use and types of water using equipment in the facility. The audit then asks eight important questions:

1. How much water is the facility using?
2. Where in the facility is the water being used?
3. When is the water being used?
4. How and for what is it being used?
5. Who controls its use?
6. Why is water needed here?
7. Are there other ways to do the same work that reduces or does not use water?
8. Can an alternate water source be used, reused?

Once these eight questions have been answered, the facility manager can evaluate ways for each individual operation to reduce use. The first step is to repair malfunctions and leaks. Generally, the facility may reduce use by employing one of these five measures:

1. Adjust existing equipment to use less water.
2. Modify existing equipment or install a water saving device.
3. Replace existing equipment with more efficient models or types.
4. Reuse and recycle water where possible.
5. Choose equipment or methods that eliminate water use.

Another method a facility manager may take to reduce water use is to examine how water may be reused within the facility. This reuse can range from process water in an industry to the capture of rainwater or air conditioning condensate for use in irrigation or a cooling tower. The following figure may help the facility manager or engineer identify all water uses, the water quality needed for that operation, and the water streams from their operation to see if they may be candidates for reuse either as is or after additional treatment.

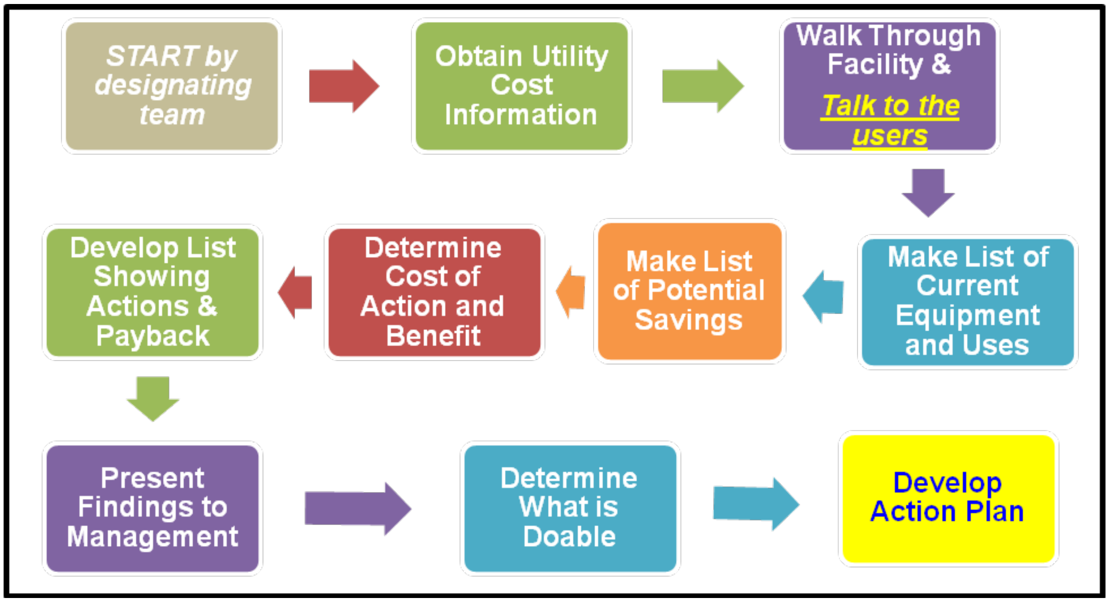

Figure 6-1. The Audit Process

7.0 Commercial, Institutional & Industrial Sectors and BMPs

This report is intended to help businesses be more water efficient by providing information on water-saving technologies and best management practices (BMPs) applicable in the commercial, industrial, and institutional sectors. Following is a summary of the layout and use of the report and the information contained in it. The report is intended for use as a resource for:

- Existing and new businesses;
- Developers, consultants and designers;
- Water service providers; and
- Planning agencies.

Since technology and practices change over time, the information in this report is intended and recommended to be updated periodically.

The report provides the CII sector with valuable information to capture the multiple benefits of reduced costs for water, energy, wastewater and on-site water and wastewater treatment facilities. The report contains information on landscape water use efficiency practices, since outdoor water use is an important issue and may represent a significant percent of the use for any given business. Recommendations include the use of alternate water sources for certain applications and many of the BMPs can be applied to other business types not specifically addressed herein.

The report contains summaries for each business type, technology, and BMP, that describes the end uses of water and refers the reader to the section in Volume II that contains an in-depth description of the hardware and processes associated with water-use efficiency improvements to various business types along with a series of proven example case studies. The information provided also includes references on where to find additional technical data and recommendations to address water use metrics, water savings potential, economic payback and consideration of business risk factors.

Volume I Section 7 is a summary of the more detailed technical discussion of Volume II Section 7.

The Best Management Practices are divided into three distinct sections:

1. Section 7.1 contains BMPs related to Common CII uses;

2. Section 7.2 contains BMPs related to specific industrial Sectors which the Task Force determined were responsible for a significant amount of water use in California;
3. Section 7.3 contains BMPs related to common water uses found among many CII sites.

The source for the information about CII BMPs found in Volume II includes; the US EPA' WaterSense program; the CUWCC's potential BMP research projects; the Federal Energy Management Program (FEMP), and the Consortium on Energy Efficiency (CEE). Also included is research performed by academia, CII Associations, and other industrial sources performed using statistically and scientifically defensible methods. A wide number of sources were considered, and are cited in association with the BMPs to which they relate. When available, general information about the size of the business sector and water uses associated is included with the BMPs. As indicated earlier in this volume, the BMPs included are technically feasible because they are in use. Many business factors affect water use and thus water use efficiency potential in businesses including the size, type and location of the business, the relative market impacts of the general economy, and for some uses, weather. There are also differences in the price of water and relative ease of use or reuse of treated effluent or alternative water resources (rainfall, stormwater, and on-site reuse of water which is covered in greater detail in Volume II. However, there are common technologies and best management practices which traverse multiple commercial, institutional and Industrial sectors.

7.A The Commercial and Institutional BMPs

This section includes BMPs organized by business type and subdivided by specific water uses. As indicated in the matrix in Table 7-1, this two-volume report applies XX water use technologies and practices to more than XX common CI sectors ranging from bakeries, laundries, metal finishers and car washes to municipalities. Within each water use section, the BMPs are presented as improvements both in equipment and processes; improvements in maintenance or management practices are also presented when relevant. They also include water use efficiency standards that can be applied to the equipment that is used. The information is organized to be useful both for those who are intending to implement or assist in the implementation of the BMPs and for those concerned with the overall potential for water use efficiency and conservation through the use of the BMPs.

The following lists summarize the types of BMPs by business category. Common processes and practices found in different types of businesses, e.g. restrooms, plumbing, water treatment, ice machines, and etc. are described in Section 7C and listed below. Volume II has detailed discussions of the BMPs listed below.

Table 7-1. Matrix showing Water Use Technologies and Practices

Water Using Processes	Food Processing Industry									
	Animal Processing	Animal Food	Bakeries & Tortillas	Beverages	Dairy Products	Fruits & Vegetables	Grains & Oil Seeds	*Miscellaneous	Seafood	Sugars & Confectionaries
1. Potential Water Reuse	x	x	x	x	x	x	x	x	x	X
2. Environmental Control	x	x	x	x	x	x	x	x	x	X
1. Air Pollution	x	x	x	x	x	x	x	x	x	X
2. Area Cleaning/Dust Cont.	x	x	x	x	x	x	x	x	x	X
3. Wastewater Treatment/Reuse	x	x	x	x	x	x	x	x	x	X
3. Process Water Use	x	x	x	x	x	x	x	x	x	X
4. Inclusion in product	x	x	x	x	x	x	x	x	x	X
5. Fluming/transport	x	x				x		x	x	
6. Product washing	x	x	x	x	x	x	x	x	x	X
7. Cooking/Autoclaving	x	x	x	x	x	x	x	x	x	X
8. Blanching/Pre-cook	x					x		x	x	
9. Peeling & Prep.						x			x	
10. Processing animal parts	x	x	x	x	x	x	x	x	x	
11. Canning & bottling	x	x		x	x	x	x	x	x	
12. Can/bottle cooling/warming	x	x		x	x	x	x	x	x	
13. Conveyor lubrication	x	x	x	x	x	x	x	x	x	
14. Pump seal water & other uses	x	x	x	x	x	x	x	x	x	X
4. Cleaning	x	x	x	x	x	x	x	x	x	X
15. Clean in/out-or place systems	x	x	x	x	x	x	x	x	x	X
16. Can/bottle/package cleaning	x	x	x	x	x	x	x	x	x	X
17. Transport vehicle cleaning	x	x	x	x	x	x	x	x	x	X
18. Crate & pallet washing	x	x	x	x	x	x	x	x	x	X
19. Other cleaning	x	x	x	x	x	x	x	x	x	X

7A1: Commercial Food Service

- **Common Practices**
- Scullery Operations
- Pre-Rinse Spray Valves
- Commercial Dishwashers (Warewashers)
- Commercial Ice Machines
- Combination Ovens
- Dipper Wells
- Steam Cookers
  - Boiler-based steamers
  - Boilerless (connectionless) steamers
  - Steam Kettles
- Wok Stoves
- Washing and sanitation
- Sinks
  - Defrosting
  - Food Washing
  - Table Water

7A2: Fabric Cleaning and Washing Equipment

- Commercial Coin- and Card-Operated Washers
- Single-Load Clothes Washers
- Multi-Load Washers
- Washer Extractors
- Tunnel Washers
- Ozone Laundry Systems

7A3 Hospitality: Lodging - Hotels and Motels

- **Common Practices**

7A4: Medical and Laboratory Equipment & Processes

- Sterilizers
- Vacuum Systems
- Laboratory Fume Hoods
- Best Management Practices for Laboratory Hoods
- Instrument, Glassware, Cage, Rack, and Bottle Washers
- Vivariums and Aquariums
- Photographic and X-Ray Equipment

7A5: Office Buildings

- **Common Practices**

7A6: Prisons and Correctional Facilities

- Special Fixtures – Restrooms and Plumbing
- **Common Practices**

7A7: Retail, Grocery Stores and Food Markets

- **Common Practices**

7A8: Schools and Educational Facilities

- **Common Practices**
- Special Facilities
- Residence Halls (college and university)

7A9: Vehicle Washing

- **Common Practices**
- Self-Service
- In-bay Automatic
- Conveyor
- Large Vehicles
- Reclaim

7.B The Industrial Process BMPs

The Industrial Process BMPs (7B) includes BMPs focused on a subset of California industries which CII Task Force members identified as being significant water users, and therefore worthy of attention in order to identify water savings opportunities. Each of these sections was developed by Working Group or Subcommittees of the CII Task Force. Much of the focus on these sections are on processes which control the use of water within a facility and therefore it is important to note that actual water savings potential in the field will be affected by the size of a business, and by the type of processes used.

Geographic location in the state will also affect the water use efficiency potential due to wide variation in evapotranspiration, temperature and rainfall levels throughout the state. This variability as it applies to specific BMPs is explained within each section, as is the gross potential for water savings and the general business information.

The following industries were selected and are discussed in much greater detail in Volume II.

1. Aerospace and Metal Finishing Industries
2. Food Processing and Beverage Manufacturing
3. The High-tech Industry in California
4. Solar
5. The Petroleum Refining and Chemical Industries
6. The Pharmaceutical and Biotech Industries
7. Power Plants

7.C Common Practices within the CII sectors

Common Practices (7C) are explained in this section, so that businesses and other users of Volume II have one place to go for information on water use BMPs for domestic uses of water, as well as other commonly used techniques in the CII sector, such as heating and cooling (thermodynamic processes), water treatment, and use of alternative water sources.

Use of alternate on-site sources of water supplies is an area of growing interest in California. On-site capture of water from various sources, including rainwater, stormwater, graywater, foundation seepage, cooling system condensate and other sources, may significantly reduce potable water demands. Outside sources of non-potable water such as recycled municipal wastewater can also have a significant impact on reducing potable water demands. One impediment to use of alternate on-site sources of water is a lack of clarity concerning what is allowed, the standards that would apply and whether there are agencies responsible for permitting the use. The International Association of Plumbing and Mechanical Officials (IAPMO) adopted standards for alternative water supplies. The Task Force is recommending that the California Building Standards use the IAPMO Codes as a starting point for establishing standards for California.

Several thermodynamic processes have a significant potential for water use efficiencies by changing how the systems operate. These include water cooled systems, cooling towers and boiler systems. Through instrumentation, treatment, proper design and operation, and management of water quality, the water use efficiencies of these thermodynamic processes may be greatly improved. Although there are common approaches, what works best on each site needs to be evaluated by a person with expertise in these processes.

Metering is a key BMP for the CII sector to determine how much water is being used and the efficiencies that may be achieved. The Task Force recommends CII businesses install source meters and sub-meters for proper measurement and tracking of water use at an installation.

Water is commonly used for cleaning that excludes water used to meet Environmental, Health and Safety requirement of local, state and federal laws. Something along the following: "Use of BMPs for cleaning must be considered in light of Environmental, Health and Safety requirements of local, state and federal laws."

These types of cleaning systems and processes include clean in place, clean out of place and bottle/container cleaning, crate and pallet washers and equipment and floor cleaning. Some common approaches for BMPs for these systems include ensuring a good design of the system that would avoid accumulation of product and recovery, reuse and recirculation of water.

Commercial landscapes use a significant amount of water in the CII sector. Therefore, the Task Force included a BMP for landscapes that recognizes the design and operating standards developed by DWR in the model landscape ordinance required by AB 1881. This BMP takes the standards a step further by encouraging their application to existing landscapes and supporting the use of alternative water supplies.

A number of devices are common to all of the CII sectors associated with building sanitary and safety applications. These include toilet fixtures, urinal fixtures, shower fixtures and faucets. The approach to BMPs has been to set specific standards associated with these fixtures. Water use efficiency standards have been established through voluntary standards such as WaterSense, legislation mandating efficiency standards and plumbing code changes, such as Calgreen. These standards apply to all newly installed fixtures (Senate Bill 471 applies to existing commercial properties). Where it is cost effective, nonconforming fixtures may be replaced with new conforming fixtures.

Pools and spas have the potential to use significant amounts of water. Among the BMPs to reduce water use in pools and spas are pool covers to prevent evaporation, leak prevention, splash out reduction, and efficient operation of pool cleaning equipment such as pool filtration, disinfection and water quality control.

8.0 Standards and Codes for Water Use Efficiency

Plumbing and building standards, codes play an important role in governing the installation and use of water efficient products.

8.1 What are standards?

Webster's defines a standard as: "...something set up as a rule for measuring or as a model to be followed..." In the vast world of water-efficient products, standards (or "rules for measuring") are necessary to establish standard dimensional requirements and the minimum performance level for all manufacturers to meet with their products. Compliance with established standards, however, is voluntary. That is, until such time as an ANSI[2] consensus standard is adopted into law by regulation (e.g., building codes) or legislation (e.g., the National Energy Policy Act – EPAct), the standards have no force of law.

Once adopted, however, new products from new manufacturers entering the U.S. marketplace, or new product models introduced by existing manufacturers, must be measured against the relevant standards and meet specified minimum requirements in order to be sold in the marketplace.

The Energy Commission is also currently conducting public workshops in August to discuss the scope of future proceedings to amend the Appliance Efficiency Regulations. This effort is addressing water using appliances such as commercial dishwashers and clothes washers, irrigation controls, and continuous hot water recirculation pumps.

8.2 What are codes?

Codes are promulgated by code authorities and adopted by jurisdictions to protect the health and safety of the citizens. It is important to note that, whereas the national standards approved by ANSI are voluntary consensus-based standards, the codes (which may or may not adopt the national standards by reference) are mandatory within the jurisdiction that adopts them.

Like the standards process, the codes process is complex. There once were five different plumbing code development organizations in the U.S., but mergers have reduced this number to only two. The IAPMO produce the Uniform Plumbing Code (UPC), and the International Code Council (ICC) produces the International Plumbing Code (IPC). These code-authoring organizations have a 3-year development cycle to update their respective model codes. California, through its CBSC and the Department of Housing and Community Development

[2] American National Standards Institute

(HCD)[3], uses the UPC as the model plumbing code for the State and makes modifications to that model code to address California-specific interests.

The plumbing codes themselves have no legal status until adopted by jurisdictions such as cities, counties and states. Where adopted, the codes become as local ordinances and laws. All jurisdictions can amend the model code before and after adoption, and some do this to better suit local conditions. Each of the two plumbing codes contains more than 400 pages of complex requirements; few jurisdictions, however, have the ability to review and analyze every single provision before adopting the code as law.

[3] http://www.hcd.ca.gov/

9.0 Public Infrastructure Needs for Recycled Water

Commercial, industrial, and institutional (CII) water users may contribute to better management of the State's water by replacing potable or fresh water with recycled water or by using less water following the BMPs cited in other sections of this report. This Section focuses on CII use of recycled water, as defined in Box 9-1, obtained from a municipal recycled water supplier. One of the fundamental challenges to increasing CII use of recycled municipal water is infrastructure limitations. For this report, the term "infrastructure" includes both "public infrastructure" facilities serving the community and "on-site infrastructure" located on customer sites, as shown in Figure 9-1.

Box 9-1.
"Recycled water" is defined in the Water Code (see glossary) as wastewater treated to a quality suitable for beneficial use. The Water Code definition neither designates the source of the wastewater nor indicates a certain level of treatment. In the context of this section, the discussion of recycled water is focused on treated wastewater of municipal origin and will usually be referred to as "municipal recycled water." It is distinguished from onsite reuse, which is an internal iterative or cascading use of wastewater through multiple cycles or processes and is discussed in other sections of this report. Municipal wastewater is considered to be community wastewater containing a domestic wastewater component.

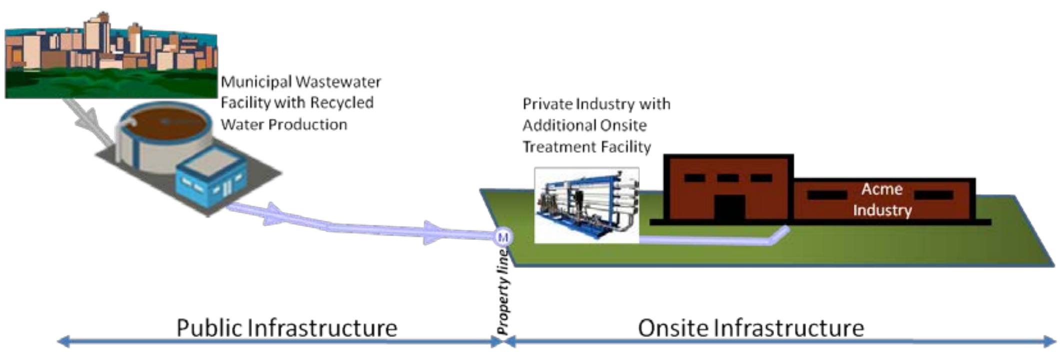

Figure 9-1. Public and Onsite Recycled Water Infrastructure. Public infrastructure is defined as community-based wastewater collection, treatment and distribution system. Onsite infrastructure is defined as customer-owned pipelines or supplemental treatment systems dedicated to treating water used at a commercial or industrial facility.

9.1 Municipal Recycled Water in California

Municipal recycled water is used extensively in California to meet municipal, environmental, commercial, industrial, and institutional water supply needs. Municipal recycled water projects are almost exclusively implemented on the local or regional level and involve multiple agencies working cooperatively to address wastewater and recycled water supply issues. Because of the link between wastewater and water supply quality, quantity, and reliability, as well as jurisdictional issues and distribution systems, implementing projects can involve extensive interagency collaboration.

Currently, municipal recycled water is used to meet the water needs of the CII sector through non-potable systems and augmentation of groundwater aquifers used for potable water supply. Non-potable municipal recycled water is delivered from the recycled water treatment facility to water users via dedicated water pipeline systems and is typically used by the CII sector for manufacturing processes or landscape irrigation. Eighty-one percent of municipal recycled water use in California is for non-potable purposes and is delivered in these "dual distribution" systems. Municipal recycled water used for groundwater recharge or direct injection for a seawater intrusion barrier is indirectly available for potable reuse, including by CII sectors.

Types of uses for municipal recycled water in California in 2009 are shown in Figure 9-2. The categories of CII use are commercial, industrial, golf course irrigation, landscape irrigation, and geothermal energy production. A few minor CII uses, such as toilet flushing and dust control, are in the "Other" category. These uses total about 34 percent of total municipal recycled water use in California and almost nine percent of the total 2.6 MAF CII water use (see Figure 3-2). Though Institutional uses were not categorized separately 10,200 AF of the total municipal recycled water uses was reported by prisons, colleges, and military bases were for golf course, landscape, and agricultural irrigation.

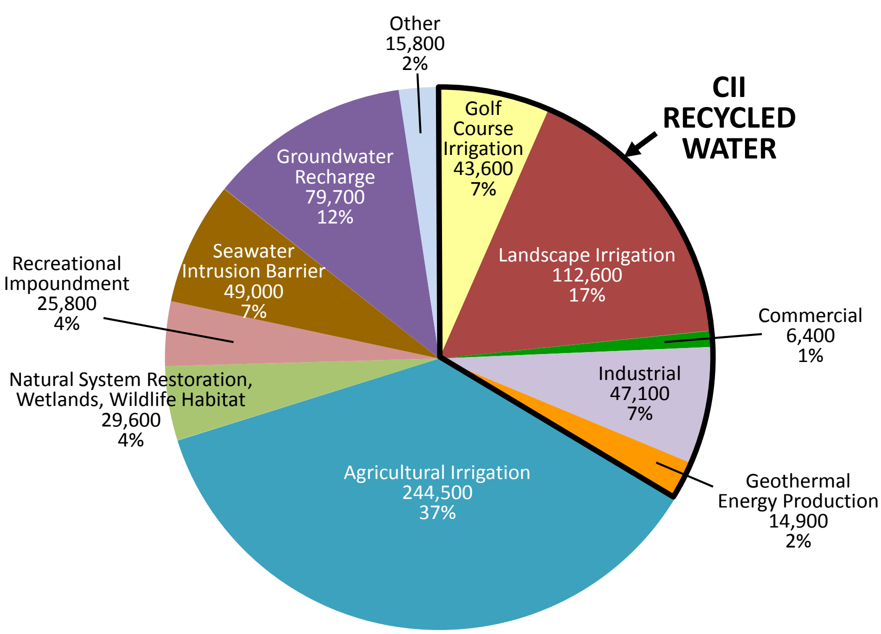

Figure 9-2. Recycled Water Beneficial Use Distribution in 2009. 2009 Municipal Recycled Wastewater Survey, showing beneficial use categories, volume of water in acre-feet beneficially used in 2009, and the overall percentage of the category based on the annual amount of water beneficially used.

9.1.4 The Health and Safety Code Levels of Treatment

The California Department of Public Health (CDPH) prescribes the levels of treatment required for municipal recycled water to protect public health. In general, the levels of treatment are based on levels of human exposure and types of exposure that provide pathways to infection. The required levels of treatment are specified in Title 22 of the California Code of Regulations (Division 4, Chapter 3, §60301 et seq.).

A key components of incorporating municipal recycled water into CII applications is aligning potential uses to the availability of various levels of treated municipal recycled water. Volume II includes a summary (Table 9-2) of CII applications that are allowed for the different levels of municipal recycled water treatment specified in Title 22. Water treated to a higher level can be used for potable reuse projects.

9.1.5 Regulatory Agencies and their Roles in Statewide Recycling

The current framework for regulating municipal recycled water has been in place since the 1970s. Primary authority for overseeing municipal recycled water is divided between the SWRCB, including the nine RWQCBs, and CDPH. A memorandum of agreement between the SWRCB and CDPH documents this arrangement and clarifies the roles of the agencies.

Four other state agencies are directly involved with California municipal recycled water issues and implement various sections of state law: DWR, California Public Utilities Commission, California Department of Housing and Community Development, and California Building Standards Commission. Statutes governing municipal recycled water are within the Water, Health and Safety, and Public Utilities codes and regulations and in various subdivisions (titles) of the California Code of Regulations (CCR). See Volume II, Table 9-3 for a summary of state and local agency roles and responsibilities relative to municipal recycled water.

9.2 Municipal Recycled Water Infrastructure

The infrastructure for use of municipal recycled water begins with the wastewater collection system and ends with the plumbing on the recycled water user's site. Infrastructure for potable reuse is similar to that for non-potable reuse except that additional treatment may be included and groundwater percolation or injection facilities are included. Potable reuse projects can be less costly per unit of water served.

Municipal wastewater recycling projects are generally infrastructure-intensive to construct and operate, requiring capital investment, project sitting, construction, maintenance, and other significant challenges for the builder and operator of the project. Key project-specific variables affecting infrastructure requirements for future water recycling projects in California include source control, proper treatment consistent with the use, separate distribution and storage, and cross-connection control.

Existing CII water users must retrofit their sites to meet CDPH requirements before receiving recycled water. In new developments where municipal recycled water delivery is planned, sites can be designed from the beginning with separated potable and recycled water plumbing.

On-site infrastructure modifications incur expenses for both users and suppliers of municipal recycled water. On-site design includes use of purple pipes and appurtenances, overspray prevention, and separate potable water and recycled water systems with appropriate backflow prevention to avoid cross-connections. Other on-site issues may include the need for changes in on-site treatment process and other operating criteria to accommodate the differences in water quality.

Prior to implementing onsite use of municipal recycled water, a user is required to:

- Conduct cross-connection testing
- Submit use site plans for review and approval by CDPH or the local county health department

9.3 Municipal Recycled Water CII Applications

CII businesses are successfully integrating municipal recycled water into many aspects of their process, as indicated in Table 9-1. Three key areas affecting the ability of CII businesses to integrate municipal recycled water into its water supply are:

- Water Quality – Impacts many aspects of CII recycled water use. For example, high concentrations of some dissolved minerals can affect how many times water can be cycled through the cooling towers and the concentration of the discharge. These concentrations affect both the plant operation and waste disposal – both of which are costly to power plant operation. See Volume 2 for additional discussion of water quality issues.

- Supply Issues – These include public and onsite infrastructure, pricing and supply interruptions and back up requirements.

- Alternate Distribution System Options – Alternate solutions to a dedicated municipal recycled water distribution system includes satellite treatment plants and potable system distribution.

Table 9-1. CII Sector Municipal Recycled Water Applications. Refer to Volume II, Table 9-2 for a summary of municipal recycled water applications approved under Title 22 of the California Code of Regulations (Division 4, Chapter 3, §60301 et seq.), based on required treatment levels.

CII SECTOR	CII TASK FORCE REPORT SECTION	APPLICATION[1]						CASE STUDIES[2]
		Cooling Tower Make up	Indoor (Dual) Plumbing	Landscape Irrigation	Process Water	Boiler Feed	Other	
Commercial and Institutional Sector Uses								
Office Buildings	7A5	○	○	○				Irvine Ranch Water District supplies recycled water to dual plumbed to many office buildings
Prisons	7A6			○			●	Prisons in California use recycled water for agricultural and landscape irrigation.
Schools and Educational Facilities	7A8	○	○	●				UC San Diego, San Jose State University, and some schools within IRWD
Vehicle Washing	7A9						○	Marin Municipal Water District
Industrial Sector Uses								
Microelectronics	7B2c						○	South Bay Water Recycling provides recycled water to several high-tech industries for cooling server centers.
Petroleum refining and chemicals	7B2d	●				●		BP Carson
Pharmaceutical	7B2e	○				○		none identified at this time
Power Plants	7B2f	●						Metcalf Energy Center (South Bay Water Recycling), Walnut Energy Center (Turlock) Several proposed solar projects have not begun construction or operation.

NOTES:

1. Filled circles are common applications of municipal recycled water. Open circles are less common applications, but are approved. Small dots are applications which currently have limited application.
2. Case studies cited here are not the only locations where CII municipal recycled water is being used for the application, but they are merely cited here as examples.

Indirect potable reuse projects can generally be built on a larger scale realizing greater increases in recycled water use in a shorter time frame compared to non-potable reuse projects. Current projects include groundwater recharge through percolation and direct injection. With additional research and approvals by CDPH, future projects may include reservoir augmentation or augmentation of raw water supplies. Direct delivery to potable water systems will also be considered under the provisions of SB 918. These projects may be the best approach to meeting the statewide recycled water goals.

9.4 Public Infrastructure Needs for Increasing CII Municipal Recycled Water Use

Despite the gains in California's use of municipal recycled water since the early 1990s, the State is not on target to attain the projected 2030 recycled water use potential of 2.5 MAF (an additional 2 MAF above 2009, from the SWRCB Recycled Water Policy). If the current pace of adding recycled water use continues the state will only be recycling about 1.1 MAF by 2030. Strong focus and direction are needed to make better progress to achieving a goal of at least 2 MAF by 2030. The slow pace of infrastructure expansion is a major challenge to meeting the projections.

> Maintaining local and regional control of municipal recycled water works well. However, the State of California sees an overall benefit to expanding municipal recycled water use because doing so supports the overall objective of water supply reliability and sustainability.

The remainder of this section addresses the requirement established for the CII Task Force was in Water Code section 10608.43(c): to evaluate "public infrastructure necessary for delivery of recycled water to the commercial, industrial, and institutional sectors." Barriers and solutions to increasing municipal recycled water use are included in Section 10, with a focus on overcoming infrastructure barrier in Section 10.1.

9.4.1 Municipal Recycled Water Implementation

Municipal recycled water is produced and distributed on a local level, allowing suppliers to maintain control of their systems and meet the needs of their customers. It also enables water agencies with water source challenges to increase local supplies and reduce dependency on imported water.

The success of a local municipal recycled water project depends on good planning and local interagency cooperation. It enables alternatives to be evaluated and to develop an approach to address customer and water supply needs. It also considers both onsite and offsite infrastructure costs. Solutions to this obstacle are discussed in Sections 10.1.1 and 10.1.3.The CII Task Force encourages local planning efforts using good planning practices to maximize the potential implementation of municipal recycled water use. Recommendations to accomplish this goal are identified below.

9.4.2 Justification for Additional Municipal Recycled Water Funding

Infrastructure is a fundamental requirement for water recycling to support water resource supply demands. Local water and wastewater agencies are postponing or shelving planned projects because of fiscal challenges. If additional projects are not implemented, increased municipal recycled water use may not occur.

Augmenting statewide municipal recycled water funding, even in light of current statewide budget issues is expected by the Task Force to provide long-term benefit to the state for the following reasons:

- Utilizing existing water supply efficiently can buffer against continued population growth and recurring periods of drought, .
- Establishing and fully utilizing municipal recycled water supplies reduce dependence on imported water
- Developing local water resources will provide the communities with increased self reliance in the face of potential global warming impacts to the state's water system.
- Using municipal recycled water may reduce greenhouse gas emissions because less energy is needed to treat and reuse water than to convey fresh water long distances.

9.4.3 Known Issues

Three infrastructure needs were identified:

- Local Delivery Infrastructure – Some municipal recycled water purveyors have been able to construct recycled water facilities. However, expanding customer bases and delivering municipal recycled water to have been problematic. Additional funding would support installation of additional conveyance and could also be used to support appropriate onsite infrastructure improvements.

- Brine Disposal Needs – This continues to be a significant obstacle to expanding municipal recycled water development, particularly in inland communities. As an example; Southern California has successfully developed portions of the Santa Ana Regional Interceptor, a brine export line. Expansion of infrastructure to dispose of brine would provide opportunities for additional municipal recycled water supply.

- Expanded potable reuse -- Expansion of potable reuse infrastructure will avoid the costs associated with dual distribution of recycled water and user retrofits. At the same time, it may provide reliable drought proof supplies to allow local economic expansion.

9.4.4 Specific Public Infrastructure Needs

The State should work with stakeholders to develop the most appropriate approach to Statewide investment in additional recycled water projects. The State, working with stakeholders may consider developing;

Statewide Recycled Water Master Plan implementation should focus on the following steps.

1. (Beginning Immediately) Provide additional funding to existing municipal recycled water suppliers.
2. Expand recycled water supplies to brine management projects as soon as possible to enable increased use of municipal recycled water.
3. Provide funding as soon as possible for the increased use of municipal recycled water use.

9.5 Funding/Cost

While identifying specific infrastructure necessary for delivery of municipal recycled water to CII sectors is not possible, the overall costs of this infrastructure may be estimated based on historic data and experience. The Recycled Water Task Force (RWTF) estimated in 2003 the state-wide capital investment between $9.2 and $11 billion (in 2003 dollars) was needed to increase all municipal recycling from 0.5 to 2.0 MAF (1.5 MAF increase) by 2030. The high cost of municipal recycled water projects may be reduced through regulatory streamlining, which is discussed in Section 10. The RWTF recommended increasing State and federal funding assistance to the local and regional agencies implementing and operating the water recycling projects. This recommendation has been implemented through grants and loans administered both by the SWRCB and the DWR and through Title XVI federal funding.

Costs of water recycling projects have a wide range. San Diego area costs reported in 2010 for potable and non-potable reuse projects provide an indication of costs typically encountered including annual capital and operating costs. Proposed potable projects include estimated costs associated conveyance systems necessary to reach the ground or surface water recharge or blending sites, but do not account for wastewater benefits. Ranges of recycled water costs are estimated to be:

- Existing non-potable projects (4): $1,259 - $1,662 per AF
- Proposed non-potable projects (5): $1,000 - $2,437 per AF
- Proposed indirect potable projects (2): $1,400 - $1,814 per AF

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10.0 Evaluation of Institutional and Economic Barriers to Municipal Recycled Water Use

Increasing the amount of municipal recycled water used in California augments the State's water supply resources and provides environmental benefits. As noted in Section 9, water recycling in California has achieved some level of success, but continued barriers hinder additional expansion. This Section builds upon the background information provided in Section 9 and identifies existing barriers and proposes solutions to increasing CII municipal recycled water use in California, in accordance with Water Code Section 10608.43(d).

The CII Task Force developed a list of 10 barriers to integrating municipal recycled water into CII applications. To develop the list, the CII Task Force evaluated obstacles and recommendations of the Recycled Water Task Force (DWR, 2003), and reviewed and assessed the current level of implementation of the recommendations. The CII Task Force also evaluated obstacles not addressed by the RW TF, drawing upon professional experience and knowledge. Finally, the CII Task Force qualitatively ranked the barriers based on their potential to limit increasing local and regional recycled water use and identified possible solutions.

The CII Task Force's ranking of the institutional and economic barriers to increasing the CII use of municipal recycled water reflects a range of different factors related to CII businesses, municipal recycled water producers and distributors, and State policymakers and regulators. The barriers, listed below, are ranked according how much they are limiting statewide use of municipal recycled water (with number one being the largest barrier).

1. Infrastructure Cost and Feasibility
2. Regulatory Impediments
3. Awareness and Education of Recycled Water Quality
4. Public/Customer Acceptance
5. Cost for CII Users
6. Source Water Quality
7. Recycled Water Supply Reliability
8. Terminology Used in Describing Process
9. Data for Tracking Use
10. Institutional Coordination among Agencies

Table 10-1 is a summary of the barriers to increasing municipal recycled water use by CII businesses and corresponding solutions. It also includes a listing of suggested key actions and implementers for each barrier and solution. Volume II provides additional discussion for the solutions and key actions with selected examples for solutions.

Table 10-1. Barriers and Possible Solutions to Increased CII Municipal Recycled Water Use.

BARRIER	VOLUME II SECTION	SOLUTION	KEY ACTIONS	IMPLEMENTORS
Infrastructure Cost And Feasibility	10.1.1	Conduct Local and Regional Water Recycling Planning by Analyzing Appropriate Options	• Evaluate trade-offs for potable reuse versus dedicated parallel distribution systems (purple pipe)	Water supply and wastewater agencies
	10.1.2	Seek or Provide Funding Sources to Facilitate Local Projects	• Identify onsite and offsite infrastructure funding • Identify recycled water unit pricing • Identify possible financial incentives	Local, regional, and state agencies
	10.1.3	Include Evaluation of On-Site Retrofit and Other Modifications When Assessing Municipal Recycled Water Feasibility	• Consider onsite retrofit costs during recycled water feasibility studies • Consider developing strategies to financially support onsite retrofit, or onsite facility or process modification	Water supply and wastewater agencies, CII water users
	10.1.4	Fund Development of Indirect and Direct Potable Reuse Regulations	• Consider onsite retrofit costs during recycled water feasibility studies	Legislature
	10.1.5	Provide Greater State Funding for Municipal Recycled Water Projects Commensurate With Benefit to State	• Consider state and federal funding subsidies • Consider state and federal low-interest loans	Legislature
	10.1.6	Provide incentives for installation of customer-side (on-site) infrastructure	• Consider providing technical and financial assistance • Support rate structures and utility subsidies	Water supply agencies and CPUC
Regulatory Impediments	10.2.1	Revise water recycling statutes	• Consider re-codifying laws to consolidate and simplify recycled water statutes into a single "water recycling" code section • Consider amending statutes to provide simplified and consistently implemented permitting • Suggest CDHP regulate the use of "advanced treated" recycled water to be used for potable reuse and RWQCBs regulate other uses of recycled water • Consider updating statutes to address constituents of emerging concern	SWRCB, CDPH, and Legislature

BARRIER	VOLUME II SECTION	SOLUTION	KEY ACTIONS	IMPLEMENTORS
Regulatory Impediments (continued)	Section 10.2.2	Provide consistent implementation of the SWRCB's recycled water policy and revise policy as appropriate	• Develop specific CEC monitoring requirements and salt and nutrient management plans guidelines • Evaluate recommendations and propose changes to the SWRCB's Recycled Water Policy (adopted in 2009) and incorporate recommendations into the groundwater recharge criteria being developed by CDPH • The State Board should work with stakeholders to prepare a guidance document comparing MS4 and NPDES permits to evaluate permitting opportunities and appropriate approaches	RWQCBs, SWRCB, Stakeholders, CDPH, CEC Expert Panel, and other potential monitoring entities (USGS)
	10.2.3	Implement consistent use site oversight throughout the state	• Develop and implement consistent oversight recommendations • Prepare oversight guidance and training • Consider oversight delegation	CDPH, RWQCBs, County health departments, and recycled water purveyors
	10.2.4	Revise water recycling regulations and California Plumbing Code	• Change Titles 17 and 22 to eliminate unnecessary restrictions and inconsistencies and to align with the California Plumbing Code	CDPH, DWR, California Building Standards Commission
	10.2.5	Support the Ocean Plan update addressing brine disposal from municipal recycled water and groundwater facilities	• Work with the SWRCB to modify the Ocean Plan in a way that recognizes the importance of advanced treatment in achieving the State's water recycling goals and identifies appropriate and protective approaches to ocean brine disposal	SWRCB, USEPA, and potential ocean brine dischargers
Awareness and Education of Municipal Recycled Water Quality	10.3.1	Educate potential municipal recycled water users and suppliers	• Expand outreach to CII businesses, with focus on technical information, case studies, the types of municipal recycled water locally available, and the solutions presented in this report	DWR, WateReuse California, recycled water users, trade groups, ACWA, and environmental advocacy groups
	10.3.2	Create and Promote Information on Use of Municipal Recycled Water in CII	• Create and disseminate information on recycling opportunities in various CII settings	WateReuse California, trade associations, water agencies, DWR

BARRIER	VOLUME II SECTION	SOLUTION	KEY ACTIONS	IMPLEMENTORS
Public/Customer Acceptance	Section 10.4.1	Educate and promote municipal recycled water	• Conduct a state-wide information campaign to offer authoritative views from recognized experts including SWRCB, DWR, CDPH, and independent research groups, such as the Pacific Institute and environmental NGOs • Develop a "tool kit" for agencies involved in producing or marketing municipal recycled water	DWR, WateReuse California, ACWA, and industry groups
	10.4.2	Implement community value-based decision-making model for project planning	• Develop and incorporate community value-based decision-making practices into recycled water project planning	Water suppliers
Cost for CII Users	10.5.1	Base recycled water pricing on total cost of use and provide incentives	• Consider various pricing strategies to help make recycled water feasible for CII businesses	Retail water suppliers
Source Water Quality	10.6.1	Provide water quality suitable for intended use	• Facilitate linking water quality to CII needs by assessing a range of options including onsite or supplemental treatment.	Water supply agencies, CII businesses, WateReuse California, industry trade associations
Recycled Water Supply Reliability	10.7.1	Consider increased recycled water system reliability features and backup water supply	• Assess the required reliability of recycled water system reliability for the given end-user needs and evaluate the need for additional system redundancy	Water supply agencies and users
Terminology Used in Describing the Process	10.8.1	Establish terminology	• Establish universal terminology that is transparent, comprehensible, and consistent with State statutes and regulations • Establish a forum of water agencies, regulators and interested parties • "Determine if changing the definition of "waste" in Section 13050(d) of the Water Code and other sections of statute is needed to address a perception that recycled water is being regulated as a waste rather than as a valuable resource."	WateReuse California, water supply agencies and users, SWRCB, CDPH, DWR, AWCA
	10.8.2	Use new terminology	• Communicate this consistent, clear terminology to water industry professionals and seek its widespread use	SWRCB, CDPH, DWR, WateReuse California, and

				ACWA
Data for Tracking Use	10.9.1	Create Unified Recycled Water Use and Compliance Reporting System	• Develop consistent reporting requirements and a web-based reporting system that meets regulatory compliance needs of regional water quality control boards and data gathering needs of water supply planners	SWRCB, CDPH, WateReuse California, and DWR

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BARRIER	VOLUME II SECTION	SOLUTION	KEY ACTIONS	IMPLEMENTORS
Institutional Coordination Between Agencies	10.10.1	Review Duplication of Service Regulations	• Determine if laws and regulations need to be revised relative to duplication of service	WateReuse California, DWR, ACWA, and CPUC
	10.10.2	Provide Agency Partnering Case Studies	• Develop case studies where partnering between water, waste water and other utilities has been effective in providing recycled water to CII businesses	WateReuse California, DWR

Appendix H: Glossary

Activated Carbon: An activated carbon filter is used for the removal of dissolved organics, color and odor- causing compounds. Generally high-molecular-weight, non-polar compounds are adsorbed more effectively than low-molecular-weight, polar compounds.

Aggregate-level metric: A metric that does not apply to a specific set of conditions, such as system-wide or sector-wide measures.

Alternative turf: See Synthetic turf.

Alternative water source: Any non-potable water source used for irrigation purposes.

Artificial turf: See Synthetic turf.

As-built documentation: Set of reproducible drawings that show significant changes in the work made during construction and that are usually based on drawings marked up in the field and other data furnished by the contractor (MWELO, Section 491).

Back flow prevention device: A safety device used to prevent pollution or contamination of the water supply due to the reverse flow of water from the irrigation system (MWELO, Section 491).

Benchmark: (1) A particular (numerical) value of a metric that denotes a specific level of performance; (2) A current value or beginning value of a metric.

BMP: Best management practices**;** recommended methods or practices designed to increase irrigation efficiency and uniformity thereby reducing water consumption and runoff, protecting water quality.

Chemical of emerging concern: Constituents that may occur in wastewater and may be resistant to some treatment processes. These constituents include: personal care products, pharmaceuticals including antibiotics and antimicrobials; industrial, agricultural, and household chemicals; natural hormones; food additives (e.g., phytoestrogens, caffeine, sweeteners); transformation products, inorganic constituents (e.g., boron, chlorate, gadolinium); and nanomaterials. Research is ongoing in the scientific community to assess the impacts of chemicals of emerging concern on flora and fauna exposed to wastewater. The term is often used interchangeably with ‘constituents of emerging concern’ or ‘compounds of emerging concern’. It is also frequently abbreviated CECs.

Commercial water user: A water user that provides or distributes a product or service. (See CWC §10608.12(d)).

Confounding-factors: Factors affecting the numeric value of a metric that are not related to the purpose of a metric.

Conservation Index (CI): Nomenclature denoting conservation metric.

CII: Commercial, institutional, and industrial customers; examples of commercial users include customers who provide or distribute a product or service, such as hotels, restaurants, office buildings, commercial businesses, or other places of commerce; institutional customers include schools, courts, churches, hospitals, and government institutions regardless of ownership; industrial customers are those who primarily manufacture or process materials as defined by NAICS.

Definitional noise: The inaccuracies in both the numerator and denominator of a metric as a result of different, specific or general, definitions used for collecting data.

De-ionization: Ion exchange onto synthetic resins or activated alumina is considered for the removal of mineral ions or hardness in the water. De-ionized water is used in the spot-free rinse by some professional car wash operators.

Direct potable reuse: The planned introduction of highly treated recycled water either directly into a potable water supply distribution system downstream of any water treatment plant or into a raw water supply immediately upstream of a water treatment plant. (Paraphrase of Water Code §13561(b)).

Direct reuse: The use of recycled water that has been transported from a wastewater treatment plant to a reuse site without passing through a natural body of either surface water or ground water.

Economic Efficiency: An efficiency measure that incorporates the concept of value, such as including a monetary or resource factor.

Efficiency: The ratio of output to input or vice versa. Water use metrics and benchmarks are inextricably linked to the concepts of "water conservation" and "water-use efficiency." Therefore, it is also helpful to define these concepts in the context of evaluating water use. The term "efficiency" derives from engineering practice where it is typically used to describe technical efficiency, or the ratio of output to input.

Enterprise: A legal entity operating as a business, government, or other organization which may have one or more places of operation or activity.

Establishment: A specific water use site (e.g., land parcel or building) at which there may be one or more end-uses of water.

Evapotranspiration: A combination of water transpired from vegetation and evaporated from the soil and plant surfaces (ASABE, 1998).

Existing landscape: For the purposes of this BMP, an established landscape associated with a CII site.

Filtration: The process by which suspended solids are removed from the water in order to better utilize the water in a greater number of processes. Granular media filters such as sand, glass and olivine are all in use. Bag or sack filters, made of woven material such as cloth or paper, are also in use.

Flocculation: The process by which anionic and cationic materials in the reclaim water are removed through use of polymers and/or metal salts. The chemical interactions result in the coagulation and sedimentation of suspended solids smaller than 5 microns. Flocculation can be used to effectively remove turbidity, color and total suspended solids. It is dependent on the proper selection of flocculent, precise control of the dosage and proper design of the hardware.

Graywater: Untreated wastewater that has not been contaminated by any toilet discharge, has not been affected by infectious, contaminated, or unhealthy bodily wastes, and does not present a threat from contamination by unhealthful processing, manufacturing, or operating wastes. Graywater includes wastewater from bathtubs, showers, bathroom washbasins, clothes washing machines, and laundry tubs, but does not include wastewater from kitchen sinks or dishwashers. (Water Code §14876)

Groundwater recharge: The infiltration or injection of water into a groundwater aquifer.

Hardscape: Any durable material pervious and non-pervious (MWELO, Section 491).

Hydro-zones: Portion of the landscaped area having plants with similar water needs. A hydro-zone may be irrigated or non-irrigated (MWELO, Section 491).

Incidental Water User: Water that is used by industry for purposes not related to producing a product or product content or research and development. This includes incidental cooling, air conditioning, heating, landscape irrigation, sanitation, bathrooms, cleaning, food preparation, kitchens, or other water uses not related to the manufacturing of a product or research and development (23 CCR §596.1a(6).

Indirect potable reuse: The planned incorporation of recycled water into a raw water supply such as in potable water storage reservoirs or a groundwater aquifer resulting in mixing and assimilation, thus providing an environmental buffer. (Metcalf & Eddy/AECOM textbook, consistent with definition of "indirect potable reuse for groundwater recharge" in Water Code §13561(c)). Note that as "surface water augmentation" has been defined in the Water Code, it has been distinguished from direct potable reuse and would be a form of indirect potable reuse.

Indirect reuse: The use of recycled water indirectly after it has passed through a natural body of water after discharge from a wastewater treatment plant.

Industrial Water User: (1) A water user that is primarily a manufacturer or processor of materials as defined by the North American Industry Classification System (NAICS) code sectors 31 to 33, inclusive, or an entity that is a water user primarily engaged in research and development (CWC §10608.12(h)). (2) A water user that is primarily manufacturer or processor of materials.

In-line irrigation: See Subsurface irrigation.

Institutional Water User: A water user dedicated to public service. This type of user includes, among other users, higher education institutions, schools, courts, churches, hospitals, government facilities, and non-profit research institutions. (CWC§10608.12 (i)).

Irrigation scheduling: Determining when to irrigate and how much water to apply based on measurements or estimates of soil moisture or crop water used by a plant (NRCS, 1997).

Irrigation system design: Drawings and associated documents detailing irrigation system layout, and component installation and maintenance requirements (IA, 2010).

Landscape budget: A volume of water allocated to the entire landscape area for some period of time. This allowance is established by the water purveyor for the purpose of ensuring adequate supply of water resources (IA, 2010).

Maximum Applied Water Allowance (MAWA): The upper limit of annual applied water for the established landscaped area as specified in MWELO Section 492.4 (MWELO, Section 491).

Metric: A unit of measure (or a parameter being measured) that can be used to assess the rate of water use during a given period of time and at a given level of data aggregation (e.g., system-wide, sector-wide, customer level, or end-use level). Another term for a *metric* is *performance indicator*.

Metric value: A numerical value either (1) calculated from the mathematical formula for any given metric or (2) assigned to a given metric. A metric is not a benchmark or target.

Microclimate: Climate of a small, specific area that may contrast with the climate of the overall landscape area due to factors such as wind, sun exposure, plant density, or proximity to reflective surfaces (MWELO, 491).

Mulch: Any organic material, such as leaves, bark, straw, and compost, or inorganic mineral material, such as rocks, gravel, and decomposed granite left loose and applied to the soil surface for the beneficial purposes of reducing evaporation, suppressing weeds, moderating soil temperature, and preventing soil erosion (MWELO, 491).

MWELO: The Model Water Efficient Landscape Ordinance of the Department of Water Resources California Code of Regulations.

North American Industry Classification System (NAICS): The North American Industry Classification System (NAICS) is the standard used by Federal statistical agencies in classifying business establishments for the purpose of collecting, analyzing, and publishing statistical data related to the U.S. business economy. NAICS is based on a production-oriented concept, meaning that it groups establishments into industries according to similarity in the processes used to produce goods or services.

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New construction landscape: For the purposes of this BMP, a new building with a landscape or other new landscape associated with a CII site.

New landscape: See New construction landscape.

Ozonation: The process of treating reclaim water with ozone to remove odor producing hydrocarbons. Ozone is a powerful oxidizing agent and effective as a disinfectant. In water ozone is a powerful bleaching agent, acting more rapidly than chlorine, hydrogen peroxide or sulphur dioxide. Ozone has an additional advantage over chlorine since it does not leave undesirable odors nor produce trihalomethanes - both potential by-products of chlorine use. One common means of producing ozone for injection in reclaim water is corona discharge. Another method is to produce ozone using UV light.

Oxidation: Oxidation in simple chemical terms is the loss of electrons. The purpose of oxidation in water treatment is to convert undesirable chemicals to a form that is neither harmful, nor as objectionable as the original form. In the professional car wash reclaim system, oxidation is used to treat for odor, color or organisms such as bacteria and algae. Common oxidants include chlorine, ozone, and oxygen or air.

Performance indicator: The same meaning as “metric.”

Permeable: Any surface or material that allows the passage of water through the material and into the underlying soil (MWELO, 491).

Planned reuse: The deliberate direct or indirect use of recycled water without relinquishing control over the water during its delivery.

Process water: (1) a water used for producing a product or product content or water used for research and development, including, but not limited to, continuous manufacturing processes, water used for testing and maintaining equipment used in producing a product or product content, and water used in combined heat and power facilities used in producing a product or product content. Process water does not mean incidental water uses not related to the production of a product or product content, including, but not limited to, water used for restrooms, landscaping, air conditioning, heating, kitchens, and laundry. (CWC§10608.12 (l)) (2) a water used by industrial water users for producing a product or product content, or water used for research and development. Process water includes, but is not limited to; the continuous manufacturing processes, water used for testing, cleaning and maintaining equipment. Water used to cool machinery or buildings used in the manufacturing process or necessary to maintain product quality or chemical characteristics for product manufacturing or control rooms, data centers, laboratories, clean rooms and other industrial facility units that are integral to the manufacturing or research and development process shall be considered process water. Water used in the manufacturing process that is necessary for complying with local, State, and federal health and safety laws, and is not incidental water, shall be considered process water. Process water does not include incidental, commercial or institutional water uses (23 CCR 596.1a(11).

Productivity: A measure of the efficiency of production. The ratio of production output to what is required to produce it (inputs), total output per one unit of a total input.

Rainwater harvesting: Rainwater collection and distribution systems used as an alternative water source for irrigation (AWE, 2010).

Reclaimed water: Same meaning as "recycled water." (Water Code §26)

Recycled water: Water [that], as a result of treatment of waste, is suitable for a direct beneficial use or a controlled use that would not otherwise occur and is therefore considered a valuable resource. (Water Code §13050(n))

Rehabilitated landscape: Any re-landscaping project that requires a permit, plan check, or design review, meets the requirements of MWELO Section 490.1, and the modified landscape area is equal to or greater than 2,500 square feet, is 50% of the total landscape area, and the modifications are completed within one year (MWELO, Section 491).

Reverse Osmosis: Osmosis is defined in terms of water in an ideal state as the transport from a reservoir of pure water through a semipermeable membrane to a reservoir of water containing dissolved solutes. Reverse osmosis (RO) occurs when pressure is increased on the side of the membrane containing the solutes above the osmotic pressure of the solution. In this case water flows from the osmotic side of the membrane to the pure water side.

Scaling variable: Variable that can be used to standardize or characterize per unit rates of water use. Also called "scaling factor."

Separation: The first stage in a reclaim operation. Separation uses a settling tank, usually divided into at least three compartments, to allow grit to settle and to separate grease and oils from the water prior to reclaim in the professional car wash or discharge to the sanitary sewer. The tank will typically be located in-ground with the sections designed for gravity sedimentation, grease and oil separation, and with the third section of the tank for final clarification and discharge to reuse in the professional car wash or to the sanitary sewer system. At this point usually particles of up a range of 50 to 100 microns in size are removed, depending upon the size of the settling tank, and resultant residence time of the water. A cyclonic separator may also be used to increase the total amount of suspended solids removed from the water.

Standard Industrial Classification (SIC): A classification system for commercial, industrial, and institutional activities that classifies establishments by their primary type of activity and organizes industries in an increasing level of detail ranging from general economic sectors (e.g., manufacturing, services) to specific industry segments (e.g., commercial sports, laundry businesses). This system organizes industries by their output. SIC was replaced by the North American Industry Classification System (NAICS) in 1997.

Soil management: Utilizing a soil analysis report that includes soil properties such as soil type and infiltration rate when designing and scheduling irrigation systems.

Subsurface irrigation: Application of water below the soil surface through emitters, with discharge rates generally in the same range as drip irrigation. The method of water application is different from and not to be confused with sub-irrigation where the root zone is irrigated by water table control (ASABE, 1998).

Surface water augmentation: The planned placement of recycled water into a surface water reservoir used as a source of domestic drinking water supply (Water Code §13561(d)) or into any surface water when discharged for the purpose of aquatic habitat enhancement.

Synthetic turf: A product manufactured to look like natural turfgrass; a permeable ground cover made from synthetic fibers.

Target: A benchmark that indicates a state of achievement expected at some time in the future.

Turf: A ground cover surface of mowed grass (MWELO, Section 491).

Ultrafiltration: The process of using a membrane to filter out dissolved solids as well as the finest of suspended solids. Unlike reverse osmosis, ultrafiltration is not dependent on overcoming osmotic pressure differential, and can be accomplished at low pressure differences of 5 - 100 psi. The primary mechanism is selective sieving through pores.

UM: A water use metric acronym expressed as “usage ratios” or “usage rates.” The “ratio” metric designates the quotient obtained by dividing the volume of water sold over a specified period of time (day, month, season or year) by a scaling factor (e.g. number of accounts, population served or number of employees). Additional letters, superscripts and subscripts can be added to the UM acronym to designate user sector and the scaling variable being used.

Unplanned reuse: Unplanned reuse of treated wastewater effluent after disposal. Also called “incidental reuse.”

Warm season turf: Grasses that grow vigorously in warm summer months and then generally enter some state of dormancy in winter, thereby having a lower water need compared to cool season turf. Examples of warm season grasses include Bermuda, Zoysia and Buffalo grasses.

Water audit: Also known as an irrigation survey, a water audit is an in-depth evaluation of the performance of an irrigation system that includes, but is not limited to: inspection, system tune-up, system test with distribution uniformity or emission uniformity, reporting overspray or runoff that causes overland flow, and preparation of an irrigation schedule (MWELO, Section 491).

Water budget: Volume of irrigation water required to maintain a functional, healthy landscape with the minimum amount of water. A water budget is established through a method of water-efficiency standards for landscapes by providing the water necessary to meet the ET of the landscaped area.

Water conservation: A reduction in water use, water loss, or waste.

Water-efficient landscape: A landscape that minimizes water requirements and consumption through proper design, installation, and management (AWE, 2010).

Water reclamation: (1) Same meaning as definition 1 for "water recycling." (2) The treatment of water of impaired quality, including brackish water and seawater, to produce a water of suitable quality for the intended use.

Water recycling: (1) The process of treating wastewater for beneficial use, storing and distributing recycled water, and the actual use of recycled water. (2) The reuse of water through the same series of processes, pipes, or vessels more than once by one user, wherein the effluent from one use is captured and redirected back into the same use or directed to another use within the same facility of the user.

Water reuse: (1) The use of treated wastewater for a beneficial purpose, such as agricultural irrigation and industrial cooling. (2) The additional use of previously used water.

Water use efficiency: The relation of water-related tasks accomplished with an amount of water. For example, the ratio of input of water to output of a product.

Water Use Metadata: The multitude of agents that may produce or have the capability of producing an effect on whether a metric is appropriate can be termed water metric "metadata", for they are data about the metric. Under further development - DWR.

Water use productivity: The relation of specific or general product, outputs, or economic activity to amount of water associated with those products, outputs, or activities.

Winterization: The process of removing water from the irrigation system before the onset of freezing temperatures (IA, 2010).