Recommendations for In-Lieu Technologies for Dedicated Irrigation Meters for Commercial, Industrial, and Institutional Outdoor Irrigation Water Use Performance Measure

WUES-DWR-2021-19

A Report to the State Water Resources Control Board Prepared Pursuant to California Water Code Section 10609.10

September 2022

California Department of Water Resources
Water Use Efficiency Branch

Note: This report is part of the package of reports developed by the California Department of Water Resources to meet the requirements of Senate Bill 606 and Assembly Bill 1668 of 2018 for urban water use efficiency.

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Abbreviations and Acronyms

2013 CII Task Force Report	2013 Commercial, Industrial, and Institutional Task Force Water Use Best Management Practices Report to the Legislature
2018 Legislation	2018 Legislation on Water Conservation and Drought Planning (Senate Bill 606 [Hertzberg] and Assembly Bill 1668 [Friedman], as amended)
AB	Assembly Bill
ACWA	Association of California Water Agencies
APN	assessor's parcel number
AWE	Alliance for Water Efficiency
AWWA	American Water Works Association
BMP	best management practice
CalWEP	California Water Efficiency Partnership
CCR	California Code of Regulations
CCWD	Contra Costa Water District
CII	commercial, industrial, and institutional
CII-BMP	commercial, industrial, and institutional water use best management practice
CII-BMPs Performance Measure	Commercial, Industrial, and Institutional Water Use Best Management Practices Performance Measure
CII-DIMWUS	Commercial, Industrial, and Institutional Outdoor Irrigation of Landscape Areas with Dedicated Irrigation Meters Water Use Efficiency Standard
Conversion Threshold PM	Conversion Threshold Performance Measure
CPUC	California Public Utilities Commission
CUWA	California Urban Water Agencies
CUWCC	California Urban Water Conservation Council (now California Water Efficiency Partnership)
CWA	California Water Association
DIM	dedicated irrigation meter
DWR	California Department of Water Resources

ETAF	evapotranspiration factor in Model Water Efficient Landscape Ordinance design standard (on parcel level)
ETF	evapotranspiration factor (on urban retail water supplier level)
gpcd	gallons per capita per day
gpd	gallons per day
II	irrigable-irrigated
INI	irrigable-not irrigated
In-Lieu Technologies PM	In-Lieu Technologies Performance Measure
IRWD	Irvine Ranch Water District
IRWUS	Indoor Residential Water Use Efficiency Standard
Legislature	California State Legislature
MAWA	maximum applied water allowance
MWDOC	Municipal Water District of Orange County
MWELO	Model Water Efficient Landscape Ordinance
NAICS	North American Industry Classification System
NAIP	National Agricultural Imagery Program
ORWUS	Outdoor Residential Water Use Efficiency Standard
Recommendation Package	Urban Water Use Efficiency Recommendation Package
ROI	return on investment
SB	Senate Bill
SLA	Special Landscape Area
State	State of California
State Water Board	State Water Resources Control Board
SWAT	smart water application technologies and protocols
UCANR	University of California, Division of Agriculture and Natural Resources Center
UWUO	urban water use objective
WC	California Water Code

WELO	Water Efficient Landscape Ordinance
WLS	Water Loss Standard

Executive Summary

The California State Legislature passed the 2018 Legislation on Water Conservation and Drought Planning (Senate Bill 606 [Hertzberg] and Assembly Bill 1668 [Friedman], as amended; hereinafter referred to as the "2018 Legislation"), which includes provisions for advancing urban water use efficiency through developing and implementing various water use efficiency standards, variances, and performance measures. This report is submitted pursuant to California Water Code (WC) Section 10609.10, which directs the California Department of Water Resources (DWR), in coordination with the State Water Resources Control Board (State Water Board), to conduct necessary studies and investigations and recommend performance measures for commercial, industrial, and institutional (CII) water use for the State Water Board's adoption. Among other things, these performance measures include recommendations for an In-Lieu Technologies Performance Measure (In-Lieu Technologies PM) for those CII landscapes that exceed a certain size threshold (WC Section 10609.10).

DWR developed the recommendations for the In-Lieu Technologies PM as part of the CII water use performance measures based on the legislative directive. In particular, the WC also requires the CII water use performance measures to be consistent with *Commercial, Industrial, and Institutional Task Force Water Use Best Management Practices Report to the Legislature* (DWR, 2013a and 2013b). The technical and financial feasibility recommendations provided in that report are aimed at supporting the economic productivity of the State of California's (State) CII sectors (WC Section 10609.10(c)). The documentation of the implementation of the CII water use performance measures, including the In-Lieu Technologies PM, is required in the urban retail water supplier's Annual Water Use Report filing (WC Section 10609.24(a)(3)). However, quantification of water use per category is not required as the associated CII water use is excluded in the quantification reporting per provisions related to the urban water use objective.

Consistent with the legislative directive, DWR used a public process involving a diverse group of stakeholders in the review and development of the In-Lieu Technologies PM. The Water Use Studies Working Group and Standards, Methods, and Performance Measures Working Group that DWR established to assist in implementing the 2018 Legislation were the primary stakeholders involved in the development process for the CII water use performance measures. Additional stakeholders included State agencies, cities, counties, urban retail water suppliers, environmental organizations, and other interested parties. Working group members and stakeholders were provided with many opportunities to comment on and inform the suitability and practical application of the recommended In-Lieu Technologies PM for water use efficiency for CII landscapes that exceed the conversion threshold identified in *Recommendations for Dedicated Irrigation Meter Conversion Threshold for Commercial, Industrial, and Institutional Outdoor Irrigation Water Use Performance Measure* (WUES-DWR-2021-18). Technical

feasibility, financial considerations, and associated potential economic effects on CII sectors were also considered during the development process. In responding to stakeholder input, DWR incorporated the consideration of the limited authority urban retail water suppliers may have to unilaterally implement certain actions without explicit cooperation from CII water users in formulating the recommended performance measures.

DWR's recommended in-lieu technologies under the In-Lieu Technologies PM that are designed to achieve improved water use efficiency are referred to as "In-Lieu Technologies." Based on the research, technical studies, and stakeholder feedback, DWR recommends the implementation of In-Lieu Technologies for irrigated CII landscapes, greater than the conversion threshold, that are served by a mixed-use meter and have not been converted to a dedicated irrigation meter (DIM) (or equivalent technology). The In-Lieu Technologies comprise both adequate efficient water use technologies and associated water management practices designed for improved irrigation water use efficiency. For efficiency in streamlining the implementation, DWR also recommends that the schedule for implementing the In-Lieu Technologies PM be coordinated with implementing the Commercial, Industrial, and Institutional Water Use Classification System Performance Measure and that implementation be completed by urban retail water suppliers within six years after the State Water Board adopts the regulation.

DWR's recommendations for the In-Lieu Technologies PM are included in the report, *Summary of Recommendations for Performance Measures for Commercial, Industrial, and Institutional Water Use* (WUES-DWR-2021-15), along with other recommendations on CII water use performance measures for coordinated implementation, which DWR prepared per the requirements of the 2018 Legislation and are to be transmitted to the State Water Board for adoption. The associated performance measure for determining the irrigated landscapes served by mixed-use meters that exceed the threshold for converting to a DIM (or equivalent technology) or implementation of in-lieu technologies is described in the report, *Recommendations for Dedicated Irrigation Meter Conversion Threshold for Commercial, Industrial, and Institutional Outdoor Irrigation Water Use Performance Measure* (WUES-DWR-2021-18). DWR's recommendations for the In-Lieu Technologies PM and associated annual reporting requirements are also included in the report, *Recommendations for Urban Water Use Efficiency Standards, Variances, Performance Measures, and Annual Water Use Reporting* (WUES-DWR-2021-01A), which provides the complete context of the Urban Water Use Efficiency Recommendation Package and its implementation.

1.0 Introduction

Senate Bill (SB) 606 (Hertzberg) and Assembly Bill (AB) 1668 (Friedman) of 2018, as amended (hereinafter referred to as the "2018 Legislation"), established a new foundation for long-term improvements in water conservation and drought planning to adapt to climate change and the resulting longer and more intense droughts in the State of California (State). These two bills provide expanded and new authorities and requirements to enable permanent changes and actions for those purposes, thereby improving the State's water future for generations to come. Details of these provisions are summarized in *Making Water Conservation a California Way of Life: Primer of 2018 Legislation on Water Conservation and Drought Planning, Senate Bill 606 (Hertzberg) and Assembly Bill 1668 (Friedman)* (DWR and State Water Board, 2018).

1.1 New Approach to Urban Water Use Efficiency

Among other things, the 2018 Legislation contains provisions for advancing urban water use efficiency through developing and implementing various water use efficiency standards, variances, and performance measures per California Water Code (WC) Section 10609. This new water conservation framework is different than SB X7-7, which was established in 2009. The focus of SB X7-7 was to reduce statewide urban water use by 20 percent in 2020 compared to baseline calculated in 2010. The 2018 Legislation requires a bottom-up estimate from urban retail water suppliers of the urban water use objective (UWUO) based on the aggregated efficient water use volume by considering four urban water use efficiency standards and appropriate variances. The four standards are:

- Indoor Residential Water Use Efficiency Standard (IRWUS).
- Outdoor Residential Water Use Efficiency Standard (ORWUS).
- Commercial, Industrial, and Institutional Outdoor Irrigation of Landscape Areas with Dedicated Irrigation Meters Water Use Efficiency Standard (CII-DIMWUS).
- Water Loss Standard (WLS).

Commercial, industrial, and institutional (CII) water use not associated with dedicated irrigation meters (DIM) (or equivalent technologies) for outdoor irrigation of landscape areas is excluded from the UWUO.

Each of the procedural requirements to formalize these four standards for implementation is different. The 2018 Legislation includes a default, progressively reduced IRWUS (WC Section 10609.4(a)). In November 2021, in collaboration with the

State Water Resources Control Board (State Water Board), the California Department of Water Resources (DWR) submitted the joint recommendations for IRWUS to the California State Legislature (Legislature) for further consideration, per WC Section 10609.4(b). Separately, the State Water Board is currently conducting a rulemaking process to adopt the proposed WLS, which was originally authorized by SB 555 of 2015. For ORWUS and CII-DIMWUS, the 2018 Legislation requires DWR, in coordination with the State Water Board, to conduct necessary studies and investigations and develop recommendations to the State Water Board by October 1, 2021 (WC Sections 10609.6 and 10609.8).

Another major difference between the SB X7-7 requirements and those of the 2018 Legislation is that the anticipated outcome was measured on a statewide level per SB X7-7 and on an individual urban retail water supplier level per the 2018 Legislation. Recognizing the diversity of water use to support local economic, social, and environmental needs and varying climate conditions in the State, the 2018 Legislation requires DWR, in coordination with the State Water Board, to conduct necessary studies and investigations. It also requires DWR to develop recommendations for adoption by the State Water Board by October 1, 2021, for appropriate variances for unique uses that can have a material effect on an urban retail water supplier's UWUO and the corresponding thresholds of significance (WC Section 10609.14). In this context, DWR interpreted that a material effect means that this unique water use, although used in an efficient manner, when not excluded from an urban retail water supplier's UWUO, could unfairly jeopardize the ability of an urban retail water supplier to comply with the UWUO calculated using the standards per the 2018 Legislation.

As a supporting recommendation, the 2018 Legislation requires DWR to develop accompanying guidelines and methodologies for calculating the UWUO (WC Section 10609.16) and provide the recommendation to the State Water Board for adoption, along with DWR's recommendations on ORWUS, CII-DIMWUS, and appropriate variances by June 30, 2022 (WC Section 10609.2). The 2018 Legislation further requires DWR and the State Water Board to solicit broad public participation throughout the development and adoption processes (WC Section 10609(b)(3)).

Not all urban water uses are included in the UWUO. The 2018 Legislation includes considerations to manage CII water use separately, because CII water use can be complex and diverse and have direct connections to economic productivity. Additionally, there is currently insufficient information available to properly set standards or variances for CII water use, if even feasible, as there is for other categories of urban water use (e.g., indoor residential and outdoor residential). However, progress should still be made to improve CII water use efficiency. Therefore, the 2018 Legislation requires that DWR develop recommendations on performance measures for CII water use other than water use for CII outdoor irrigation of landscape areas with DIMs (or equivalent technologies) (already included as one of the standards) and process water (excluded

from both the UWUO and CII water use performance measures). More detailed discussion is provided in Section 1.2.

This performance measure approach for CII water use in the 2018 Legislation is different from the previous SB X7-7 requirements. The SB X7-7 water conservation framework required urban retail water suppliers to set conservation targets in gallons per capita per day (gpcd) and accounted for CII water use in a lumped reduction format with process water excluded. However, reporting CII water use in gpcd could be misleading, because CII water use may not have a direct correlation to the permanent residents in the service area. Reporting CII water use in gpcd or other metrics without the context of associated economic activities is not effective for showing progress in increased CII water use efficiency; efficient water uses of similar or different CII-related economic activities can vary significantly in volume depending on a number of factors. Therefore, urban retail water suppliers are often required to provide additional justifications or description for CII water use efficiency that cannot be demonstrated by using gpcd statistics or other metrics, including factors that may hinder the anticipated progress, such as lack of authority to unilaterally implement improvements or best management practices (BMP) without explicit cooperation of CII water users.

Under the 2018 Legislation, urban retail water suppliers are not required to report the volume of CII water use, except for the outdoor irrigation water use under CII-DIMWUS. However, urban retail water suppliers are required to report the performance measures in their Annual Water Use Report, including the actions they take to improve CII water use efficiency and associated outcomes. This more granular approach to improving CII water use efficiency is consistent with the approach to the volumetric reporting requirements under the UWUO and provides an opportunity for understanding the causations between performance measure actions and resulting water use efficiency improvements.

1.2 Commercial, Industrial, and Institutional Water Use Performance Measures

Following the 2012 to 2016 drought, the State reevaluated its water use practices and resolved to prioritize long-term water conservation and drought planning. In a broader sense, the 2018 Legislation calls for increased water conservation and more efficient use of water. In particular, WC Section 10608(e) states, “The success of [S]tate and local water conservation programs to increase efficiency of water use is best determined on the basis of measurable outcomes.” Providing measurable outcomes of increased water use efficiency requires the evaluation of baseline water use conditions for comparative purposes. However, recognizing that the diverse conditions preclude determination of baseline water use for varying water use in CII sectors in the State, the 2018 Legislation requires DWR to make recommendations on CII water use

performance measures for CII water uses other than outdoor irrigation for landscapes with DIMs.

In the context of CII water use, recommendations on sustainable water use and demand reduction performance measures must, "[s]upport the economic productivity of California's agricultural, commercial, and industrial sectors" (WC Section 10608.4(j)), but that "…does not require a reduction in the total water used in the agricultural or urban sectors, because other factors, including, but not limited to, changes in agricultural economics or population growth may have greater effects on water use. This part does not limit the economic productivity of California's agricultural, commercial, or industrial sectors" (WC Section 10608.8(c)).

DWR was required to conduct necessary studies and investigations and make recommendations on performance measures for CII water use to the State Water Board for its adoption by no later than October 1, 2021, as specified in AB 1668 and codified in WC Section 10609.10. In this context, "CII water use" means water used by commercial water users, industrial water users, institutional water users, and large landscapes (WC Section 10608.12(d)) with the following supporting definitions.

> *"Commercial water user" means a water user that provides or distributes a product or service* (WC Section 10608.12(e)).
>
> *"Industrial water user" means 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* (WC Section 10608.12(i)).
>
> *"Institutional water user" means 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 nonprofit research institutions* (WC Section 10608.12(j)).
>
> *"Large landscape" means a nonresidential landscape as described in the performance measures for CII water use adopted pursuant to WC Section 10609.10* (WC Section 10608.12(l)).

In addition, per WC Section 10608.12(n) "performance measures" are:

> *…actions to be taken by urban retail water suppliers that will result in increased water use efficiency by CII water users. Performance measures may include, but are not limited to, educating CII water users on best management practices, conducting water use audits, and preparing water management plans. Performance measures do not include process water.*

In this context, per WC Section 10608.12(p), "process water" means:

> *… 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, continuous manufacturing processes, and 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 is process water. Water used in the manufacturing process that is necessary for complying with local, [S]tate, and federal health and safety laws, and is not incidental water, is process water. Process water does not mean incidental water uses.*

As previously mentioned, except for landscape irrigation with DIMs (or equivalent technologies), CII water use is not part of the UWUO that urban retail water suppliers need to report quantitively in their respective Annual Water Use Reports. Water use efficiency in CII sectors is instead addressed through implementation of CII water use performance measures. The 2018 Legislation directs DWR to develop and recommend CII water use performance measures that include the following:

- CII water use classification system to address significant uses of water.
- Minimum size threshold for converting mixed-use CII meters to DIMs or in-lieu of technologies.
- BMPs, which may include, but are not limited to, water audits and water management plans for CII water users above a certain size, volume of use, or other thresholds.

The 2018 Legislation further requires that DWR's recommended CII water use performance measures be consistent with *Commercial, Industrial, and Institutional Task Force Water Use Best Management Practices Report to the Legislature* (DWR, 2013a and 2013b) (WC Section 10609.10(c)), hereinafter referred to as the "2013 CII Task Force Report." The Task Force consisted of stakeholders and experts convened by DWR and the California Urban Water Conservation Council, which is now the California Water Efficiency Partnership (CUWCC, now CalWEP), to develop BMPs for CII water users, as directed by WC Section 10608. The following recommendations by the Task Force (DWR, 2013a) are particularly relevant to the development of CII water use performance measures:

Recommendation 5-7: DWR should work with the Association of California Water Agencies (ACWA), CUWCC [now CalWEP]*, 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 water use 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).*

Recommendation 5-8: DWR, in consultation with a stakeholder advisory committee and through a public process, should develop a system and implementation plan for standardized collection of water production, delivery, and use data; 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****: DWR should develop a water-centric water use and user classification system.*
- ***Option 5-8.2****: Water service providers should classify water users using a common classification system and update their customer databases to incorporate this system.*
- ***Option 5-8.3****: Water service providers should consider recording and maintaining key data fields, such as assessor's* [sic] *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 5-8.4****: Water service providers and self-supplied water users meeting defined criteria should be required to report water use to the [S]tate.*
- ***Option 5-8.5****: Water service providers, CUWCC* [now CalWEP]*, 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.*

Recommendation 6-3: *Water and energy service providers should incorporate water audits into their efficiency programs, consider financial incentives for BMP implementation, and provide other technical assistance as appropriate.*

> ***Recommendation 6-4:*** *Organizations representing businesses and industry, water service providers, the CUWCC* [now CalWEP]*, other interested parties, and DWR should educate CII water users or entities on the BMPs and approaches to doing audits and performing a cost-effectiveness analysis.*

The ”Recommendations” section (Section 5.2) of the 2013 CII Task Force Report states:

> *This section does not currently recommend any single metric for use in all CII sectors.*
>
> *Furthermore, the CII Task Force cautions against setting regulatory minimum standards for water use efficiency metrics that would be applicable to specific CII establishments, sectors, or subsectors. Even within subsectors, it would be difficult to set uniform standards across CII establishments (defined as individual CII water user sites) because of the variability in the types of products made or services provided and the many confounding factors in how water is used.*

The 2013 CII Task Force Report presents the following option for further study or action to improve data collection and reporting. This option is specifically related to the development of a water use and user classification system (DWR, 2013b):

> *Option 1: DWR should develop a water use and user classification system. The system should comprehensively address all sectors of water use, not just CII water users. The system should be designed for all water use establishments to be classified using a full-spectrum water-centric coding system integrated with national, [S]tate, regional, and local goals and objectives for water resources planning and management. The classification system should include common definitions for water use sectors for consistent aggregation of data. Consideration should be given to using a commonly accepted coding system, such as NAICS, as a basis for definitions.*

Section 7.3.5 of Volumes I and II of the 2013 CII Task Force Report provides recommendations for large landscape BMPs (DWR 2013a and 2013b).

Per WC Section 10609.10(d), the State Water Board, in coordination with DWR, must adopt the performance measures on or before June 30, 2022. Documentation of the implementation of CII water use performance measures, including progress and implementation of a performance measure for in-lieu technologies, is required in the urban retail water supplier’s Annual Water Use Report filing (WC Section 10609.24(a)(3)).

1.3 Purpose of the Report

Per legislative requirements and with stakeholder engagement, DWR conducted studies and investigations to develop and recommend CII water use performance measures for adoption by the State Water Board. This report focuses on the In-Lieu Technologies Performance Measure (In-Lieu Technologies PM) for technologies that could be used in-lieu of requiring DIMs (or equivalent technologies) for irrigated CII landscapes served by mixed-use meters and is one of three performance measure–specific reports produced by DWR per requirements of the 2018 Legislation. Refer to the report, *Recommendations for Dedicated Irrigation Meter Conversion Threshold for Commercial, Industrial, and Institutional Outdoor Irrigation Water Use Performance Measure* (WUES-DWR-2012-18), for a comprehensive discussion of the Conversion Threshold Performance Measure (Conversion Threshold PM) that sets minimum size thresholds for converting mixed-use CII meters to DIMs (or equivalent technologies) or to acceptable in-lieu technologies.

Commercial, Industrial, and Institutional Large Landscapes

The In-Lieu Technologies PM is applicable to "large landscapes," served by CII mixed-use meters, that have an irrigated area equal to or greater than the conversion threshold recommended by DWR under the Conversion Threshold PM and adopted by the State Water Board (see *Recommendations for Dedicated Irrigation Meter Conversion Threshold for Commercial, Industrial, and Institutional Outdoor Irrigation Water Use Performance Measure* [WUES-DWR-2021-18]). "Large landscapes" are defined in the Conversion Threshold PM in accordance with WC Section 10608.12.(l), and this definition also applies to the In-Lieu Technologies PM. In this report, a "large landscape" means a CII landscape with a size equal to or greater than the conversion threshold. A CII mixed-use meter means a CII meter that measures both CII indoor water use and irrigation water use.

Relationship to California Department of Water Resources' Urban Water Use Efficiency Recommendation Package

DWR has completed a significant body of work to meet the requirements of the 2018 Legislation and provide recommendations on different topics to the State Water Board for adoption. To streamline document development and recognize the inherent interrelationship among different topics and the need for overall consistency, DWR organized the various reports in an Urban Water Use Efficiency Recommendation Package (Recommendation Package) that allows mutual referencing and incorporate content by reference. All reports in this Recommendation Package are given a serial number in the form of "WUES-DWR-2021-xx." For each report, Appendix A includes the list of documents within the Recommendation Package that are incorporated by reference.

Specifically, this report, *Recommendations for In-Lieu Technologies for Dedicated Irrigation Meters for Commercial, Industrial, and Institutional Outdoor Irrigation Water Use Performance Measure* (WUES-DWR-2021-19), provides the detailed documentation for the review and subsequent recommendations on specifications, implementation, and guidelines and methodologies for the In-Lieu Technologies PM. DWR's recommendations for this performance measure were summarized in the report, *Summary of Recommendations for Performance Measures for Commercial, Industrial, and Institutional Water Use* (WUES-DWR-2021-15), along with other performance measures for coordinated implementation. The additional context, performance measure development process and approach, evaluation of options, and stakeholder input included in this document are incorporated by reference. DWR's recommendations and associated annual reporting requirements are also included in the report, *Recommendations for Urban Water Use Efficiency Standards, Variances, Performance Measures, and Annual Water Use Reporting* (DWR Report Number WUES-DWR-2021-01A), which provides the complete context of the Recommendation Package and its implementation. Key terms and their definitions used in this report, along with abbreviations and acronyms, are included in *Urban Water Use Efficiency Recommendation Package: Glossary and Abbreviations and Acronyms* (WUES-DWR-2021-21).

The In-Lieu Technologies PM is used in conjunction with the Commercial, Industrial, and Institutional Water Use Best Management Practices Performance Measure (CII-BMPs Performance Measure) and Conversion Threshold PM provided in *Recommendations for Commercial, Industrial, and Institutional Water Use Best Management Practices Performance Measur*e ((WUES-DWR-2021-16) and *Recommendations for Dedicated Irrigation Meter Conversion Threshold for Commercial, Industrial, and Institutional Outdoor Irrigation Water Use Performance Measure* (WUES-DWR-2021-18), respectively.

Effects on Existing Law and Regulations

DWR developed the recommendations on the In-Lieu Technologies PM pursuant to legislative directive. The recommended In-Lieu Technologies PM does not set, rescind, or modify existing requirements or authorities for implementing these technologies.

1.4 Report Organization

This report is organized into six sections:

- **Section 1 – Introduction** provides the background and purpose of this document.

- **Section 2 – Scope Definition** provides the process and rationales used in defining the scope for this potential performance measure that reflects alternative compliance pathways.
- **Section 3 – Approach** describes the technical approach and stakeholder engagement that DWR conducted to support performance measure development, and the performance measure specifically applied to the technologies that could be used in-lieu of requiring DIMs (or equivalent technologies).
- **Section 4 – Recommendations for In-Lieu Technologies Performance Measure** provides DWR's recommendations for the specifications, guidelines, and methodologies for this performance measure.
- **Section 5 – Glossary** provides a list of key terms and their definitions used in this document.
- **Section 6 – References** provides a list of references used in this document.

This report includes one appendix:

- **Appendix A** provides the list of documents in DWR's Recommendation Package that are incorporated by reference.

2.0 Scope Definition

Per WC Section 10609.10, DWR conducted studies and investigations, solicited stakeholder participation, and ensured consistency with the 2013 CII Task Force Report in developing the information necessary to make a recommendation on the In-Lieu Technologies PM to the State Water Board (DWR 2013a and 2013b):

> *(a) The department, in coordination with the board, shall conduct necessary studies and investigations and recommend, no later than October 1, 2021, performance measures for CII water use for adoption by the board in accordance with this chapter.*
>
> *(b) Prior to recommending performance measures for CII water use, the department shall solicit broad public participation from stakeholders and other interested persons relating to all of the following:* […]
>
> > *(2) Recommendations for setting minimum size thresholds for converting mixed CII meters to dedicated irrigation meters, and evaluation of, and recommendations for, technologies that could be used in lieu of requiring dedicated irrigation meters.* […]
>
> *(c) Recommendations of appropriate performance measures for CII water use shall be consistent with the October 21, 2013, report to the Legislature by the Commercial, Industrial, and Institutional Task Force entitled "Water Use Best Management Practices," including the technical and financial feasibility recommendations provided in that report, and shall support the economic productivity of California's commercial, industrial, and institutional sectors.*

Irrigated CII landscapes subject to the In-Lieu Technologies PM are large landscapes with the following characteristics:

- They are served by one or more mixed-use meters.
- Their irrigated landscape area served by mixed-use meter(s) is equal to or exceeds the conversion threshold.
- The CII water user and urban retail water supplier will not convert the existing mixed-use meter(s) to a DIM (or equivalent technology).

In the context of the 2018 Legislation, CII water use performance measures are actions taken by the urban retail water supplier that result in increased CII water use efficiency (WC Section 10609.12(n)). As such, DWR's recommended in-lieu technologies under the In-Lieu Technologies PM (hereinafter referred to as "In-Lieu Technologies") that

could be used in-lieu of requiring DIMs (or equivalent technologies) and must result in increased water use efficiency.

In considering appropriate In-Lieu Technologies, "technologies" are not limited to hardware. According to *Merriam-Webster*, "technology" can be defined as: (1a) the practical application of knowledge especially in a particular area; (1b) a capability given by the practical application of knowledge; (2) a manner of accomplishing a task, especially using technical processes, methods, or knowledge; or (3) the specialized aspects of a particular field of endeavor.[2]

Consistent with the WC, extensive stakeholder outreach was conducted for developing the recommendations on the In-Lieu Technologies PM, with incorporation of feedback and experience provided by urban retail water suppliers, landscape professionals, and stakeholders. Implementation challenges were also identified. DWR's goals in conforming with WC Section 10609.10 were to identify appropriate In-Lieu Technologies and an associated implementation schedule and process.

2.1 Roles in Implementation of Commercial, Industrial, and Institutional Water Use Landscape Irrigation with In-Lieu Technologies

It is important to recognize that there are many potential in-lieu technologies for large, irrigated CII landscapes served by a mixed-use meter that cannot be unilaterally implemented by urban retail water suppliers without explicit cooperation from CII water users, property managers, or property owners. At the same time, the 2018 Legislation requires that a commercial, industrial, and institutional dedicated irrigation meter (CII-DIM) be installed or that In-Lieu Technologies as defined in the In-Lieu Technologies PM be implemented on a CII landscape subject to the Conversion Threshold PM. Therefore, it is important that urban retail water suppliers collaborate with CII water users, property managers, or property owners for successful implementation.

Commercial, Industrial, and Institutional Water Users

CII water users and property owners have a role in managing their landscape water use efficiently. Implementing certain landscape BMPs can help improve landscape water use efficiency. Some landscape water use BMPs that can be implemented by CII water users, property managers, or property owner include:

[2] *Merriam-Webster*, s.v. "technology (n.)," Accessed at: https://www.merriam-webster.com/dictionary/technology

- **Irrigation System Hardware Improvements and Design**. Irrigation system hardware improvements and design can achieve improved water use efficiency by replacing inefficient hardware and irrigation systems with more efficient ones. There are many different opportunities for improving existing irrigation system hardware with minimal cost or effort to the CII water user, property manager, or property owner. Proper design and installation of new landscapes by the CII property owner can also achieve improved water use efficiency compared to older existing systems.

- **Landscape Plant Pallet Transformations**. Changing the existing landscape plant palette from high water use plants to low-to-medium water use plants or features is another way for CII water users, property managers, or property owners to reduce large landscape water use. This type of action will likely be more expensive than other options, but may be more compatible with the broader business case of the CII water user or property owner.

- **Water-Requirement-Based Management**. CII water users or property managers may implement irrigation practices that consider the water requirements of existing plants and the irrigation systems that serve them. Irrigation management practices may include water budgets, remote sensing for irrigation scheduling, use of smart irrigation controllers, and other processes, typically in combination with grouping plants by same water requirement zones. Such practices can help avoid over-irrigation and therefore result in cost-savings for CII water users.

- **Irrigation Scheduling and System Maintenance**. Proper irrigation system scheduling and maintenance are key components of any landscape water use efficiency program that CII water users or property managers can implement. Scheduling irrigation timing and amount of water applied to best meet the plant requirements can reduce water waste resulting from excessive evaporation, runoff, or leaching. Proper irrigation system maintenance can reduce water leaks, improve distribution uniformity, and ensure effective application of irrigation water, thus reducing water waste.

- **Communication**. Communication between the CII water user, property manager, and landscaper are essential to ensuring water use efficiency. However, it is only successful when all relevant parties are contributing to the conversation and working towards the same goals.

In general, all CII water user BMPs in the 2013 CII Task Force Report, including landscape BMPs and conversion of mixed-use meters to DIMs, are technically feasible, some have been used in the past, and are cost-effective. However, the 2013 CII Task Force Report recognizes that all BMPs might not be applicable in all cases. As noted in the 2013 CII Task Force Report (DWR, 2013b):

*1. **One size does not fit all** – For any given CII sector, subsector, or entity, 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 CII sector, 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 BMPs in this document should be used only as a guide** – The intent of this report is to provide a compendium of BMPs that are possible measures that CII entities can adopt for their specific situation.*

There are often associated costs to the CII water user, property manager, or property owner with implementing in-lieu technologies, such as the initial construction and/or materials costs, long-term maintenance costs, and potentially other costs, such as personnel training. Therefore, implementation of in-lieu technologies requires concurrence and cooperation by the CII water user, property manager, or property owner.

CII water users, property managers, and property owners will often consider the business case for implementing specific commercial, industrial, and institutional water use best management practices (CII-BMP), such as implementing an in-lieu technology. A frequent consideration is the payback period – how long it takes for cost savings (e.g., reduced water and wastewater charges) to exceed the initial up-front costs. An additional consideration may be the available staffing resources for implementation or maintenance, even for certain CII-BMPs with a favorable return on investment (ROI). Sometimes, property owners may also restrict certain changes for different reasons. However, there may also be conditions where CII water users or property owners may implement certain CII-BMPs in exchange for other benefits that may not be related to direct revenues or profits. A number of CII-BMPs by water users and their implementation challenges can be found in the technical report, *Best Management Practices for Improving Efficiency in Commercial, Industrial, and Institutional Water Use: Key Successes and Challenges in California* (WUES-DWR-2021-16.T1).

Urban Retail Water Suppliers

Urban retail water suppliers have a role to assist and incentivize implementation of CII landscape water use BMPs such as DIMs (or equivalent technologies) or in-lieu technologies. Additionally, there are certain landscape water use BMPs they may be able to implement unilaterally. However, urban retail water suppliers often lack proper authority to implement a number of potential in-lieu technologies without explicit

cooperation from CII water users, property managers, or property owners; CII water users or CII property owners retain the right to decide on actions taken on their properties, subject to specific regulatory requirements, and they can be responsible for all or a portion of the associated cost. Some landscape water use BMPs that can be unilaterally implemented by urban retail water suppliers include:

- **Water Budget–Based Rate Structures**. If passed, a water budget–based rate structure, where an indoor and outdoor water budget is determined and water rates are based on whether they are within budget or over budget, can be unilaterally implemented by the urban retail water supplier. Cooperation by the CII water user or property manager is advised in order to set reasonable water budgets.

- **Remote Sensing to Estimate Landscape Water Use**. Remote sensing can be used unilaterally by the urban retail water supplier to estimate the water use on CII landscapes. However, this analysis, alone, does not typically result in improved water use efficiency and would not qualify as an in-lieu technology without further actions that may not be unilaterally implemented by the urban retail water supplier.

- **Communication**. Understanding how much water is being used for irrigating landscape areas and what programs are available to help reduce water use can help CII water users or property managers in their decisions regarding implementation of landscape water use BMPs. Urban retail water suppliers can unilaterally provide CII water users with information regarding their water use, what they can do to reduce use, and what programs are available to help. However, it may be difficult for them to reach the correct decision-maker. Urban retail water suppliers may also be able to assist CII water users in fostering communication between property managers, property owners, and landscapers.

- **Technical Assistance**. Technical assistance, such as distribution system uniformity tests, tools for calculating ROI, irrigation system scheduling, and irrigation system maintenance training may be needed by CII water users, property managers, or property owners in order for these parties to implement associated landscape water use efficiency improvements. Urban retail water suppliers can often unilaterally provide technical assistance, but they cannot require that CII water users, property managers, or property owners avail themselves of the offered assistance.

The 2018 Legislation does not directly impose requirements on individual residents or CII water users, but instead imposes these requirements on the associated urban retail water supplier. Performance measures could include actions taken by urban retail water suppliers to incentivize, encourage, or assist CII water users, property managers, or

property owners in implementing landscape BMPs that achieve, on a service area aggregate, improved CII water use efficiency.

It should be noted that it is possible that an equivalent technology could be unilaterally implemented by an urban retail water supplier. Equivalent technology, as defined in *Recommendations for Commercial, Industrial, and Institutional Outdoor Irrigation of Landscape Areas with Dedicated Irrigation Meters Water Use Efficiency Standard* (WUES-DWR-2021-03), means it is functionally equivalent to a DIM. While DWR is not aware at this time of an equivalent technology substantially similar to a DIM, DWR is not precluding that such a technology could exist in the future (e.g., a technology that could be used on a time scale and with an accuracy similar to a DIM, whereby water use could be measured for billing purposes). Therefore, DWR acknowledges that should a technology equivalent to a DIM become available, an urban retailer water supplier could unilaterally implement it.

2.2 Clarified Scope for Performance Measure Development

Based on the above discussion and legislative directive, DWR considered that the In-Lieu Technologies PM for urban retail water suppliers should focus on: (1) actions the urban retail water supplier can take to unilaterally implement processes or procedures to improve landscape water use efficiency, or (2) actions they can unilaterally take to assist, encourage, or incentivize improved water use efficiency through the implementation of landscape water use BMPs by the CII water user, property manager, or property owner.

Consistent with the *Merriam-Webster* definition for "technology,"[3] DWR recognized that in-lieu technologies should not be limited to specific devices, equipment, or analytical methods. In addition, they should include application of processes or programs that improve CII landscape water use efficiency through the implementation of efficient landscape water use efficiency management practices and technologies.

DWR also recognized the following principles in developing the In-Lieu Technologies PM, consistent with the legislative guidance:

- Recommended CII water use performance measures, including the In-Lieu Technologies PM, must be consistent with the 2013 CII Task Force Report (WC Section 10609.10(c)).

- Recommended In-Lieu Technologies PM should allow flexibity and customization for local conditions. Although technically feasible, in-lieu technologies identified in

[3] *Merriam-Webster*, s.v. "technology (n.)," Accessed at: https://www.merriam-webster.com/dictionary/technology

the 2013 CII Task Force Report as BMP options for landscapes may not always be cost-effective or able to be implemented due to the wide diversity of characteristics of CII water use.

Except for outdoor irrigation of landscape areas with DIMs (or equivalent technologies) in connection with CII water use, CII water use is not part of the quantitative reporting requirements for the UWUO. However, an urban retail water supplier's progress towards implementing CII water use performance measures, including the In-Lieu Technologies PM, is part of the annual reporting requirements for the Annual Water Use Report.

It is important to recognize the difference between equivalent technologies and technologies that can be used in-lieu of a DIM. A DIM is used to measures the volume of water delivered to the landscape and reports data directly to the urban retail water supplier in some time interval and accuracy, depending on the specifications of the meter. Usually, the metered data are the basis of billing customers' water use. Therefore, an equivalent technology is defined as any other device or process that is not a DIM, but provides the same functions of direct measurement as a DIM and facilitates the same utilities to the urban retail water supplier as a DIM. Refer to *Recommendations for Commercial, Industrial, and Institutional Outdoor Irrigation of Landscape Areas with Dedicated Irrigation Meters Water Use Efficiency Standard* (DWR-WUE-2021-03) for a discussion related to qualified equivalent technologies.

In-Lieu Technologies are focused on achieving the same intended outcome for the water use of a DIM that is subject to CII-DIMWUS; in the context of the 2018 Legislation, the intended outcome is to improve water use efficiency for CII landscape irrigation. Therefore, In-Lieu Technologies should not be technologies that directly measure the CII landscape water use and report that water use directly to the urban retail water supplier as a CII-DIM (or equivalent technology). Rather, In-Lieu Technologies should be technologies that increase water use efficiency using methods other than those providing a direct measurement of water use, and they may or may not provide data directly to urban retail water suppliers. However, urban retail water suppliers are still required to provide evidence that water use efficiency for CII landscape irrigation will be improved by deploying the In-Lieu Technologies.

2.3 Relationship to Other Commercial, Industrial, and Institutional Water Use Standards and Performance Measures

DWR developed the CII water use standard and performance measures to be mutually supportive and for integrated implementation, as discussed in *Summary of Recommendations for Commercial, Industrial, and Institutional Water Use Performance*

Measures (WUES-DWR-2021-15). The following describes the key connections among the In-Lieu Technologies PM, CII-DIMWUS, the Conversion Threshold PM, and the CII-BMPs Performance Measure.

The In-Lieu Technologies PM is related to CII-DIMWUS and other CII water use performance measures in that the conversion of mixed-use meters to DIMs for large landscape irrigation or implementation of in-lieu technologies will eventually change the way in which outdoor water use by some CII water users is accounted for by urban retail water suppliers.

Commercial, Industrial, and Institutional Outdoor Irrigation of Landscape Areas with Dedicated Irrigation Meters Water Use Efficiency Standard

Irrigated CII landscapes served by DIMs are subject to CII-DIMWUS; and water use efficiency on these landscapes is accounted for as part of the UWUO. CII landscapes within the scope of CII-DIMWUS are excluded from the In-Lieu Technologies PM (see *Recommendations for Commercial, Industrial, and Institutional Outdoor Irrigation of Landscape Areas with Dedicated Irrigation Meters Water Use Efficiency Standard* [DWR-WUE-2021-03]).

Conversion Threshold Performance Measure

The In-Lieu Technologies PM is related to the Conversion Threshold PM in that the conversion of mixed-use meters to DIMs (or equivalent technologies) will eventually change the way in which landscape water use by some CII water users is accounted for. Under the Conversion Threshold PM, urban retail water suppliers must convert large landscapes served by mixed-use meters exceeding the conversion threshold to a DIM (or equivalent technology), or implement In-Lieu Technologies as identified in the In-Lieu Technologies PM (see *Recommendations for Dedicated Irrigation Meter Conversion Threshold for Commercial, Industrial, and Institutional Outdoor Irrigation Water Use Performance Measure* [WUES-DWR-2021-18]). As such, DWR anticipates that the implementation of in-lieu technologies for landscapes served by mixed-use meters that exceed the conversion threshold but do not convert to a DIM (or equivalent technology) will achieve improved water use efficiency through implementation of the In-Lieu Technologies PM.

Commercial, Industrial, and Institutional Water Use Best Management Practices Performance Measure

The CII-BMPs Performance Measure includes BMPs that are applicable to CII landscapes irrigated with mixed-use meters below the conversion threshold. In some cases, CII water users may have plans for changing the size of a large, irrigated landscape served by CII mixed-use meters, thereby reducing the irrigated landscape area below the conversion threshold. As a result, urban retail water suppliers would not need to implement the Conversion Threshold PM and/or In-Lieu Technologies PM for

these landscapes. Rather, the urban retail water supplier would focus on implementing CII landscape BMPs included under the CII-BMPs Performance Measure and report accordingly in their Annual Water Use Report. Refer to *Recommendations for Commercial, Industrial, and Institutional Water Use Best Management Practices Performance Measure* (DWR-WUE-2021-16) for details on the CII-BMPs Performance Measure.

2.4 Relationship to Model Water Efficient Landscape Ordinance

The Model Water Efficient Landscape Ordinance (MWELO) is a State regulation that sets water use efficiency standards for new developments and rehabilitated landscapes. The 2015 MWELO was the latest version adopted as California Code of Regulations (CCR), Title 23, Sections 490 through 495; and is also referenced by CCR Title 24, Part 11, Chapters 4 and 5 (California Green Building Standards Code). All local agencies (i.e., cities and counties) must adopt, implement, and enforce MWELO or a local Water Efficient Landscape Ordinance (WELO) that is at least as effective as MWELO. Usually, local agencies that adopt WELOs create a more stringent ordinance than MWELO.

The In-Lieu Technologies PM includes the following definitions and associated context in MWELO:

- "[N]ew construction projects with an aggregate landscape area equal to or greater than 500 square feet requiring a building or landscape permit, plant check or design review" (CCR, Section 490.1(a)(1)) are hereinafter referred to as "new landscapes."

- "[R]ehabilitated landscape means any relandscaping project that requires a permit, plan check, or design review…and the modified landscape area is equal to or greater than 2,500 square feet" (CCR, Section 491(ooo)).

- "…Recognizing the special landscape management needs of cemeteries, new and rehabilitated cemeteries are limited to Sections 492.4 [Water Efficient Landscape Worksheet], 492.11 [Landscape and Irrigation Maintenance Schedule], and 492.12 [Irrigation Audit, Irrigation Survey, and Irrigation Water Use Analysis]; and existing cemeteries are limited to Sections 493 [Provisions for Existing Landscapes], 493.1 [Irrigation Audit, Irrigation Survey, and Irrigation Water Use Analysis], and 493.2 [Water Waste Prevention]" (CCR, Section 490.1(a)(4)).

Incorporation of Model Water Efficient Landscape Ordinance Principles in Commercial, Industrial, and Institutional Water Use Performance Measures

The 2018 Legislation requires DWR to incorporate the principles of MWELO when developing the recommendations for ORWUS and CII-DIMWUS. WC Section 10609.9 provides DWR the specific direction on the principles of MWELO to be considered.

> […] *"principles of the model water efficient landscape ordinance" means those provisions of the model water efficient landscape ordinance applicable to the establishment or determination of the amount of water necessary to efficiently irrigate both new and existing landscapes. These provisions include, but are not limited to, all of the following:*
>
> *(a) Evapotranspiration adjustment factors, as applicable.*
>
> *(b) Landscape area.*
>
> *(c) Maximum applied water allowance.*
>
> *(d) Reference evapotranspiration.*
>
> *(e) Special landscape areas, including provisions governing evapotranspiration adjustment factors for different types of water used for irrigating the landscape.*

Additionally, per Section 7.3.5 of Volumes I and II of the 2013 CII Task Force Report (DWR 2013a and 2013b):

> *The Task Force included landscape BMPs that recognizes the design and operating standards developed by DWR in the model landscape ordinance required by AB 1881 (Model Water Efficient Landscape Ordinance (MWELO) found in the California Code of Regulations, Title 23, Division 2, Chapter 2.7, which became effective in January 2010) and encourages their application to existing landscapes.*

For consistency with DWR's recommendations in ORWUS, CII-DIMWUS, and the 2013 CII Task Force Report, the principles of MWELO should be incorporated into the development of the Conversion Threshold PM and by reference the In-Lieu Technologies PM as applicable to CII landscape water use.

Specific Considerations

The following provides specific considerations from MWELO that should be incorporated into the development of the In-Lieu Technologies PM. MWELO requires local land use authorities responsible for implementing MWELO be actively involved with managing water use on certain existing landscapes (CCR, Title 23, Section 493.1).

> *(a) This section, 493.1, shall apply to all existing landscapes that were installed before December 1, 2015 and are over one acre in size.*
>
> *(1) For all landscapes in 493.1 (a) that have a water meter, the local agency shall administer programs that may include, but not be limited to, irrigation water use analyses, irrigation surveys, and irrigation audits […]*

Specifically, the local authority responsible for implementing the 2015 MWELO is required to administer programs that may include, but are not limited to, irrigation water use analyses, irrigation surveys, and irrigation audits to evaluate water use and provide recommendations, as necessary, to reduce landscape water use to a level that does not exceed a maximum applied water allowance (MAWA) calculated using an evapotranspiration factor (ETF) of 0.8. The MAWA, in gallons, is then the product of 0.8, reference evapotranspiration in inches, landscape area in square feet, and a unit conversion factor of 0.62. The use of certain efficient water use technologies and water management practices that maintain the efficiency of those technologies could help meet the MAWA goal for individual CII landscapes.

MWELO requires that a DIM or private submeter for landscape irrigation be installed for all new or rehabilitated CII landscapes more than 1,000 square feet and up to 5,000 square feet of irrigated landscape area. WC Section 535, referenced in MWELO (CCR, Section 492.7(a)(1)), specifically applies to new service connections with more than 5,000 square feet of irrigated landscape.

> […] *(A) Landscape water meters, defined as either a dedicated water service meter or private submeter, shall be installed for all non-residential irrigated landscapes of 1,000 sq. ft. but not more than 5,000 sq.ft. (the level at which Water Code 535 applies) and residential irrigated landscapes of 5,000 sq. ft. or greater. A landscape water meter may be either:*
>
> > *(1) a customer service meter dedicated to landscape use provided by the local water purveyor; or*
> >
> > *(2) a privately owned meter or submeter.*

In other words, the MWELO threshold for requiring a DIM or submeter for new landscapes is lower than DWR's recommended conversion threshold of 1 acre (see *Recommendations for Dedicated Irrigation Meter Conversion Threshold for Commercial, Industrial, and Institutional Outdoor Irrigation Water Use Performance Measure* [WUES-DWR-2021-18]). Therefore, it is expected that the In-Lieu Technologies PM would primarily apply to existing CII landscapes. However, depending on WELO adopted by the local authority and if a submeter is installed instead of a DIM (or equivalent

technology), the In-Lieu Technologies PM may also apply to new and rehabilitated landscapes.

Furthermore, under the 2015 MWELO, certain landscapes are exempt from the water budget requirements described in CCR 490.1(e). Existing cemeteries are categorically exempted from most provisions in MWELO as described in CCR Sections 493, 493.1, and 493.2 (Title 23, Chapter 2.7, MWELO). Due to the exempt status of certain landscapes included in MWELO, the same exempt status was carried through to DWR's recommendations in the Conversion Threshold PM. Therefore, the In-Lieu Technologies PM should not be applicable to these exempt landscapes (see *Recommendations for Dedicated Irrigation Meter Conversion Threshold for Commercial, Industrial, and Institutional Outdoor Irrigation Water Use Performance Measure* [WUES-DWR-2021-18]).

2.5 Relationship to Other Existing Law and Regulations

Other existing laws and regulations relevant to the In-Lieu Technologies PM include the DIM requirements under WC Section 535:

> *(a) A water purveyor shall require as a condition of new retail water service on and after January 1, 2008, the installation of separate water meters to measure the volume of water used exclusively for landscape purposes.*
>
> *(b) Subdivision (a) does not apply to either of the following:*
>
> *(1) Single-family residential connections.*
>
> *(2) Connections used to supply water for the commercial production of agricultural crops or livestock.*
>
> *(c) Subdivision (a) applies only to a service connection for which both of the following apply:*
>
> *(1) The connection serves property with more than 5,000 square feet of irrigated landscape.*
>
> *(2) The connection is supplied by a water purveyor that serves 15 or more service connections.*
>
> *(d) For the purposes of this section, "new retail water service" means the installation of a new water meter where water service has not been*

> *previously provided, and does not include applications for new water service submitted before January 1, 2007.*

This DIM requirement is applicable to CII landscapes greater than 5,000 square feet of irrigated landscape where a new service connection is installed. Similar to the above discussion of DIMs under MWELO or submeter requirements on new landscapes, the DIM requirement size threshold from WC Section 535 is lower than the recommended conversion threshold of 1 acre in the Conversion Threshold PM. Therefore, it further supports the likelihood that the In-Lieu Technologies PM is primarily applicable to existing landscapes.

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3.0 Approach

Per the with WC, DWR was directed to study, investigate, and make recommendations on technologies that could be used in-lieu of requiring DIMs (or equivalent technologies). To that end, DWR engaged stakeholders to establish an understanding of current in-lieu technology implementation across the State and to evaluate implementation considerations. The findings from studies and research, as well as stakeholder input, were taken into consideration when DWR formulated the recommendations.

3.1 Stakeholder Process

Consistent with the legislative directive, DWR used a public process involving diverse stakeholders in the review and development of CII water use-related topics. The stakeholder process was part of the larger engagement process to implement the provisions of urban water use efficiency in the 2018 Legislation (see *Stakeholder Outreach Summary for Developing Urban Water Use Efficiency Standards, Variances and Performance Measures* [WUES-DWR-2021-20]). More focused stakeholder engagement specifically for CII water use performance measures started in October 2020, with periodic meetings and workshops held through early 2022.

DWR established two working groups to assist in implementing the 2018 Legislation, and these groups formed the base of the stakeholder involvement process that included State agencies, cities, counties, urban retail water suppliers, environmental organizations, professionals, and other stakeholders and interested parties. The Water Use Studies Working Group was established in July 2019 to inform DWR in developing water use studies for setting up standards, variances, and performance measures. Concurrently, the Standards, Methods, and Performance Measures Working Group was also established to provide input to DWR on developing the structure and specifications of water use efficiency standards, variances, methodologies, and performance measures. However, due to the close relationships between research on different CII water use performance measures and the implementation of urban water use efficiency standards and variances, members of both working groups were invited to participate in the same stakeholder meetings and workshops. DWR opened working group meetings and workshops to the public to allow for broader participation in and input from other stakeholders, interested parties, and individuals.

During the working group meetings, presentations and discussions covered the legislative background, DWR research into in-lieu technologies, and the approach to the performance measure. Stakeholder presentations were designed to provide information to a large number of participants. Working group members and other participants had ample opportunities to learn about the approach to the In-Lieu Technologies PM considered by DWR and to review and provide feedback on technology identification.

They provided input on implementation, such as resource needs (staff) and other implementation considerations.

DWR also conducted and responded to requests for additional meetings and public outreach and engagement activities with both individual entities and groups of stakeholders to learn from their experiences, understand their specific concerns, and receive other feedback. DWR also had multiple meetings and collaborated with the ACWA, the University of California Division of Agricultural and Natural Resources (UCANR), Waterfluence, the Municipal Water District of Orange County, Irvine Ranch Water District, City of Santa Clara, and Contra Costa Water District (CCWD) to exchange viewpoints.

3.2 Principles

Within the context of CII water use performance measures developed per the 2018 Legislation, the in-lieu technologies discussed in Section 2 are those that can be implemented by the urban retail water suppliers unilaterally (WC Section 10608.12(n)). As described in Section 2, this performance measure should identify what actions the urban retail water suppliers can take to encourage individual CII water user implementation of in-lieu technologies to improve water use efficiency. Significant stakeholder input throughout the process emphasized the importance of developing a performance measure that: (1) is able to be implemented; (2) is measurable; and (3) holds the urban retail water suppliers accountable regarding the implementation of the In-Lieu Technologies.

The main consideration for designing an In-Lieu Technologies PM is identifying types of water use technologies that promote CII landscape irrigation water use efficiency, maintain those water use efficiency improvements over time, and recognize the potential resource needs and implementation challenges.

Based on WC requirements, the main criteria for in-lieu technologies include:

- Actions taken by urban retail water suppliers that achieve improved water use efficiency on aggregate across the service area (WC Section 10608.12(n)).
- Actions that are consistent with the 2013 CII Task Force Report, including consideration of technical and financial feasibility (WC Section 10609.10(d)).
- Technologies that do not quantify water use to a level that would be considered ‘equivalent technologies’ to a DIM but are effective in increasing irrigation water use efficiency.
    - Equivalent technologies and in-lieu technologies are mutually exclusive. Equivalent technologies are ***functionally equivalent*** to a DIM; otherwise, it

cannot be used for calculating actual water use as required for the Annual Water Use Report. Functionally equivalent means that equivalent technologies must report directly to the urban retail water supplier, on the same time interval (e.g., monthly), and, at a minimum, measure the volume of water delivered with an equivalent accuracy, such that it could be used for billing purposes should an urban retail water supplier choose to do so *(see Recommendations for Commercial, Industrial, and Institutional Outdoor Irrigation of Landscape Areas with Dedicated Irrigation Meters Water Use Efficiency Standard* [WUES-DWR-2021-03]).

- In order to be considered an in-lieu technology, the technology needs to demonstrate improved water use efficiency per the WC definition of a performance measure (discussed further in Section 4 of this report).

3.3 Evaluation of Efficient Water Use Technologies

The WC allows for in-lieu technologies to be used with a mixed-use meter for irrigated CII landscapes exceeding the conversion threshold (WC Section 10609.10(b)(2)) when the mixed-use meter is not converted to a DIM (or equivalent technology). However, the WC does not specifically enumerate what those in-lieu technologies may be.

For several decades, many efficient water use technologies and associated management actions have been undertaken by urban retail water suppliers and CII water users to improve landscape water use efficiency. Additionally, many innovations, research, and experimental work have contributed to the improvement of landscape irrigation water use efficiency. An evaluation of these existing efficient water use technologies and associated actions can inform the development and appropriate scope of the In-Lieu Technologies PM.

Irrigation System Hardware Improvements and Design

Hardware improvements and design can achieve improved water use efficiency through the replacement of inefficient hardware and irrigation systems with more efficient ones, as summarized in further detail below. Irrigation system upgrades have been offered through many urban retail water supplier water conservation programs. For example, SoCal Water$mart is a regional rebate program offered by the Metropolitan Water District of Southern California in partnership with its 26 member agencies to encourage water conservation. SoCal Water$mart offers rebates for efficient water use technologies for landscape irrigation, including weather-based irrigation controllers and soil moisture sensors, rotating spray nozzle retrofits, large rotary nozzles, turf replacement, and in-stem flow regulators. To receive a rebate, the efficient water use

technology must be a qualifying model under Metropolitan Water District of Southern California's list (SoCal Water$mart, 2022).

- **Improved Distribution System Uniformity**. The historical estimates of distribution uniformity for spray sprinklers and rotary nozzles range from 0.45 to 0.65, as estimated by the Irrigation Association (ACWA and CMUA, 2021), a professional membership organization for irrigation equipment and system manufacturers, dealers, distributors, designers, consultants, contractors, and end users. A UCANR study on retrofitting existing irrigation systems found that by switching from spray systems to rotating nozzles, the distribution uniformities (a metric related to irrigation efficiency) could be increased by about 13 percent, and performing repair and maintenance of drip systems could reduce water use 10 percent or more.[4]

- **Irrigation System Conversion**. The Municipal Water District of Orange County's (MWDOC) Spray-to-Drip Pilot conversion program showed residential savings were 0.121 gallons per day (gpd) per square foot and commercial savings were 0.095 gpd per square foot (MWDOC, 2018).

- **Pressure-Regulating Sprinkler Heads**. Replacing sprinkler bodies in an irrigation system operating above 60 pounds per square inch of water pressure with WaterSense sprinkler bodies can save more than 20 percent of irrigation water use (EPA, 2017).

- **Smart Irrigation Controllers**. The use of sophisticated irrigation controllers can improve water use efficiency when programmed appropriately for the given situation and applies irrigation in accordance with a locally specific efficient irrigation schedule (Irrigation Association and American Society of Irrigation Consultants, 2014). Smart controller retrofits on existing irrigation systems were estimated to save 49.6 gpd per timer for residential sites and 549.8 gpd per timer for commercial sites, in line with previous studies evaluating water savings from irrigation timers (MWDOC, 2018).

- **Landscape Design**. Landscapes managed by landscape contractors are often maintained to achieve an acceptable appearance for the lowest performing landscape area, meaning that the rest of the landscape is often over-watered. An irrigation system designed to provide specific amounts of water (e.g., irrigation system with hydrozones based on plants grouped with similar plant factors or soil conditions) can effectively reduce overwatering on areas that do not need extra water, while providing sufficient water to the areas that need it.

[4] University of California, Division of Agriculture and Natural Resources (UCANR), Center for Landscape and Urban Horticulture. n.d. Turfgrass Crop Coefficients (Kc). Accessed at: https://ucanr.edu/sites/UrbanHort/Water_Use_of_Turfgrass_and_Landscape_Plant_Materials/

- **Proper Installation of New Irrigation Systems**. New irrigation systems, if installed correctly and properly maintained, can achieve irrigation efficiencies 15 to 38 percent greater than existing rotary nozzles based on irrigation efficiencies of 0.75 (MWELO sprinklers) and 0.90 (MWELO high-efficiency drip), compared to the existing statewide average for rotary nozzles of 0.65 (ACWA and CMUA, 2021).

  The use of sophisticated irrigation controllers can improve water use efficiency when programmed appropriately for the given situation and applies irrigation in accordance with a locally specific efficient irrigation schedule (Irrigation Association and American Society of Irrigation Consultants, 2014).

Case Study

As a wholesale water supplier, MWDOC offers rebates for indoor and outdoor water efficient devices as part of the SoCal Water$mart program. MWDOC implemented a rebate program targeting updates for old irrigation equipment in residential landscapes for weather-based irrigation controllers, high-efficiency rotating nozzles, drip irrigation as part of the Spray-to-Drip Program, turf removal, and the conversion of dedicated irrigation meters from potable to recycled water. The rebate program was combined with inspections to ensure quality control and demonstrate water savings. Most of the devices showed a statistically significant water savings ranging from 41 to 87 gpd (MWDOC, 2018).

Irrigation Association Recommendations

The Irrigation Association is committed to identifying, testing, and promoting innovative irrigation technologies and related best practices that improve water use efficiency. The Irrigation Association has developed standards for smart water application technologies and protocols (SWAT) and a Large Landscape Irrigation BMP to improve water use efficiency on large landscapes.

- **SWAT**. Automated irrigation controllers like those identified in the SWAT technologies and protocols, as defined by the Irrigation Association (2022), can be used to set and adjust water application rates to landscapes in response to changes in weather conditions. These SWAT technologies and protocols allow inputs for precipitation rates, plant material type, soil type and slope, and climate information that are used to estimate plant water needs and can automatically adjust landscape watering for seasonal weather changes.

A list of SWAT-approved water-efficient technologies includes rain sensors, soil moisture-based controllers, weather-based controllers, pressure-regulating spray heads, spray head sprinkler nozzles, pop-up sprinkler head check valves, and irrigation flow sensors (Irrigation Association, 2021). In addition to defining types of efficient water use technologies and best practices, the Irrigation Association also encourages

partnerships among all involved landscape management stakeholders to improve efficient landscape water use. The SWAT technologies are approved by the U.S. Environmental Protection Agency's WaterSense program (EPA, 2017) and referenced in MWELO (CCR, Sections 492.7 and 493.1).

In addition to SWAT, the Irrigation Association recommends that other Landscape Irrigation BMPs be implemented to achieve and sustain efficient water use in a managed landscape. These BMPs include proper design and implementation of the irrigation system, along with managing the landscape water use (Irrigation Association and American Society of Irrigation Consultants, 2014).

Landscape Water Budget–Based Management

Landscape water budget–based management is the development and application of individualized water budgets for efficient landscape water use with or without an associated rate structure. In accordance with Section 7.3.5 of the 2013 CII Task Force Report, "*a landscape budget should be defined between the site owner and manager, water service provider, and landscape maintenance staff*" (DWR, 2013a).

For each site, landscape water budget–based management systems require identification of the meter location, measured irrigated landscape areas, and water budgets calculated and tracked in the program. Reports on water use are then available for each site, and irrigation efficiency trends and opportunities for improvement can be evaluated. In order to achieve water use efficiency, this technology requires ongoing coordination and communication among landscape management stakeholders, including urban retail water suppliers, landscape contractors, and property managers.

- CalWEP (formerly CUWCC) recognizes that water budgets can be used to improve water use efficiencies on landscapes, per BMP 5 Handbook: A Guide to Implementing Large Landscape Conservation Programs as Specified in Best Management Practice 5 (CUWCC, 1999). The following summarizes the topics drawn from CUWCC's guidebook that are germane to this discussion: Water use budgets are based on measurements of the irrigated landscape area and on estimates of indoor water budgets for mixed-use meter sites. Water budgets can also generate interest in water use surveys by allowing CII water users to compare their budgeted versus actual water use.

- Water budgets should be presented in an understandable format to CII water users and key decision makers regarding landscape management, including a comparison of the water use budget versus actual water use.

- When coupled with water pricing, water budgets can make CII water users aware of their water use and create an additional financial incentive for over-budget CII water users to improve irrigation efficiency (CUWCC, 1999; pg. 2-17).

Water Budget–Based Rate Structures

Water budget–based rates are used by some urban retail water suppliers as an efficient water use technology and have demonstrated an ability to achieve and maintain efficient water use when paired with actions taken by the urban retail water supplier for individual CII water users. Budget-based rates are structured to provide each CII water user with an economic incentive to use only the amount of water required to serve the CII indoor and outdoor demands. Individual CII water users receive customized water use budgets based on a variety of factors, including the number of employees, a budget for CII indoor water use, landscape requirements, and other unique water uses, such as process water requirements. Irrigated landscapes are measured by urban retail water suppliers or provided by CII water users with field verification performed by the urban retail water supplier. Water budgets can be adjusted as water use requirements change, improvements are made, and changes occur in what is considered a reasonable use of water.

- Outdoor water budgets are calculated using the irrigated landscape area, local near real-time climate conditions, and efficiency adjustment factors based at least, in part, on plant types and irrigation efficiencies (Budget Based Rates, n.d.).

Coupled with landscape water conservation BMPs and targeted messaging to CII water users, urban retail water suppliers with a water budget–based rate structure can send strong price signals to CII water users with inefficient water use. Currently, 16 urban retail water suppliers in the State are implementing budget-based rates and 28 water agencies are implementing budget-based rates nationwide (City of Palo Alto, 2019).

Case Study

As a budget-based urban retail water supplier, Irvine Ranch Water District (IRWD) provided DWR with a technical memo detailing the components of their water budget–based rate structure demonstrated to achieve CII landscape water use efficiencies with CII mixed-use meter accounts (IRWD, 2021). In summary:

- Mixed-use meter accounts include both an indoor and outdoor water budget.
  - Outdoor water budgets are calculated using real time evapotranspiration data from one of IRWD's three weather stations and the irrigated landscape area associated with the mixed-use meter.
- Water user accounts are either within budget or over-budget.
  - Water use that is over-budget is billed at the wasteful rate of almost seven times the within-budget rate.

  - Customers who are unable to identify the cause for high use on their own can request a free water efficiency site survey from IRWD.

- Customers are provided with information on water efficiency programs and incentives.

- Monitoring and outreach:

  - IRWD reviews all water budgets for CII accounts every three years or more frequently as the need arises.

  - IRWD reviews actual water use with budgeted water use on a monthly basis for individual CII water users. Underperforming accounts are proactively targeted for outreach and offered a water efficiency survey and assistance with identifying other water-saving opportunities.

- Data analysis of CII mixed-use meter accounts shows that IRWD's efficient water use program results in 65 percent of the CII mixed-use accounts that go overbudget are back within budget after one month of over-budget water use, and 97 percent of CII mixed-use accounts operating back within their water budget within two to four months of being notified of being over their water budget.

Water Budget–Based Management Structures

Water budget–based management without an associated rate structure is identical to budget-based rate structures, except there is no pricing incentive and, therefore, requires closer coordination and cooperation among landscapers, CII water users, property managers, and property owners to achieve efficiencies. These types of efficient water use technology and management programs can be developed and managed internally, but are often developed and managed through a third-party provider.

Case Study

An example of a water budget–based management system that has demonstrated the ability to improve water use efficiency for large urban landscapes is the Bay Area Water Supply and Conservation Agency's contract with the third-party provider, Waterfluence. Through this external management program, over-budget sites can be readily identified and targeted for improvements in water use efficiency. Waterfluence has tracked water use over time for individual water users and demonstrated a reduction in water use on commercial and public landscapes. and states in their 2020 annual report that overwatering at both commercial and public sites has dropped over 50 percent since 2002 (BAWSCA, 2020). This type of efficient water use technology and management program works best when landscapers are involved as collaborators.

Landscape Plant Palette Transformation

Changing the existing landscape plant palette from high water use plants to low-to-medium water use plants or features is one way to reduce large landscape water use and implement efficient water use technologies. Turfgrass is typically a high water use plant, making it an attractive target for removal and replacement by urban retail water suppliers. Urban retail water suppliers can incentivize replacement of turf by CII water users through turf removal rebate programs, turf replacement programs, or other landscape transformation programs that reduce the amount of water necessary to support the landscape. This can be more effective in areas with predominantly turfgrass landscapes (CUWCC, 2013).

Potential Water Use Efficiency Improvement

The amount of water use efficiency achieved by removing and replacing turfgrass will vary by site depending on the local climate, irrigation system efficiency, type of turfgrass removed, plant types used to replace the turfgrass, and if improvements are made to the irrigation system.

The plant factor or crop coefficient is a relative measure of how much water is needed for optimal growth. For warm-season turfgrass, the annual average plant factor is 0.8, and for cool-season turfgrass, the annual average plant factor is 0.6.[5] Moderate water use plants have an average plant factor of about 0.5 (CCR, Section 491(ggg)). When compared to moderate water use plant types, cool-season turfgrass will typically use about 80 percent more water and warm-season turfgrass will use about 35 percent more water. This is also in part because turfgrass is often irrigated with sprinkler systems, whereas moderate water use shrubs and trees can more readily be irrigated with drip irrigation systems (see the Irrigation System Hardware Improvements and Design section of this report for a discussion of improvements in irrigation efficiency). The resulting water use efficiency improvement through a landscape transformation program requires maintenance; therefore, proper monitoring and maintenance by CII water users would be a necessary part of a landscape transformation program for improved water use efficiency.

Turfgrass Removal or Replacement Rebate Programs

Rebate programs can encourage CII water users to adopt landscape plant palette transformations through turf removal and replacement, along with requirements for the implementation of other water use efficiency technologies. Many urban retail water

[5] University of California, Division of Agriculture and Natural Resources (UCANR), Center for Landscape and Urban Horticulture. n.d. Turfgrass Crop Coefficients (Kc). Accessed at: https://ucanr.edu/sites/UrbanHort/Water_Use_of_Turfgrass_and_Landscape_Plant_Materials/Turfgrass_Crop_Coefficients_Kc/

suppliers offer turf removal rebates with varying program specifications and criteria for what may replace the removed turfgrass.

As an example, SoCal Water$mart turf replacement rebates offered by SoCal Water$mart requires removing existing turfgrass and replacing it with organic, drought tolerant landscaping. The turfgrass replacement program does not allow the use of synthetic turf and requires specific live vegetation coverage of three plants per 100 square feet of area transformed, a stormwater retention feature, no hardscape within the transformed area except for permeable hardscape, and the replacement or modification of overhead spray sprinklers (SoCal Water$mart, 2015).

Urban retail water supplier turf removal rebate programs have resulted in various success rates, as shown in the case studies provided by regional wholesalers and urban retail water suppliers, and in the Alliance for Water Efficiency survey described below.

Case Study: Municipal Water District of Orange County

As a wholesale water agency, MWDOC has offered a regional turfgrass removal rebate program to their 27 urban retail water supply agencies since 2007. Not including program management costs, the average cost per square foot of turf removed is between $5.60 and $7.90, with an average of 1,100 square feet of turf removed per participant. Over the past 11 years, approximately 1.8 percent of all single-family homes in MWDOC's service area have participated in the program, which is an annual participation of 0.16 percent per year. Approximately 24.8 million square feet of turfgrass has been rehabilitated with California-friendly plants, with an estimated total cumulative water savings of approximately 22,000 acre-feet (MWDOC, n.d.).

Case Study: Irvine Ranch Water District

As part of MWDOC, IRWD is an urban retail water supplier with a budget-based rate structure and has supplemented the MWDOC turf removal rebate for residential and CII water users since the early 2000s. CII water users in IRWD's service area have replaced turfgrass representing less than 1.25 percent of IRWD's total CII turf area. Not all turfgrass is considered available for removal, as it also includes functional turf for golf courses, parks, cemeteries, and other landscapes. The total amount of turfgrass removed from both residential and CII customers represents about 5.6 percent of IRWD's total turf grass area. The estimated cumulative water savings attributed to IRWD is about 4,600 acre-feet of the 22,000 acre-feet cumulatively saved from the whole of MWDOC's program (IRWD, 2022).

IRWD performed a study that calculated the multiplier effect of turfgrass removal rebates for its residential turfgrass removal program. The multiplier effect is an estimate of the number of additional homeowners, within a certain distance of turfgrass removal participants, who replaced their turfgrass with a more water efficient landscape without

applying for a rebate. Between 2012 and 2016, for every seven rebate participants there were approximately 16 non-rebate participants; this more than doubled the amount of turfgrass replacement offered through rebates (IRWD, 2017). Although the study was not directly related to CII water users, the multiplier effect is likely applicable to CII water users.

Case Study: Contra Costa Water District

CCWD has invested in water use efficiency improvements for 30 years, spending an estimated $3 million in addition to the water users' costs to remove 3.6 million square feet of turfgrass across 3,300 participating sites. Most of the rebates were given to single-family residential water users. This represents 5.3 percent of all potable water users and is a participation rate of less than 0.2 percent of water users per year.

While CCWD did not provide an estimate of landscape area, estimates are available from DWR's ORWUS Landscape Area Measurement study (see *Landscape Area Measurements Final Project, Report EA-133C-16-CQ-0044* [WUES-DWR-2021-02.T1]). CCWD's estimated Irrigable-Irrigated (II) area is 227,304,191 square feet and the Irrigable-Not Irrigated area (INI) is 56,679,212 square feet. The total amount of turfgrass removed through rebates represents approximately 1.5 percent of CCWD's II, plus 20 percent of the INI area (CCWD, 2022).

Case Study: City of Santa Rosa Water Department

The City of Santa Rosa is a predominantly working class city (United States Census Bureau, 2021) with water rates that are higher than neighboring communities (Santa Rosa Water, 2015) . The City of Santa Rosa has offered a lawn removal rebate program since 2006 for residential and commercial water users, and has spent approximately $1.7 million to remove 3.8 million square feet of turfgrass representing about 6 percent of the service area. Since the inception of the program, an annual average of 193 residential rebates have been given out, with an average of 820 square feet removed per site, representing less than 0.4 percent of all water users annually; most of the rebates are for residential water users (City of Santa Rosa, 2022).

Survey: Alliance for Water Efficiency

The Alliance for Water Efficiency (AWE) evaluated the success of landscape transformation programs for 14 water agencies across the U.S., with survey participation from eight urban retail water suppliers in the State. While the survey was focused on single-family homes, the principles of a successful landscape transformation program can also apply to CII water users. AWE recommended the following five actions to increase adoption by water users (AWE, 2018):

- Correct customer misperceptions about water use.
- Educate the customer, right from the start.

- Find the optimal design balance.
- Balance program requirements.
- Expand program messaging and tailor to each customer.

More than half of single-family water users surveyed believe they use more water indoors than outdoors, in addition to having misperceptions about the efficiency of their existing irrigation equipment. These two misperceptions directly influence their view on outdoor water savings and turfgrass removal. Educating project participants about the project costs and potential challenges through urban retail water supplier–led meetings, workshops, and ongoing assistance can help water users understand the level of commitment needed and may provide them with tools to be successful. Each urban retail water supplier has different climates, customer perspectives, and other unique constraints that should be considered when determining what the appropriate components of their landscape transformation program should be. Often the cost-benefit ratio of most landscape transformation projects is not significant enough to influence a water user's decision to implement a project. Urban retail water suppliers can overcome these barriers to water users implementing this efficient water use technology by including messages about beautiful landscapes, ease of maintenance, and benefits to the local environment, in addition to the money and water saved (AWE, 2018).

Remote Sensing

Remote sensing is an indirect measurement of surface conditions that can be used to estimate actual evapotranspiration (consumptive use) by landscape vegetation, which is an indication of how much water was used. Alternatively, it can also be used for irrigation scheduling by determining the plant water requirements for optimal plant health. The equations and algorithms typically need to be calibrated for local conditions and improved accuracy. Refer to *Landscape Area Measurements Final Project, Report EA-133C-16-CQ-0044* (DWR-WUES-2021-02.T1) for details on remote sensing technology. However, it is important to recognize that remote sensing by itself cannot be an efficient water use technology because it can only estimate water use; additional actions are needed to efficiently use water in the landscape.

Remote sensing has been used in agriculture for irrigation scheduling and water management for decades to improve water use efficiency. Meanwhile, the application of remote sensing in urban landscapes is an emerging technology. Urban retail water suppliers are different than agricultural water users in that they largely deliver water to users in urban settings; and unlike agriculture, where there is typically one type of plant (crop) grown over a large area, urban landscapes are more heterogeneously complex. Remote sensing can be used to identify plant types, height, and density at a parcel scale, enabling an estimate of outdoor water use with reasonable accuracy.

The spatial and temporal resolution and accuracy of INI surface classification varies across imagery sources and is important to consider for different urban applications (Coleman et al., 2020). Studies using remote sensing commonly lack adequate validation with measured irrigation volumes and report significant uncertainties at both field and regional scales (Foster et al., 2020). While advances in remote sensing have enhanced the mapping and monitoring of irrigated areas, producing accurate plant type information through satellite image classification is complex due to the diversity and temporal variability of landscapes, changes in reflectance of different land-covers, the remote sensing data selected and image processing methods used, among others (Nhamo et al., 2018).

Remote sensing when used to monitor and assess urban landscape health may not always be adequate for the specific problem being addressed. Ideally, the imagery should have a pixel resolution smaller than the size of the area of interest in order to be able to differentiate between plants and hardscape. Remote sensing can often be combined with other available data and imagery to meet the study purpose. The following components should be carefully evaluated before using remote sensing in a study (Ludwig et al., 2007):

- **Spatial scope**. Consider the spatial extent of the study area and pixel resolution of the imagery used for remote sensing.
- **Spectral resolution**. Consider both the visible and near-infrared bandwidths.
- **Temporal resolution**. Consider the frequency of data collection and length of time the observations are available.

With sufficient studies and calibrated application and monitoring methods, remote sensing techniques, along with accompanying actions, may become sufficiently accurate to be considered an equivalent technology. However, while providing useful information, in most situations, the data gained by remote sensing techniques are not likely to result in data functionally equivalent to a DIM (or equivalent technology). This does not limit the application of remote sensing, as the results of the analysis can be paired with other efficient water use technologies to achieve greater landscape water use efficiency.

Example

A study from August 2016 (Shurtz et al., 2022) evaluated improving landscape irrigation management with remote sensing and statistical analysis of relationships among water use, irrigated area, and plant health by comparing landscape water use for two urban retail water suppliers in Utah. The study used the publicly available National Agricultural Imagery Program (NAIP) data with 1-meter spatial resolution combined with Landsat data products available through the U.S. Geological Survey. NAIP imagery is currently updated every two years. Landsat data, while more frequently available, have a 30-

meter pixel resolution and cannot be used to adequately distinguish the difference between plants and buildings. The study used a combination of remote sensing and on-site measurements to correlate plant health with water use at the parcel level. The study found that the scaled normalized difference vegetation index correlated positively with water application rates up to 20 to 30 centimeters per month, then declined with increasing water application rates, which, while well known by plant scientists, was proven through an empirical analysis of the two service areas using publicly available imagery.

3.4 Evaluation of Associated Water Management Practices

DWR recognized that CII water users who implement the above-described efficient water use technologies are not guaranteed to achieve increased water use efficiency. A UCANR review of SWAT technologies concluded that use of their recommended technologies does not guarantee water conservation, is complex to set up, does not eliminate the need for stakeholder involvement, and likely requires professional monitoring and follow-up (Shaw and Pittenger, 2009).

In addition, urban retail water suppliers cannot unilaterally implement the above identified efficient water use technologies. The water management BMPs described in this section are complementary to efficient water use technologies described above and consistent with the 2013 CII Task Force Report, including a consideration of the technical and financial feasibility for urban retail water suppliers. Because in-lieu technologies should not be limited to specific devices, equipment, or analytical methods, the evaluation of associated water management practices is relevant. This section reviews several landscape water management BMPs (or conservation BMPs) for consideration as part of the In-Lieu Technologies PM.

Practices Identified in Model Water Efficient Landscape Ordinance

MWELO's purpose is to promote the conservation and efficient use of water. To this end, MWELO established design standards for new and rehabilitated landscapes (CCR, Section 490(b)(2)) and provisions for BMPs and water waste prevention to ensure proper irrigation system design and function and sustained water use efficiency on new, rehabilitated, and existing landscapes.

- For existing landscapes, MWELO identifies necessary minimum actions to reduce irrigation water use to a level deemed efficient, including irrigation water use analysis, irrigation surveys, and irrigation audits to evaluate water use and provide recommendations, as needed (CCR, Sections 490(b)(3) and 493.1(a)(1)).

- MWELO also includes requirements for monitoring and maintenance; irrigation emission devices and controller specifications; prevention of runoff and overspray; mulching; irrigation scheduling, and others applicable to both existing landscape and new or rehabilitated landscapes (CCR, Sections 392.7, 492.10, 492.11, 492.12, 492.15, and 492.16).

Practices Recommended in 2013 Commercial, Industrial, and Institutional Task Force Report

The 2013 CII Task Force Report recognized that certain actions are necessary to establish and sustain landscape water use efficiencies, as described in both Volumes I and II of the Task Force Report (DWR 2013a and 2013b):

> ***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.*
>
> ***Recommendation 5-2:*** *CII associations, water service providers, and the CUWCC* [now CALWEP]*, among others, should provide tools, guidance, and training to their constituents and customers on BMPs and the establishment and use of metrics-based benchmarking to demonstrate improved water use efficiency over time.*
>
> ***Recommendation 6-5:*** *All new water users should consider implementing the recommended BMPs at the time of installation or construction.*

Other Task Force Report Recommendations specific to the In-Lieu Technologies PM include (DWR, 2013b):

> *Proper landscape maintenance is critical to capturing a site's potential water savings over time. Maintenance BMPs include the development of a work schedule that addresses the need for:*
>
> - *Use of trained or certified workers.*
> - *Mulching.*
> - *Irrigation system leak detection and repair.*
> - *Review/fine t*uning of the irrigation schedule.
> - *Winterization (if appropriate).*
> - *Inspection of the site's back flow prevention device and water pressure.*

> *In addition to the regular review of a landscape's various components, sites should also develop a communication plan between site staff and management that includes an emergency action plan for water shutoff.*
>
> *[…] An important BMP includes performing regular site monitoring and communication between site staff and management to ensure that the irrigation schedule is correct, the irrigation system is functioning properly, the necessary repairs are being made, and the site is meeting its water budget.*
>
> *[…] Irrigation audits represent an opportunity to review the system's water use efficiency and make the necessary repairs and adjustments. Information on irrigation audits may be found in MWELO, Section 492.12.*
>
> *[…] Proper management of a site's irrigation schedule is a critical component of efficient landscape water use.*
>
> *[…] Proper irrigation system design, and understanding emerging water-efficient technology, is critical to efficient water use and involves numerous components ranging from the use of weather-based controllers to drip irrigation.*
>
> - *System design information may be found in MWELO, Section 492.7.*
> - *Replace overhead irrigation systems with some type of low volume irrigation, where feasible.*
>
> […] *removing turf where it is not needed and replacing it with drought-tolerant shrubs and trees, permeable walkways, and mulch can lead to substantial water savings in commercial landscapes* […].
>
> […] *Plants should be grouped based on similar water requirements and site characteristics (e.g., root depth, solar radiation, location, slope, etc.), called 'hydro-zones', to help with irrigation design and application. Refer to MWELO, Section 492.6.*

Additionally, Section 7.3.5.5 of the 2013 CII Task Force Report states (DWR, 2013b):

> […] *Individuals responsible for irrigation programming, inspections, and audits to ensure experience and proficiency in water conservation techniques should be carefully selected.*

Practices Recommended by California Urban Water Conservation Council

The CUWCC's (now CalWEP) mission is to maximize urban water efficiency and conservation. Integrating water use surveys, water use budgets, and supplemental landscape programs can make CII water users aware of inefficiencies and provide incentives and practices to improve irrigation system performance (CUWCC, 1999; pg. 4-1). The CUWCC's guidance for increasing landscape water use efficiency, *BMP 5 Handbook: A Guide to Implementing Large Landscape Conservation Programs as Specified in Best Management Practice 5* (CUWCC, 1999), recommends that a successful water efficient landscape program include the following, as summarized below:

- **Water Use Surveys**. Water use surveys, when performed on a regular basis by trained staff, can improve the operation and performance efficiency of the irrigation system. Surveys include five basic elements: landscape area measurements, irrigation system checks of technical performance, distribution uniformity analysis of sprinkler systems, review of irrigation schedules, and survey report and information packet to CII water users (CUWCC, 1999; pgs. 3-1 and 3-2).

  - Follow-up water use surveys can be useful when there is a changeover in property or landscape manager at a site. This may include providing a new copy of the information provided from the original survey (CUWCC, 1999; pg. 3-10).

  - Water surveys may be more appropriate for sites where irrigation scheduling is performed by landscape contractors who often pad irrigation schedule runtimes to reduce their site maintenance costs.

    CUWCC recognized in its BMP 5 Handbook that the most challenging and expensive task of implementing the BMP is measuring the landscape area associated with the meter. CUWCC (1999) recommended water use surveys be performed for 20 percent of CII mixed-use accounts every two years for maximizing implementation efficiency and cost-effectiveness, as summarized briefly below:

  - In order to maximize the cost-effectiveness of water use surveys, the first step is identifying CII water users with large landscape water use by targeting sites with the greatest water use savings potential. Well-maintained or small sites may not see the benefits of a full survey.

  - The survey's cost-effectiveness does not always increase with site size. Water surveys of mid-sized landscapes (0.5 to 3 acres) may offer the best returns (CUWCC, 1999; pg. 3-4).

- **Supplemental Landscape Programs**. Supplemental landscape programs include providing financial incentives, training and educational opportunities, follow-up irrigation surveys, and encouraging CII mixed-use meter water users to convert to DIMs (or equivalent technologies).

  When landscapes that are inefficient are identified through water use surveys, water budgets, or other means, CUWCC (1999) recommends that urban retail water suppliers offer financial incentives to motivate CII water users' adoption of actions to improve the mechanical performance of their irrigation systems (e.g., efficient emitters). However these actions alone may not be sufficient to encourage long-term behavioral changes. Additional actions (e.g., proper irrigation scheduling, maintenance, and repairs) are also necessary for improved water use efficiency (CUWCC, 1999; pg. 4-2).

  Financial incentives for equipment upgrades can motivate water users to use more water-efficient equipment when it is also properly implemented and operated. However:

  - Financial incentives only improve and upgrade the irrigation equipment, not the behavioral operation of the system; and additional actions are needed to improve inefficiencies (CUWCC, 1999; pg. 4-2).

  - Sophisticated irrigation system controllers may require follow-up surveys, including training CII water users on irrigation scheduling and calibration (CUWCC, 1999; pg. 3-10).

- **Communication**. Targeting irrigation water use efficiency messaging to key decision makers in landscape management may prove useful, although can be an additional resource burden (CUWCC, 1999; pg. 3-1).

Practices Identified by University of California Division of Agriculture and Natural Resources Center

The UCANR Center for Landscape and Urban Horticulture has conducted extensive research in irrigated landscape water use and implementation of efficient water use technologies. The following summary of UCANR's recommendations include BMPs to conserve water in a landscape:[6]

- **Irrigation System Maintenance**. Perform regular irrigation system checks for leaks and address physical and operational problems that reduce the efficiency and function of sprinklers, drip emitters, and other water delivery devices.

[6] University of California, Division of Agriculture and Natural Resources (UCANR), Center for Landscape and Urban Horticulture. n.d. Questions & Answers About Drought & Water Conservation. Accessed at: https://ucanr.edu/sites/UrbanHort/Water_Use_of_Turfgrass_and_Landscape_Plant_Materials/

  - Check automatic valves to ensure proper function.
  - Repair any leaks at valves, spray heads, and other connections.
  - Walk through an area while the irrigation system is running and repair or replace sprinklers or other types of emitters that are broken, sunken, crooked, or clogged with soil or debris.
  - Confirm that plants are not blocking or interfering with a sprinkler's spray pattern, that roots are not clogging drip emitters, and that all sprinklers and emitters are of the same manufacturer and model.
  - For sprinkler systems, ensure the spray or streams completely overlap among the sprinklers by adjusting their output or adding sprinklers.

- **Irrigation System Scheduling**. The best approach for conserving water in a landscape is by changing the water budgeting or seasonal adjust feature on controllers to fine-tune runtimes and achieve optimum water conservation.
- **Documenting Efficiencies**. To document that water use efficiency is being achieved for CII landscapes with a mixed-use meter, a periodic review and maintenance of the irrigation system to document that the efficient water use technologies are performing as designed by the manufacturer is required.

University of California Division of Agriculture and Natural Resources Center Evapotranspiration Factor Study

An evapotranspiration factor (ETAF) study performed by UCANR from 2014 to 2016 evaluated the potential to reduce applied water to large urban landscapes, as measured by an ETAF of 0.7, while maintaining a healthy and attractive landscape (Hartin et al., 2019). The 31 sites spanned six regions within the State, including the Central Valley, Central Coast, South Coast, Los Angeles Basin, Inland Empire, and Desert. These sites included a wide variety of plant species, microclimates, densities, and site sizes. This study illuminated several lessons regarding efficient CII landscape irrigation, as summarized below (Hartin et al., 2019):

- Improving distribution uniformity significantly reduced water use and the quality of the landscape did not suffer.
  - Turfgrass sites averaged a 13 percent increase in distribution uniformity by switching from spray to rotating nozzles, performing sprinkler maintenance, replacing underperforming rotary sprinklers and worn-out nozzles, matching nozzle to pressure and spacing, and matching nozzles.

  - Each of the 14 turfgrass sites lowered its water consumption. The water savings was a 19 percent reduction in water usage.

- Properly designing landscapes using low water use plants and highly efficient and uniform irrigation systems will enable plants to survive in low water applications.

  - Twenty-four of the sites had landscape beds containing shrubs and used considerably less water compared to turfgrass. In 2014, shrubs used 13 gallons per square foot, compared with 20 gallons per square foot for turfgrass. During 2015, shrub water use increased to 14 gallons per square foot, but was still below the budgeted ETAF of 0.7. The total amount of water used for shrubs was below the water budget for both years, with 2014 irrigating with an actual ETAF of 0.58, and increasing to 0.61 in 2015/2016.

  - Fourteen out of the 24 shrub locations reduced water consumption in 2015/2016. The increase in water use for shrubs was attributed to three sites, which had valves stuck open for extended periods and one site with three different managers during the study period. As a group, the shrub sites watering at an ETAF of 0.58 did not experience any adverse effects to the plant material. Nine of the sites had drip irrigation, and in 2014 they watered at an ETAF of 0.35. In 2015 and 2016, the irrigation was further reduced as water applications were lowered to an ETAF of 0.29.

- Quarterly irrigation maintenance inspections and water audits can have significant water savings. If quarterly audits cannot be accomplished, biannual audits should be integrated with the sites' irrigation maintenance program.

Practices Identified in Commercial, Industrial, and Institutional Outdoor Irrigation of Landscape Areas with Dedicated Irrigation Meters Water Use Efficiency Standard

As described in CII-DIMWUS (see *Recommendations for Commercial, Industrial, and Institutional Outdoor Irrigation of Landscape Areas with Dedicated Irrigation Meters Water Use Efficiency Standard* [WUES-DWR-2021-03]), successfully increasing water use efficiency on large urban landscapes served by CII-DIMs and mixed-use meters depends on the close coordination among property owners, property managers, landscape contractors, CII water users, urban retail water suppliers, and, potentially, property owners.

- **Communication and Coordination**. The proper design, installation, and ongoing management of a water-use-efficient CII landscape depends on the coordination among architects, designers, and irrigation system specialists, as well as the above identified parties. Effective communication and engagement with the parties involved with efficient CII landscape water use is critical to

overcoming these unique landscape challenges for each CII landscape with a mixed-use meter.

- A communication and outreach program is crucial, because CII landscapes differ in operation and management from residential landscapes, and CII landscapes irrigated with mixed-use meters are managed similar to CII landscapes irrigated with DIMs (or equivalent technologies). CII landscapes with mixed-use meters may require more engagement than CII DIM landscapes to achieve water use efficiency.
  - The expectations of the property owner and annual landscape budget in dollars will greatly influence how well a site is managed.
  - A landscape manager's goal is to provide acceptable landscape appearance for the least amount of time and labor expended. This means that CII landscapes are often managed to provide acceptable appearance to the worst performing part of the landscape by "watering to the brown spot" (i.e., if a brown spot appears on a turf landscape, providing an acceptable appearance to that part of the landscape controls how the rest of the landscape is irrigated) and using water efficiently is not a priority when plant death or poor appearance will cause the maintenance contractor to lose the account.
  - The cost of wasted water is often minor in comparison to other CII operations costs and other cost incentives, such as the effect of overwatering on structure degradation and ease of maintenance, and environmental benefits can be included in customer messaging to encourage water use efficiency improvements.

- **Landscape Maintenance**. Existing landscapes with pressure issues and leaks are often poorly maintained, with repairs completed using mismatched equipment with different design standards that directly affect irrigation system efficiencies. Maintenance using parts and equipment complementary to existing systems is essential for consistent performance in water use efficiency.

3.5 Findings

The exclusion of quantifying most CII water use from an urban retail water supplier's UWUO recognizes the diversity and complexity associated with CII water use. The legislative direction for the In-Lieu Technologies PM is to focus on actions taken by urban retail water suppliers to improve CII water use efficiency. The allowance for an alternative pathway for implementation of in-lieu technologies instead of a DIM (or equivalent technology) implies that the in-lieu technologies do not have to quantify water use, but should include actions that improve water use efficiency.

Efficient water use technologies, coupled with necessary complementary actions, have demonstrated increased water use efficiency. Landscape water use efficiency improvements applied by the CII water user, property manager, or property owner, alone, cannot be considered in the In-Lieu Technologies PM; and, in general, they cannot be implemented unilaterally by urban retail water suppliers without explicit cooperation with and consent by CII water users, property managers, and/or property owners. However, they can be an outcome of the actions taken by urban retail water suppliers, because without implementation by CII water users, property managers, or property owners, the improvement of CII water use efficiency would not be realized.

Through research and review of available literature and case studies, DWR evaluated many types of potential water use efficiency technologies and associated landscape water management practices for informing actions by urban retail water suppliers that could be considered in the In-Lieu Technologies PM. Additional stakeholder input was also incorporated in the consideration. The following provides a summary of findings that form the basis for the recommendations detailed in Section 4.

Need for Customizable Implementation

DWR recognizes that the In-Lieu Technologies PM needs to be informed by the principles of MWELO, stakeholder feedback, practitioner experience, and a review of efficient water use technologies and water management practices that increase landscape water use efficiency. Due to the diversity of how CII landscape water use is managed, even for landscapes of a similar type, the effectiveness of any potential water-efficient technology cannot be generalized statewide or even across different CII sectors or classifications. Unique location conditions, including the weather conditions, land use, and mix of CII water users, could significantly affect the effectiveness of any In-Lieu Technologies program. The history of CII landscapes, their maturity, and business cases for landscape management may also influence the applicability and effectiveness of certain landscape-efficient water use technologies and water management practices. DWR further recognizes that many existing CII irrigation systems are older, heterogenous, and built according to the design standards and technology available at the time of installation.

It would be prudent to rely on the knowledge of urban retail water suppliers about their respective service areas, CII water users, types of CII landscapes, property managers and property owners, and work completed to date on CII landscape water use efficiency improvements in order to identify applicable efficient water use technologies and accompanying efficient water management practices. In other words, the In-Lieu Technologies PM should allow urban retail water suppliers the opportunity to develop a program customized to their conditions and needs that allow for incorporation of the necessary sequence of actions to improve CII landscape water use efficiency. It also would be necessary to allow program changes through time to incorporate new or changed conditions, implementation outcomes, and lessons learned.

Lastly, it is necessary to recognize that, currently, not all urban retail water suppliers have a well-developed program for CII landscape water use efficiency. In-Lieu Technologies permissible under the In-Lieu Technologies PM may need time and resources to develop, and the outcome may not be realized immediately. Even for those who have a long history of program implementation for CII water use efficiency, adjustments are likely required to conform to the requirements of the In-Lieu Technologies PM in conjunction with those of other CII water use performance measures, such as the CII-BMPs Performance Measure.

Effectiveness of a Programmatic Approach

The recommended In-Lieu Technologies PM should be implemented in conjunction and coordination with the Commercial, Industrial, and Institutional Water Use Classification System PM (CII Classification System PM), CII-DIMWUS, Conversion Threshold PM, and CII-BMPs Performance Measure. Therefore, a focus on the legislative requirements and implementation considerations relative to standard and performance measures in designing the In-Lieu Technologies PM is warranted.

The recommended In-Lieu Technologies PM should also take into consideration existing regulations, such as MWELO. MWELO establishes design standards for new landscapes and includes provisions for water management practices and water waste prevention for existing landscapes (CCR, Sections 490(b)(3) and 493.1). The local authority responsible for implementing MWELO is required to administer programs than ensure improved water use efficiencies, which include, but are not limited to, irrigation audits, irrigation surveys, and irrigation water use analyses to evaluate water use and provide recommendations, as necessary, to reduce landscape water use to a level that does not exceed the MAWA.

In-Lieu Technologies that Improve Landscape Water Use Efficiency

As described above, the WC does not specifically define in-lieu technologies and, as previously discussed, these technologies are not limited to devices, equipment, or analytical methods. DWR recognizes that the following characteristics are important considerations for determining applicable in-lieu technologies.

- Urban retail water suppliers, landscape management experts, research studies, and literature have all identified that efficient water use technologies are only effective at achieving water use efficiency when they are combined with actions such as BMPs that include communication, irrigation system maintenance, and irrigation scheduling with the correct frequency and duration.

- Because of potentially competing goals regarding CII landscape management, the communication among landscape contractors and managers, property managers, CII water users, urban retail water suppliers, and, potentially, property owners are essential to facilitating correct operation and maintenance of irrigation

systems, tracking of and reporting on water use and waste, and implementation of any changes for improved landscape irrigation efficiency.

- When efficient water use technologies are properly installed, operated, and maintained, irrigation water use efficiency can be increased. Even for a properly designed and implemented irrigation system, as irrigation systems and landscapes change over time, there may be a reduction in system performance. Regular monitoring of the landscape, the irrigation system, and maintaining efficient water use technologies are essential to increase water use efficiency.

- MWELO design standards recognize technologies that can achieve efficient water use by requiring efficient irrigation equipment and a regular irrigation system maintenance schedule to ensure continued water use efficiency.

- Additionally, achieving efficient water use for CII landscapes with mixed-use meters requires the involvement of trained staff familiar with the proper operation and performance of the irrigation system and making sure that efficient water use technologies are performing as designed.

Implementation Considerations

As noted in Section 3.4, CUWCC's BMP No. 5 Handbook (CUWCC, 1999) recognized that the most challenging and expensive task of implementing the BMP is measuring the landscape area associated with the meter. To maximize implementation efficiency and cost-effectiveness, CUWCC (1999) recommends that water use surveys be performed for 20 percent of CII mixed-use accounts every two years and that integrating water use surveys, water use budgets, and supplemental landscape programs can make CII water users aware of inefficiencies and provide incentives and practices to improve irrigation system performance (refer to Section 3.4 above for additional information).

Adequate Considerations of Technical Feasibility, Financial Feasibility, and Economic Productivity

DWR recognized that the diversity among locations, sectors, and CII water users within sectors does not lend itself to quantified standards or metrics for CII water use efficiency. As a result, while all landscape water-efficient technologies and water management practices identified above may be technically feasible, the financial feasibility of or effects on economic productivity from each water efficient technology and associated water management practices are difficult to assess.

The economic and technical considerations of converting each mixed-use meter serving irrigated landscape areas above the conversion threshold to either a DIM (or equivalent technology) or implementing in-lieu technologies is identified in the Conversion Threshold PM (see *Recommendations for Dedicated Irrigation Meter Conversion*

Threshold for Commercial, Industrial, and Institutional Outdoor Irrigation Water Use Performance Measure [WUES-DWR-2021-18]). If the mixed-use meter is equal to or exceeds the conversion threshold and is not converted to a DIM (or equivalent technology), the In-Lieu Technologies PM must be implemented.

In determining whether to implement in-lieu technologies, CII water users usually consider the associated financial feasibility. More precisely, they consider the business cases that are often beyond the volume and cost of water use. These include additional costs for business practices, staff and process requirements, and other factors affecting the productivity of the individual CII water user. Since characterizing effects on individual CII water users can be challenging, the resulting effects on economic productivity are even more difficult to measure.

Because the 2018 Legislation directs DWR to set requirements for urban retail water suppliers (but not CII water users), and since urban retail water suppliers cannot unilaterally implement landscape water-efficient technologies and associated water management practices without explicit cooperation and consent from CII water users, urban retail water suppliers have their own financial feasibility or ROI to consider for their actions. During stakeholder engagement, urban retail water suppliers indicated that education and communication are foundational and cost-effective, because they promotes behavioral changes. However, actual water use efficiency improvement relies on implementation of actions by CII water users and, thus, the resulting ROI for urban retail water suppliers is difficult to define without the quantifiable improvement.

Another major comment from stakeholders related to financial feasibility and economic productivity is the affordability of water. New requirements for standards, variances, and CII water use performance measures would likely increase the capacity requirements for urban retail water suppliers and, therefore, potentially increase the resulting rates for residents and CII water users, which affects the affordability. Because affordability is an urban retail water supplier–specific issue, depending on the demographics and CII landscape types within a given service area, the detailed analyses are beyond the scope of this study's current efforts.

DWR's recommendations for technologies to be used in-lieu of requiring a DIM (or equivalent technology) should consider the technical and financial feasibility of implementing the technologies, the potential for long-term increased water use efficiency, and the CII sectors' economic productivity. Technical and financial feasibility of implementing landscape efficient water use technologies will vary depending on the unique characteristics of each CII water user, landscape, and local conditions in each urban retail water supplier's service area. Therefore, flexibility for urban retail water suppliers in developing and implementing in-lieu technologies is warranted, provided that the efficient water use technologies and water management practices show evidence of improved water use efficiency.

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4.0 Recommendations for In-Lieu Technologies Performance Measure

This section provides DWR's recommendations for the In-Lieu Technologies PM. It is incumbent upon the urban retail water supplier, when implementing the performance measure, to confirm that the In-Lieu Technologies PM and associated guidelines and methodologies adopted by the State Water Board are being used. In addition, the implementation of the In-Lieu Technologies PM, as well as other CII water use performance measures recommended by DWR as part of the Recommendation Package, does not require urban retail water users to report CII water use quantitively, CII water use efficiency, or amount of water savings as a whole or by sector (i.e., classification) as part of their Annual Water Use Report.

DWR's recommended In-Lieu Technologies PM does not restrict CII water users from modifying landscape areas, including reducing the total landscape area on a parcel basis, if desired. Similarly, DWR's recommendations do not restrict CII water users, in coordination with urban retail water suppliers, from implementing the In-Lieu Technologies PM for any irrigated landscape, including those irrigated with a DIM (or equivalent technology).

4.1 Specifications for In-Lieu Technologies Performance Measure

DWR recommends the following specifications for the In-Lieu Technologies PM:

- In-Lieu Technologies, in the context of the 2018 Legislation and this recommendation, includes both efficient water use technologies and actions required for sustained water use efficiency improvements. Any efficient water use technologies can be implemented for each CII landscape subject to the In-Lieu Technologies PM.
- The In-Lieu Technologies PM is required to be implemented for each CII landscape identified during implementation of the Conversion Threshold PM not converted to a DIM (or equivalent technology).
- Water use associated with CII mixed-use meter landscapes does not need to be quantified. This recognizes that properly accounting for indoor and outdoor water use associated with CII mixed-use meter may fluctuate based on seasonal or varying CII indoor or process water use.
- The In-Lieu Technologies PM may be implemented by individual urban retail water suppliers or as part of a regional program.

- Urban retail water suppliers are to design an In-Lieu Technologies implementation program specific to their service areas' CII water users subject to this performance measure.

- The In-Lieu Technologies implementation program is to consist of the following:

  - An implementation plan and schedule for all components of the In-Lieu Technologies implementation program. This plan and schedule should recognize that the In-Lieu Technologies implementation program may be implemented in phases as funding and other resources are acquired or as programs are completed, as applicable.

  - Description of selected efficient water use technologies.

  - Description of water management practices required for efficient water use technologies.

  - A budget and finance plan for all components of the In-Lieu Technologies implementation program.

  - Documentation of expected water use efficiency improvements from the In-Lieu Technologies implementation program.

  - Periodic review and revision of the In-Lieu Technologies implementation program as new efficient water use technology is developed or if unsuccessful in the service area, and at a minimum reviewed and updated every five years.

  - Development of procedures to monitor the In-Lieu Technologies implementation program. The tracking system may include:

    - Tracking implementation for the Annual Water Use Report, such as the dates the In-Lieu Technologies implementation program components are implemented, associated CII customer accounts, incentives accessed by customers, training provided, and other information that can be used to assess the effectiveness of the program and demonstrate water use efficiency improvements.

    - Program flexibility to allow for addition of new efficient water use technologies or water management practices.

    - Identification of challenges and successes with implementation of the In-Lieu Technologies PM.

- Urban retail water suppliers are encouraged to promote the In-Lieu Technologies PM for all CII landscapes, regardless of their size.

- Information documenting an urban retail water supplier's compliance with the adopted In-Lieu Technologies PM should be available upon request by DWR and the State Water Board, and retained for the period the data is used, plus three years.

Specifications for Efficient Water Use Technologies

DWR recommends the following efficient water use technologies to be included as part of the In-Lieu Technologies defined in the In-Lieu Technologies PM. Urban retail water suppliers are not limited to implementation of a single efficient water use technology within their service areas or for each landscape.

Water Budget–Based Rate Structures

DWR recommends water budget–based rate structures as an efficient water use technology with the following criteria:

- Each CII water user implementing water budget–based rate structures as an efficient water use technology has an appropriate indoor water use budget. Indoor CII water use is not required to be reported, but is essential for identifying compliance with the outdoor water budget.
- The rate structure includes the description of how the indoor and outdoor CII water use budgets are determined.
- Each CII water user should have a set, site-specific landscape water use budget, such that the landscape water use for all service area CII landscapes subject to this efficient water use technology should on an aggregate urban retail water supplier level meet the adopted 2030 *ETF* in CII-DIMWUS or the maximum applied water allowance for special landscape areas *(MAWA_SLA),* as appropriate (WUES-DWR-2021-03).
- Individual CII landscapes within an urban retail water supplier's service area subject to this efficient water use technology may have a higher or lower landscape water use budget, so long as the water use of all landscapes implementing this efficient water use technology within the service area meets an aggregate outdoor water budget in accordance with the adopted 2030 *ETF* in CII-DIMWUS or *MAWA_SLA*, as appropriate.
- Documented processes for tracking updates to the irrigated landscape area and indoor water use budget for adequate water budget setting and documenting efficient water use.

- Communication and outreach with CII water users when the individual water use budget is exceeded. CII water users should be notified when they are above their water budget and informed of assistance programs to correct the inefficiencies.

- Water rates should be set to discourage water waste and encourage water users to remain within their water use budget.

- To remain qualified as an efficient water use technology, document that the water budget–based rate structure increases landscape water use efficiency for the aggregate service area. This can include information on out-of-compliance rates and return-to-compliance rates.

Water Budget–Based Management Program Without a Rate Structure

DWR recommends water budget–based management programs without a rate structure as an efficient water use technology with the following criteria:

- Each CII water user implementing the water budget–based management program without a rate structure as an efficient water use technology has an appropriate indoor water use budget. Indoor CII water use is not required to be reported, but is essential for identifying compliance with the outdoor water budget.

- The management program contains the description of how the indoor and outdoor CII water use budgets are determined.

- Each CII water user is provided a set, site-specific landscape water use budget, such that the landscape water use for all CII landscapes subject to this efficient water use technology within the urban retail water supplier's service area should on aggregate meet the adopted 2030 *ETF* in CII-DIMWUS or the *MAWA_SLA,* as appropriate.

- Individual CII landscapes subject to this efficient water use technology may have higher or lower landscape water use budgets, so long as the water use of the aggregate of all landscapes implementing this efficient water use technology within the urban retail water supplier's service area meets an aggregate outdoor water budget in accordance with the adopted 2030 *ETF* in CII-DIMWUS or *MAWA_SLA*, as appropriate.

- Documented processes for tracking updates to the landscape area and indoor water use budget for adequate water budget setting and documenting efficient water use.

- Communication and outreach procedures for when the water use budget is exceeded for individual CII water users. Individual CII water users are notified

when above their water budget and informed of assistance programs to correct the inefficiencies. The urban retail water supplier or their representative performs outreach with the landscape contractor, property manager, CII water user, and, potentially, property owner to encourage and assist CII water users in implementing irrigation system operations, inspections, repairs, and maintenance for improved water use efficiency.

- Documentation that the water budget–based management program can continue to provide aggregate service area landscape water use efficiency to remain qualified as a water use–efficient technology. This can include information on out-of-compliance rates and return-to-compliance rates.

Hardware Improvements with Enhanced Function and Performance

DWR recommends irrigation hardware upgrades and improvements as efficient water use technologies if supporting evidence demonstrates that the upgrades result in increased water use efficiency on aggregate for the urban retail water supplier's service area and meets the following criteria:

- Proof that the hardware improvements increase water use efficiency may include, but is not limited to, documentation of hardware acceptance with U.S. Environmental Protection Agency's WaterSense label, which also includes hardware meeting standards of the American Society of Agricultural and Biological Engineers/International Code Council, and other standards with sufficient proof.
- Hardware improvements are installed by a qualified professional.
- Hardware improvements are installed, operated, and maintained in accordance with manufacturers' specifications.
- Hardware improvements that have already been installed to measure water use on CII landscapes have the irrigation system performance reviewed by a qualified professional familiar with the technology.
- Examples of hardware improvements include, but are not limited to:
  - Hardware improvements used to monitor and evaluate irrigation system functional and operational water use efficiency, including but not limited by:
    - Advanced metering infrastructure with disaggregation of indoor and outdoor water use. In specific instances, this may instead be considered an equivalent technology.
    - Irrigation flow sensors or submeters.

- Zoned irrigation designed and operated to irrigate according to plant water requirements.
- Hardware improvements that increase water use efficiency through improved irrigation distribution system uniformity, including the use of pop-up sprinkler head check valves; replacing inefficient emitters with more efficient ones; emitter replacement to the same emitter type across zones; pressure-regulating emitter heads; and others as appropriate.
- Properly programmed smart irrigation controllers, either soil- or weather-based, programmed in accordance with landscape plant requirements, irrigation zones, soil type, and other controller specifications.
- A submeter installed to meet the requirements for new and rehabilitated CII landscapes of 1,000 to 5,000 square feet, as defined in CCR, Section 492.7, actively used for irrigation scheduling and water budget management purposes with documentation of improved water use efficiency.
- Other irrigation system or hardware improvements with supporting documentation of increased water use efficiency.

Remote Sensing

DWR recommends remote sensing be acceptable as an efficient water use technology when it is combined with other efficient water use technologies and when an urban retail water supplier demonstrates increased water use efficiency for each CII water user, reported on an aggregate service-area level. DWR does not recommend remote sensing, by itself, as an efficient water use technology.

Remote sensing applications that could qualify as efficient water use technologies include, but are not limited by:

- Remote sensing coupled with hardware improvements.
- Remote sensing coupled with climate data (e.g., precipitation and temperature) used for efficient irrigation scheduling.

In specific instances, remote sensing may be considered an equivalent technology if the temporal and spatial accuracy of water use data and reporting is ‘functionally equivalent” to a DIM, as defined in the recommended CII-DIMWUS (see *Recommendations for Commercial, Industrial, and Institutional Outdoor Irrigation of Landscape Areas with Dedicated Irrigation Meters Water Use Efficiency Standard* [WUES-DWR-2021-03]).

Landscape Plant Palette Transformation Programs

DWR recommends landscape transformation programs as an efficient water use technology when higher water use plants are replaced with lower water use plants or where some irrigated landscape is eliminated altogether and meets the following criteria:

- Compliance with the current MWELO or local WELO if the landscape transformation includes landscape plant replacement, regardless of whether a permit, plan check, or design review is required, and:
  - A minimum of 25 percent of the converted area must include low-water-use, drought tolerant, or California native plants.
  - Existing trees in the project area should count towards the plant replacement requirements.
- Turfgrass removal or replacement programs should be strongly encouraged as part of the urban retail water supplier's efficient water use technology program.
  - Cool-season turfgrass can be replaced with warm-season turfgrass, where turfgrass is needed for recreational purposes or where necessary for CII water user preference.
  - All turfgrass can be replaced with lower water use turfgrass alternatives or other lower water use plants, where appropriate.
- Urban retail water suppliers shall document the amount of landscape transformed, turfgrass removed or replaced, and supporting information for the claim that new plantings meet the requirements of the urban retail water supplier's turf removal rebate program or other landscape rebate program(s), if applicable.
- Implement landscape BMPs as defined in the CII-BMPs Performance Measure for individual CII water users, regardless of the amount of landscape transformed, and demonstrate that water use efficiency is being achieved.

Other Efficient Water Use Technologies with Proof of Improved Water Use Efficiency

Other efficient water use technologies not included in DWR's recommendations may be included as efficient water use technologies when the following conditions are met:

- The efficient water use technology is not a direct measurement of landscape water use at the same accuracy and reporting requirements for technology that is functionally equivalent to a DIM.

- The efficient water use technology is demonstrated to increase landscape water use efficiency when used in combination with the required water management practices.
- The efficient water use technology is approved for use by the State Water Board.

Specifications for Water Management Practices Required for Efficient Water Use Technologies

DWR recommends that the following three water management practices, which are defined as BMPs, be required with the implementation of efficient water use technologies to demonstrate improved water use efficiency. All of the water management practices are required to be offered by urban retail water suppliers to each CII water user implementing efficient water use technologies and reported on an aggregate urban retail water supplier level.

Communications Water Management Practice

DWR recommends urban retail water suppliers design and implement a Communications Water Management Practice to encourage and maintain communication for CII water users implementing efficient water use technologies.

The Communications Water Management Practice should include processes that:

- Inform and educate CII water users on the importance of landscape water use efficiency and reduced water waste. This may include:
  - Employing cost-benefit analysis of water-efficient technologies to the extent practicable.
  - Identifying other impacts from over-irrigation to the extent practicable.
  - Identifying benefits to the community related to efficient water practices.
- Informing CII water users about available programs and technical assistance for monitoring and maintaining efficient water use technologies.
- Assisting CII water users with communication and engagement among the landscape contractor, property manager, property owner, and others, as appropriate.

Where applicable, urban retail water suppliers actively participate in communicating measured or estimated landscape water waste to CII water users, landscape contractors, property managers, and/or property owners with the goal of educating, informing, and assisting in effective implementation of efficient water use technologies.

Urban retail water users needs to establish processes and procedures to document communications with each CII water user implementing water-efficient technologies. Reporting can include a general description of activities performed by the urban retail water supplier across the service area, with more detailed records available upon request.

The Communications Water Management Practice should be periodically reviewed, at a minimum of every five years, and revised as appropriate to improve the implementation of efficient water use technologies.

Irrigation Systems Maintenance Water Management Practice

DWR recommends urban retail water suppliers design and implement an Irrigation Systems Maintenance Water Management Practice designed to assist CII water users with irrigation systems inspection, repair, and maintenance.

The Irrigation Systems Maintenance Water Management Practice may include, but is not limited by, implementation of the following BMPs:

- Providing fact sheets and tips for landscape contractors.
- Offering tools and/or training on maintaining irrigation system pressures and finding and fixing leaks.
- Where applicable and allowed, offering free irrigation audits and inspection, and sprinkler and irrigation controller rebates, and other assistance to improve the operation and maintenance of efficient water use technologies.
- Where applicable and allowed, urban retail water supplier assistance to CII water users may include direct technical assistance or may be a list of qualified professionals trained or certified on the Irrigation Systems Maintenance Water Management Practice that provide services within the urban retail water supplier boundaries.
- Documentation of Irrigation Systems Maintenance Water Management Practice offered for each CII water user implementing water-efficient technologies. The Annual Water Use Report filing can include a general description of activities performed by the urban retail water supplier across the service area, with more detailed records available upon request.
- The Irrigation Systems Maintenance Water Management Practice should be periodically reviewed, at a minimum of every five years, and revised as appropriate to improve the implementation of efficient water use technologies.

Irrigation Scheduling Water Management Practice

DWR recommends that urban retail water suppliers design and implement an Irrigation Scheduling Water Management Practice to aid CII water users with properly setting-up and updating irrigation schedules appropriate for the landscape.

The Irrigation Scheduling Water Management Practice may include, but is not limited by, implementation of the following BMPs:

- Offering irrigation scheduling tools, training, guidance, direct assistance, and other assistance as appropriate.
- Where applicable and allowed, urban retail water supplier assistance to CII water users may include direct technical assistance or providing a list of qualified professionals trained or certified on the Irrigation Scheduling Water Management Practice.
- Documentation of the Irrigation Scheduling Water Management Practice offered for each CII water user implementing water-efficient technologies. The Annual Water Use Report filing can include a general description of activities performed by the urban retail water supplier across the service area, with more detailed records available upon request.
- The Irrigation Scheduling Water Management Practice should be periodically reviewed, at a minimum of every five years, and revised as appropriate to improve the implementation of efficient water use technologies.

Requirements for Implementation

DWR recommends that the In-Lieu Technologies PM be implemented in conjuction with DWR's recommended Conversion Threshold PM (see *Recommendations for Dedicated Irrigation Meter Conversion Threshold for Commercial, Industrial, and Institutional Outdoor Irrigation Water Use Performance Measure* [WUES-DWR-2021-18]); CII-BMPs Performance Measure (see *Recommendations for Commercial, Industrial, and Institutional Water Use Best Management Practices Performance Measure* [WUES-DWR-2021-16]); and CII Classification System PM (see *Recommendations for Commercial, Industrial, and Institutional Water Use Classification System Performance Measure* [WUES-DWR-2021-17]).

Based on analysis and stakeholder input, DWR recommends the following In-Lieu Technologies PM for CII mixed-use meter outdoor irrigation water use that exceeds the conversion threshold from the Conversion Threshold PM (see *Recommendations for Dedicated Irrigation Meter Conversion Threshold for Commercial, Industrial, and Institutional Outdoor Irrigation Water Use Performance Measure* [WUES-DWR-2021-

18]). DWR recommends that the In-Lieu Technologies PM include the recommended BMPs and any recommended efficient water use technology.

The In-Lieu Technologies PM will be implemented within a maximum of six years following adoption of the CII water use performance measures by the State Water Board. The implementation of the In-Lieu Technologies PM relies on a determination that mixed-use meters will not be converted to DIMs (or equivalent technologies) as identified in the Conversion Threshold PM and shall be implemented for those mixed-use meters in the following year.

- The In-Lieu Technologies PM applies to irrigated CII landscapes that exceed the conversion threshold for mixed-use meter(s), including regular and Special Landscape Areas (SLA) (see *Recommendations for Commercial, Industrial, and Institutional Outdoor Irrigation of Landscape Areas with Dedicated Irrigation Meters Water Use Efficiency Standard* [WUES-DWR-2021-03]).

- DWR strongly recommends that implementation of the In-Lieu Technologies PM be coordinated with the related CII-DIMWUS and CII water use performance measures that include the CII Classification System PM, Conversion Threshold PM, and CII-BMPs Performance Measure.

- CII landscape areas served by a DIM are not subject to In-Lieu Technologies PM. All CII landscapes served by a DIM (or equivalent technology) are subject to CII-DIMWUS.

- SLAs, as defined in the recommended CII-DIMWUS, when served by a CII mixed-use meter greater than the conversion threshold, are subject to In-Lieu Technologies PM.

- Exempt landscapes, as identified in the recommended CII-DIMWUS, are not required to implement the In-Lieu Technologies PM and include:

  - Registered federal, State, and local historical sites.

  - Ecological projects that do not require a permanent irrigation system.

  - Mined-land reclamation projects that do not require a permanent irrigation system (pre-2015).

  - Existing plant collections, botanical gardens, and arboretums open to the public (pre-2015).

  - Water use for cemeteries built before 2015.

- CII mixed-use meters with non-irrigation water use of no more than 5 percent of the total water use (i.e., landscapes with minor, non-irrigation water use) can be considered a CII-DIM and reported under CII-DIMWUS for the purposes of the UWUO and Annual Water Use Report.

- DWR's recommendation does not prevent an urban retail water supplier from implementing In-Lieu Technologies PM for aggregate CII landscape areas crossing two or more parcels or for irrigated CII landscapes less than the conversion threshold.

- Starting in Year 2 after adoption of the CII water use performance measures by the State Water Board, DWR recommends that urban retail water suppliers implement the In-Lieu Technologies PM for individual CII water users determined from the previous year during implementation of the Conversion Threshold PM.

  - In the related Conversion Threshold PM, the minimum level of progress identifying mixed-use meter mapping and irrigated area measurement to identify qualified CII landscape areas per year is 20 percent of all CII water user accounts, starting in Year 1, after adoption of the CII water use performance measures by the State Water Board.

  - When the In-Lieu Technologies PM compliance pathway is determined for a mixed-use meter based on the Conversion Threshold PM, the In-Lieu Technologies PM will be implemented for the corresponding landscape in the following year.

  - When a mixed-use meter is converted to a DIM (or equivalent technology) from the Conversion Threshold PM, these landscape areas are not required to implement In-Lieu Technologies PM; all CII landscapes served by a DIM (or equivalent technology) are subject to CII-DIMWUS.

  - If a CII water user reduces a landscape area irrigated by a mixed-use meter below the conversion threshold, that landscape is no longer subject to the Conversion Threshold PM. These landscapes are required to implement the landscape BMPs described in the CII-BMPs Performance Measure (see *Recommendations for Commercial, Industrial, and Institutional Water Use Best Management Practices Performance Measure* [WUES-DWR-2021-16]).

- Urban retail water suppliers are encouraged to implement CII landscape BMPs as defined in the CII-BMPs Performance Measure for all landscapes, including exempt landscapes, SLAs, landscapes below the conversion threshold, and landscapes subject to CII-DIMWUS.

- Urban retail water suppliers can complete the implementation of the In-Lieu Technology PM before Year 6 at their discretion and should, at a minimum, meet the annual requirements.

Qualified Conditions and Exemptions

It is incumbent upon the urban retail water supplier, when implementing the In-Lieu Technologies PM, to confirm that the following are used: Conversion Threshold PM (see *Recommendations for Dedicated Irrigation Meter Conversion Threshold for Commercial, Industrial, and Institutional Outdoor Irrigation Water Use Performance Measure* [WUES-DWR-2021-18]); CII-BMPs Performance Measure (see *Recommendations for Commercial, Industrial, and Institutional Water Use Best Management Practices Performance Measure* [WUES-DWR-2021-16]); CII Classification System PM (see *Recommendations for Commercial, Industrial, and Institutional Water Use Classification System Performance Measure* [WUES-DWR-2021-17]); CII-DIMWUS (see *Recommendations for Commercial, Industrial, and Institutional Outdoor Irrigation of Landscape Areas with Dedicated Irrigation Meters Water Use Efficiency Standard* [WUES-DWR-2021-03]); and appropriate guidelines and methodologies as adopted by the State Water Board.

All irrigated CII landscape areas served by mixed-use meters at or exceeding the conversion threshold (see *Recommendations for Dedicated Irrigation Meter Conversion Threshold for Commercial, Industrial, and Institutional Outdoor Irrigation Water Use Performance Measure* [WUES-DWR-2021-18]), including SLAs as defined in CII-DIMWUS (see *Recommendations for Commercial, Industrial, and Institutional Outdoor Irrigation of Landscape Areas with Dedicated Irrigation Meters Water Use Efficiency Standard* [WUES-DWR-2021-03]), are required to implement the In-Lieu Technologies PM when the mixed-use meter is not converted to a DIM (or equivalent technology).

- CII landscapes irrigated with a DIM (or equivalent technology) are not subject to In-Lieu Technologies PM, but are instead included in CII-DIMWUS.
  - New water service to CII landscapes that exceed 5,000 square feet of irrigated landscape, as defined in WC Section 535, requires installation of a DIM and is not subject to In-Lieu Technologies PM.
  - New and rehabilitated CII landscapes of 1,000 to 5,000 square feet as defined under CCR, Section 492.7, where a landscape water meter [DIM (or equivalent technology), or submeter] is installed to meet the requirements of CCR, Section 492.7(a)(1)(A), are not subject to In-Lieu Technologies PM.
- DWR recommends that exempt landscapes, as defined in CII-DIMWUS, are exempted from the Conversion Threshold PM and In-Lieu Technologies PM; however, they remain subject to the CII-BMPs Performance Measure (see

Recommendations for Commercial, Industrial, and Institutional Water Use Best Management Practices Performance Measure [WUES-DWR-2021-16).

- DWR recommends that a CII mixed-use meter with non-irrigation water use of no more than 5 percent of the total water use (i.e., landscapes with minor non-irrigation water use) can be considered a CII-DIM. If urban retail water suppliers elect to consider this meter a CII-DIM:
  - These landscapes are exempted from the Conversion Threshold PM and associated In-Lieu Technologies PM due to minor non-irrigation water use.
  - Urban retail water suppliers shall instead report the associated landscape area and irrigation water use under CII-DIMWUS (see *Recommendations for Commercial, Industrial, and Institutional Water Use Classification System Performance Measur*e [WUES-DWR-2021-17]).
- DWR recommends that CII landscapes irrigated with a mixed-use meter and the estimated landscape water use satisfy the requirements for the 2030 *ETF* in CII-DIMWUS or *MAWA_SLA*, as appropriate, on a per-parcel basis, are considered to be implementing the In-Lieu Technologies PM. Urban retail water suppliers should document the situation with supporting information and follow the reporting requirements of the In-Lieu Technologies PM.

4.2 Performance Measure

The following provides DWR's recommendations for performance measures.

No Restrictions on Actions by Commercial, Industrial, and Institutional Water Users

DWR's recommendations for the In-Lieu Technologies PM does not restrict CII water users from modifying their irrigated landscape areas, including reducing the total landscape area, if desired. Similarly, the recommendations do not restrict CII water users, in coordination with urban retail water suppliers, from implementing in-lieu technologies for any irrigated landscape.

Data Provided or Obtained by the Urban Retail Water Supplier

- Number and aggregate area of CII mixed-use meter landscapes that exceed the conversion threshold implementing In-Lieu Technologies PM. The information should include type(s) of efficient water use technologies offered and implemented and outcomes of the water management practices.

- Supporting documentation for how the In-Lieu Technologies PM increases water use efficiency, as described in the requirements for each efficient water use technology.
- Necessary data that supports the selected efficient water use technology (e.g., for water budget–based management, include the landscape area).
- Number and aggregate area of CII mixed-use meter SLA landscapes (that exceed the conversion threshold) that are implementing the In-Lieu Technologies PM.
- Aggregate exempt landscape area for the service area.
- Where an irrigated CII landscape is served by a combination of DIM(s) and mixed-use meter(s), only the landscape area irrigated by the mixed-use meter(s) is subject to the Conversion Threshold PM and In-Lieu Technologies PM.
- Urban retail water suppliers shall retain map(s) and documentation of mixed-use meter locations, landscape area measurements, and efficient water technologies employed for individual CII water users to assist with future Annual Water Use Report filing requirements.

Data Accuracy Requirements

To ensure data accuracy, DWR recommends that urban retail water suppliers provide in their respective Annual Water Use Report a description of the offered efficient water use technologies and water management practices. DWR recommends that this description include, at a minimum:

- Data collection and verification process or procedures, such as: documentation and records retention; update process; and follow-up procedures (if necessary).
- Credentials (such as licenses, certifications, educational, training, or professional background of staff) for the entity/party that conducted the water management practices.
- Credentials (e.g., licenses, certifications, education, training, or professional background of staff) for the entity/party that conducted the landscape area measurement and the entity/party that approved the data for efficient water use technologies that require landscape area measurements.
- Affidavit or certification of the landscape area measurement data by a qualified urban retail water supplier staff member responsible for data quality.
    - Certification of the landscape area measurement data by the entity/party that produced it if not produced by the urban retail water supplier’s staff.

4.3 Annual Reporting Requirements

The In-Lieu Technologies PM does not require urban retail water suppliers to report water use of CII mixed-use meters; it requires urban retail water suppliers to implement In-Lieu Technologies, which are actions taken by the urban retail water supplier that result in increased water use efficiency (WC Section 10608.12(n)). The In-Lieu Technologies PM is the compliance pathway from the Conversion Threshold PM when the mixed-use meter serving a CII landscape that exceeds the conversion threshold is not converted to a DIM (or equivalent technology) (see *Recommendations for Dedicated Irrigation Meter Conversion Threshold for Commercial, Industrial, and Institutional Outdoor Irrigation Water Use Performance Measure* [WUES-DWR-2021-18]). Urban retail water suppliers will have to report on the progress of implementing the In-Lieu Technologies PM in their respective Annual Water Use Report.

DWR recommends the following reporting requirements:

- Reporting on the implementation of performance measures cannot occur until they have been adopted by the State Water Board.
- The performance measure annual reporting requirements are specific to each urban retail water supplier's annual milestones, which are at the end of each implementation year and not reported on specific Annual Water Use Reports.
  - There will be differences in reporting between urban retail water suppliers implementing the performance measure on a calendar year or fiscal year basis.
- Progress towards implementing the In-Lieu Technologies PM is to be reported in the Annual Water Use Report submitted to DWR in accordance with WC Section 10609.24 no later than January 1, 2024, and by January 1 every year thereafter, including documentation that the In-Lieu Technologies increase and maintain outdoor water use efficiency.
- In the first Annual Water Use Report, by January 1, 2024, DWR recommends that, at a minimum, urban retail water suppliers assess and report on available data, existing processes, and generally describe existing in-lieu technologies and historical program performance, including the associated regulatory setting with CII water users that may exceed the conversion threshold.
- Additionally, in the first Annual Water Use Report, the urban retail water supplier should include a description of the education and outreach performed to inform CII water users about the new 2018 Legislation requirements for performance measures.

- By Annual Water Use Report - Year 1, after adoption of the CII water use performance measures by the State Water Board, DWR recommends urban retail water suppliers describe their In-Lieu Technologies PM program, including program strategy and metrics that document increased water use efficiency.
- Reporting on each CII landscape implementing In-Lieu Technologies PM should be on an aggregate urban retail water supplier level.
- Urban retail water suppliers can accelerate implementation of the performance measure for all CII water users before Annual Water Use Report - Year 6 at their discretion and, at a minimum, meet each years' requirements in Table 4-1, as adopted.

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Table 4-1 California Department of Water Resources' Recommended In-Lieu Technologies Performance Measure Reporting Requirements

Reporting Schedule	Reporting Requirement	Expected Progress	Reporting Value
End of Year 1 after adoption as part of the Annual Water Use Report due the following January.	• Completed In-Lieu Technologies implementation plan.	• Complete development of the In-Lieu Technologies PM and describe In-Lieu Technologies implementation plan that meets the adopted requirements.	• Description of the In-Lieu Technologies program, including program strategy and metrics that indicate increased water use efficiency. • Progress with the implementation of the In-Lieu Technologies PM, if any.
End of Year 2 after adoption as part of the Annual Water Use Report due the following January.	• Number of CII water users and associated irrigated landscape areas implementing In-Lieu Technologies, identified in the Conversion Threshold PM from implementation Year 1. • Progress with Implementation of In-Lieu Technologies implementation plan.	• Implement In-Lieu Technologies plan for mixed-use meters above the conversion threshold not converted to a DIM (or equivalent technology) identified in implementation Year 1 of the Conversion Threshold PM.	• Number and total area of CII landscapes exceeding the conversion threshold implementing In-Lieu Technologies and metrics that document increased water use efficiency. • Progress with the implementation of the In-Lieu Technologies PM.
End of Year 3 after adoption as part of the Annual Water Use Report due the following January.	• Number of CII water users and associated irrigated landscape areas implementing In-Lieu Technologies, identified in the Conversion Threshold PM from implementation Year 2. • Progress with implementation of In-Lieu Technologies implementation plan.	• Implement In-Lieu Technologies plan for mixed-use meters above the conversion threshold not converted to a DIM (or equivalent technology) identified in implementation Year 2 of the Conversion Threshold PM.	• Number and total area of CII landscapes exceeding the conversion threshold implementing In-Lieu Technologies and metrics that document increased water use efficiency. • Progress with the implementation of the In-Lieu Technologies PM.
End of Year 4 after adoption as part of the Annual Water Use Report due the following January.	• Number of CII water users and associated irrigated landscape areas implementing In-Lieu Technologies, identified in the Conversion Threshold PM from implementation Year 3. • Progress with implementation of In-Lieu Technologies implementation plan.	• Implement In-Lieu Technologies plan for mixed-use meters above the conversion threshold not converted to a DIM (or equivalent technology) identified in implementation Year 3 of the Conversion Threshold PM.	• Number and total area of CII landscapes exceeding the conversion threshold implementing In-Lieu Technologies. • Progress with the implementation of the In-Lieu Technologies PM.
End of Year 5 after adoption as part of the Annual Water Use Report due the following January.	• Number of CII water users and associated irrigated landscape areas implementing In-Lieu Technologies, identified in the Conversion Threshold PM from implementation Year 4. • Progress with implementation of In-Lieu Technologies implementation plan.	• Implement In-Lieu Technologies plan for mixed-use meters above the conversion threshold not converted to a DIM (or equivalent technology) identified in implementation Year 4 of the Conversion Threshold PM.	• Number and total area of CII landscapes exceeding the conversion threshold implementing In-Lieu Technologies and metrics that document increased water use efficiency. • Progress with the implementation of the In-Lieu Technologies PM.
End of Year 6 after adoption as part of the Annual Water Use Report due the following January.	• Number of CII water users and associated irrigated landscape areas implementing In-Lieu Technologies, identified in the Conversion Threshold PM from implementation Year 5. • Progress with implementation of In-Lieu Technologies implementation plan.	• Implement In-Lieu Technologies plan for mixed-use meters above the conversion threshold not converted to a DIM (or equivalent technology) identified in implementation Year 5 of the Conversion Threshold PM.	• Number and total area of CII landscapes exceeding the conversion threshold implementing In-Lieu Technologies and metrics that document increased water use efficiency. • Progress with the implementation of the In-Lieu Technologies PM. • Review and update In-Lieu Technologies program including implementation of the water management practices every five years, at a minimum.

Key:
CII = commercial, industrial, and institutional
Conversion Threshold PM = Conversion Threshold Performance Measure
DIM = dedicated irrigation meter
In-Lieu Technologies = DWR's recommended in-lieu technologies under the In-Lieu Technologies Performance Measure

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4.4 Challenges and Considerations

As detailed above, DWR has taken into consideration the implementation challenges identified during its necessary studies and investigations and stakeholder engagement relative to its recommendations associated with the In-Lieu Technologies PM. For reference and additional context, DWR has summarized the perspectives of urban retail water suppliers and stakeholders regarding implementation challenges and other considerations below.

Several suggestions and recommendations were proposed by stakeholders in the various working groups and the public meetings. These were not specific recommendations, but are included herein as suggestions, since improving urban water use efficiency depends on the successful implementation of the final water use standards and performance measures adopted by the State Water Board. These suggestions and recommendations also recognize that the successful implementation of the new water use standards, UWUOs, and performance measures require complementary actions by the State to assist urban retail water suppliers as they implement the new framework. Stakeholders repeatedly commented to DWR that technical and financial support for urban retail water suppliers is key for the successful implementation of the new framework.

DWR includes these stakeholder recommendations and suggestions to underscore their importance for future consideration. It will require time, effort, and funding to implement these suggestions, and the pace of implementation will depend upon the feasibility and availability of resources and competing priorities.

Account and Landscape Area Measurement Data

- **Identifying CII mixed-use meter irrigated landscapes**. Many urban retail water suppliers do not have measurements of the landscape area associated with mixed-use meters. Urban retail water suppliers will face difficulties with identifying mixed-use meters and identifying the associated irrigated landscape area. Some urban retail water suppliers do not have separate billing classifications for DIMs, making it difficult for them to identify which meters may be mixed-use. Additionally, many CII landscapes are served by both mixed-use meters and DIMs. Many urban retail water suppliers will have to identify mixed-use landscapes and measure associated irrigated landscape areas.

- **Measuring the associated landscape area**. Measuring the irrigated CII landscape area requires coordination among the property owners, landscape mangers, building owners, and the urban retail water supplier for either direct field measurements or for ground-truthing aerial imagery. This requires substantial resources for the costly and time-consuming measurements.

Feasibility of Implementing In-Lieu Technologies with a Commercial, Industrial, and Institutional Mixed-Use Meter

Stakeholders identified that implementing In-Lieu Technologies with CII mixed-use meters often requires incentive programs, and it is frequently not a high priority or cost-effective for most CII water users. In addition, installing efficient water use technologies does not guarantee water savings without ongoing BMPs.

- More time should be allowed for urban retail water suppliers to perform outreach and coordination with their CII water users to comply with the 2018 Legislation.
- Stakeholders have recommended that DWR acknowledge urban retail water suppliers' authority limitations with their CII water users. They can only offer services and programs and cannot require customer participation.
- Implementing efficient water use technologies for landscapes with CII mixed-use meters does not guarantee water savings will occur. Additional technical assistance and investments to change water use behavior is necessary and may include professional water management services, water audits, and tracking water budgets for each CII water user.
- Implementing the In-Lieu Technologies PM for landscapes with CII mixed-use meters are often not cost effective for CII customers without incentives offered by urban retail water suppliers, and sometimes not even then, depending on the complexity of the system and how much water or wastewater rate savings may be achieved.

Other Considerations

- Many CII water users may not have the resources or people to implement offered water efficiency programs. For many, the lack of productivity cost, or additional landscaping cost, exceeds the cost of wasted water.
- Since 2000, IRWD has provided $1.95 million in incentives to CII customers and has leveraged other incentive funding from regional wholesalers, including the Metropolitan Water District of Southern California and MWDOC in the amount of $4.4 million. Projects and devices include, but are not limited to, water-efficient plumbing fixtures, weather-based irrigation controllers, cooling tower controllers, and custom pay for performance process improvements. More than 62,000 devices and/or projects have been installed or completed, resulting in an estimated annual water savings of 3,930 acre-feet and greater than 41,000 acre-feet in estimated lifetime savings (IRWD, 2021).

5.0 Glossary

The following key terms are listed below for easy reference. Where applicable, existing definitions from statutes and regulations are provided.

commercial, industrial, and institutional water use. Water used by commercial water users, industrial water users, institutional water users, and large landscape water users, as defined in California Water Code Section 10608.12(d).

commercial water user. A water user that provides or distributes a product or service, as defined in California Water Code Section 10608.12(e).

conversion threshold. The minimum size threshold for converting mixed-use commercial, industrial, and institutional dedicated irrigation meters or In-Lieu Technologies.

dedicated irrigation meter. A meter used only for irrigation of outdoor landscape areas. However, a mixed-use meter with no more than five percent of total delivered water serving non-landscape irrigation can also be considered a dedicated irrigation meter for the purpose of the urban water use objective and actual water use calculations and reporting.

efficient water use technology. Any device or process that improves water use efficiency and does not directly measure the amount of water used. Efficient water use technologies are not equivalent technologies.

equivalent technology. Any other device or process that is not a dedicated irrigation meter that measures the volume of water delivered to the landscape and reports directly to the urban retail water supplier, on the same time interval as service area dedicated irrigation meters, and with the same accuracy as service area dedicated irrigation meters, such that it can be used for billing purposes if an urban retail water supplier chooses to do so.

evapotranspiration factor. An adjustment factor when applied to reference evapotranspiration that adjusts for plant factors and irrigation efficiency which are two major influences upon the amount of water that needs to be applied to the landscape.

industrial water user. A water user that is primarily a manufacturer or processor of materials as defined by the North American Industry Classification System code sectors 31 to 33, inclusive, or an entity that is a water user primarily engaged in research and development, as defined in California Water Code Section 10608.12(i).

In-Lieu Technologies. Technologies that improve landscape water use efficiency by any means other than the direct measurement of water use that is an equivalent

technology. In-Lieu Technologies refers to the devices, equipment, or analytical methods that are defined in the California Department of Water Resources' recommended In-Lieu Technologies Performance Measure.

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 nonprofit research institutions, as defined in California Water Code Section 10608.12(j).

irrigable-irrigated land. A landscape area of healthy vegetation where the vegetation appears to be in growth, not senesced, and is foliated. The area is presumed to be maintained and managed through active irrigation.

irrigable-not irrigated. A landscape area of planted and previously maintained vegetation that appears water stressed (brown or leafless plants). These are areas that likely were not irrigated when the imagery was taken, but possibly were irrigated in the past, and may be irrigated again during the year after the imagery was taken.

large landscape. A nonresidential landscape as described in the performance measures for commercial, industrial, and institutional water use adopted pursuant to California Water Code Section 10609.10, as defined in California Water Code Section 10608.12(l).

maximum applied water allowance. The upper limit of annual applied water for the established landscaped area, as specified in the Model Water Efficient Landscape Ordinance. It is based upon the area's reference evapotranspiration, the evapotranspiration factor, and the size of the landscape area.

mixed-use meter. A meter serving both indoor water use and outdoor landscape irrigation.

new landscape. New construction projects with an aggregate landscape area equal to or greater than 500 square feet requiring a building or landscape permit, plan check or design review, as defined in California Code of Regulations Section 490.1(a)(1).

performance measures. Actions to be taken by urban retail water suppliers that will result in increased water use efficiency by commercial, industrial, and institutional water users. Performance measures may include, but are not limited to, educating commercial, industrial, and institutional water users on best management practices, conducting water use audits, and preparing water management plans. Performance measures do not include process water, as defined in California Water Code Section 10608.12(n).

reference evapotranspiration. The evapotranspiration rate from an extended surface of 3- to 6-inch-tall (8- to 15-centimeter-tall) green grass cover of uniform height, actively

growing, completely shading the ground, and not short on water (the reference evapotranspiration rate reported by the California Irrigation Management Information System).

rehabilitated landscapes. Any relandscaping project that requires a permit, plan check, or design review; and the modified landscape area is equal to or greater than 2,500 square feet, as defined in California Code of Regulations Section 491(ooo).

return on investment. Is A profitability metric used to evaluate the efficiency of an investment or to compare the efficiency of a number of different investments.

service connection. The point of connection between the customer's piping or constructed conveyance, and the water system's meter, service pipe, or constructed conveyance (California Health and Safety Code Section 116275(s)).

Special Landscape Area. An area of the landscape dedicated solely to edible plants, areas irrigated with recycled water, water features using recycled water and areas dedicated to active play such as parks, sports fields, golf courses, and where turf provides a playing surface, as defined in California Code of Regulations, Title 23, Section 491(iii).

urban retail water supplier. A water supplier, either publicly or privately owned, that directly provides potable municipal water to more than 3,000 end users or that supplies more than 3,000 acre-feet of potable water annually at retail for municipal purposes, as defined in California Water Code Section 10608.12(t).

urban water use objective. An estimate of aggregate efficient water use for the previous year based on adopted water use efficiency standards and local service area characteristics for that year, as described in California Water Code Section 10609.20, as defined in California Water Code Section 10608.12(u).

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6.0 References

ACWA and CMUA (Association of California Water Agencies and California Municipal Utilities Association.). 2021. Comment Letter Re: Provisional Outdoor Standard. August 17. Accessed at: https://calwep.org/wp-content/uploads/2021/08/ACWA-Comments_-DWR-Proposed-Outdoor-Standard_8.17.21.pdf

AWE (Alliance for Water Efficiency). 2018. What are the Customer Landscape Preferences and What Drives Customers to Change Their Landscape? 2018 Market Analysis and Recommendations, AWE Nonmember Edition. Accessed at: https://www.allianceforwaterefficiency.org/sites/www.allianceforwaterefficiency.org/files/assets/LT_Market_Report_NonMember_Final.pdf. Accessed May 26, 2022.

BAWSCA (Bay Area Water Supply and Conservation Agency). 2020. 2020 Annual Report, Large Landscape Program. February.

Budget Based Rates. n.d. Accessed at: http://budgetbasedrates.com/

CCWD (Contra Costa Water District). 2022. Bob Eagle and Nicholle Fratus, email messages and personal communication. May 6.

City of Palo Alto. 2019. Water Budget Rate Structure Evaluation. May. Accessed at: https://www.cityofpaloalto.org/files/assets/public/agendas-minutes-reports/reports/city-manager-reports-cmrs/attachments/attachment-x-6055209-attachment-a-palo-alto-water-budget-memo_clean.pdf?t=48331.38

City of Santa Rosa. 2022. Claire Nordlie. Email messages and personal communication. May 16.

Coleman, R.W.; N. Stavros; G. Hulley; N. Parazoo. Comparison of Thermal Infrared-Derived Maps of Irrigated and Non-Irrigated Vegetation in Urban and Non-Urban Areas of Southern California. 2020. Remote Sens. 2020, 12, 4102. Accessed at: https://doi.org/10.3390/rs12244102

CUWCC (California Urban Water Conservation Council). 1999. BMP 5 Handbook: A Guide to Implementing Large Landscape Conservation Programs as Specified in Best Management Practice 5. Accessed at: https://calwep.org/wp-content/uploads/2020/04/CIIGuidebook.pdf

_____. 2013. Baum-Haley, Melissa. *Potential Best Management Practices – Turf Removal*. September.

DWR (California Department of Water Resources). 2013a. “Commercial, Industrial, and Institutional Task Force Water Use Best Management Practices Report to the Legislature.” Volume I: A Summary. October 21.

_____. 2013b. “Commercial, Industrial, and Institutional Task Force Water Use Best Management Practices Report to the Legislature.” Volume II: Technical Information. October 21.

DWR and State Water Board (California Department of Water Resources and State Water Resources Control Board). 2018. Making Water Conservation a California Way of Life. Primer of 2018 Legislation on Water Conservation and Drought Planning Senate Bill 606 (Hertzberg) and Assembly Bill 1668 (Friedman). Accessed at: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/Water-Use-And-Efficiency/Make-Water-Conservation-A-California-Way-of-Life/Files/PDFs/Final-WCL-Primer.pdf?la=en&hash=B442FD7A34349FA91DA5CDEFC47134EA38ABF209

EPA (United States Environmental Protection Agency). 2017. WaterSense Water Efficiency Management Guide Landscaping and Irrigation, EPA 832-F-17-016b. November. Accessed at: https://www.epa.gov/sites/default/files/2017-12/documents/ws-commercialbuildings-waterscore-irrigation-landscape-guide.pdf

Foster, T., T. Mieno, and N. Brozovic. 2020. Satellite-based monitoring of irrigation water use: Assessing measurement errors and their implications for agricultural water management policy. Water Resources Research, 56, e2020WR028378. doi: https:// doi.org/10.1029/2020WR028378

Hartin J, Oki L, Fujino D, Reid K, Ingels C, Haver D, Baker W. 2019. UC ANR research and education influences landscape water conservation and public policy. California Agriculture 73(1):25-32. Accessed at: https://doi.org/10.3733/ca.2018a0041

Irrigation Association. 2021. Water-efficient products. December. Accessed at: https://www.irrigation.org/SWAT/Water-Efficient-Products/SWAT/Water-efficient-Products/Water-efficient-Products.aspx?hkey=f3774f79-b8a9-453e-9274-547408af198d

_____. 2022. “Smart Water Irrigation Technologies.” Accessed at: https://www.irrigation.org/SWAT/Home_Page/SWAT/SWAT_Home_Page.aspx?hkey=b5e6661e-e67c-4963-abe7-55357052cc60

Irrigation Association and American Society of Irrigation Consultants. 2014. Landscape Irrigation Management Best Practices. May. Accessed at: https://www.irrigation.org/SWAT/Smart-People/Landscape-BMPs/SWAT/Smart-People/Landscape-BMPs.aspx?hkey=dfc642d3-723c-4260-b630-a05a039756ea

IRWD (Irvine Ranch Water District). 2017. Multiplier Effect Study, 2016 Update and Presentation, CA-NV AWWA Spring 2017 Conference. 2017

_____. 2021. Effectiveness of Commercial, Industrial, and Institutional Customer Water Budgets in Achieving Efficient Water Use for Mixed Use Meters (memo). July 16.

_____. 2022. Fiona Sanchez. Email messages and personal communication. May 6.

Ludwig, J.A., G.N. Bastin, J.F. Wallace et al. 2007. Assessing landscape health by scaling with remote sensing: when is it not enough? Landscape Ecology 22, 163–169. Accessed at: https://doi.org/10.1007/s10980-006-9038-6

MWDOC (Municipal Water District of Orange County). 2018. 2018. Evaluation of Municipal Water District of Orange County's Comprehensive Landscape Water Use Efficiency Program (CLWUE). Prepared for United States Department of the Interior, Bureau of Reclamation, Agreement No. R15AP00129. December. Accessed at: https://www.mwdoc.com/wp-content/uploads/2019/05/Comprehensive-Landscape-Water-Savings-Evaluation.pdf

_____. n.d. *Turf Removal Program Terms and Conditions*. Accessed at: https://mwdoc.dropletportal.com/rebate/turf/terms

Nhamo, L., R. Van. Dijk, J. Magidi, D. Wiberg, and K. Tshikolomo. 2018. *Improving the Accuracy of Remotely Sensed Irrigated Areas Using Post-Classification Enhancement Through UAV Capability. Remote Sens*ing, 10, 712. https://doi.org/10.3390/rs10050712

Santa Rosa Water. 2015. Water and Wastewater Rate Study, Final Report. Accessed at: https://www.srcity.org/DocumentCenter/View/6663/Current-Rate-Report---September-9-2015-PDF

SoCal Water$mart. 2015. Accessed at: https://socalwatersmart.com/en/residential/rebates/general-information/about-the-program/

_____. 2022. Landscaping Equipment. January. Accessed at: https://socalwatersmart.com/en/commercial/rebates/available-rebates/commercial-devices/

Shurtz, K.M., E. Dicataldo, R.B. Sowby, and G.P. Williams. 2022. Insights into Efficient Irrigation of Urban Landscapes: Analysis Using Remote Sensing, Parcel Data, Water Use, and Tiered Rates. Sustainability, 1427. Accessed at: https://doi.org/10.3390/su14031427

United States Census Bureau. QuickFacts, California; Santa Rosa City, California. Accessed at: https://www.census.gov/quickfacts/fact/table/CA,santarosacitycalifornia/PST045221

Shaw, David A., and Dennis. Pittenger. 2009. Landscape Irrigation System Evaluation and Management. University of California, Division of Agriculture and Natural Resources. April. Accessed at: https://ucanr.edu/sites/UrbanHort/files/160836.pdf

Appendix A – Urban Water Use Efficiency Recommendation Package Reports Incorporated by Reference

DWR (California Department of Water Resources). September 2022. Recommendations for Urban Water Use Efficiency Standards, Variances, Performance Measures, and Annual Water Use Reporting. DWR Report Number: WUES-DWR-2021-01A.

DWR (California Department of Water Resources). September 2022. *Landscape Area Measurements Final Project, Report EA-133C-16-CQ-0044.* DWR Report Number: WUES-DWR-2021-02.T1.

DWR (California Department of Water Resources). September 2022. Recommendations for Commercial, Industrial, and Institutional Outdoor Irrigation of Landscape Areas with Dedicated Irrigation Meters Water Use Efficiency Standard. DWR Report Number: WUES-DWR-2021-03.

DWR (California Department of Water Resources). September 2022. Summary of Recommendations for Performance Measures for Commercial, Industrial, and Institutional Water Use. DWR Report Number: WUES-DWR-2021-15.

DWR (California Department of Water Resources). September 2022. Recommendations for Commercial, Industrial, and Institutional Water Use Best Management Practices Performance Measure. DWR Report Number: WUES-DWR-2021-16.

DWR (California Department of Water Resources). September 2022. Best Management Practices for Improving Efficiency in Commercial, Industrial, and Institutional Water Use: Key Successes and Challenges in California. DWR Report Number: WUES-DWR-2021-16.T.1.DWR (California Department of Water Resources). September 2022. Recommendations for Commercial, Industrial, and Institutional Water Use Classification System Performance Measure. DWR Report Number: WUES-DWR-2021-17.

DWR (California Department of Water Resources). September 2022. Recommendations for Dedicated Irrigation Meter Conversion Threshold for Commercial, Industrial, and Institutional Outdoor Irrigation Water Use Performance Measure. DWR Report Number: WUES-DWR-2021-18.

DWR (California Department of Water Resources). September 2022. Stakeholder Outreach Summary for Developing Urban Water Use Efficiency Standards, Variances, and Performance Measures. DWR Report Number: WUES-DWR-2021-20.

DWR (California Department of Water Resources). September 2022. Urban Water Use Efficiency Recommendation Package: Glossary and Abbreviations and Acronyms. DWR Report Number: WUES-DWR-2021-21.