Proposed Framework for Performance Standards for Water Loss

Background

California Water Code section 10608.34 (Senate Bill 555, 2015) sets statutory requirements for monitoring and reducing water losses through leaks in distribution systems. The State Water Resources Control Board (State Water Board) is required to develop performance standards for water loss by July 2020 for urban retail water suppliers (URWS). One important factor the State Water Board is required to evaluate in the development of the performance standards is a life cycle cost assessment[1].

URWS's have been required to submit water loss audits since October 2017 pursuant to Water Code section 10608.34, subdivision (b) and regulations developed by Department of Water Resources. The water loss audits are required to be conducted per the M36 manual by the American Water Works Association (AWWA). The accuracy of the water loss estimates from these audits depends on the quality of entered data. The process of assessing the quality of data entered in the audit is called validation. State law requires the submitted audits to be validated as pursuant to California Water Code section 638.3, subdivision (a).

Assembly Bill 1668 and Senate Bill 606, passed in 2018, require URWS's to calculate their own individual urban water use objective beginning in 2023. The objectives will be calculated based on efficient indoor, outdoor and commercial, industrial and institutional irrigation, and an allowable water loss volume.

As part of the pre-rulemaking process for Senate Bill 555, the State Water Board has been engaging with stakeholders, including, water suppliers, industry experts, and environmental justice groups, through public meetings and workshops, and correspondence received from stakeholders. The stakeholder engagement covered topics such as data accuracy and variability, focus areas, program implementation, costs, feasibility and efficiency of interventions. Public meetings were held in Sacramento, Oakland, and Los Angeles in 2018.

Additionally, the State Water Board is collecting data through the Electronic Annual Report (eAR) on existing distribution system characteristics and incurred costs, and the corresponding achieved water loss reduction, to inform the development of cost-effective volumetric standards. Stakeholder feedback was incorporated through public meetings and comment letters to inform the data collection through the eAR.

The formal rulemaking process is expected to begin in June 2019. The regulatory package is anticipated to include appropriate environmental analyses to comply with the California Environmental Quality Act and an assessment of the state-wide fiscal and economic impacts of this regulation.

This document describes the staff framework proposal for performance standards required to be adopted by the State Water Board in 2020 pursuant to California Water Code 10608.34. The

[1] The lifecycle cost assessment will consider costs, and benefits, projected to accrue while implementing interventions over their lifetime, including planning, installation, implementation, and operation of interventions that may be used to meet the performance standards.

framework is an initial staff proposal. After obtaining feedback from stakeholders, staff will develop a regulatory proposal for the formal rulemaking process.

Overview of proposed framework for performance standards

Leakage reduction relies in part on planning infrastructure maintenance and replacement, thus indicating a long-term approach to achieve cost-effective outcomes. The typical approach includes assessment of current leakage, selection of technologies, implementation of water loss reduction technologies, and continued operation of these technologies [1] [2].

For example, to determine a strategy to cost-effectively reduce losses for a distribution system, it is necessary to determine the nature of losses in the system and conduct trials and pilot implementations to assess different available technologies and vendors. The results of these feasibility assessments and technology selection processes can then be used to implement a system-wide strategy. Reductions in water loss are typically observed after the assessment, planning, and implementation in this multi-step process. Hence, the State Water Board proposes to follow a similar phased, progressive approach.

Initial performance standards will be adopted in 2020 by the State Water Board for all URWS through its regulations. Compliance with the regulations will be in the form of volumetric water loss reduction and performance measures. The regulations for performance standards would require compliance in each of four Phases:

1. Improved data collection and quality, as needed (2020 - 2022)
2. Initial implementation (2023 - 2027)
3. System-wide implementation (2028 - 2035)
4. Ongoing water loss control (2036 onwards)

The initial performance standards will include allowable water loss volumes during Phases 2, 3, and 4. The proposed approach will provide opportunities for adjustments to those volumes based on additional data in Phase 1. The allowable water loss volumes for Phases 3 and 4 could be adjusted at the end of Phase 2. Additional details are provided below in sections describing the proposed individual phases.

<u>Adjustments</u>: Staff proposes opportunities and processes for URWS's to request adjustments of either their allowable water loss volume based on updated, validated data or a compliance deadline in case of exceptional scenarios. Additional details on the format and provisions of these adjustments are outlined in the section titled Provision for Filing of Adjustments by UWRS's.

<u>Phase 1: Improved data collection and quality (2020 - 2022)</u>

The State Water Board provided $3.2 million in funding to the California-Nevada section of AWWA (CA-NV AWWA) to develop and execute a Technical Assistance Program (TAP) over a period of two years to facilitate the reporting of water loss volumes through AWWA audits. The report on TAP [3] outlined gaps in collected data and monitoring practices that could impact the reliability of data from water loss audits. The gaps identified were uncertainty in estimating source and customer meter inaccuracy and average operating pressure and negative or technically implausible estimates for water loss. The stakeholder process, water audits and the electronic annual reports together show that some URWS's in California lack adequate data to reasonably assess the potential for water loss reduction and select appropriate technologies and approaches.

Validated water loss audits have a provision to assess the reliability of the data entered, known as "grades." Grades are entered by the reporter and validated by a certified individual distinct from the reporter for various data such as water produced, water exported or imported, billed or unbilled consumption, metered and unmetered consumption, system characteristics such as length of mains, number of service connections, and average operational pressure. The grades are in the form of numbers from one through ten, where a higher numeric grade represents higher data reliability owing to more effective practices. The TAP report provides recommendations for certain monitoring practices and analyses which can improve data quality to resolve such uncertainties and provide a more robust estimate of real losses.[2] Improving the quality of these data supports planning of water loss control strategies.

The objective for Phase 1 is to improve collection and quality of data that will increase the reliability of real loss estimates and provide the basis for determining available and appropriate water loss control strategies. This objective will be achieved through the following compliance requirements:

1. Conduct and submit Leakage Component Analysis in 2022
   Water loss through leaks consist of three broad categories: reported, unreported and background leakage. Water suppliers are alerted of reported leaks through visual observation, as these leaks present visible signs. Large main breaks fall into this category. Unreported leaks are detected by specialized equipment and typically are smaller in size than reported leaks. Background leakage is generally comprised of small flows of leakage that cannot be easily detected through leak detection equipment, and is affected by the operational pressure, age, and condition of the system. Assessment of the nature and composition of leakage is crucial for determining a cost-effective water loss control strategy.

   A spreadsheet-based tool,[3] known as the Leakage Component Analysis Model developed by the Water Research Foundation, provides a system-level assessment of the nature of water losses. The Leakage Component Analysis is informed by reports on leaks, results from any leak detection activities conducted throughout the distribution system, and the operational pressure and age of the distribution system. Thus, the analysis relies on data collected on individual leakage events and broad operational characteristics to obtain the real loss volume for the distribution system. In addition to providing a high-level leakage profile for the system, it also provides a check for the real loss estimated in the water loss audit [4]. The tool and report provide guidelines for a data collection for the Component Analysis. Staff proposes that the Leakage Component Analysis be conducted according to the Leak Repair Data Collection Guide provided with the Leakage Component Analysis Model.[3]

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[2] 'Real losses' are water losses through physical leaks in the system, as opposed to 'apparent losses' which are revenue losses due to billing, systematic or metering errors, or theft of water.

[3] Leakage Component Analysis Model (2014): http://www.waterrf.org/resources/Pages/PublicWebTools-Detail.aspx?ItemID=27
Real Loss Component Analysis: A Tool for Economic Water Loss Control, 2014, http://www.waterrf.org/Pages/Projects.aspx?PID=4372

The Component Analysis may entail instituting practices for systematic data collection and improving records. The proposed regulation would allow a URWS to file for an adjustment for an extension to the submission date if the URWS can demonstrate that additional time is required to complete and submit a Component Analysis.

2. <u>Achieve at least grade 4 for average operational pressure in AWWA M36 validated water loss audit submitted in 2021</u>
   High operational pressure and variation can increase the amount of leakage from distribution systems [5] [6] [7] [8]. Higher operational pressure can cause higher loss of water through defects in infrastructure, as it tends to increase flow of water through such defects. Additionally, overall variations such as extremely high maximum operational pressure and short-term spikes in pressure can strain infrastructure. These effects are pronounced within distribution systems with high operational pressure, pressure fluctuations and a higher portion of flexible pipe material. Pressure reduction and management are established interventions, recommended by industry experts, to reduce leakage and main breaks in such distribution systems. Further, pressure management provides benefits such as increased infrastructure durability and energy-efficient operation due to the reduced operational pressure for the distribution system [9].

   The first step towards determining the potential benefits of pressure management is to effectively monitor the operational pressure in the distribution system. A distribution system is typically divided into pressure zones according to pressure needs for different areas of the service area [10]. Each pressure zone is typically operated at an average operational pressure. These individual pressure zone measurements are used to determine the average operational pressure for the entire system. As the Leakage Component Analysis incorporates system condition and operational pressure to determine the leakage profile, determining the average operational zone pressure for the entire system is a crucial data input for conducting a sound and constructive Component Analysis.

   Receiving grade 4 for the data entered for average operational pressure represents pressure monitoring for individual zones from limited pressure monitoring and supplementary calculations using ground elevation data. As reflected in water loss audits submitted in 2017, 63 URWS's received a grade lower than grade 4 in average operational pressure monitoring. These utilities did not implement practices that could provide a basis for obtaining reasonable estimates for the pressure in individual pressure zones (Figure 1). Lack of basic pressure monitoring could prove to be roadblock in determining the potential of leakage reduction through pressure management, and thus restrict options that might be available to an URWS for cost-effective water loss reduction.

   Accordingly, State Water Board staff propose compliance with the practices included in grade 4 at minimum for the operational pressure entry of the AWWA water loss audit to establish data collection and estimation techniques to obtain average operational pressure estimates. This would allow and ensure all URWS's to progress towards obtaining estimates of average operational pressure in their distribution system for the

Component Analysis and to determine potential pressure management strategies. *The proposed compliance deadline is October 1, 2021, in alignment with the annual water loss audit submission date.*

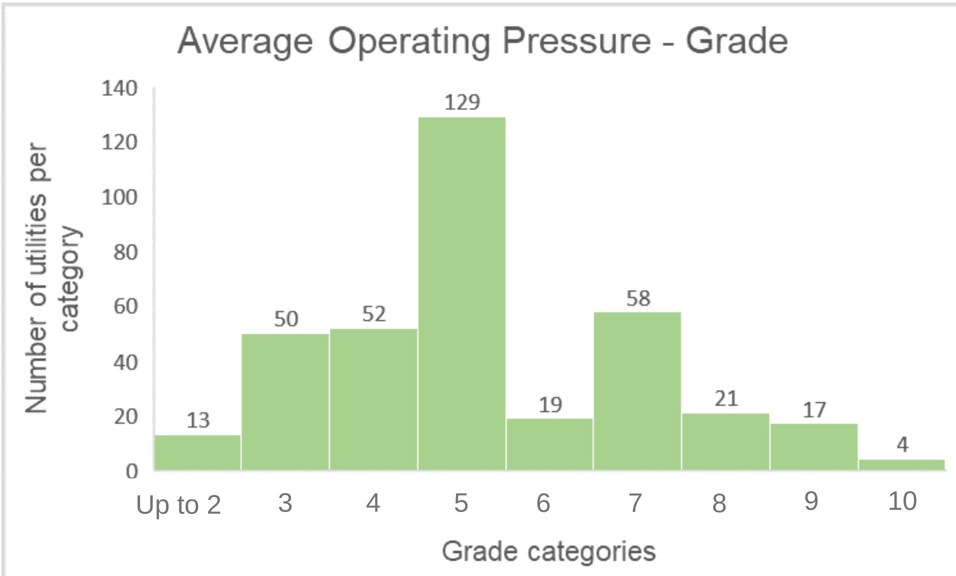

Figure 1 Distribution of Grades for Average Operating Pressure (2017)

URWS's would be able to request adjustments to the compliance date for Phase 2 in case of inability to collect data of adequate quality. Approval by the State Water Board of an adjustment will require evidence of inability to collect data by established methods required for compliance with regulatory requirements for this phase. Please refer to the section on adjustments for additional details and deadlines.

Phase 2: Initial Implementation (2023-2027)

Allowable water loss volume to be included in urban water use objective by 2027

Water loss control can be addressed through four foundational approaches: Detecting and locating leaks, efficient responses to reported leaks, reducing operational pressure and pressure variations, and prioritizing infrastructure replacement (Figure 2). These approaches can be implemented through various types of interventions currently available in the industry. The feasibility of implementation for different interventions depends on a given distribution system's unique characteristics, including the nature of leakage in the system. The objective of this phase is to utilize findings from the Component Analysis submitted in 2022, determine suitable interventions and require initiation of feasible and effective intervention strategies.

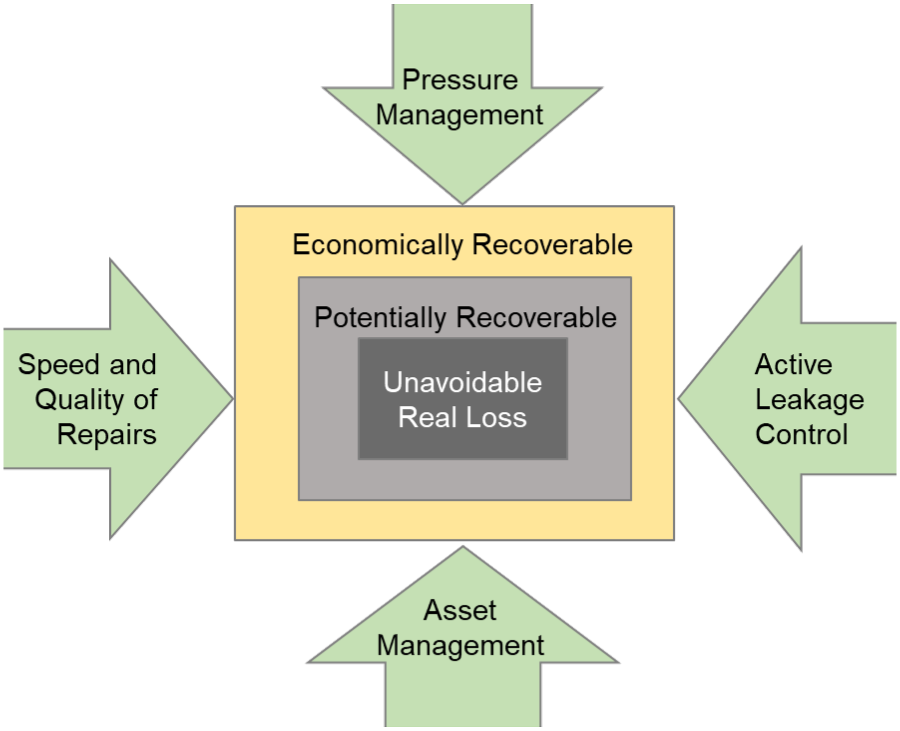

Figure 2 Foundational Approaches to Leak Detection

Based on stakeholder feedback and several reports on planning for water loss control, [11] [12] [13], a crucial step in technology selection is conducting pilot studies and observing efficiencies on a small scale before a full-scale implementation. The proposed regulation would provide time for URWS's to conduct these pilot studies to select efficient technologies and begin initial implementation towards reducing water losses.

From 2023 to 2026, staff proposes that URWS's submit Leakage Component Analyses during at least two years. For example, URWS's would be able to choose two years from 2023, 2024, 2025 and 2026 as their submission years for two separate submissions of the Leakage Component Analysis. The objective behind this proposed requirement is that the Component Analyses and findings from initial implementation of water loss control interventions inform each other for an efficient system-wide implementation in the later phases.

During this phase, URWS's will also have to comply with their urban water use objective, which will include an allowable water loss volume determined from the real loss reduction achieved through the initial implementation of interventions. The allowable water loss volume will be based on the initial performance standards adopted in 2020. This volume will be determined through an economic assessment using data from electronic annual reports and available literature. Additional details are provided in the section "Framework of Economic Model."

State Water Board staff anticipate that additional data on costs incurred and associated water loss reduction will be available from improved data quality and initial implementation in Phases 1 and 2, which will be reported via Leakage Component Analyses and Electronic Annual Reports. Staff proposes an additional assessment in 2027 of the initial (2020) performance standards after Phase 2 to determine final performance standards. Compliance with these final performance standards would be required at the end of Phase 3 in 2035 and on an ongoing basis in Phase 4 beginning in 2036.

Phase 3: System-wide Implementation (2028 - 2035)

This phase will require URWS's to implement feasible technologies on a system-wide scale to effectively detect and locate leaks, prioritize infrastructure replacement and repair or replace infrastructure cost-effectively. For URWS's that opt for pressure management in part or whole of their system, large-scale implementation of pressure management [8] will be expected in this phase. The objective of this phase is for URWS's to achieve an economically achievable water loss reduction as part of a sustainable water loss control strategy.

Staff proposes that in 2035 URWS's comply with the allowable water loss volume adjusted as per the additional assessment in 2027 of the initial 2020 performance standards. Findings from the Component Analyses, data from water loss audits and Electronic Annual Reports submitted by URWS's after 2020 will be incorporated in this assessment.

Phase 4: Ongoing Water Loss Control (2036 onwards)

Maintaining an appropriately low level of leakage efficiently requires continued infrastructure maintenance to control newly emerging leakage over time. These maintenance efforts involve regular monitoring of the distribution system, prioritizing infrastructure replacement and continued repair (and replacement as suitable) for system components. From 2036 onwards, URWS's would be required to comply with their final allowable water loss volume on a three-year average basis with a maximum allowed deviation of 5%.

Staff proposes that URWS's be able to request adjustments to this deviation during Phase 3. This would enable the State Water Board to incorporate this adjustment in the assessment of the initial performance standards while providing the final performance standards for Phase 3 and beyond.

Figure 3 provides and overview of the compliance and adjustment requirements.

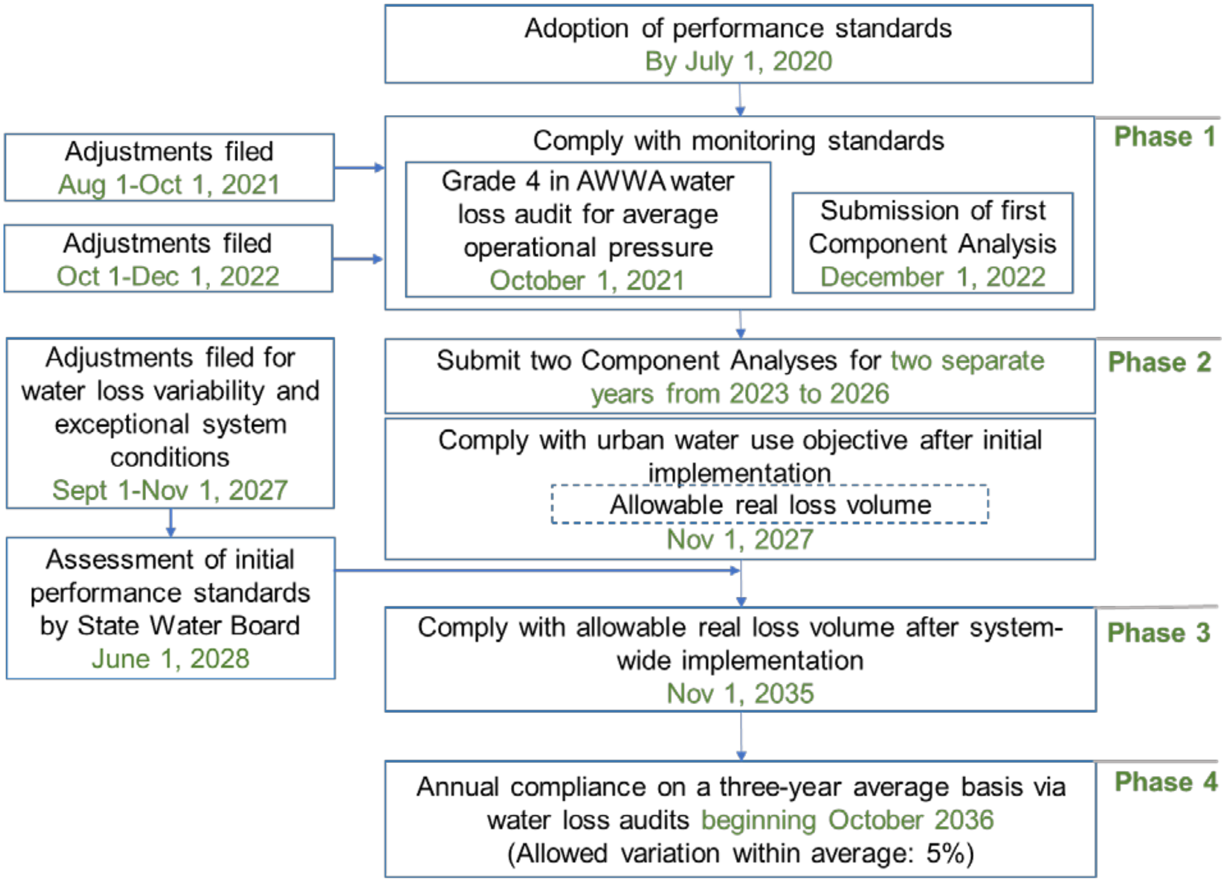

Figure 3 Overview of water loss performance standard setting process and compliance milestones

Framework for Economic Model

Water Code section 10608.34 requires the State Water Board to consider life-cycle cost accounting in its development of water loss performance standards. For URWS's, cost-effective water loss reduction requires a balance between the potential benefits, and costs associated with reducing and maintaining losses at a lower level. For example, eliminating leakage completely from a water distribution system may not be economical, with the costs incurred being out of proportion with the benefits achieved (this is reflected in Figure 2 as economically recoverable leakage). The objective of these regulations is to determine the water loss volume that can be cost-effectively achieved for each URWS, with costs and benefits estimated over the life cycle of an intervention strategy or combination of intervention strategies.

Costs and benefits need to be evaluated in light of climate change. The effects of climate change are expected to be extended and severe droughts and warmer temperatures that affect precipitation patterns. At the same time, California faces an increasing demand for water. Water loss control from distribution systems is an effective way of conserving water and strengthening drought resilience and potentially avoiding the need for additional water resources. Additionally, water lost through leakage from URWS's infrastructure is usually treated to potable quality, conveyed from treatment facilities to the end user, and at times imported from distant sources of water before being lost as leakage. Accordingly, the water lost can also have a high energy and carbon footprint for the URWS.

The major anticipated costs and benefits associated with compliance with the approach outlined in this document are expected to be:

Costs

- Equipment and staffing to improve pressure monitoring to AWWA water loss audit grade 4
- Data collection, software requirements and staffing for the three submissions of Leakage Component Analysis
- Technology, staffing, selection, procurement, installation, operation, monitoring, and analysis for implementing interventions pertaining to:
    - Active leak detection and associated repair
    - Efficient response to repairing reported leaks
    - Pressure management including operational pressure and transient reduction
    - Prioritized pipe replacement
- Communications and outreach for activities related to pipe replacement and pressure reduction
- Staffing for reporting

Benefits

- Avoided costs of water owing to:
    - Avoided future "demand" or other water supply needs due to water loss reduction
    - Operational energy reduction
- Additional benefits associated with preventing main breaks that surface to the ground. In the initial performance standards, the estimates will be proportioned based on number of breaks reported in the electronic annual reports. In the assessment in 2027, the Component Analysis will inform this estimation:
    - Avoided damage to property
    - Avoided water outages and associated economic and public health impacts: The extent of outages will be determined from pipe sizes and typical leak flows from affected pipes [14].
    - Avoided traffic increase: Available methods to calculate the extent and impacts of traffic will be used to determine the benefits [15] [16]. The extent of impact will be estimated from case studies and examples.
    - Reduced firefighting capability due to water outages: The impact on firefighting capability affected by water outages can determined from the pipe size and typical flows from the pipe.

Different intervention approaches incur different costs depending on various system characteristics. Based on stakeholder feedback and various studies, certain distribution system characteristics can pose constraints to the implementation of commonly used technologies and incur higher costs per mile of pipe, per pressure zone or per leak [17]. The economic model will incorporate the effect of such system characteristics on costs and efficiencies of intervention technologies. Such system characteristics are broadly outlined as follows:

- Number of pressure zones: Distribution systems are typically divided into zones based on pressure requirements. Large pressure zones can increase the cost of implementation for pressure monitoring and management. The average size of pressure zones will be derived from data provided in electronic annual reports and water loss audit reports.
- Pipe material: Acoustic or sound-based leak detection methods, which detect typical noises due to water leaking through a pipe defect, are widely used for water loss control. Such technologies may have decreased efficiencies in non-metallic, that is, plastic or cement-based pipes. Leak detection on such pipe materials require additional methods such as sound amplifiers or technologies that are advanced, for example, leak correlators, that can detect sounds at lower sound frequencies and require additional training. Such technologies are available for leak detection in non-metallic pipes, but that implies a constrained group of available technologies for leak detection in such pipes. Data on distribution system composition will be obtained from electronic annual reports [18] [19].
- Pipe size: Acoustic technologies typically have reduced efficiencies in pipes larger than sixteen inches due to attenuation of the leak noise being detected. In many cases this effectively constrains the availability of cost-effective technologies for leak detection [18].
- Terrain: Rough terrain can pose challenges in leak detection and accessibility for monitoring. Cost estimates from implementation examples for conducting leak detection and monitoring in such terrains will be incorporated in the model.
- Leak size: Smaller leaks often require additional technology with a higher sensitivity for locating leaks. The occurrence of small leaks can be determined from the Component Analysis and can be incorporated in the assessment after Phase 2 [18].

Economic Analysis for the Initial Performance Standards

The initial performance standards for allowable water loss volume for Phases 3, 4 and beyond will be based on currently available data from electronic annual reports, water loss audits and literature on implemented water loss case studies [12] [8] [20] [21] [22] [23]. Limited data on costs and water loss reduction from different intervention strategies are currently available from the annual reports. Additional data from literature on water loss control implementation will be used to develop curves relating cost and the level of leakage for different intervention strategies. Case studies reporting implementation of the intervention strategies at different levels of leakage will inform these curves, thus incorporating costs for water loss control for distribution systems at low initial leakage levels.

System characteristics, and cost estimates, will be put into appropriate groups to create cost curves that apply to distribution systems with similar characteristics. Data from electronic annual reports will provide information on the pipe material composition. Water loss audits will provide estimates of water loss volumes and average operational pressure.

> Allowable water loss volume for Phase 2: Data from electronic annual reports will provide cost estimates for implementation of different interventions on a pilot scale. These estimates will be supplemented with estimates from literature [8] [12] [20] [21] [22] [23]. The allowable water loss volume will be based on a conservative estimate of water loss reduction typically achieved through pilot implementations, given the toolbox of

technologies available to the URWS. URWS's will be required to comply with their urban water use objective, which includes this allowable water loss volume.

Allowable water loss volume for Phase 3: Cost curves developed from the process described above will be used to determine an allowable water loss volume for compliance at the end of Phase 3 and ongoing compliance in Phase 4.

The allowable water loss volume will be dependent on the projected cost to be incurred. The eventual costs will depend on intervention strategies that will likely be employed, which in turn depend on the needs of the distribution system. The need for different foundational approaches will be assessed based on the condition of infrastructure and the nature of leakage, as described below.

Prioritized pipe replacement

Distribution systems may include pipes that are at or near the end of their lifetime. The analysis will include estimation of the proportion of distribution system pipes that could require prioritized replacement. Material, age and size of pipe are factors intrinsic to distribution systems that determine the useful lifetime of pipes. External factors such as soil corrosivity, soil temperature and moisture variation have been found to be significant [24] [25]. A recent report on life cycle assessment of water distribution pipes provides typical estimates for service life from an extensive review of field observations of different pipe materials, subject to external and intrinsic factors.[4] The analysis will be based on these estimates and industry estimates, to determine the need for scheduled prioritized pipe replacement in the various phases of the implementation of the regulation. This replacement need will be deemed to be additional to repairs or replacement occurring to address unreported or reported leaks. Estimates of typical leak reduction associated with prioritized pipe replacement will be obtained from data from electronic annual reports.

Characterization of leakage

Leakage can occur in different forms and thus can and needs to be detected in different ways. Leaks can be typically controlled by managing operational pressure if not reported on observation or detected by leak detection surveys. Before the nature and scope of leakages in a URWS's system can be more comprehensively determined by the Leakage Component Analyses, proposed to be submitted in 2022, the nature of leakage in distribution systems is proposed to be characterized based on the average operational pressure and real loss volume for the distribution system.

The proposed initial approach is based on methods used for assessment of water loss by observing pressure and real loss simultaneously [26] [23]. For example, for a URWS, if the real loss per connection per day is high as compared to other URWS's with similar characteristics, while the pressure is comparatively low, a substantial portion of the overall water loss has a high likelihood of being rectified through active leak detection and quicker response to repairs. If the operational pressure is comparatively high, pressure management has a high likelihood of rectifying background leakage. Studies

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[4] Sustainable Solutions Corporation, 2017, Life Cycle Assessment of PVC Water and Sewer Pipe and Comparative Sustainability Analysis of Pipe Materials

on implementation of the quadrant analysis recommend grouping systems according to connection density (connections per mile) for a reliable preliminary analysis. The proposed analysis will inform costs curves that will be considered for determining an allowable water loss volume as part of the initial performance standards to be adopted in 2020.

Data on average operational pressure and real loss volume will be available from annual water loss audits. These data reported by URWS's will be benchmarked on a quadrant plot as shown in Figure 3. A quadrant plot is a cross-plot between two performance indicators, pressure and real loss in this case, for a preliminary assessment of the foundational approaches that will provide effective water loss control strategies for water loss reduction [27].

The quadrant analysis is typically conducted using indices that compare current levels to the technical minimum for pressure and water loss (Infrastructure Leakage Index). For this analysis, performance indicators that are proposed to be considered are:

- Average operational pressure and volumetric real loss per mile per day
- Average operational pressure and volumetric real loss per connection per day

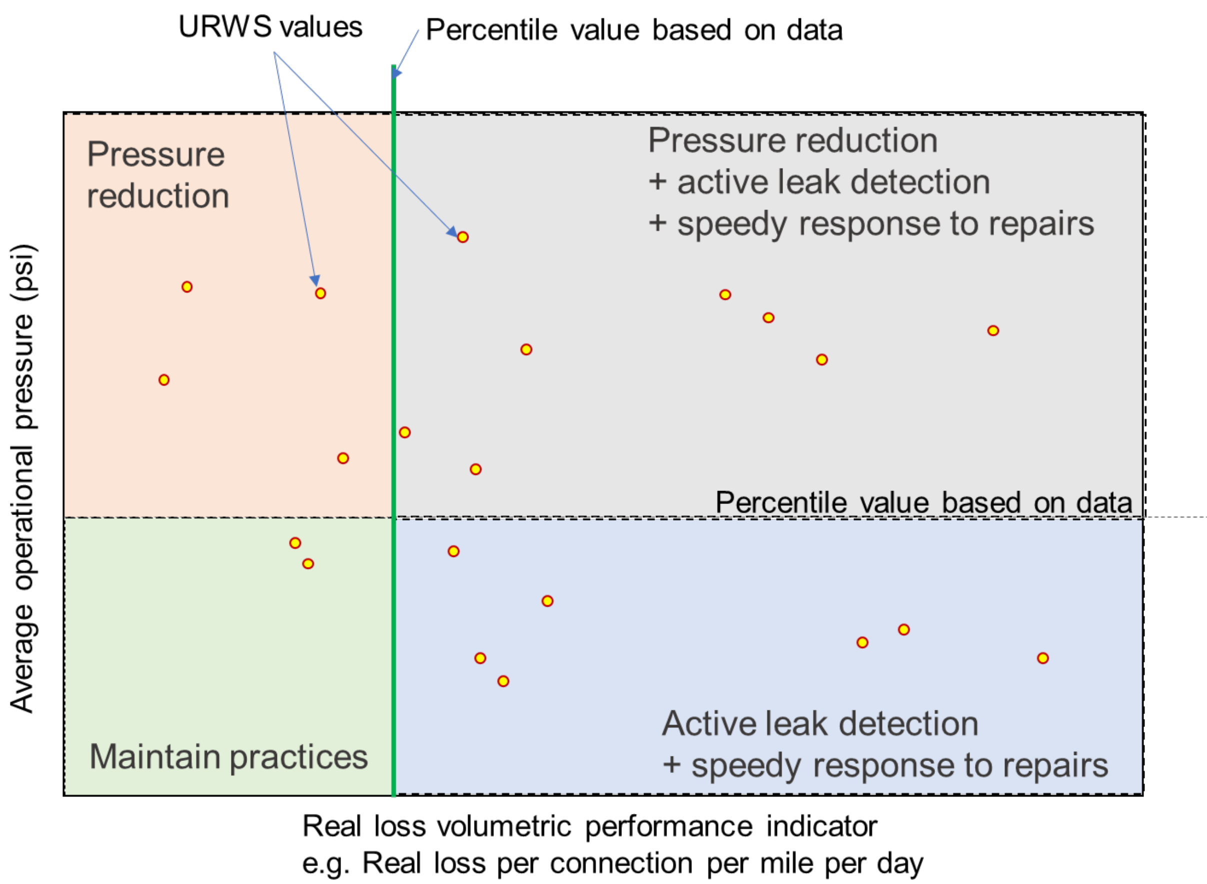

Figure 4 Quadrant Analysis to characterize real loss

Cost curves will be evaluated according to the leakage profile of a system established from the methods described above. An economical level of leakage will be expected to be achieved based on a cost benefit analysis, given the intervention technologies available in each foundational approach for water loss control. These curves will be used to determine a conservative estimate of water loss reduction.

Assessment for final performance standards

Staff proposes to assess the initial performance standards based on additional data from Phases 1 and 2 to determine final performance standards for Phases 3 and 4. These data would include annual water loss audits up to 2027, findings from the Component Analysis submitted in 2022, and reporting on initial implementation via electronic annual reports.

The results from the Leakage Component Analysis would be used to adjust the characterization of leakage for each system, which would inform cost assessment based on likely intervention strategies available to the URWS. Cost and water loss reduction estimates from the initial implementation will provide additional data for the cost curves.

Provision for Requesting Adjustments by UWRS's

URWS's would be able to request adjustments to the standards with respect to compliance dates or allowable volumes during specific periods proposed for each adjustment. It can be reasonably expected that there will arise conditions that are likely to impact an URWS's ability to comply with their regulatory obligations. These adjustments will be evaluated on a case-by-case basis. Some expected causes for adjustment and their specific filing periods are as follows:

- Compliance deadline extension for Phase 1
  URWS's would be able to request an extension to the compliance dates for Phase 1 if they can demonstrate a justifiable inability to obtain the data required to comply with the Phase 1 requirements. A URWS would be able to request these adjustments on the grounds that they have exceptional conditions which prevent them from implementing established measures or strategies to comply with these requirements. The request would need to be accompanied by evidence of conditions pertaining to distribution system characteristics or administrative procedures warranting the adjustment. There would be two opportunities to request adjustments during Phase 1:
  - Achieving at least grade 4 for average operational pressure in the annual water loss audit by October 1, 2021
    If an URWS is unable to take steps to at least grade 4 due to unavoidable or delaying conditions, it would be able to request an extension of the compliance date. The filing period for any such request would be between *August 1 and October 1, 2021.*
  - Submission of Component Analysis by December 1, 2022
    If an URWS is unable to compile a Component Analysis by December 2022, due to inability to collect the required data, it would be able to request an extension of the compliance date. The filing period for any such request would be between *October 1 and December 1, 2022.*
- Adjustment to allowable water loss volume for Phase 2
  A URWS would be able to request an adjustment to the allowable water loss volume adopted by the State Water Board in 2020, due to a change in their estimated water loss

level based on water loss audits conducted in 2021 and/or 2022. A URWS would need to demonstrate a significant change in their real loss estimates from their findings in the submitted water loss audits in 2021 and 2022. A URWS would also be able to request an adjustment to the allowable water loss volume for Phase 2 if it can demonstrate exceptional conditions which prevent it from implementing established measures or strategies to comply with these requirements. The request would need to be accompanied by evidence of conditions pertaining to distribution system characteristics or administrative procedures warranting the adjustment.

- Adjustments to real loss volume and variability requirements for Phases 3 and 4
  Requests for these adjustments would be filed between *September 1 and November 1, 2027*. Case-by-case evaluations of these adjustments will be incorporated in the assessment of the initial performance standards by the State Water Board. An URWS would be able to request either or both adjustments.
  - Adjustment to allowable real loss volume for Phases 3 and 4
    An URWS would be able to request an adjustment due to exceptional conditions which prevent it from implementing identified intervention strategies that have been otherwise demonstrated in to be effective for real loss reduction with strong consistency. A request for this type of adjustment would need to be supported with evidence of approaches that were not successful and the justification for inability to use any alternative approach to achieve the allowable real loss volume.
  - Adjustment to the allowed maximum annual real loss variability of 5% for Phase 4
    An URWS would be able to request an adjustment if some condition(s) unique to it cause the annually monitored real loss for its distribution system to consistently vary by more than 5%. The request for adjustment would need to be supported by evidence on the causes for such variability, measures taken to address the variability and lack of success of said measures to decrease the variability.

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