



Guide to Asset Management Improvement Planning for the Pacific Water Sector



Pacific Region Infrastructure Facility



PACIFIC WATER AND
WASTEWATER ASSOCIATION



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Abbreviations

ADB	Asian Development Bank
AMMA	asset management maturity assessment
BC	British Columbia, Canada
DOWR	Department of Water Resources (Vanuatu)
GIS	geographic information system
IIMM	<i>International Infrastructure Management Manual</i>
ISO	International Organization for Standardization
LOS	levels of service
MCA	multi-criteria analysis
NRW	non-revenue water
PIC	Pacific island country
PRIF	Pacific Region Infrastructure Facility
PWWA	Pacific Water and Wastewater Association
QGIS	Quantum Geographic Information System
SDB	supply-demand balance
SMART	Specific, Measurable, Achievable, Relevant, and Time-Bound
SWA	Samoa Water Authority
TA	Technical Assistance
TMV	Te Mato Vai (Cook Islands)
TTV	To Tatou Vai (Cook Islands)
URA	Utilities Regulatory Authority (Vanuatu)
WAF	Water Authority of Fiji
WASH	water, sanitation, and hygiene
WHO	World Health Organization



Foreword

Accessibility and sustainable management of quality water are key to the well-being of people and all other life forms. The Pacific as a region lags far behind other regions of the world in water availability and security. At the same time, the threat of water insecurity is exacerbated by climate change, jeopardizing not only people's livelihoods, but also the already-stressed infrastructure assets in the sector. Given the increasing impact of climate change in the region, maintaining the resilience of infrastructure has become crucial.

The PWWA's vision of "sustainable water and sanitation for Pasifika" puts strategic priority on improved quality, access to safe drinking water, and sanitation by building the technical capacity and capability of its utilities to better provide these services. In September 2022, the PWWA and PRIF released a report titled *Diagnostics of Pacific Water and Wastewater Association Water Utilities*, in which a key recommendation for water utilities was to make optimal use of the capacity of the current water supply and sewerage system by improving performance. This cannot be achieved, however, without sound asset management practices. A 2021 baseline assessment by PRIF, the *Pacific Infrastructure Maintenance Benchmarking Report*, noted that asset information is also a key requirement for calculating appropriate tariff and cost-recovery alternatives. Given the gap in information and support to utilities in the Pacific island countries, the report proposed to complement the efforts of PRIF's development partners by focusing on the water sector, specifically on the neglected area of operation and maintenance.

It has been our pleasure to collaborate with PRIF, which provided the technical and financial support to this technical assistance (TA) project, Strengthening Capital Maintenance Practices and Capabilities in the Pacific Water Sector, which worked to strengthen overall institutional capacity in asset management, planning, and execution in the water sector. This publication, *Guide to Asset Management Improvement Planning for the Pacific Water Sector*, is a key output of this TA and is available to all Pacific utility companies. The water utilities participating in the project underwent intensive training and mentoring exercises, and they vouch for the valuable learnings and knowledge sharing in the project. This collaboration and partnership in capacity building is a model to be shared and extended for the way to achieve sustainable and secure water sectors.

We look forward to working with PRIF and our member utility companies to ensure that this guide becomes a major operational tool for the much-needed resilience of the water sector in the context of increasing climate change challenges.



Pitola Lusio Sefo Leau
Chief Executive Officer
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How to Use This Guide

The *Guide to Asset Management Improvement Planning for the Pacific Water Sector* was developed for Pacific water supply utilities by PRIF in collaboration with the Pacific Water and Wastewater Association (PWWA). The purpose of this guide is to provide practical advice for water utilities on how to assess the organization's asset management maturity and how to develop an asset management improvement plan.

Asset management maturity is a measure of how advanced an organization's asset management practices are. An asset management maturity assessment (AMMA) includes an evaluation of an organization's current maturity level and the setting of an appropriate target maturity level that the organization should aim to achieve over a defined time frame. The gap analysis under the AMMA is used to identify the actions needed to address the gap between the current and target maturity levels. The resulting improvements in the maturity level are then prioritized and incorporated into a tactical asset management improvement plan. A tactical improvement plan is a task-level plan in which each asset management improvement action is treated as a task or project.

The Introduction section of this guide describes the AMMA and asset management improvement plan in more detail, including the benefits that a water utility can expect from adopting these processes. The full benefits of developing an asset management improvement plan will only be realized when the improvement actions have been implemented and embedded in the organization. The objective of developing a tactical plan is to scope the expected improvements in sufficient detail so that the tactical plan can be used by a water utility to request funding from donor partners if the utility needs external support.

The Asset Management Maturity Assessment section of this guide describes the framework and step-by-step methodology for completing an AMMA. The Developing an Asset Management Improvement Plan section of this guide provides practical advice on the steps for a water utility to follow when developing a tactical asset management improvement plan to address the gaps identified by the AMMA. The AMMA outcomes are also useful for:

- managing and informing the scope of external consultants when there is a related project that can be utilized to address relevant gaps in asset management maturity¹;
- informing capital infrastructure improvements, for example by improving water demand forecasting to determine the design capacity of new water treatment infrastructure;
- benchmarking the organization's asset management maturity level relative to others in the same industry and in other industries; and
- highlighting the strengths and opportunities of the organization.

Case studies from the water utilities participating in the pilot TA project, which took place in 2023, are included throughout this guide to provide real-life examples of asset management challenges and solutions adopted by water utilities in Pacific island countries.

Key point

This guide provides practical advice on how to assess the organization's asset management maturity and how to develop an asset management improvement plan. These are important steps towards better operation and maintenance of the important assets used to deliver services.

¹ Useful resources on working with external asset management consultants can be found at: Federation of Canadian Municipalities. Ensuring Continuation of Asset Management Once Consultant Services Are Complete. <https://fcm.ca/en/resources/mamp/ensuring-continuation-asset-management-once-consultant-services-are-complete>.

1 Introduction

1.1 Background

This *Guide to Asset Management Improvement Planning for the Pacific Water Sector* is a key output of the 2023 technical assistance (TA) project Strengthening Capital Maintenance Practices and Capabilities in the Pacific Water Sector, led by the Pacific Region Infrastructure Facility (PRIF) in collaboration with the Pacific Water and Wastewater Association (PWWA) to strengthen overall institutional capacity for asset management, planning, and execution in the water sector.

Water supports life, and a well-maintained water supply infrastructure is essential for ensuring that the people of the Pacific Island countries (PICs) have access to reliable services. Inadequate infrastructure maintenance has long been recognized as a challenge. The failure to maintain physical infrastructure has led to its premature deterioration around the world, particularly in PICs. A PRIF study in 2013 found a pattern of “Build-Neglect-Rebuild” across the PICs and identified areas for improvement that have since been supported at different levels (PRIF 2013), but there is still much to be done. Development partners support PIC governments with water supply infrastructure investments. But they have historically focused their financing on building new and large infrastructure, including the rebuild of deteriorated infrastructure, while the burden of operation and maintenance has mostly fallen on the PICs.

The report *Diagnostics of Pacific Water and Wastewater Association Water Utilities*, prepared by PRIF and the PWWA in 2022, recommended that water utilities make optimal use of the current capacity of the current water supply and sewerage system by improving performance, which cannot be achieved without sound asset management practices (PRIF 2022a). The foundation of asset management planning is understanding the current performance and condition of existing assets and developing a robust asset register. This is an essential first step before an organization can move from a reactive to a proactive approach to maintaining its infrastructure.

In 2022, PRIF also published *Pacific Infrastructure Maintenance Benchmarking Report: A 2021 Baseline Assessment*. This report identified that the capital cost of building infrastructure in PICs is around one-fifth of the total cost of operating and maintaining the infrastructure over its lifetime (PRIF 2022c). Capital maintenance is highly significant for the water supply sector, but is often underfunded and neglected. The report also noted that the water sector lacks accountability due to the lack of regional or national oversight, compared with the aviation, maritime, and energy sectors. The provision of funding for new capital expenditures can also distort decision-making, with infrastructure capital treated as if it were a “free” good. It alters asset management practices and reduces incentives to consider the impact and cost of infrastructure management over an asset’s life cycle.

The 2023 TA project mission was to:

- (i) support the strengthening of workforce capabilities through an asset management training program for the first cohort of water supply utilities;
- (ii) help the participating water supply utilities to assess their asset management maturity and develop tactical asset management improvement plans; and
- (iii) facilitate a platform for sharing information gained from the training program with other water supply utilities through collaboration with the PWWA.

This guide is available to all PIC water utilities, to assist them in assessing their asset management maturity and in developing their first asset management improvement plans.

Key point

This guide builds on previous work including the *Diagnostics of Pacific Water and Wastewater Association Water Utilities* (2022) and *Pacific Infrastructure Maintenance Benchmarking Report: A 2021 Baseline Assessment*.

1.2 What is Asset Management?

The objective of asset management as defined by the *International Infrastructure Management Manual* (IIMM) is “to meet a required level of service, in the most cost effective manner, through the management of assets for present and future customers.”

Effective asset management practices maximize the benefits of new infrastructure investments by ensuring that they can provide the required service throughout their expected asset life. Asset management planning is carried out by an asset owner to answer questions such as:

- (i) What are the required levels of service and performance delivery?
- (ii) How will demand for this change over time?
- (iii) What is the current state of the assets?
- (iv) Are they capable of meeting these demands now and in the future?
- (v) What are the risks that the assets may not be able to meet the required demands?
- (vi) What are the best strategies for operating, maintaining, replacing, and improving the assets?
- (vii) How much will providing the service cost over the long term? What is the best long-term funding strategy?

By providing answers to these questions, asset management practices help asset owners to improve cost efficiencies, prioritize investments, boost customer satisfaction, and strengthen risk management. The levels of service are the outputs an organization intends to deliver to its customers. An example of a water utility’s level of service is the provision of water that is safe to drink and meets the appropriate drinking water standards.

Key point

Better asset management will assist in ensuring the levels of service (water supply quality, reliability and quantity) can be maintained and improved over the long-term.

1.3 What is an Asset Management Maturity Assessment?

Asset management maturity is a term used to describe how advanced an organization’s asset-management practices are. The objective of assessing an organization’s asset management maturity is to determine its current maturity level and set an appropriate target level. The next step is to identify improvement actions to address the gap between the current and target maturity levels and to incorporate the priority improvements into an asset management improvement plan.

The implementation of asset management planning in an organization can be seen as a journey, with increasing levels of complexity over time. The starting point and the target level of maturity will depend on elements such as the size of the organization, the financial value of the asset base, and the degree to which service delivery is reliant on assets. Complex high-value and high-risk assets generally warrant more advanced asset management analysis. Water supply infrastructure fits this description, so a water utility should apply good asset management practices to ensure a reliable supply of quality drinking water.

It is important to note that an asset management maturity assessment does not measure the current state of the assets. It is possible to have assets that are in good condition and perform well, but have a low rating on the scale of asset management maturity; and, conversely, it is possible to have assets in poor condition (e.g., if underfunded), yet have a mature asset management maturity rating.

1.4 What are the Benefits of Assessing Asset Management Maturity?

An AMMA is the first step taken by an organization toward establishing a continuous improvement approach for its asset management practices, systems, tools, and capabilities. Identifying and then implementing improvements in asset management practices, systems, tools, and capabilities will, in

turn, lead to improved asset management outcomes. The results of an AMMA can also be used for benchmarking vis-à-vis similar organizations to identify leading practices and areas for improvement.

A well-managed AMMA should also:

- provide learning opportunities for the organization's staff,
- help to break down organizational silos by including staff from across the organization in group interviews,
- create a road map for continual improvement (the asset management improvement plan), and
- create a more integrated and consistent asset management approach.

Key point

A key part of asset management is undertaking an Asset Management Maturity Assessment (AMMA). This assists an organization in assessing its capabilities and performance to ensure service needs can be met in the long-term and to identify what could be improved. This is outlined in detail in Section 2 of this guide.

1.5 What is an Asset Management Improvement Plan?

An asset management improvement plan is a compilation of the improvement actions identified through the AMMA that will address the “gap” between the current and the target levels of asset management maturity. It is a road map for continual improvement in asset management planning.

It is important to note that, just as an asset management maturity assessment does not evaluate the current state of an organization's assets, the improvement actions will not by themselves change the state of those assets. The asset management improvement actions will not include capital infrastructure investments. Take, for example, the issue of aging customer meters that may be in poor condition and contributing to high non-revenue water (NRW).² This issue could be addressed by an asset management improvement action to assess the condition of the assets, i.e., an improvement action to implement a customer meter testing program, followed by an improvement action to develop a renewal plan for customer meters. The capital replacement of the customer meters is not considered to be an asset management improvement action.

There are many elements involved in asset management planning, and there may be gaps in asset management maturity identified for each element, some of which may require multiple improvement actions. It is unwise for an organization to try to implement all the needed improvements at once. The asset management improvement plan is typically developed as a staged program or road map, with the priority improvement actions delivered first. There are a variety of methods that could be used to prioritize improvement actions, such as a gauging of the logical order, an intuitive assessment of impact versus difficulty, or more advanced methods such as cost-benefit analysis or a risk-mitigation approach.

1.6 What are the Benefits of Developing an Asset Management Improvement Plan?

The asset management improvement plan is the outcome of the AMMA that enables continuous improvement in asset management maturity for the organization. The PRIF-PWWA approach was to develop tactical asset management improvement plans for each priority action. A “tactical” plan builds on the description of an improvement in asset management and develops it into a mini project plan to track progress. The tactical asset management improvement plan is discussed further in section 3.3, including a description of the essential elements. The benefit of a tactical asset management

² Non-revenue water is defined as the volume of water that a water utility does not receive revenue for. It is the sum of physical leakage of water from the network plus apparent losses of water due to customer meter under-registration and unauthorized consumption.

improvement plan is that it is actionable because it identifies the person who will lead each of the improvement actions and it defines the resource requirements and estimated costs. A tactical improvement plan can also be used by a water utility to support a request for funding from donor partners.

The asset management improvement plan also needs to be sustainably resourced and regularly monitored and reported on. The full benefits of developing an asset management improvement plan will only be realized when the improvement actions have been implemented and embedded in the organization.

Key point

An asset management improvement plan documents the actions identified through the AMMA that will improve asset management and service delivery, providing a road map for continual improvement in asset management planning. This is outlined in detail in Section 3 of this guide.

2 Assessing Asset Management Maturity

2.1 Maturity Assessment Framework

There are a few approaches to AMMA that are in use internationally, but most AMMA tools are unavailable in any spreadsheet tool that can be downloaded for free. This guide uses the IIMM framework, which offers a spreadsheet tool that is downloadable for free from the Āpōpō website.³ The other AMMA approaches are aligned with different asset management frameworks, such as the Institute of Asset Management model, which has six subject groups covering 39 asset management

Box 1: Do You Want to Learn More about Asset Management?

There are free resources available online, including the selection of handbooks and guides on asset management listed below.

Managing Infrastructure Assets for Sustainable Development: A Handbook for Local and National Governments was published by the United Nations in 2021. This handbook contains practical tools for improving infrastructure asset management, plus recommendations on how to adapt asset management to socioeconomic and environmental challenges, including climate change and public health emergencies.

<https://www.un.org/development/desa/financing/document/un-handbook-infrastructure-asset-management>

A.M. Kan Work! is an online guidebook on asset management and energy efficiency. It was written by the Southwest Environmental Finance Center, based in the United States, and is aimed at smaller to medium-sized water and wastewater utilities.

<https://swefc.unm.edu/home/resource/am-kan-work-an-asset-management-and-energy-efficiency-manual-2/>

Asset Management Ontario (AMONTario), based in Canada, provides free online guides and templates for asset management that are designed for specialists in public sector asset management.

<https://www.amontario.ca/guides-templates/>

The Asset Management British Columbia (AMBC) framework “Asset Management for Sustainable Service Delivery,” establishes a high-level approach to support local government in moving toward service, asset, and financial sustainability through an asset management process. This approach is scalable to community size and capacity.

<https://www.assetmanagementbc.ca/framework/>

In addition to these free resources, there are asset management organizations that provide paid training courses. See Appendix B for more details. The Pacific Region Infrastructure Facility teamed with Āpōpō for this pilot project to strengthen asset management in the water sectors of the Pacific island countries.

Source: The author.

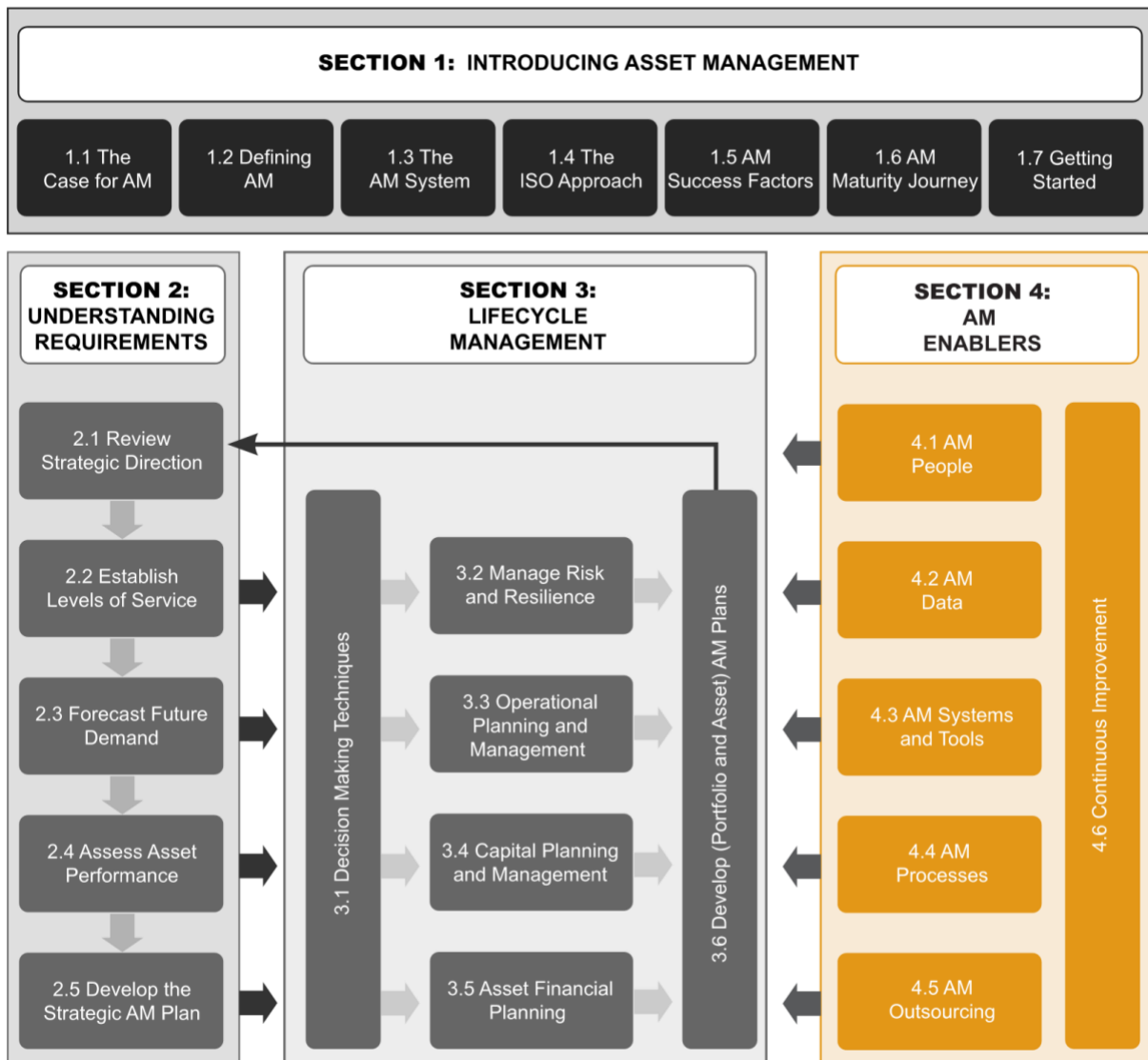
³ Āpōpō. Asset Management Maturity Assessment Tool (xlsx). <https://apopo.co.nz/product/asset-management-maturity-assessment-tool-xlsx/>.

subjects. The other assessment approaches are also not available in spreadsheet tools that are free to download. An annotated extract of the AMMA tool is included in Appendix 1.

The IIMM framework is shown in Figure 1. This AMMA tool allows a maturity assessment for 16 elements, or areas of asset management, under IIMM sections 2 to 4. (One element is not assessed, “3.1 Decision making techniques,” as this is covered by the other elements under section 3).

Sections 2, 3, and 4 are often referred to as the three pillars of the IIMM asset management framework: Understanding Requirements, Lifecycle Management, and Asset Management Enablers. Descriptions of what is assessed under each of the IIMM pillars and elements is described in sections 2.3 to 2.5 in Figure 1.

Figure 1 : International Infrastructure Management Manual Framework



AM = asset management, ISO = International Organization for Standardization.

Source: Institute of Public Works Engineering Australasia (IPWEA). 2020. *International Infrastructure Management Manual*. North Sydney, Australia.

Key point

There are several frameworks and tools available for an organization to use. This guide uses the IIMM framework that also has a free on-line tool for the AMMA.

2.2 Maturity Assessment Methodology

Assessments of asset management maturity can range from the more informal self-assessments to a full audit aimed at achieving the ISO 55001 certification under the International Organization for Standardization (ISO). The ISO 55001:2014 standard specifies the requirements for an asset management system, and can be applied to all types of assets by all types and sizes of organizations. It specifies the “what,” but not the “how” of an asset management system. The IIMM was updated in 2020 to map the ISO’s “what is required” clauses against the IIMM’s “how to” sections.

This guide recommends a Facilitated Self-Assessment Methodology, under which the organization completes its own assessment, with an external agency reviewing the organization’s self-assessment and validating the scores for both the current and target asset management maturity.

Figure 2 shows the step-by-step process for completing an AMMA and identifying the improvement actions needed to address the maturity gap. The process could include in-country visits during which the external agency reviews and validates the draft AMMA through a combination of interviews and workshops with staff from the water utility and relevant government departments, and a review of evidence provided by the water utility. The full list of evidence, the reasoning for the scores and the interview notes are documented in the AMMA spreadsheet tool.

Water distribution pumps, Vanuatu

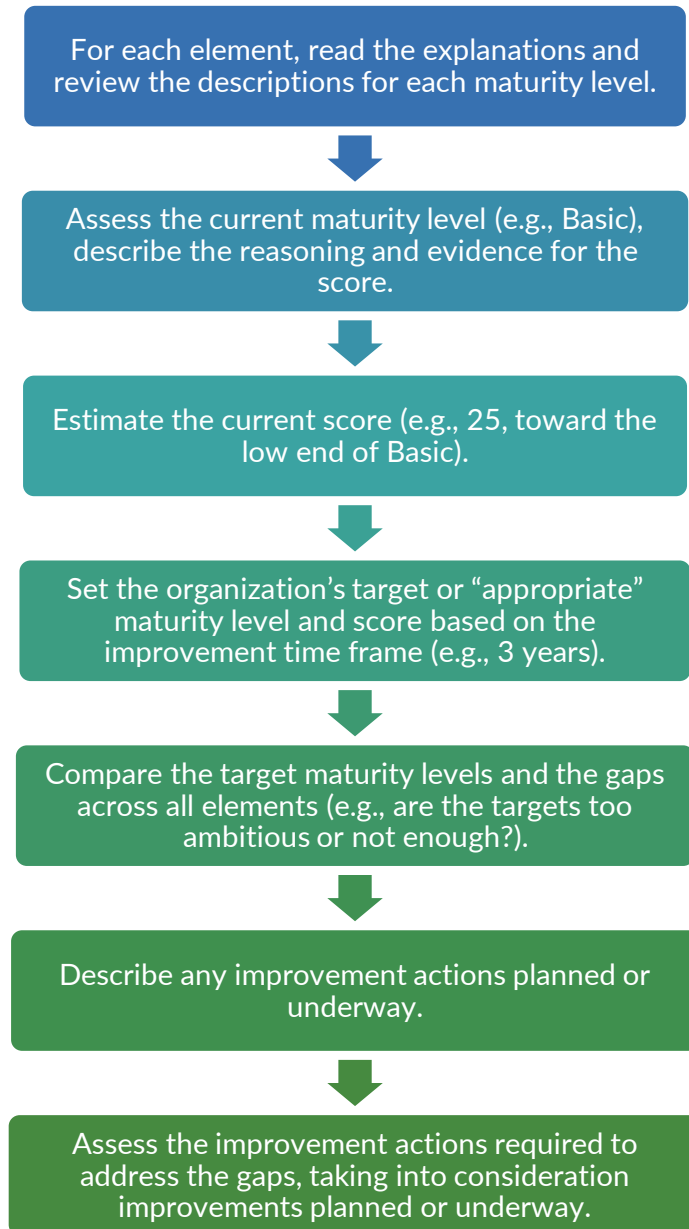


Source: Author

Key point

A simple facilitated step-by-step self-assessment approach is recommended for completing an AMMA. This includes an assessment of the current levels of maturity and the target levels of maturity. This is outlined below.

Figure 2: Process for Completing the Asset Management Maturity Assessment



Source: The author.

There are five maturity levels in this AMMA tool, as shown in Figure 3, including a generic explanation for each of the maturity levels. The subsequent maturity level builds on the preceding level. The AMMA tool has specific descriptions that explain the maturity level against each element of asset management planning, see Table 1 for an example of the specific descriptions under one element. A quantitative score from 0 to 100 is assigned to each of the 16 asset management elements to match the organization's asset management maturity within the band of scores for each maturity level. Both the current score and target score for each IIMM question are recorded in whole numbers, in 5-point increments.

Figure 3: Maturity Levels in the International Infrastructure Management Manual Assessment Tool

Maturity Level	Generic Description
Aware (0–20)	The organization demonstrates an awareness of this element of asset management planning.
Basic (21–40)	The organization has a basic level of understanding of this element, this may include the existence of a repeatable process.
Core (41–60)	The organization has a moderate level of understanding and applying this element, this is likely to include the existence of well-defined and repeatable processes.
Intermediate (61–80)	The organization has an intermediate level of understanding and applying this element. The organization is managing this aspect with well-defined and repeatable processes.
Advanced (81–100)	The organization has an advanced level of understanding and applying this element. The organization has optimized their processes for managing this aspect.

Source: The author (generic descriptions). Āpōpō. 2020. Asset Management Maturity Assessment Tool (xlsx). <https://apopo.co.nz/product/asset-management-maturity-assessment-tool-xlsx/> (accessed 8 August 2023).

The top score for each maturity level (20 for Aware, 40 for Basic, 60 for Core, 80 for Intermediate, and 100 for Advanced) in Figure 3, means that the requirements outlined in the AMMA tool for all levels up to and including that maturity level must have been achieved through processes that are well embedded, regularly reviewed, and regularly applied in the organization. If an asset management process is in place, but only in parts of the organization and/or the process is not always followed, for example, or if a document is in place but has not been updated in the last 3 to 5 years, the score will be marked down to reflect this.

Table 1: Example of One Element Analyzed by the Asset Management Maturity Assessment Tool

Asset Management Element	2.1: Analyzing the Strategic Direction (Asset Management Policy and Objectives)
Current situation for water utility	There is an existing asset management policy in place that was prepared by an external company 10 years ago. Water utility staff are not widely aware of it, and do not use it or refer to it. The staff members who were interviewed only found out about the existing policy after the AMMA interview process.
Current score for water utility	It is 25, toward the lower end of Basic. See the descriptions from the AMMA below.
Reason for scores	The water utility has a strategic plan document that describes the strategic issues influencing the delivery of asset management. The existence of such a document raises the water utility to the low end of Basic, but no further. The water utility is not achieving the Core maturity level because there is almost no awareness among the staff of its existing asset management policy. Moreover, the policy was written 10 years ago, and so is unlikely to reflect the current asset management system or the current leadership expectations of the system.
Aware (0–20)	The organization demonstrates an awareness of its external and internal strategic environment (evident in responses to interview questions).
Basic (21–40)	A high-level, informal strategic analysis has been carried out to determine major trends (strategic issues) influencing the delivery of asset management, and the results have been documented. Strategic organizational planning may be in place but not integrated with asset management.

Core (41–60)	<p>Governance and leadership expectations of the asset management system are expressed through an approved asset management policy and asset management objectives.</p> <p>The asset management policy and objectives cover all aspects of the asset life cycle. The asset management policy and objectives are being actively applied.</p> <p>The asset management objectives are aligned with organizational objectives.</p>
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AMMA = Asset Management Maturity Assessment.

Sources: Āpōpō. 2020. Asset Management Maturity Assessment Tool (xlsx). <https://apopo.co.nz/product/asset-management-maturity-assessment-tool-xlsx/> (accessed 8 August 2023); the author; Institute of Public Works Engineering Australasia (IPWEA). 2020. *International Infrastructure Management Manual*. North Sydney, Australia.

The water utilities of Pacific island countries (PICs) often supply networks that vary widely in size, from the larger urban networks in the capital cities to small community networks that may be in remote locations, including outer atolls or islands. This leads to a wide range of asset management practices across these networks, which may be operated by different staff members who have extensive local knowledge that is not formally recorded or captured in an asset register or database.

The first AMMA for water supply utilities that cover multiple networks may only reflect the asset management practices and processes in the organization’s larger urban networks, as the AMMA interviews are generally conducted in the capital cities. It would be useful for these organizations to take a graduated approach and prepare separate AMMA that capture the smaller community networks, with targeted recommendations for improvement actions. Organizations that provide both water supply and sanitation services would also find it useful to conduct separate AMMA to cover water supply and sanitation.

Deciding on the appropriate target asset management maturity level is a key strategic decision for the organization, as the target maturity level will determine the level of investment required to improve asset management practices and policies. The water utility staff involved in asset management should collectively discuss the asset management maturity level and agree on an appropriate target, but an appropriate representative from the executive leadership team (e.g., the chief executive officer or managing director) needs to review and confirm the asset management maturity level for each element.

Factors that should be considered in selecting the appropriate asset-maturity target will include the importance of the assets, as well as the risks associated with service failure, the costs, and benefits of improving asset management practices, the legal and regulatory requirements, and customer and stakeholder expectations. Expectations for the organization’s target maturity may already exist and may be expressed in the organization’s strategic documents.

Water utilities that have enough qualified staff members to implement asset management improvement actions typically select a target maturity level that is at least the minimum of the Core range. Smaller water utilities that have a current asset management maturity level below Basic, combined with a low capacity and insufficient staff resources, are more likely to select the lower target maturity level of Basic for at least some of the asset management elements.

It is expected that the appropriate asset management maturity will change over time, as technology and practices evolve; therefore, targets should be reviewed during each maturity assessment.

2.3 Pillar 1: Understanding Requirements

The first pillar of asset management is about understanding and defining what services the water supply infrastructure assets should deliver. This is covered in section 2 of the IIMM, which helps water supply infrastructure managers answer the following questions:

- (i) What are the required levels of service and performance delivery to meet for meeting customer and stakeholder requirements?

- (ii) How will demand for these services and performance change over time?
- (iii) What is the current state of my assets?
- (iv) Are they capable of meeting these demands now and in the future?

Table 2 shows the AMMA questions under the five elements in the “Understanding Requirements” pillar, along with the asset management risks for an organization if it does not achieve the appropriate level of asset management maturity.

Table 2: Understanding Requirements—Questions and Risks

IIMM Section No.	Asset-Management Element	Questions	Risks When the Appropriate Level of Maturity Is Not Reached
2.1	Analyzing the strategic direction (asset management policy and objectives)	<p>How well does your water utility</p> <ul style="list-style-type: none"> · analyze its strategic environment to understand the potential asset? · articulate its asset management implications and risks? · articulate its asset management policy and objectives in alignment with the organization's strategic direction? 	There is no clear leadership or understanding of asset management expectations, and organizational roles are unclear, thereby limiting asset management progress and the realization of asset management benefits.
2.2	Levels of service framework	<p>How well does your water utility</p> <ul style="list-style-type: none"> · determine the appropriate levels of service for its customers? · ensure that asset performance measures are appropriate and aligned with those service levels? · incorporate levels of service criteria into decision-making? 	There is an: <ul style="list-style-type: none"> · increased risk of customer dissatisfaction with the services provided, · increased risk of failing to meet the defined level of service and performance expectations, and · a risk of delivering more than is required at an unnecessary cost to customers.
2.3	Demand forecasting and management	<p>How well does your water utility</p> <ul style="list-style-type: none"> · forecast the demand for its services? · assess the possible impact on its asset portfolios? · evaluate demand management options as part of its network and/or project analysis? 	The water utility does not adequately predict and plan for changes in demand, possibly resulting in service shortages, demand constraints, unexpected funding requirements, and reduced levels of service.
2.4	Asset condition and performance	<p>How well does the water utility</p> <ul style="list-style-type: none"> · measure and report on the condition and performance of its assets? · monitor the physical health of its network over time, to inform risk and investment decisions? 	Data are not available to support asset management planning, resulting in: <ul style="list-style-type: none"> · reactive and non-optimal asset treatment approaches, · a higher risk of unexpected asset failures, and · inefficient work practices (i.e., the data are hard to access).
2.5	The Strategic Asset Management Plan	<p>How well does your water utility develop, communicate, resource, and implement its strategic asset management plan?</p> <p>How effectively does the SAMP define the asset management system and link organizational and asset management objectives?</p>	<p>There is no clear framework or understanding of the asset management system, limiting asset management progress and the realization of asset management benefits.</p> <p>The organization does not adequately predict and plan for long-term strategic changes, possibly resulting in unexpected funding requirements, reduced levels of service, and increased asset failures.</p>

IIMM = *International Infrastructure Management Manual*, SAMP = strategic asset management plan.

Note: The numbering of the elements in this table reflect the numeration system in the IIMM. This guide focuses on three of the pillars discussed in the IIMM; “Understanding Requirements” is the second pillar listed in the manual.

Sources: Āpōpō. 2020. Asset Management Maturity Assessment Tool (xlsx). <https://apopo.co.nz/product/asset-management-maturity-assessment-tool-xlsx/> (accessed 8 August 2023); Institute of Public Works Engineering Australasia (IPWEA). 2020. *International Infrastructure Management Manual*. North Sydney, Australia.

Key point

There are five elements to an assessment under Pillar 1: Understanding Requirements. Several case studies from the participating water utilities are provided in Appendix 2 and hyperlinked in Table 2 to the relevant element of the framework. Two elements that are particularly important for water suppliers are explored in more detail below: Levels of Service; and Non-Revenue Water Reduction.

Levels of Service

In simple terms, the water supply levels of service (LOS) are the reasons that the water supply assets exist. Levels of service define the outcomes that customers can expect from asset-based activities, and are measured through achievement of defined performance measures and targets. The LOS framework provides a tangible link between higher-level objectives and more detailed operational decisions. The top level of the LOS framework is the “service parameters”, the service outcomes for customers. Examples of water supply service parameters include: safety, quality, accessibility, capacity, affordability, reliability, quantity, efficiency, responsiveness, sustainability, and resilience. The next level of the LOS framework covers the LOS objectives, these are described from the customer point of view and should be written in language that customers can understand. Under each LOS objective, a performance measure is defined to monitor whether the objective is being achieved. The final level of the LOS framework is the performance target for each measure.

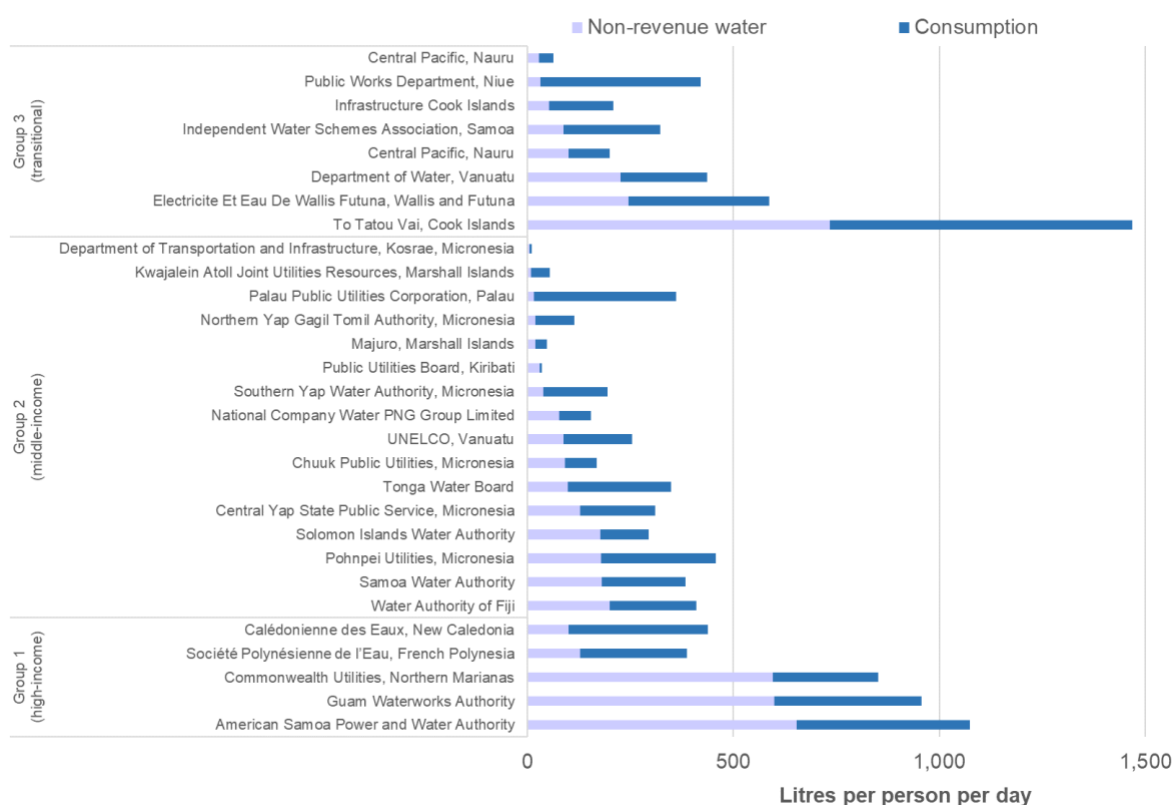
Non-Revenue Water Reduction

The AMMA is agnostic regarding the infrastructure sector, but it should be noted that water supply asset management planning requires a significant emphasis on asset management element 2.3, “Demand Forecasting and Management.” This element covers non-revenue water (NRW) management, other demand-management strategies, demand forecasting, and the assessment of the supply–demand balance forecast. Both demand management and demand forecasting are significant activities and a fundamental part of water-resource management planning.

NRW management, especially the reduction of physical losses, is a significant issue for water networks around the world and particularly in the PICs. High levels of leakage and NRW are strongly linked across several asset management elements. Asset management planning is also identified as one of the four primary factors influencing the level of leakage. Aging water networks often have high levels of leakage that can sometimes only be reduced through significant pipe renewal programs. High levels of NRW undermine the financial sustainability of water supply utilities and threaten the provision of safe drinking water for both current and future customers.

Figure 5 shows the breakdown of the 2022 average water supplied into NRW and consumption in liters per person per day, for the 30 water utilities participating in the most recent PWWA benchmarking study, *PWWA Benchmarking Report: Post-COVID Recovery and New Frontiers* (PWWA 2023). The results are shown in order of increasing NRW volume per person per day within each group of water utilities. The groups are defined by the level of economic development in the host countries or territories. It is clear from the benchmarking comparison that NRW is a significant issue for almost all water utilities in the PICs.

Figure 4: Breakdown of Water Supplied into Non-Revenue Water and Consumption, 2022
(Liters Per Person Per Day)



Note: The groups are based on the level of economic development of the host country or territory. The data labels show the NRW as a percentage of water supplied.

Source: Pacific Water and Wastewater Association (PWWA). 2023. *PWWA Benchmarking Report: Post-COVID Recovery and New Frontiers*. Apia, Samoa.

Reducing high NRW volumes requires significant and sustained effort across many of the functions of the water utilities. More guidance is available online, including Water New Zealand's 2023 publications *Water Loss Guidelines: Overview* (second edition) and *Water Loss Guidelines: Detailed Technical Guide* (second edition).⁴ There are also tools available for finding out the water loss maturity of a utility, for example the World Bank's NRW Practices Rating Tool.⁵ Free resources on NRW management are available at the Global Non Revenue Water website.⁶

⁴ The Water New Zealand water loss guideline resources are available from this web page: Water New Zealand. 2023. *Waterloss Guidelines*. https://www.waternz.org.nz/Article?Action=View&Article_id=2542.

⁵ The World Bank, Public-Private Partnership Legal Resource Center. 2018. *NRW Practices Rating Tool*. <https://ppp.worldbank.org/public-private-partnership/library/nrw-practices-rating-tool> (accessed 31 October 2023).

⁶ Global NRW. <https://globalnrw.com/>.

Avatiu Public Water Supply System



Source: Author

Samoa Water Authority participants certificate award ceremony, Samoa



Source: Author

2.4 Pillar 2: Lifecycle Management

The second pillar of asset management, covered in section 3 of the IIMM, is selecting the most effective lifecycle management strategies for fulfilling the requirements defined under the first pillar. Through this pillar, water supply infrastructure managers answer the following questions:

- (i) What are my best strategies for operating, maintaining, replacing, and improving the assets?
- (ii) How much will the cost of service provision amount to over the long term?
- (iii) What is my best long-term funding strategy?

This pillar covers the management of assets over their life cycles, including the financial planning for their operation, maintenance, and renewal. Maintenance planning is well recognized as an asset management activity that needs attention in the PIC water sectors. Infrastructure maintenance practices in the region were highlighted in a PRIF 2022 report that provided a baseline assessment of infrastructure maintenance benchmarking. This report can be referred to for guidance on the requirements for good maintenance management (PRIF 2022c).

The importance of maintaining water infrastructure in good condition is well known, yet many PIC water utilities spend more time on reactive maintenance, fixing assets in poor condition, instead of proactive maintenance.

The easiest way to defer or postpone capital replacement expenditure is to improve the maintenance of existing assets. When a water utility moves from a reactive to a proactive approach to maintaining water supply infrastructure, this will extend the life of the asset, improve the water-supply service reliability and performance, and reduce costs.

When a utility has detailed knowledge of its assets and tracks its maintenance information—including costs—separately from operations information, it will be able to make decisions about optimizing maintenance and the timing of asset renewal or decommissioning. Most Pacific water utility budgets combine operations and maintenance costs and there is limited tracking of maintenance costs against asset types or specific assets. Digital tools and systems for tracking costs separately are typically only used by larger communities, however, there are scalable tools and techniques available that are suitable for use in smaller communities. It can be a challenge in the Pacific for water utility field staff responsible for asset operations and maintenance to adopt digital tools, but it is critical for a water utility to better track maintenance so that they can improve asset life, service delivery and the lowest life-cycle cost.

Key point

Good lifecycle management of assets will extend the useful life of assets, improve service level and save money in the long-term. Pillar 2: Lifecycle Management includes key elements of good practice lifecycle asset management.

Table 3 shows the AMMA questions under the five elements in the Lifecycle Management pillar, along with the asset management risks for a utility if it does not achieve the appropriate maturity.

Table 3: Lifecycle Management Maturity—Questions and Risks

IIMM Section No.	Asset-Management Element	Questions	Risks When the Appropriate Level of Maturity Is Not Reached
3.2	Managing risk and resilience	How well is risk-management and resilience planning integrated into your asset management decision-making?	There is a greater likelihood that asset management objectives will not be achieved because of multiple failures, including critical asset failures. Also, investments may be suboptimal (e.g., too much or too little focus on noncritical assets).
3.3	Operational planning	How well does your water utility plan and manage its operations and maintenance	Investments may be suboptimal due to such causes as too much or too little focus on non-critical assets, a reliance on reactive maintenance, or a new

IIMM Section No.	Asset-Management Element	Questions	Risks When the Appropriate Level of Maturity Is Not Reached
		activity to keep assets in service and meet asset management objectives?	transformational investment implemented at the expense of maintaining existing assets.
3.4	Capital works planning	How well does the water utility plan and prioritize capital expenditure, including renewal programs?	Planned capital projects will not meet renewal, levels of service, or growth needs for the activity.
3.5	Asset financial planning and management	How well does your water utility <ul style="list-style-type: none"> · plan for asset-related expenditure and funding? · revalue its assets and consider depreciation in its funding strategy? · consider the whole-of-life cost of asset investments? 	The water utility retains a short-term view of financial requirements with the risk of a deferred backlog and reduced levels of service. The risk that future customers are faced with meeting generational funding shortfalls. Lack of understanding of loss of service potential (depreciation) leads to underfunding of renewals.
3.6	Asset management plan (for the asset portfolio and assets)	How well does your water utility develop, communicate, resource, and implement its asset management plans?	There is a lack of documented evidence to support long-term financial forecasts. Therefore, <ul style="list-style-type: none"> · required funding will not be provided, and · asset management needs will not be adequately communicated and addressed.

IIMM = *International Infrastructure Management Manual*.

Note: The numbering of the elements in this table reflect the numeration system in the IIMM. This guide focuses on three of the pillars discussed in the IIMM; “Life cycle Management” is the third pillar listed in the manual.

Sources: Āpōpō. 2020. Asset Management Maturity Assessment Tool (xlsx). <https://apopo.co.nz/product/asset-management-maturity-assessment-tool-xlsx/> (accessed 8 August 2023); Institute of Public Works Engineering Australasia (IPWEA). 2020. *International Infrastructure Management Manual*. North Sydney, Australia.

Key point

There are six elements to an assessment under Pillar 2: Lifecycle Management. The element that is particularly important for water suppliers is Operational Planning including maintenance planning. The importance of maintenance planning is explored in more detail below:

The Importance of Maintenance

Asset maintenance is widely known to ensure that capital-intensive infrastructure remains in good condition and lasts for its expected service life. It is also cheaper to fund and do routine and preventative maintenance than to allow infrastructure to deteriorate to a point where an asset is in poor condition and a rebuild may be the only option. Yet many water utilities in the PICs spend most of their repair-related time and funding on reactive maintenance. The maintenance management practices of four of the five water utilities participating in the pilot project were rated as Aware or Basic under the AMMA, as their maintenance was largely based on historical practices, with little emphasis on planned maintenance. Only one water utility operated under a planned maintenance schedule and fulfilled the requirements for the Core classification under Section 3.3, Operational Planning (which requires an understanding of the trends in planned and unplanned maintenance and renewal activities, including the trade-offs involved in determining optimal maintenance and renewal frequencies).

References and Further Reading on Maintenance

The PRIF's benchmarking report here defines the categories of maintenance, identifies core competency areas for maintenance that are aligned with the IIMM framework, and defines good requirements for maintenance management:

PRIF. 2021b. *Pacific Infrastructure Maintenance Benchmarking Report: 2021 Baseline Assessment*. Sydney: PRIF. <https://www.theprif.org/document/regional/infrastructure-maintenance/benchmarking-infrastructure-maintenance-pacific-island>.

The Canadian organization Asset Management BC, which is governed by a partnership of several agencies of the British Columbia provincial government, published a primer on how to improve a utility's operation-and-maintenance practices:

Asset Management BC. 2019b. *The Role of Operations and Maintenance in Asset Management: A Sustainable Service Delivery Primer*. Victoria, British Columbia, Canada: Asset Management BC. <https://www.assetmanagementbc.ca/wp-content/uploads/The-Role-of-Operations-Maintenance-in-Asset-management.pdf>.

2.5 Pillar 3: Asset Management Enablers

The third pillar of asset management, "Asset Management Enablers," covered in IIMM section 4, provides guidance on the "enablers" that support the infrastructure planning and decision-making processes described in the previous two pillars. This pillar includes the structures, capabilities, plans, systems, tools, and external resources the organization needs for effective asset management. It also details an approach for ensuring that asset management practices are continuously improved.

Key point

Asset management enablers are the elements of asset management that underpin the management process such as the commitment of leadership to asset management, information and asset management systems and processes used to manage assets.

Table 4 shows the AMMA questions under the six elements in the Asset Management Enablers pillar, along with the asset management risks for an organization if it does not achieve the appropriate maturity.

Table 4: Asset Management Enablers Maturity—Questions and Risks

IIMM Section No.	Asset-Management Element	Questions	Risks When the Appropriate Level of Maturity Is Not Reached
4.1	Asset management people and leaders	<p>What is the level of the water utility's commitment to asset management?</p> <p>How is this reflected in the water utility's organizational structure, responsibilities, and resourcing of asset management responsibilities?</p>	<p>The water utility leadership will lack the authority, capability, and capacity to improve the asset management system, and the benefits of good asset management (described in section 2.1) will not be realized.</p> <p>Staff are dissatisfied due to the lack of role clarity, purpose, and leadership support.</p> <p>Governance does not adequately monitor asset risks, costs, or performance. The utility lacks adequate capability, capacity, and</p>

IIMM Section No.	Asset-Management Element	Questions	Risks When the Appropriate Level of Maturity Is Not Reached
			direction regarding asset management implementation.
4.2	Asset data and information	<p>How well does your water utility define its asset-data requirements?</p> <p>What asset-related information does the water utility collect?</p> <p>How does the water utility ensure that it has information of the requisite quality (accuracy, consistency, reliability)?</p>	<p>Data are not available to support asset management planning, resulting in:</p> <ul style="list-style-type: none"> · reactive and nonoptimal approaches to asset treatment, · a higher risk of unexpected asset failures, and · inefficient work practices.
4.3	Asset management information systems	How well does the utility ensure that appropriate information systems are in place and fit for purpose, considering the complexity of the assets and the level of asset management maturity required? ^a	The water utility is unable to support the appropriate level of asset management analysis, leading to nonoptimal decisions and inefficient work practices.
4.4	Asset management process management	<p>How well does your water utility</p> <ul style="list-style-type: none"> · define and implement appropriate asset management process documentation? · review and improve asset management processes? · align asset management processes with those in other management systems? 	<p>There is a greater risk that processes will not be followed, leading to</p> <ul style="list-style-type: none"> · nonoptimal decisions, · a higher probability of asset or operational failures, and · inefficient work practices.
4.5	Outsourcing and procurement	<p>How well does your water utility</p> <ul style="list-style-type: none"> · procure assets and asset-related services such as maintenance and consumables for different classes of assets? · exercise control over outsourced asset-management services? 	<p>The risks will include</p> <ul style="list-style-type: none"> · higher contracting costs; · no understanding of the balance of risk, resulting in higher unintended cost coverage; · poor contractor performance; and · performance that is not aligned with asset management objectives.
4.6	Continual improvement	How well does your water utility ensure that it continues to develop its asset-management capability towards an appropriate level of maturity?	<p>The required changes will not be implemented, and none of the asset management benefits will be realized.</p> <p>The water utility will be unable to demonstrate the benefits of asset management improvements to governance and leaders.</p> <p>The water utility will not learn and adapt to changing circumstances.</p>

IIMM = *International Infrastructure Management Manual*.

Note: The numbering of the elements in this table reflect the numeration system in the IIMM. This guide focuses on three of the pillars discussed in the IIMM; “Asset Management Enablers” is the fourth pillar listed in the manual.

^a Before your company considers investing in software to support an asset management information system, there are questions that the water utility should ask themselves and questions that the water utility should ask suppliers of asset management software. See: Federation of Canadian Municipalities. Guide: Questions to Ask before Your Municipality Considers Asset Management Software <https://fcm.ca/en/resources/mamp/guide-questions-ask-your-municipality-considers-asset-management-software>.

Sources: Āpōpō. 2020. Asset Management Maturity Assessment Tool (xlsx). <https://apopo.co.nz/product/asset-management-maturity-assessment-tool-xlsx/> (accessed 8 August 2023); Institute of Public Works Engineering Australasia (IPWEA). 2020. *International Infrastructure Management Manual*. North Sydney, Australia.

Key point

There are six elements to an assessment under Pillar 3: Asset Management Enablers. A case study on asset data from a participating water utility is provided in Appendix 2 and hyperlinked in Table 2 under the relevant element of the framework.



Cook Islands Water Infrastructure



Source: Author

2.6 Maturity Assessment Results

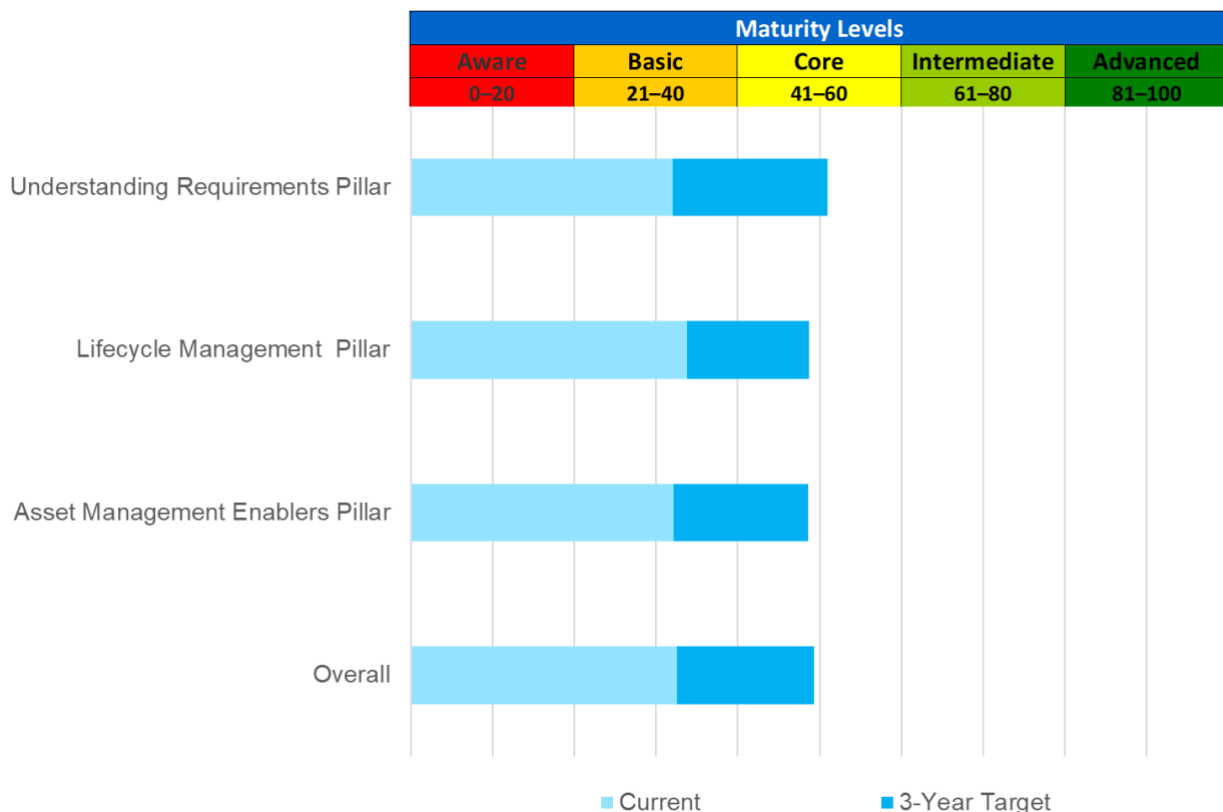
The maturity assessment results are presented in the AMMA tool for each of the 16 asset management elements, with the mean score for each of the three asset management pillars and an overall score. There are two chart types: bar charts and the radar chart. The AMMA bar charts have been modified for this guide to include all five maturity levels, in order to improve the interpretation of the results.

Figure shows the current and target average scores for a fictional water utility, “Water Authority X,” under each of the three pillars of asset management, as well as the overall score. The light blue bars represent the current maturity levels, while the dark blue bars show the maturity gap between the current score and the three-year target score.

Key insights from Figure 9 include the following:

- Overall, Water Authority X is currently just above the middle of the Basic range, and has a target of the middle of the Core range.
- Water Authority X is aiming to increase its asset management maturity by approximately one level across each of the three pillars of asset management.
- Core is the target maturity level for each pillar.
- The largest targeted improvement would be in the first pillar, Understanding Requirements, for which Water Authority X is aiming to reach just above the middle of Core within 3 years.

Figure 5: Sample Result of an Asset Management Maturity Assessment

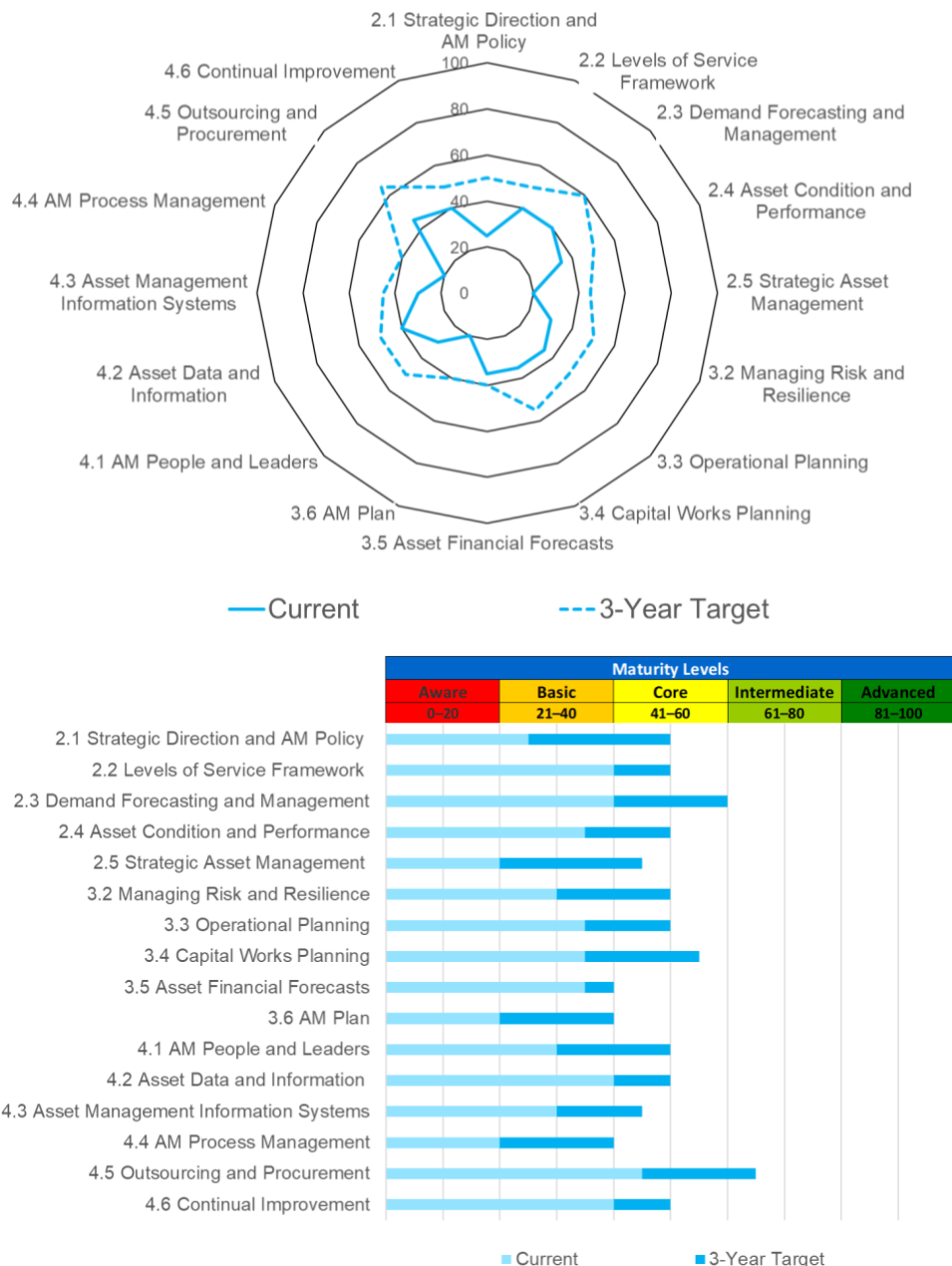


Note: The y-axis labels show three asset management pillars defined in the *International Infrastructure Management Manual*, and the maturity levels are those defined in the Asset Management Maturity Assessment Tool.

Sources: Āpōpō. 2020. Asset Management Maturity Assessment Tool (xlsx). <https://apopo.co.nz/product/asset-management-maturity-assessment-tool-xlsx/> (accessed 8 August 2023); the author; Institute of Public Works Engineering Australasia (IPWEA). 2020. *International Infrastructure Management Manual*. North Sydney, Australia.

Figure 6 shows the current scores for Water Authority X under each of the sixteen elements of the IIMM framework in both radar and bar chart formats. The graphs show that Water Authority X's current maturity levels are lowest for 2.5 Strategic Asset Management, 3.6 Asset Management Plan, and 4.4 Asset Management Process Management. These asset management elements are activities that are focused on documentation: documenting the asset management system; documenting the processes for asset management; and pulling all the information from the other asset management elements, and documenting it in the asset management plan. Water Authority X's current maturity levels are highest for 4.5 Outsourcing and Procurement, followed by 2.3 Demand Forecasting and Management and by 4.2 Asset Data and Information.

Figure 6: Radar and Bar Graphs Sample Result of Asset Management Maturity, by Element



AM = asset management.

Note: The y-axis labels refer to the numbers and names of the elements as defined in the *International Infrastructure Management Manual*.

Sources: Āpōpō. 2020. Asset Management Maturity Assessment Tool (xlsx). <https://apopo.co.nz/product/asset-management-maturity-assessment-tool-xlsx/> (accessed 8 August 2023); the author; Institute of Public Works Engineering Australasia (IPWEA). 2020. *International Infrastructure Management Manual*. North Sydney, Australia.

Key point

After working through the assessment of the three pillars in the AMMA tool (outlined in Section 2.2 to 2.5 of this guide), the AMMA tool automatically summarizes results for each of the 16 asset management elements, with the mean score for each of the three asset management pillars and an overall score. This includes the current assessment of maturity and the target level of maturity.

This provides a basis for identifying the gaps between the current maturity assessment and the target maturity, and assists in identifying what actions may be necessary to include in the Asset Management Improvement Plan.

An example of a maturity assessment and gap analysis is shown in Table 5, which shows results for two asset management elements under the pillar of Understanding Requirements.



Table 5: Example of a Maturity Assessment and Gap Analysis for Two Elements under the Understanding Requirements Pillar

IIMM Section No.	Asset management Element	Current Maturity and Description from IIMM	Reason for Current Score	Target Maturity and Description from IIMM	Gap between Current and Target Maturity Levels
2.1	Analyzing the strategic direction (asset management policy and objectives).	<p>Basic (Lower), score of 25 out of 40.</p> <p>The utility in question, Water Authority X, carried out a high-level, informal strategic analysis to determine major trends (strategic issues) influencing its delivery of asset management, and the results were documented.</p> <p>Strategic organizational planning may be in place, but it is not integrated with asset management.</p>	<p>Water Authority X does not have an asset management policy, though it does have a strategic plan document that describes the issues that are influencing the delivery of asset management. This brings the water utility to the low end of Basic.</p> <p>An asset management policy for the utility was written 10 years ago by an external company. It is unlikely to reflect the current asset management system or the current leadership's expectations of the asset management system.</p>	<p>Core (Middle)</p> <p>Governance and leadership expectations of the asset management system are expressed through an approved asset management policy and objectives.</p> <p>The organization has an asset management policy with objectives that cover all aspects of the asset life cycle. The asset management policy and objectives are being actively applied by the organization.</p> <p>The asset management objectives are aligned with organizational objectives.</p>	<p>Water Authority X needs to develop a new asset management policy, including asset management objectives that cover all aspects of the asset life cycle.</p> <p>To achieve the highest maturity score under Core, the utility will need to provide evidence at the next maturity assessment that it is actively applying its asset management policy and objectives.</p>
2.2	Levels of service framework	<p>Basic (Highest), score of 40 out of 40.</p> <p>The utility's customer groups are defined, and their requirements informally understood.</p> <p>Some key performance measures have been defined.</p>	<p>Water Authority X has an informal understanding of its customer groups through staff knowledge. It has also defined key performance measures for water supplies, including the target of achieving the WHO drinking water standards by 2024 for all urban water supply schemes.</p>	<p>Core (Middle)</p> <p>The customer groups' needs and expectations are analyzed and documented by the organization.</p> <p>The organization's levels of service statements cover a range of service attributes, and are:</p> <ul style="list-style-type: none"> aligned with the organizational service planning and performance management processes, periodically measured and reviewed, and 	<p>To reach a middling Core score, Water Authority X needs to accomplish everything described under Core—apart from the more advanced step of understanding the relationship between the levels of service and costs.</p> <p>Documenting the relationship between the levels of service and costs in the AMP will also</p>

IIMM Section No.	Asset management Element	Current Maturity and Description from IIMM	Reason for Current Score	Target Maturity and Description from IIMM	Gap between Current and Target Maturity Levels
				<ul style="list-style-type: none"> aligned and integrated with performance measures. <p>The relationship between the levels of service and the cost to achieve the target performance is understood and described in the AMP.</p>	require the development of an AMP.

AMP = asset management plan, IIMM = *International Infrastructure Management Manual*, WHO = World Health Organization.

Notes:

1. The "gap analysis" looks at the gap between the current and target levels of asset management maturity as defined in the Asset Management Maturity Assessment Tool.
2. "Water Authority X" is the name of a fictional water utility that serves as a model for this maturity assessment and gap analysis.

Sources: Āpōpō. 2020. Asset Management Maturity Assessment Tool (xlsx). <https://apopo.co.nz/product/asset-management-maturity-assessment-tool-xlsx/> (accessed 8 August 2023); the author; Institute of Public Works Engineering Australasia (IPWEA). 2020. *International Infrastructure Management Manual*. North Sydney, Australia.

3 Developing an Asset Management Improvement Plan

3.1 Collate a Long List of Improvement Actions

A long list of improvement actions can be identified based on the analysis shown in Table 5 of the “gap” between the current and the target levels of asset management maturity, as identified through an asset management maturity assessment (AMMA). The starting point for addressing the gap is the difference between the descriptions of the current and target levels of asset management maturity for each element included in the AMMA tool. See Appendix A for an annotated example using one asset management element.

An example with two elements defined by the AMMA tool is shown in Table 6.

Table 6: Example of an Identification of Improvement Actions Based on a Gap Analysis

IIMM Section No.	Asset Management Element	Gap between Current and Target Maturity Levels	Improvement Action
2.1	Analyzing the strategic direction (asset management policy and objectives)	There is a need to develop a new asset management policy, including asset management objectives that cover all aspects of the asset life cycle. To achieve the highest maturity score under Core, the water utility in question will need to provide evidence at the next maturity assessment that it is actively applying its asset management policy and objectives.	<u>Develop an asset management policy</u> , including asset management objectives that cover all aspects of the asset life cycle.
2.2	Levels of service framework	Everything described under Core must be accomplished, apart from the more advanced step of understanding the relationship between the levels of service and costs, and aligning this with performance measures. Documenting the relationship between the levels of service and costs in the AMP will require the development of an AMP.	<u>Develop a Levels of Service Framework</u> Step 1: Document the water utility’s analysis of each customer group’s needs and expectations. For example, “Our residential and commercial customers need safe drinking water that meets the country’s drinking water standards 100% of the time.” Step 2: Develop customer-level service statements that cover the priority service attributes and are aligned with the organizational service-planning and performance-management processes. The priority service attributes could include accessibility, affordability, efficiency, quality, quantity, reliability, responsiveness, sustainability, resilience, and safety. Step 3: Develop SMART performance measures for each customer level of service. Step 4: Set up processes to periodically measure performance.

AMP = asset management plan, SMART= Specific, Measurable, Achievable, Relevant, and Time-Bound.

Source: The authors.

Key point

After completing the asset management maturity assessment, a long list of potential improvement actions will be identified from analysis of the “gap” between the current and the target levels of asset management maturity.

3.2 Prioritize the Improvement Actions

As stated earlier, it is unwise for a water utility to try to implement all identified improvements at once. The first asset management improvement plan should be developed from a short list of priority improvement actions. The ideal number of actions in the short list will vary from water utility to water utility, depending on factors such as the water utility’s staffing levels dedicated to asset management and the level of available funding for external consultant support. It is better to select a small number of improvement actions and complete them well than to select many improvement actions and fail to complete any.

There are three methods recommended for prioritizing the improvement actions for Pacific island country (PIC) water utilities that are implementing their first asset management improvement plan. A combination of these methods can also be used.

The recommended method for less advanced organizations (with an overall asset management maturity of Aware or Basic) is the “logical order of priority.” For example, asset information needs to be captured in a robust asset register before analytical tools can be applied to conduct renewal forecasting. The logical order of priority is illustrated in Figure 11. This diagram shows that the first step is to “Assess,” starting with the organization’s asset management practices (e.g., using the AMMA tool) and then assessing the current state of the assets, before moving on to the steps under “Plan,” which include developing an asset management policy that describes the utility’s approach to asset management, among other things. This approach will prioritize the strengthening of the asset register, which is the foundation for understanding the assets. Developing the levels of service framework element and assessing the current and future demands for the assets and services are also included in this “Assess” stage.

Figure 7: Logical Order Based on the Asset Management British Columbia Framework



Source: Asset Management British Columbia. 2019a. *Asset Management for Sustainable Service Delivery: A BC Framework*. Victoria, British Columbia, Canada. https://www.assetmanagementbc.ca/wp-content/uploads/Asset_management-for-Sustainable-Service-Delivery-A-BC-Framework-.pdf.

The two more advanced methods are for water utilities which have already completed a robust assessment of their asset management practices and the current state of their assets. The recommended method for water utilities that have an overall asset management maturity of at least the middle of Basic is an intuitive assessment of the impact and difficulty (or effort) of each improvement action.

In this approach, the impact of the improvement is assigned a score between 0 (very low impact) and 10 (very high impact); and the difficulty of the improvement (which could include the cost, duration, and ability to be completed inhouse) is assigned a score between 0 (very low difficulty) and 10 (very high difficulty). The results are then graphed on a prioritization matrix, as illustrated in Figure 12, with the x-axis and y-axis scales running from 0 to 10. The accuracy of this score is not as important as the relative scores from one improvement action to another. The scores can be compared across the improvement actions to check if they are realistic and comparable. As evident in the example shown in Figure 12, the improvement actions with a difficulty score lower than 5 and an impact score higher than 5 will fall into the “Yes” quadrant and proceed to the short list.

One of the improvement actions sitting in the “Yes” quadrant is to develop an asset management policy. The importance of an asset management policy is highlighted in the case study involving the Samoa Water Authority, presented in Appendix 2.

Figure 8: Example of an Improvement-Action Prioritization Matrix



AM = asset management, AMP = asset management plan, LOS = levels of service.

Note: The numbering of the improvement actions is based on the numbering in the *International Infrastructure Management Manual*.

Sources: The author; Institute of Public Works Engineering Australasia (IPWEA). 2020. *International Infrastructure Management Manual*. North Sydney, Australia.

The recommended method for water utilities that have an overall asset management maturity level of at least Basic, and have the organizational capacity, is a multi-criteria analysis (MCA) prioritization

framework. The MCA involves prioritizing a long list of options by evaluating their positive and negative impacts. It is similar to the approach taken for the impact and difficulty prioritization matrix but involves multiple criteria. The selected criteria are typically categorized under themes. The themes that are typically used for infrastructure projects are economic, social, and environmental. The organization should select criteria relevant to them and categorize these criteria into themes (for example the three pillars of the asset management framework could be adopted as themes). Each criterion is scored against each improvement action, and the scores under each theme are typically weighted to calculate a total score. The long list of improvement actions can then be ranked in order of descending score to identify the priority actions.

Key point

Improvement actions will need to be prioritized as utilities will rarely have the capacity and resources to implement all possible improvement actions in the short term. There are different approaches that can be used to prioritize improvement actions. The use of approach should reflect the capacity and maturity of the utility.

3.3 Develop a Tactical Improvement Plan for the Priority Improvement Actions

A tactical improvement plan is a task-level plan in which each asset management improvement action is treated as a task or project. The key elements of a tactical level plan for an improvement action include the following:

- the current status, including background information on this improvement action;
- a description of why this improvement action is important;
- the scope description for the work involved in implementing the action;
- the risks incurred if this improvement action is not completed;
- predecessors (the improvement actions that need to be completed prior to the start of this action).
- dependencies (the improvement actions that can start only after the completion of this action).
- identification of the internal staff resources and project team;
- estimated time commitments for the internal staff to complete this work (person-months);
- expected time frame and duration to complete the action;
- the start and finish dates;
- a description of the external resource requirements;
- a description of project risks that could delay the completion of the project or increase the estimated project cost (e.g., water utility staff turnover);
- estimates of the external costs, including expenses (e.g., asset management information system software) and external consultant fees;
- estimate quality grade for the cost estimates (Table 3: Lifecycle Management Maturity—Questions and Risks);
- determination of whether the external costs have been funded or not by existing or planned projects;
- percentage of the cost estimate that is funded;
- funding sources; and
- commentary on cost assumptions, potential donors, and linked donor projects. (All assumptions regarding the cost estimates should be documented, including any project costs that have not been included.)

The tactical plan will also include summary information on the individual improvement actions, such as that concerning the schedule, estimated costs, and internal staff inputs.

A Microsoft Excel tool has been developed to scope the priority actions for the PIC water utilities' first asset management improvement plan. The goal is to create a tactical improvement plan that is costed and resourced, with indicative timing.

The tool includes a template for a one-page summary for each priority improvement action (Appendix 3), a sheet for developing the cost estimates, a cost summary sheet, and a schedule sheet. The one-page summary template, in Excel, also includes metadata for the most recent update of each improvement action (including the person who made the update, details of the update, and the date).

The one-page summary includes an input field for the user to enter the IIMM section heading number for the asset management element relevant to this improvement action.

There are a number of potential data and information sources that could be used by the water utility staff to estimate the cost and duration of each improvement action, for example: an engineer's evaluation regarding the number of person-months required to complete the action, multiplied by the estimated cost per month; case studies from other water utilities; and cost estimates from external consultants. The water utility should adjust the cost estimates to take into account the efficiency of the water utility, and the availability of internal staff to compile input data and complete some of the work.

There are four cost-estimate quality grades, as shown in Table 7. It is expected that the improvement actions identified for the first time as part of the AMMA process will have an estimate quality of "Poor" or "Fair," depending on the scope definition and the confidence in the cost estimate. Improvement actions that are well scoped and aligned with other projects are likely to have a higher estimate quality. The reliability of the cost estimate is also expected to improve as projects get closer to budget approval.

Table 7: Cost Estimate Quality

Estimate Quality	Description
Excellent	Engineering level. Scope and design parameters known. Budget level estimate built up from unit costs.
Good	Feasibility level. Scope defined.
Fair	Rough order cost. Scope reasonably defined. Estimate based on engineering judgement. No breakdown.
Poor	Order of magnitude. Scope not well defined. Cost indicative only.

Source: Pacific Region Infrastructure Facility. 2022b. *Guideline to Preparing National Infrastructure Investment Plans*. Sydney.

The implementation timeline for the improvement actions should be mapped out using the simplified template in the Excel spreadsheet or a more sophisticated approach, such as project management software. A champion should be identified to monitor the implementation of the improvement plan by regularly checking in with the "owner" of each improvement action (e.g., monthly or quarterly) on that action's progress. Some of the improvement actions will require significant time, and may not have a clear completion date. Therefore, it is helpful to identify milestones to celebrate, for example the development of an asset management policy and its approval by the organization's Board.

Key point

Finally, a Tactical Improvement Plan for the Priority Improvement Actions should be developed. This scopes the implementation of the actions in more detail including the rationale for the action, the resources required, and the costs.

The implementation of improved asset management planning practices in a water utility is a journey of continual improvement. It is recommended that the water utility identifies the expected annual change in asset management maturity for each asset management element and monitors progress through an annual update of the AMMA tool, with a new “current score” for each asset management element.

Department of Water Resources and UNELCO training participants, Vanuatu



Source: Author



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APPENDIX 1: Annotated Extract of An Asset Management Maturity Assessment Tool

Portfolio: Water Supply				Maturity Levels					Columns to be completed					
				Aware	Basic	Core	Intermediate	Advanced	Current Score	Appropriate Target in 3 Years	Reason for Scores (Current and Target)	Evidence Supporting the Current Score	Improvement Actions Planned or Underway	Improvement Actions to Meet the Target
Element	Questions	Evidence	Implications/Risks if Appropriate Maturity Is Not Achieved	0–20	21–40	41–60	61–80	81–100						
Understanding Requirements Pillar														
2.1	Analyzing the Strategic Direction (AM Policy and Objectives). Note that while the AM Objectives are often documented in the SAMP or AMP, these planning documents are separately assessed in 2.5 and 3.6.	How well does your water utility analyze its strategic environment to understand potential AM implications and risks? How well does the water utility articulate its AM policy and AM objectives in alignment with the water utility's strategic direction?	AM policy. AM objectives (which should be documented in the SAMP or AMP). Corporate information such as a strategic plan outlining strategic goals and objectives and "environmental scan" of external trends and influences.	There is no clear leadership or understanding of asset management expectations, and organizational roles are unclear, thereby limiting asset management progress and the realization of asset management benefits.	The water utility demonstrates an awareness of its external and internal strategic environment (evident in responses to interview questions).	A high-level, informal strategic analysis has been carried out to determine major trends (strategic issues) influencing the delivery of AM, and the results documented. Strategic organizational planning may be in place, but not integrated with asset management.	Governance and leadership expectations of the AM system are expressed through an approved and AM policy and AM objectives. The AM policy and objectives cover all aspects of the asset lifecycle. The AM policy and objectives are being actively applied. The AM objectives are aligned with organizational objectives.	As for Core, plus: The AM policy and objectives have been developed with demonstrable consideration of the implications of: · the analysis of the strategic context (internal, external, customer-related), and · the analysis of the asset portfolio to determine fitness for purpose (current and future).	As for Intermediate, plus: Achievements of AM objectives and delivery of the AM policy are regularly monitored and reported. Regular environmental scans are done to identify strategic changes implicating the AM system, and required changes are managed through SAMP and AMP review processes.					
The information in these five boxes describes what is expected for this asset management element at each maturity level.														
2.2	Levels of Service Framework Note that this element defines the levels of service and performance measures. The management and reporting of asset performance data are included in element 2.4.	How well does your water utility: · determine the appropriate levels of service for its customers? · ensure that asset performance measures are appropriate and aligned with those service levels? · incorporate levels of service criteria into decision-making?	The AMP has level of service statements and performance measures, including past results and future targets over the planning period. The AMP or SAMP summarizes customer issues and expectations. Detailed evidence of the inputs into levels of service are provided, such as those generating service-planning outputs and customer-engagement results. There is an AM performance management database containing information on past results and future targets for each measurement of performance. There is a communications plan	Increased risk of customer dissatisfaction with the services provided. Increased risk of failing to meet the defined level of service and performance expectations. Risk of delivering more than is required at unnecessary cost to customers.	The water utility recognizes the benefits of defining the levels of service, but the levels of service are not yet documented or quantified. (This is evident from the responses to interview questions.)	The utility's customer groups are defined, and their requirements are informally understood. Some key performance measures have been defined.	Customer groups' needs and expectations are analyzed and documented. Level of service statements cover a range of service attributes, and are: · aligned with the organizational service planning and performance management processes · periodically measured and reviewed; and · aligned and integrated with performance measures. Level of service and cost relationship is understood and described in the AMP.	As for core, plus: Service level options (with associated risks and costs) have been presented to executive and governance teams to support level of service decisions. The levels of service are well integrated into decision making and business planning, and there is evidence that AM strategies and decision frameworks are aligned to the levels of service framework. Asset (technical) performance measures are aligned to service (customer) performance measures.	As for intermediate, plus: There is a communications plan that outlines the processes for engaging with customers and stakeholders, and there is evidence that the plan is being implemented. Key customers and stakeholders are informed about and consulted on significant service levels and options, with key outcomes documented in the AMP.	40	50			
Complete the cell to the right—in the "Improvement Actions to Meet the Target" column—by referring to the description under the relevant maturity level, and considering the gap between the current and target levels, as shown in this example														

AM = asset management, AMP = asset management plan, SAMP = strategic asset management plan.

Source: Adapted from Āpōpō. 2020. Asset Management Maturity Assessment Tool (xlsx). <https://apopo.co.nz/product/asset-management-maturity-assessment-tool-xlsx/> (accessed 8 August 2023).

There are drop-down menus for "Current Score" and "Appropriate Target," with selections from 0 to 100 in increments of five points. For each element, a score should be selected that aligns with the description in the relevant maturity-level box.

APPENDIX 2: Case Studies

Case Study: Developing an Asset Management Policy by Samoa Water Authority

The Challenge

During its AMMA review in September 2023, the Samoa Water Authority (SWA) realized that it had an existing asset management policy from 2001, but no one knew about the policy, as it was not being applied and was no longer relevant to the SWA's current practices. The SWA's current maturity rating from its AMMA is at the low end of Basic for IIMM section 2.1, "Analyzing the Strategic Direction." Its target was at the low end of Core, which requires the implementation of an asset management policy that covers all aspects of the asset's life cycle. The SWA needed a new asset management policy to formalize its asset management approach and to demonstrate the support of its management and board of directors. The SWA is already practicing asset management, but wanted to know if it was doing it efficiently. The asset management practices are currently fragmented across the organization, so there is an opportunity to create an all-of-organization approach to asset management led by the utility's newly formed asset management unit.

Scope

The SWA asset management engineer championed the development of the utility's asset management policy, beginning with a draft policy structure prepared by the Asian Development Bank (ADB) technical assistance (TA) for strengthening water, sanitation, and hygiene (WASH) practices and hygiene behavioral change in the Pacific. The engineer researched asset management policies at other organizations, including water utilities in Australia, and prepared a stock take of the SWA's asset management practices. She then adapted the draft policy to make it more relevant for the SWA and the Pacific water utility context, considering the recommendations from ISO 55001. The goal was to produce an asset management policy document that was tailored to the SWA and succinct (i.e., no more than two pages long). The process of finalizing and approving the policy involved an engagement- and awareness-building approach that included:

- (i) the delivery of a two-part workshop to the executive leadership team, to provide an overview of the asset management system (Figure 4), demonstrate how each team member plays a role in asset management, share other example asset management policies, and then to present the draft SWA policy;
- (ii) minor modifications of the draft policy; and
- (iii) a presentation of the final draft policy to the Board, so the members can improve their understanding of asset management, and review and approve the SWA asset management policy.

Figure 9: The Samoa Water Authority's Asset Management System



AM = asset management, O&M = operation and maintenance, SWA = Samoa Water Authority.

Source: Samoa Water Authority. 2023. *Samoa Water Authority Asset Management: Overview and Asset Management Policy*. Presentation to the Samoa Water Authority Board of Directors on asset management and the proposed asset management policy. Apia, Samoa. October 2023.

Outcomes

From start to finish, the process took less than 2 months, and it resulted in a succinct asset management policy that was understood and endorsed by the SWA management and Board of Directors (Figure 4). Key success factors included:

- high-level buy-in and advocacy from the SWA chief executive officer;
- dedicated time from the SWA asset management engineer to prepare an engaging presentation to the SWA management and Board that increased their understanding of the importance of asset management and of an asset management policy; and
- external TA support, including guidance and advice on the policy structure.

Developing an asset management policy is a quick win and an ideal first milestone along the SWA's asset management improvement journey. The SWA asset management policy is the foundation for the utility's asset management practices. It delineates the lines of responsibility and the importance of the asset management unit.

References and Further Reading

Technical advice on how to write an asset management policy:

Assetivity. n.d. "How to Write a Good Asset Management Policy—Implementing ISO 55000." Accessed 22 November 2023.

https://www.assetivity.com.au/articles/asset_management/implementing-iso-55000-part-3-how-to-write-a-good-asset-management-policy/.

Examples from other organizations and water utilities (though they will need to be adapted to the PIC water sector and to the unique needs of each water utility):

University of Auckland. 2019. "Asset Management Policy." Approved May 2019. <https://www.auckland.ac.nz/en/about-us/about-the-university/policy-hub/enabling-environment/finance-capital-risk/asset-management/asset-management-policy.html>.

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Case Study: Developing a Levels of Service Framework for the Department of Water Resources, Vanuatu

The Challenge

The Department of Water Resources (DOWR) of Vanuatu supplies water to over 20,000 people in four urban schemes on the outer islands, with the largest scheme in Luganville, on Espiritu Santo island. DOWR also oversees the water supplies of more than 2,000 communities throughout Vanuatu. DOWR has no documented LOS. Its vision is for "Sustainable and Equitable access to Safe Water and Sanitation for the People of Vanuatu to support improved Public Health and Promote Social and Economic Development" (Ministry of Lands & Natural Resources 2023). The Vanuatu National Water Strategy, 2018–2030 identifies the significant challenges that the DOWR faces in its goal to make access to safe water more equitable and sustainable.

A LOS framework will assist DOWR in formalizing the LOS for its customers, ensuring that performance measures are appropriate and aligned with those service levels, and in ultimately incorporating LOS criteria into decision-making. The Utilities Regulatory Authority oversees the water supply and sets strategic objectives for water for both DOWR and UNELCO.

Scope

The proposed steps toward developing a LOS framework, and reaching at least the lower end of Core maturity, are as follows:

- (i) Review available strategic documents for the organization's objectives and find out what performance measures are currently in use across the organization. Identify how these measures line up with the organization's objectives and service parameters.
- (ii) Consult with customers to select the priority service parameters that are important to them. Less mature organizations could start with a small number of priority parameters for their first LOS framework, such as safety, quality, accessibility, affordability, and reliability.
- (iii) Define at least one objective for each of the priority service parameters (some parameters may require more than one objective). These may be strategic, tactical (asset related) or operational objectives that the organization intends to realize. Start with the minimum level of service required by legislation, for example providing water that meets drinking water regulations.
- (iv) Consult with customers and give them an opportunity to communicate their priorities (what are they willing to pay for?). Validate the LOS objectives based on customer priorities and write the objectives into statements that focus on the customers' point of view.
- (v) Develop a SMART performance measure for each LOS objective. The SMART measures are Specific, Measurable, Achievable, Relevant, and Time-Bound.
- (vi) Establish a process for measuring the current performance for each measure.
- (vii) Set the performance target for each measure. If the target is to improve performance in the future, need to estimate the cost to increase the level of service and a practical time frame to achieve this, taking into account funding available to invest in service improvement.

Outcomes

The outcome of this activity will be a LOS framework that formalizes the service levels that customers should expect from the DOWR urban water-supply schemes, and identifies how these will be measured and reported on. The LOS framework will ultimately enable DOWR to incorporate LOS criteria into decision-making, for example the investment required to meet the target performance when it is higher than the current performance.

References and Further Reading

PRIF's 2021 report on infrastructure performance indicators in PICs includes technical performance measures for the water, sanitation, and hygiene (WASH) sector. Some of these could be adapted for use as customer LOS performance measures:

PRIF. 2021c. *Review of Economic Infrastructure in the Pacific: Pacific Infrastructure Performance Indicators 2021*.

<https://www.theprif.org/document/regional/infrastructure-performance/pacific-infrastructure-performance-indicators-2021>.

Similarly, the PWWA's benchmarking of PIC water utilities includes measures that could be adapted for use as customer LOS performance measures:

PWWA. n.d. "Benchmarking Objective." Benchmarking. Accessed 15 November 2023. <https://www.pwwa.ws/benchmarking/>.

Asset Management Ontario (AMONTario) offers guidance on developing customer LOS and asset (technical) LOS here:

AMONTario. n.d. *Asset Management Technical Assistance*. N.p.: AMONTario. https://www.amontario.ca/wp-content/uploads/2021/08/AMONTario_Levels-of-Service-1.pdf.

A.M. Kan Work! is an online guidebook on asset management by the Southwest Environmental Finance Center, in the United States. Chapter 4 provides guidance on LOS:

Southwest Environmental Finance Center, Department of Civil Engineering, University of New Mexico. n.d. *AM Kan Work!* N.p.: Kansas Government Department of Health and Environment. See esp. Chapter 4, "Level of Service."

<https://swefc.unm.edu/home/amkan/main.php?chapterId=Chapter4&page=1>.

Case Study: The Impact of an Independent Regulatory Authority on Water Supply in Vanuatu

The Vanuatu water supply sector is regulated by the Utilities Regulatory Authority (URA), an independent office established by the Government of Vanuatu in 2007. A primary aim of the URA is to ensure that water utilities charge reasonable water tariff rates, while the URA also works to ensure the viability of the utilities.

The URA's mission is stated in its Strategic and Action Plan, 2022–2026 as follows:

To enhance quality of life and business growth in Vanuatu by ensuring sustainable, safe and reliable energy and water services at reasonable prices accessible to all who demand it (URA 2022).

The URA's Strategic Plan also sets out its vision and strategic objectives. The strategic objectives relevant to water supply asset management planning include:

- Objective 2: Strengthen and monitor price and safe provision of regulated services,
- Objective 3: Promote reliability and enhance quality of regulated services,
- Objective 4: Identify means to enable regulated services to become more affordable.
- Objective 5: Maximize access to regulated services.
- Objective 6: Promote utility service resilience and environmental conservation objectives through regulation.

The relevant customer LOS attributes are underlined in the list above.

Under each objective, the URA has set out its key activities, outputs, and time frames for delivery. For instance, a key activity under Objective 3 is to increase the emphasis on water regulation with

regard to service quality and reliability. The URA is currently developing water regulatory reporting requirements for all water utilities in Vanuatu, and this may cover various aspects of the customer LOS. DOWR and UNELCO will need to coordinate the development of their customer LOS frameworks with the URA's water regulatory requirements. A similar situation exists in Australia and New Zealand, where the water regulatory authorities set environmental performance measures for drinking water networks (e.g., Taumata Arowai, in New Zealand, set environmental performance measures for drinking water networks that focus on both customer service and technical performance. These measures were incorporated into the water utilities' LOS frameworks).

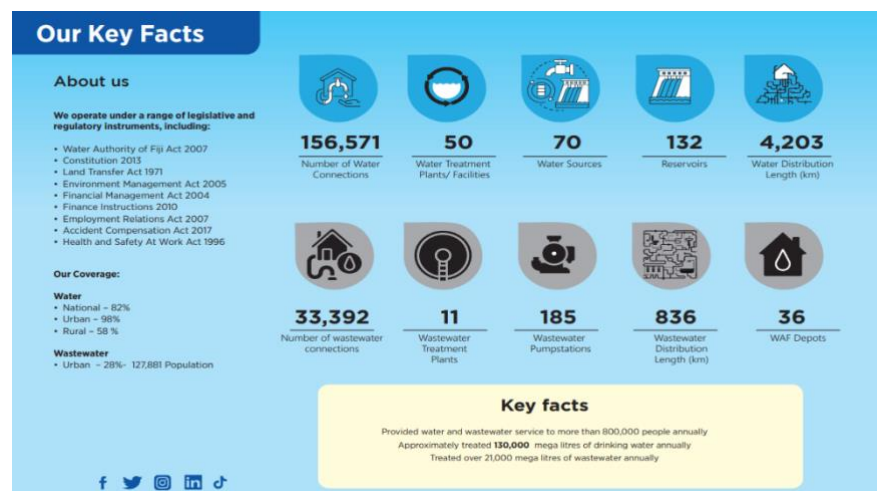
Case Study: Preparing Demand Forecasts by the Water Authority of Fiji

The Challenge

The Water Authority of Fiji (WAF) is the largest water supplier in the PICs. WAF provides drinking water to over 156,000 customers, who reside largely in urban areas. WAF manages over 50 water-treatment facilities and 70 water sources. Key facts are shown in Figure 6.

WAF has limited data on water consumption, limiting its ability to quantify the existing infrastructure can supply current and future demands. WAF's lack of robust water-demand forecasts means that the utility cannot adequately plan for changes in demand. This problem could lead to service shortages, demand constraints, unexpected funding requirements, and reduced levels of service. WAF's current maturity rating based on its AMMA is the highest level of Basic for IIMM section 2.3 "Demand Forecasting and Management."

Figure 10: Key Facts on the Water Authority of Fiji



Source: Water Authority of Fiji. 2023. *Asset Management Maturity Process*. Presentation at a Pacific Water and Wastewater Association regional meeting. Microsoft Teams. 24 October.

WAF's target maturity level is the upper level of Core, which will require the preparation of demand forecasts based on relevant primary demand factors (e.g., population growth, changes in NRW) and extrapolation from historic demand trends, incorporating expected changes in demand drivers.

WAF has developed a draft methodology for preparing water-demand forecasts that meet the Core requirements, as follows:

- (i) Analyze historical demands for priority water supply schemes to identify:
 - (a) annual demand trends;
 - (b) estimated leakage volumes, if possible;
 - (c) the timing and duration of peak periods;
 - (d) data anomalies to screen during the analysis; and
 - (e) sources of uncertainty.
- (ii) Assess the risks to each network's water supply, including the required LOS.
- (iii) Determine the assumptions informing the forecasting of demand, including the:
 - (a) population and the forecasted population growth;
 - (b) split between residential and nonresidential consumption;

- (c) relationship between consumption and connected customer sectors; and
- (d) the effects of climate change and other significant demand drivers on peak demand.
- (iv) Prepare demand forecasts for each network for average and peak demand, based on at least one growth scenario. Incorporate the impact of expected changes in demand drivers.
- (v) Prepare supply–demand balance (SDB) forecasts for each network to compare the demand forecasts with the supply infrastructure limits, for example:
 - (a) water source capacity limitations as defined by hydrometric analysis (of surface water sources), groundwater aquifer capacity, and future meteorological changes (including climate change impacts);
 - (b) water treatment plant design and operational capacity; and
 - (c) reservoir storage capacity.
- (vi) Review the SDB forecasts to identify any supply deficits to be addressed by new assets, asset upgrades, and/or non-asset solutions such as water-demand management (including NRW reduction).

Outcomes

The outcomes of this activity will be an improved understanding of the current water demands of the priority water supply schemes, estimates of future demand, and a comparison of the demand forecasts with the supply limitations. The SDB forecasts will enable WAF to determine if the existing supply infrastructure can meet the current and projected future levels of demand. The outputs will be used for the capital forecast planning included in the region's water supply asset management plans.

References and Further Reading

A conference paper proposing a framework for forecasting the urban demand for water in New Zealand, including suggested data analysis and methods for developing input assumptions:

Reed, Charlotte, and Jonathan Reed. "A Proposed Framework for Forecasting the Demand for Urban Water in New Zealand." Paper presented at the New Zealand Water and Wastes Association (NZWWA) 56th Annual Conference and Expo, Rotorua, New Zealand, September 2014. https://www.waternz.org.nz/Article?Action=View&Article_id=212.

A guide from the United States on evaluating future urban water demand:

Heberger, Matthew, Kristina Donnelly, and Heather Cooley. 2016. *A Community Guide for Evaluating Future Urban Water Demand*. Oakland, CA: Pacific Institute. <https://pacinst.org/publication/community-guide-evaluating-urban-water-demand-forecasts/>.

Case Study: Strengthening the Asset Register by To Tatou Vai, Cook Islands

The Challenge

To Tatou Vai (TTV) is a statutory not-for-profit corporation established in 2019, and responsible for delivering water supply services to Rarotonga, Cook Islands. TTV inherited both the old water supply network that had been managed by the Ministry of Infrastructure and the new infrastructure that had been completed under the Te Mato Vai (TMV) project.

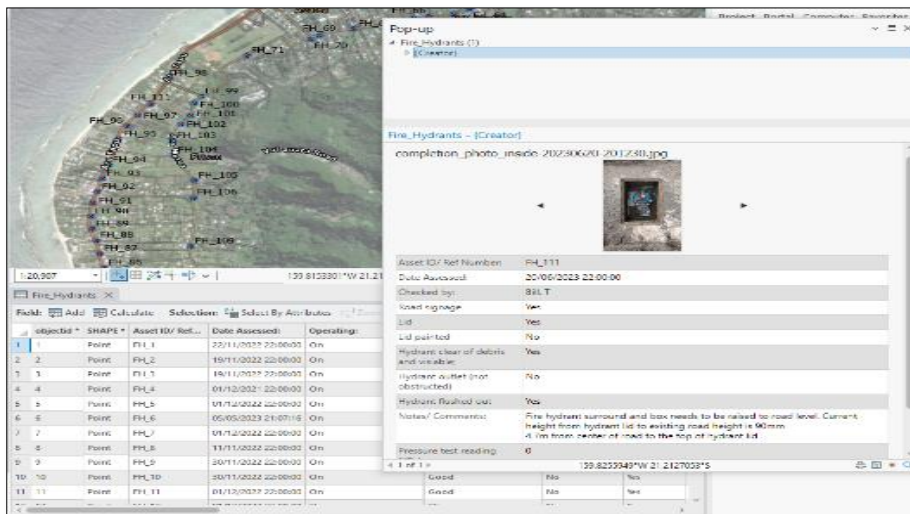
- (i) New assets:
 - (a) water treatment plants, including storage tanks (10x); and
 - (b) trunk, ring and submain upgrades.
- (ii) Inherited assets:
 - (a) ring-main network,
 - (b) submain and branch main networks,
 - (c) service connections, and
 - (d) pump stations.

Scope

TTV has identified the strengthening of the asset register as a priority program. This work is included within TTV's Statement of Corporate Intent as a key performance area that will have many benefits when successfully delivered. Currently, this program is underway at TTV with a focus on the following:

- (i) Data collecting and collating of asset information into a single source, which will entail:
 - (a) reviewing current datasets and formats (e.g., AutoCAD);
 - (b) completing the physical field verification of key network assets (e.g., valves, hydrants);
 - (c) understanding connection points between old, new, and disposed parts of the network system;
 - (d) identifying key control points (e.g., valves); and
 - (e) utilizing the network team to support the collection and editing of key asset information, including asset type, subtype, condition, and spatial coordinates.
- (ii) Awareness and capacity building programs, which will entail developing data entry forms to support the capture of consistent information during the data-collection process. An example is shown in Figure 8. Forms are being completed on valves, hydrants, and flush-out programs through the use of mobile devices that directly feed into a cloud-based information system for.
- (iii) Developing new processes and systems to support the ongoing capture and management of asset information, which will entail:
 - (a) centralizing information within an asset-information system, including:
 - i. information stored and reviewed, with analysis conducted to develop the standard operating procedures; and
 - ii. asset ID, make and model, and current condition.
 - (b) applying a standard approach to new connections and extensions of the network, including:
 - i. an installation process, with standards for improved planning and job execution;
 - ii. standardization of item lists and construction drawings (e.g., trench specifications, fixture and fittings lists); and
- (iv) formalization of the process for capturing information on changes or additions to the network.

Figure 11: To Tatou Vai Data Entry Forms in the Geographic Information System



Source: To Tatou Vai. 2023. *Strengthening Asset Registers*. Paper presented on behalf of To Tatou Vai to the PRIF and Pacific Water and Wastewater Association (PWWA) 3rd Regional Meeting, Microsoft Teams. 21 November.

Outcomes

The completion of this program to strengthen TTV's water supply asset register will provide numerous benefits to the water utility, including:

- (i) improved information on the locations of all assets,
- (ii) a complete map of the entire system showing the connections between the old and new assets,
- (iii) an improved understanding of the water network system as a whole, and
- (iv) sufficient asset information to develop a renewal program for the critical assets.

References and Further Reading

Asian Development Bank (ADB). 2013. *Water Utility Asset Management: A Guide for Development Practitioners*. Manila: ADB. https://www.adb.org/sites/default/files/institutional-document/42451/water-utility-asset-management-guide_0.pdf.

A.M. Kan *Work!* is an online guidebook on asset management by the Southwest Environmental Finance Center, in the United States. Chapter 3 covers the asset register and methods for assessing the current state of assets:

Southwest Environmental Finance Center, Department of Civil Engineering, University of New Mexico. n.d. *AM Kan Work!* N.p.: Kansas Government Department of Health and Environment. See esp. Chapter 3, "Current State of the Assets."

<https://swefc.unm.edu/home/amkan/main.php?chapterId=Chapter4&page=1>.

APPENDIX 3: Asset Management Training Options

Asset Management Training Provider Options

The International Organization for Standardization (ISO) website has a page with links to some asset-management organizations:

<https://committee.iso.org/sites/tc251/social-links/resources/Learning-more.html>

Āpōpō is a New Zealand-based association for infrastructure-asset-management professionals, and has a digital badge training framework for asset management. The Climate Ready Project under the United States Agency for International Development (USAID) used this digital badge training to provide asset-management training to public sector staff from 11 Pacific island countries (PICs) in collaboration with the New Zealand PacificTA program (a New Zealand local government technical assistance facility for PICs) between 2019 and 2022. PRIF teamed up with Āpōpō for the Asset Management Improvement Planning for the Pacific Water Sector pilot project to strengthen asset management in the water sectors of the PICs. The digital badges are bite-sized online courses with content that is aligned with international standards (ISO 55000) and the authoritative *International Infrastructure Management Manual* (IIMM). The first five asset-management badges cover the concept of managing assets from the very beginning. The other badges cover different subjects in more detail, and are appropriate for more experienced practitioners. Learners can pick and choose which digital badges suit them.

<https://apopo.co.nz/digital-badges/>

The Institute of Public Works Engineering Australasia (IPWEA) has a formal asset-management education pathway that is also aligned with ISO 55000 and the IIMM. There are online courses, including an “Asset Management Foundations” course and a course titled “Professional Certificate in Asset Management Planning.” The Foundations course is a self-paced, with four modules designed to increase one’s understanding of the asset-management discipline. The Professional Certificate course comprises seven modules, with live question-and-answer sessions and group discussions.

<https://www.ipwea.org/educationandevents/ampathway/>

The Asset Management Council, based in Australia, offers an online course titled, “Asset Management Fundamentals.” This course is delivered through two live interactive sessions. It provides a thorough overview that allows the learners to understand the fundamentals of asset management and the benefits of asset management for their entities.

<https://www.amcouncil.com.au/training/>

Considerations When Selecting an Asset Management Training Provider

Training cost

- Does the cost of training include ongoing access to the training materials, with updates for all learners participating in the training (i.e., lifetime access at no additional cost)?
- Does the training require only one lump-sum payment or are there annual subscription or licensing fees?

Training delivery

- Is there an option for the learners to have the support of a training facilitator for interactive discussions, including question-and-answer sessions?
- Is there an option for the learners to engage in activities with a small group?

- Will the training provider tailor the training to include specific case studies that are relevant to the water sector and/or to the PICs?
- Is technical support readily available from the training provider (e.g., if the learner is unable to log into the online training platform)?

Training content

- Is the training content interactive and engaging (e.g., a mix of text, images, videos, exercises, group activities, and case studies)?
- Is the training platform easy to use (e.g., with the learner able to bookmark content of special interest)?
- Is there an assessment for each training course?
- Will the learner receive a qualification or credential upon completion of the course assessment (i.e., formal certification that the learner has achieved a set of learning outcomes to a set standard)?

APPENDIX 4: Sample Improvement Action Template



LOGO of Water Utility

Pacific Region Infrastructure Facility—Pacific Water and Wastewater Association Strengthening Asset Management Project, 2023

Title of Improvement Action:

Date (or date when last modified):

Element as defined in the International Infrastructure Management Manual (IIMM)

Current status

Why is this improvement action important?

Scope description

Risks incurred if improvement is not implemented

Predecessors (which improvements need to be completed before this one starts) Dependencies (which improvements cannot be started until this one is completed)

--	--

Project team External resources needed

--	--

Start date

Completion date

Project risks

Commitments by staff (person months)

Comments on staffing

Cost estimate

Currency

Estimate quality

% Funded

Funded/not funded

Funding source

Comments on cost assumptions, potential donors, and linked donor projects



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