It is my distinct pleasure to introduce Charleston Water System’s Strategic Asset Management Plan (SAMP). It’s a clear, concise, and powerful instrument that provides an actionable plan for day-to-day operations and long term planning.

Ageing infrastructure is an ever increasing national issue of importance, particularly for utilities such as ours who manage assets that are essential for life, health, and the environment. We’re proud to be an industry leader in the quest to solve this increasingly complex problem, and our SAMP is one of the keystones we rely on to assure success.

This SAMP is a collaborative effort that taps into the vast wealth of operational knowledge offered by our most important assets, the people. It provides an informed and data driven roadmap for building our Asset Management program and achieving the appropriate level of sustainability for the infrastructure entrusted to our stewardship by our Board of Commissioners and our valued customers.
A. Alignment of SAMP and Our Organizational Vision
Charleston Water System (CWS) Vision 2017 Operations Focus Team Goal: Fully implement a comprehensive Asset Management (AM) program to include infrastructure and technology.
CWS Vision 2023 Leadership and Strategic Planning Team Goal: Complete the deployment of the SAMP in order to improve financial management, operational performance, and customer satisfaction.

B. Benefits of Asset Management

Good Business Practice
AM produces data driven decisions.
Aligning AM with strategic policies and direction supports long-term success at CWS.

More Meaningful Financial Reporting
General Accounting Standards Board statement 34 (GASB 34) requires reporting of asset ownership costs. AM will help achieve GASB 34 compliance. Long term asset cost forecasts will also improve capital planning.

Improved Regulatory Compliance
AM leads to better operational and maintenance practices, which greatly improves regulatory compliance.

Improved Reliability
AM requires a better understanding of system assets and their actual condition. This reduces unexpected asset failures and high costs of emergency repairs and customer management.

Long Term System Integrity
AM leads to sustainable infrastructure. Assigning costs to asset condition and developing long term planning for assets provides CWS leadership with data they need to sustain the infrastructure.

Cost Savings
An AM life cycle approach to managing infrastructure ensures that CWS gets the most value from its assets.

C. AM Decision Making and Accountability

Team Structure
A key aspect of AM decision making and accountability is the AM team structure. CWS employs a two-tier team structure consisting of the Strategic Asset Management Team (SAM Team) as the top tier and the Network Asset Sub-Team (NAS-Team) and Plant Asset Sub-Team (PAS-Team) as second tier.
Leadership Support
Leadership support is an important part of AM program success. CWS leaders show their commitment to AM by investing in AM-related human and system resources, instituting an AM policy, establishing AM-related objectives, developing a SAMP, and providing input and direction.

ISO 55000
Our AM program aligns with the International Organization of Standards (ISO) 55000 suite of AM standards. This provides a proven road map for AM program development and an ability to benchmark against other ISO 55000-aligned organizations.

AM Program Framework
The CWS program framework is based on ISO 55000 requirements and includes four supporting pillars:

• SAMP outlines the organization’s objectives and strategies for each four year strategic planning period.
• Asset Information Management System (AIMS)
  Specifies the IT systems, architecture, and processes used to manage asset data.
• Tactical Asset Management Plans (TAMPs) specify the asset lifecycle management activities and methods for each asset type.
• Asset Portfolio reports on the current state and expected long-term financial investments for assets.

D. SAMP Supporting Data and Analysis

Stakeholder Expectations
Senior leaders were asked a simple question, “What is your expectation of Asset Management?” A group of 29 leaders provided a total of 122 expectation statements. The statements were grouped into relevant categories and ranked based on repetition to identify the collective AM priorities. The highest ranking categories, in order of priority, were: Strategy, Communication, Data and Asset Register, Budgeting, Risk and Criticality, and AM Planning.
AM Maturity and Gap Analysis
The Institute of Asset Management Self-Assessment Methodology (IAM SAM) was used to measure the maturity of our AM practices. The IAM SAM measures the overall AM maturity and the maturity for 27 specific AM focus areas according to ISO 55000 requirements.

E. Measuring AM Success

Overall AM Maturity and Maturity by Clause
The CWS Overall AM Maturity at the start of the strategic planning cycle was 1.5 (of a possible 5) which corresponds with an organization that is “aware” and transitioning towards “developing.” CWS is targeting a score of 2.25 which will correspond with an organization that is “developing” and transitioning towards “competent.” The CWS maturity scores for each of the 27 ISO focus areas are listed on page 56 of the SAMP. CWS is targeting the achievement of a Maturity Level 2 across each focus area. This is due to the dependency of the clauses on one another.

F. Objectives and Strategies

AM Objectives and Strategies
The AM objectives were determined through stakeholder expectations analysis and AM gap analysis. Each objective has several corresponding strategies that when delivered will signify completion of the objective. Each strategy is documented through a task level action plan that outlines the specific activities and responsibilities for delivering the strategy.

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A. ABBREVIATIONS

AIMS: Asset Information Management System
AM: Asset Management
CAMP: Corporate Asset Management Plan
CWS: Charleston Water System
CMMS: Computerized Maintenance Management System
EMS: Environmental Management System
ERP: Enterprise Resource Planning System
EUM: Effective Utility Management
GIS: Geographic Information System
IAM: Institute of Asset Management
IIMM: International Infrastructure Management Manual
IPWEA: Institute of Public Works Engineers Australasia
LOE: Level of Effort
LOS: Level of Service
RMP: Risk Management Program
SAMP: Strategic Asset Management Plan
SME: Subject Matter Expert
TAMP: Tactical Asset Management Plan
1. Strategic Asset Management Plan Audience

Charleston Water System (CWS) is an essential service provider that manages an extensive range of assets, which facilitate or support the provision of potable water distribution and waste water collection. The activities of all CWS associates have potential to impact those assets. The Strategic Asset Management Plan (SAMP) should be communicated to all CWS associates for this reason. At a minimum, all CWS associates should be aware of the SAMP and the organizational desire to transition towards an Asset Management (AM) focused culture. There are varying levels of impact that associates can have depending on their position and responsibilities within the organization. The positions that have the most potential to impact AM are the primary target audience. Those positions and their interaction with the SAMP and AM program are provided below:

- **Executive Officers**: require a high-level understanding of the AM program and the SAMP in order to understand the resulting organizational changes, provide direction and support, track program progress, and sign off on major AM-related initiatives and resource investments.

- **Directors and Managers**: require a detailed understanding of the AM program and the SAMP in order to consider, plan, and implement staff directions and departmental level changes associated with the delivery of their respective AM responsibilities as outlined in the AM policy (see Appendix I.1. AM Policy).

- **Technical Staff and Subject Matter Experts**: require a detailed understanding of the AM program and SAMP in order to understand the nature and purpose of the strategic input and tactical tasks that they are responsible for delivering.

2. SAMP Purpose

The International Organization for Standards (ISO) AM Standard 55000 series (ISO 55000) was selected as the guiding framework for the CWS AM program. It defines the SAMP as “Documented information that specifies how organizational objectives are to be converted into AM objectives, the approach for developing AM plans, and the role of the AM program in supporting achievement of the AM objectives” (see Appendix I.2. ISO 55000 AM Standard). This definition is further supplemented by the following ISO 55000 clauses which outline the SAMP requirements:

- **Clause 4.1**: AM objectives, included in the SAMP, shall be aligned to, and consistent with, the organizational objectives.

- **Clause 4.3**: The scope of the AM program shall be aligned with the SAMP and the AM policy.

- **Clause 4.4**: The organization shall develop a SAMP which includes documentation of the role of the AM program in supporting achievement of the AM objectives.

- **Clause 5.3**: Responsibilities shall be determined for; a) establishing and updating the SAMP, including AM objectives and b) ensuring that the AM program supports delivery of the SAMP.

- **Clause 6.2.1**: AM objectives shall be established and updated as part of the SAMP.

- **Clause 6.2.2**: The organization shall establish, document and maintain AM plan(s) to achieve the AM objectives. These AM plan(s) shall be aligned with the AM policy and the SAMP.

In addition to the generalized purpose of the SAMP offered by ISO 55000, the SAMP should also provide specific context that defines the purpose of the SAMP unique to CWS. This context helps to answer strategic
questions which are critical to developing AM objectives, strategies, and delivery action plans suited to CWS needs and capabilities. These strategic questions have been listed below:

- What is important to CWS stakeholders regarding AM?
- Where is CWS currently with AM?
- Where does CWS want to be in the future with AM?
- What path will CWS take to get there?
- How soon does CWS want to get there?
- How does CWS measure AM program progress?

The ISO 55000 SAMP definition and related clauses have been given due consideration in the development of the CWS SAMP. Given the infancy of the CWS AM program and the organizational desire to achieve significant AM program progress over the upcoming strategic planning cycle, a level of detail greater than that specified by ISO 55000 has been provided in this first version of the SAMP. Considerate of all of these influencing factors, the purpose of the SAMP can be distilled down to the following statement:

- The purpose of the CWS SAMP is to provide a clear strategic direction and a firm foundation for confidently building and managing the AM program.

3. CWS AM Background

CWS has substantially improved AM awareness within the organization over the previous fifteen years. The development of the current level of awareness has been characterized by three distinct phases of progress. These phases of progress are outlined below:

- **Phase 1 Interest 2000-2006**: This phase consisted of CWS understanding that the traditional reactive approach to managing assets is not sustainable. This is primarily due to the aging infrastructure and limited funding issues currently faced by most asset focused enterprises. As this issue became more evident in the late 1990’s and early 2000’s CWS began seeking potential solutions. The solution came in the form of industry consensus on the benefit of AM lifecycle planning and risk-based asset prioritization offered by AM programs. Although CWS understood a better means of managing assets existed, it lacked the appropriate resource investments, Subject Matter Experts (SME), AM competence, and information management systems required to achieve tangible AM program progress. This phase was characterized by the assignment of a CWS associate tasked with researching AM program requirements and communicating those requirements to other CWS associates considered integral to AM.

- **Phase 2 Building Awareness 2007-2013**: This phase consisted of CWS investing effort and resources required to develop the awareness and competence to progress AM program development and AM in general. This phase was characterized by; inclusion of AM program development as an objective in the 2007-12 Corporate Strategic Plan, progress in developing the Computerized Maintenance Management Systems (CMMS), and the adoption of a more sophisticated approach towards utilizing the Geographic Information System (GIS). Although an initial attempt was made to develop a SAMP and document an AM program, it became apparent that a more substantial resource investment would be required to deliver an initiative of the magnitude of developing an AM program. Although there is documentation of the efforts applied during this phase there was no tangible or meaningful progress towards AM program development other than the substantial awareness achieved.
B. EXECUTIVE SUMMARY

- **Phase 3 Understanding Resource Requirements 2014-present:** This phase consists of CWS building off of the awareness achieved in phase 2, and gaining an intuitive understanding of the resources required to develop and manage an AM program. This phase has been characterized by an investment into the creation and hiring of; an AMandGIS department director position to oversee the critical aspects of AM program development; an experienced AM program manager to lead the development and management of the AM program; and an AM analyst tasked with research, analysis, and reporting of AM data and information. An investment is also currently being made into an AM information management and planning system as well as Enterprise Resource Planning (ERP) system software. Notable progress has also been achieved in other key aspects of AM program development including but not limited to; establishing the AM Strategic Team which acts as the centralized AM decision making body; developing asset registers and asset attributes; gaining awareness of risk management concepts; establishing methodologies for assigning asset criticality; and communicating and educating associates on AM concepts; and understanding the impact of resourcing on AM program progress (see Section D. AM Approach). Throughout phase 3 the stage has been progressively set to facilitate substantial AM program development through the next five year strategic planning cycle.

4. Objectives and Strategies Summary

The objectives and strategies for the 2018-23 strategic planning cycle were developed in 2016 and 2017. These objectives and strategies were developed using a rigorous, collaborative, and data driven process (see Section D. AM Approach) that align with the principles of the corporate strategic plans, “Vision 2017” and “Vision 2023”.

**AM Objectives**

The objectives for the 2018-23 strategic planning cycle include:

- **Asset Register Development:** consists of developing and optimizing both the network and plant asset registers. Achieving this objective is necessary for progressing numerous other critical aspects of the AM program including but not limited to; reporting on the asset portfolio, structuring asset work programs, accurately tracking the condition of CWS assets.

- **AM Program Development:** consists of developing and maintaining an AM program that is aligned with the requirements of ISO 55000 and the strategic objectives of Vision 2017 and 2023. Achieving this objective will result in the realization of the benefits associated with effectively implementing AM. These benefits include but are not limited to; improved business practices, greater accuracy in financial reporting, improved regulatory compliance, improved asset reliability, long-term integrity of network and plant assets, cost savings, compliance with anticipated future federal asset funding requirements.

- **Asset Information Management System (AIMS) Optimization and Management:** consists of developing AM decision making systems, integration and alignment of supporting information systems, and improving the functionality of under-utilized CMMSs. Achieving this objective will substantially improve the AM information management and planning capabilities. The systems which contribute to the AIMS and may be impacted by this objective include but are not limited to; Cityworks, CUES Granite, ESRI ArcGIS, Infor EAM, PowerPlan, ERP system.
**B. EXECUTIVE SUMMARY**

**AM Strategic Objectives Delivery Strategies**

The strategies that will facilitate the delivery of the 2018-23 strategic planning cycle AM objectives have been documented in the below table:

*Table 1. AM Objectives and Strategies Executive Summary*

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<td><strong>AM Program Development</strong></td>
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<td>• Corporate Asset Management Plan (CAMP Development)</td>
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<td>• Asset Portfolio Development</td>
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<td>• Tactical Asset Management Plans (TAMP) Development</td>
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<td>• Communication and Education</td>
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<td>• AM Program Improvement Plan Development</td>
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<td>• AM Gap Analysis, Objectives, Strategies Development 2022</td>
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<td>• SAMP Development 2022</td>
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<td>• AM Risk Management</td>
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<td>• Asset Levels of Service (LOS) Development</td>
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<td>• AM Resource Options Analysis</td>
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<td><strong>AIMS Optimization and Management</strong></td>
<td>• PowerPlan Preparation, Development, Deployment</td>
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<td>• Cityworks Optimization and Alignment</td>
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<td>• Infor EAM Optimization and Alignment</td>
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<td>• GIS Capability Development</td>
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C. AM POLICY

1. Purpose
The intention of the AM policy is to support the development and implementation of an AM program which will facilitate the realization of long term benefits related to effective AM. This policy outlines the drivers, principles, and responsibilities for AM within CWS. Achievement of the CWS mission, “...to protect the health and environment of our service community by providing clean water services of exceptional quality and value” is fully supported by this policy as outlined in detail within the policy drivers. Through the sound application of this policy CWS will demonstrate an appropriate level of stewardship for the essential infrastructure entrusted to the Commission by the citizens of the Charleston metropolitan area.

2. Drivers
Effective AM will have a positive impact on the following drivers through:

Safety
• Preventing the loss of potable water, sanitary sewer, fire protection and health services
• Mitigating public exposure to unsafe environments such as sink holes or contaminated areas
• Decreasing reactive repair responses in which safety cannot always be adequately planned

Environmental
• Reducing the likelihood of contamination or degradation of sensitive environments
• Supporting the achievement of regulatory compliance
• Decreasing reactive repairs in which environmental protections cannot always be adequately planned

Value for Money
• Providing data and value driven long term asset investment plans
• Maximizing useful life of assets in the most cost effective manner possible
• Decreasing instances of costly reactive repairs which cannot be accurately budgeted

Levels of Service
• Facilitating processes to proactively collect and analyze asset condition and performance data
• Renewing assets in a prioritized and planned manner based on the condition and criticality of the asset
• Maintaining assets utilizing long term maintenance planning practices

Strategic Plan
• Facilitating implementation of a comprehensive AM program
• Aligning the SAMP and CAMP with the Corporate Strategic Plan
• Supporting the transformations of operations and organizational structure to eliminate departmental silos

3. Principles
Open and Honest Communication
Open and honest communication is the keystone of an effective AM program. AM consists of a wide variety of asset responsibilities, undertaken by a range of associates spread over several different departments.
C. AM POLICY

It is integral that these associates and departments operate in an environment that promotes open communication. To achieve this, the development of AM plans and initiatives will be collaborative efforts consisting of input from the full range of stakeholders. These efforts are to be coordinated by the AM program manager with a firm focus on communication, education and collaboration.

**Accountability and Data Driven Decision Making**

As a public utility it is imperative that the asset investment decisions we make are transparent, justifiable, beneficial, and accountable to the customers and the community we serve. To achieve this the AM program will be developed with a focus on facilitating asset investment decisions and plans that are anchored by verifiable data, conditioned by the triple bottom line value, and considerate of asset criticality.

**Achieving Utility Industry Excellence**

CWS is one of the larger regional water and sanitary sewer utilities in the state of South Carolina. It provides bulk water to several regional utilities. This provides CWS with the unique opportunity to set an example of industry leadership through its AM and business practices. In order to demonstrate this it is necessary that CWS compares its performance to other industry leaders on a national and international scale through benchmarking exercises such as the European Benchmarking Co-operation, Florida Benchmarking Co-operation, and the AWWA QualServ program. Through these benchmarking exercises CWS will be able to demonstrate areas where industry excellence is being achieved. Conversely, areas which lack excellence can be identified and addressed through established systematic improvement processes.

**Risk and Criticality Awareness**

AM planning and decision-making will take into account the risk associated with the investment decisions made as well as the criticality of the associated infrastructure. Where practical, risks will be identified, objectively assessed, and mitigations proposed for asset investments to reduce the likelihood of negative consequences. Criticality is linked to the severity of consequence associated with a particular asset’s risk profile. The amount of population served, the severity of potential impacts to ancillary infrastructure (i.e., roads, gas mains, storm drains), the potential impact to private property, and the potential for excessive costs are all examples of items which affect the level of criticality of an asset. All assets will be assessed for their associated level of criticality which will be considered in the asset investment planning process.

**Continual Improvement and Innovation**

The AM program will aspire to achieve continual improvement that is assessed and measured by an industry-accepted AM maturity standard. The maturity will be objectively assessed on a bi-annual basis and formally reported to senior management. Based on the results of the maturity assessment, improvement initiatives will be developed and implemented in collaboration with the stakeholders. In addition to the formal assessment, ideas for improvement and innovation will be informally solicited from all levels of the organization. All ideas will be considered, discussed, and the potential benefits analyzed by stakeholders. This will promote an environment where continual improvement and innovation are both prioritized and achievable.
C. AM POLICY

Teamwork
AM is the responsibility of the entire organization. Mature AM practices require cross functional interdepartmental teams that work towards the shared goal of effective AM. The intention of the AM program is to ensure that the various teams and associates have a shared understanding of that goal as well as consistent processes to achieve the goal. AM understanding and awareness will be provided through organizational education and training initiatives which will promote a cohesive team focus on AM. A cross functional AM team, consisting of subject matter experts across the primary areas of AM influence, will be tasked with developing and continually improving the AM program. This approach will ensure collaboration and promote a teamwork mentality towards AM program progress.

Consistency and Integration
AM requires consistency and integration across processes and data in order to achieve objectives in an effective and efficient manner. Data consistency will be developed through the alignment of information system sources to single points of accountability. Consistency will also be achieved through the alignment of data collection and measurement methodologies across responsible departments. Similarly, through collaborative teamwork, the AM program will identify areas of inconsistency in AM processes across the responsible departments. The processes that are identified as beneficial will be developed, communicated and integrated. The processes that are identified as counterproductive will be abandoned and communicated to avoid repetition of similar inefficiencies. Over time this approach will produce a consistent and integrated AM program that promotes the effective implementation of AM projects and initiatives.

Resource Development
AM is a labor and data-intensive practice. Both of these elements require an investment of resources to adequately support AM program development. In order to develop and maintain an AM program, resource requirements will be routinely assessed to determine the needs of the program. The required resources will be allocated when justified. This includes asset data management and planning tools as well as technically proficient human resources. The competency needs of the associates responsible for AM will be routinely assessed and, when required, training and education initiatives implemented.

Sustainability
AM is a long term investment. Although some initial gains such as organizational cohesiveness and better clarity of long term asset investments will be evident in the near term, the vast majority of AM program benefits will not be realized for many years. Sustainability and longevity are key to the program’s success for this reason. AM plans and resources will be developed with adaptability, flexibility, and fidelity incorporated as fundamental conditions. This approach coupled with the principles of continual improvement, resource development, and teamwork will ensure that the AM program is sustainable and capable of delivering long term benefits.

Customer Service Focus
The AM program will facilitate a proactive approach to the maintenance, assessment and renewal of the infrastructure responsible for the delivery of essential water and sanitary sewer services to our valued customers. Overtime this will result in fewer asset failures and the corresponding customer dissatisfaction resulting from those failures. A well-defined AM program will also demonstrate the appropriate level of asset stewardship, which will give our customers confidence that their investment in CWS is being prudently spent.
1. Corporate Strategic Plan (Vision 2017 and 2023)

An important aspect of the SAMP is demonstrating alignment with the Corporate Strategic Plan and the objectives contained therein. This section is intended to provide an overview of the Corporate Strategic Plan and highlight objectives that relate to AM in order to provide organizational context.

Vision 2017

The corporate strategic plan for the five year planning cycle ending in 2017 is generally referred to as Vision 2017 (see Appendix I.3. Vision 2017 Corporate Strategic Plan). The overall vision for this plan was to become worthy of the Malcolm Baldrige National Quality Award. Noteworthy progress was made towards this goal by integrating business processes. This progress resulted in a site visit and assessment which is considered a rare achievement for first time Baldrige Award applicants. The most notable strategic objective achieved during this period, which has a direct bearing on AM, was the effort to eliminate departmental silos through the creation of collaborative cross functional strategic teams. This positive cultural change is an important aspect of achieving success with an AM program.

The team structure was a key aspect of delivering Vision 2017 strategic objectives. The team structure consisted of:

- Vision Achievement Team (VAT): responsible for guiding the implementation of Vision 2017
- The Strategic Plan Leadership Team (SPLT): a sub-team of the VAT that facilitates strategic planning, guides the Steering Teams, and supports the VAT
- Steering Teams: there are five steering teams; Leadership and Strategic Planning, Customer Focus, Measurement, Workforce Focus, and Operations Focus
- Point Leaders: serve as team leaders for the departmental teams and a link between the Steering Teams and the department teams

Each of the five steering teams was assigned objectives to deliver throughout the five year strategic planning cycle. A total of twenty seven objectives, each supporting the overall vision, were distributed amongst the five teams. The objectives relating directly to AM have been listed below:

- Transform operations and organizational structure to eliminate departmental silos
- Develop a financial forecast to coincide with the capital improvements master plan time frame and costs
- Develop systematic processes for making data-based decisions on predicted outcomes
- Develop a reliable and sustainable measurement, benchmarking and data analysis system to drive data based decision making
- Foster a culture of sharing knowledge and best practices across departments and work groups to improve operational effectiveness and efficiency
- Systematically monitor and assess improvement initiatives and performance results
- Fully implement a comprehensive AM program to include infrastructure and technology
D. ORGANIZATIONAL CONTEXT

Vision 2023

Vision 2023 maintains the team structure for delivering the plans goals. Vision 2023 is focused on incorporating the best management practices offered by Effective Utility Management (EUM) (see Appendices H.4. Vision 2023 Corporate Strategic Plan and H.5. Effective Utility Management 2017). These best practices have been developed based on the experiences of a collective of utility industry SMEs known as “Collaborating Organizations” and are intended to provide a path for achieving utility sustainability. The best practices have been provided in the EUM’s Ten Attributes of Effectively Managed Utilities and Five Keys to Management Success. As a part of the Vision 2023 development process all associates were engaged and asked to provide stakeholder expectation statements. A total of 962 statements were provided. These statements were thoroughly analyzed, consolidated, and then linked to selected EUM attributes. The consolidated statements were then socialized to and prioritized by associates using a ranking system. The prioritized statements were then used to identify viable organizational goals for Vision 2023. Several of the goals relate directly to the SAMP and many of the remaining goals relate indirectly to AM. The close relationship between Vision 2023 goals and SAMP 2023 objectives demonstrates full alignment between both of these crucial organizational strategic plans. This alignment is best demonstrated by the top goal documented in Leadership and Strategic Planning section of Vision 2023; fully implement a comprehensive AM program in a way that complies with ISO 55000 standards.

Figure 1. The Ten Attributes of Effectively Managed Utilities and Five Keys to Management Success
2. AM Roles and Responsibilities

AM is a responsibility of the entire organization. The full breadth of the CWS asset portfolio is extensive and varied in its types. This requires a full range of dedicated SMEs to understand and plan for the needs of each specific asset type. These SMEs are dispersed across different departments, each with its own set of discrete AM responsibilities. As a part of developing the AM policy these responsibilities were identified at the department level, documented, and approved by The SPLIT/VAT and signed off on by the Executive Officers. Although it is noteworthy that more detailed responsibilities will be required at the team and associate level, those responsibilities will be developed by the respective departments with the cooperation and support of the AMandGIS Department and AM team with due consideration given to the intent of the AM policy. The departmental AM responsibilities have been provided in the table below:

Table 2. AM Responsibilities by Department

<table>
<thead>
<tr>
<th>Department</th>
<th>AM Responsibilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM&amp;GIS</td>
<td>• Development and coordination of AM program</td>
</tr>
<tr>
<td></td>
<td>• Management: and analysis of asset data</td>
</tr>
<tr>
<td></td>
<td>• AM strategic planning</td>
</tr>
<tr>
<td></td>
<td>• AM tactical planning support</td>
</tr>
<tr>
<td></td>
<td>• Champions of AIMS</td>
</tr>
<tr>
<td></td>
<td>• Project closeout and new asset data entry</td>
</tr>
<tr>
<td></td>
<td>• GIS data entry and system management</td>
</tr>
<tr>
<td>Engineering and Construction</td>
<td>• Delivery of major capital projects</td>
</tr>
<tr>
<td></td>
<td>• Development of minimum standards ensuring compliance</td>
</tr>
<tr>
<td></td>
<td>• Growth and demand planning</td>
</tr>
<tr>
<td>Water Distribution (WD)</td>
<td>• Development of maintenance plans for WD assets</td>
</tr>
<tr>
<td></td>
<td>• Development of TAMPs for WD assets</td>
</tr>
<tr>
<td></td>
<td>• Maintenance, assessment, and minor renewals for WD assets</td>
</tr>
<tr>
<td></td>
<td>• WD asset data collection and entry</td>
</tr>
<tr>
<td></td>
<td>• Identification of operational needs of WD assets</td>
</tr>
<tr>
<td>Wastewater Collection (WWC)</td>
<td>• Development of maintenance plans for WWC assets</td>
</tr>
<tr>
<td></td>
<td>• Development of TAMPs for WWC assets</td>
</tr>
<tr>
<td></td>
<td>• Maintenance, assessment, and minor renewals for WWC assets</td>
</tr>
<tr>
<td></td>
<td>• WWC asset data collection and entry</td>
</tr>
<tr>
<td></td>
<td>• Identification of operational needs of WWC assets</td>
</tr>
<tr>
<td>Hanahan Water Treatment Plant (HWTP)</td>
<td>• Development of maintenance plans for HWTP assets</td>
</tr>
<tr>
<td></td>
<td>• Development of TAMPs for HWTP assets</td>
</tr>
<tr>
<td></td>
<td>• Maintenance, assessment, and minor renewals for HWTP assets</td>
</tr>
<tr>
<td></td>
<td>• HWTP asset data collection and entry</td>
</tr>
<tr>
<td></td>
<td>• Identification of operational needs of HWTP assets</td>
</tr>
<tr>
<td>Department</td>
<td>AM Responsibilities</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| Environmental Resources (ERD)    | • Development of maintenance plans for ERD assets  
• Development of TAMPs for ERD assets  
• Maintenance, assessment, and minor renewals for ERD assets  
• ERD asset data collection and entry  
• Identification of operational needs of ERD assets |
| Customer Service                 | • Development of maintenance plans for meter assets  
• Development of TAMPs for meter assets  
• Maintenance, assessment, and minor renewals for meter assets  
• Meter asset data collection and entry  
• Identification of operational needs of meter assets |
| Information Technology (IT)      | • Information system development, management, and support  
• Technical support of database management  
• Management of IT assets  
• AM IT resource needs analysis support |
| Accounting                       | • Management of asset valuation and depreciation activities  
• Operational and Capital asset cost allocation |
| Budgeting                        | • Operational budget allocation for asset assessment needs  
• Operational budget allocation for asset maintenance  
• Capital budget allocation for asset renewals  
• Budget request analysis |
| Finance and Billing              | • AM capital and operational expenditure analysis and reporting  
• Guidance and support of long term AM financial forecasting  
• AM competency building  
• AM human resource needs analysis support  
• AM human resource allocation |
| Human Resources                  | • Management of fleet and facility assets  
• Safety planning, training, assessment, and reporting for AM tasks |
| Safety and Support Services      | • AM related purchasing and contract development  
• Supply chain monitoring and management |
| Purchasing                       | • Management of AM program auditing  
• Recommendation of AM program improvement opportunities |
| Internal Auditing                | • Reporting lab results which may indicate potential asset degradation  
• Management of laboratory assets |
3. Capital Improvement Program

The CWS Capital Improvement Program (CIP) is the primary capital project prioritization and justification mechanism. It serves as the business case for capital expenditure and master planning for both growth-related and AM-related projects (see Appendix I.6. CIP 2014-17). Although the CIP has resulted in significant progress towards effectively managing existing assets, currently there is no differentiation between AM and growth-related Capital Expenditure (CapEx). This complicates the tracking of the AM infrastructure investments and the potential impacts. Prioritization of capital AM projects and the corresponding assets is typically done reactively based on operational need. This approach does not conform to data driven, risk-based, and systematic processes recommended by the EUM 2017, ISO 55000, and Governmental Finance Officers Association (GFOA). It is recommended that the following changes, which support the AM program, are considered for future iterations of the CIP; AM scope is identified and differentiated in order to more effectively track the AM investment; and efforts are made to develop and incorporate data driven risk prioritization methods for more effectively targeting capital AM investments. An excerpt from the CIP Annual Report 2016 Executive Summary (see Appendix I.19. CIP Annual Report 2016), which provides an overview of the program, has been provided below for reference:

The Charleston Water System’s 2010 Capital Improvements Program together with the Charleston Water System’s 2014 Capital Improvements Program (collectively the CIP) consists of master plan improvements and expansions to water and wastewater infrastructure for the years 2011 through 2018. Each of the plans constituting the CIP was developed based upon long-term master planning undertaken by the staff and consulting engineers, and were adopted by the Commissioners in 2010 and 2014, respectively. The CIP was designed not only to accommodate projected growth within the service area, but from an asset management perspective to also include substantial funds for rehabilitation and replacement of aging infrastructure. It further includes project funding to help meet an increasing number of utility relocation needs resulting from SCDOT and County road improvements projects. The construction schedule for the various improvements included in the CIP was determined on the basis of relative need and importance of each such improvement, the time required for planning and design work, and the extent to which modifications can be effected on existing facilities. The CIP is financed out of proceeds of the Series 2010 Bonds and the Series 2015 Bonds, as well as from current and future revenues and funds of Charleston Water System.

4. Financial Position, Asset Funding, and Rate Model Considerations

The Comprehensive Annual Financial Report (CAFR) is CWS’s single point of truth for financial data and information (see Appendix I.7. Comprehensive Annual Financial Report 2016). The report outlines the detailed financial positions of all aspects of the organization’s operations in conformance with the guidelines of the GFOA and Generally Accepted Accounting Principles (GAAP) as applied to local government entities which are prescribed by the Government Accounting Standards Board (GASB). Financial reporting considered directly related to AM is summarized by the CAFR 2016 excerpts provided below:

Financial Position: Total assets increased by $46.67 million in 2016 compared to $196.40 million in 2015. Current assets increased by $22.51 million. Capital assets grew by $67.02 million as we continued to work on our capital improvement program. Total liabilities increased by $5.63 million or 0.77% in 2016 as compared to the $148.93 million or 25.45% increase in 2015. The primary difference is there was no capital improvement debt issued in 2016.
D. ORGANIZATIONAL CONTEXT

**Operating Expenses:** The maintenance and upkeep of Charleston Water’s infrastructure is part of our operating expenses. The water distribution system is composed of 1,758 miles of pipes and 9,427 hydrants, while the wastewater collection system contains 578 miles of gravity sewer pipe and approximately 121 miles of sewer force main. The Hanahan Water Treatment Plant is a surface water treatment plant with a finished water capacity of 115.4 million gallons per day (MGD). The Plum Island Wastewater Treatment Plant has a design capacity of 36 million gallons per day (MGD). Total operating expenses increased by $3.88 million or 4.26% in 2016, which was more than the 2015 increase of $2.87 million or 3.25% in 2015. Personnel services, maintenance and repairs, and depreciation continue to be the largest components of operating expenses.

**Rate Covenant:** Charleston Water has covenanted to maintain rates and charges for its products and services which at all times shall be sufficient to pay operation and maintenance expense to keep the system in good repair and working order, to provide for the punctual payment of the principal and interest on all outstanding debt, to maintain the required amounts in the debt service and debt service reserve accounts, to build and maintain a reserve for depreciation for contingencies and improvements, and to discharge all obligations imposed by the bond ordinance. Charleston Water has further covenanted to collect rates and charges, which together with other income, will reasonably yield annual net earnings of at least 120% of the annual principal and interest requirement. The net earnings available for debt service were 206% in 2014, 215% in 2015 and 228% in 2016.

**Capital Assets:** At year-end 2016, the balance in capital assets was approximately $1.07 billion. This balance includes property, plant, and equipment in addition to infrastructure assets such as water and sewer lines and water and sewer treatment plants.

**Long-Term Debt:** In 2016, revenue bonds of $165 million par value were refunded to reduce our future interest burden. We saw a decrease in interest expense in 2016 and should see that trend continue as a result of the bond refunding. The amount of outstanding bonds at year-end decreased from $608.14 million to $587.41 million due mostly to scheduled debt repayment. Rating reviews were conducted prior to refunding by Moody’s, Standard and Poor’s, and Fitch Ratings. All of our credit ratings were affirmed with Standard and Poor’s, Moody’s and Fitch Ratings at AAA, Aaa and AA+ respectively.

5. Stakeholder Requirements

Stakeholder AM expectation statements were gathered from twenty four senior leaders and the five officers over the course of sixteen meetings carried out between the 23rd of January 2017 and 22nd March 2017. Those statements were captured with minimum pretext provided in order to promote objectivity in the statements. The statements were classified into ten categories and twenty eight sub categories related to AM. The resulting data was analyzed to identify and prioritize the AM expectations (see Appendix I.8. Stakeholder Expectations Analysis). The categories and subcategories were ranked based on the frequency of statements that applied to each respective category. The expectations with the highest potential to satisfy stakeholders were established. These expectations have been utilized throughout the AM strategic planning process to guide decision making and develop objectives. Satisfying the highest priority expectations ensure continued stakeholder support and sustainability of the AM program. The results of the stakeholder expectations analysis are provided below in tabular and graphical formats:
### Table 3. AM Stakeholder Expectations by Category

<table>
<thead>
<tr>
<th>Priority Rank</th>
<th>Stakeholder Expectation Category</th>
<th># of Statements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Strategy</td>
<td>25</td>
</tr>
<tr>
<td>2</td>
<td>Communication</td>
<td>18</td>
</tr>
<tr>
<td>3</td>
<td>Data and Asset Register</td>
<td>17</td>
</tr>
<tr>
<td>4</td>
<td>Budgeting</td>
<td>15</td>
</tr>
<tr>
<td>5</td>
<td>AM Planning</td>
<td>10</td>
</tr>
<tr>
<td>5</td>
<td>Risk and Criticality</td>
<td>10</td>
</tr>
<tr>
<td>6</td>
<td>Metrics</td>
<td>9</td>
</tr>
<tr>
<td>7</td>
<td>Resourcing</td>
<td>8</td>
</tr>
<tr>
<td>8</td>
<td>Project Management</td>
<td>7</td>
</tr>
<tr>
<td>9</td>
<td>Change Management</td>
<td>3</td>
</tr>
</tbody>
</table>
Figure 2. AM Stakeholders Expectations by Category Graph

Stakeholder Expectation Statements by Category

- Strategy: 25
- Communication: 18
- Data and Asset Register: 17
- Budgeting: 15
- AM Planning: 10
- Risk and Criticality: 10
- Metrics: 9
- Resourcing: 8
- Project Management: 7
- Change Management: 3

Category
## D. ORGANIZATIONAL CONTEXT

### Table 4. AM Stakeholder Expectations by Subcategory

<table>
<thead>
<tr>
<th>Priority Rank</th>
<th>Stakeholder Expectation Subcategory</th>
<th>Related Category</th>
<th>Difference in Priority</th>
<th># of Statements</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Asset data is available and useful for all associates</td>
<td>Data</td>
<td>100</td>
<td>11</td>
</tr>
<tr>
<td>2</td>
<td>Data and plan driven budgeting and acct processes</td>
<td>Budgeting</td>
<td>73</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>Long term planning of maintenance, assessments and renewals</td>
<td>AM Planning</td>
<td>73</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Alignment with existing strategies and culture</td>
<td>Strategy</td>
<td>64</td>
<td>7</td>
</tr>
<tr>
<td>4</td>
<td>AM concepts communicated to the organization</td>
<td>Communication</td>
<td>55</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Measures the effectiveness of the AM Program</td>
<td>Metrics</td>
<td>55</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Resources considered in AM Strategy development</td>
<td>Resourcing</td>
<td>55</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Data drives planning and decision making</td>
<td>Strategy</td>
<td>55</td>
<td>6</td>
</tr>
<tr>
<td>5</td>
<td>Objectively measure the criticality of assets</td>
<td>Risk</td>
<td>45</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Risk drives project prioritization and investment</td>
<td>Risk</td>
<td>45</td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>Long term forward planning of budgets</td>
<td>Budgeting</td>
<td>36</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Improved documentation practices</td>
<td>Communication</td>
<td>36</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Organizational support for AM Program is maintained</td>
<td>Strategy</td>
<td>36</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Maintenance needs considered for growing asset base</td>
<td>Budgeting</td>
<td>27</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Aligned practices across all operational departments</td>
<td>Communication</td>
<td>27</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Improved communication between operations and financial departments</td>
<td>Communication</td>
<td>27</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td>Improve existing metrics for AM related processes</td>
<td>Metrics</td>
<td>27</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>AM Strategy accounts for change management</td>
<td>Change Management</td>
<td>27</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Improved project creation and planning processes</td>
<td>Project Management</td>
<td>27</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Existence of historic assets validated and documented</td>
<td>Data</td>
<td>27</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Establish process for valuing historic assets</td>
<td>Data</td>
<td>27</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Well defined strategy and objectives</td>
<td>Strategy</td>
<td>27</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Existing tools are used to their full functionality</td>
<td>Strategy</td>
<td>27</td>
<td>3</td>
</tr>
<tr>
<td>8</td>
<td>Advancement of modern technological asset monitoring capabilities</td>
<td>AM Planning</td>
<td>18</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Clearly defined AM roles and responsibilities</td>
<td>Communication</td>
<td>18</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Improved major capital project delivery processing time</td>
<td>Project Management</td>
<td>18</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Improved asset data capture for major capital projects</td>
<td>Project Management</td>
<td>18</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Improved support for wholesale customers and assets</td>
<td>Strategy</td>
<td>18</td>
<td>2</td>
</tr>
</tbody>
</table>

Corporate Risk
CWS does not systematically manage risk as an organization. Risks are typically identified as a result of adverse consequences and treatments are reactively developed and implemented. This has resulted in a wide variety of misaligned and undocumented approaches across the organization.

Process Risk
The current approach to managing risk at the process level is the aspect grading requirements of the ISO 14001 Environmental Standard certified CWS Environmental Management System (EMS). Although this is an excellent method for identifying critical processes, it only represents one component of risk related to understanding the level of environmental consequences. EMS aspect grading is also limited in its application, as it is intended specifically for processes and environmental impacts.

Project Risk
Project risk is managed intuitively based on organizational experience and knowledge of the respective departmental project managers. Major capital projects generally have more rigor and documentation regarding risks than operational projects. Major capital project risk is typically identified by supporting consultants according to their proprietary risk identification processes or through operational departmental knowledge. These risks are incorporated into the master planning process to assist in project prioritization. Although this approach is helpful it is not systematic or consistent and can result in a lack of equity between the risk identified among different projects. This creates missed opportunities to reprioritize capital investments. Net recurring projects delivered by the operational departments lack a formal process for risk prioritization. Generally projects are prioritized based on asset failure and maintenance data generated by the CMMS, the intuitive application of operational knowledge, and the perceived severity of the emergent failures many of the projects are intended to address.

Asset Risk
Although significant gains were made towards understanding and establishing asset criticality over the course of 2017, CWS still lacks a formal process for establishing asset risk. In general the approach to asset risk relies on operational knowledge and asset failure history. This is commonly referred to as a “reactive” or “run to failure” approach to AM. The assets which fail the most are treated first, irrespective of the assets which may actually pose the greatest risk to the organization. This is due to an inability to accurately identify critical assets, inconsistent condition data for critical assets, and the absence of a process for assigning probability and consequence of failure to assets (the two factors contributing to risk). Efforts will continue through 2018 and beyond to develop the automation of asset risk profiles within the asset registers (see Section D. AM Approach). Efforts will also be applied to consistently identify, mitigate, and document risks associated with the AM program.

7. Current Approach to Levels of Service
AM relies heavily on LOS to set work program improvement targets and track progress towards achieving those targets. A LOS is defined by the International Infrastructure Management Manual (IIMM) as:

*The parameter or combination of parameters that reflect social, political, environmental, and economic outcomes that the organization delivers. LOS statements describe the outputs or objectives an organization or activity intends to deliver to customers.*
D. ORGANIZATIONAL CONTEXT

Formal LOS for CWS do not exist currently in a capacity that can promote AM program growth. Key Performance Indicators (KPI), regulatory requirements, new development minimum standards, customer service specifications, and the organizational mission statement serve as default LOS. In many cases it is difficult to tell how these default LOS are aligned with strategic initiatives. The data collection and documentation processes for the default LOS are inconsistent and do not necessarily correspond to minimum service thresholds. These factors along with the current organizational approach to performance measurement presents difficulty in planning and tracking asset improvement objectives. Although CWS has participated in utility benchmarking programs such as the European Benchmarking Co-operation and Qualserv, these comparisons fall short of providing actual LOS.

Examples of the CWS default LOS are provided below:

- **CWS Mission Statement**: Support public health and protect the environment.
- **CWS Development Standard for Minimum Water Pressure**: The minimum pressure in all public water mains under conditions of maximum instantaneous demand shall be 25 psi at every customer’s tap. 20 psi will be acceptable at any tap when fire flows or flushing flows are provided in excess of maximum peak hourly flow.
- **CWS Contact Center Service Level**: CWS’s Contact Center standard is 77% of calls answered within 60 seconds.

The absence of a formalized LOS framework is considered an impediment to AM program development. As a result, asset-related LOS will be addressed at a tactical AM planning level throughout the 2018-23 strategic planning cycle. However, there is a greater organizational need to establish a LOS framework and a full range of LOS that can be formally communicated to stakeholders and customers.

8. Current Approach to Resourcing

Appropriate resourcing is an important aspect of AM program success. Without adequate resources in place to develop and maintain an AM program the organization runs a significant risk of failing to achieve AM objectives in reasonable time frames. This can lead to AM program stagnation, diminished stakeholder support, and wasted expenditure and efforts. If the purpose of the AM program is not illustrated to stakeholders with tangible results there will be a tendency to return to unsustainable traditional reactive AM approaches.

CWS currently has two associate positions dedicated to AM program development and maintenance. Those positions include the AM Program Manager and AM Analyst. These associates are responsible for coordination, communication, and documentation of AM initiatives. In addition to these associates, associates from the departments with AM responsibilities collaborate on AM decisions, plans, strategies, and tasks as an additional activity within their standard operational duties. This group of associates typically meet an average of once per month as a part of the AM team. The departments with representatives on the AM Strategic Team include: AMandGIS, Engineering and Construction, Accounting, Customer Service, Wastewater Collections, Environmental Resources, Hanahan Water Treatment Plant, and Information Technology.

CWS currently has no method for analyzing the resource requirements for achieving objectives. The application of resources has been primarily intuitive up to this point. This is considered a significant impediment to establishing realistic time frames for AM program development. As a result a model has
been developed to estimate the resource requirements and time frames for delivering the AM strategic objectives (see Appendix I.9. Resource Analysis Model). This model will be used to provide a data-driven approach for analyzing resource requirements, establishing time frames, and communicating resource requirements to CWS senior leadership.

Discussions with industry AM leaders such as Portland Water Bureau, Henderson Utility Services, and the District of Columbia have yielded a common theme in AM program success. The investment of resources into AM is directly proportional to the speed at which an AM program is developed and improved returns on asset investments achieved.
1. AM Decision Making

AM program development throughout 2017 has proceeded according to IIMM, IAM, and ISO 55000 guidelines. The focus on the initial stages of development has been on communication, policy creation, AM team development, understanding the organizational context, and documentation of the AM strategic objectives and strategies in the SAMP. The purpose of this has been to prepare for the transition from strategic AM planning to tactical AM planning. AM program development has proceeded according to a logical progression of IAM recommended activities and has been considerate of the CWS organizational context. The building blocks of this approach were planned and documented in early 2017. The plan was followed throughout the year and has culminated in the documentation of the SAMP and a clear strategic direction for AM program development moving forward. As each of the AM program foundational building blocks are created they are documented and socialized to AM program stakeholders. Future AM program development will also take into account EUM requirements to facilitate alignment with the Corporate Strategic Plan 2023. The following AM program development diagram illustrates the relationship and interaction of the various AM program elements:

Figure 3. AM Program Development Diagram
E. AM APPROACH

2. Alignment of AM Program with ISO 55000 AM Standard

The ISO 55000 suite of AM standards are the governing standards the CWS AM program will be developed and managed according to. ISO 55000 was chosen for the following reasons:

- It is an internationally recognized standard
- There are numerous organizations to benchmark against
- CWS is currently certified for ISO 14000 EMS standard
- There are readily available ISO 55000-focused AM maturity assessment tools and processes

ISO 55000 is an international standard that has recently conditioned public utilities’ approaches to AM. There has been an organizational push to align with ISO standards which includes ISO 14000 EMS. This provides several benefits including alignment to proven industry standards and the ability to compare CWS practices across a full range of regional, national, and international utilities.

CWS has thus far demonstrated alignment with ISO 55000 in the following ways:

- AM program framework established based on ISO 55000 guidelines
- Maturity assessment tool selected and administered according to ISO 55000 and IAM guidance
- AM program effectiveness measured by ISO 55000 aligned metrics
- Policy and SAMP developed and documented according to ISO 55000 guidelines

CWS will continue adhering to the guidelines of ISO 55000 as the AM program is developed during the 2018-23 strategic planning cycle. The primary resource guiding the development of the CWS AM program will continue to be the IIMM published by Institute of Public Works Engineers Australia (IPWEA). This manual provides detailed guidance on AM program development and maintenance in conformance with the ISO 55000 standard according to the input from international AM industry leaders (see Appendix I.14. International Infrastructure Management Manual).

3. Alignment with Corporate Strategic Plan (Vision 2017 and 2023)

Vision 2017

AM program development was undertaken during the course of the Vision 2017 Corporate Strategic Plan (see Appendix I.3. Vision 2017 Corporate Strategic Plan). AM-related hallmarks of Vision 2017 include an objective for the Operations Focus (OF) strategic team that states CWS shall, “fully implement a comprehensive AM program to include infrastructure and technology.” CWS did not succeed in accomplishing this objective due to resource constraints. However, an investment into AM resources was made in 2015 and again in 2016 allowing for substantial AM program progress throughout late 2016 and 2017. Although improved, resourcing is still a constraint and as a result may continue to limit the ability to deliver a fully documented AM program within the 2018-23 strategic planning cycle. Despite this constraint, CWS is still poised to make considerable AM program progress over this strategic planning cycle when compared to the progress achieved over the previous planning cycle. In addition to the obvious alignment with the noted OF team objective, the AM program has been structured to align with Vision 2017 organizational vision and core values. The AM policy principles and drivers clearly reflect this alignment as illustrated in the figures provided below:
Figure 4. AM Program Drivers Alignment with CWS Mission

AM Drivers per Policy
- Strategic Plan
- Safety
- Environmental
- Levels of Service
- Value for Money

CWS Mission per Vision 2017
Our mission is to protect public health and the environment of our service community by providing clean water services of exceptional quality and value.

Figure 5. AM Program Principles Alignment with CWS Mission

AM Principles per Policy
- Open and Honest Communication
- Accountability and Data Driven Decisions
- Achieving Utility Industry Excellence
- Risk and Criticality Awareness
- Continual Improvement and Innovation
- Teamwork
- Consistency and Integration
- Resource Development
- Sustainability
- Customer Service Focus

Our Core Values Per Vision 2017
- Open and Honest Communication
- Accountability
- Innovation
- Teamwork
- Ethical Behavior & Integrity
- Customer Service Focus
E. AM APPROACH

Vision 2023

The corporate strategic plan for the 2018-23 strategic planning cycle, Vision 2023, will maintain the mission, and core values from Vision 2017. Alignment of the AM program with these aspects has been achieved and will be maintained through the Vision 2023 planning cycle. The most notable addition to Vision 2023 is the incorporation of the EUM framework as a central guide to organizational business process improvements. The EUM framework and AM program have natural alignments as the EUM has been developed by AM-focused utility industry leaders. This natural alignment is exemplified by the EUM Primer Key Messages to the Water Sector. An excerpt from the EUM Primer has been provided below:

Key Messages to the Water Sector

EUM and this Primer are the keys to unlock the potential of your utility to protect public health and the environment in the 21st century:

- EUM helps you take a 360-degree look at your utility and then set priorities that work for you and your community.
- It helps you protect your current infrastructure investments and ensure that your workforce is motivated and able to address the challenges that they face every day.
- It moves you from reacting only to the “hot priorities” of the day to proactively planning for the future.
- It helps you engage your staff in the process of assessing and charting your own course for the future.
- It is simple, actionable, affordable, and scalable to meet the needs of all utilities.
- Finally, YOU CAN DO THIS. Staff across all levels of your utility can use the Primer, helping them collaborate internally and work with the community to provide affordable and sustainable services.

In addition to the incorporation of the EUM, CWS associates were given the opportunity to provide input into the strategic planning process by providing Strength-Weakness-Opportunity-Threat (SWOT) statements. A total of 962 SWOT statements were gathered, categorized according to the EUM attributes, and then prioritized. The prioritization consisted of a simple voting process conducted by Vision Achievement Team (VAT) members, Steering Team Leaders, and Point Leaders as a part of the VAT workshop conducted in October 2017. The Infrastructure and AM category received a substantial amount of attention indicating the organizational desire to maintain AM program development as a priority for Vision 2023.

In order to supplement the corporate strategic planning process in a manner that is productive for AM program alignment, a separate analysis was conducted on the 962 statements. This analysis was intended to identify the strengths, weaknesses, opportunities, and threats associated with specific AM focus areas and establish relationships between those focus areas and the EUM attributes. The general results of the AM program focused SWOT analysis demonstrate the alignment and overarching influence of EUM on AM. The results also reflect the findings of the Stakeholder Expectations Analysis and AM Gap Analysis which highlights risk, AM program development, and resources as areas requiring significant focus during the 2018-23 strategic planning cycle.
4. AM Communication and Education

Organizational communication and education is an important aspect of building and maintaining a mature AM program. One of the primary objectives of 2017 was to develop and implement an AM communication and outreach plan to guide the development of the CWS AM program and foster the transition towards an AM focused organizational culture during the 2018-23 strategic planning cycle. That plan has been beneficial in achieving communication initiatives including:

- Establishing a regular AM-focused feature article in the Water Weekly organizational newsletter with a total of 22 articles having been published in 2017
- Conducting stakeholder interviews and one on one meetings with senior leadership
- Providing AM presentations to the AM team, EandC and AMandGIS departments, Operations Focus Team, and SPLT/VAT
- Working with the full range of organizational SMEs in seven AM maturity assessment workshops
- Development of material to support AM focused training that will be rolled out to all associates as a part of the Leadership Training Program

Communication and education will continue as a prevalent theme in AM program development during the 2018-23 strategic planning cycle. The communication and education action plan has been developed to reflect the objectives of this SAMP and the tasks completed in 2017. The primary focus of this action plan will be to develop and implement an AM-focused Leadership Training Block. This objective along with other communication-focused initiatives will be undertaken using the basic principles of the AM communication plan which have been outlined below.

Purpose

The primary reason in planning for and engaging in robust communication is to facilitate a smooth and seamless evolution of the AM program through proactively educating stakeholders. This will ensure the organization has associate level ownership of the AM program, which in turn will promote the greatest potential for AM program success.

Audience

- **Executive Leadership:** communication of AM program development progress
- **Department Heads (Directors and Assistant Directors):** communication of AM program strategy development, task level progress and requests for feedback and approvals.
- **Team Leaders and Subject Matter Experts (Coordinators, Supervisors and Managers):** communication of task development, action item progress and requests for updates and feedback.
- **Strategic Plan Operations Focus Team and Point Leaders:** communication of AM program strategy development, task level progress and requests for feedback.
- **Organization Wide:** communication of AM educational objectives and general awareness.

Message

- **Purpose of an AM Program:** to provide the most efficient, cost effective, safe and environmentally friendly assets possible through the proactive maintenance, assessment, renewal, documentation,
accounting, and long term planning of the assets in a consistent, structured, and measurable program.

- **Benefits**: including but not limited to greater efficiency of operation, clearly defined long term maintenance and capital works budgets, reduction in asset failures, increased return on investment, transparent budget justification, identification of synergies across departmental groups and reduction of unplanned impacts to customers.

- **Impacts**: policy, process, reporting and procedure changes are all likely impacts of AM program evolution. One of the intentions of this communication plan is to identify these potential specific impacts and adequately address them through proactive change management.

- **Change Management (CM)**: training, educational and change management initiatives are imminent with the development of any new program. This communication plan will identify potential CM issues with AM program development and provide suitable responsive measures to facilitate positive change and avoid substantial delays to implementation.

- **Clear and Transparent Progressive AM Communication**: the success of an AM program is wholly dependent on all parties participating in robust and transparent communication of AM related subjects particularly regarding lessons learned and successes achieved across departments. This will ensure that groups are not operating in a vacuum thus avoiding repeating mistakes twice or missing improvement opportunities. If we, as CWS associates, are unable to communicate in a transparent manner regarding AM then we will be unable to transparently communicate to the commission, external stakeholders and customers.

**Communication Methods**

- **Email**: communication of AM updates, general information, circulation of documentation for review or approval and arrangement of meetings

- **Phone**: relationship building, quick clarifications, strategy discussion and general feedback

- **Team Meetings**: communication of strategy development, task level agendas, action item progress, schedule updates, performance review, general feedback, and identification of issues which may affect the development of an AM program

- **One on One Meetings**: relationship building, conflict resolution, department level strategy development and identification of coordination issues

- **Reports**: formal communication of AM planning, policy, procedures, and processes

- **Trainings and Presentations**: communication of broader AM concepts, specific task level procedures, education, general awareness, and guidance on the use of system tools

5. **AM Decision Making**

AM decision making has been delegated to the AM team. This team is a cross functional group that includes representatives and SMEs from each of the departments considered to have substantial AM responsibilities. The represented departments include; AM and Geographic Information System (AMandGIS), Engineering and Construction (EandC), Accounting (ACCT), Environmental Resources Department (ERD), Wastewater Collection (WWC), Hanahan Water Treatment Plant (HWTP), Water
Distribution (WD), Customer Service (CS) and Safety and Support Services (SSS). Over the last two years this team, under the coordination of the AMandGIS Director initially and the AM Program Manager more recently, has been responsible for the delivery of AM task-level objectives and developing the strategic AM direction. The AM team meetings have occurred monthly since the team’s inception. In general the AM decision-making process has been systematic and consistently undertaken according to typical project management stakeholder engagement process. The AM team decision-making process consists of:

- Problem identified and communicated to AM team
- AM team provides feedback on desired outcome or expectations
- AMandGIS representatives develop and analyze solution options
- Options communicated to AM team
- AM team selects preferred option and provides initial feedback
- Preferred solution option is documented as an Action Plan (AP)
- AP is communicated to AM team
- AM Team provides feedback on AP
- AP finalized and implemented
- AP progress reported monthly to AM team

Delivery of APs has thus far been facilitated by task focused subcommittees of the AM team. The first of which being the Plant Asset Register Development Subcommittee (PARD) and the second being the PowerPlan Preparation Subcommittee (PPP). The subcommittees have met at a variable frequency based on resource availability. Generally, this has been monthly.

Although the decision making approach described above has been focused and productive, several circumstances have prompted changes to the team structure for the 2018-23 strategic planning cycle. The circumstances affecting the decision-making process include:

- Resource availability
- A need for greater efficiency of meeting time,
- Transitioning from strategic AM focus to tactical AM focus
- Need for greater leadership representation in strategic decisions

As a result the AM decision making approach will be altered to reflect the current circumstances. The process outlined above will be maintained. However, the team structures and frequencies of meeting will be changed.

The changes will include establishing a Strategic AM Team (SAM Team) that meets quarterly and includes CWS senior leadership as core members. Director and assistant director level associates with AM responsibilities will be required attendees while Executive Officers will be optional attendees. These meetings will focus on identifying AM gaps, making strategic decisions, final approval of tactical APs, and updating the progress of tactical AP delivery. This is intended to prompt input from the necessary decision makers on AM elements that may have an impact on departmental resourcing, scheduling, and budget allocations. This structure will promote efficiency in approval processing and more economical use of senior leadership’s time thus reducing the relative associated costs of achieving AM decisions.
The SAM Team will oversee two tactical teams that meet monthly and are intended to facilitate delivery of task-level events. The teams will be structured to reflect the organizational decision to use different asset registers and work order systems. Assets maintained by the WD and WWC departments are housed in GIS and managed through the Cityworks CMMS. Infor EAM contains both the asset register and the work management data for each of the treatment plants. As a result the AM tactical teams will be divided into a Plant Asset Sub-Team (PAS Team) and a Network Asset Sub-Team (NAS Team). This structure will promote more efficient use of meeting time and help focus each team’s effort on tasks relevant to the actual assets the team members are responsible for. The AM team structure and work flow are illustrated in the diagrams provided below:

**Figure 6. AM Team Structures**
6. AM Program Documentation Requirements

AM planning is documented in a variety of formats depending on the nature of the activity. The primary mechanism for documentation of AM program development is the AM team meeting minutes and agendas which are stored on the AM team SharePoint (SP) site (see Appendix I.12. AM Team Meeting Minutes and Agendas). AM research and analysis results are provided in a technical memorandum format while larger bodies of work such as the SAMP and CAMP are provided in a formal technical report format. Final drafts of AM memorandums and reports are also stored on the AM team SP site (see Appendix I.13. AM Team SharePoint Page). Other AM documentation, which can be accessed on the AM team SP site include:

- Educational and informative presentations
- Research memorandums and research references
- Strategy delivery action plans
- Planning tools

AM related Standard Operating Instructions (SOI) and process maps are documented according to EMS formatting and storage requirements. The Quality Management System (QMS) is the single point of truth for SOI, policy, and process related documentation. A listing of key AM planning documentation requirements has been provided in the table below:

Table 5. AM Program Key Documentation Requirements

<table>
<thead>
<tr>
<th>Document</th>
<th>Description</th>
<th>Format</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM Policy</td>
<td>The AM policy provides the organizations commitment to AM along with the drivers, principles and responsibilities for developing and maintaining an AM program.</td>
<td>• Technical Memo (signed)   • EMS</td>
<td>• QMS • AM team SP site (reference)</td>
</tr>
<tr>
<td>Strategic Asset Management Plan</td>
<td>The SAMP provides the AM strategic objectives and the strategies for achieving them. It also outlines the planning process and justifications for choosing or prioritizing objectives.</td>
<td>• Technical Report</td>
<td>• AM Team SP site</td>
</tr>
<tr>
<td>Tactical Asset Management Plans</td>
<td>The TAMPs provide the tactical plans for each of the primary asset types. It provides lifecycle models, assessment and renewal treatment specifications and cost estimates, SOIs, processes, performance metrics, and LOS.</td>
<td>• Technical Memo</td>
<td>• AM team SP site • Operational department SharePoint sites (reference)</td>
</tr>
<tr>
<td>Corporate Asset Management Plan</td>
<td>The CAMP provides documentation of the entirety of the AM program including the Asset Information Management System (AIMS), Asset Portfolio, TAMPs, SAMP, Policy, and long term AM cost forecasts.</td>
<td>• Technical Report</td>
<td>• AM team SP site</td>
</tr>
<tr>
<td>AM Team Meeting Minutes and Agendas</td>
<td>The AM team minutes and agendas documents the LOE and progress made towards achieving strategic goals and delivering tasks. They also provide the history of AM program development to the current point in time.</td>
<td>• CWS Template</td>
<td>• AM team SP site</td>
</tr>
</tbody>
</table>
7. Risk Management

Risk management is a fundamental practice of an AM Program. An organization’s Risk Management Program (RMP) provides a framework, guidance, and systematic process for managing all forms of organizational risk including AM program-related risks. Although CWS manages some risks informally it lacks a consistent, systematic, and comprehensive approach. This is considered an impediment to AM program development. A formalized RMP is usually the responsibility of a single department or team within an organization, although there is heavy reliance on a full range of stakeholders to contribute to the development of the program. The alignment of risk management activities throughout CWS is considered a company-wide initiative that is outside the scope of the AM program due to the complexity and resource requirements. As a result, an AM program-specific approach to risk management will be developed and utilized as an interim measure. Research and analysis were conducted to identify the most advantageous approaches to risk management for both the organization and the AM program. The results of this analysis were reported on, and outline the intended approach to managing AM program and asset risks (see Appendix I.10. Risk Management Program Report).

AM Program Risk Management

Based on the Risk Management Report recommendations, the AM program approach to risk management will be developed according to the principles, framework, and processes outlined in the ISO 31000 Risk Management Standard (ISO 31000). The reasons for utilizing this standard include:

- ISO 31000 is an internationally accepted standard that is based on many of the same principles ISO 14000 Environment Management Standard is founded
- ISO 31000 aligns with ISO 55000 AM standard on which the CWS AM program is founded
- Allows for eventual alignment with a corporate RMP once it is developed
- Meets the basic needs of the AM program

ISO 31000 is designed to “help organizations increase the likelihood of achieving objectives, improve the identification of opportunities and threats, and effectively allocate and use resources for risk treatment.” It focuses on mitigating risks that will impact the success of achieving organizational objectives. It is designed to be applied to “strategies and decisions, operations, processes, functions, projects, products, services and assets”. The AM program does not plan to develop a sophisticated risk management framework within the scope of this five-year planning cycle. It will instead focus efforts on developing a basic risk management framework that aligns with ISO 31000 Standard and specifically targets AM program risks.

Asset Risk Management

The AM team began delivery of the PowerPlan Asset Investment Optimization (AIO) Preparation strategy action plan in May 2017. This action plan was focused on developing standards for assessing asset risk. The PowerPlan AIO Preparation subcommittee (PPP), a smaller group of the AM team, identified an objective for developing asset criticality concepts and tools.

Development efforts for an asset risk framework have primarily been the responsibility of the PPP. The initial focus of the team was establishing the criteria and weighting factors for asset criticality to support the deployment of PowerPlan AIO. Criticality is related to Consequence of Failure (COF) which is one of the three component variables of the risk profiling equation. The other two components are the risk
score itself and the Probability of Failure (POF). Critical assets are generally assets with the highest COF (generally the most costly to fix). Substantial progress was made towards establishing and documenting criticality criteria for assets in 2017 (see Appendix I.11. Asset Criticality Criteria Tables). Work towards this objective will continue into 2018. This work will be focused on automating criticality scores for all assets in the respective asset register systems based on the documented criteria. This will provide a crucial missing piece of the risk profiling equation and enable CWS to leverage the full functionality of asset prioritization and planning functions of PowerPlan AIO.

Each operations department will be responsible for creating a plan to apply the accepted criticality criteria to assets which they are responsible. The technique used to apply the criteria for assets will be automated within the asset registers as much as possible. Once criticality criteria has been established each sub team will begin addressing probability criteria. POF metrics will depend on condition assessment data. Age, material, and useful life data will be used to estimate condition where reliable condition assessment data does not exist. Asset information beyond age, material, and useful life will be considered as it is available (i.e. soil corrosiveness). After POF is assigned, the AM program will have the ability to compare the risk levels of assets. Any guidance developed relating to risk management for assets will be documented in the asset’s TAMP.

8. Levels of Service

LOS are important communication tools that allow an organization to convert external and internal stakeholder expectations into objective performance requirements. LOS are typically negotiated and reflect an acceptable balance between performance requirements and the required resources necessary for delivering services to meet those requirements. A document commonly known as a customer service charter can be used to communicate the organization’s established LOS to all stakeholders. In the case of the AM program the TAMPs will be the primary means to communicate LOS specifically for asset performance. Performance measures related to each LOS will also be documented within each TAMP.

The IPWEA has produced documents that outline many LOS concepts. IPWEA’s IIMM which has a section dedicated to LOS. According to IPWEA’s IIMM, “Levels of service typically relate to service attributes such as quality, reliability, responsiveness, sustainability, timeliness, accessibility and cost.” Once LOS are established, strategic objectives (corporate or program-related) are developed which should link to at least one established LOS.

The AM program will develop a strategy for identifying and documenting LOS for assets. Regulatory, quality, capacity, efficiency, and cost requirements will be used as a basis. LOS will be identified based upon current capabilities and resource availability. Asset lifecycle planning will play a role in the ability of assets to continuously meet a minimum service level. The inability to meet a specified LOS is considered a failure in asset performance therefore is an important prerequisite for developing a mature AM program.

9. Resourcing

The ability to specify appropriate resourcing is an important aspect of AM program development and maintenance. Having too few or too many resources can have a detrimental impact on AM program progress and the ability to maintain stakeholder support. As a result, a resource analysis model has been developed. The resource analysis model is intended to provide a data driven method for analyzing the resource requirements of strategic and tactical tasks associated with the delivery of AM objectives for the
2018-23 strategic planning cycle. The model has been developed based on data from meeting minutes and agendas of the AM team over the last two years. The results of the analysis have been used to establish time frames for the delivery of AM objectives based on the currently available resources and to demonstrate the impact of additional resourcing options on AM objective delivery.

**Resource Analysis Model**

The resource analysis model takes into account the four factors that contribute to the resource outlays associated with the delivery of strategic tasks. The four factors include:

- AM staff that focus 90% of their time towards AM task delivery
- Strategic task managers that focus approximately 1.5% of their time towards AM task delivery
- Tactical task managers that focus approximately 15% of their time towards AM task delivery
- AM meeting attendance

Basic equations were created for calculating the Level of Effort (LOE) for each of these contributing factors. The summation of all of these contributing LOE factors provides the LOE for the tasks associated with a strategy. The summation of the resulting task-level LOEs provides the cumulative LOE required to deliver the associated strategies and objectives.

**Timing of AM Objective Delivery**

The resource analysis model was applied to the eight highest priority action plans to determine the LOE required to deliver them. The resulting average LOE for these action plans was used to estimate the LOE for the remaining medium priority action plans. The summation of both the medium and high priority action plan LOEs was used to determine the total LOE required to deliver all of the AM objectives proposed for the 2018-23 strategic planning cycle. Based on the model results 41,918 hours of LOE are required to deliver all of the AM objectives proposed for the 2018-23 strategic planning cycle.

Considering the currently available resources, the resource analysis model indicates the total LOE available in a given year to be 5,425 hours. The total LOE required to deliver all AM objectives proposed for the 2018-23 strategic planning cycle is 41,918 hours. Based on the currently available resources it will take approximately eight years to deliver the objectives and provide a fully documented AM program as specified by ISO 55000. Future AM resourcing initiatives will be undertaken to develop, analyze, and communicate a range of alternative resourcing options intended to expedite AM program development. These options will be communicated to senior leadership for consideration at a later date.
10. AM Program Framework

The AM program framework was developed using three primary principles; alignment with ISO 55000 AM Standard, consideration of the CWS organizational context, and adherence to the advice and guidance of AM industry leaders. Common themes of AM success identified through applying these principles included:

- Comprehensive organizational AM policies supported by senior leadership
- Strategic plans developed with organizational SME input
- Documented asset information management systems and processes
- Investment and planning for proactive asset treatments
- Clear understanding of their assets’ composition, needs, condition, and lifecycle costs
- Well defined LOS and AM metrics

The Institute of Asset Management (IAM) is considered an industry leader for AM guidance and is the primary organization responsible for developing ISO 55000. IAM guidance suggests incorporating these basic concepts into an organization-specific AM program framework:

- Alignment with the corporate strategic plan
- Robust stakeholder input and collaborative AM decision making
- Strategic AM and tactical AM planning based on the assets’ lifecycles
- Information and risk management

These concepts are illustrated in the IAM AM program framework graphic below:

Figure 7. IAM AM Program Framework Template
E. AM APPROACH

Figure 8. CWS AM Program Detailed Framework

Corporate Asset Management Plan
The CAMP documents the CWS AM program in its entirety. The CAMP defines, classifies, and values the assets that CWS is responsible for managing. The CAMP outlines the approaches to AM planning, works delivery, and information management. The CAMP also forecasts the long term capital and operational expenditure required to manage each respective asset type.

Figure 9. AM Program Hierarchy Interaction Diagram
E. AM APPROACH

Strategic Asset Management Plan
The SAMP documents CWS’s approach to asset management planning.

The SAMP answers several important questions:

- What is important to CWS stakeholders?
- How does CWS measure AM success?
- Where is CWS at now with AM?
- Where does CWS want to be in the future with AM?
- How does CWS intend to get to where it wants to be with AM?
- How soon does CWS want to get there?

Figure 10. AM Program Hierarchy Interaction Diagram

*The SAMP documents the strategies for achieving objectives relating to each of the four functional areas of the AM Program Hierarchy.*
E. AM APPROACH

Asset Information Management System

The AIMS documents the CWS AM tools and processes used to collect, store, manage, and analyze asset information and data. Several different systems are used to manage the volume and varying types of asset information required to manage CWS assets. The AIMS is responsible for the management of these systems including the asset register, work order, financial, and decision-support systems. The complex interaction of these systems will be documented in detail within the CAMP. The AIMS relies primarily on the following software systems:

- ArcGIS (asset register and decision support for network assets)
- Infor EAM (asset register, decision support, and work order management for plant assets)
- Cityworks (decision support and work order management for network assets)
- Financial Management System (FMS) (Financial tracking and decision support) (note: this system will be replaced by an ERP during the next five years)
- PowerPlan AIO (decision support and risk management)

Figure 11. AM Program Hierarchy Interaction Diagram

The AIMS supplies the asset information required to document the asset portfolio profile, provides structure to the TAMPs, and prioritizes the scope of work for Work Programs.

Tactical Asset Management Plans

The TAMPs are collections of management plans which guide how each asset type is managed throughout its lifecycle. TAMPs cover activities such as warranty inspections, operations and maintenance, assessments, and renewals. TAMPs specify the way assets are prioritized, frequency of activities, estimated cost of activities, work program structure and funding mechanisms, way works are undertaken, and associates responsible for each aspect. TAMPs also provide tactical AM metrics and targets (i.e. Reduce water distribution mains failure rate by 20% by 2022). The metrics and targets provide an ability to monitor the effectiveness of work programs to determine if program or budget changes are required.
**E. AM APPROACH**

**Figure 12. AM Program Hierarchy Interaction Diagram**

*The TAMPs along with the Asset Portfolio are used to structure Work Programs, while the AIMS designates and prioritizes the scope of work for each program.*

*Work Programs create asset information that feeds back into the AIMS in order to recondition future work programs, incorporate lessons learned into the TAMPs, and update the Asset Portfolio.*

---

**Asset Portfolio**

The Asset Portfolio describes the infrastructure assets which CWS is responsible for managing. It provides a high-level profile for each of the respective asset types. The Asset Portfolio specifies the quantities of each asset type by material (if applicable), age, condition, and criticality. The Asset Portfolio also provides the acquisition costs, estimated value, and replacement cost for each asset type. It defines the work programs utilized to manage each asset type through its lifecycle according to the TAMPs. The cost to deliver the TAMP work programs over a ten year planning horizon are estimated and provided in the Asset Portfolio.

**Figure 13. AM Program Hierarchy Interaction Diagram**

*The Asset Portfolio directly influences Work Programs by identifying the type and quantity of assets likely to require treatments during a ten year planning horizon.*
F. CWS AM OBJECTIVES AND STRATEGIES

1. AM Objectives

The AM program objectives for the 2018-2023 strategic planning cycle were developed using a collaborative decision-making process. This process was driven by data from the stakeholder expectations analysis and the AM gap analysis. Each of the resulting AM objectives are described below.

Asset Register Optimization

This objective consists of developing the plant asset register hierarchy in Infor EAM, aligning the network asset register with the plant asset register, and optimizing the functionality of both registers. The goal of this objective is to promote consistent and systematic processes for functions that rely on the asset registers.

AM Program Development

This objective consists of documenting the AM program management processes so that they can be systematically and consistently applied to future strategic planning cycles. The strategies for achieving this objective will aid in developing aspects of the AM program as specified by ISO 55000 and the IAM. ISO 55000 certification is currently not a goal of the organization but accomplishing this objective will position CWS to meet the minimum requirements for certification.

Asset Information Management System Optimization

This objective consists of optimizing and aligning the systems that contribute to the AIMS. These systems include Infor EAM, GIS, Cityworks, Granite, and PowerPlan. The primary goal of this objective is to develop efficient data collection, management, and analysis processes in order to improve AM planning capabilities.

2. Objectives Beyond the Scope of the AM Program

It is recommended that the organizational strategic planning process consider the following objectives identified during the AM gap analysis, which are considered beyond the scope of the AM program. The gaps associated with the following objectives are considered impediments to future AM program development:

- Develop a systematic and consistent organizational approach to Risk Management
- Develop a systematic and consistent organizational approach to analyzing and reporting on the resource requirements for strategic initiatives
- Develop a systematic and consistent organizational approach to analyzing and planning for the impacts associated with organizational change
- Develop a systematic and consistent organizational approach to managing and monitoring outsourced activities

3. CWS AM Strategies

Twenty AM strategies that contribute to the delivery of the AM objectives have been identified. All twenty strategies require a corresponding action plan for accountability purposes. Twelve strategies are considered priorities for delivery during the 2018-23 strategic planning cycle due to their positive impact on AM program development. Those strategies are listed in order of priority below:

- Communication and Education: Communication is an ongoing strategy that is of the highest importance due to the reliance of AM Programs success on robust open and honest communication
F. CWS AM OBJECTIVES AND STRATEGIES

...with stakeholders. This strategy is underway and considered a permanent ongoing initiative.

- **Plant Asset Register Development:** The cornerstone of AM program success is a well-developed, documented, and managed asset register that facilitates efficiency in work order execution, financial tracking, and AM planning. This strategy is underway.

- **PowerPlan Preparation and Development:** PowerPlan AIO is intended to be the AM planning and decision making engine. It will utilize data from the CMMSs, asset registers, ERP, and other information systems to prioritize and optimize asset investments based on risk, regulatory requirements, and other pertinent factors. This strategy is underway.

- **AM Resource Analysis:** A detailed resource analysis will accomplish two key outcomes; establishment of realistic timelines for strategy delivery, and development of AM resourcing options. A detailed resource analysis will be conducted early in the 2018-23 strategic planning cycle.

- **AM Risk Management Plan:** Risk management is a fundamental aspect of AM planning. In the absence of an organizational RMP an interim strategy to support the development of the AM program will be developed and delivered in the 2018-23 strategic planning cycle.

- **AM Levels of Service Development:** LOS is a fundamental aspect of AM. It is key in determining triggers for asset treatments and developing TAMPs. Asset performance related LOS will be developed and documented in the 2018-23 strategic planning cycle.

- **Network Asset Register Optimization:** Although the network asset register is developed it lacks alignment with the AM program and the full functionality has not yet been realized.

- **ERP Development Support:** The AIMS and ERP systems exchange AM and financial data. As a result they will have interlinked processes. This necessitates a strategy for ensuring the ERP and AIMS are aligned and that efficient system processes are implemented.

- **Asset Portfolio Development:** The asset portfolio is a critical component for long term AM planning. It describes the full range of assets according to the significant asset attributes such as age, material type, and condition. The Asset Portfolio is a central pillar of the AM Program framework.

- **Tactical Asset Management Plan Development:** The TAMPs provide the fundamental processes associated with each asset type including the lifecycle management plan. The TAMPs are a central pillar of the AM program framework.

- **Asset Information Management System Development:** The AIMS is the documented interactions and processes associated with the various contributing AM information systems. The AIMS is a central pillar of the AM program framework.

- **Corporate Asset Management Plan Development:** The CAMP is the documented AM program. It is a culmination of the Policy, SAMP, AIMS, TAMPs, and Asset Portfolio. Completion of the CAMP will signify the achievement of a fully documented AM program and the starting point for tracking the benefits of the AM program.

The full scope of strategies along with their respective objectives, priority ranking, and action plan development status have been provided in the below table:
### Table 6. AM Objectives and Prioritized Strategies

<table>
<thead>
<tr>
<th>AM Objective</th>
<th>AM Strategy</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Asset Register Development</strong></td>
<td>Plant Asset Register Development</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Network Asset Register Optimization and Alignment</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Facilities Asset Register Development</td>
<td>14</td>
</tr>
<tr>
<td><strong>AM Program Development</strong></td>
<td>Policy Development</td>
<td>Complete</td>
</tr>
<tr>
<td></td>
<td>SAMP Development</td>
<td>Complete</td>
</tr>
<tr>
<td></td>
<td>CAMP Development</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>AIMS Development</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Asset Portfolio Development</td>
<td>9</td>
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<tr>
<td></td>
<td>TAMPS Development</td>
<td>10</td>
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<td></td>
<td>Communication and Education</td>
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<td></td>
<td>AM Program Improvement Plan Development</td>
<td>13</td>
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<tr>
<td></td>
<td>SAMP Development 2022</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>AM Gap Analysis, Objectives, and Strategy Development 2022</td>
<td>18</td>
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<tr>
<td></td>
<td>AM Levels of Service Development</td>
<td>6</td>
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<tr>
<td></td>
<td>AM Risk Management Plan</td>
<td>5</td>
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<tr>
<td></td>
<td>AM Resource Analysis</td>
<td>4</td>
</tr>
<tr>
<td><strong>Asset Information Management Systems (AIMS) Optimization</strong></td>
<td>PowerPlan Preparation and Development</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Cityworks Optimization and Alignment</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Infor EAM Optimization and Alignment</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>GIS Capability Development</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>ERP Development Support</td>
<td>8</td>
</tr>
</tbody>
</table>
F. CWS AM OBJECTIVES AND STRATEGIES
1. Purpose of Measuring AM Maturity
Measuring AM maturity is an important aspect of AM program development and maintenance. It provides an objective measure of an organization’s AM fitness so that areas requiring improvement can be identified and AM program progress can be tracked. The primary purposes for measuring AM maturity include:

- Establishing a systematic and consistent means of measuring AM program maturity
- Establishing a baseline AM maturity rating to measure progress against
- Identifying gaps in AM maturity that can be filled by a well-constructed AM program
- Identifying gaps that are beyond the scope of an AM program and require organizational support to fill

2. Institute of Asset Management Self-Assessment Methodology
IAM SAM was chosen as the preferred AM maturity assessment tool and process because of its ability to fully meet all of the selection criteria to a satisfactory degree. Those criteria include:

- Ability to align with ISO 55000
- Minimal Cost
- Ease of Implementation
- Ability to continuously measure progress

The primary benefit of this tool is its flexibility and adaptability regarding AM standards including ISO 55000, PAS-55 and AM Landscape. The primary risk with this tool is that it is recommended that an approved third party assessor administer the tool when an organization is attempting to achieve ISO 55000 certification. This risk could also be attributed to the other tools which were considered as viable maturity assessment options. In order to mitigate this risk a high standard for implementation, evidence collection, documentation, and reporting was adhered to.

In June 2017 the IAM SAM was administered to a full range of CWS stakeholders. IAM SAM was used to measure the maturity of CWS’s AM program and practices against the ISO 55000 maturity rating. The results of the IAM SAM compared with the target levels of AM maturity are in industry accepted method for analyzing AM gaps. The data collected through administration of the IAM SAM and the AM maturity targets established by the AM team were used in combination to perform an AM gap analysis for CWS.

3. ISO 55000 Maturity Rating Scale
The ISO 55000 maturity rating scale reports on the level of fitness of an organizations AM program and practices regarding the twenty seven standard clauses. The scale is composed of a 1-5 rating system with scores greater than three considered beyond the requirements for ISO 55000 certification. An excerpt from the IAM SAM Guidelines, which describes the ISO 55000 AM maturity ratings, is provided below:
## G. CWS ASSET MANAGEMENT MATURITY

**Figure 14. ISO 55000 Maturity Rating**

<table>
<thead>
<tr>
<th>Scale</th>
<th>Description</th>
<th>Definition</th>
<th>Maturity Characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Innocent</td>
<td>The organisation has not recognised the need for this requirement and/or there is no evidence of commitment to put it in place</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Aware</td>
<td>The organisation has identified the need for this requirement, and there is evidence of intent to progress it.</td>
<td>Proposals are under development and some requirements may be in place. Processes are poorly controlled, reactive and performance is unpredictable.</td>
</tr>
<tr>
<td>2</td>
<td>Developing</td>
<td>The organisation has identified the means of systematically and consistently achieving the requirements, and can demonstrate that these are being progressed with credible and resourced plans in place.</td>
<td>Notes: this is a ‘transition state’. Processes are planned, documented (where necessary), applied and controlled at a local level or within functional departments; often in a reactive mode but could achieve expected results on a repeatable basis. The processes are insufficiently integrated, with limited consistency or coordination across the organisation.</td>
</tr>
<tr>
<td>3</td>
<td>Competent</td>
<td>The organisation can demonstrate that it systematically and consistently achieves relevant requirements set out in ISO 55001.</td>
<td>This involves a formal documented asset management system embedded within the organisation. The performance of the asset management system elements is measured, reviewed and continually improved to achieve the asset management objectives.</td>
</tr>
<tr>
<td>4</td>
<td>Optimising</td>
<td>The organisation can demonstrate that it is systematically and consistently optimising its asset management practice, in line with the organisation’s objectives and operating context.</td>
<td>Notes: this is 2nd ‘transition state’ characteristics of being in this stage will include: Monitoring and quantification of performance; and resolution of trade-offs between competing goals in an agile decision-making framework, innovation is a way of life, continual improvement can be widely demonstrated with evidence of results, benchmarking is employed to identify further improvement opportunity, and the management system is even further integrated and effective.</td>
</tr>
<tr>
<td>5</td>
<td>Excellent</td>
<td>The organisation can demonstrate that it employs the leading practices, and achieves maximum value from the management of its assets, in line with the organisation’s objectives and operating context.</td>
<td>This is a dynamic and context-sensitive state, so the evidence must include demonstration of awareness of benchmarking positions against similar best in class organisations and that, in both asset management practices, and asset management results (value realisation) there are no known improvements that have not already been implemented</td>
</tr>
</tbody>
</table>
4. ISO 55000 AM Standard Clauses

The twenty seven ISO standard clauses relate to specific areas of the AM program and AM practices. They are used to govern the development and management of an organizations approach to AM. The ISO 55000 clauses and corresponding guidance have been summarized in the table below:

Table 7. ISO 55000 AM Standard Clauses

<table>
<thead>
<tr>
<th>Clause No</th>
<th>Subsection</th>
<th>Guidance</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1</td>
<td>Understanding the organization and its context</td>
<td>Evaluating the organization’s external context can include issues such as social and cultural, political, legal, regulatory, financial, technological, economic and environmental factors. Internal context can include issues such as the organizational culture, governance, structure, capability, organizational policies, objectives, strategies, etc.; see 4.1.2 of ISO 55002 for details</td>
</tr>
<tr>
<td>4.2</td>
<td>Understanding the needs and expectations of stakeholders</td>
<td>Reporting requirements for financial and non-financial information should take account of the needs of stakeholders (including legal requirements), be consistent across the organizational functions (e.g. AM and Finance), and be at an appropriate level of detail.</td>
</tr>
<tr>
<td>4.3</td>
<td>Determining the scope of the AM program</td>
<td>ISO 55002, 4.3 provides guidance on what should be considered in determining the scope of the AM program including: the assets and their boundaries and interdependencies; the organization’s period of responsibility; other organizations involved in meeting the AM program requirements; interfaces with other organizational management systems.</td>
</tr>
<tr>
<td>4.4</td>
<td>AM program</td>
<td>The organization’s AM program should be formally established, and appropriately documented, by closely integrating the various people, process, information and technology components necessary to achieve the AM objectives; with appropriate linkages to other organizational functions and management systems, see 4.4 of ISO 55002 for details.</td>
</tr>
<tr>
<td>5.1</td>
<td>Leadership and commitment</td>
<td>Top management (ISO55000 3.1.23) can demonstrate leadership (ISO55000 2.5.3.3) with respect to AM by supporting asset management improvement activities and ensuring AM is given the same level of stature within the organization as quality, safety etc.</td>
</tr>
<tr>
<td>5.2</td>
<td>Policy</td>
<td>The AM policy (as defined in ISO55000 3.1.18) is a concise statement that outlines the principles the organization seeks to adopt in its application of AM to achieve its organizational objectives.</td>
</tr>
<tr>
<td>5.3</td>
<td>Organizational roles, responsibilities and authorities</td>
<td>Definition of responsibilities and authorities (ISO55002 5.3) should include both internal and outsourced responsibilities and interfaces and boundaries between functions should be addressed. The responsibilities assigned to each role can be captured in job descriptions or through an organizational chart.</td>
</tr>
</tbody>
</table>
## G. CWS ASSET MANAGEMENT MATURITY

<table>
<thead>
<tr>
<th>Clause No</th>
<th>Subsection</th>
<th>Guidance</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1</td>
<td>Actions to address risks and opportunities for the AM program</td>
<td>Note that risks and opportunities arising from assets (in meeting their required performance) and the actions required to address them are considered in 6.2.2 as part of AM planning. Therefore, only the risks and opportunities impacting on the overall AM program should be considered in assessing compliance with clause 6.1.</td>
</tr>
<tr>
<td>6.2.1</td>
<td>AM objectives</td>
<td>The assessor should focus on checking how the organizational objectives are translated into asset management objectives at the highest level (as part of developing the SAMP); and then how these are systematically cascaded down to the different functions (e.g. projects, operations, maintenance, etc.) and at different levels (e.g. operating unit, divisions, departments etc. or portfolio, asset system, asset types, etc.).</td>
</tr>
<tr>
<td>6.2.2</td>
<td>Planning to achieve AM objectives</td>
<td>As per the definition in ISO 55000, clause 3.3.3, an AM plan can be developed for an individual asset or for grouping of assets by asset type, asset system, or the asset portfolio. The AM plan(s) must: be derived from and consistent with the SAMP; clearly demonstrate how the organization’s AM objectives will be achieved.</td>
</tr>
<tr>
<td>7.1</td>
<td>Resources</td>
<td>ISO 55002 7.1 identifies resourcing aspects an organization should consider including: Analyze and mapping its available resources; Determine any gaps; Identify options for resourcing the activities; Criteria and processes for prioritizing AM activities and reconciling proposed activities with available resources.</td>
</tr>
<tr>
<td>7.2</td>
<td>Competence</td>
<td>ISO 55002 7.2 provides an overall context for AM competence and how it should be addressed within an organization. Guidance within ISO 55002 7.2.2 provides an example of content for: A competence gap analysis; The resulting competency improvement; Competence training plans</td>
</tr>
<tr>
<td>7.3</td>
<td>Awareness</td>
<td>The need for an organization to make sure that all people working under the organizations control are provided with an appropriate awareness of the AM program and activities is detailed in ISO 55002 7.3.1 with further examples of how the level of organizational awareness can be improved provided in 7.3.2. (Note - there are two 7.3.1 in ISO 55002).</td>
</tr>
<tr>
<td>7.4</td>
<td>Communication</td>
<td>ISO 55002 7.4.2 provides examples what a communication plan should consider when being developed with further guidance on the content of a communications plan detailed in ISO 55002 7.4.3.</td>
</tr>
<tr>
<td>7.5</td>
<td>Information requirements</td>
<td>The definition of documented information is provided within ISO 55000 3.1.6 as &quot;Information required to be controlled and maintained by an organization (defined in ISO 55000 3.1.13) and the medium on which it is contained.&quot;</td>
</tr>
<tr>
<td>7.6.1</td>
<td>Documented information general</td>
<td>Documented Information can refer to: the management system (ISO 55000 3.4.2), including related processes (ISO 55000 3.1.19); information created in order for the organization to operate (documentation); evidence of results achieved (e.g. records, key performance indicators).</td>
</tr>
</tbody>
</table>
### G. CWS ASSET MANAGEMENT MATURITY

<table>
<thead>
<tr>
<th>Clause No</th>
<th>Subsection</th>
<th>Guidance</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.6.2</td>
<td>Creating and updating documented information</td>
<td>ISO 55002, 7.6 provides some limited information related to this</td>
</tr>
<tr>
<td>7.6.3</td>
<td>Control of documented information</td>
<td>Organizational considerations are provided within ISO 55002. 7.6 includes guidance on information that is required to be maintained; over the asset life cycle and/or through the period of organizational responsibility; after the asset has been disposed; to ensure effectiveness of the AM program.</td>
</tr>
<tr>
<td>8.1</td>
<td>Operational planning and control</td>
<td>ISO 55002, clause 8.1.3 gives control mechanisms, while 8.1.4 provides guidance on the identification and treatment of risks during delivery activities, in particular risks changing with time.</td>
</tr>
<tr>
<td>8.2</td>
<td>Management of change</td>
<td>ISO 55002, clause 8.2.3 gives guidance and examples on how planned changes in one area can have adverse impacts on some other parts of the organization; and how these should be monitored and controlled.</td>
</tr>
<tr>
<td>8.3</td>
<td>Outsourcing</td>
<td>ISO 55002 provides guidance on: 8.3.2. How to formalize the relationship with outsourced service providers to ensure adequate knowledge sharing and effective control of outsourced activities and processes; 8.3.3. How to control outsourced activities and any risks arising from these; 8.3.4. How to address potential IPR issues.</td>
</tr>
<tr>
<td>9.1</td>
<td>Monitoring, measurement, analysis and evaluation</td>
<td>ISO 55002 9.1.2 identifies what organizations should consider in relation to evaluation of performance (and compliance), which could, in part, be achieved through internal audits (9.2). Other aspects of evaluation, relevant to Q33 are identified in: 6.1. Evaluating effectiveness of actions taken to manage risks</td>
</tr>
<tr>
<td>9.2</td>
<td>Internal audit</td>
<td>ISO 55002 9.2.1 and 9.2.2 provide guidance on the scope of an internal audit program, issues to consider in developing it, selection of auditors, and factors to consider in undertaking individual audits.</td>
</tr>
<tr>
<td>9.3</td>
<td>Management review</td>
<td>ISO 55002 contains guidance related to this question in: 9.3.1. What should be considered in relation to the scope of management review; 9.3.3. Suggests how reviews should be scheduled, and identifies that it is not necessary for all parts of the AM program to be reviewed at the same time; 9.3.5. Documented evidence</td>
</tr>
<tr>
<td>10.1</td>
<td>Nonconformity and corrective action</td>
<td>By definition (ISO 55000, 3.1.8) an incident is a more significant nonconformity which results in damage or other loss. The AM program should cater for the management of asset-related incidents or emergency situations through emergency response and business continuity planning.</td>
</tr>
<tr>
<td>10.2</td>
<td>Preventive action</td>
<td>The activities organizations would put in place to address this question will be closely linked with those for monitoring, analyzing and evaluating asset performance (see clause 8.2 of ISO 55001) - which should enable potential failures to be identified.</td>
</tr>
<tr>
<td>10.3</td>
<td>Continual improvement</td>
<td>Continual improvement is a consistent theme throughout all of the ISO 55001 clauses including: 4.4. The organization shall continually improve an AM program; 5.1. Top management shall demonstrate leadership and commitment by promoting continual improvement; 5.2. (d) Top management shall establish an AM policy that includes a commitment to continual improvement.</td>
</tr>
</tbody>
</table>
5. Maturity Assessment Methodology

IAM SAM poses thirty nine questions which identify AM maturity levels according to ISO 55000 AM Standard. Each question pertains to one of the twenty seven ISO 55000 clauses. Each clause relates to a specific AM focus area. The methodology for the AM maturity assessment survey administration followed prescriptive IAM SAM recommendations and guidelines (see Appendix I.15. IAM SAM Guidelines). The aspects of the methodology specific to the CWS survey administration are listed below:

- Seven departmental workshops, consisting of a total of thirty eight total SMEs were administered in June 2017
- Each workshop answered 15-17 IAM SAM targeted questions to ensure the SMEs with the most relevant knowledge were answering the best fit questions
- In order to prevent subjective responses each question was asked in a minimum of three different SME workshops, with the final score being an average of the three responses
- Each of the final individual clause scores were averaged to provide an overall AM program maturity rating

6. CWS AM Maturity Rating

Figure 15. CWS ISO 55000 AM Program Maturity Rating
### G. CWS ASSET MANAGEMENT MATURITY

Table 8. CWS ISO 55000 AM Maturity Rating by Clause

<table>
<thead>
<tr>
<th>ISO 55000 Clause</th>
<th>CWS Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1 Understanding the organization and its context</td>
<td>1.33</td>
</tr>
<tr>
<td>4.2 Understanding the needs and expectations of stakeholders</td>
<td>2.11</td>
</tr>
<tr>
<td>4.3 Determining the scope of the AM program</td>
<td>2.00</td>
</tr>
<tr>
<td>4.4 AM program</td>
<td>1.00</td>
</tr>
<tr>
<td>5.1 Leadership and commitment</td>
<td>2.00</td>
</tr>
<tr>
<td>5.2 Policy</td>
<td>2.00</td>
</tr>
<tr>
<td>5.3 Organizational roles, responsibilities, and authorities</td>
<td>2.00</td>
</tr>
<tr>
<td>6.1 Actions to address risks and opportunities for the AM program</td>
<td>1.00</td>
</tr>
<tr>
<td>6.2.1 AM objectives</td>
<td>1.00</td>
</tr>
<tr>
<td>6.2.2 Planning to achieve AM objectives</td>
<td>1.17</td>
</tr>
<tr>
<td>7.1 Resources</td>
<td>1.00</td>
</tr>
<tr>
<td>7.2 Competence</td>
<td>2.00</td>
</tr>
<tr>
<td>7.3 Awareness</td>
<td>1.00</td>
</tr>
<tr>
<td>7.4 Communication</td>
<td>2.00</td>
</tr>
<tr>
<td>7.5 Information requirements</td>
<td>2.00</td>
</tr>
<tr>
<td>7.6.1 Documented information general</td>
<td>1.67</td>
</tr>
<tr>
<td>7.6.2 Creating and updating documented information</td>
<td>2.00</td>
</tr>
<tr>
<td>7.6.3 Control of documented information</td>
<td>2.00</td>
</tr>
<tr>
<td>8.1 Operational planning and control</td>
<td>1.00</td>
</tr>
<tr>
<td>8.2 Management of change</td>
<td>1.33</td>
</tr>
<tr>
<td>8.3 Outsourcing</td>
<td>1.33</td>
</tr>
<tr>
<td>9.1 Monitoring, measurement, analysis, and evaluation</td>
<td>2.00</td>
</tr>
<tr>
<td>9.2 Internal audit</td>
<td>1.00</td>
</tr>
<tr>
<td>9.3 Management review</td>
<td>1.00</td>
</tr>
<tr>
<td>10.1 Nonconformity and corrective action</td>
<td>1.56</td>
</tr>
<tr>
<td>10.2 Preventive action</td>
<td>2.00</td>
</tr>
<tr>
<td>10.3 Continual improvement</td>
<td>1.00</td>
</tr>
</tbody>
</table>

**CWS Overall Maturity Rating (average of clause ratings)** 1.50
Figure 16. CWS ISO 55000 AM Maturity Rating by Clause

ISO 55000 Clauses
4.1 Understanding the organization and its context
4.2 Understanding the needs and expectations of stakeholders
4.3 Determining the scope of the asset management system
4.4 Asset management system
5.1 Leadership and commitment
5.2 Policy
5.3 Organizational roles, responsibilities and authorities
6.1 Actions to address risks and opportunities for the asset management system
6.2.1 Asset management objectives
6.2.2 Planning to achieve asset management objectives
7.1 Resources
7.2 Competence
7.3 Awareness
7.4 Communication
7.5 Information requirements
7.6.1 Documented information general
7.6.2 Creating and updating documented information
7.6.3 Control of documented information
8.1 Operational planning and control
8.2 Management of change
8.3 Outsourcing
9.1 Monitoring, measurement, analysis and evaluation
9.2 Internal audit
9.3 Management review
10.1 Nonconformity and corrective action
10.2 Preventive action
10.3 Continual improvement
7. Supporting Evidence

Evidence of how AM is performed is key to judging the maturity of the AM program. CWS utilizes Microsoft SharePoint as a means to share and communicate important internal information including AM documentation. In addition to this a specialized version of SharePoint, QMS, has been developed to maintain documents that must follow a formal review and approval process according to EMS document management requirements.

The task of collecting and reporting a comprehensive list of evidence was undertaken to support the scores resulting from each of the IAM SAM workshops. The methodology to collect this information was fairly simple. The internal SharePoint sites (including QMS) and the external CWS website were used to locate supporting evidence. Since SharePoint is a work in progress some evidence was not available for reference. Only evidence that is accessible by external and internal stakeholders was considered when scoring asset management maturity. The full list of supporting evidence for the 2017 AM maturity assessment has been compiled and documented according to IAM recommendations (see Appendix I.17. CWS IAM SAM Supporting Evidence 2017).

The IAM SAM 2017 Evidence Log is too extensive to report in this document. An excerpt from the log has been provided below to demonstrate the rigor and format applied to evidence collection:

**Table 9. CWS IAM SAM Evidence Log Excerpt**

<table>
<thead>
<tr>
<th>Question Number</th>
<th>Question</th>
<th>Clause</th>
<th>Evidence</th>
</tr>
</thead>
</table>
| 1               | How does the organization determine external and internal issues relevant to its purpose that impact on its ability to achieve the intended outcomes of its AM program? | 4.1 - Understanding the organization and its context | 1. AM policy  
2. Stakeholder Expectation Analysis  
3. Strategic Plan  
4. Cross Functional Teams  
5. Customer Focus Group  
6. Surveys (SOIs)  
7. Other Industry Groups  
8. Wholesale Contracts |
| 2               | How does the organization ensure that AM objectives are aligned with organizational objectives? | 4.1 - Understanding the organization and its context | 1. AM policy  
2. Stakeholder Expectation Analysis  
3. Strategic Plan  
4. Cross Functional Teams  
5. IT Master Plan  
6. Major Capital Planning |
| 3               | How does the organization identify and determine the needs and expectations of stakeholders | 4.2 - Understanding the needs and expectations of stakeholders | 1. Stakeholder Expectation Analysis  
2. Strategic Plan  
3. Cross Functional Teams  
4. Customer Surveys  
5. Vendor Surveys  
6. Incentive Check |
H. AM GAP ANALYSIS

1. Purpose
An AM gap analysis is an important contributing factor in AM objective and strategy development. The gap analysis identifies the relative difference in actual AM maturity and the desired level of maturity across the twenty seven ISO 55000 clauses (see Appendix I.18. AM Gap Analysis Report 2017). This allows for identification of the most significant AM program and AM practices performance gaps. AM objectives will typically be targeted at filling significant gaps.

2. Gap Analysis Methodology
The gap analysis methodology was conducted according to IAM recommendations. The fundamental steps of that analysis are listed below:

- The IAM SAM baseline maturity results were presented to AM team and discussed
- The AM team collaboratively developed AM program metrics, targets, and objectives
- The targets were compared to the baseline AM maturity
- Gaps between the target and baseline maturities were identified and reported to AM team
- The AM team developed strategic AM objectives to fill the identified gaps
- The IAM SAM was re-scored assuming the completion of the proposed objectives that are within the scope of the AM program
- The AM maturity results, considering the assumed completion of the proposed objectives, were compared to the proposed targets
- The remaining gaps, which are considered beyond the scope of the AM program, were identified and communicated to stakeholders

3. Establishing AM Metrics and Targets
The AM team reviewed the AM gap analysis results during the July 2017 monthly meeting. During that meeting two levels of metrics related to the IAM SAM were considered and adopted. The first level consists of a single measure, which provides a holistic or overall AM maturity rating. The second level consists of the individual maturity measures for each of the twenty seven ISO 55000 clauses. The individual clause ratings provide a more detailed perspective of the maturity for specific AM focus areas.

Overall AM Maturity Rating
This rating consists of the average of all of the individual ISO 55000 clause maturity ratings resulting from the IAM SAM. This metric provides a holistic view of AM program maturity.

Individual ISO 55000 Clause Maturity Rating
These measures consist of the individual ISO 55000 maturity ratings for each of the twenty seven clauses. They provide the ability to drill down into specific ISO 55000 focus areas and better identify the strengths or weaknesses contributing to the overall AM program maturity rating.

CWS AM Program Maturity Target
The CWS AM program aims to progress the current 1.5 overall AM maturity rating to 2.25, corresponding with the “Developing” designation, over the course of the 2018-23 strategic planning cycle. This level
of maturity is characterized by; documentation of a policy, SAMP, TAMPs, and CAMP to support the implementation of AM and other organizational initiatives, projects, and activities.

Figure 17. AM Program Overall Maturity Target

CWS Maturity Rating by Clause Target

Due to the link between clauses it is important they mature uniformly, otherwise one clause may limit or cause inefficiencies in achieving higher levels of maturity for other clauses. An example of the link between clauses is the relationship between clause 9.2 Internal Audit and clause 4.4 AM program. Although CWS has a well-defined internal audit program it cannot currently demonstrate a high level of maturity for this clause. In order to do so a well-defined SAMP and CAMP which are associated with Clause 4.4 are required. The CWS AM program aims to achieve a minimum maturity rating of 2 for each of the twenty seven clauses. This target will ensure uniform maturation for the individual clauses and avoid inefficiencies in achieving higher levels of maturity.

It is worth noting that the IAM recommends an organization demonstrate a maturity level of 2.5 for each of the clauses prior to considering certification for the ISO 55000 standard. Although CWS will pursue higher levels of maturity, certification against ISO 55000 is not currently an AM program driver.
H. AM GAP ANALYSIS

4. CWS AM Gaps

Once the performance metrics and targets were established for the AM program the gap analysis was performed. All of the ISO 55000 clauses which do not currently meet the AM performance targets were identified and documented.

Table 10. CWS AM Gaps by ISO 55000 Clauses

<table>
<thead>
<tr>
<th>ISO 55000 Clause</th>
<th>CWS Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1 Understanding the organization and its context</td>
<td>1.33</td>
</tr>
<tr>
<td>4.4 AM program</td>
<td>1.00</td>
</tr>
<tr>
<td>6.1 Actions to address risks and opportunities for the AM program</td>
<td>1.00</td>
</tr>
<tr>
<td>6.2.1 AM objectives</td>
<td>1.00</td>
</tr>
<tr>
<td>6.2.2 Planning to achieve asset management objectives</td>
<td>1.17</td>
</tr>
<tr>
<td>7.1 Resources</td>
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</tr>
<tr>
<td>7.3 Awareness</td>
<td>1.00</td>
</tr>
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</tr>
<tr>
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</tr>
<tr>
<td>8.2 Management of change</td>
<td>1.33</td>
</tr>
<tr>
<td>8.3 Outsourcing</td>
<td>1.33</td>
</tr>
<tr>
<td>9.2 Internal audit</td>
<td>1.00</td>
</tr>
<tr>
<td>9.3 Management review</td>
<td>1.00</td>
</tr>
<tr>
<td>10.1 Nonconformity and corrective action</td>
<td>1.56</td>
</tr>
<tr>
<td>10.3 Continual improvement</td>
<td>1.00</td>
</tr>
</tbody>
</table>
Figure 18. CWS AM Maturity Gaps

ISO 55000 Clause
4.1 Understanding the organization and its context
4.2 Understanding the needs and expectations of stakeholders
4.3 Determining the scope of the asset management system
4.4 Asset management system
5.1 Leadership and commitment
5.2 Policy
5.3 Organizational roles, responsibilities and authorities
6.1 Actions to address risks and opportunities for the asset management system
6.2.1 Asset management objectives
6.2.2 Planning to achieve asset management objectives
7.1 Resources
7.2 Competence
7.3 Awareness
7.4 Communication
7.5 Information requirements
7.6.1 Documented information general
7.6.2 Creating and updating documented information
7.6.3 Control of documented information
8.1 Operational planning and control
8.2 Management of change
8.3 Outsourcing
9.1 Monitoring, measurement, analysis and evaluation
9.2 Internal audit
9.3 Management review
10.1 Nonconformity and corrective action
10.2 Preventive action
10.3 Continual improvement

Current AM Maturity by Clause

Proposed Target of 2 for Each Clause
5. AM Objectives’ Impact on AM Maturity

When considering the results of the IAM SAM, assuming full achievement of the current AM objectives, it was found that twenty two of the twenty seven clauses achieved a score equal to or greater than the target of 2. This validates the potential effectiveness of the current AM strategic objectives. It also indicates that the current AM strategic approach will come very close to fully satisfying the AM team proposed performance target. The overall AM maturity rating, considering the expected results, increases from 1.5 to 2.26. This result also satisfies the overall AM maturity rating performance target of 2.25.

6. Gaps Beyond the Scope of AM Program Requiring Organizational Support

An important aspect of the AM gap analysis, which has a bearing on the organizational strategic planning process, are the five gaps that remain after application of the current AM objectives. These gaps are reflected by the red shaded areas on Figure 19. CWS Objectives Impact on AM Maturity. Although the current objectives reduce some of these gaps, they do not satisfy the AM team performance target of a uniform clause maturity rating of 2. The remaining gaps will require the development of a separate process or supporting system to demonstrate higher levels of AM maturity. These gaps are considered outside of the scope of the AM program. If these clauses are not adequately addressed they will become limiting factors in improving AM program maturity.

Table 11.Remaining Gaps Post AM Objective Achievement

<table>
<thead>
<tr>
<th>ISO 55000 Clause</th>
<th>CWS Baseline Rating</th>
<th>Impact of Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1 Actions to address risks and opportunities for the AM Program</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>7.1 Resources</td>
<td>1.00</td>
<td>1.50</td>
</tr>
<tr>
<td>8.2 Management of change</td>
<td>1.33</td>
<td>1.83</td>
</tr>
<tr>
<td>8.3 Outsourcing</td>
<td>1.33</td>
<td>1.33</td>
</tr>
<tr>
<td>10.1 Nonconformity and corrective action</td>
<td>1.56</td>
<td>1.99</td>
</tr>
</tbody>
</table>

Unfilled Gaps Defined

The five remaining gaps have been grouped into two focus areas. The gap associated with clause 10.1 Nonconformity and Corrective Action has been omitted due to the negligible size of the remaining gap. The two focus areas and their relationship to the contributing ISO 55000 clauses have been defined below.
Risk Management

Risk management consists solely of Clause 6.1 Actions to address risks and opportunities for the AM program. In order to achieve a maturity rating of 3 “Competent” the following requirements must be met and evidence of conformance documented:

- Processes and measures are in place to ensure the desired outcomes of the AM program are achieved and undesired effects are mitigated
- The organization’s internal and external context (c.f. 4.1) and stakeholder requirements (c.f. 4.2) are considered in determining the risks and opportunities, including how they vary over time, and actions are planned to address these
- The organization regularly monitors the effectiveness of actions and processes for addressing the risks and opportunities
- The organization can demonstrate how continual improvement of the AM program is achieved through risk and opportunity management

Resource Management

Resource management consists of clauses 7.1 Resources, 8.2 Management of change, and 8.3 Outsourcing. The remaining resource management gaps relate specifically to; analyzing, planning and tracking the resource requirements of organizational initiatives and projects; understanding and planning for organizational changes; and the monitoring and controlling of outsourced activities. In order to achieve a maturity rating of 3 “Competent” the following requirements must be met and evidence of conformance documented:

- The organization has a fully developed and embedded approach to identifying resource requirements for achieving the AM objectives, and that plans can be demonstrated as aligned to resources
- The organization can demonstrate that it has evaluated and provided adequate resources to establish, maintain and improve the AM program
- Changes impacting the AM program are being identified and assessed before a change is implemented
- The organization puts controls in place while implementing planned changes, monitors consequences and takes action to mitigate adverse effects
- The organization has an established risk management process that ensures outsourced processes and activities are controlled and integrated with the organization’s AM program
- The following are specified and documented:
  - Processes that are to be outsourced, including interfaces to internal processes
  - Responsibilities and authorities for managing outsourced activity are documented
  - Requirements and the means for knowledge sharing
  - Competency, awareness and documented procedures consistent with AM program requirements (7.2, 7.3 and 7.6)
  - Requirements for monitoring consistent with AM program requirements (9.1)
Figure 19. CWS Objectives Impact on AM Maturity

ISO 55000 Clause
4.1 Understanding the organization and its context
4.2 Understanding the needs and expectations of stakeholders
4.3 Determining the scope of the asset management system
4.4 Asset management system
5.1 Leadership and commitment
5.2 Policy
5.3 Organizational roles, responsibilities and authorities
6.1 Actions to address risks and opportunities for the asset management system
6.2.1 Asset management objectives
6.2.2 Planning to achieve asset management objectives
7.1 Resources
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7.5 Information requirements
7.6.1 Documented information general
7.6.2 Creating and updating documented information
7.6.3 Control of documented information
8.1 Operational planning and control
8.2 Management of change
8.3 Outsourcing
9.1 Monitoring, measurement, analysis and evaluation
9.2 Internal audit
9.3 Management review
10.1 Nonconformity and corrective action
10.2 Preventive action
10.3 Continual improvement

Proposed Target of 2 for Each Clause
Current Objectives Impact
Current AM Maturity
Remaining Gaps

66
1. AM Policy
2. ISO 55000 AM Standard
3. Vision 2017 Corporate Strategic Plan
4. Vision 2023 Corporate Strategic Plan
5. Effective Utility Management 2017
6. Capital Improvement Program 2014-17
8. Stakeholder Expectations Analysis
9. Resource Analysis Model
10. Risk Management Program Report
11. Asset Criticality Criteria Tables
12. AM Team Meeting Minutes and Agendas
13. AM Team SharePoint Page
15. IAM SAM Guidelines
16. CWS IAM SAM Survey 2017
17. CWS IAM SAM Supporting Evidence 2017
18. AM Gap Analysis Report 2017