Asset Management Technical Guidance

PURPOSE

To promote the responsible maintenance, investment, and rehabilitation of New Jersey's clean water and drinking water systems, the New Jersey Department of Environmental Protection (DEP) is providing this technical guidance[1] that outlines the essential elements of asset management. Adherence to the general principles of asset management fosters compliance with regulatory requirements and attainment of the utility's service standard.[2] This document focuses on the five (5) Core Elements of asset management as identified by the U.S. Environmental Protection Agency (EPA)[3], informs government officials, utility managers, and staff about the components of asset management and serves as a model on how to develop and implement an Asset Management Program. Together, documentation of each of the components of Asset Management can be considered an Asset Management Plan (AMP).

THE FIVE COMPONENTS OF ASSET MANAGEMENT

Asset Inventory/Mapping and Condition Assessment

The first step in managing utility assets is to complete a comprehensive inventory of system components (i.e., pipes, valves, tanks, pumps, wells, treatment facilities, hydrants, and any other components that make up the system). Once identified and catalogued, the next critical steps are to locate or map the assets, determine their condition, and establish the remaining useful life of each identified and catalogued component. Inventorying and mapping may occur in stages based on the level of detail of the system components included: basic/ threshold (where the key components of the system are inventoried and mapped, such as water mains and trunks and

[1] This technical guidance is based on the NJDEP's 2014 "Asset Management Guidance and Best Practices" document. The information presented has been informed by the EPA's Advanced Asset Management training as well as other resources referenced throughout the Guidance.

[2] Service standard can be defined as the system's responsibility to continually maintain effective operations, or a system's capability to meet demands at sufficient volume and pressure, while meeting applicable water quality standards and permit conditions.

[3] EPA has a number of resources and training on Asset Management that are recommended:
Training Series that gives details on each component of AM: https://www.epa.gov/sustainable-water-infrastructure/asset-management-workshops-training-slides; Best Practices Overview: https://www.epa.gov/sites/production/files/2015-02/documents/asset_management_best_practices_guide.pdf; Overview for local officials: https://www.epa.gov/sites/production/files/2015-02/documents/guide_smallsystems_assetmanagement_localofficials.pdf

pumps), intermediate (more detail such as motors of pumps identified in first stage), and advanced (for example, laterals to water mains and trunks included).

The purpose of this Asset Management component is to ensure that most system assets have been inventoried and that their condition and remaining useful life have been considered and documented. Having an inventory of assets that includes both spatial location and condition will help inform future management and capital project decisions. Put simply, this endeavor serves as the essential bridge that can demonstrate how the utility arrived at priorities within its Operation & Maintenance (O&M) plan, Capital Improvement Plan and Financial Management Strategy.

a. **Asset Identification**:
   - *Locate/Identify the assets.* Identify above and below-ground assets and record their locations. Document assets. Digital photographs can be an effective means of accumulating and storing inventory data. Consider adding a physical label to the assets while collecting field data and recording the corresponding number in the inventory data base.
   - Develop a numbering system or nomenclature (unique identifier) that will facilitate identifying the asset, or reverse lookup, at a future date:
     - *Asset ID Numbering*. Having a unique identifier for each asset will assist in developing the asset inventory (see below). This identifier can be anything, as long as it is unique. It is suggested a "smart" alphanumeric system be used to label assets, but it is at the utility's discretion as to which identification system is the most feasible for them. The following is an example of a "smart" alphanumeric designator[4]:

       A BCD EFG 1

       A = Drinking Water (DW) or Clean Water (CW)
       BCD = Facility Name (i.e., abbreviation for facility/component)
       EFG = Equipment name (i.e., abbreviation for name of equipment)
       1 = Equipment Number

       Example: DWMPSPMP1

       DW = Water System
       MPS = Main Street Pump Station
       PMP = Pump
       1 = Pump #1

     - Ensure an identification tag is placed on each visible asset and the corresponding alphanumeric designator is logged into the utility's asset registry.

   - Some criteria to consider when prioritizing the inventorying of system components are:

[4] AM Kan Work! An Asset Management and Energy Efficiency Manual, New Mexico Environmental Finance Center/New Mexico Tech, http://efcnetwork.org/publication/asset-management-manual/

- Type of asset, (i.e. primary mover, pipe or valve, electrical, structural);
- Condition;[5]
- Size/length;
- Age;
- Construction materials/techniques;
- Soil conditions/characteristics, as applicable;
- Service history;
- Location;
- Present value;
- Replacement cost;
- Operations and Maintenance data (date and type of last service).

- *Determine the remaining life and value of the assets*. In the absence of reliable in-house resources in determining the remaining life and value of the asset, a utility can use standard default values as a starting point. These default values can be obtained from manufacturer and industry guides.
- *Determine the energy use of the assets*[6]. Use one or several of the following assessment techniques:
  - Type of energy used;
  - Horsepower;
  - Variable or constant speed;
  - Design specifications;
  - Operating status and practices;
  - Hours of operation per year;
  - Average equipment run times;
  - Measured power consumption;
  - Peak energy demands;
  - Total kilowatt-hours (kWh) of electrical consumption.

b. **Developing an Asset Inventory:**
Once the answers to the questions in the previous section are determined (what assets the water system owns, where each component is located, what condition it is in, and what type and how much energy does it use), the information must be organized in an asset inventory.

- *Utilize the asset identifiers.*
- *Create an Asset Registry***.** There are many options[7] for managing the asset inventory data. Although hand-written inventories can be maintained, it is highly recommended that inventories be maintained electronically. Electronic options include:

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[5] When evaluating asset condition and approximate age, any condition rating system that is understood by the utility and that is consistently applied is recommended.

[6] The best method of gathering information about energy use by an individual asset is actual metered energy usage; however, most utilities don’t have energy meters on each piece of equipment that uses energy and some utilities may only have one master energy meter that indicates overall energy use. In these cases, estimates will have to be made of asset energy use based on load, performance factors, equipment efficiencies, operator experiences, manufacturer’s data, and reference guides. A particular reference guide that may be helpful is EPA’s Energy Star Program.

[7] The Environmental Finance Center Network and EPA provide clearinghouses for database, software, and other tools that can be used for inventory development: http://efcnetwork.org/resources/tools/; https://www.epa.gov/sites/production/files/2016-04/documents/am_tools_guide_may_2014.pdf

- Commercially available software for asset inventories;[8]
- Generic database software;
- Spreadsheet software.

c. **Asset Mapping:**

Mapping of a system's inventoried assets is another critical component of asset management. It is strongly recommended that each utility map its inventoried horizontal assets (such as interceptor pipelines and collection system lines or mains and laterals) in an acceptable digitized GIS format[9]. Linking an asset inventory with digitized geospatial data of system assets allows for a detailed mapping of the system that offers many benefits:

- Allows the utility to quickly and easily locate assets for inspections, maintenance, and protection/recovery during or after an emergency/event;
- Promotes effective decision-making;
- Reduces time, energy and disruption (e.g. roadway excavation/detours) that otherwise would be spent attempting to locate certain assets;
- Enhances personnel succession planning – institutional knowledge of system assets often leaves with personnel as they move on to other positions or retire;
- The GIS format is consistent with DEP's mapping and data record system.

The asset inventory or part of an Asset Management Plan should identify how up-to-date asset maps can be accessed.

d. **Condition Assessment/ Remaining Useful Life:**

Determining the original life span as well as the useful (remaining) life span[10] of each infrastructure component is essential for prioritizing asset improvements and cash reserve needs. Infrastructure asset characteristics, such as the date of installation, construction materials, repair history and environmental conditions, allow for a qualified assessment of the condition of the system's components and how much longer they may reliably be expected to remain in service. In order to do this, an estimate of the remaining useful life of each of the inventoried assets is needed.

- Determine the expected useful life by using the manufacturer's recommendations or industry guidance for specific types of infrastructure components;
- Calculate an adjusted useful life by taking into account the service history and current condition of your asset.
    - The relative condition of each of the inventoried assets can be assessed by using a ranking scale based on extent of deterioration or ability to be repaired/ serviced. For example, on a scale of 1-5, 1= new or excellent condition; 3=moderate deterioration, some repair or service needed; 5=deteriorated and unserviceable.

[8] For example, CUPSS is a free, comprehensive, asset management tool that will assist in inventorying and recording tasks associated with an asset management plan: https://www.epa.gov/dwcapacity/information-check-program-small-systems-cupss-asset-management-tool. Other resources are available at DEP's webpage: www.nj.gov/dep/assetmanagement

[9] Digital mapping shall conform to the "New Jersey Department of Environmental Protection Mapping the Present to Protect New Jersey's Future: Mapping and Digital Data Standards," in N.J.A.C. 7:1D, Appendix A. Guidance related to the mapping and digital data standards is available at the DEP's website at http://www.state.nj.us/dep/gis. DEP will provide its GIS theme coverage(s), associated metadata and digital data transfer standards, as established at N.J.A.C. 7:1D, Appendix A, at the request of the applicant.

[10] Remaining lifespan might be a range of time such as 0-2 years, 2-5 years, etc.

Level of Service

Level of Service (LOS) refers to the intended goals of the utility, with consideration for the role and function of a utility's infrastructure assets and how they are expected to perform. LOS is useful for a utility to assess their growth, performance, and success with implementing Asset Management.

The utility's regulatory requirements[11] at the Federal, State, and local level should inform the LOS goals. LOS consideration may involve whatever components, services and goals the utility and customers deem appropriate, provided all regulatory requirements are met. LOS goals are essential to establishing which assets are prioritized in the AM Program and these goals should be tracked to ensure that the utility's objectives and service standard are being met. The goals should be updated, as needed, to account for changes such as growth, regulatory requirements, and/or technology improvements.

Determine the goals of your utility:

Goals can be, but are not limited to, the following areas:

- Customer Service/Accountability;
- Energy/Water Efficiency and Conservation;
- Social and Environmental Considerations.

LOS Goals may include a focus on system quality control and service quality:

1. System-related – These goals define utility operations and are derived from the technical knowledge, experience, professional standards and training of the utility owner/operator. Examples of these types of goals include:
    - Maintenance Scheduling;
    - Safety and Security;
    - Proper Staff Certification;
    - (Reduction in) Number of pipe breaks per mile;
    - (Reduction in) Non-revenue ("unaccounted–for") water losses.

2. Customer-facing– Such goals directly impact customers. The basic question a utility should ask when addressing external goals is "What do customers want or expect?" Examples of these types of goals are:
    - Cost of Service/Rates;
    - Response time for water outages or sewer backups;
    - Response time for customer complaints;
    - Water savings from water conservation;

[11] **Federal Standards**–Safe Drinking Water Act and Clean Water Act including Section 603(d)(1)(E) of the Water Resources Reform and Development Act (WRRDA), as amended under the Federal Water Pollution Control Act, requires a utility receiving State Revolving Funds to implement a Fiscal Sustainability Plan (FSP).
State Standards– NJ Safe Drinking Water Act, NJ Water Supply Management Act, NJ Water Supply Allocation Permits Rules, NJ Pollutant Discharge Elimination System (NJPDES) Rules, Water Supply and Wastewater Operators' Licensing Act.
Local requirements– counties, cities, or utility authorities may adopt ordinances or other types of regulations that they want the utility to follow.

- Water pressure consistency.

The key factors to keep in mind in developing the LOS Goals are:

- Keep goals simple;
- The quality of the goals, not quantity, is most important;
- Make sure the goals are relevant, measurable, and within the capabilities of the utility;
- Ensure goals allow compliance with federal, state, and local regulations;
- Engage utility staff in the process of setting internal goals;
- Engage utility customers in setting external goals;
- Make sure the goals are updated regularly.

Criticality/ Prioritization Assessment

A function central to managing utility assets is justifying timely investments in particular assets before others. To responsibly prioritize the repair or replacement of specific infrastructure components, a utility can make informed management decisions based on the criticality of an asset and the risk and significance of failure to the operation of the system. The threat of an asset failing potentially compromises a utility's ability to function and meet performance standards. This compromised function exposes the utility to adverse consequences, from both a financial and regulatory standpoint. Greater exposure of this risk is associated with assets deemed critical to the operation of the system and those that are more likely to fail before reaching the end of their useful life.

"Business risk exposure" (BRE)[12] is a method of calculating (scoring) the nature and level of exposure that a utility is likely to confront through a potential failure of a specified asset. Determining the criticality of system assets is necessary in order to determine the priority order in which infrastructure components will be addressed as part of the asset management program. Therefore, in conducting a prioritization assessment of system assets, there are key questions that should be considered when evaluating a system's assets:

- Which assets are most critical to the sustained function of the system?
- What is the likelihood of each of these assets failing?
- And, what are the consequences if an asset fails?

Together, the probability and consequence of failure of an asset indicates the Business Risk Exposure (BRE) or criticality of that asset.

a. **Probability of Failure (PoF)**:
   Determine the likelihood of failure of each asset. There are a number of considerations:
   - *Mortality* – The system component physically fails either through collapse, rupture, or some other mechanism and could be the result of a number of factors, which should be considered:
     - Asset age/condition
     - Installation/environmental characteristics (e.g. soil conditions)
     - Repair/service history

[12] There are tools available through software to calculate assess risk or BRE. One source: http://simple.werf.org/simple/media/BRE/howTo.html

    - Operation and maintenance history
    - Historical knowledge
  - Operator experience with similar assets
- *Financial Inefficiency* – The cost operating and maintaining an asset exceeds its economic value. It is cheaper to replace the asset.
- *Deficient Capacity* – The asset is still operational, but is unable to provide the capacity needed or level of service expected.

The probability of failure of each component can be ranked using a scale of 1 to 5: very low (improbable failure) to very high (imminent failure).

Ratings for Probability of Failure (PoF) for System Asset Components[13]

Rating	Description	Experience with/ Likelihood of Failure
5	Imminent	Component continuously fails; very high likelihood the component will fail during its life
4	Probable	Fails frequently; failure will occur several times in life of component
3	Occasional	Failure has occurred a few times; likely to fail some time
2	Remote	Has not failed, but possible to fail during life of component
1	Improbable	Has not failed and unlikely to fail

b. **Consequence of Failure (CoF)**:
Determine the severity of loss a system would incur as a result of the failure of a particular asset. The consequence of failure involves the consideration of several tangible and intangible factors:

- Public health / safety impacts or costs (may include injury to staff or the public);
- Environmental impacts or costs: environmental consequences may be contamination, threat to life or health of species or plants, unpleasant odors or sights, etc.;
- Social impacts or costs: Social or community-impact consequences may be traffic disruption, impeding tourism or the public's ability to use or enjoy an area or facility, etc.;
- Reduction in Level of Service (LOS);
- Cost of repair/replacement that may be unbudgeted expenditures;
- Costs or impacts related to collateral damage caused by the failure;
- Legal costs associated with asset failure;
- Any other costs or impacts related to the asset failure such as loss of revenue or impacts to businesses.

In assessing the overall consequences of asset failure, the utility should consider the associated costs above.

[13] Based on State of Michigan's *Asset Management Guidance for Wastewater and Stormwater Systems* (July 2013): http://www.michigan.gov/documents/deq/deq-ess-mfs-formsguidance-SRFassetmngmntguide_426745_7.pdf

<u>Ratings for Consequence of Failure (CoF)</u>[12]

Rating	Description	Level of Effect
5	Catastrophic disruption	Massive system failure, severe economic, environmental, health, and/ or social consequences, persistent and extensive damage, unable to meet LOS goals
4	Major disruption	Major effect, loss of system capacity, major consequences or costs, LOS compromised
3	Moderate disruption	Moderate effects, loss of some system capacity, yet important LOS still achieved
2	Minor disruption	Minor effect, some loss of system capacity, but minimal costs or impacts
1	Insignificant disruption	Negligible effect on costs, no significant consequences or impact on LOS

c. **Combined Rating**:

Assessing assets for prioritization can be done through ranking assets based on the significance of risk of the loss of each asset. The relative risk, or expected loss, associated with the failure of one asset versus another is based on both the probability and the consequence or severity of the asset failing. Assets that are most likely to fail and which have the greatest consequences from failing are those that pose the greatest Business Risk Exposure (BRE) and should be prioritized for repair or replacement.

To assess this risk, the Probability and Consequence ratings for each component can be combined to get a "criticality or BRE rating" by using the following formula:

Criticality (BRE) Rating= Probability of Failure (PoF) X Consequence of Failure (CoF)

Each asset can be described by its condition, history, and this criticality/ prioritization assessment. Here is a brief example:

- Asset Description: 10-inch Cast Iron pipe (constructed in 1950);
- Service History: Numerous breaks in the past 5 years;
- Service Area: Residential customers only (serves 3 major subdivisions);
- *Probability of failure = 4* – pipe has broken many times, but when repaired it was still in reasonable condition;
- *Consequence of failure = 2* – there are loop lines that will prevent the simultaneous loss of service (to all 3 subdivisions) when this pipe is under repair. Repair costs are moderate. Line is not in a critical roadway, so repair is relatively easy;
- The *combined BRE/ criticality factor* assigned to the 10-inch CI pipe = *8.*

Now it is possible to have all of the inventoried assets listed in a matrix/ table that can be organized by BRE/ criticality rating. If using the suggested rating scales for PoF and CoF, the BRE/ criticality rating scale would range from 1 (lowest)- 25 (highest).

Once all of the system assets have been evaluated in this manner, the assigned BRE/ criticality values can be arranged from highest to lowest as a means of prioritizing the assets necessary to adequately maintain the system.

It is important that the criticality/ prioritization assessment be updated periodically to account for changes in treatment, demands, and regulatory requirements.

d. **Vulnerability**[14] is a component of risk and should be considered-- Based on location or construction, some assets may be more exposed to potential threats (storms/flooding, sabotage or terrorism, accidental damage, etc.) that could compromise the effective operation of the system. The potential adverse effects to system operations from the vulnerability of assets should be considered along with the condition of assets and the criticality/ business risk exposure rating when prioritizing assets.

Life Cycle Costing

Life Cycle Costing is at the heart of Asset Management; essentially, it will help devise a schedule for maintenance, repair, and replacement, as well as capital improvements, which is informed by the criticality / prioritization assessment. Knowing exactly how much and what type of maintenance to do on an asset during its life and the correct point to replace the asset optimizes operational and capital expenditures. Prioritizing those assets with a high Business Risk Exposure/ criticality rating is a good starting point for deciding what maintenance to perform.

Many utility management software programs include automated maintenance schedules, work order management, and Capital Improvement Plan capabilities that significantly reduce the need for utility personnel to monitor maintenance and/or forecast the rehabilitation or replacement of assets. These programs, however, are only as good as the accuracy and reliability of the data inputs emphasizing the importance of the inventory, mapping, conditional and criticality assessment.

Life cycle costing can guide:

a. **Operations and Maintenance (O&M) Program**:
   - *Operations:*
     - Standard Operating Procedures (SOP) – Used on a routine or scheduled basis to keep the plant functional and to ensure that all permit conditions or regulatory requirements are met.
     - Alternate Operating Procedures – Used when conditions change and SOPs are no longer practical or possible. An example of this would be a piece of equipment being taken off line for maintenance or repair or for scheduled shut-downs.

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[14] A widely recognized standard for assessing vulnerability to worst-case scenario threats is the Risk Analysis and Management for Critical Asset Protection (RAMCAP®) methodology. The RAMCAP® methodology has been accepted by the water/wastewater industry through ANSI/ASME-ITI/AWWA Standard J-100, which sets the requirements for all-hazards risk and resilience analysis and management and prescribes methods that can be used for addressing these requirements. Further information on the RAMCAP Plus (SM) process and related products and activities can be found at http://www.asme-iti.org/.

- Emergency Operating Procedures – Used when severe conditions occur, such as unanticipated disasters (flooding, tornadoes, fire, etc.) or the sudden failure of a critical asset.

- *Maintenance*[15] – Involves those activities that help keep the assets in good working order so that they will function reliably. Maintenance falls into the broad categories listed below:
  - Routine/Planned Maintenance;
  - Preventive Maintenance;
  - Warranty-Related Maintenance;
  - Corrective Maintenance.

b. Repair/Replacement Schedule:

Assets should be prioritized for repair or replacement based on the following:

- *High criticality or BRE factor* (consequence and probability of failure) – Assets with greater risk of failure should be prioritized above all others to be replaced.
- *Energy Efficiency* – If the asset uses greater than usual amounts of energy, it should be evaluated for cause of energy inefficiency and repaired or replaced with a more energy efficient asset.
- *Alignment with LOS goals* -- Similarly, if the LOS includes a goal to reduce greenhouse gas emissions and the asset can be replaced by an asset that uses a "green" source of energy, replacement of the asset may be a good strategic idea, even if this option is not the cheapest alternative.

Figure 4.1 gives an example of what a repair/ replacement schedule might look like.

Year	Item	Brief Description	Estimated Cost	Method of Estimation	One Time or Recurring	Time Period of Recurrence
2010	Meters	Replace 1/5 of meters	$10,000	Knowledge of meter costs from previous purchases	Recurring	Every 5 Years
2011						
2012	Chlorine Pump	Replace chlorine pump	$2,000	Based on previous purchase	Recurring	Every 8 years based on past experience
2013	Tank 1 Repair (and Maintenance)	Repair if inspection shows need, (Tank Clean-ing, Painting, and Inspection should be noted on O&M schedule)	$50,000	Cost for neighboring system with similar tank	Recurring	Every 10 years
2014						
2015	Meters	Replace 1/5 of meters	$10,000	Knowledge of meter costs from previous purchases	Recurring	Every 5 Years
2016						
2017						
2018						
2019						
2020	Meters	Replace 1/5 of meters	$10,000	Knowledge of meter costs from previous purchases	Recurring	Every 5 Years
	Chlorine Pump	Replace chlorine pump	$2,000	Based on previous purchase	Recurring	Every 8 years based on past experience
2021						
2022						
2023	Tank 1 Repair (and Maintenance)	Repair if inspection shows need, (Tank Clean-ing, Painting, and Inspection should be noted on O&M schedule)	$50,000	Cost for neighboring system with similar tank	Recurring	Every 10 years
2024						
2025	Meters	Replace 1/5 of meters	$10,000	Knowledge of meter costs from previous purchases	Recurring	Every 5 Years
2026						
2027						
2028	Chlorine Pump	Replace chlorine pump	$2,000	Based on previous purchase	Recurring	Every 8 years based on past experience

[15] A goal for utilities that follow Asset Management principles is a ratio of 80 percent planned maintenance (including the categories of planned, preventive, and warranty-related) and 20 percent reactionary (corrective) maintenance *[Kansas, AM Kan Work! An Asset Management and Energy Efficiency Manual,* New Mexico Environmental Finance Center/New Mexico Tech, http://southwestefc.unm.edu/main.php?page]

Figure 4-1. Repair and Replacement Schedule example from New Mexico Environmental Finance Center/New Mexico Tech, "Asset Management: A Guide for Water and Wastewater Systems" (2006 Edition)

c. **Capital Improvement Plan** (CIP):

- A CIP determines a system's short and long-term asset rehabilitation and replacement projections, based on the asset inventory, life cycle costs and O&M needs. This spending plan, demonstrating an annualized schedule for system improvements/enhancements and should cover at least five (5) years. A CIP should include for each project to be completed:
  - Description of the project;
  - Need for and benefits of the project;
  - Estimate of project cost;
  - Estimate of O&M;
  - Funding source(s).
- For asset management planning, a CIP should describe the following:
  - Future capital projects (and anticipated associated expenditures) for plans to add new assets to the system that upgrade or improve existing capacity;
  - Renewal projects (and associated expenditures) for plans to restore an existing asset to its original capacity, without increasing an asset's design capacity.
- A CIP should be updated annually so that it always covers the same length of time. Projects that were listed for the current year that were not completed should be moved to the following year. If no projects are anticipated for a given year, the CIP should reflect this.

Figure 4.2 gives an example of what a detailed CIP schedule could look like.

Year	Project Name	Project Description	Project Need	Date Flexible (Y or N)	Estimate of Project Cost	Method of Estimation	Potential Funding Source	Changes in Operation	Impact of Project on LOS
2010	Main Street Line Extension	Extend Main Street 6" PVC pipe to serve 20 customers currently on individual wells	20 customers are facing significant challenges with individual wells and must be added to water system	Yes, could be delayed up to 2 years	$150,000	Based on previous line extension cost; increased 5% to cover inflation	50% connection fees; 25%CDBG; 25% RIP Loan	None	Will be able to provide additional customers with water
2011	None Needed								
2012	Arsenic Removal Facility	Add Arsenic Adsorption System with building and all needed equipment	Source water cannot meet new regulatory requirement of 10 ppb	N, must meet date for regulatory requirements	$300,000	Engineer's Estimate	Requesting Legislative Grant; SRF loan	Higher level operator, Replacement and disposal of media, O&M costs higher	Will allow system to meet LOS requirement to be in compliance with regulatory standards
	2nd Street Line Replacement	Replacement of 2nd Street Line with new pipe	Line failures are so numerous, LOS can not be met	Y, but needs replaced within 1 to 2 years	$250,000	Based on previous costs	30% reserves; USDA RD loan/grant	None	Will meet LOS requirements
2013	None Needed								
2014	Replace 4 miles of 6" PVC Distribution Pipe	4 miles of pipe needs to be replaced due to current condition assessment and est. useful life	Needed to keep the system in good operating order	Y	$1.5 million	Engineer's Estimate	SRF loan or RD loan/grant	None	Reduce number of unplanned outages
2015-2016	None Needed								
2017	Replace Storage Tank 3	Replace Storage Tank #3 with a new, larger tank	Tank is well maintained but is reaching the end of its useful life, further rehab difficult; also, size needs to be increased	Y	$500,000	Cost several neighboring systems paid for similar tank	Need 50% grant, 50% from revenues or loan sources	May require some changes in the amount of time wells are pumped.	Improve overall quantity of storage; Increase fire flow; improve system pressure
2018-2022	None Needed								
2023	Replace Well #7	Drill a new well to take the place of Well #7	Well #7 has been declining in quantity for many years. It is anticipated that it will need replacement by 2024.	N	$15,000	Driller's Estimate	50% existing revenues and reserve funds; 50% loan funds	May require changes in the current pumping system	Improve overall water availability and the system's ability to provide water service

Figure 4-2. Capital Improvement Plan example from New Mexico Environmental Finance Center/New Mexico Tech, "Asset Management: A Guide for Water and Wastewater Systems" (2006 Edition)

Long-Term Funding Strategy[16]

A funding strategy to support asset management should be guided by the condition assessment and asset prioritization and resulting Life Cycle Costing. This funding strategy should include funding source(s), estimated annual expenditures to address identified criticality/priority areas (including repairs/ upgrades/ treatment required to meet environmental standards or enforcement actions), and a schedule for replacing/repairing the individual infrastructure components based on the analysis performed in Life Cycle Costing to ensure a system's performance meets or exceeds the LOS.

a. **Estimated Costs:**
   Know the full life cycle costs of each of its assets. These costs include:
   - Initial cost of installation;
   - O&M expenses;
   - Repair/rehabilitation costs;
   - Disposal costs;
   - Legal, environmental, or social costs.

b. **Sources of Revenue:**
   Identify the dedicated and sufficient sources of funding that will promote the long-term sustainability of the system[17]. This may include generating and reserving adequate funds for continual operations and maintenance as well as long-range capital planning.
   - *External Funding* – Derived from borrowed sources (e.g. loans, the New Jersey Environmental Infrastructure Trust (NJEIT), BANS, bonds, etc.) and grant programs. Most federal and state loan and grant programs fund only capital projects and the utility is responsible for the overall operations and maintenance of the procured infrastructure.
   - *Internal Funding* – Derived from utility rates and fees associated with routine operations. These rates and fees should be sufficient to cover the cost of operations and all existing debt service. A rate/fee structure that covers all anticipated utility costs (i.e. full-cost pricing) should be developed to ensure that adequate revenue is generated for five major areas:
     - O&M Costs;
     - Routine Repairs and Replacements;
     - Capital Improvements;
     - Debt Service;
     - Emergency Operating Reserves.

ASSET MANAGEMENT PLANNING PROGRESS

[16] A successful funding plan will ensure that sufficient revenues are generated and dedicated for the purpose of reinvestment in the utility rather than being diverted to cover other shortfalls in the utility budget. *For further assistance in developing a long-term financial strategy, refer to pages 47-57 of the EPA's "Planning for Sustainability" handbook (http://water.epa.gov/infrastructure/sustain/upload/EPA-s-Planning-for-Sustainability-Handbook.pdf)*

[17] The New Jersey Board of Public Utilities is responsible for reviewing and approving rates for investor owned-utilities, and the State's Department of Community Affairs (DCA) oversees the budgets of publicly-owned, municipal utilities and, in general, the budgets of local governments. These oversights help determine the adequacy of funding and sufficiency of revenue.

An AM Plan documents a utility's AM Program, thus the Plan should be considered a set of documents and resources (such as electronic data management systems) that guide and inform the utility's day-to-day activities and decision-making associated with its Asset Management Program. Continuous change is inevitable and a utility's AM Program documentation will require review, revisions, and updates on a regular basis. We highly recommend that the utility maintain an electronic version of the AM Program documentation in a format that can be easily revised and updated. The AM Plan will be revised over time as the AM Program is evaluated. It's useful to identify goals for both short-term and long-term revision processes. An action plan can identify not only what steps will be taken to develop an Asset Management Program, but also what steps are needed to revise and improve the program over time.

Appendix A: Asset Management Program Checklist

Asset Management Plan Assessment Guide

Title/System Name:	Date:
Prepared For:	**Prepared By:**

Prior to beginning your Plan, the Department of Environmental Protection (DEP) suggests taking these **first steps,** which will provide a background and introduction in Asset Management Planning for your Utility:

1. **Reflect on the History of Asset Management in your Utility**
    a. Identify if a Plan is already in place
        i. Discuss past strengths and areas for improvement in your updated document
        ii. Highlight areas in which a revised Plan improves upon previous iterations
    b. Identify the current Mission Statement and Level of Service Goals for the utility
2. **Prepare Your Organization for Asset Management**
    a. Develop a list of asset management roles and responsibilities (Asset Management Team)
        i. Some key staff members to include on the Asset Management Team may be well versed in the following
            1. **Overlapping Programs/Initiatives**: Operations and Maintenance, Capacity Development, Emergency Response, Finance/Budgeting, Water Quality Management Planning, State Revolving Fund, EPA Clean Water and Drinking Water Infrastructure Sustainability Policy, Effective Utility Management
            2. **Software/Tools:** GIS, CAD, Database (such as Microsoft Access), Spreadsheets, CUPPS, Dashboard, Pubworks
    b. Develop a schedule for ongoing staff training and engagement
3. **Discuss the Past, Present, and Future of your Utility**
    a. Define the mission statement and purpose of Asset Management Planning for your utility
    b. Describe the history and present state of your utility: indicate when major system components/assets began operations, the overall advancement of treatment, conveyance, and distribution processes, source(s), miles of pipe, the number of customers and connections for each service area (i.e. residential, commercial, industrial)
    c. Describe the future outlook for the utility: summarize the anticipated conditions the utility will face – economic conditions, user/customer demographics, future types of industry and businesses to be served, whether the service population or systems demands are expected to grow, stabilize, or diminish.

- ❖ Definitions are provided for all terms underlined hereinafter.

Asset Management Plan Assessment Guide

Contents

Certifications Recommended signatures from appropriate officials committing to Asset Management Planning.				
Page #	**Evaluation Criteria**	**Notes**	**Completed (Y/N/Partial)**	**Best Practices**
	In order to ensure the utility is committed to asset management planning, the Department suggests obtaining the following certifications[1]: • By a professional engineer licensed in the State of New Jersey, certifying that the AMP is complete and that all the technical aspects, supporting information, and conclusions about system reliability, vulnerability, and asset prioritization are true and accurate, and were developed with a commitment to ensuring the safe and efficient operation of the entire system and continually meeting all applicable rules, permit requirements and standards; and • By an authorized water system/municipal official or employee with primary fiscal responsibility, certifying their commitment to reserve and expend such moneys as are necessary to fully implement the submitted Action Plan, Preventative Maintenance Program, and Capital Improvement Program.			

[1] Obtaining the listed certifications may be required in certain cases.

Asset Inventory and Condition Assessment Knowledge of what physical components are owned (assets), where those assets are located, the current condition of assets, and how much longer assets are expected to last.				
Page #	**Evaluation Criteria**	**Notes**	**Completed (Y/N/Partial)**	**Best Practices**
	For each asset, prepare an inventory by collecting information including but not limited to the following: • unique identifier (can be given at the time of collection if not already labeled) • type of asset • condition • size/length • age • construction materials/techniques • soil conditions/characteristics, as applicable • service history • criticality* see critical assets section below • location • remaining useful life • present value • replacement cost			*If restricted by time/staffing, inventory critical assets first. Utilize an asset registry or utility management program (e.g. Microsoft Access, CREAT, CUPPS, VueWorks, Maximo, SEMS) Incorporate O&M into your asset registry.
	Clearly define asset locations with local names or unique identifiers and coordinates on a map/blueprint/schematic.			Prepare a system map utilizing GIS that includes all information collected for the inventory[2].
	Assess the current condition and performance of each asset.			Develop a condition assessment and rating system Utilize standard condition categories

[2] When utilizing GIS, mapping shall be in accordance with Department standards at http://www.nj.gov/dep/gis/standards.html

Asset Management Plan Assessment Guide

Page #	Evaluation Criteria	Notes	Completed (Y/N/Partial)	Best Practices
Level of Service A function of how the utility operates infrastructure and manages assets to meet stakeholder expectations.				
	Determine Level of Service Goals, which are reflective of the following: • The level of service the stakeholders and customers expect. • The level of service the utility intends to provide. • The level of service the regulators require			Write/Communicate/Publish level of service "agreement" to the public
	Define realistic goals that are updated regularly.			Levels of service are informed by the current actual performance and physical capabilities of assets as well as current staffing and resources available to the utility.
Critical Assets Above and below ground owned physical components that have a high risk of failing and/or major consequences associated with failure.				
	Summarize and list past asset failure.			Reference the utility's maintenance records that include the maintenance history, needs, and cost of each asset Include this information in the asset inventory.
	Rank assets according to the likelihood and consequence of asset failure. Analyze the criticality of your assets based on the information obtained during the asset inventory.			Utilizing a standard scale, list assets according to how critical they are to system operations, developing a ranking system (think about the consequence of failure related to expenses, safety, social impacts, or health concerns)
	Based on the asset criticality determination above, assess the vulnerability of assets and the potential to adversely affect system functioning. Estimate the effects in terms of the following: • Power supply (primary and auxiliary) • Communication • Equipment and Supplies • Personnel • Security • Emergency Procedures to be followed • Treatment Processes • Conveyance/Distribution capability			Consult the utility's Emergency Response Plan Review Vulnerability Index Tools Include this information in the asset inventory. Describe how criticality will be updated over time (who and how often?)

Asset Management Plan Assessment Guide

Life Cycle Costing A management strategy with both fiscal and physical considerations to implement at different phases during an assets life.				
Page #	**Evaluation Criteria**	**Notes**	**Completed (Y/N/Partial)**	**Best Practices**
	For each asset consider the past and present maintenance needs (utilizing your Operations and Maintenance Manual) of existing assets. Determine the costs for rehabilitation, repair, replacement and disposal.			*Keep in mind- costing for critical assets is the priority Note cost benefits when comparing rehab to replacement Deploy resources based on asset conditions
	Based on results from the above criteria and in concert with your utility's O&M program, develop and implement a preventative maintenance program.			Identify the Plan's actions that extend useful life or lower cost.
	Develop and implement a capital improvement program based on the life cycle of assets.			* Critical assets should remain the priority
Long Term Funding Strategy A financial strategy to ensure level of service goals are met with adequate sources of funding for current, future operation and maintenance and capital needs				
	Review the current financial status of the utility and determine how to allocate funds based on desired Asset Management Planning Goals. • Ensure that all sources of funding (revenues/loans/bonds, etc.) are sufficient to maintain system assets at the desired level of service • Ensure the rate structure and other sources of revenue are sustainable for the system's long-term needs.			*Keep in mind- costing for critical assets is the priority Fund a dedicated reserve Consider revising the rate structure if needed Consider investments based on risk of failure
	Based on results from the above criteria and in concert with your utility's O&M program, develop and implement an overall funding plan.			Relate level of service goals and the overall funding plan to a CIP, O&M, and PMP.

Asset Management Plan Assessment Guide

Implementation A course of action that is informed by each of the sections above				
Page #	**Evaluation Criteria**	**Notes**	**Completed (Y/N/Partial)**	**Best Practices**
	Describe the overall implementation process or action plan.			Incorporate goals into an action plan to prioritize and implement sustainability in the facility's infrastructure Include who will be involved, what the next steps are, how the plans will be funded, and the time frame for implementation.
	Develop a schedule for Plan revisions.			Consider the plan to be a "living document"
	Determine a method to measure success and evaluate progress.			Use level of service standards to track performance over time Conduct ongoing staff training programs
	Discuss updated manuals and plans associated with Asset Management that have been made available to staff (i.e. Operations and Maintenance Manual, Standard Operation Procedures and Guidance, Emergency Response Plan, Capital Improvement Program, Preventative Maintenance Program etc)			Develop a schedule for updates
	Review and implement, where appropriate, energy/water conservation measures that may advance asset management			Provide incentives for those who practice conservation

References

Tools

1. Environmental Finance Center Network Tools http://efcnetwork.org/resources/tools/
2. The West Virginia Bureau for Public Health Guidance, Utility Self-Assessments, Tables, Worksheet, and Templates http://www.wvdhhr.org/oehs/eed/i&cd/Asset_management.asp

Resources

1. Asset Management for Water and Wastewater Treatment Systems: A Best Practices Guide, USEPA, https://www.epa.gov/sites/production/files/2015-02/documents/asset_management_best_practices_guide.pdf
2. Asset Management Guidance and Best Practices, NJDEP, 2014, http://www.nj.gov/dep/watersupply/pdf/guidance-amp.pdf
3. Asset Management for Water and Wastewater Treatment Systems for Local Officials, USEPA, https://www.epa.gov/sites/production/files/2015-02/documents/guide_smallsystems_assetmanagement_localofficials.pdf
4. Emergency Response Preparedness/Planning: Guidance and Best Practices, NJDEP, http://www.nj.gov/dep/dwq/pdf/guidance_erp.pdf
5. Sustainable Infrastructure Management Program Learning Environment (SIMPLE), Water Environment Research Foundation and Water Research Foundation, http://simple.werf.org/Books/Contents/What-is-SIMPLE-/Overview
6. Kansas, AM KAN Work! An Asset Management and Energy Efficiency Manual, New Mexico Environmental Finance Center, http://southwestefc.unm.edu/main.php?page=2
7. Asset Management: A Guide for Water and Wastewater Systems, 2006 Edition, Environmental Finance Center, New Mexico Tech, New Mexico Environmental Finance Center http://www.nmenv.state.nm.us/dwb/assistance/documents/AssetManagementGuide.pdf

Definitions

- ***Asset*** – Infrastructure, equipment, machinery, property, buildings, vehicles, and other components that have a distinct value to the organization.
- ***Asset Registry –*** A systematic record of assets and their attributes. The asset register provides information for strategic planning and operational management by asset custodian including physical condition details, financial details, asset performance and service delivery performance indicators and targets.
- ***Capital Improvement Program-*** is a short-range plan, usually four to ten years, which identifies capital projects and equipment purchases, provides a planning schedule and identifies options for financing the plan.
- ***Condition Assessment*** – A technical assessment of an asset based on a physical inspection, for the purpose of determining its condition and remaining useful life relative to a defined standard.
- ***Critical Asset*** – An asset whose failure would have significant consequences, either in the ability of the system to provide service to its customers, comply with regulatory requirements, or adversely affect the environment.
- ***Criticality*** – The qualitative determination of the significance of an asset based on its importance to the continued, effective operation of the system, as may be determined by its likelihood of failure and the consequence of failure.
- ***Disposal Costs*** – Certain activities are often necessary to dispose of a decommissioned asset. The costs associated with such asset disposal are recognized as part of the life cycle costs of the asset.
- ***Level of Service*** – The defined service quality for a particular asset or service, against which performance can be measured.
- ***Life Cycle Costing*** – The Life Cycle Costs of an asset is the total costs associated with an asset over the entire period it is owned; includes planning, design, construction, acquisition costs, total life time operational & maintenance costs, potential repair costs, possible rehabilitation costs, and disposal costs.
- ***Preventative Maintenance Program-*** a program to commit to maintenance that is regularly performed on a piece of equipment to lessen the likelihood of it failing. Preventative maintenance is performed while the equipment is still working, so that it does not break down unexpectedly.
- ***Remaining Useful Life*** – The difference between the asset's actual age and the adjusted useful life. Estimate the adjusted useful life for each asset by considering the manufacturer's recommendation, its current condition and service history.
  - ***Useful Life*** – or Economic Life – the period from the acquisition of an asset to the time when the asset, while able to provide a service, ceases to be the lowest cost alternative to satisfy a particular level of service.
- ***Replacement Costs*** – the value of an asset as determined by the estimated cost of replacing it, includes all costs inclusive of material, equipment, construction, engineering planning, design etc. fees, administration and all other costs necessary for the replacement of the asset under typical conditions.