ASSET MANAGEMENT GUIDANCE DOCUMENT

Asset Management
Water Division/Drinking Water Groundwater Bureau
Capacity Development

This guidance briefly describes the major components of an Asset Management Program and the tasks that could potentially make you eligible for funding under the Drinking Water Asset Management Grant.

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WHAT IS ASSET MANAGEMENT?

Asset Management is a systematic process of operating, maintaining, upgrading and disposing of assets cost-effectively while maintaining a level of service that is acceptable to the customers. NHDES' goal is to establish a centralized location to provide information, technical assistance and funding opportunities to assist communities with the development of sustainable asset management programs (AMP).
Core Components of an Asset Management Program (AMP):

1. Asset Inventory
2. Level of Service
3. Critical Assets
4. Life-cycle Costing
5. Long-term Funding Strategy
6. Implementation/communication

The intent of asset management is to ensure the long-term sustainability of the water utility. By helping utility managers make better decisions on when it is most appropriate to repair, replace, or rehabilitate particular assets and by developing a long-term funding strategy, the utilities can ensure their ability to deliver the required level of service perpetually.

CREATING AN ASSET INVENTORY AND ASSESSING THE CONDITION OF ASSETS

Every one of the core elements mentioned previously are important components to an AMP, some people would argue that the inventory is by far the most important of them all. An inventory is a must have in order for utilities to operate efficiently. Along with the inventory, you must conduct a condition assessment to have a better understanding of the state of the asset.

Inventory
The first step in managing assets is knowing their current state. Some water utilities do not have a complete inventory of their infrastructure assets, not to mention, an accounting of the age, condition, and expected life of such assets.

FIVE REASONS YOU SHOULD IMPLEMENT AN AMP IN YOUR COMMUNITY:

1. Helps you document what your assets are
2. Helps you prioritize replacement of critical assets
3. Helps you clearly define the level of service
4. It improves security, safety and response to emergencies within your community
5. It brings validation to your mission and/or vision by providing the data to support your decisions

To develop the initial inventory, there are a number of resources a utility can draw upon such as as-built drawings, invoices, staff knowledge, visual observation and interviews with residents and consultants. A utility should use as many approaches as it deems necessary to get the best initial inventory of assets.

Questions to ask about inventory:

- What do I own?
- Where are they?
- What condition are they in?
- What is the remaining useful life?
- What is their value?

A common mistake that too many utilities make during this process is the inability for utilities to get beyond the point of making a decision on specific software and technology to create the inventory list. While the use of technology is encouraged to create efficiency of reproducing and analyzing the data, it is not the only method of achieving this goal. Some other methods such as Microsoft excel spreadsheets or even a handwritten list could be as effective. The methodology is not as important as the content.

Typically, such inventory will consist of the following:

- Identification number (i.e., unique number assigned to the asset)
- Asset Name
- Location (e.g., street name and/or address, name of building)
- Asset category (e.g., "pump")
- Asset type (e.g., "raw water pump")
- Pertinent capacity information (e.g., size, length, horsepower, etc.)
- Estimated remaining useful life (see Pg. 5)
- Estimated replacement cost (incl. purchase, installation costs, etc.)
- Condition (see Pg. 4)
- Probability of failure, consequence of failure, and overall risk ratings (see risk assessment discussion Pg. 9).
- Notes related to basis for condition ranking (include date of assessment)
- Photo (if possible)

The spreadsheet below is an example of the minimum information that should be collected during the inventory process. Please make sure to be very specific with asset name(s) and location(s). A digital copy of this spreadsheet is available per request.

PWS Name: Date:

Town:

INVENTORY OF WATER SYSTEM ASSETS AND USEFUL LIFE

Prepared By:

Asset Name	Location	Asset Category	Asset Type	Capacity or Size	Asset Material	Year Installed	Estimated Useful Life (yrs.)	Remaining Useful Life (yrs.)	Estimated Replacement Cost ($)	Condition Score (1-5)	Redundancy	Probability of Failure (1-5) A	Impact Score (1-5) B	Risk Score A x B (1-25)	Equipment Make/Model	Annual Reserve (
Well #___				Ft (depth)												
Well Pump #1				HP / gpm			10-15									
Pump House				ft. x ft.			30-60									
Electrical/Controls				Amps			7-10									
Chemical Feed Pump				HP/gpm			10-15									
Chemical Feed Tank				Gal.			10-15									
Treatment Vessel				CF			10-15									
Source Meter(s)				In			10-15									
Service Meters				In			10-15									
Atm Storage Tank(s)				Gal.			30-60									
Pressure Tank(s)				Gal.			30-50									
Booster Pumps				HP			10-15									
Valves				In			35-40									
Hydrants				In			40-60									
Distribution Mains				Ft			35-40									
Distribution Mains				Ft			35-40									
Generator				Kw/hr.												

Condition Score (5) Unserviceable; (4) Significant; (3) Moderate; (2) Minor; (1) Excellent

Impact Score: (5) Catastrophic; (4) Major; (3) Moderate; (2) Minor; (1) Insignificant

Probability of Failure: (5) Imminent; (4) Probable; (3) Occasional; (2) Remote; (1) Improbable

Locate/Map the assets

A map is a graphic representation or scale model of spatial concepts. As technology has evolved, so has the art of map making. Geographic information systems, known collectively as GIS, are probably best known because of online mapping sites such as Google Earth and MapQuest, but they also are essential analytical tools. GIS is a computer-based mapping system that allows data to be displayed on maps and analyzed based on spatial factors. GIS software packages can be used to view base maps of geographic sections (e.g., cities, counties, states, countries, etc.) with “layers” of attribute data (e.g., structures, sources, water lines, individual services, etc.) over the top.

In New Hampshire most of the utilities’ water infrastructure is buried and out-of-sight, thus it becomes crucial to have documentation of the location and descriptive information. The grant proposal must describe 1) which assets will be mapped, 2) the form that the map(s) will be created in (e.g., handsketch, Google Earth, Geographic Information System, CADD, etc.), 3) who will create them, 4) how system staff will have access to use the map(s) (e.g. paper, computer tablet, etc.), and 5) how the map(s) will be kept current (i.e., who will update the maps, etc.).

Utilities should choose a mapping system that best meets their needs, capabilities, and resources. Similar to the concept of an AMP not being a one size fits all approach, mapping is the same. There is little benefit to having a sophisticated mapping system if it is not readily available and most importantly comprehensive to the staff. It is extremely important for the utility to understand this concept as it will have a direct impact on the success of the program.

Asset(s) Condition

After the assets have been identified and located, it is important to know the condition of the assets. A condition assessment can be completed in many different ways, depending on the capability and resources of the utility. The simplest way is to assign a numerical ranking to each asset. This approach uses the best information available. Below is an example of a ranking system. For some utilities, this process is highly dependent on institutional knowledge for a better analysis of this assessment.

Condition Assessment

Condition Rating	Description
5	Unserviceable
4	Significant Deterioration
3	Moderate Deterioration
2	Minor Deterioration
1	New or Excellent Condition

In order to assure efficiency and viability of the condition assessment ranking system, stakeholders must agree on the ranking system prior to commencing with the evaluation. The complexity of the ranking system depends on the outputs that you are trying to achieve. If resources are available, a higher level of assessment could include leak detection, Sonar, 3D and 4D laser for water pipes and other forms. Technology advances are enabling better, faster, and/or less expensive collection, reporting, and analysis of structural data from water mains, tanks and other buried infrastructure.

Remaining Life and Value

All assets will eventually reach the end of their remaining useful life. Some assets will reach this point sooner than other assets. There are many factors that will affect the useful life of an asset such as maintenance practices, type of materials, usage, and surrounding environment. Useful life will also vary over time; for example, a pump may originally have been assigned a useful life of 15 years, but with proper maintenance that useful life may extend to 20 years. Useful life should be reevaluated on a regular basis. Past experience, system knowledge, existing and future conditions, and maintenance practices will dictate ongoing changes/updates to the useful life.

Estimated Useful Life

Assets	Expected Useful Life (in years)
Intake Structures	34-45
Wells and Springs	25-35
Galleries and Tunnels	30-40
Chlorination Equipment	10-15
Other Treatment Equipment	10-15
Storage Tanks	30-60
Pumps	10-15
Buildings	30-60
Electrical Systems	7-10
Transmission Mains	35-40
Distribution Pipes	35-40
Valves	35-40
Blow-off Valves	35-40
Backflow Prevention	35-40
Meters	10-15
Service Lines	30-50
Hydrants	40-60
Lab/Monitoring Equipment	5-7
Tools and Shop Equipment	10-15
Transportation Equipment	10
Note: These numbers are ranges of expected useful lives drawn from a variety of sources. The ranges assume that assets have been properly maintained.	

Credit: Asset Management: A Handbook for Small Water Systems One of the Simple Tools for Effective Performance (STEP) Guide Series by EPA, September 2003

The value of the asset is the cost to replace the asset after it has exhausted its useful life. Obtaining costs for the asset replacement is not easy. In some cases, the utility will use an estimate based on best practices; in other cases, the utility may rely on a consultant or manufacturer's catalogs and sales representatives. More reliable data can be added when available. Analyzing the life cycle costs of owning assets can help a system create budgets; evaluate alternatives when purchasing new assets; and decide when it is best to maintain, repair, rehabilitate, or replace an asset. An analysis might show, for example, that it would be less expensive to replace an asset than to keep it in service - the asset has failed economically. Indicators that an asset has failed economically, or might fail soon, include high energy use (e.g., inefficient or undersized pump), and frequent or expensive repairs (e.g., to fix an aging pump or leaks in a section of pipe).

LEVEL OF SERVICE

Level of Service (LOS) establishes the exclusive reason for why your utility does what it does. LOS outlines the major goals that arrive from conversations with your customers. Goals can be in several different areas, such as water quality, water loss, water conservation, or customer service and should be "SMART" (specific, measurable, attainable, realistic or relevant, and time bound.)

All utilities must operate within state and federal regulations and requirements. Although the state and federal regulations set bare minimum standards of operation in the LOS, these standards will not adequately address all areas of

LIFE CYCLE COST INCLUDES:

1. Initial capital costs (planning, purchasing, installation)
2. Operation and maintenance costs (labor, materials, fuel, electricity, etc.)
3. Repair and rehabilitation costs
4. Legal, environmental, and social costs
5. Disposal costs or salvage value.

operation and should not be the sole factor of the LOS. Utilities should include many other factors to delineate important areas of the utility's operation.

There is a direct link between the LOS provided and the cost of service to the customer. When a higher LOS is provided, costs to provide that higher LOS will likely increase. This direct link demands that the utility has an open dialogue with its customers regarding the LOS desired and the amount the customers are willing to pay for this LOS or increased services. This would be a great opportunity to educate your customers and the public of the true cost to produce safe drinking water and the service cost for the delivery of the water.

It is essential to inquire and incorporate stakeholders input as this will provide a true representation of the customer service that your stakeholders expect from your utility. Adjustments may be needed as time goes on because the utility and the stakeholders may discover that it is too costly to operate the system at the level of service that was previously agreed on regulatory demands may force these changes.
Typical questions to consider when developing the LOS for the system:

1. What is the LOS goal for health, safety, and security?
2. How often is the system out of compliance with regulations?
3. Are the operators properly certified?
4. How does the utility stay aware of and prepare for new regulations?
5. Do you share your LOS agreement with your customers?
6. How do you track and respond to customer needs/complaints?
7. Can the current process be improved?
8. How quickly does the utility respond to customer issues?
9. Is maintenance being deferred to save money?
10. How much will the improvements cost and how will they be funded?
11. Are assets being properly maintained to insure they are in reliable working condition?
12. What areas within the system are most important to insure the best LOS possible?
13. When considering a preferred LOS, are asset age and life cycles, asset conditions, funding availability, etc. being factored in?
14. How often will the LOS agreement be reviewed in order to capture changes such as funding availability (growth and decline), regulatory requirements, demand of customers (increases/decreases in customers), and physical deterioration of assets (addressing water loss/maintenance)?
15. Are O&M activities being maximized to meet the LOS goals?

The following example is **not** the ideal LOS agreement that we are looking for

> "ABC Water Department is dedicated to providing safe, clean potable drinking water to its customers that is reliable and meets and exceeds state and federal regulations. ABC Water Department is committed to upgrades, including water mains, valves and hydrants. By improving the distributions system, water main breaks are being reduce. We will provide drinking water 24 hour a day, 7 days a week and provide fire protection while maintaining an equitable water rate…."

This example while it does provide some of the qualities that a SMART statement should have. It is not very specific, and for the most part is not measurable, but the biggest flaw in the statement is that you will provide water 24 hours a day for 7 days a week. We all know that there will be times that shutdowns must occur because of emergencies or pre-planned updates or repairs.

The agreement must include goals (external and internal) and performance measures to determine if goals are being met. The goals should be specific, measurable, achievable, relevant, and time bound Meeting federal and state drinking water requirements must be a goal for all systems but customer service and LOS should stride for far more.

The example below is a more acceptable LOS statement as defined by the SMART definition.

Examples of Level of Service

External Level of Service Goals	Performance Measures
Comply with all federal and state water drinking water regulations 100% of the time.	Review monthly compliance reports
Meet state and federal secondary standards related to aesthetics at least 95% of the time.	Review quarterly water quality test results
Provide minimum water pressures of 35 pounds per square inch throughout the system at least 90% of the time	Review monthly pressure readings
Respond to customer complaints within two business days at least 95% of the time	Review complaint logs monthly
Adequate fire flow will be available for all customers	Review flow testing every three years

Internal Level of Service Goals	Performance Measures
Rates will be reviewed annually and raised as needed to ensure full cost recovery.	Yearly by review committee
By-laws, ordinances, and policies will be reviewed at least every three years and amended as needed to ensure that level of service goals (including federal and state requirements) can be met.	Triennially by review committee
Conduct an annual water audit following American Water Works Association (AWWA) standards.	Annual water audit
Repair water line breaks within eight hours of initiation of repair 95% of the time	Review complaint logs and work orders annually

CRITICAL ASSETS

When trying to define critical assets, here are some questions that may help you with defining which assets are of importance within your utility:

- What are the social, economic, and environmental consequences when the asset fails?
- What is the probability of failure?
- Which assets are the highest priorities based on the consequences and probabilities?

Each system needs to determine which assets are most critical to the reliable operation of the utility on a sustainable basis. In addition to evaluating asset criticality, an assessment of asset vulnerability is also essential. Critical assets that are also vulnerable (due to their location or construction) to a variety of potential threats (storms, sabotage or terrorism, etc.) that could compromise the effective operation of the system should be considered for higher priority in the asset management plan.

A common approach to determining risk is by the combination of probability of failure and consequence of failure. Risk scoring provides a defensible prioritization for replacement, rehabilitation, or maintenance and is graphically represented in the chart below.

1	Very Low
2	Low
3	Moderate
4	High
5	Very High

RISK = PROBABILITY X CONSEQUENCE

Probability of Failure

For most systems, a simple rating scale like the one below can be used. When assessing the likelihood that an asset will fail, the system should consider the asset's age, estimated remaining useful life, condition, vulnerability to hazards (e.g., floods, erosion, ice damage), history with similar assets, and staff's knowledge about the asset.

Rating or Score	Probability of Failure	Type of Failure
1	Improbable	Unlikely to occur, but possible
2	Remote	Unlikely, but can reasonably be expected to occur
3	Occasional	Will occur a few times
4	Probable	Will occur frequently
5	Imminent	Continuously experienced

Consequences of Failure

When an asset fails (e.g., pump station goes down) it has social, economic, and/or environmental consequences. As part of the risk assessment, the system must adopt a method to rate the consequences of failure, and use the method to rate each asset in the inventory relative to its other assets. A simple rating scale like the one below may be used. When rating assets, the system should consider all potential costs and impacts related to its failure, but does not have to determine exact costs.

Rating or Score	Consequence of Failure	Type of Failure
1	Insignificant disruption	Slight effect
2	Minor disruption	Minor effect, minor costs
3	Moderate disruption	Moderate effect, moderate cost, important LOS still achieved
4	Major disruption	Major effect, major cost, important LOS compromised
5	Catastrophic disruption	Massive system failure, extensive damage

When assigning consequences of failure ratings, the system should also consider whether there is redundancy for each asset. If an asset can provide the same service (or partial service) that another asset provides, then the consequences of failure can be reduced. For example, the consequences of a well failing will be less severe if there is another well that can be used. A simple way to account for redundancy is to multiply the consequences of failure rating by a "redundancy factor" (see table below).

Amount of Redundancy	Redundancy Factor
None	1
25%	0.9
50%	0.7
75%	0.5
100%	0.4
150%	0.3
200%	0.25

Example:
ABC utilities North side pump station has a 5 hp pump that has been there for more than 6 years. This station provides water to 85% of ABC's customers including the school and the hospital. It is very important for them to make sure that they have spare pumps on the shelf as backup plans. The life expectancy of these pumps is 5-10 years. The utility has 2 spare pumps.

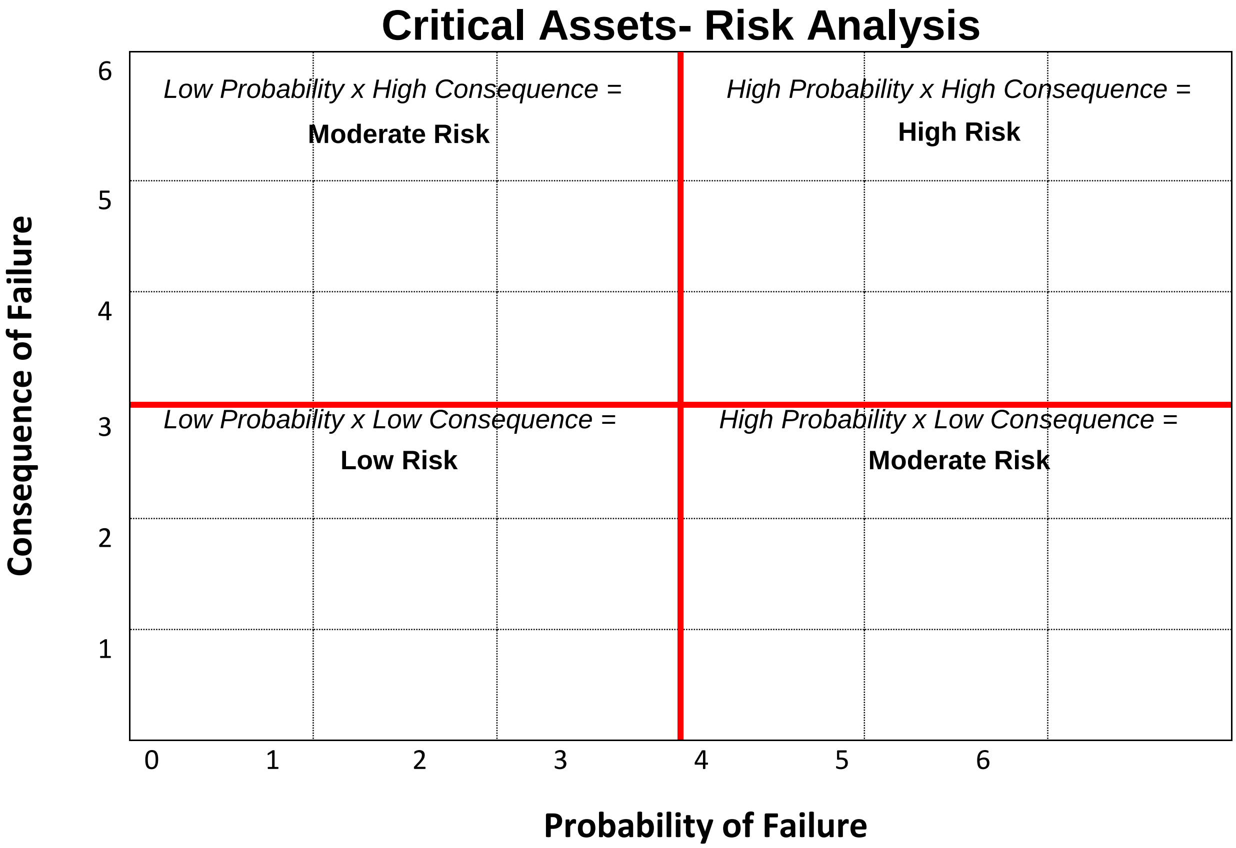
Asset Name	POF Score	COF Score	Redundancy	Total Score w/ Redundancy
Northside Pump	4	5	0.25	5

This example would have been more critical if there was no redundancy available. The total score was drastically reduced because of the availability of spare parts to keep the operation of the station.

Prioritize Assets
Based on the consequences and probabilities of failure ratings, the system should assess each asset's risk to identify priority of assets. So the system must decide on a methodology for assigning an overall risk rating to each asset. A simple way to do this is to multiply the consequence of failure rating (adjusted for redundancy) by the probability of failure rating. Assets with the highest risk scores would be considered the greatest priorities. Graphing assets based on their consequence of failure (COF) and probability of failure (POF) scores (see below) allows systems to easily see which factor (COF or POF) contributes more to the risk rating. These factors will be used to help decide how assets are treated (see the Developing Risk and Life Cycle Cost Reduction Measures Section, below).

Asset	**Probability of Failure**	**Consequence of Failure (Adjusted for Redundancy)**	**Risk Rating or Score**

When the risk assessment for each asset has been completed, a graph showing the risk for each asset is useful tool to quickly see which of the assets is most critical. Plotting the risk number on a graph with probability of failure on one axis and consequences of failure on the other axis is the easiest way to accomplish this. The graph can be divided into four categories into four categories of risk. As shown on the risk matrix below.



Criticality Analysis Over Time

The condition of the asset will change over time as will the consequences related to failure. Therefore, it will be necessary to periodically review the criticality analysis and make adjustments to account for changes in the probability of failure and the consequence of failure. As with all the components of the Asset Management Program, the criticality analysis is an on-going process.

LIFE-CYCLE COSTING

The utility will need to make decisions as to how they will operate and maintain their assets including deciding when to continue to repair an asset and when to replace it. Typically, by spending more on routine maintenance means spending less on replacement. Generally speaking, routine maintenance is cheaper than replacing assets. Utilities will need to evaluate how much time and money is devoted to routine maintenance and that will involve thinking about the criticality of the assets. More routine maintenance should be performed on the higher critical assets rather than those that are less critical.

I. What is the life expectancy of your assets?
II. What are the operation and maintenance costs?
III. What will it cost to replace them?
IV. How do you know when to repair or rehabilitate and when to replace?

Another consideration that must be identified when dealing with the life cycle cost is the energy efficiency of the asset(s). A significant number of water systems allocate a tremendous amount of money toward the Power Budget as a result of the unwillingness to move on from existing asset as is still working. The reason for collecting and analyzing data is to be able to make decisions as to when it is counterproductive to continue with the operation of an asset that is ultimately costing you more to run than if you were to invest into a newer model with less required maintenance and energy to operate.

> ***Managing sustainable water systems***
>
> ***Managing for sustainability requires a more flexible, forward-thinking and integrated approach that considers the following factors:***
>
> ***Adaptability***
> ***Integration of natural systems***
> ***Resource efficiency***
> ***Multiple benefits across sectors***
> ***Full life cycle management and pricing***
> ***Asset Management***
> ***Good governance***

LONG-TERM FUNDING STRATEGY

In order to manage and operate the utility at the desired level of service at the appropriate cost to your customers, you will need to have a sustainable funding strategy. You will need to determine if you are funding the operation and maintenance, repair, rehabilitation, and replacement of assets at the appropriate level. Most utilities have both internal and external sources of revenue.

Internal Funding

Internal funding for day-to-day operations comes from utility rates and fees. These rates and fees should be sufficient to recover the cost of operations but it should also take into consideration creating excess funds to pay for rehabilitation and replacement of infrastructure. Besides rates, a utility may have other fees such as connection fees, stand-by fees, reconnection fees, cross connection control program fees, fire protection, impact fee, inspection fee, etc.

External Funding

Unfortunately, the revenues created from the internal funding over the past few decades have not yielded enough to properly maintain the infrastructure. This has created a scenario where more frequently than not, communities are forced to find financing through other methods such external funding sources. External sources can include debt (such as governmental loans), equity contributions (such as grants), customer contributions, tax benefit districts, or private sector investment.

Water utilities need to embrace various financing changes in order to ensure long-term sustainability. As infrastructure ages and the population grows beyond the capacity of existing systems, the need to invest millions of dollars into the water infrastructure will increase.

Full cost recovery has been a term that lately has gained a great amount of momentum. The definition of full cost recovery is a pricing structure for drinking water which fully recovers the cost of providing that service in an economically efficient, environmentally sound, and socially acceptable manner and which promotes efficient water use by customers.

IMPLEMENTATION/COMMUNICATION

Asset management is a way of thinking about managing assets in a more efficient and customer-centric way and unfortunately, there is not a one size fits all solution. There are many acceptable approaches to asset management, as long as the five (5) previously mentioned concepts form the basis of the program. An additional concept that NHDES requires through their funding opportunities is the implementation and communication plan.

We all know that good communication is the key to success in most accomplishments and it is true in asset management. AMPs are living documents that require constant updates and improvements. Both, the staff and customers can provide important information that can aid in keeping the AMP relative and effective.

A communication plan lays out the road map and ensures that lines of communication remain open between the utility and the customers. There are two basic types of communication that you should address-internal and external. Each of these corresponds to different audiences and different needs.

Internal Communication

Internal communication is for the staff, managers and decision-makers. This provides the structure to the asset management program and it creates the culture of being pro-active with all of the aspects of the infrastructure.

Communication	The basics (Inform)	Show Consideration (inform and consult)	Work together (Inform, consult and collaborate)	Keep satisfied (Evaluate and lessons learned)
Staff, managers, decision-makers	Need to make sure that the workforce is well informed and feel confident about promoting the asset management program and managing the customer expectations. Need to make			

	sure that the staff is skilled and knowledgeable and are proud of the service they provide. Need to make sure that the staff is aware of the level of service that the customer expects.			
	• Websites • Noticeboards • Monitoring and improving employee satisfaction • Intranet • Customer training	• Promote the board's key messages	• Meetings • Team brief • Staff forum • Team meetings • Collaborate with other utilities through user groups.	• Publish annual operating reports • Publish asset management achievements

External Communication

External communication is just as important as internal communications. It is crucial to keep your customers well informed of your operations. Perspective rate increases or the success of future projects will depend on your ability to be transparent with customers.

Communication	The basics (Inform)	Show Consideration (inform and consult)	Work together (Inform, consult and collaborate)	Keep satisfied (Evaluate and lessons learned)
Customers	Need to make sure that customers get the right information the first time. Need to provide an efficient, effective and adequate level of information to the customers. Transparency will improve perception and trust in the work that utilities do and the public will appreciate the service that they receive.			
	• Websites • Emails • Newsletters • Social Media • Public events • Publishing asset management policies and strategies	• Customer relationship management • Newsletters • Information updates • Targeted communications and alerts	• Community working groups • Consultation events	• Publish annual operating reports • Publish asset management achievements • Customer satisfaction surveys • Public meetings

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