AVEVA

Asset Performance Management for Water and Wastewater Utilities

Minimize risk and maximize performance of assets in your water and wastewater operations with a digital, proactive maintenance and reliability approach that can extend the useful life of your infrastructure investment.

Overview

Water utilities and water network operators have a very simple mission: Deliver safe and reliable water and wastewater services to their customers. But to deliver these services, utilities must rely on numerous assets and equipment, many of which are ageing or should be upgraded in order to effectively fulfill this mission

Luckily, technology triggers like the Industrial Internet of Things (IIoT), big data analytics, mobility and workforce collaboration represent new opportunities for significant reliability, efficiency and safety improvements for water and wastewater utilities, enabling them to extend the useful life of their infrastructure investments.

To remain cost-effective in the face of these market trends, utilities are seeking an operations-centric view where proactive and predictive maintenance opportunities empower front-line personnel to act before costly failures occur. With Asset Performance Management (APM) solutions, utilities can extend the life of critical assets, thus minimizing maintenance costs and improving reliability.

As a result, plant and field crews are empowered to act before equipment failure occurs, maintenance and operations costs are reduced, and the overall maintenance and operations strategy supports key continuous improvement objectives.
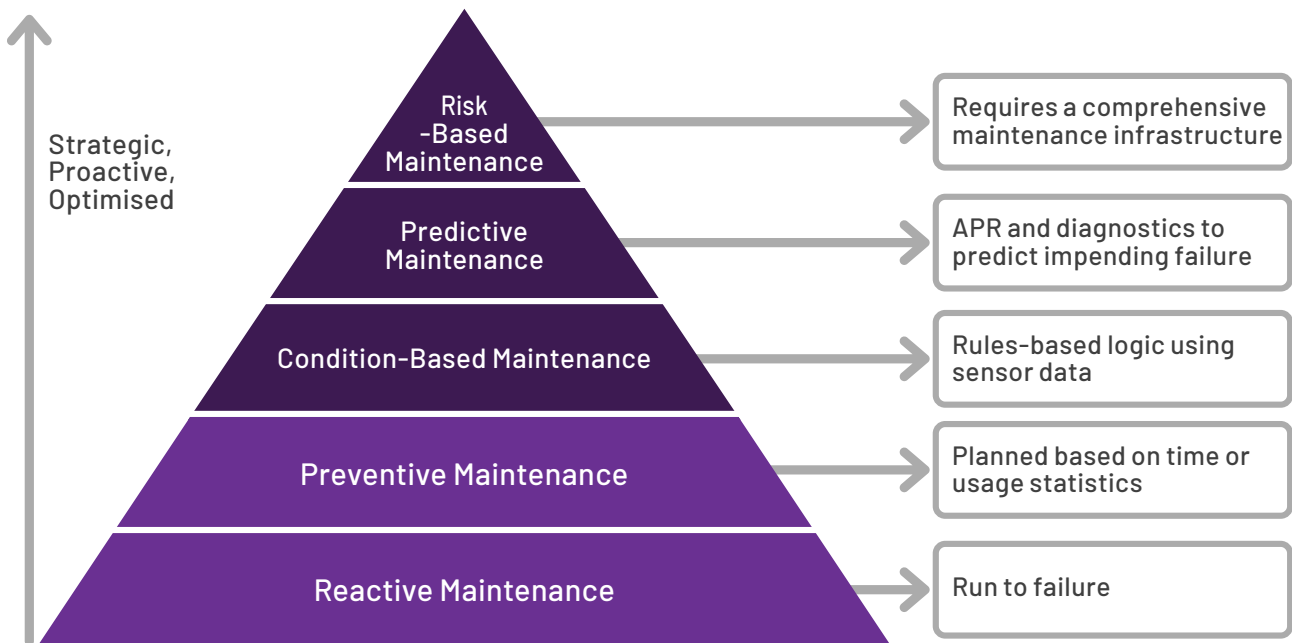
Maintenance Practices

APM solutions integrate all the various elements of a comprehensive maintenance program, making valuable information accessible and delivering context for smarter decisions. It requires a broad solution portfolio to develop a strategy that supports business objectives, collects, analyzes and contextualizes data across asset and operations lifecycles, and provides the framework and toolsets for optimized maintenance execution. All to support the continuous improvement processes as outlined in the Maintenance Maturity Pyramid.

The higher you move up the Maintenance Maturity Pyramid, the more proactive the strategy becomes, requiring more advanced warning of equipment problems. This enables maintenance teams to better plan resources, order materials, and minimize unplanned downtime.

Economic Incentive

Shifting from reactive maintenance to proactive and predictive maintenance delivers the greatest economic return for all asset types. This is made possible by integrating various technologies and devices and applying advanced analytics to determine where improvements should be made.

Strategic, Proactive, Optimised

Risk-Based Maintenance → Requires a comprehensive maintenance infrastructure

Predictive Maintenance → APR and diagnostics to predict impending failure

Condition-Based Maintenance → Rules-based logic using sensor data

Preventive Maintenance → Planned based on time or usage statistics

Reactive Maintenance → Run to failure

Maintenance Maturity Pyramid

AVEVA

Benefits span all functional areas from strategic, to operational, to financial and safety. Operational benefits can be achieved through the early identification of equipment problems to reduce unplanned downtime. Engineers can spend less time sifting through raw data and spend more time improving the reliability and performance of assets. There are financial and safety benefits to be achieved through increased asset utilization and reduced downtime, as well as the opportunity to identify equipment problems before a major failure causes significant or catastrophic damage.

In addition to improving reliability and availability, utilities can leverage asset performance management solutions to reduce purchasing costs, improve maintenance scheduling and defer capital expenditures. Resources and planning can be optimized by improving communication across disciplines. And workforce enablement, in particular, mobile workforce enablement, allows workers in the field to collect data remotely and implement condition-based maintenance tactics.

Actual Savings Achieved with APM

30%+ Improvement in regulatory compliance

25% Reduction in unplanned downtime

30% Reduction in maintenance costs

20% Increase in asset availability

$50K Savings from early warning of performance issues

25% Increase in planned work

30% Improvement in asset utilisation

25% Improved labor utilisation

Condition-Based Maintenance - The "Check Engine" Light for Your Plant

Condition-based maintenance is one of the most straightforward and effective asset performance applications a water or wastewater utility can undertake. It is often the first step taken by an operator looking to move from a preventive maintenance regime into a proactive maintenance approach.

Just like the "Check Engine" light in your car, AVEVA's Condition Management solution collects and analyzes real-time diagnostics from all production assets and drives appropriate action to improve overall asset performance, operations, engineering and maintenance.

The system automates the maintenance process through the monitoring of user-defined rules and algorithms that initiate necessary maintenance activities based on measured operating condition. When the equipment is operating out of the normal range, condition-based maintenance raises an alarm to the operator to make them aware of the abnormal conditions and allow them to make an informed decision about what maintenance is required.

Condition Management can monitor and aggregate more than one real-time point from different sources to make intelligent decisions. A few examples often seen in a water plant include:

- **Time-based decisions**: Lubrication based on motor run-time – For example, after 3000 hours of run-time create a lubrication activity requesting lubricant from the warehouse, with operations providing the resource.

- **State-based decisions**: Monitor the Motor Bearing Temperature - If exceeded, create a work order for bearing replacement.

- **Dual comparison decisions**: Track pump power consumption versus volume flowrate looking for excessive power consumption for known pumping capacities to detect mechanical degradation of pump.

- **Multivariate analysis**: Compare temperature, vibration, density, rpms etc. to detect mechanical degradation prior to failure.

By adopting a condition-based maintenance solution in the utility, operators can get early-warnings for equipment operation that may lead to failure, and take an informed, proactive approach to maintenance reducing downtime and equipment failure costs.
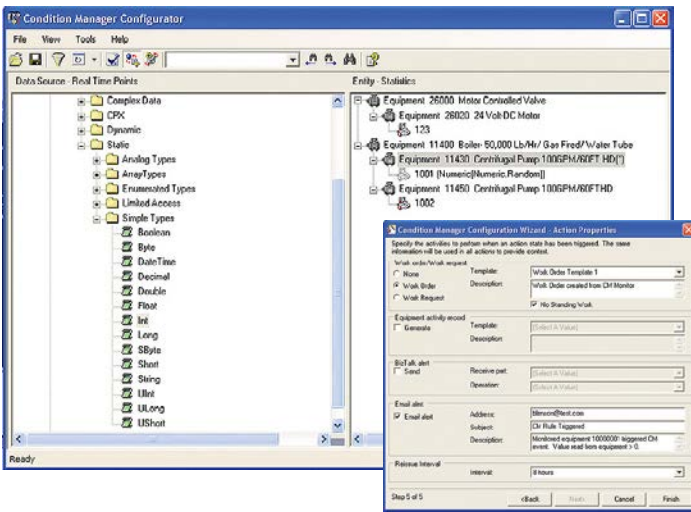
Digitally Transform Operator Rounds and Connect Stranded Assets

One of the biggest challenges to improving asset performance is that 40-60% of the equipment in a typical water or wastewater utility remains digitally disconnected from the automation system. These "stranded assets" are invisible to operators unless they perform frequent inspection rounds and manually take down readings and condition assessment, traditionally on paper log sheets. This type of manual data collection is error-prone and often leads to loss of information. The lack of standardization in these inspection processes can also lead to service issues and safety hazards. Furthermore, knowledge loss can occur as more experienced operators retire and fail to pass along their wisdom to the next-generation operators.

Water and wastewater utilities that have implemented a mobile workforce and decision support system are able to reap the benefits of using configurable software and ruggedized mobile hardware to enable workflow, data collection, and general task management for plant operations, maintenance management, processing tracking, and compliance applications. AVEVA's Mobile Operator Rounds solution enables:

- **Advanced Workflow Management** - Users can set alert thresholds to communicate when the deviation between actual values and predicted values exceeds allowed limits. Each alert event is also directly linked to a graphical trend for that asset that shows the event data, threshold limits, and times when the values are in alarm.

- **Comprehensive Analysis and Reporting** - Detailed and comprehensive reports can be generated and accessed over web connections for cross-functional team sharing so management has enhanced visibility of performed field tasks. Images can be captured and marked up to accelerate problem resolution.

- **Accelerate Process Improvements -** Enable reliable, safe, and profitable operations through consistent execution of best practices by the field workforce, accelerating and sustaining mainstream process improvement.

- **Automated Procedure Triggering** - Drive consistent execution of best practices by the field workforce, accelerating and sustaining mainstream process improvement.

AVEVA's Mobile Operator Rounds will enable the entire workforce:

- Maintenance Managers can align maintenance and business strategies.

- Maintenance Engineers have enhanced risk assessment and management capabilities.

- Plant/Network Operators can ensure site and service performance.

- Operations Leads are enabled to provide safe, reliable, high quality service with on budget performance.

All of this can be accomplished using a solution that is compatible with a wide array of industrial mobile devices as well as your Android or Apple smartphone or tablet.

The asset information you need, in the right place, on the right device

The urban water cycle, from source, to plant, to consumer spans a massive geographical area and water and wastewater utilities often need access to their asset information in a variety of locations – not just in the control room. With the proliferation of Industrial Internet of Things-enabled sensors and advanced metering infrastructure, the number of data sources and types of data available to utilities is constantly increasing. However, this data is often not available in context that makes the information useful. In addition, accessing this data outside the control room is often difficult due to data security concerns and the high cost of significant setup and maintenance requirements of a virtual private network to support employee data access.

AVEVA Insight is a secure, managed solution for collecting, storing, visualizing, and analyzing water and wastewater data in the cloud for faster, smarter operational decisions. It consolidates data from disparate systems and puts the data in context for complete visibility into how operations are performing, and enables utility employees to access the data anytime, anywhere, and on the mobile device of their choice.

AVEVA Insight unlocks trapped data in water and wastewater operations while breaking down data silos to make industrial analytics accessible across the utility. Using AEVA Insight, operators can enhance performance by exposing hidden opportunities for improving operations and improve reliability and maintenance activities via access to real-time critical data in the field. Best of all, the simplicity of leveraging a managed software service reduces cost to setup and maintain a secure, remote access data platform by leveraging the most modern, cloud-based, cybersecure platform available today.
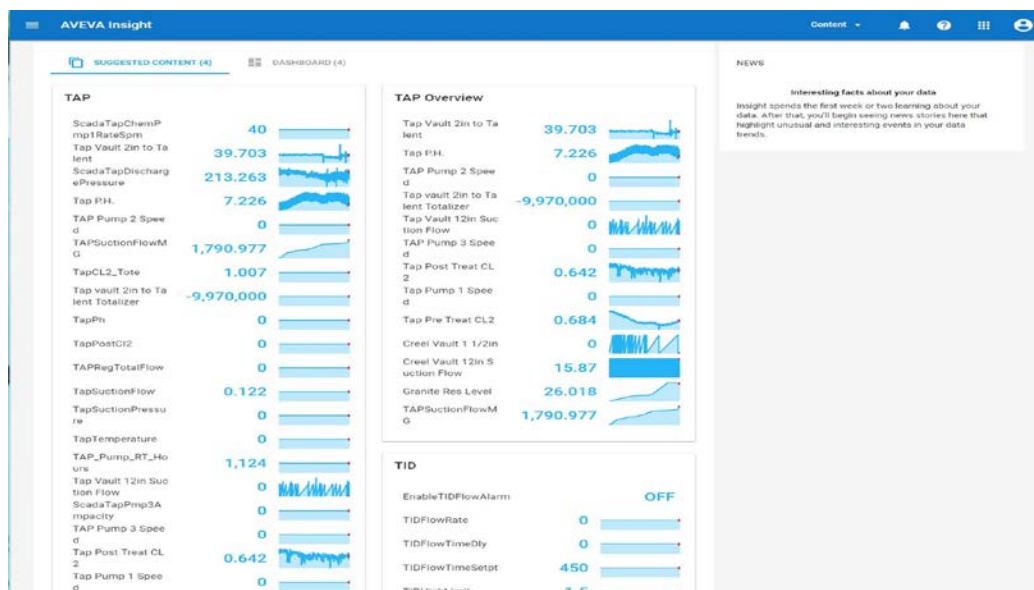

Reduce Operations, Maintenance, and Inventory Costs

AVEVA's Enterprise Asset Management (EAM) is a comprehensive solution for providing maintenance management, spares, and inventory management, and provides complete procurement capabilities for water and wastewater utilities. AVEVA's EAM increases asset availability by seeing that necessary maintenance is performed and enables maximum output from expensive and complex assets. Leveraging our unique Rapid Implementation Methodology (InRIM), based on predefined business processes and best practices, AVEVA's Enterprise Asset Management solution minimizes employee time investment and reduces implementation risk. With increased visibility into maintenance history, inventory, and procurement, utilities can implement a preventive maintenance program that maximizes return on asset investment.

AVEVA's Enterprise Asset Management solution enables many parts of your maintenance and reliability operations including:

- **Work Management** - This enables the utility to manage and plan incoming work requests, as well as automatically generate work from preventive maintenance programs. The planning function ensures that labor, materials, tools, drawings, subcontractor requirements, and safety information can be identified on work orders to support proactive maintenance activities.

- **Preventive Maintenance** - Create a library of standard, repeatable jobs with automatic work order generation based on any combination of user-defined triggering criteria such as operating statistics, elapsed time, and calendar date, as well as inspection checklists and PM routes. The application is fully integrated to distributed control systems, such as the Foxboro I/A Series System or AVEVA System Platform to support the automated downloading of real-time operating statistics from the plant floor.

- **Reliability Analysis** - Build a detailed history of equipment information based on day-to-day maintenance activities. Failure history, including symptoms, the cause of failure, and action taken can be easily reviewed and analyzed. In addition, indicators such as mean-time-between-failure and mean-time-to-repair reporting are available to determine proper fine-tuning of equipment maintenance requirements.

- **MRO Inventory Management** - Address the main challenges of maintenance repair and operations to enable the control of a large number of unique and low-unit value items. The system automates the reorder process by recognizing calculated safety stock levels, replenishment lead times, and sophisticated "available-to-promise" logic based on expected receipts (open purchase orders) and issues.

- **Procurement** - Minimize the cost of buying high volumes of MRO inventory items and ensure that parts are available when needed. Fully automate the entire procurement process, including requisitions, purchase orders, expediting, receiving, quotations and contract, and invoice matching. Improve contract negotiation and vendor relationship management.

- **Approval and EAM Workflow** - Approval routes are defined by the user and can be based on both financial and functional rules. Approvals are electronically performed through an approval inbox or via your standard email system, thus enabling off-line approvals to be performed at your convenience. Approved documents can be automatically processed to their next stage via workflow.
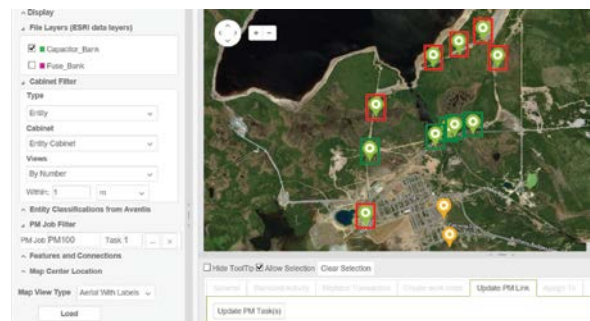
Match Maintenance Strategy to Asset Criticality with Risk-Based Maintenance

The strict budget environment in which most municipalities must operate challenges utilities to drive as much cost out of their operations as possible while maximizing return on asset investment. A Risk-Based Maintenance (RBM) approach helps utilities improve asset performance by integrating risk-based maintenance into an overall asset performance management strategy. The software solution generates optimized maintenance and spare parts strategies by first looking at the utilities' strategy and objectives, and then prioritizing actions down to an individual asset level to maximize return on asset investment.

AVEVA's Risk-Based Maintenance solutions enable a comprehensive view into current asset performance to identify improvement opportunities, perform analyses and simulation, determine the best maintenance strategies, and visualize deployment effects.

- **Complete Asset Control** – Utilities can establish the same control parameters for all plants and various locations to be benchmarked and analyzed at the same level to identify opportunities for improvement.

- **Maximized Return** – The RBM solution allows the identification of new opportunities to decrease unscheduled downtime, identify asset failures before they occur, and ensure your business operations are meeting safety and regulatory compliance.

- **Root Cause Analysis (RCA)** - A comprehensive root cause analysis module for incident logging, solution definitions, and secure prevention is built-in to the solution and has driven ROIs for customers at a ratio of 1:30.

- **Industry Equipment Libraries** - Built with 20+ years of equipment reliability data, including directly from the water and wastewater industry, the Risk-Based Maintenance software accelerates deployment time by up to 90 percent, allowing users to obtain return on investment much more quickly.

Success Story: PIMA County

Serving a population of around one million people, the Pima County Regional Wastewater Reclamation Department manages an average daily flow of about 60 million gallons of water. Pima County manages 3,700 miles of sewer lines stretching across a 700-mile area. With two metropolitan treatment plants, seven sub-regional facilities, 27 lift stations and 77,000 manholes, Pima County employees must cover a significant geographical area daily in their operations.

To assist with this challenge, Pima County chose to implement a situational awareness and workforce enablement solution based on AVEVA System Platform, Historian, and Mobile Operator Rounds.

AVEVA Historian is a high-performance process historian capable of storing huge volumes of data generated from Pima County's industrial wastewater facilities. Historian easily retrieves and securely delivers information to operators' desktop or mobile devices, enabling them to analyze processes anywhere, at any time. The solution combines a high-speed data acquisition and storage system with a traditional relational database management system, which facilitates access to plant data using open database standards. This enables faster troubleshooting and easier discovery of high value process improvement opportunities.

"Being able to access detailed data from the Historian allowed the Regional Wastewater Reclamation Department (RWRD) to analyze our electrical usage and determine that we could save more than $200,000 a year on a time-of-use electrical rate," said Eric Nelson, technical services manager at Pima County. "The preliminary analysis would have been impossible to do without the Historian and we would have missed a huge opportunity to reduce our service costs to our ratepayers."

In addition, the data-mining capabilities of the application produced detailed documentation, which enabled the county to receive a $352,000 rebate check from the local utility.

Mobile Operator Rounds, a sophisticated mobile workforce and decision support system, was also implemented by Pima County. The solution collects information from stand-alone assets not previously connected to the automation system. Mobile Operator Rounds exception-based, web reports keep everyone on the team up-to-speed on the current state of plant operations.

"Mobile Operator Rounds allows us to take selected information from the plant that was not previously available in SCADA and push that to SCADA, making the data trendable alongside the information that is already available in the SCADA system," said Christopher Grant, Program Coordinator at Pima County.

As a mobile workforce and decision support system, Mobile Operator Rounds allows Pima County water technicians to quickly and easily manage operations, both at the plant site and remotely. Mobile Operator Rounds includes configurable software and ruggedized mobile hardware solutions that enable workflow, data collection, and general task management for plant operations, maintenance management, production tracking, and compliance applications.

Success Story: City of Toronto

The Water and Wastewater Division of Toronto Works and Emergency Services (WES), with the responsibility to produce and distribute potable water across the 2.5 million residents of Toronto as well as collect and treat the city's wastewater, is involved in a broad improvement initiative called the Works Best Practices Program (WBPP). WBPP is focused on developing a highly efficient organizational structure through the application of redesigned work practices and the acquisition of new process control and information systems as an enabling foundation. Revitalized maintenance practices and supporting technology are key ingredients of the WBPP. An Enterprise Asset Management (EAM) system with full maintenance, inventory, and purchasing functionality was identified early on as a key component of the WBPP applications architecture.

"We developed the Works Best Practices Program to substantially reduce operating costs, while at the same time improving overall customer service. In order to reach our goals, we knew that we must incorporate broad work practice and organizational redesign in concert with advanced information and engineering technologies. After a highly competitive evaluation that included nineteen initial EAM vendors, we selected the AVEVA Enterprise Asset Management solution to support the management of all maintenance and schedulable work activities. Our partnership with AVEVA reflects our philosophy of continuous improvement through business synergy and technological innovation," said Jim Coe, Program Manager, Water and Wastewater Division.

The Water and Wastewater Division's previous systems environment consisted primarily of aged preventive maintenance and inventory programs developed internally using dBase and similar products. Each facility or plant had its own version of these programs and the functionality of those applications was very limited.

Coe said, "We recognized that we had a productivity gap and that one of our primary weaknesses was spending most of our time in a reactive maintenance mode. Analysis indicates that the optimum level of proactive versus reactive maintenance is about 70%. We knew we needed to move in that direction and that business tools and information systems would be keys to our success."

Since implementing the AVEVA solution at the first site, the City of Toronto is beginning to realize significant benefits, including:

- **Integration Capabilities** — the AVEVA solution meets all of the WBPP's EAM core functional requirements (work management, inventory, procurement), and easily adapts to the middleware enabled "integrated information environment" being implemented under the WBPP.

- **Maintenance Costing and Work History** — the AVEVA solution is central to the Division's efforts to implement "Program-Driven Maintenance," effectively moving from a largely reactive to a fully planned maintenance environment. Management can determine accurately and quickly the costs of performing maintenance at water and wastewater operating facilities. They can review work history and generally do better planning and make better maintenance and business decisions.

- **Lower Inventory and Procurement Costs** — using the AVEVA solution, the Division is beginning to identify real savings by maintaining optimized inventory levels and improving replenishment procedures. Increased control of maintenance assets and related activities will enable the Division to better meet service agreements with its customers.

- **Easy Access to Information** — the AVEVA solution ensures that the Water and Wastewater staff has readily available, accurate, and relevant information to help them be more effective in executing the work management process.

According to Coe, "Overall, our staff is excited about AVEVA. They are impressed with the ease of use and speed with which information previously unavailable to them can now be acquired. Because they had been unfamiliar with such advanced technology being part of their day-to-day work practices, they feel motivated to improve their skill levels to gain a measure of confidence and ultimately to see just how much they can benefit from AVEVA."

Success Story: San Francisco Public Utilities Commission

The San Francisco Public Utilities Commission (SFPUC) provides retail drinking water and wastewater services to the City of San Francisco, wholesale water to three Bay Area counties, green hydroelectric and solar power. It is SFPUC's mission to provide customers with high-quality, efficient and reliable water, power, and sewer services in a manner that is inclusive of environmental and community interests. SFPUC chose to implement a Risk-Based Maintenance approach to enable the its wastewater division's asset management program.

The AVEVA turn-key solution for risk management offers an effective method to identify the necessary balance between asset performance, risks and costs. "Our solution complements SFPUC's existing business objectives, risk reduction goals and total cost of ownerships benchmark targets were all successfully achieved during the first analysis at SFPUC," said Hans Franck, senior consultant for AVEVA.

In order to be mitigated, risks first have to be identified and assessed. Although the booster pump station did not seem like the obvious place to start, it is a critical piece of SFPUC's wastewater infrastructure. During wet weather events, three out of four pumps must be operational to handle flows. However, should they fail, the risk of illegal discharges goes beyond environmental impact and can lead to violations of operating permits, steep fines, and significant reputational risk.

Using AVEVA's Asset Libraries, with 20-years of reliability data, analysis was performed utilizing 30% fewer resources of SFPUC. The recommendations addressed the most critical risks and maintenance issues. Technical back-up and protection systems were added, and critical maintenance tasks are performed to reduce risks. In addition, the risk analysis for the SFPUC booster pump station helped reduce non-critical maintenance tasks.

The analysis quickly generated sixteen new maintenance plans to increase reliability, but also an expected reduction in preventive maintenance for non-critical equipment. This leads to a theoretical reduction of 25% of the maintenance hours every year with expectations of even greater results following future analysis. The use of AVEVA's risk-based maintenance solution provided the following benefits:

- Shortened study time by 30% due to the use of libraries with reliability data

- Reduced maintenance costs by 25 % with expectations of even greater results

- Improved data integrity, leading to continuous improvements

- Reduced total cost of ownership by integrating with the existing Enterprise Asset Maintenance solution already in place.

As SFPUC continues to propagate the solution, a wider adoption of risk-based maintenance principles will continue to generate valuable data. The stronger the insights into real asset performance, the stronger the ability to foresee and avoid incidents that impact safety, quality, service levels, and costs. The collected data are the building blocks of improved maintenance strategies.

The AVEVA APM Portfolio

AVEVA offers an end-to-end Asset Performance Management solution that manages the collection of data from any number of sources, incorporates advanced analytics technology that combines machine learning with analytic rules and provides a complete asset management platform to manage asset lifecycle and maintenance processes. It also includes a variety of interactive visualization capabilities for presenting this information in intuitive ways on mobile devices and platforms.

No matter what level of maturity your water or wastewater utility has achieved on the Maintenance Maturity Pyramid, AVEVA solutions can move you one step closer to asset performance excellence. The comprehensive offering is equipment and vendor agnostic for seamless integration with existing equipment and technologies, enabling you to maximize the value of previous investments through proactive asset health and performance monitoring.

Asset Performance Management		
Strategise	**Analyse**	**Maintain**
APM Assessment	Business Intelligence	Digitised Work
Risk-based Maintenance	Predictive/ Prescriptive	Industrial Workflow
Reliability Centered Maintenance (RCM)	Optimisation	Enterprise Asset Management
Asset Information Management		

For more information on any of AVEVA's asset performance management solutions, please visit us at sw.aveva.com/asset-performance.